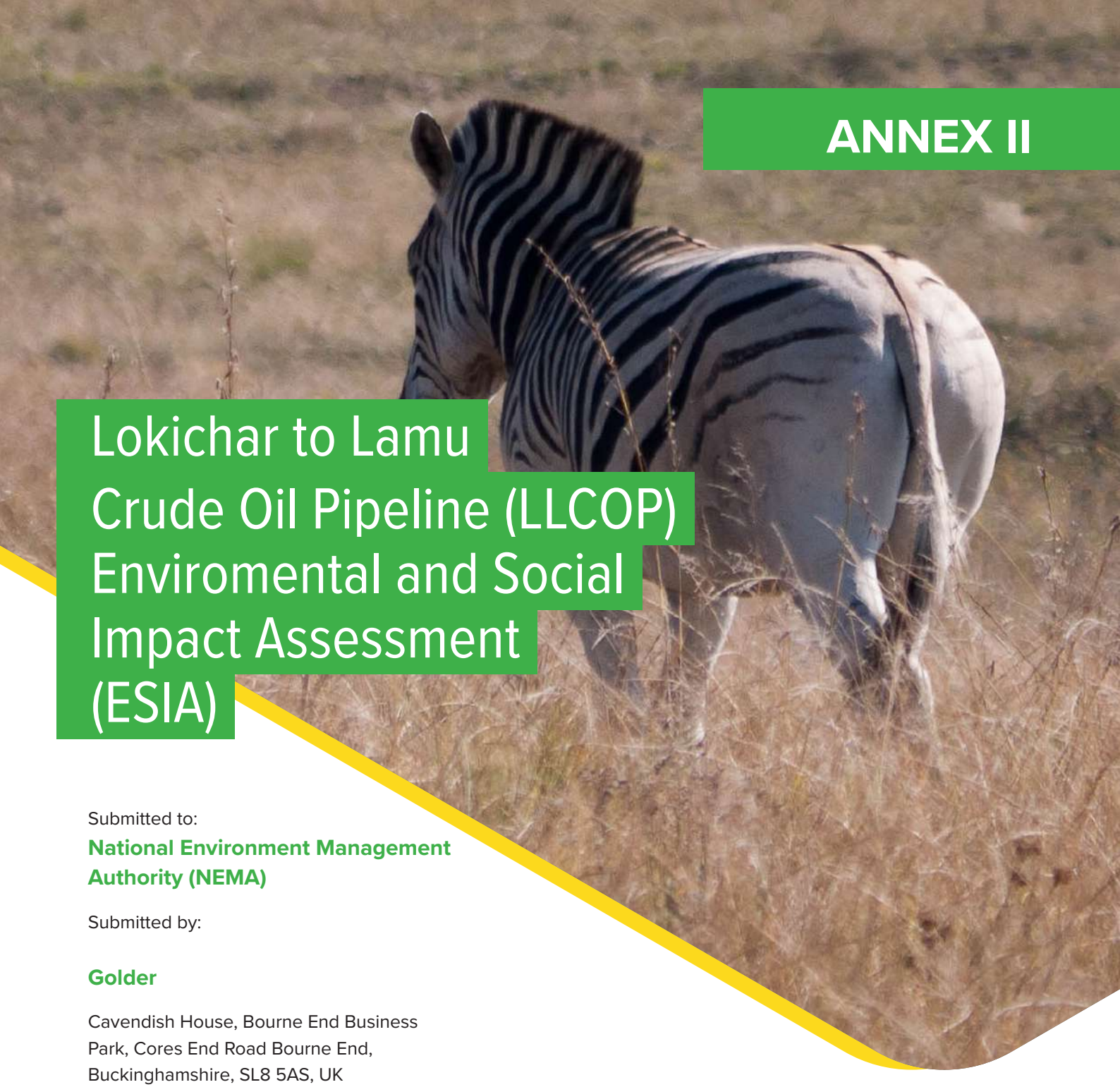

ANNEX II

Lokichar to Lamu Crude Oil Pipeline (LLCOP) Enviromental and Social Impact Assessment (ESIA)

Submitted to:

National Environment Management Authority (NEMA)

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GOLDER

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ANNEX II

A Physical Environment Baseline Reports

B Physical Environment Baseline Field Reports

C Biodiversity Baseline Reports

D Biodiversity Baseline Field Reports

E Socio-economic Baseline Reports

F Socio-economic (Cultural Heritage) Baseline Field Reports

G Oil Spill Modelling Report

ANNEX II

Signature Page

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Technical Director

Golder Associates (UK) Ltd

11 October 2019

ANNEX II

A

Physical Environment Baseline Reports

A1 Meteorology

A2 Surface Water

A3 Soils and Geology

A4 Air Quality

A5 Noise

A6 Landscape and Visual

REPORT

Meteorological Baseline

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

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August 2019

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1.0 INTRODUCTION

The proposed Lokichar to Lamu Crude Oil Pipeline (LLCOP) is an 820 km long pipeline for transporting crude oil from the proposed oil fields near Lokichar in Turkana, Kenya, to a storage and load-out facility at the new port currently under construction in Lamu, Kenya. The LLCOP will pass through six counties (Turkana, Samburu, Isiolo, Meru, Garissa and Lamu). The purpose of this report is to characterise the typical meteorological and climatic conditions encountered along the route of the pipeline. The characterisation is supported by data analysis from five meteorological stations located along the pipeline route, Kapese and Ngamia in Turkana, Meru, Garissa and Lamu (Figure 1).

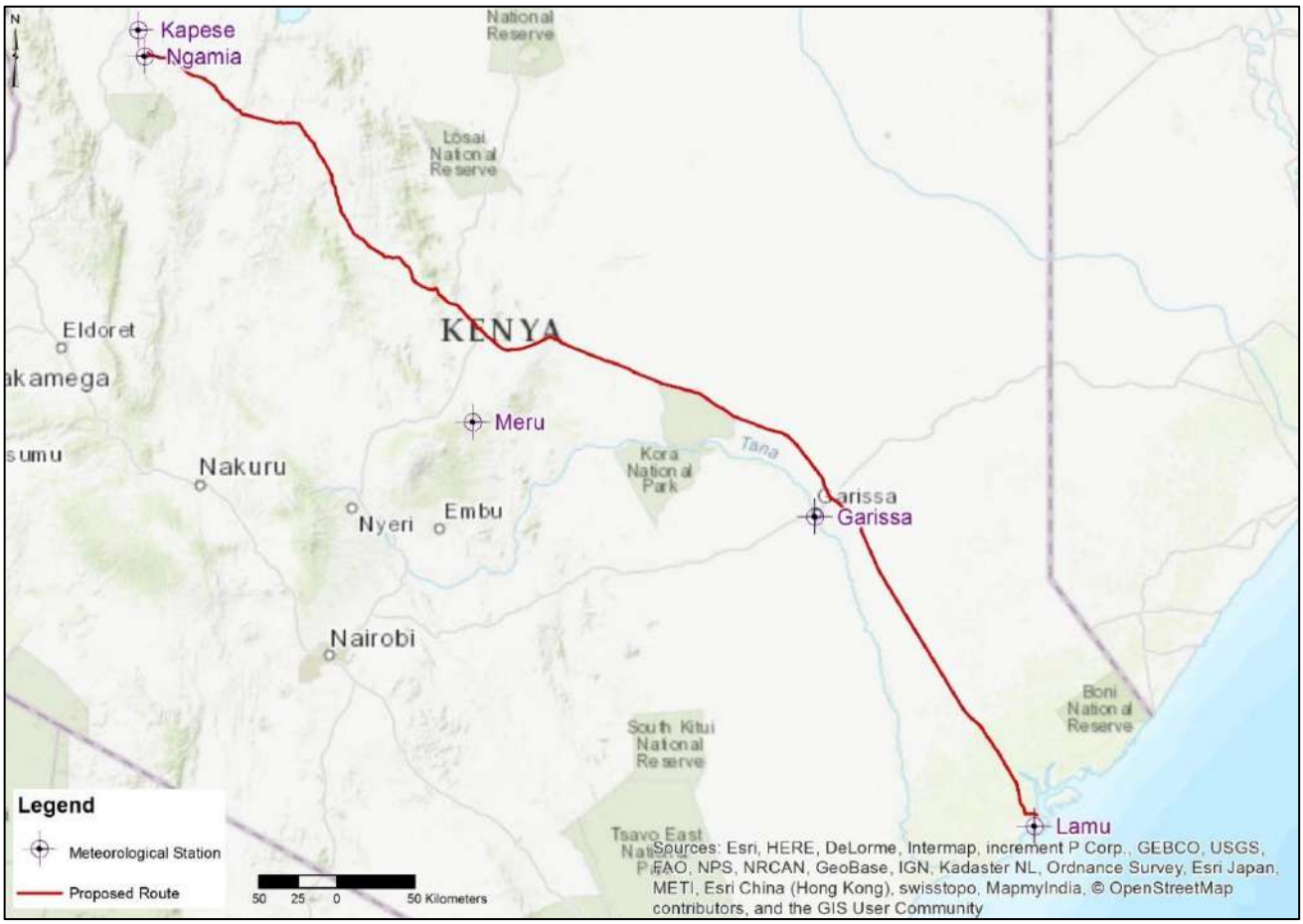

Figure 1: Location of meteorological stations used for baseline characterisation

2.0 METEOROLOGICAL CHARACTERISATION

Kenya is an equatorial country in East Africa with a very diverse relief including a short, low coastal plain on the Indian Ocean shore, extensive inland plateaux regions with altitudes between 1000 m and 1500 m, and several mountain ranges and peaks such as Mount Kenya. The reduction of temperature with altitude produces temperatures over much of Kenya which are subtropical or temperate. Its equatorial situation means that Kenya experiences very limited annual variation in temperature across the country. The constant high temperatures and humidity typically associated with equatorial latitudes only occur in the Kenya's coastal lowlands although daytime sea breezes have a cooling effect. The northern part of Kenya is hot throughout the year, however experiences lower humidity than coastal areas (UK Met Office 2011).

Most areas of equatorial eastern Africa have a double rain season between March and May and October to December as the inter-tropical convergence zone (ITCZ) passes over (Camberlin & Okoola 2003, UK Met Office 2011). Kenya's National Drought Management Authority (NDMA) classifies the seasons in Kenya as follows:

- January to March – Dry Season;
- April to June – Long Rains;
- July to September – Dry Cool Season; and
- October to December – Short Rains.

Inter-annual variability of rainfall has a major impact in Kenya. Heavy rains may cause flooding in the rainy season. Severe droughts can result from the failure of rains to arrive, especially in the arid and semi-arid regions of northern and eastern Kenya (UK Met Office 2011).

Figure 2 shows the Köppen-Geiger Climate Classification in relation to the proposed LLCOP. Most of the pipeline including its origin in Turkana is in areas with hot semi-arid climate (BSh). The meteorological stations at Kapese and Ngamia are in hot semi-arid climate. The pipeline also passes through areas of tropical savanna climate (As), for example around Meru and within the coastal plains of Lamu. The meteorological stations at Meru and Lamu are in tropical savanna climate. In addition, a short passage of the proposed pipeline will transverse through hot desert climate (BWh) within Garissa, where the Garissa meteorological station is located.

The meteorological baseline conditions experienced along the pipeline have been characterised using meteorological data collected at stations located in Kapese and Ngamia (county of Turkana), Meru (county of Meru), Garissa (county of Garissa), and Lamu (county of Lamu). The assessment methodology is detailed in Section 2.1.

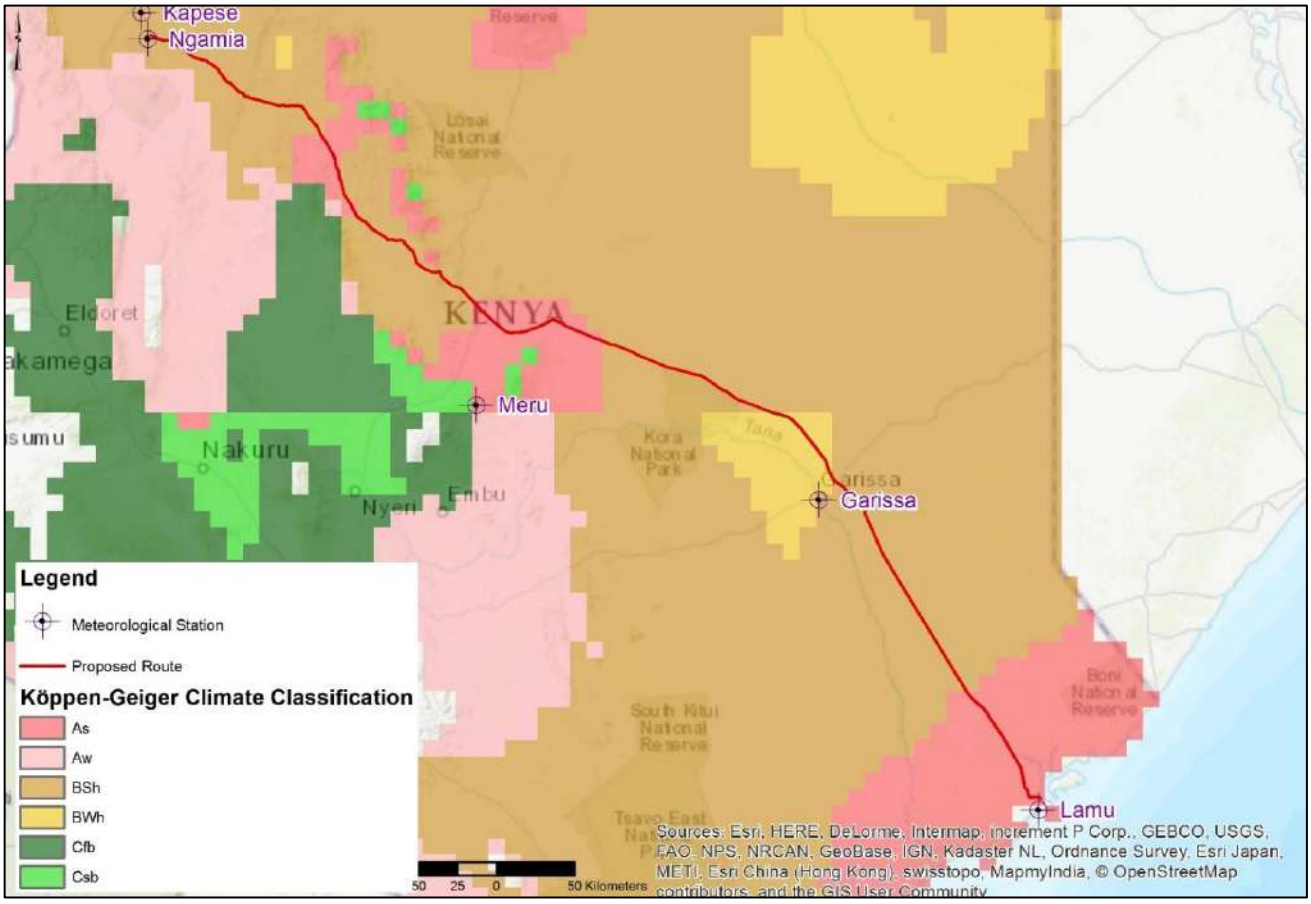

Figure 2: Köppen-Geiger climate classification in relation to LLCOP

2.1 Assessment Methodology

Meteorological data was obtained for five meteorological stations near the LLCOP. Two of these stations, Kapese and Ngamia in Turkana, have been installed on behalf of Tullow Kenya B.V to support the characterisation of meteorological conditions in the proposed oil fields near Lokichar. The meteorological stations at Meru, Garissa and Lamu are stations operated by the Kenya Meteorological Department. Station details are provided in Table 1. The periods of data records analysed were chosen based on most recent data availability and record completeness. Kapese, Ngamia, Meru and Garissa report data on an hourly basis while the meteorological station at Lamu is operated on a part-time basis only.

Table 1: Meteorological station details

Name	Climate Classification	Coordinates WGS84		Elevation (masl)	Periods of Data Record Used
		Easting	Northing		
Kapese	Hot, semi-arid (BSh)	245609.7539	761691.6551	700	01/12/2015 - 31/12/2018
Ngamia	Hot, semi-arid (BSh)	249582.477	744718.9455	730	22/01/2016 - 31/12/2018
Meru	Tropical savanna (As)	681396.7599	448029.6965	1,554	01/01/2011 - 31/12/2012 01/01/2014 - 31/12/2014 01/01/2017 - 31/12/2018
Garissa	Hot desert (BWh)	461053.5597	509174.1662	147	01/01/2009 - 31/12/2009 01/01/2011 - 31/12/2014
Lamu	Tropical savanna (As)	822584.1134	248771.9134	6	01/01/2009 - 31/12/2009 01/01/2011 - 31/12/2014

The following key meteorological parameters have been considered in the assessment to characterise meteorological baseline conditions along the LLCOP route:

- Ambient air temperature (˚C);
- Relative humidity (%)
- Total precipitation (mm);
- Wind speed (m/s); and
- Wind direction.

For all parameters, with exception of total precipitation and wind direction, monthly averages as well as monthly minimum and maximum values (where more than one month was available) were calculated and plotted. For total precipitation the monthly total sum was calculated and plotted. For stations reporting hourly data (Kapese, Ngamia, Meru and Garissa) only months with less than 35% of missing data were included. For Lamu all available data was included, however, due to the lack of continuous monitoring at this station, the findings are deemed less reliable than for the other meteorological stations as the intermittency may skew the data.

Wind direction was plotted in conjunction with wind speed as wind roses covering the entire period of data analysis for each station. The analysis results are presented in Sections 2.2 to 2. 5.

2.2 Kapese and Ngamia

The meteorological stations at Kapese and Ngamia are both located close to the proposed oil fields near Lokichar, in an area with hot, semi-arid climate.

2.2.1 Ambient Air Temperature

Figures 3 displays the monthly average ambient temperatures as well as the monthly minimum and maximum temperature range recorded for Kapese and Ngamia met stations. Monthly average temperatures at both stations are very similar and relatively stable lacking distinct seasonal fluctuations. The monthly average temperatures peak in February with 31.0˚C for both stations. The minimum monthly average temperature in June was 27.5 ˚C in Kapese and 28.1˚C in Ngamia.

2.2.2 Relative Humidity

Figure 4 displays the monthly average relative humidity as well as the monthly minimum and maximum relative humidity recorded for Kapese and Ngamia met stations. Monthly average relative humidity is low and very similar at Kapese and Ngamia met stations. The monthly average relative humidity peaks in May with 59.9% at Kapese and 59.8% at Ngamia. The minimum monthly average relative humidity occurs in February with 30.6% at Kapese and 29.1% at Ngamia.

2.2.3 Total Precipitation

Figure 5 displays the monthly total precipitation as well as the maximum monthly total precipitation recorded for Kapese and Ngamia met stations. Monthly total precipitation is generally low but strongly varies over the year as well as within years as visible from the depicted monthly maximum total precipitation. The precipitation pattern is very similar at Kapese and Ngamia. Total precipitation peaks in May with an average monthly total of 90.4 mm in Kapese and 110.6 mm in Ngamia. The minimum monthly total occurs in February at Kapese with 0.9 mm and in September at Ngamia with 4.0 mm.

2.2.4 Wind Speed

Figure 6 displays the monthly average wind speed as well as the monthly minimum and maximum wind speed recorded for Kapese and Ngamia met stations. Monthly average wind speeds are similar and very low at both met stations, however showing a slight seasonal variation. Average monthly wind speeds peak in February with 3.1 m/s at Kapese and 2.9 m/s at Ngamia. The minimum monthly total occurs in May with 2.0 m/s in Kapese and 1.8 m/s at Ngamia.

2.2.5 Wind Direction

Figure 7 and 8 display the annual wind roses for Kapese and Ngamia met station based on wind speed and wind direction data for both stations, respectively. At Kapese and Ngamia, winds blow predominantly form north to south-easterly directions. Wind at Kapese dominate from the north-east while at Ngamia the wind distribution shows two distinct peaks, one from the north-east, the other one from the south-east.

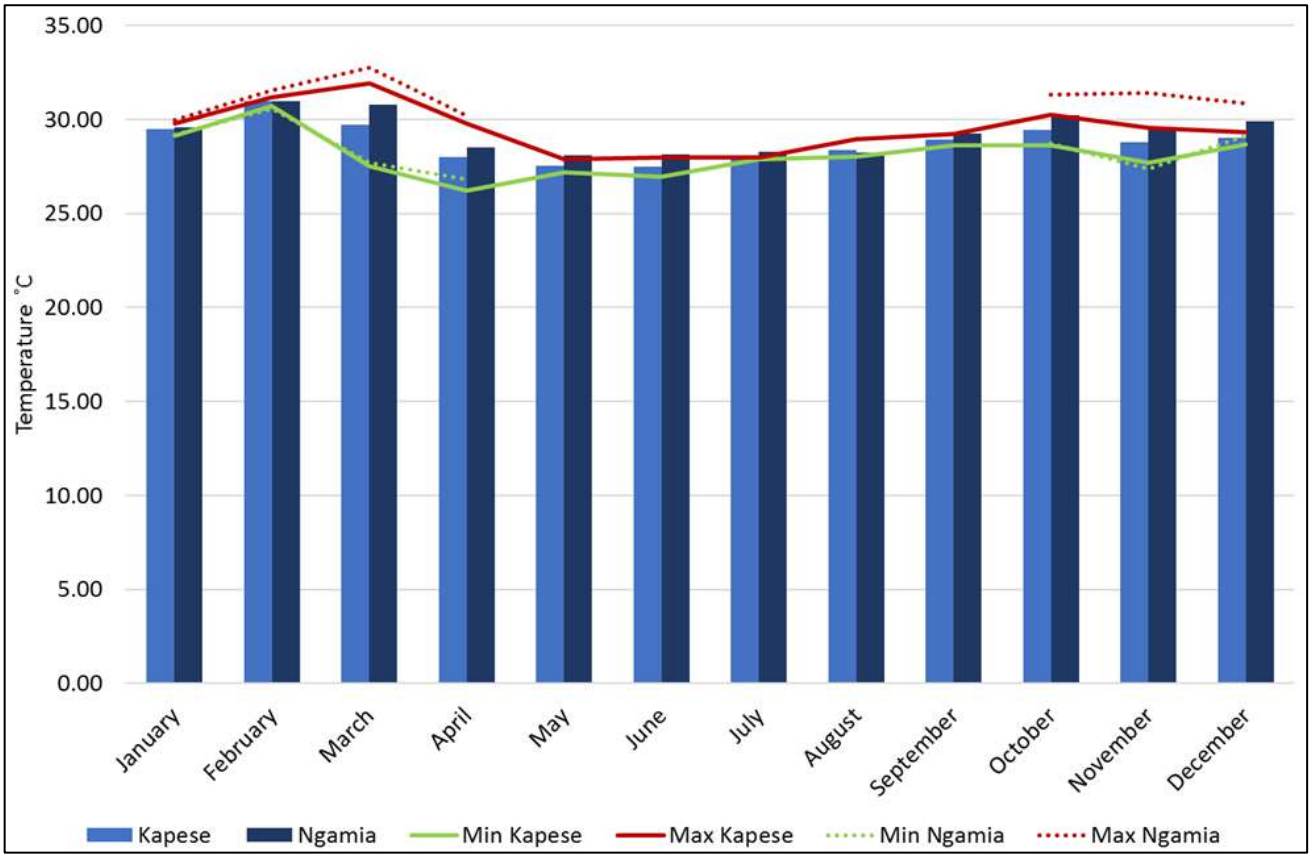

Figure 3: Average, minimum and maximum monthly temperature at Kapese and Ngamia

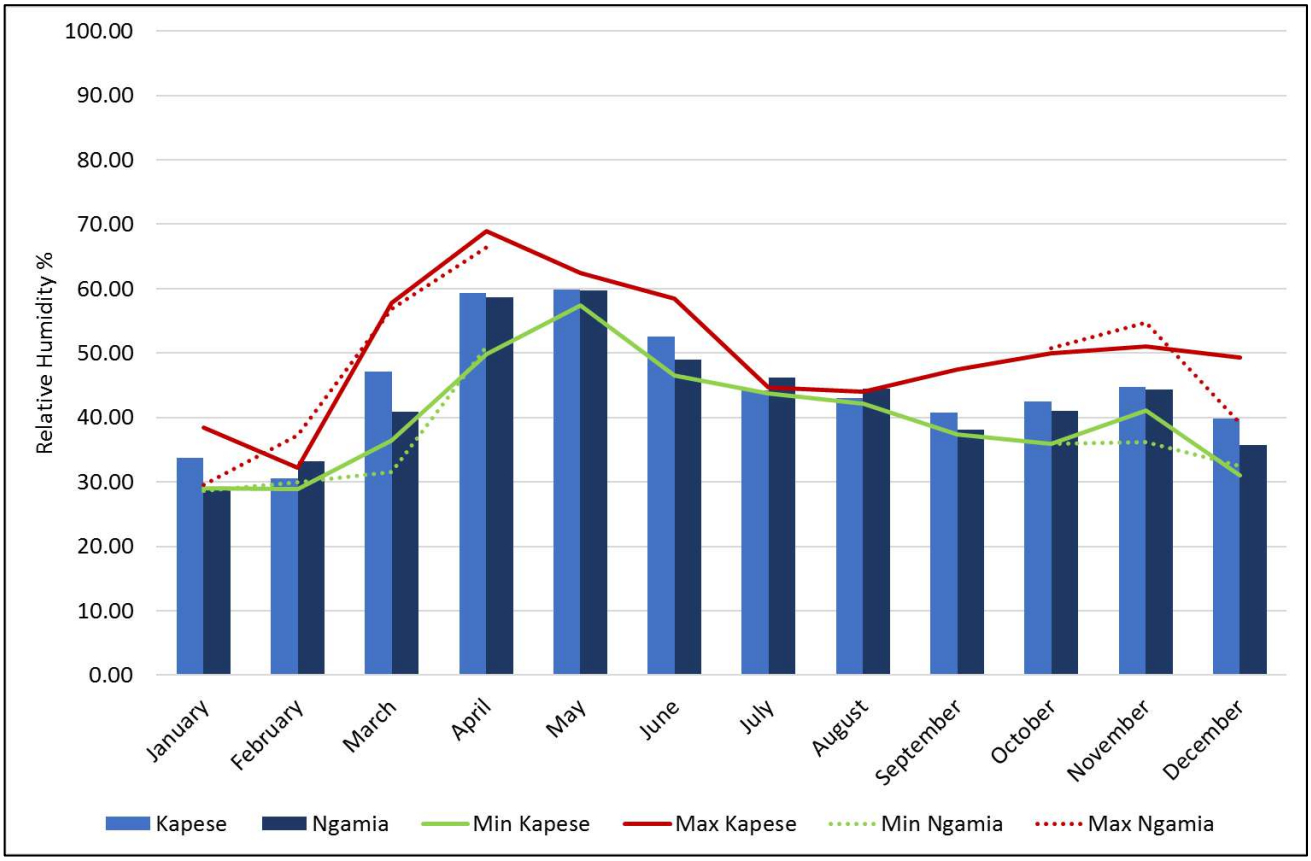

Figure 4: Average, minimum and maximum monthly relative humidity at Kapese and Ngamia

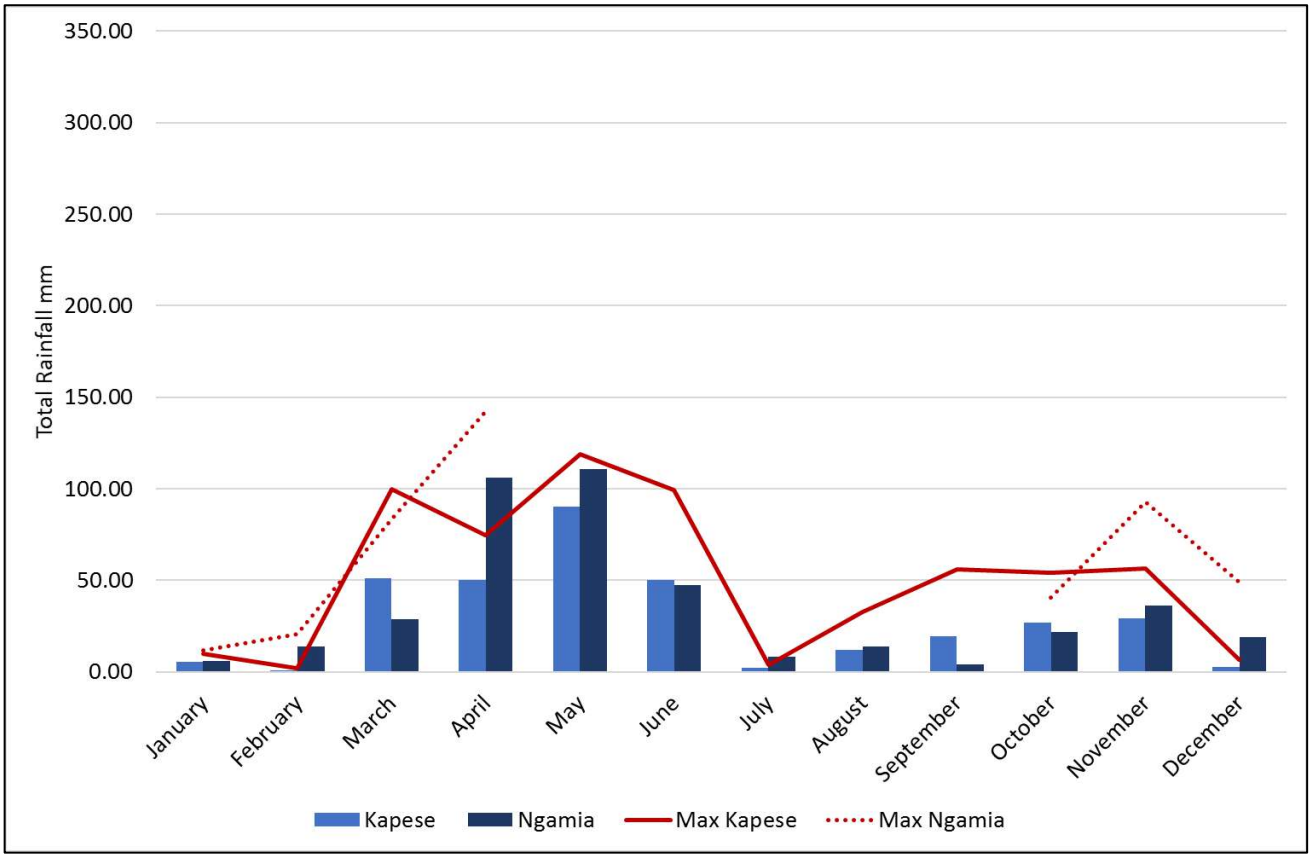

Figure 5: average and maximum monthly total precipitation at Kapese and Ngamia

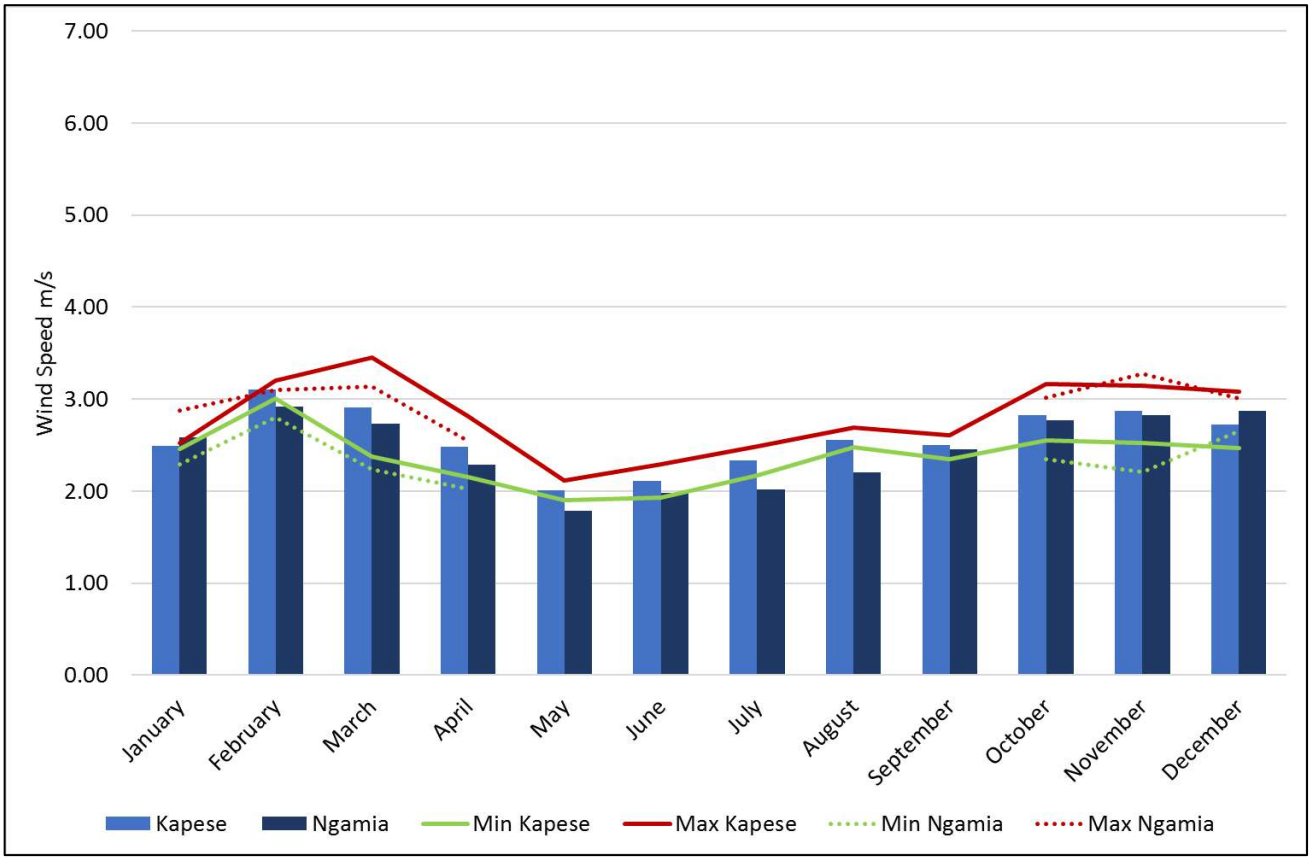

Figure 6: Average, minimum and maximum monthly wind speed at Kapese and Ngamia

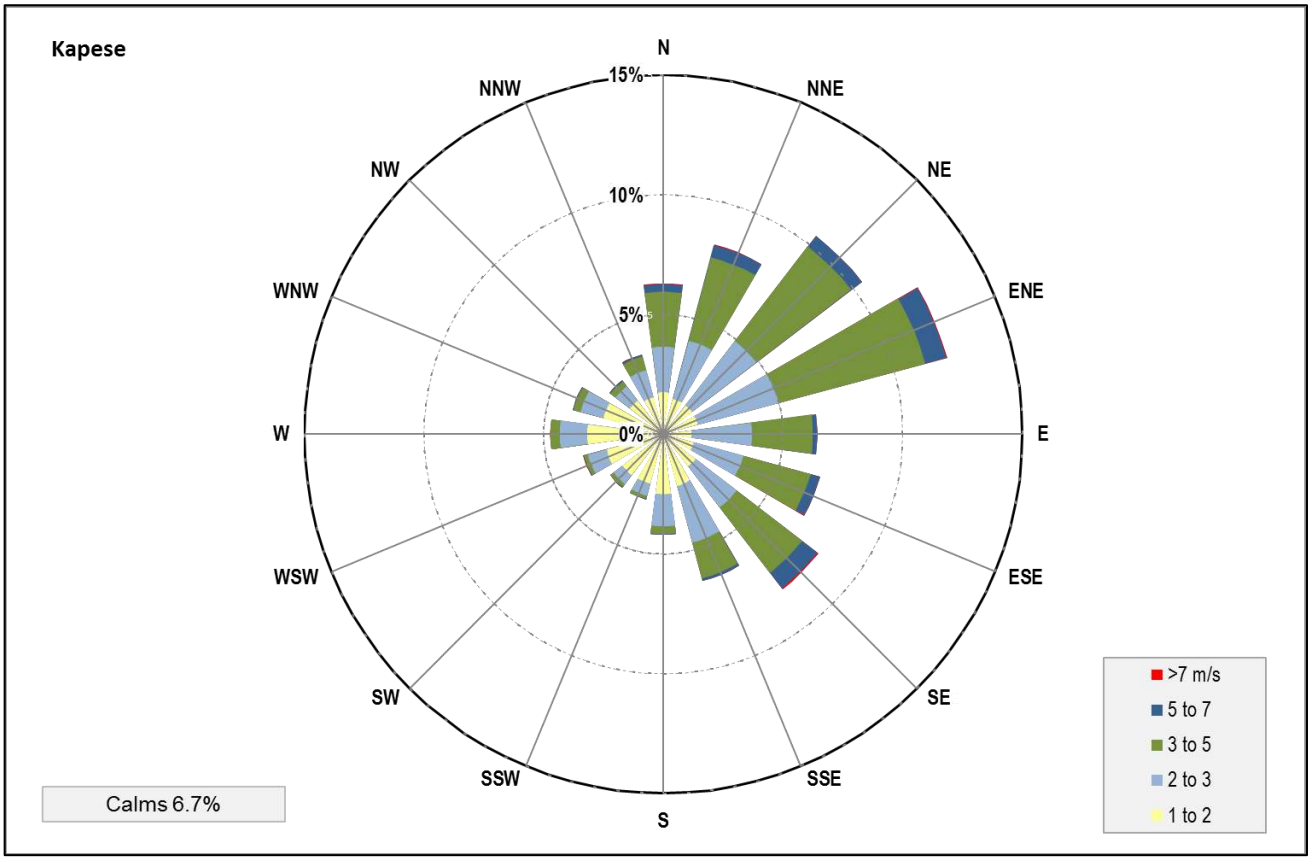

Figure 7: Windrose for Kapese

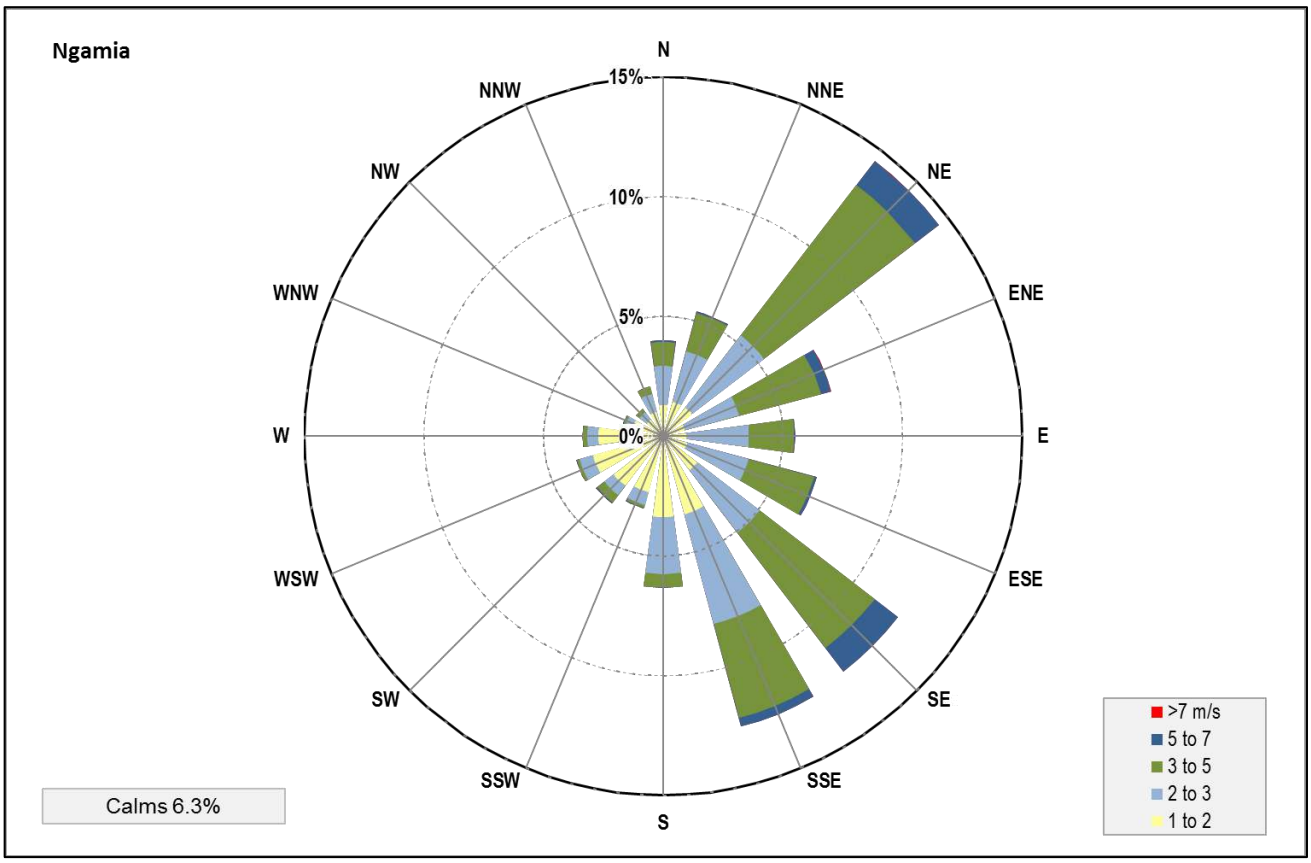

Figure 8: Windrose for Ngamia

2.3 Meru

The meteorological station at Meru is located approximately 310 km to the south-east of Lokichar in an area with tropical savanna climate. It is the station at the highest altitude at 1554 masl.

2.3.1 Ambient Air Temperature

Figures 9 displays the monthly average ambient temperatures as well as the monthly minimum and maximum temperature range recorded at Meru met station. Monthly average temperatures are much cooler than at Kapese and Ngamia but again stable and lacking distinct seasonal fluctuations. The monthly average temperatures peak in October with 19.7˚C. The minimum monthly average temperature in July is 17.1˚C.

2.3.2 Relative Humidity

Figure 10 displays the monthly average relative humidity as well as the monthly minimum and maximum relative humidity recorded for Meru met station. Monthly average relative humidity is higher than at Kapese and Ngamia. Monthly average relative humidity peaks in November with 84.3%. The minimum monthly average relative humidity occurs in September with 72.4%.

2.3.3 Total Precipitation

Figure 11 displays the monthly total precipitation as well as the maximum monthly total precipitation recorded for Meru met station. Monthly total precipitation shows a strong seasonal variation with two peaks, one occurring around April and one occurring around December. There is also variation within years as visible from the depicted monthly maximum total precipitation. Total precipitation peaks in December with an average monthly total of 153.1 mm. The minimum monthly total occurs in July with 3.0 mm.

2.3.4 Wind Speed

Figure 12 displays the monthly average wind speed as well as the monthly minimum and maximum wind speed recorded for Meru met station. Monthly average wind speeds are very low with only a slight seasonal variation. Average monthly wind speeds peak in September with 2.2 m/s. The minimum monthly total occurs in December with 1.2 m/s.

2.3.5 Wind Direction

Figure 13 displays the annual wind rose for Meru met station based on wind speed and wind direction data. At Meru winds from south to south-easterly directions strongly prevail.

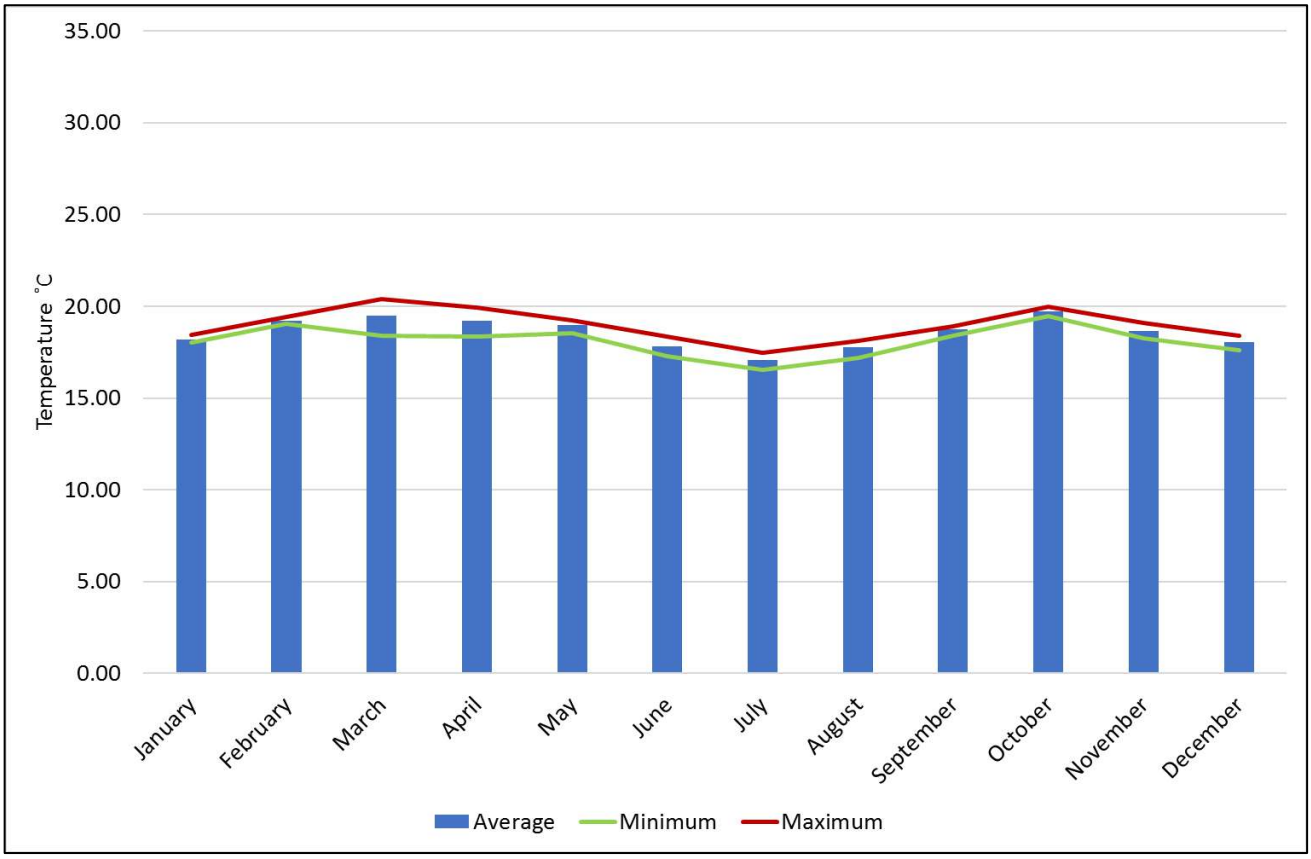

Figure 9: Average, minimum and maximum monthly temperature at Meru

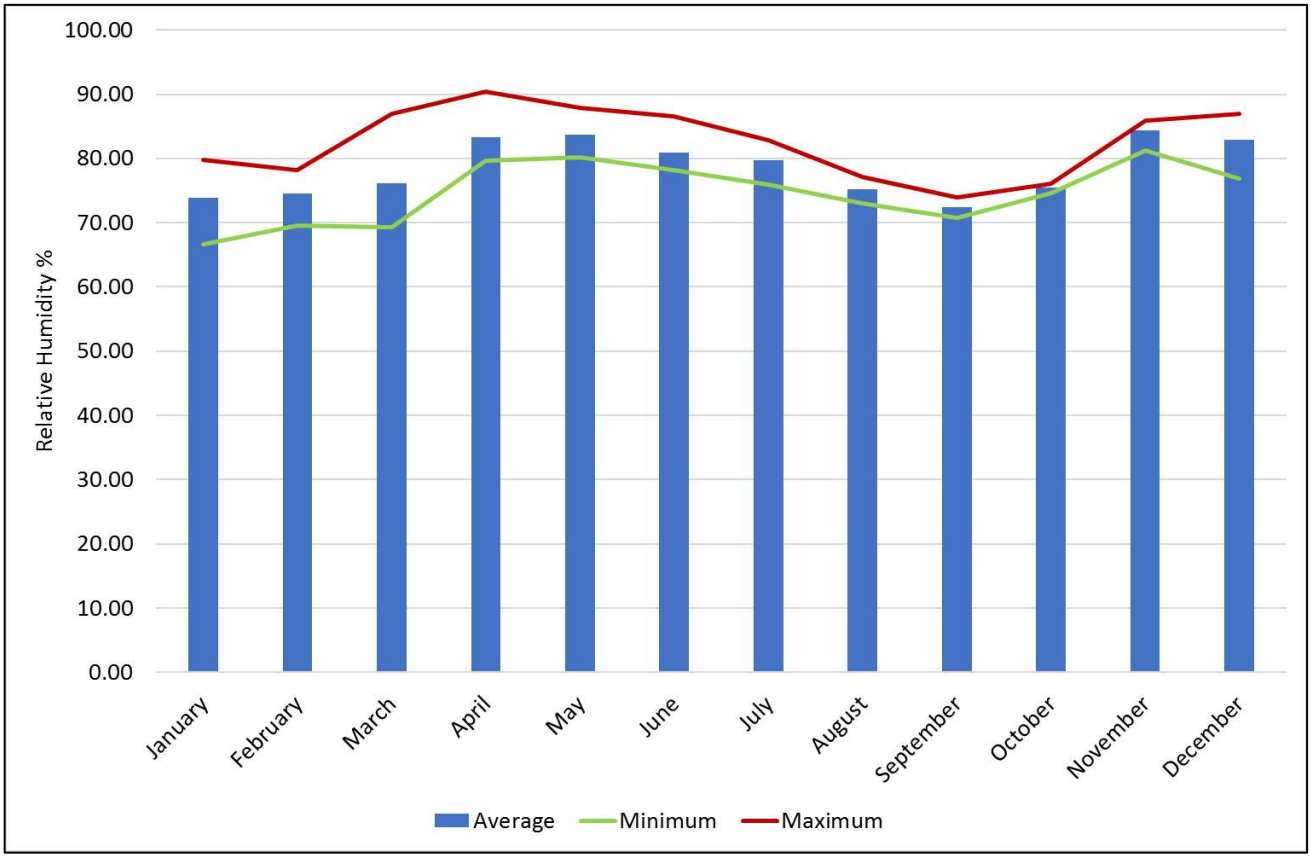

Figure 10: Average, minimum and maximum monthly relative humidity at Meru

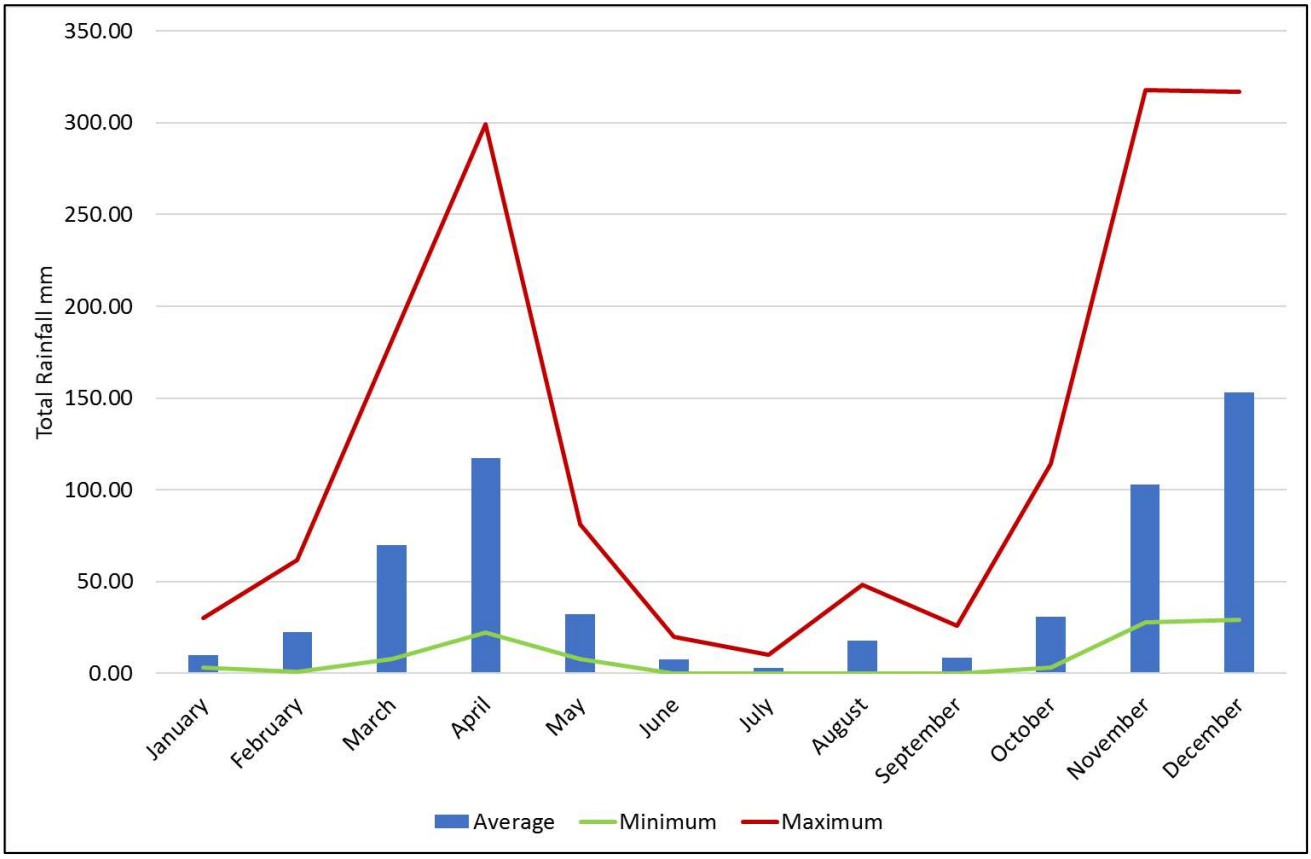

Figure 11: Average and maximum monthly total precipitation at Meru

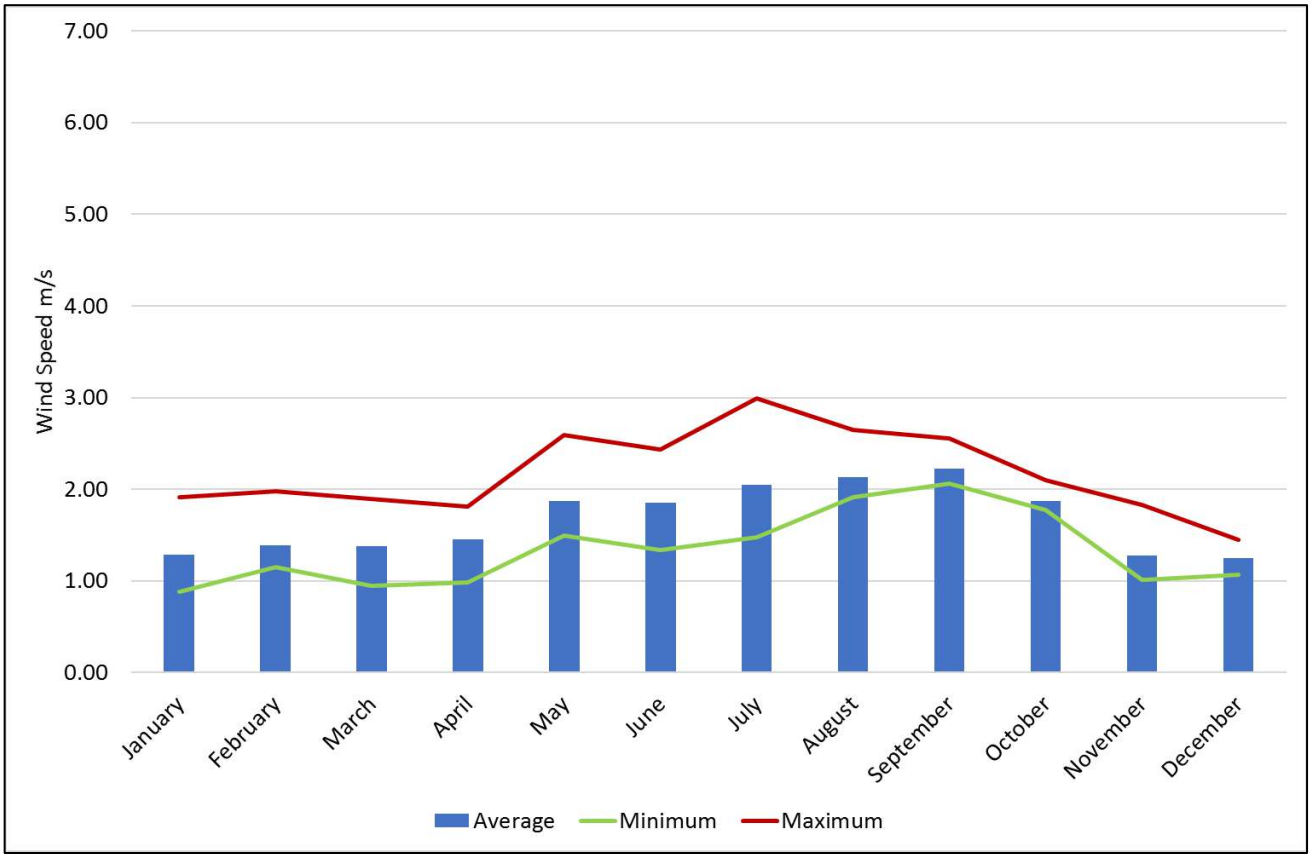

Figure 12: Average, minimum and maximum monthly wind speed at Meru

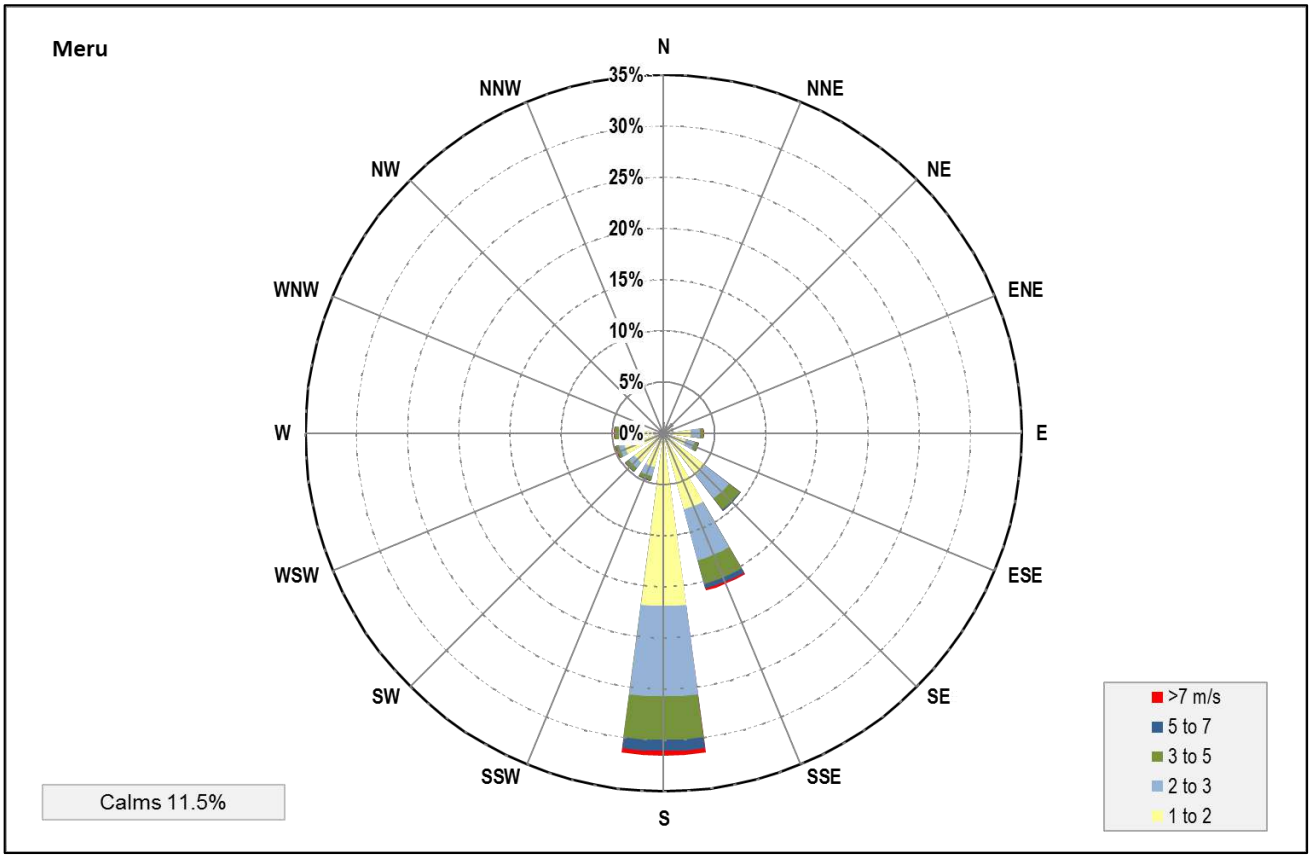

Figure 13: Windrose for Meru

2.4 Garissa

The meteorological station at Garissa is located 525 km south-east of Lokichar and 22 km south-east of Meru, in an area with hot desert climate.

2.4.1 Ambient Air Temperature

Figures 14 displays the monthly average ambient temperatures as well as the monthly minimum and maximum temperature range recorded at Garissa met station. Monthly average temperatures are high throughout the year lacking distinct seasonal fluctuations. The monthly average temperatures peak in March with 30.6˚C. The minimum monthly average temperature in July is 27.0 ˚C.

2.4.2 Relative Humidity

Figure 15 displays the monthly average relative humidity as well as the monthly minimum and maximum relative humidity recorded for Garissa met station. Monthly average relative humidity peaks in November with 68.3%. The minimum monthly average relative humidity occurs in February with 55.7%.

2.4.3 Total Precipitation

Figure 16 displays the monthly total precipitation as well as the maximum monthly total precipitation recorded for Garissa met station. Monthly total precipitation is very low throughout the year however shows a seasonal variation with two peaks, one occurring around April and one occurring around October to December similar to Meru. Total precipitation peaks in October with an average monthly total of 40.1 mm. The minimum occurs in February with 0.0 mm.

2.4.4 Wind Speed

Figure 17 displays the monthly average wind speed as well as the monthly minimum and maximum wind speed recorded for Garissa met stations. Monthly average wind speeds are slightly higher than at Kapese, Ngamia and Meru with a distinct seasonal variation. Average monthly wind speeds peak in July with 5.3 m/s at. The minimum monthly total occurs in December with 1.9 m/s.

2.4.5 Wind Direction

Figure 18 displays the annual wind rose for Meru met station based on wind speed and wind direction data. At Garissa winds from south to south-easterly directions strongly prevail.

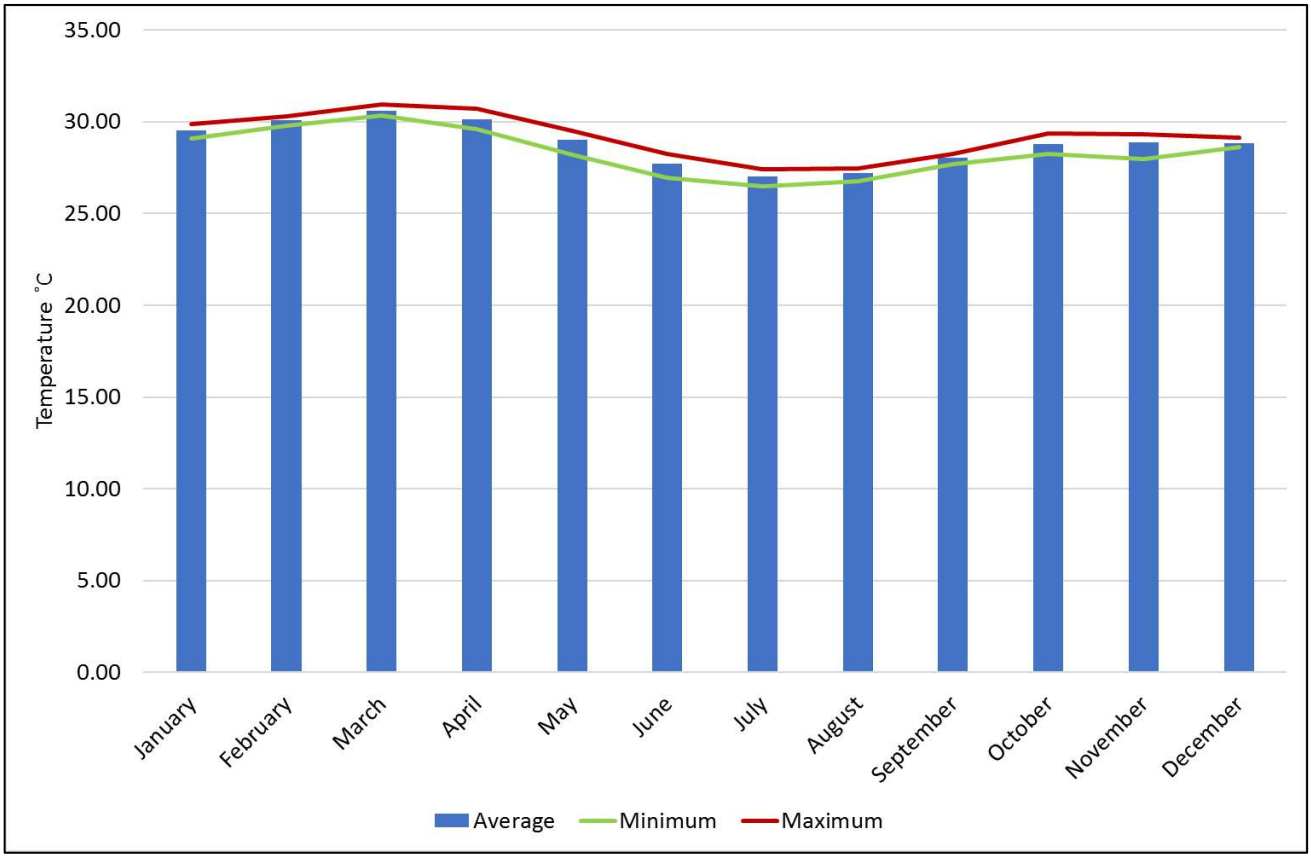

Figure 14: Average, minimum and maximum monthly temperature at Garissa

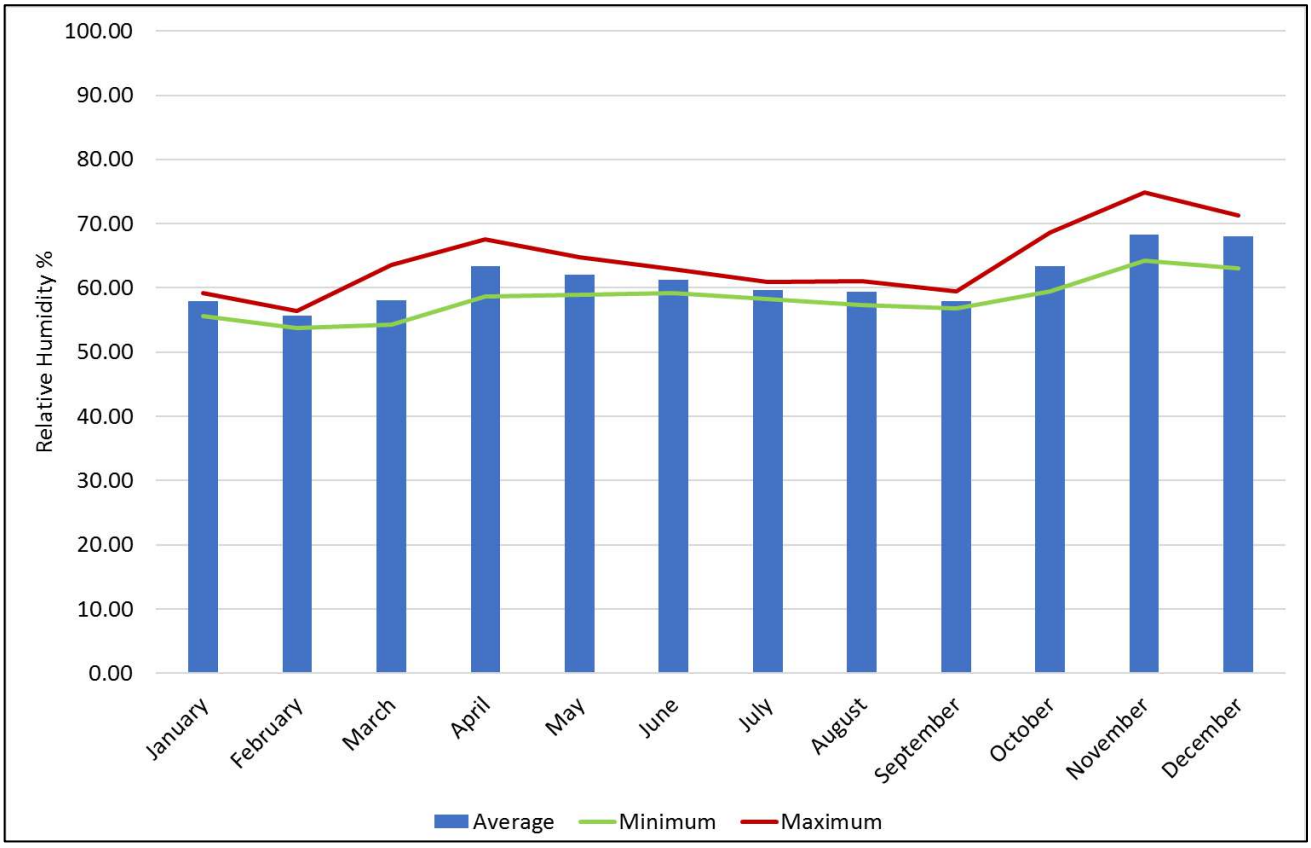

Figure 15: Average, minimum and maximum monthly relative humidity at Garissa

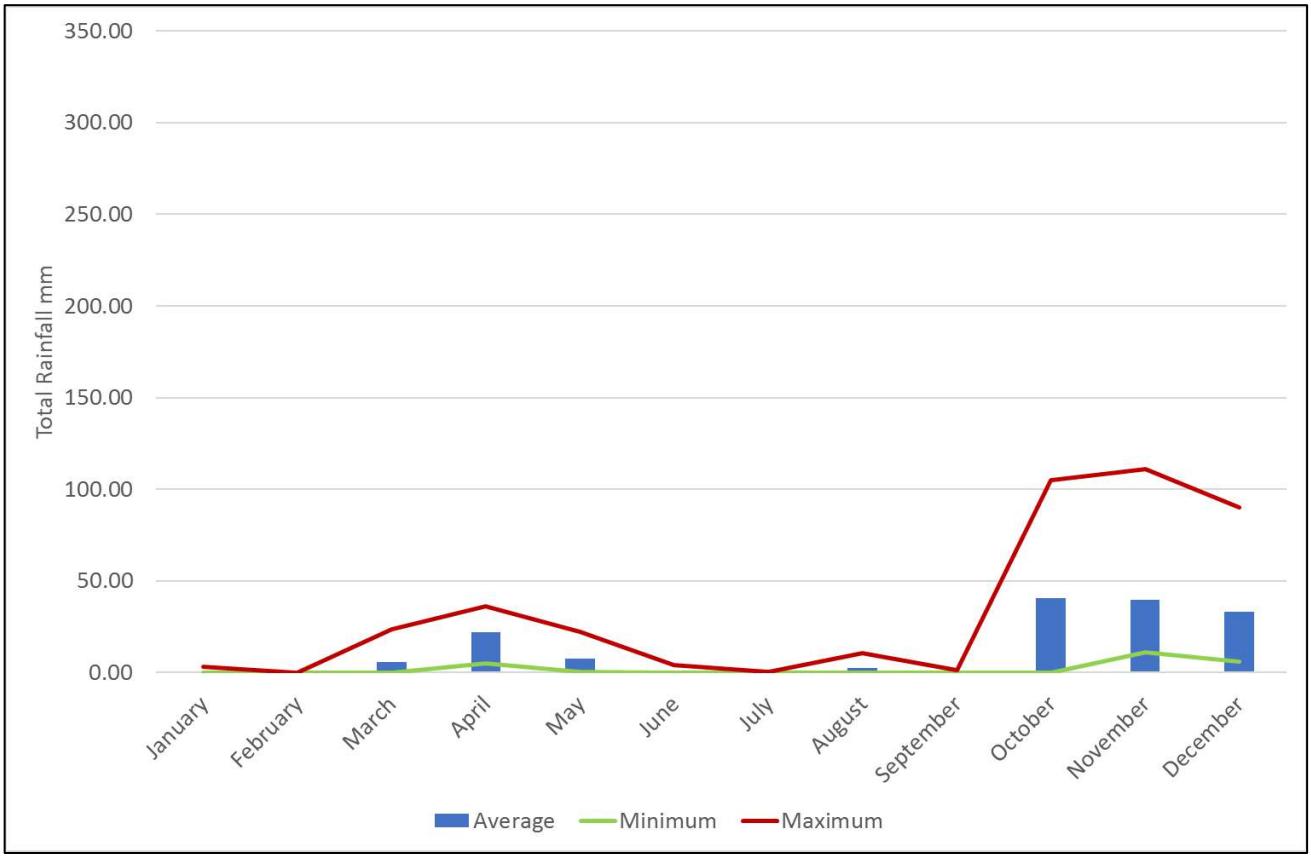

Figure 16: Average and maximum monthly total precipitation at Garissa

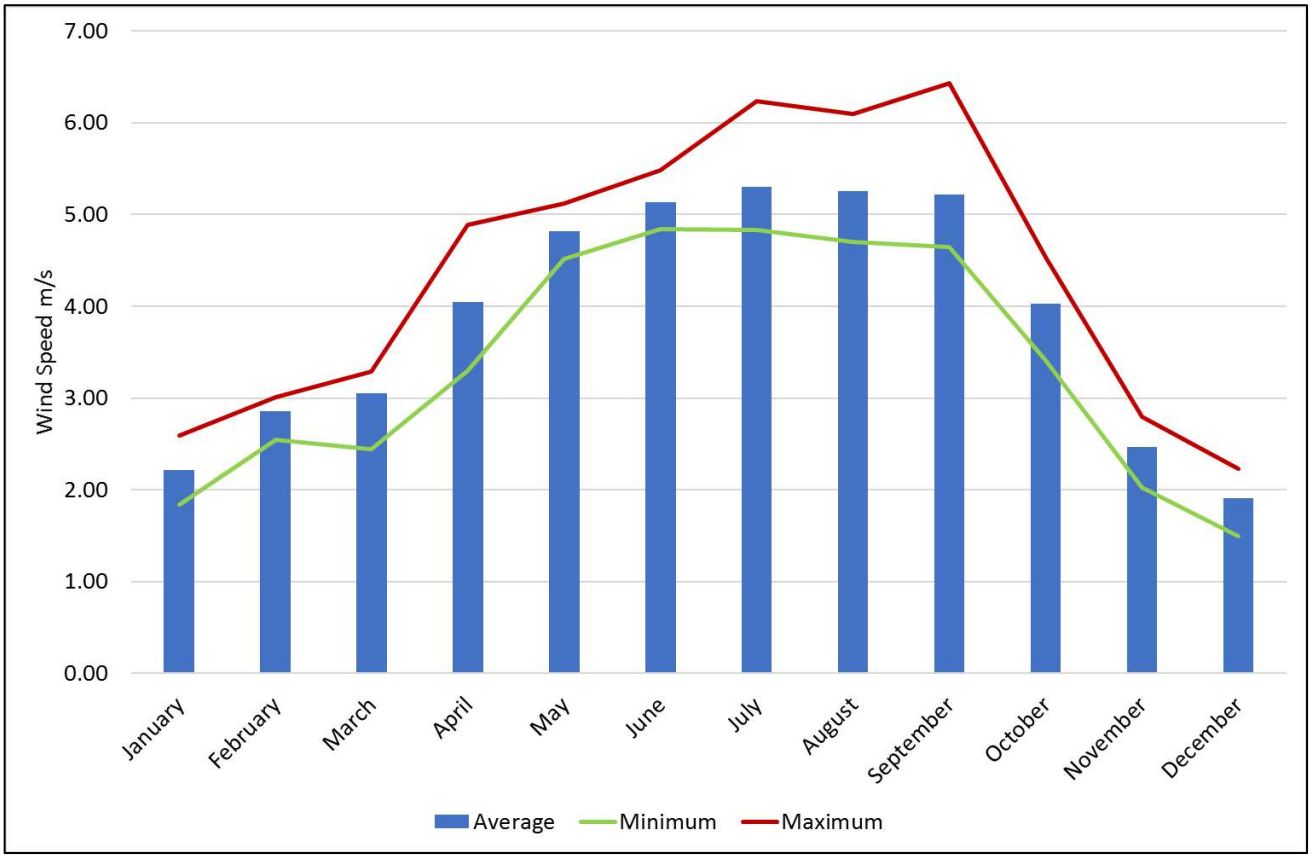

Figure 17: Average, minimum and maximum monthly wind speed at Garissa

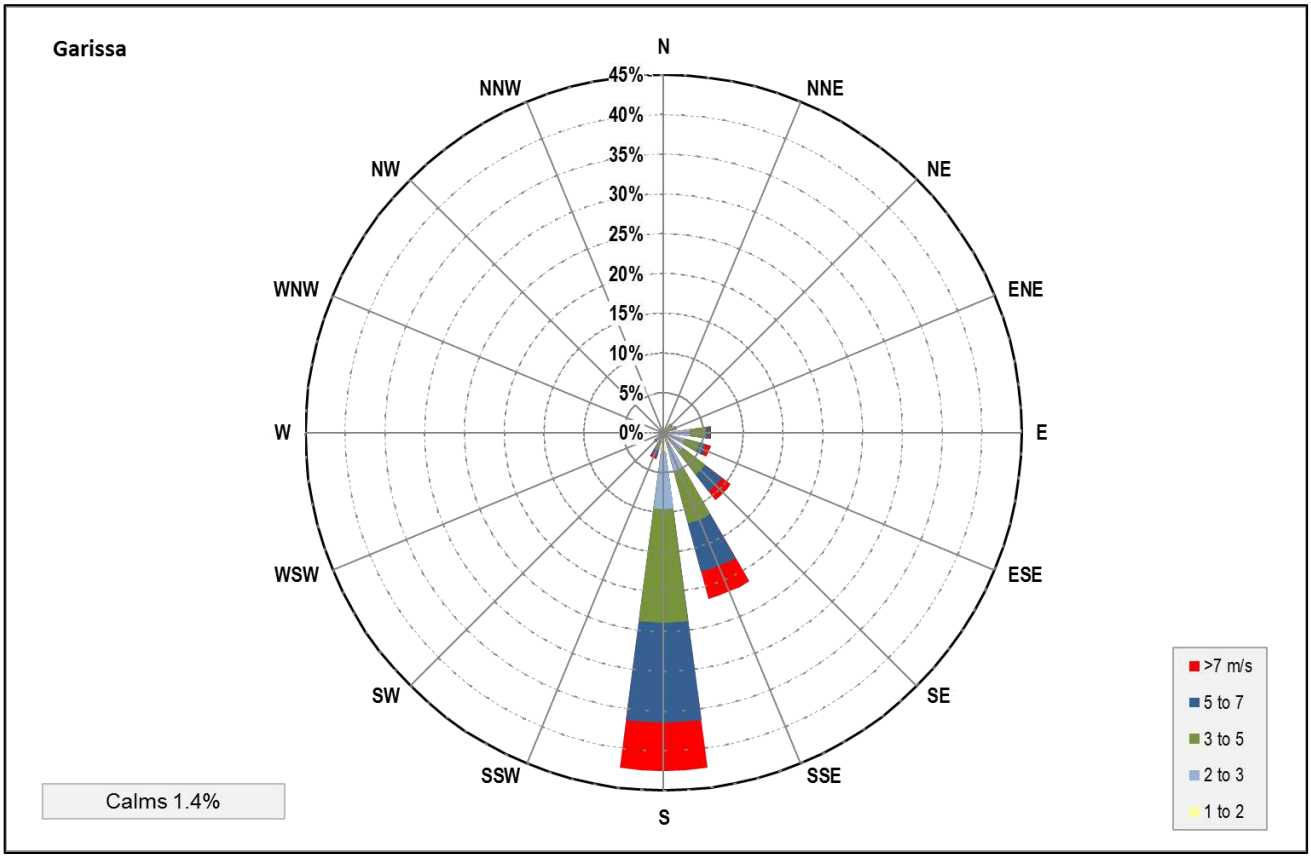

Figure 18: Windrose for Garissa

2.5 Lamu

The meteorological station at Lamu is located 760 km south-east of Lokichar, 440 km south-east of Meru and 250 km south-east of Garissa. Lamu is located at the coast of the Indian Ocean on the coastal plains of Kenya, just 6 masl, in an area with tropical savanna climate.

2.5.1 Ambient Air Temperature

Figures 19 displays the monthly average ambient temperatures as well as the monthly minimum and maximum temperature range recorded at Lamu met station. Monthly average temperatures are high throughout the year lacking distinct seasonal fluctuations. The monthly average temperatures peak in April with 30.2˚C. The minimum monthly average temperature in July is 26.8 ˚C.

2.5.2 Relative Humidity

Figure 20 displays the monthly average relative humidity as well as the monthly minimum and maximum relative humidity recorded for Lamu met station. Monthly average relative humidity is higher than at Kapese, Ngamia and Garissa, and shows very little variation throughout the year. Monthly average relative humidity peaks in May with 78.6%. The minimum monthly average relative humidity occurs in March with 69.0%.

2.5.3 Total Precipitation

As noted in Section 2.1, Lamu met station is only operated on a part-time basis with a high percentage of missing data. The total precipitation figures calculated from the available met data are therefore likely to be biased and strongly underestimate the actual total precipitation occurring in Lamu. Monthly average, minimum and maximum total precipitation is therefore not reported.

2.5.4 Wind Speed

Figure 21 displays the monthly average wind speed as well as the monthly minimum and maximum wind speed recorded for Lamu met station. Monthly average wind speeds are low. Average monthly wind speeds peak in August with 4.5 m/s at. The minimum monthly total occurs in November with 2.6 m/s.

2.5.5 Wind Direction

Figure 22 displays the annual wind rose for Meru met station based on wind speed and wind direction data. At Lamu winds from south to south-easterly directions prevail however winds from easterly directions also occur.

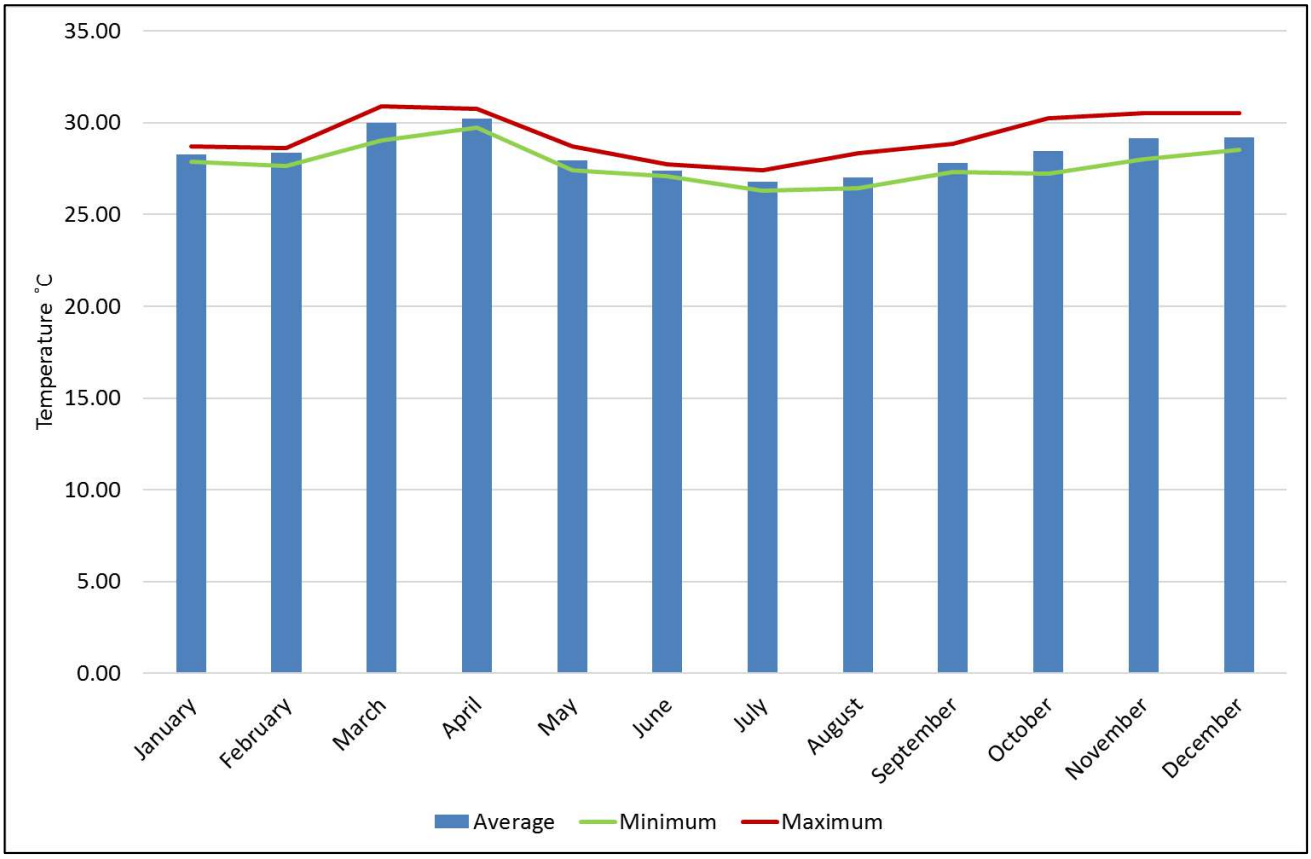

Figure 19: Average, minimum and maximum monthly temperature at Lamu

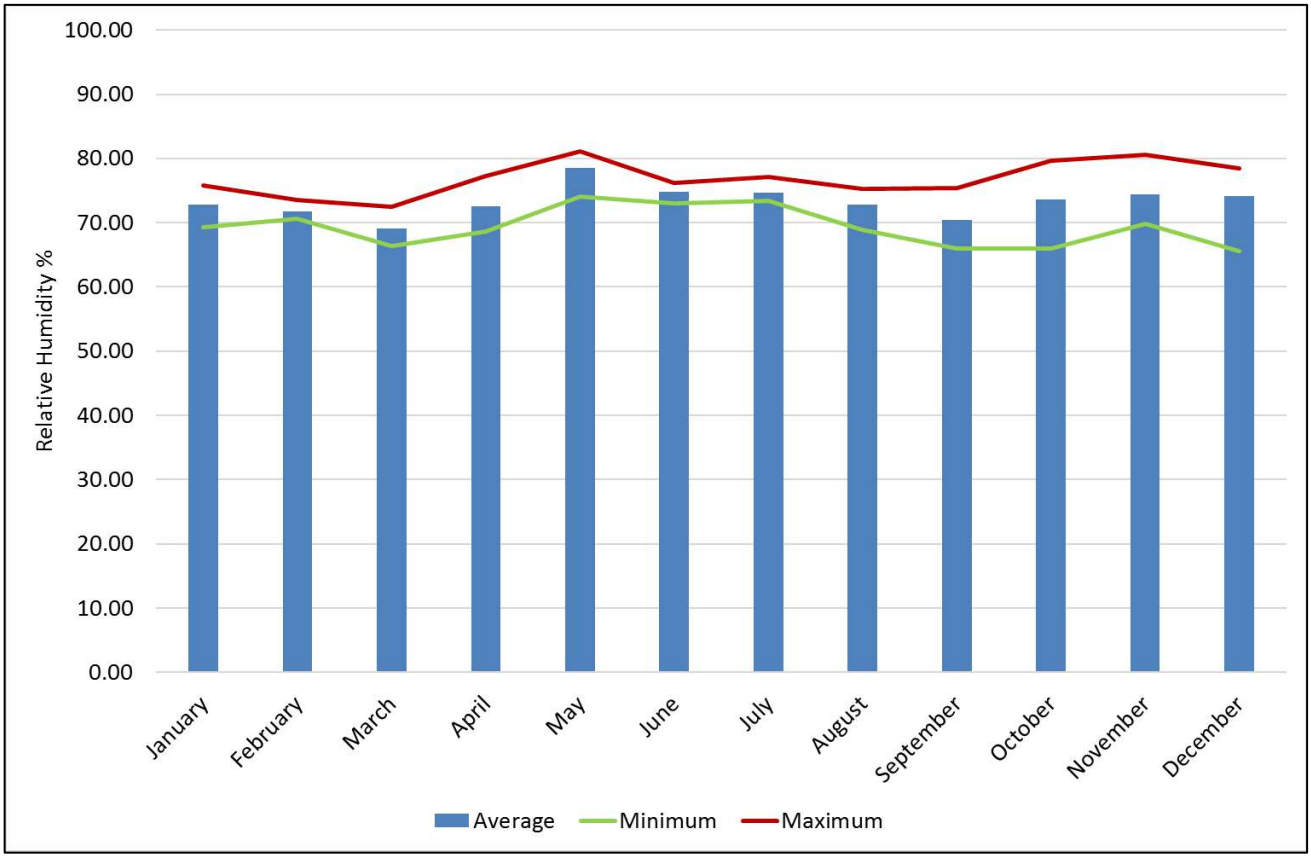

Figure 20: Average, minimum and maximum monthly relative humidity at Lamu

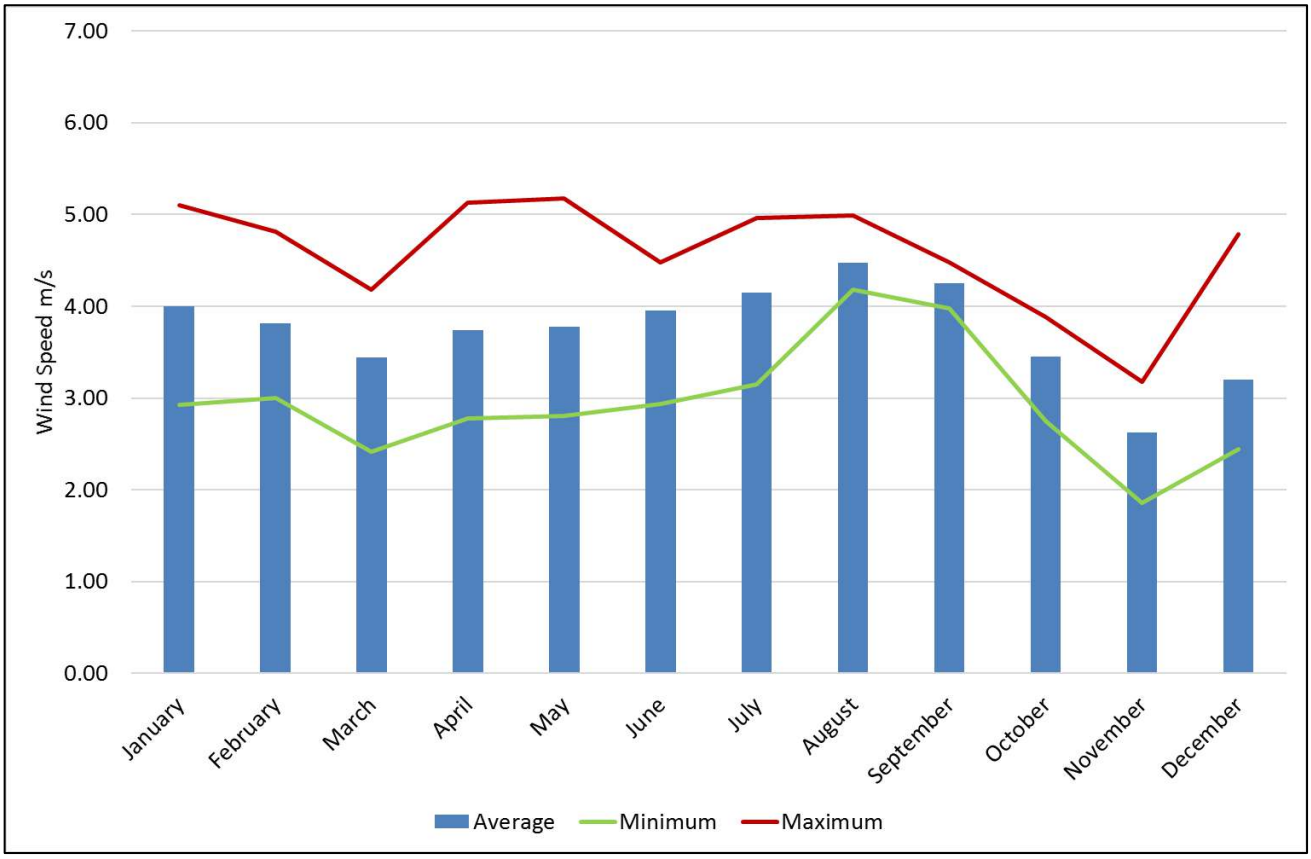

Figure 21: Average, minimum and maximum monthly wind speed at Lamu

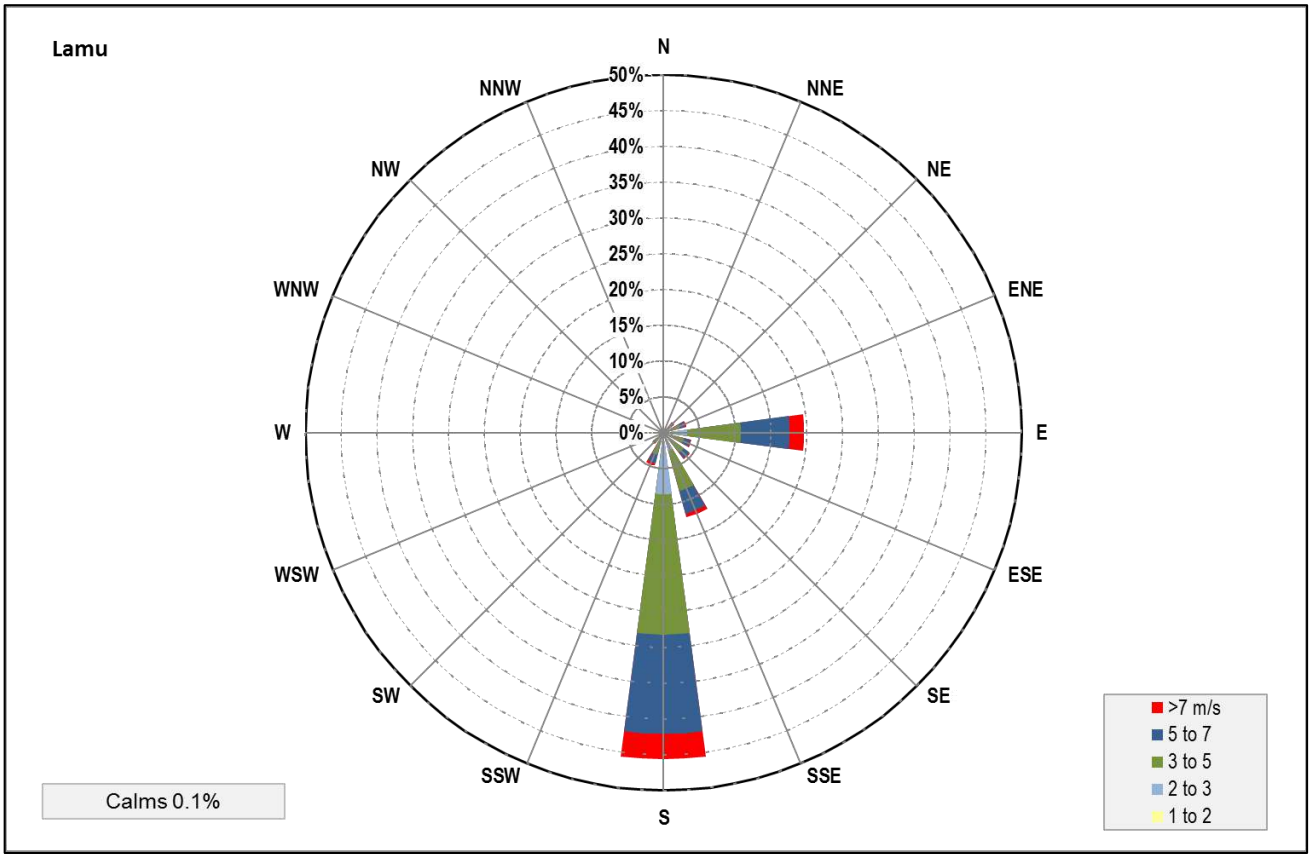

Figure 22: Windrose for Lamu

3.0 DISCUSSION

The proposed 824 km long LLCOP runs from the proposed oil fields near Lokichar in Turkana in south-easterly direction to the new port in Lamu at the coast of the Indian Ocean. The pipeline route traverses mainly areas of hot semi-arid climate however, it also passes through areas of hot desert climate and tropical savanna climate (Figure 2). The differences and similarities in meteorological conditions along the LLCOP route are portrayed by meteorological data from five meteorological stations situated along the route (Figure 1). Kapese and Ngamia are located at a height of approximately 700 masl in Turkana, in an area of hot semi-arid climate. The next meteorological station, Meru, is located approximately 310 km to the south-east Kapese and Ngamia at an altitude of 1554 masl, in an area with tropical savanna climate. Garissa follows a further 225 km south-east of Meru at a height of 147 masl, in an area with hot desert climate. The last meteorological station is in Lamu, approximately 250 km south-east of Garissa. Lamu is located at the coast of the Indian Ocean at a height of only 6 masl, in an area of tropical savanna climate.

3.1 Temperature

Figure 23 shows the average monthly temperatures at each meteorological station. Figure 23 clearly portrays the lack of seasonal variation in temperature across all stations due to the equatorial situation of Kenya. Temperatures at Kapese, Ngamia, Garissa and Lamu are similarly high in line with their equatorial situation. Temperatures at Meru are distinctively cooler than at the remaining meteorological stations because of the reduction in temperature with altitude.

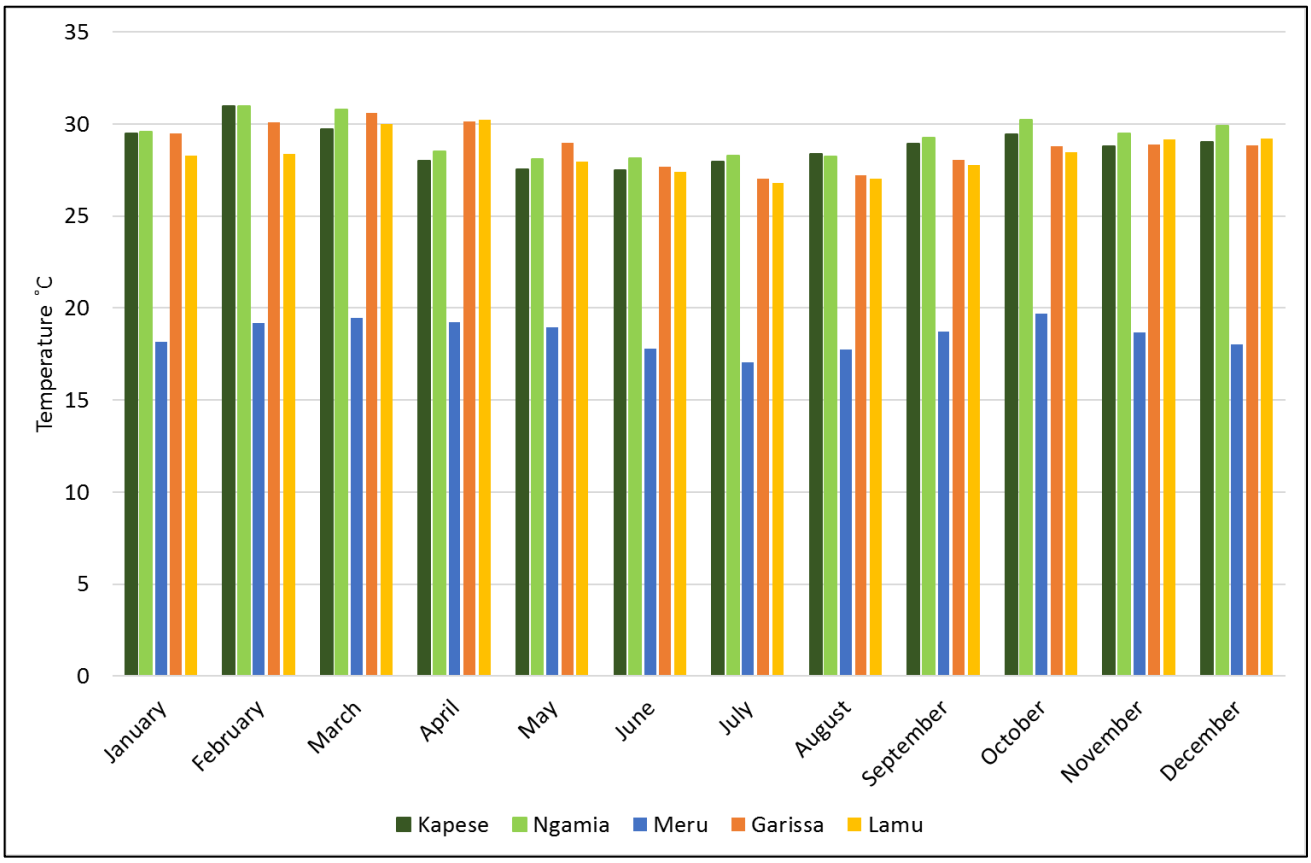

Figure 23: Average monthly temperatures in comparison

3.2 Relative Humidity

Figure 24 shows the average monthly relative humidity at each meteorological station. Relative humidity is lowest at Kapese an Ngamia, the stations that are located furthest from the Indian Ocean. Relative humidity is highest at Meru and Lamu which are in areas of tropical savanna climate.

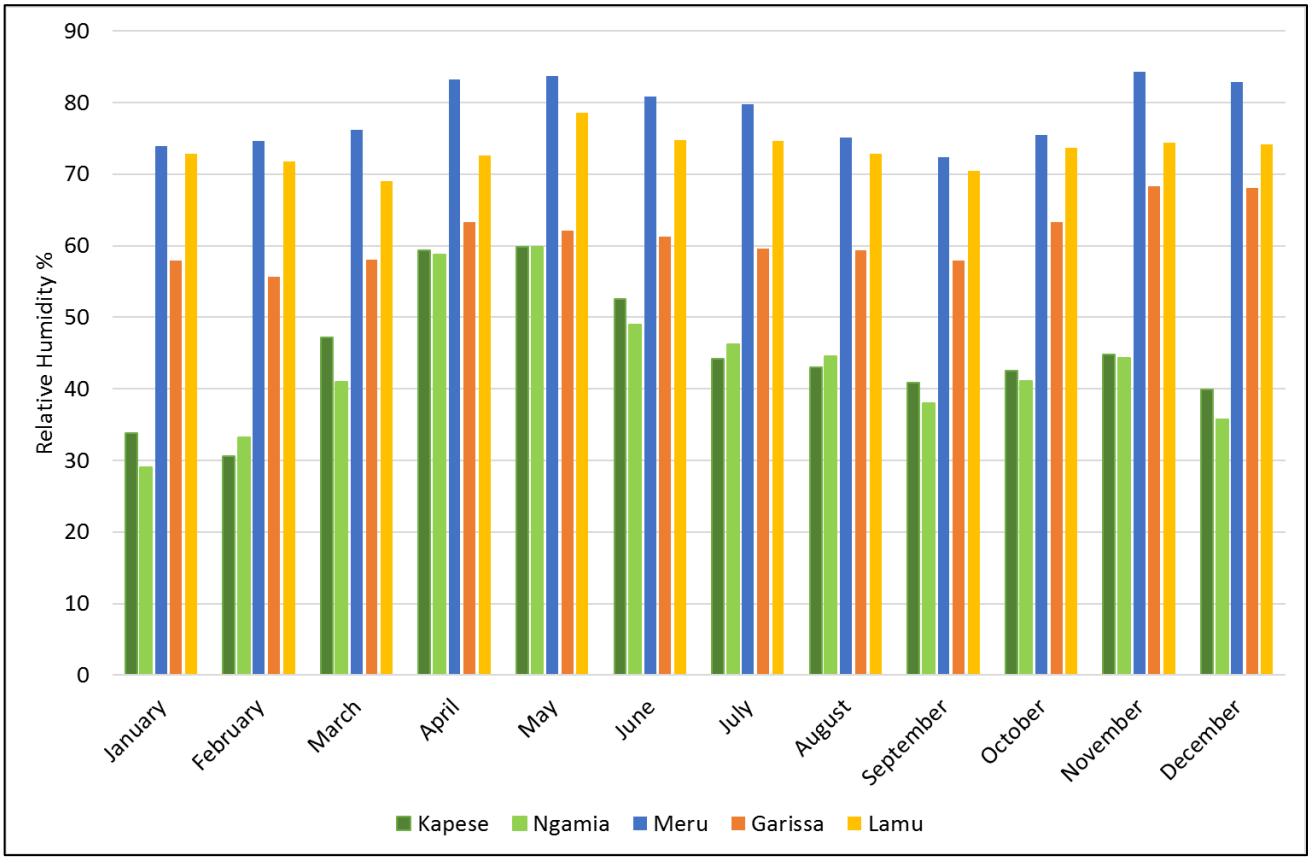

Figure 24: Average monthly relative humidity in comparison

3.3 Total Precipitation

Figure 24 shows the average monthly total rainfall at each meteorological station apart from Lamu. As noted in Section 2.1, Lamu met station is only operated on a part-time basis with a high percentage of missing data. The total precipitation figures calculated from the available met data are therefore likely to be biased and strongly underestimate the actual total precipitation occurring in Lamu. The data has therefore not been included in this comparison.

Figure 24 clearly portrays the annual monsoon patterns over Kenya with a dry season at the beginning of the year, the 'long rains' from April to June, another dry season from July and September followed by the 'short rains' in October to December. In Kapese and Ngamia most of the total precipitation appears to occur during the 'long rains', the first rain season at the beginning of the year, while in Meru average monthly total rainfall is highest during the 'short rains' at the end of the calendar year. Garissa, located in an area of hot desert climate only receives little rainfall during either the 'long rains' or 'short rains' period, and no rainfall at all in some months of the dry seasons (February, July, September).

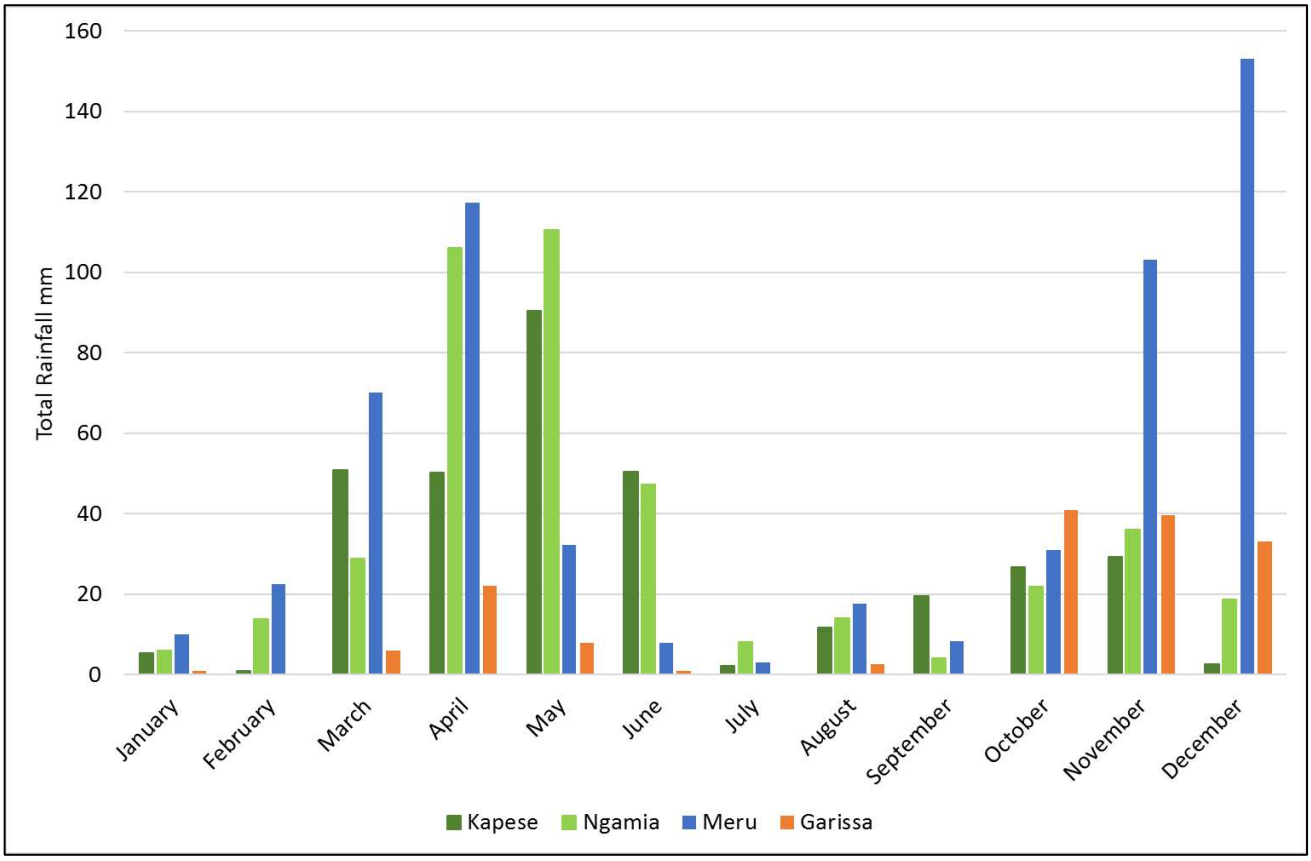

Figure 25: Average monthly total precipitation in comparison

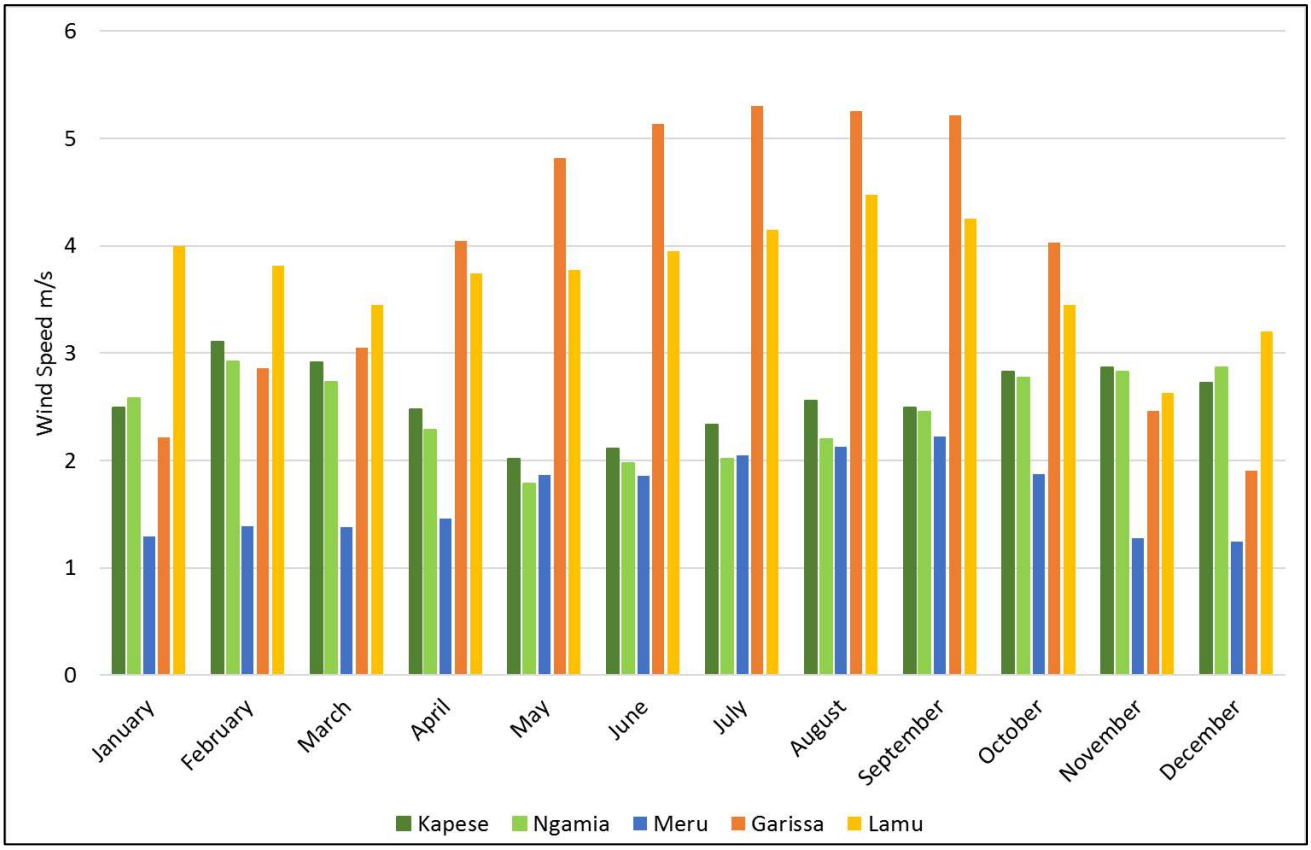

Figure 26: Average monthly wind speed in comparison

3.4 Wind Speed

Figure 26 shows the average monthly wind speed at each meteorological station. As Figure 26 shows average wind speeds are generally low. This is particularly the case for the meteorological stations located inland, Kapese, Ngamia and Meru. Wind speeds are slightly higher at Garissa and Lamu which are located further south and closer to the coast and the Indian Ocean. The differences in wind speed between the stations may also be related to local topography near individual meteorological stations.

3.5 Wind Direction

Figure 27 shows the annual windroses for each meteorological station. Figure 27 portrays the prevalence of easterly wind directions linked to the northeast and southeast monsoons over equatorial Eastern Africa (Okoola 1999, UK Met Office 2011). In Kapese and Ngamia, which are located north of the equator, winds from norther-easterly directions dominate, however south-easterly winds are also present. At the meteorological station located further south-east and at the geographic equator (Meru) or below the geographic equator (Garissa and Lamu) the wind patterns change. Here, winds from south to south-easterly directions prevail and dominate the annual windroses. As for wind speeds, prevailing wind directions and hence windroses at individual meteorological stations may also be influenced by local topography near the stations.

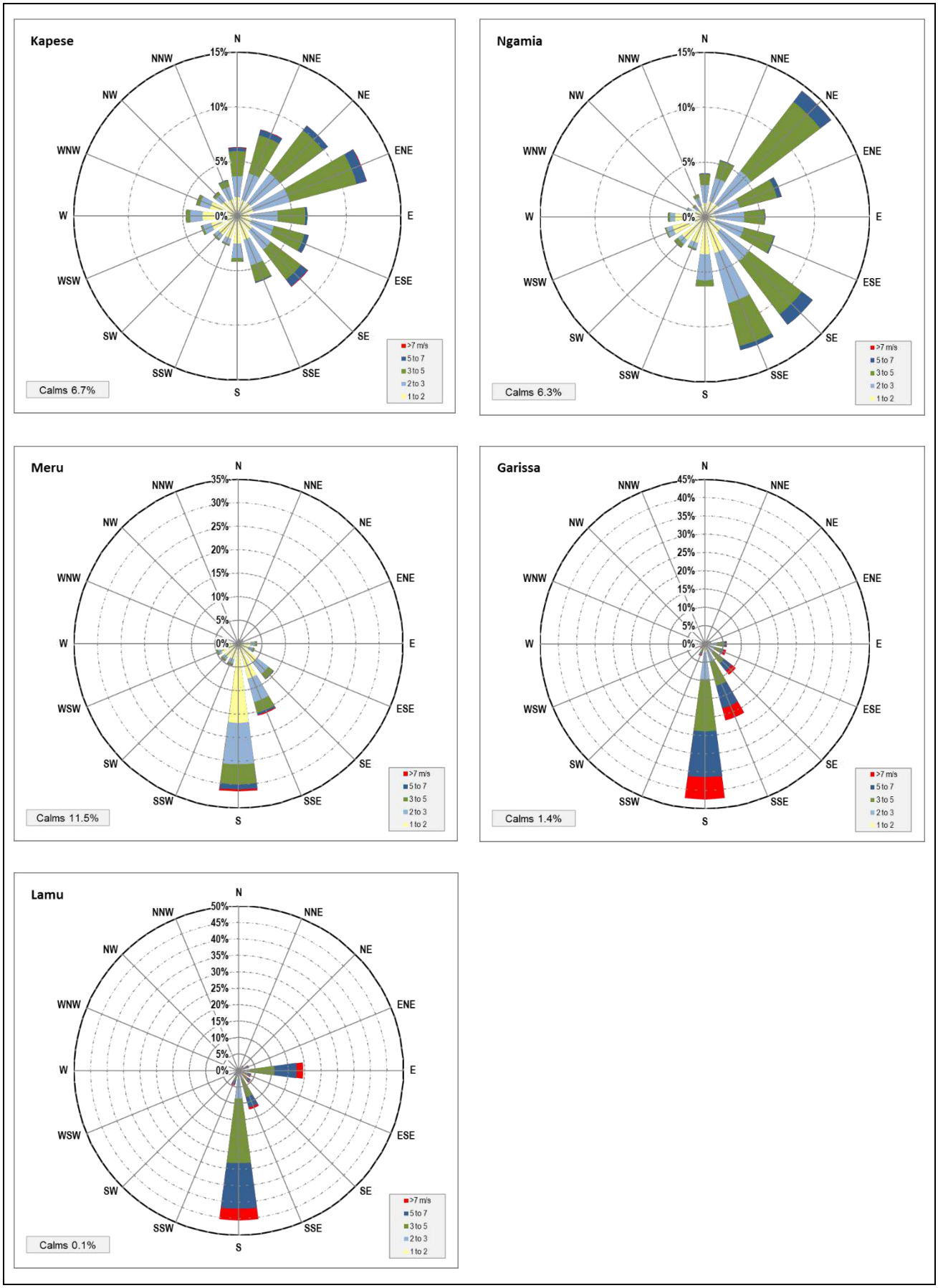

Figure 27: Annual windroses in comparison

4.0 CONCLUSION

The proposed 820 km long LLCOP runs from the proposed oil fields near Lokichar in Turkana in south-easterly direction to the new port in Lamu at the coast of the Indian Ocean. Along the route, the pipeline traverses mainly areas of hot semi-arid climate, however it also passes through areas of hot desert climate and tropical savanna climate which also dominates the coastal plains and the coastal area of Lamu.

Meteorological data from five stations situated along the route of the pipeline has been used to showcase the different meteorological conditions along the pipeline. While meteorological parameters show variation between different stations, the following general meteorological characteristics have emerged:

- Temperatures are generally high and show very little seasonal variations;
- Relative humidity increases from inland stations towards the coastal areas;
- Total precipitation follows annual monsoon patterns over Kenya with a dry season at the beginning of the year, the 'long rains' from April to June, another dry season from July and September followed by the 'short rains' in October to December;
- Wind speeds are generally low; and
- Prevailing wind directions are from the north-east at the northern most part of the pipeline however shift to south/south-eastern directions further south. The prevalence of easterly wind directions is linked to the northeast and southeast monsoons over equatorial Eastern Africa.

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REPORT

Water Resources Baseline

Lokichar to Lamu Crude Oil Pipeline Project

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Pipeline Project Management Team (PPMT)

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APPENDICES

DRAWINGS
Groundwater and Surface Water Monitoring Locations

APPENDIX A
Early Oil Pilot Scheme - Water Monitoring Data

APPENDIX B
Project Water Quality Standards

ACRONYMS AND ABBREVIATIONS

amsl	Above mean sea level
bgl	Below ground level
BGS	British Geological Survey
cm	centimetre
d	day
EARS	East African Rift System
EC	Electrical conductivity
ENNBA / ENNCA	Ewaso N. North Basin Area / Ewaso N. North Catchment Area
EOPS	Early Oil Pilot Scheme
ESIA	Environmental and Social Impact Assessment
FAO	Food and Agriculture Organisation
hr	hour
kg	kilogram
km	kilometre
LAPSSET	Lamu Port - South Sudan - Ethiopia
LLCOP	Lokichar to Lamu Crude Oil Pipeline
LOD	Limit of Detection
m	Metre
mg	milligram
mm	millimetre
NBI	Nile Basin Initiative
ORP	Oxygen Redox Potential
PAH	Polycyclic Aromatic Hydrocarbons
ppm	Parts per million
PSD	Particle Size Distribution
RVBA / RVCA	Rift Valley Basin Area / Rift Valley Catchment Area
s or sec	second
TBA / TCA	Tana Basin Area / Tana Catchment Area
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
WRA	Water Resources Authority

1.0 WATER RESOURCES

1.1 Introduction

The objective of the baseline water resources study is to characterise the surface water and groundwater regimes along the Lamu to Lokichar Crude Oil Pipeline (LLCOP) corridor, The 'Project', and the potential for flood risk to the project or any nearby receptors due to the project. Baseline conditions have been established for the following:

- Shallow groundwater and surface water quality;
- Groundwater regime, including aquifers and levels;
- Surface water flows, and flood and erosion risk; and
- Local water use.

The baseline environment reporting has been divided into a climate overview, surface water (hydrology), groundwater (hydrogeology) and water users. A combination of secondary and primary data sources have been used to collate the baseline environmental setting information. Secondary data sources typically provide overarching background to a surface water and groundwater regime and include literature, maps and available national or regional data sets. Primary data has been collected as part of the baseline to provide specific project information. Such data includes groundwater levels from intrusive site investigations, surface water quality from field sampling, information on watercourses from field observations, and information on water users. In most cases, primary data collection has been targeted on sections of the LLCOP corridor that are of most importance to inform the baseline on a certain topic. The sources of data and their coverage are discussed further in the baseline environment sections below.

1.2 Area of Influence

The Area of Influence (AoI) for water resources within which data has been gathered for the baselines, comprises the area of potential direct and indirect effects during operations and construction of the Project.

It includes a 5 km buffer area along the entire pipeline to ensure that any potential effects downstream of any watercourse, crossed by the route crossing are within the AoI.

Water features that are not typically used as a water supply source, but that are ecologically important (e.g. wetlands and mangroves) are considered within the biodiversity baseline reports.

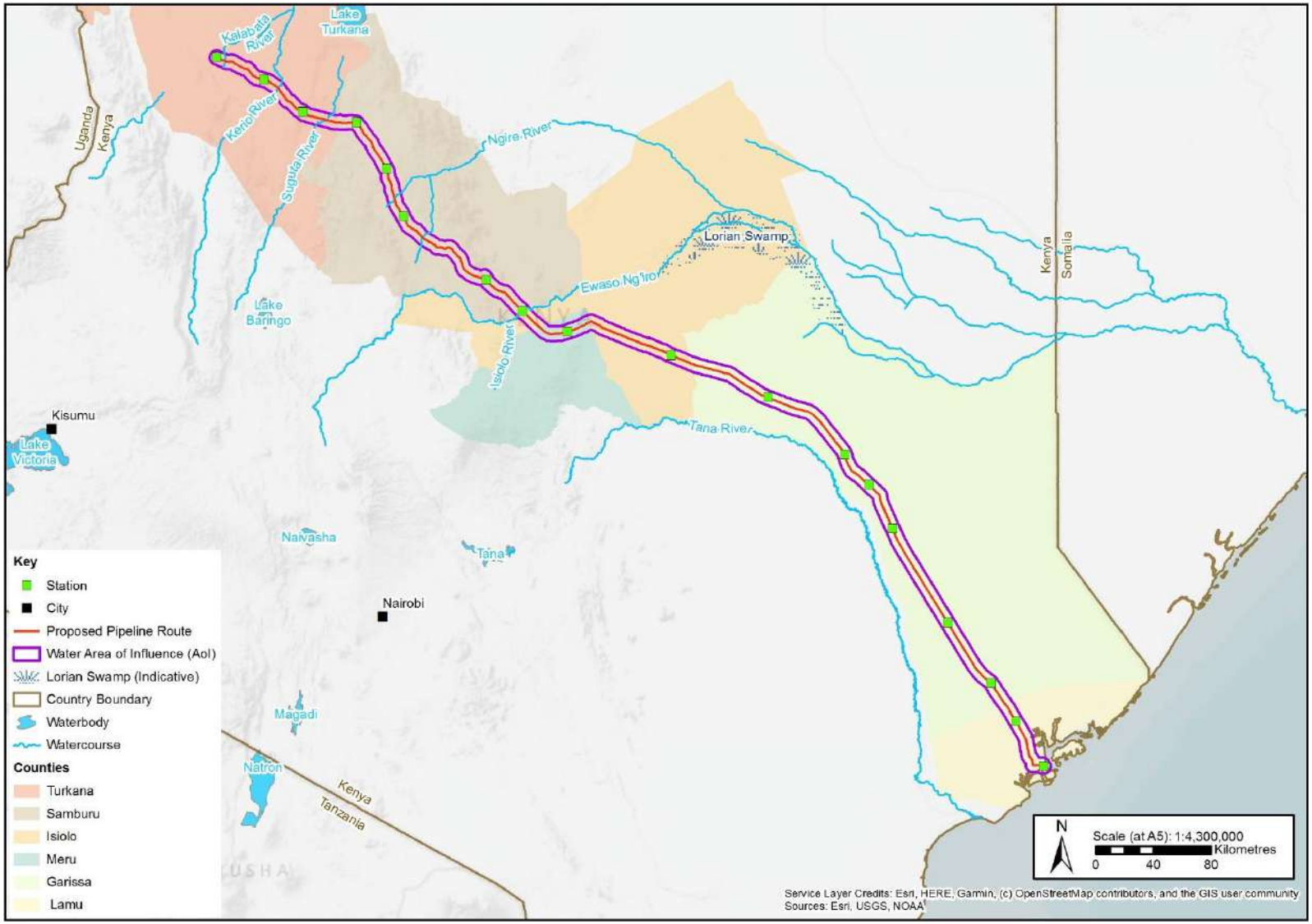

Figure 1: Key Surface Watercourses and AoI

1.3 Climate Overview

This section presents a summary of climate information relevant to the water environment. More detail about these accepts of the climate, and on other climate topic areas, is presented in Climate and Meteorology Baseline Report.

1.3.1 Regional Climate Information

Regional climate zones for Kenya, based on the updated Köppen-Geiger climate classification, are presented in Figure 2 (after BGS, 2018). The LLCOP route passes through zones 'Aw' (tropical savannah) and 'BSh' (arid steppe), and possibly also BWh (arid desert) in highest most northern part of route. Graphs showing average rainfall and temperature distributions for these regional classes is presented in Figure 3 (after BGS, 2018).

Rainfall in Kenya is typically bimodal with two peaks around the wet seasons; one between October and December and a second between March and May. The amount of rainfall that occurs is dependent on the location in Kenya. Precipitation increases with altitude by about 60 mm per 100 m altitude gain (Price, 2016). Evapotranspiration decreases with altitude and mean annual evapotranspiration has been measured at Kabarnet as 1,934 mm and at Lokori as 3,999 mm (Price, 2016).

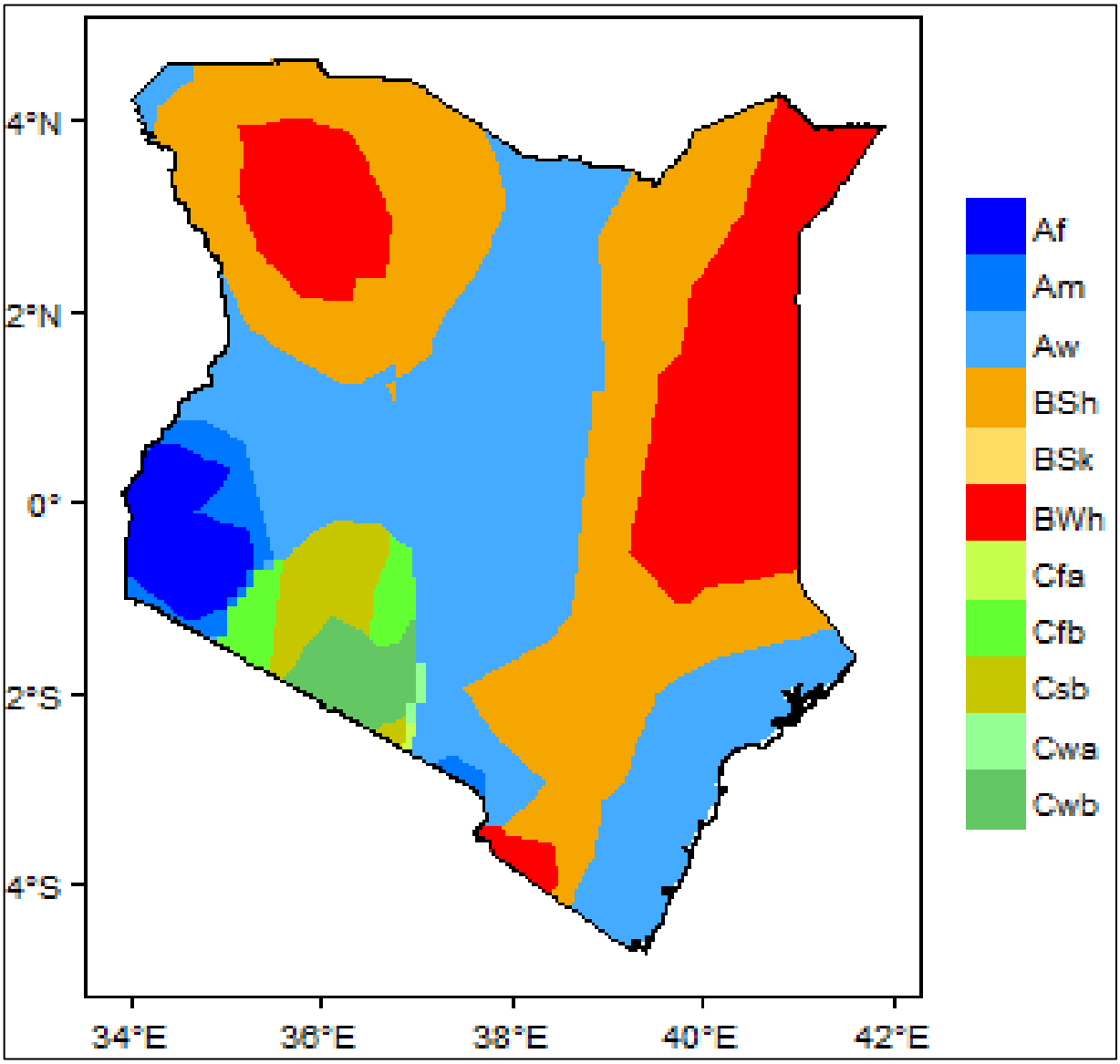

Figure 2: Climate zones in Kenya

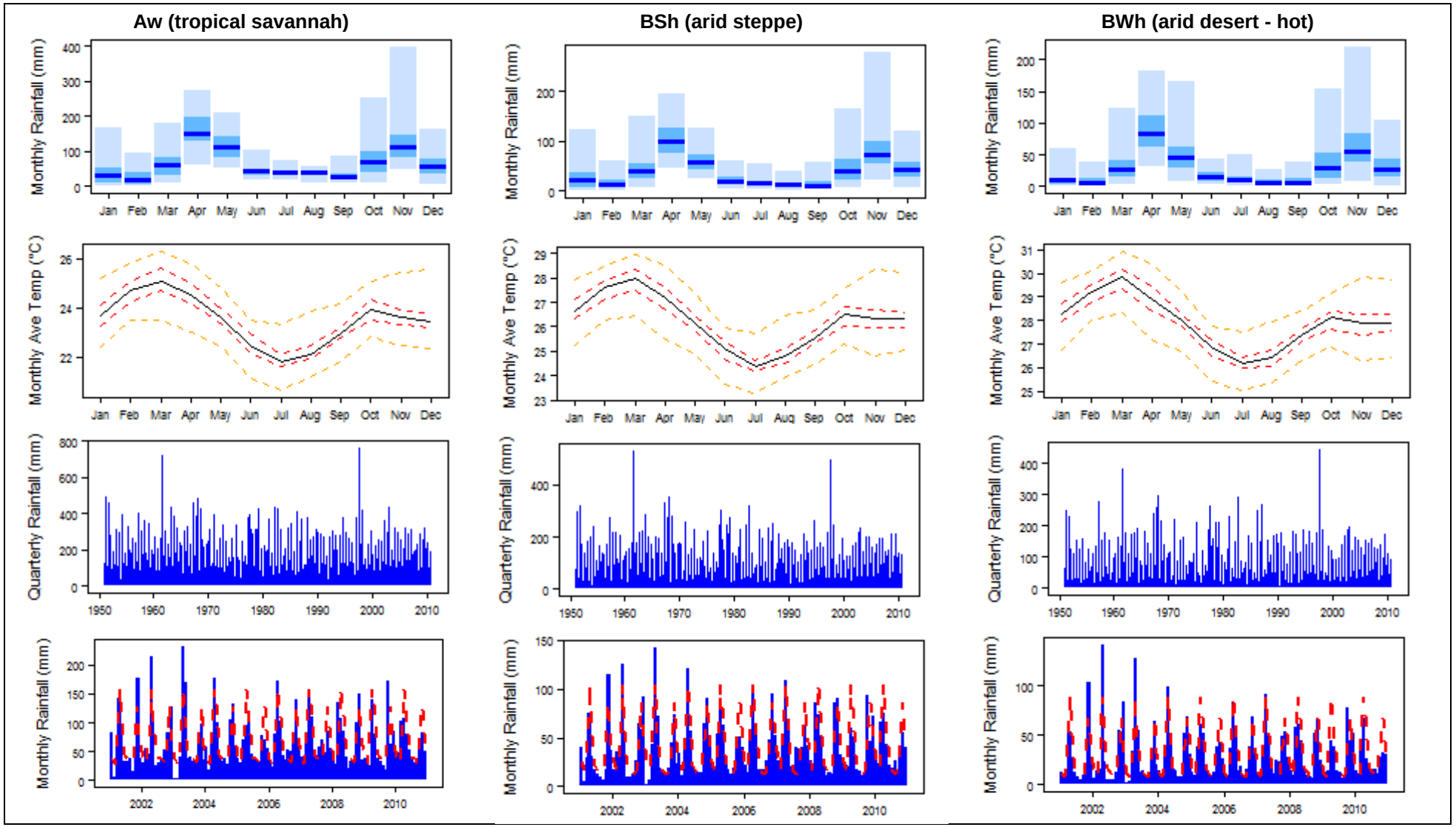

Figure 3: Region climate averages

1.3.2 Local LLCOP Climate Information

Data presented in the Strategic Environmental Assessment for the Lamu Port - South Sudan - Ethiopia (LAPSSET) project (Repcon Associates, 2017) corridor shows that evapotranspiration along the route is extremely high creating a moisture shortage, which results in moisture deficits that lead to poor recharge of surface water and groundwater resources. Average rainfall is low with the lowest levels at the northern end of the LLCOP in Turkana (see Figure 4, after Repcon Associates, 2017).

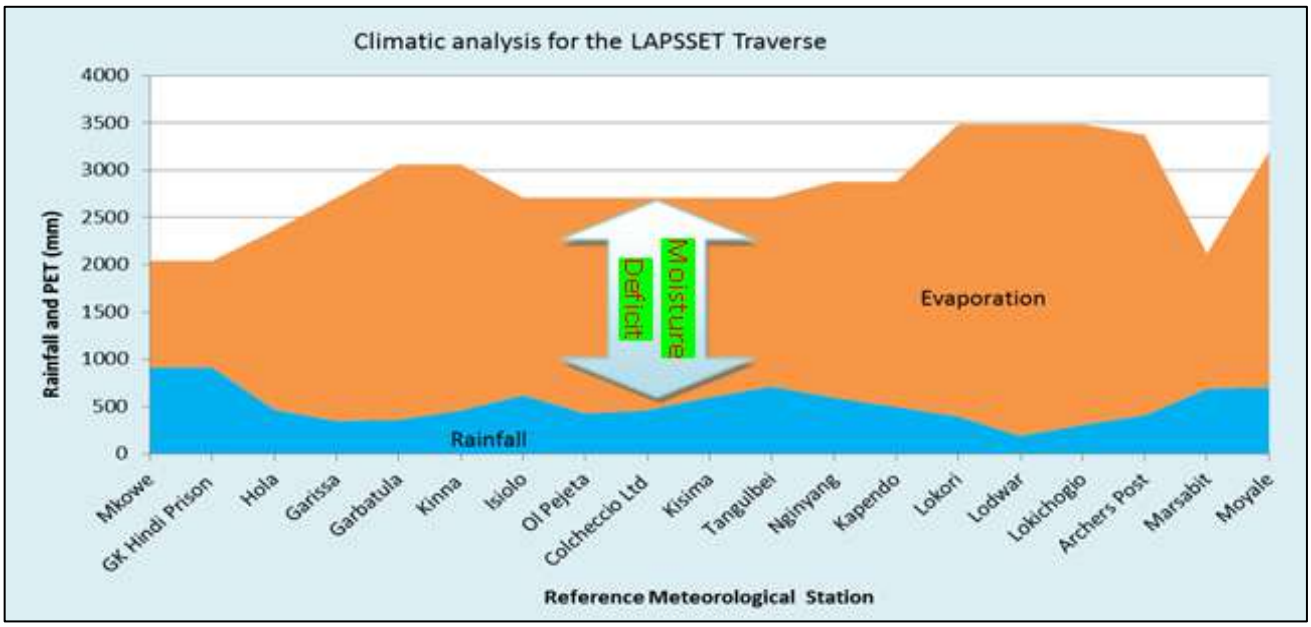

Figure 4: LAPSSET Corridor climatic analysis

The meteorological data for the proposed Project is presented in the Meteorological Baseline Report. Information presented in that report about the temperatures and precipitation recorded at meteorological stations in Turkana, Meru, Garissa and Lamu counties is summarised in the county-specific sections below. In summary the following statements can be made from the meteorological data available along the LLCOP route:

- The LLCOP route mainly passes through areas of hot semi-arid climate, but it also passes through areas of hot desert climate and tropical savanna climate. The latter dominates the coastal plains and the coastal area of Lamu.
- Temperatures show very little seasonal variations.
- Total precipitation follows annual monsoon patterns over Kenya with a dry season at the beginning of the year, the 'long rains' from April to June, another dry season from July and September that is followed by the 'short rains' in October to December. The exact timing and duration of the rains varies across Kenya and between years.
- In Turkana most of the total precipitation appears to occur during the 'long rains' (the first rain season at the beginning of the year).
- In Meru average monthly total rainfall is highest during the 'short rains' at the end of the calendar year.
- Garissa, which is located in an area of hot desert climate, only receives a little rainfall during either the 'long rains' or the 'short rains', and no rainfall at all in some months of the dry seasons (i.e. February, July and September).

1.3.2.1 Turkana County

Information presented in the Turkana Integrated Development Plan (Turkana County Government, 2013) indicates that the climate in Turkana County is arid or semi-arid. Rainfall occurs in two wet seasons and is erratic and unreliable. The long rains usually occur between April and July and the short rains between October and November. Most of the annual rainfall occurs during the long rains. Rainfall for the remainder of the year is typically low and the area is often at risk of serious drought conditions. Rainfall mostly falls in the mountains in the west of Turkana County. Annual rainfall ranges between 52 mm/yr and 480 mm/yr (average 200 mm) and the driest periods are in January, February and September. Rainfall typically occurs as brief storm rains and runoff and potential evaporation are high, which leads to flash flooding and salt capping on surface that limits agricultural production potential.

Precipitation data from a meteorological station in Lodwar is available for the years 1978 to 1998 and 2004 to 2015. Using these years, the annual rainfall ranges between 38.9 mm and 453.5 mm with an average over of 197.8 mm. The average annual rainfall for the last 10 years (2006 to 2015) is 261.1 mm (Golder, 2017).

The Suguta Valley constitutes the most arid environment in Kenya, with a documented rainfall amount of <300 mm/yr, which is distributed following a unimodal cycle, with a peak between March and May. The mean annual temperature ranges between 28°C and 31°C and mean annual evaporation ranges between 3,000 mm/yr and 4,000 mm/yr, causing high evaporation rates (Wood Group, 2018).

In addition to the above, data are also available from the Kapese and Ngamia meteorological stations. Both of these stations are located close to the proposed oil fields near Lokichar, in an area with hot, semi-arid climate. The data is presented and discussed in the Meteorological Baseline Report, but in summary includes the following information about temperatures and precipitation:

- The monthly average temperatures peak in February with 31.0˚C for both stations;
- Monthly average temperatures at both stations are very similar and relatively stable lacking distinct seasonal fluctuations;
- The minimum monthly average temperature in June was 27.5˚C in Kapese and 28.1˚C in Ngamia;
- The precipitation pattern is very similar at Kapese and Ngamia;
- Total precipitation peaks in May with an average monthly total of 90.4 mm in Kapese and 110.6 mm in Ngamia;
- The minimum monthly total occurs in February at Kapese with 0.9 mm and in September at Ngamia with 4.0 mm; and
- Monthly total precipitation is generally low, but strongly varies during the year as well as within years.

1.3.2.2 Samburu County

Samburu County receives rainfall of about 700 mm to 1000 mm per year in the mountain ranges. For period July 17 to June 18 (WRA, 2018a), the maximum monthly rainfall at the Archers Post rainfall station, located in the Ewaso Ng'iro North Basin Area near the border between Samburu County and Isiolo County, was below 200 mm per month. Rainfall recharges springs in the lowlands.

1.3.2.3 Isiolo County

Average altitude ranges from 265 to 400 m, with a bi-modal rainfall 350 - 600 mm per annum. The project area is categorised as an arid region because it has no water catchment areas and experiences frequent droughts.

1.3.2.4 Meru County

Data from the Meru rainfall station for the period July 2017 to June 2018 (WRA, 2018a) shows that the rainfall over this one-year periods was 873.7 mm. The year 2017/2018 was reportedly relatively wet compared to the long-term average and rainfall was also higher than in any of previous five years; the lowest rainfall in the last five years was 304 mm recorded between July 2013 and June 2014.

In addition to the above, data are also available from the Meru meteorological station, which is located approximately 310 km to the south-east of Lokichar in an area with a tropical savanna climate. The station is at an altitude of 1554 m asl. The data is presented and discussed in the Meteorological Baseline Report, but in summary includes the following information about temperatures and precipitation:

- Monthly average temperatures are much cooler than at Kapese and Ngamia due to the higher altitude of the station, however, are stable and lack distinct seasonal fluctuations.
- The monthly average temperatures peak in October with 19.7˚C.
- The minimum monthly average temperature in July is 17.1˚C.
- Monthly total precipitation shows a strong seasonal variation with two peaks; one occurring around April and one occurring around December.
- Total precipitation peaks in December with an average monthly total of 153.1 mm.
- The minimum monthly total occurs in July with 3.0 mm.

1.3.2.5 Garissa County

Garissa County has a spatial average annual rainfall is 430 mm per year. The annual average rainfall increases south-eastwards from inland Garissa County towards Lamu. Annual average rainfall ranges from around 300 mm per year in northern Garissa County to over 600 mm per year near the border with Lamu County. Rainfall is highly seasonally and spatially variable across the County with monthly average rainfall ranging 3 mm in February 94 mm in November. There are two rainy seasons in a typical year with the long rains from October to January and the short rains from March to May. Monthly data recorded at Garissa Met Station shows a slightly lower annual average rainfall of 347 mm (Kinconsult Associates Ltd, 2016).

Garissa County is in the Tana Basin Area (see Section 1.4.1) and the higher than average annual rainfall reported in other counties in 2017/2018 (see Meru County) resulted in floods in the Tana Basin Area (WRA, 2018a).

Like rainfall, potential evaporation is also variable across the county. Potential evaporation for much of Garissa County varies from 179 mm per month in December to 219 mm per month in October. The average monthly potential evaporation is 198 mm and an annual average is 2374 mm (Kinconsult Associates Ltd, 2016).

In addition to the above, data are also available from the Garissa meteorological station, which is located approximately 525 km to the south-east of Lokichar and 225 km south-east of Meru. It is located in an area with a hot desert climate. The data is presented and discussed in the Meteorological Baseline Report, but in summary includes the following information about temperatures and precipitation:

- Monthly average temperatures are high throughout the year and lack distinct seasonal fluctuations.
- The monthly average temperatures peak in March with 30.6˚C.
- The minimum monthly average temperature in July is 27.0˚C.

- Monthly total precipitation is low throughout the year but shows a seasonal variation with two peaks similar to that recorded at Meru; one occurring around April and one occurring around October to December.
- Total precipitation peaks in October with an average monthly total of 40.1 mm.
- The minimum occurs in February with 0.0 mm.

1.3.2.6 Lamu County

Lamu County is coastal and has a hot tropical climate where the weather is influenced by monsoon winds from Indian ocean (United Nations et al., 2006). The annual rainfall on the coast follows a strong seasonal pattern. Between November/December and early March the weather is dominated by the Northeast Monsoon (Kazkazi) that is comparatively dry. During March and April, the monsoon winds blows in an east to south-easterly direction (Kuzi) bringing in maritime air from the Indian Ocean and heavy rains. During the months of May, June, July and August, the South-easterly Monsoon influence results in cooler temperatures. Mean annual total rainfall ranges from 508 mm in the drier, northern hinterland to over 1,016 mm in the wetter areas south of Malindi.

In addition to the above, data are also available from the Lamu meteorological station. It is located on the coastal plains of Kenya at an elevation of 6 m asl in an area with tropical savanna climate. The data is presented and discussed in the Meteorological Baseline Report, but in summary includes the following information about temperatures:

- Monthly average temperatures are high throughout the year and lack distinct seasonal fluctuations.
- The monthly average temperatures peak in April with 30.2˚C.
- The minimum monthly average temperature in July is 26.8˚C.

Lamu meteorological station is only operated on a part-time basis and a high percentage of precipitation data is missing. Therefore, the precipitation data is not summarised because it will not be representative of the actual total precipitation occurring.

1.3.3 Climate Change

Climate change predictions with respect to rainfall, evaporation and flooding can be highly variable. In general, climate change in the LLCOP area is expected to increase rainfall in the long-term, but with increased extremes including intense rainfall events, drought and continuing high evapotranspiration characteristics.

Information on current temperature trends and future predictions (collated in Abour, 2019) indicates that mean annual temperatures have increased at a rate of 0.34^{o}C per decade over the last 30 years. Future temperature predications are variable, but typically fall into similar ranges. Values given for predicted regional temperature changes east Africa in the period 2080–99 (from a baseline period of 1989–99) range between 1.8^{o}C and 4.3^{o}C (mean +3.2 ^{o}C) (World Bank, 2011). By the end of the 21st century, there is a predicted increase in maximum and minimum temperatures in equatorial eastern Africa, with more days that are warmer than 2°C above the 1981-2000 average (Niang *et al.*, 2014). The summary of temperature projections (Ministry of Foreign Affairs of the Netherlands, 2018) shows an average increase of 0°C to 2.5^{o}C between 2000 and 2050 (1°C to 2°C most likely) and by 2100 a warming ranging between 1.3^{o}C and 3.9^{o}C is likely (maximum 4°C). Highest temperature increases are expected for the northeast of Kenya, and the smallest increases for the southeast (Abour, 2019). The plateaus, mountain ranges and coastal area will remain cooler than the inland lowlands, and temperature increases will be seasonal with the smallest increase expected for the start of the long-wet season (March – May) (Abour, 2019).

The first rains of the long-wet season have become unreliable and on average significantly reduced (Abour, 2019). While the average number of rainy days during the short-wet season has reduced from 60 to 30, rainfall has become more intense and the season is being prolonged into January and February, so the total rainfall for this season is higher (Abour, 2019).

Rainfall forecasts vary depending on which climate model is used. In East Africa there is high confidence in a projected increase in heavy precipitation and there is predicted to be a likely increase in mean annual precipitation over areas of central and eastern Africa (Niang *et al.*, 2014). Values given for predicted precipitation changes east Africa in the period 2080–99 (from a baseline period of 1989–99) range between -3% and +25% precipitation (mean +7%) (World Bank, 2011). Generally, a wetter climate is predicted with more intense wet seasons, and increase in the number of extreme wet days, and less severe droughts during October-November-December and March-April-May.

Although rainfall at the national level is expected to increase in Kenya, climate projections suggest that changes will be different according to location and season. The summary of climate change trends (Ministry of Foreign Affairs of the Netherlands, 2018) indicates the following:

- The highest increases (or the lowest decreases) are expected for the north of Kenya with increases, in the form of more intense rains, of up to 40% projected until 2100;
- For the long-wet season, a 100 mm decrease in precipitation is expected, although a slight increase may occur in highlands and coast; and
- For the short-wet season, an increase in rainfall is predicted, especially for the Rift Valley.

A climate change simulation for the Tana Bain Area concluded that there may be earlier onset of rainfall for both the long and short rainy seasons (Sood *et al.*, 2017). The more regional climate model studies suggest drying by the end of the 21st century over most parts of Uganda, Kenya, and South Sudan in August and September and that spring rains may be truncated and the autumn rains lengthened (Niang *et al.*, 2014).

There is uncertainty over predicted changes to river flows. Seasonal runoff volumes in the Lake Tana Basin are estimated to decrease by the 2080s under some climate model scenarios, while others report inconclusive findings. However, in other scenarios the Mara, Nyando, and Tana Rivers in eastern Africa are projected to have increased flow in the second half of this century (Niang *et al.*, 2014). A climate change simulation for the Tana Bain Area concluded that increased rainfall will lead to increased flows, with the mean annual flow at Garissa potentially increasing by more than double in some model scenarios by the end of the 21st century (Sood *et al.*, 2017). Some climate change models predict a 20% increase in Kenya's river flows by 2030 resulting from extreme runoff during intense rainfall events (Avery, 2013). Increases in runoff rates would lead to more erosion and flooding.

Groundwater systems react in different ways to climate change. Shallow aquifers with short residence times will react more quickly to changes in recharge, while deeper aquifers (particularly those with large storage) will react more slowly and be better buffered against climate change (World Bank, 2011). Changes in rainfall would not be expected to impact recharge to deep aquifers in areas receiving rainfall below 200 mm per year because recharge is already negligible due to low rainfall. Groundwater recharge may also not be significantly affected by climate change in areas that receive more than 500 mm per year because sufficient recharge would remain even if rainfall diminished (assuming current groundwater extraction rates). Areas receiving between 200 mm and 500 mm per year may experience a decline in groundwater recharge with climate change (especially in shallow aquifers) leading to more frequent prolonged droughts (Niang *et al.*, 2014).

The Intergovernmental Panel on Climate Change (IPPC) Fifth Assessment Report (2014) presents the prediction that there is very likely to be a significant increase in the occurrence of future sea level extremes by 2050 and 2100. Projections of regional changes in sea level reach values of between 10% to 20% above the global mean value in equatorial regions. Under all modelled scenarios, the rate of sea level rise is predicted to very likely exceed the observed rate of 2.0 [1.7 to 2.3] mm/yr during 1971 to 2010 (IPPC, 2014).

Sea level rise is predicted to threaten coastal aquifer systems, although it is possible that the Kenya Coast may not be affected severely (World Bank, 2011). These aquifers might be threatened due to changes in the position of the interface between fresh and saline water, over abstraction, or if coastal aquifers become submerged due to sea level increases.

Overall, it is difficult to determine the degree to which the Kenyan aquifers are sensitive to climate change given the relatively poor level of understanding of them (World Bank, 2011). The overall impact of climate change on groundwater resources in Africa is expected to be relatively small in comparison with impacts from non-climatic drivers such as population growth, urbanisation, increased reliance on irrigation to meet food demand, and land use change (Niang *et al.*, 2014).

1.4 Hydrology

1.4.1 Hydrological Setting Overview

Kenya's main rivers originate in the central highlands or in the southern foothills of the Ethiopian highlands. The Rift Valley is a dominant control on surface water flows. West of the Rift Valley, surface water flows towards Lake Victoria and into the Nile Basin; east of the Rift Valley, surface water flows southeast to the Indian Ocean (BGS, 2018).

An overview of the hydrological setting of Kenya (Food and Agriculture Organisation (FAO), 2018) indicates that most of Kenya's water originates from its five "water towers": Mau Forest Complex, Aberdare range, Mount Kenya, Mount Elgon and the Cherengani Hills. They are the largest montane forests in the country and form the upper catchments of most of the main rivers in Kenya. There are six main catchments in the country, used as units for water resources management:

- Lake Victoria North Basin Area (LCNBA) that covers 3.0% of the country;
- Lake Victoria South Basin Area (LVSBA) that covers 5.0% of the country;
- Rift Valley Basin Area (RVBA), which includes the inland lakes and covers 22.5% of the country;
- Athi Basin Area (ABA) that stretches up to the coast and covers 11.5% of the country;
- Tana Basin Area (TBA) that covers 21.7% of the country; and
- Ewaso Ng'iro North Catchment Area (ENNBA) that covers 36.3% of the country.

A map of the catchment areas is shown in Figure 5 (after WRA, 2018b).

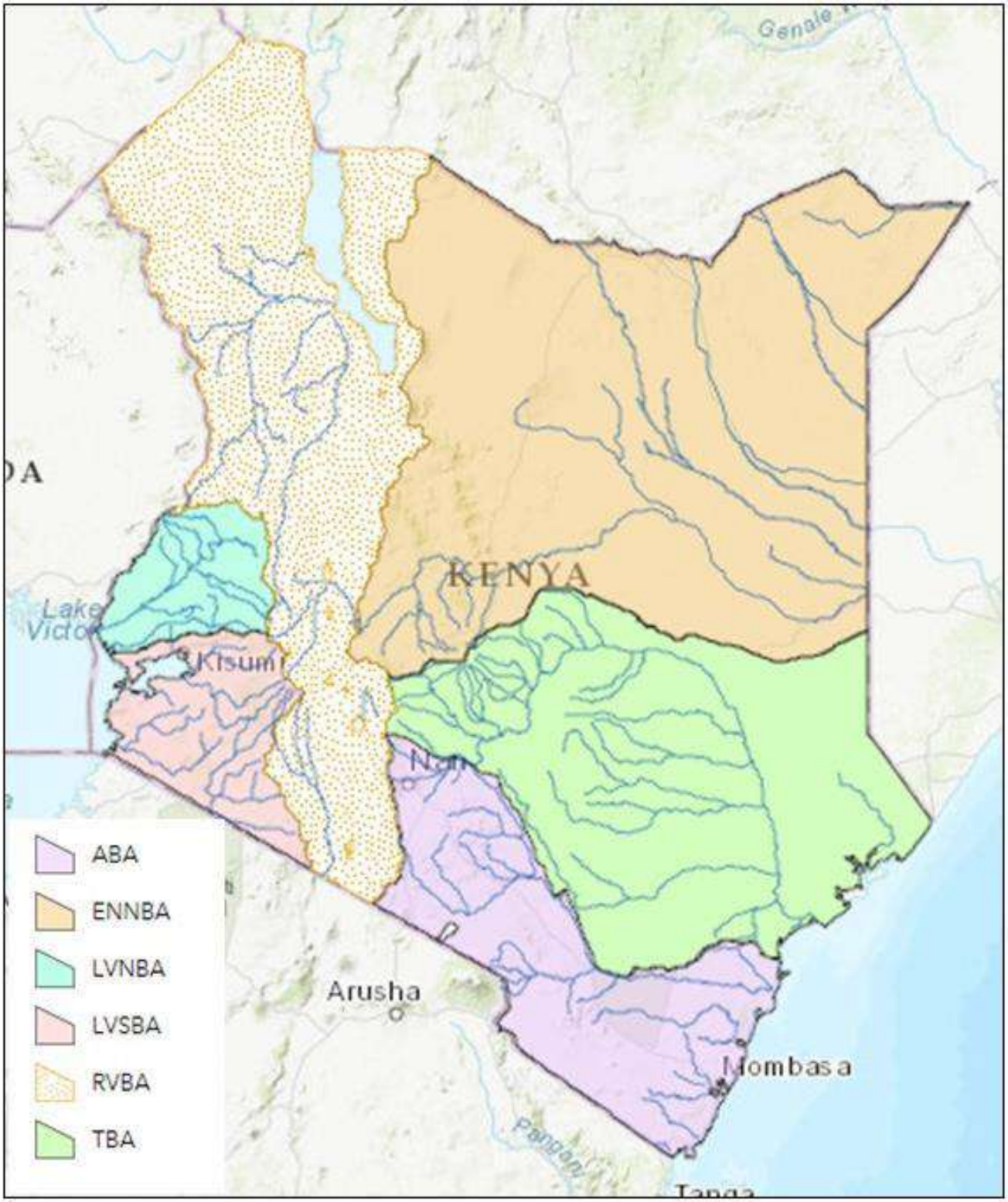

Figure 5: Main Catchment zones of Kenya

The hydrology of the coastal region is influenced by the discharge from the river and the tide (United Nations et al., 2006). Discharge to the coastal region from rivers is seasonal and can transport 80% of the sediment load in a matter of days due to heavy rainfall. Along parts of coast there is a system of tidal creeks, flood plains, coastal lakes and mangrove swamps (the Tana Delta) that is located behind a sand dune system that protects

them from the ocean. The tides are semi-diurnal most of the time (i.e. two tides every 24 hours). Spring tidal variations in East Africa can be up to 4 m (average 2.5 m to 3 m).

With respect to transboundary matters, the FOA (FAO, 2015) states that Kenya, together with the then nine other Nile riparian countries, is a member of the Nile Basin Initiative (NBI). The Ewaso Ng'iro is part of the larger Shebelle-Juba basin, of which one quarter lies within Kenya, for which there is no framework of cooperation between the NBI's riparian countries. There is also no cooperation framework between the NBI's riparian countries that border Lake Turkana (formerly Lake Rudolf). The absence of cooperative management leads to tensions, for example Ethiopia constructing dams that impact the water inflow to Lake Turkana.

1.4.2 Water Features

The LLCOP route will pass through three of the six main catchments in Kenya (see Figure 5 for catchment areas):

- The Tana Basin Area;
- The Ewaso Ng'iro North Basin Area; and
- The Rift Valley Basin Area.

Figure 6 and Figure 7 (after Wood Group, 2017) show the LLCOP route overlain onto a detailed plan of the drainage network and more detailed sub-catchments.

Along the LLCOP route within these catchments are a range of water features including lakes, rivers, streams, springs, wetlands, lagoons, mangrove and the sea. The purpose of this section is to provide general information on the water features in the Counties and present more detailed information about the main river crossings along the LLCOP.

The majority of the water features crossed will be rivers and streams that are either perennial (flow all year around) or are ephemeral (flow seasonally or are short-lived/temporary, for example during periods of heavy rainfall). The LLCOP route crosses three perennial rivers, the Kerio River and the Suguta River as they pass through Turkana County, and the Ewaso Ng'iro River as it passes through Isolo County just south of Archers Post near the border with Samburu County (Figure 1). More details about these rivers are presented in the County sub-sections, below.

In addition to these, the LLCOP route crosses 14 seasonal rivers and around one hundred ephemeral streams (Wood Group, 2018). Seasonal rivers, or luggas, are shallow temporary watercourses that are characterised by flashy, sometimes unpredictable hydrography and are dry for prolonged periods. Field observations (Wood Group, 2018) indicate that the luggas typically have low sinuosity meandering, wide channel areas with braiding. In general, they have sandy beds overlying bedrock, or the channel is cut into the bedrock. Flows in these seasonal luggas will result in erosion and sediment transport, and flooding and scouring are possible. More information on flows is presented in Section 1.4.3, and additional information on flooding and erosion is presented in Section 1.4.4.

The minor ephemeral streams that cross the pipeline corridor result from the down flow merging of eroded gullies, and are considered active only during flash flood events, as is indicated by their nearly vertical benches and lack of bar migration evidences (Wood Group, 2018). These features are found along the full LLCOP route, but especially in the initial portion of the corridor up to around KP350. Wood Group (2018) notes that the small eroded gullies could grow, merge and form new streams in project lifetime.

Baseline information of other water features (e.g. wetlands, lagoons and mangroves) is included within the biodiversity baseline.

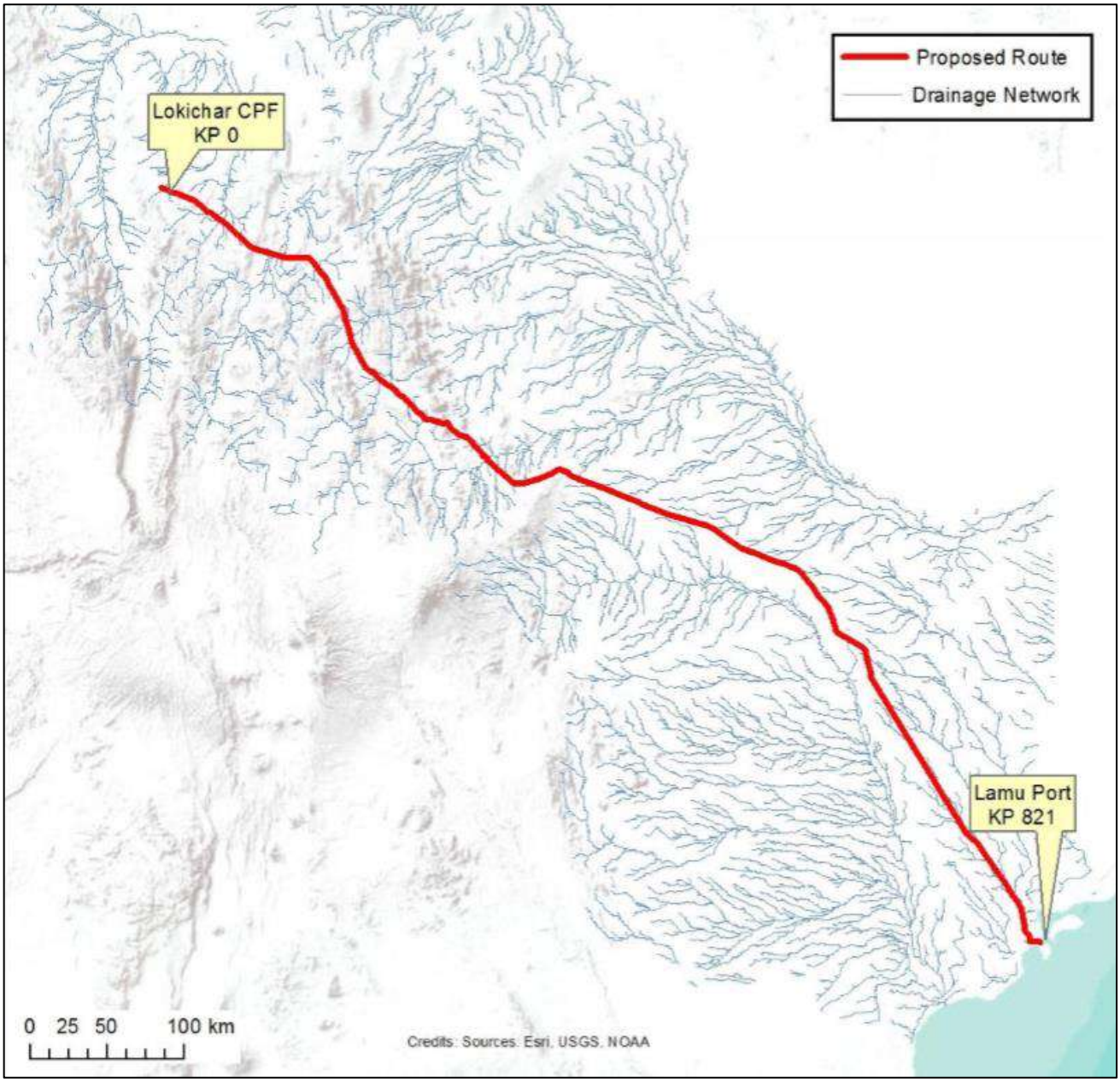

Figure 6: Drainage Work (after Wood Group, 2017)

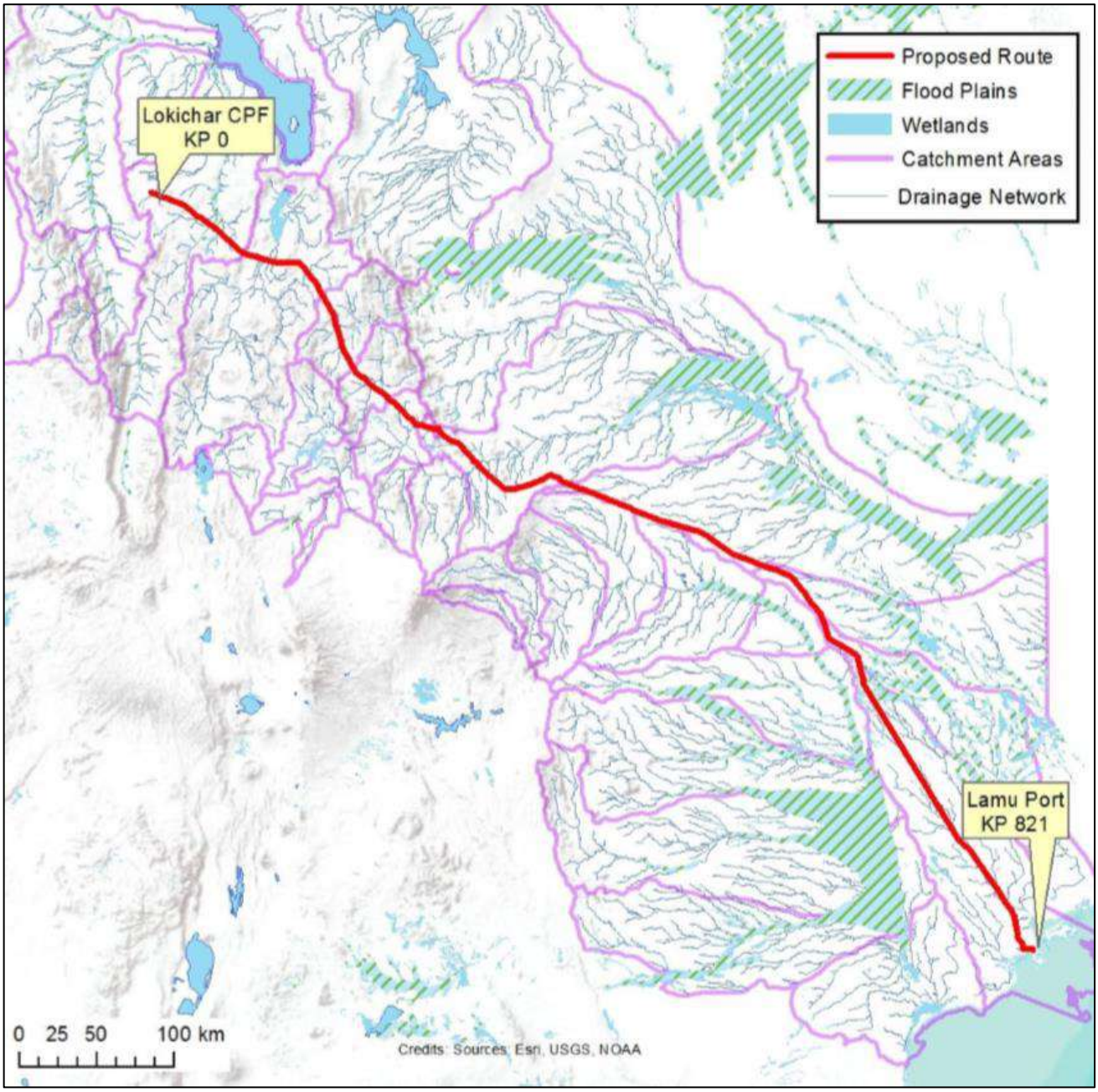

Figure 7: Sub-catchment Areas (after Wood Group, 2017)

The ESIA aquatic baseline work in June and October 2018 (Golder, 2018 and 2019b) included field observations at rivers and luggas at the locations shown on Drawings 1a to 1h. Observations made with regard to the nature of the luggas (Golder, 2019b) are reproduced in Table 1. The following key points were also made:

- Luggas surveyed derive their waters from areas near and adjacent to Maralal forest, Baragoi and Wamba area.
- Luggas with headwaters in sub-locations near Maralal forest have surface water flow much longer than other luggas and these include Suiyan, Seiya, and Barsaloi luggas.

- Those in the Ewaso Ng'iro catchment (grey in Table 1) have a wider catchment area hence they are characterised by permanent surface flow though highly fluctuating.
- Most of the luggas join together and drain into Lorian swamp which extends much further into Somalia. However, Baragoi lugga drains into Lake Logipi.
- The average length of the luggas within the proposed crude oil corridor is 2 km with the minimum of 1.09 km for Siteti lugga to a maximum of 6.5 km for Kula Mawe lugga.
- The luggas exhibit an average slope of 1.8%; Baa lugga has a minimum average slope of 0.9% while Naathu has the highest average slope of 3.6%.
- About 78% of the luggas have sandy substrates on the bed; others consist of 6% mixture of gravels, and pebbles, 6% mixture of sand and pebbles, and 6% clay sand, gravels and pebbles.

The banks of the lugga consist of 50% sand-loam soil, 11% are mostly rocky with few stones and thin layers of sand-loam, and others are mixture of rocky and stones, sand-loam and few gravels, stony and clay sand, stony and sand-loam.

Table 1: Physical Characteristics of Luggas within the LLCOP Corridor

Sampling Site (Site Code)	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Nachola - Lugga near Station 3 (S11)	2,650	1.6	Gravels, Pebbles and stones	Rocky, stony	Terter in Nachola	Downstream of Baragoi Lugga
Baragoi River/lugga (S12)	1,500	1.3	Sandy	Sandy loam and few gravels	Nachola, Lesirikan, Lkotikal area	Lake Logipi
Marti Lugga 1 (New 07)	1,330	1.7	Mostly sandy	Rocky and sandy loam soil	Marti area	Suiyan Lugga, Downstream of sampling point
Marti Lugga 2 (New 06)	3,390	1.8	Mostly sandy	Mostly Sandy loam soil	Marti area	Marti Lugga 1 (New 07)
Ngwasi Lugga (New 01)	1,630	1.4	Mostly sandy	Mostly Sandy loam soil	Mabati area	Seiya Lugga, Downstream of sampling point
Kaolet Lugga (New05)	1,150	1.8	Mostly sandy	Mostly Sandy loam soil	Barsaloi	Barsaloi Lugga, Downstream of sampling point
Siteti Lugga (New 04)	1,090	2.0	Mostly sandy	Mostly Sandy loam soil	Soit Naibor	Downstream of sampling point for Barsaloi Lugga
Bonyeke Lugga (New 03)	2,950	2.9	Mostly sandy	Mostly Sandy loam soil	Raraiti	Barsaloi Lugga, Upstream of sampling point
Koiting - Lugga near Station 6 (S16)	4,450	3.3	Mostly sandy	Mostly Sandy loam soil	Koiting	Archers Post Lugga, Downstream of sampling point
Suiyan Lugga (S10)	1,130	1.3	Sandy and pebbles	Mostly rocky with few stones and thin layers of sandy loam	Soit Naibor, Morijo and Marti	Barsaloi Lugga, Downstream of sampling point
Barsaloi Lugga	1,250	1.3	Mostly sandy	Mostly rocky with few stones and thin layers of sandy loam	Soit Naibor, Morijo and Marti, Raraiti, Mabati, Lulu	Joins with Seiyan and drain into Lorian swamp

Sampling Site (Site Code)	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Seiya Lugga (S17)	1,300	1.8	Mostly sandy	Mostly rocky, Sandy deposits	Moru, Mabati, Mugur, Nonkeek, Ressim	Joins with Seiyan and drain into Lorian swamp
Baa lugga – Ngaroni (S18)	1,100	0.9	Mostly sandy	Mostly Sandy loam soil	Ngolngotim (Ngilai), Wamba Town	Drains into Ewaso Ng'iro Downstream of sampling point
Silanga-Nanyukie Lugga (S19)	1,420	2.1	Mostly sandy	Mostly Sandy loam soil	Wamba Town	Drains into Ewaso Ng'iro Downstream of sampling point
Archers Post Lugga	1,120	1.3	Mostly sandy	Mostly Sandy loam soil	Archers Post	Drains into Ewaso Ng'iro Downstream of sampling point
Ewaso Ng'iro River (S05)	1,450	1.2	Mostly sandy	Rocky and Sandy loam	Kipsing, Mumonyot, Oldonyiro, Lodongokwe, Ngaroni, Archers Post, Wamba Town, Ngolngotim	Drains into Lorian Swamp, which disappear into Somali
Naathu - Lugga near Station 8	1,030	3.6	Mostly gravel with few sand and stones	Stony and Sandy loam	Kabachi and Naathu	Drains into Ewaso Ng'iro Downstream of sampling point
Kula Mawe Lugga (S07)	6,500	1.0	Mixed clay sand, gravels and pebbles	Stony and Clay sand	Amwathi (Kabachi)	Drains into downstream of Lorian Swamp
Kerio River (S04)	1210	1.9	Sand	Mostly sandy loam soil	Arror River, and Embobut River	Drains into Lake Turkana
Suguta River (S09)	1220	2.1	Sand	Mostly clay sand soil	Baragoi area	Drains into Lake Logipi

1.4.2.1 Turkana County

The main water features in Turkana County that are crossed by the LLCOP route are the River Kerio and the Suguta River.

The Kerio River originates from the Metkei and Timboroa forests and flows approximately 500 km towards the northeast, passing through the Kerio Valley before draining to Lake Turkana. At the crossing location the river is fairly straight and there is a distance of approximately 140 m between the banks (Wood Group, 2018).

Lake Turkana is the largest source of water in the region and receives the majority of its input (approximately 90%) from the River Omo, which originates in the Ethiopian Highlands (The Overseas Development Administration London, 1982). About 10% of water is input to the lake from the Kerio and Turkwell rivers. There are numerous ephemeral rivers that input a very small amount to Lake Turkana during short lived rainstorms, and springs, but the quantities are negligible compared to the rivers. The inputs to Lake Turkana vary seasonally, but these variations have been tempered by dams; particularly on the River Omo (Avery, 2013). The resulting changes to lake level variations can affect ecology and farming along lake shore and also impact evaporation ratios and change salinity.

The Sugatu River originates in the Suguta Valley, which is hydrologically isolated from the Turkana basin due to the volcanoes between them. Lake Logipi seasonally fills a small part of the northern end of Suguta Valley. The size of the lake varies between years and can fill almost dry up during protracted droughts. The low rainfall and high evaporation rates in the valley (see Section 1.3.2.1) meant that the flow regime in the River Sugatu is irregular and major discharge only occurs following the rainy season. The river is approximately 175 km long and the drainage catchment area is approximately 13,000 km^2. The river has a large flood valley that includes several abandoned channels. The current channel is approximately 100 m wide at the LLCOP crossing, but the floodplain (with the possibility of channel migration) means the distance between ‘banks’ could be much greater (up to 6.2 km) (Wood Group, 2018). A photograph of the Suguta River near the crossing location was taken on 6 December 2018 as part of the baseline water environment fieldwork (Golder, 2019) and as Figure 8.

Figure 8: Suguta River near the LLCOP crossing (6 December 2018)

1.4.2.2 Samburu County

Most rivers in Samburu flow for short periods after the rains. The main river in the County is the Ewaso Ng'iro River, which is located along the boundary with Isiolo County and is discussed further in Section 1.4.2.3. The river channels and luggas in Samburu are fracture-controlled, which manifests as sudden angular changes in channel directions.

1.4.2.3 Isiolo County

The drainage system in Isiolo County can be divided into four major drainage basins: the Ewaso Ng'iro, which occupies 78% of the area; Tana River basin in the south, which occupies 10% of the area; Galana Gof, which occupies 7% of the area; and Lagh Bogal, which occupies 5% of the area.

The LLCOP route crosses the Ewaso Ng'iro River near Archers Post. The river originates from the wetter Nyandarua Mountains and Mount Kenya over 200 km in the west and flows for about 700 km to the Somalian desert. Its drainage basin covers an area of 210,000 km^2 (Wood Group, 2018).

The river flows into the Lorian swamp where it is an important source of water for recharging groundwater and maintenance of vegetation cover (Kinconsult Associates Ltd, 2016). The Lorian Swamp is located approximately 100 km downstream of the Project Ewaso Ng'iro crossing. It is not a wetland area with any conservation designations.

At the LLCOP crossing, the river is approximately 150 m wide (Wood Group, 2018). The southern bank is mainly composed by fine sand, with local fluvial conglomerates underneath. Bank retreat reportedly active and ongoing. The northern bank comprises metamorphic bedrock, which is locally exposed. A photograph of the

Ewaso Ng'iro River near the LLCOP crossing location was taken on 9 December 2018 as part of the baseline water environment fieldwork (Golder, 2019) and is included as Figure 9.

Figure 9: Ewaso Ng'iro River near the LLCOP crossing (9 December 2018)

1.4.2.4 Meru County

The drainage pattern in Meru County is characterised by rivers and streams originating from catchment areas such as Mt. Kenya and Nyambene ranges in the Igembe North. The rivers cut through the hilly terrain on the upper zones to the lower zones and drain into the Tana and Ewaso Ng'iro Rivers.

There are no perennial river crossings in Meru County. The LLCOP route traverses some streams near Laare Naatu Kabachi and Kinna in Igembe North Meru county.

1.4.2.5 Garissa County

Topography in Garissa County varies from about 450 m above mean sea level (amsl) at Benane to about 50 m amsl at Boni forest reserve. There is a general decrease in topographic elevation towards the south and the sea and most of Garissa County is flat and low lying. Upper Garissa has steeper topography than lower Garissa and the land generally drains towards the Ewaso Ng'iro River. Most of the rest of Garissa County lies within the Tana Catchment, which covers an area of covers an area of 126,000 km^2 (Kinconsult Associates Ltd, 2016).

The Tana River, Kenya's longest river, is the main river in this catchment and it traverses in a generally southwards direction through Garissa county as it flows towards the Indian ocean. The Tana Catchment includes several tributaries, including Ambani, Guru, Ragati, Chania, Mathioya, Thiba, Kazita, Mutonga, Sabasaba, Maragwa, Thika, Ena, Ura and Runjeweru. Ephemeral tributaries include Tiva, and laga Kokani. The tributaries emanate from Mt. Kenya, the Aberdare's and the Nyambene hills (Kinconsult Associates Ltd, 2016).

The Ewaso Ng'iro River has the following tributaries flowing from the Aberdares and Mount Kenya; Ewaso-Narok, Likiudu, Liliaba, Ngare ndare, Ngusishi, Timau, Sirimon, Teleswani, Ontulili, Likii, Nanyuki, Rongai, Burguret, Naro-moru, Isiolo, Moyok, Ngobit, Suguroi, Pesi, and Mutara. The river flows into the Lorain swamp where it is an important source of water for recharging the groundwater and maintenance of vegetation cover (Kinconsult Associates Ltd, 2016).

The LLCOP route does not cross the Tana River or the Ewaso Ng'iro River in Garissa County. There are many un-named ephemeral streams (laggas) joining both the Tana and Ewaso Ng'iro systems.

1.4.2.6 Lamu County

Along parts of coast there is a system of tidal creeks, flood plains, coastal lakes and mangrove swamps (the Tana Delta) that are located behind a sand dune system that protects them from the ocean (United Nations Development Programme et al., 2016).

There are no permanent rivers in Lamu County, but there are several seasonal rivers as shown in Figure 10 (after ESF Consultants, 2016). The seasonal rivers in the Lamu County include the Dodori, Arosen, Duldul, Mkondo wa Bargoni, Mkondo wa Kareni, Kitoko and Mkondo wa Mkuyuni near Witu. Other important inland waters are Dodori creek, Mto wange creek, Ndau Bay, Mto wa Hidio, Mto wa Kipungani and Mto wa Mkunumbi.

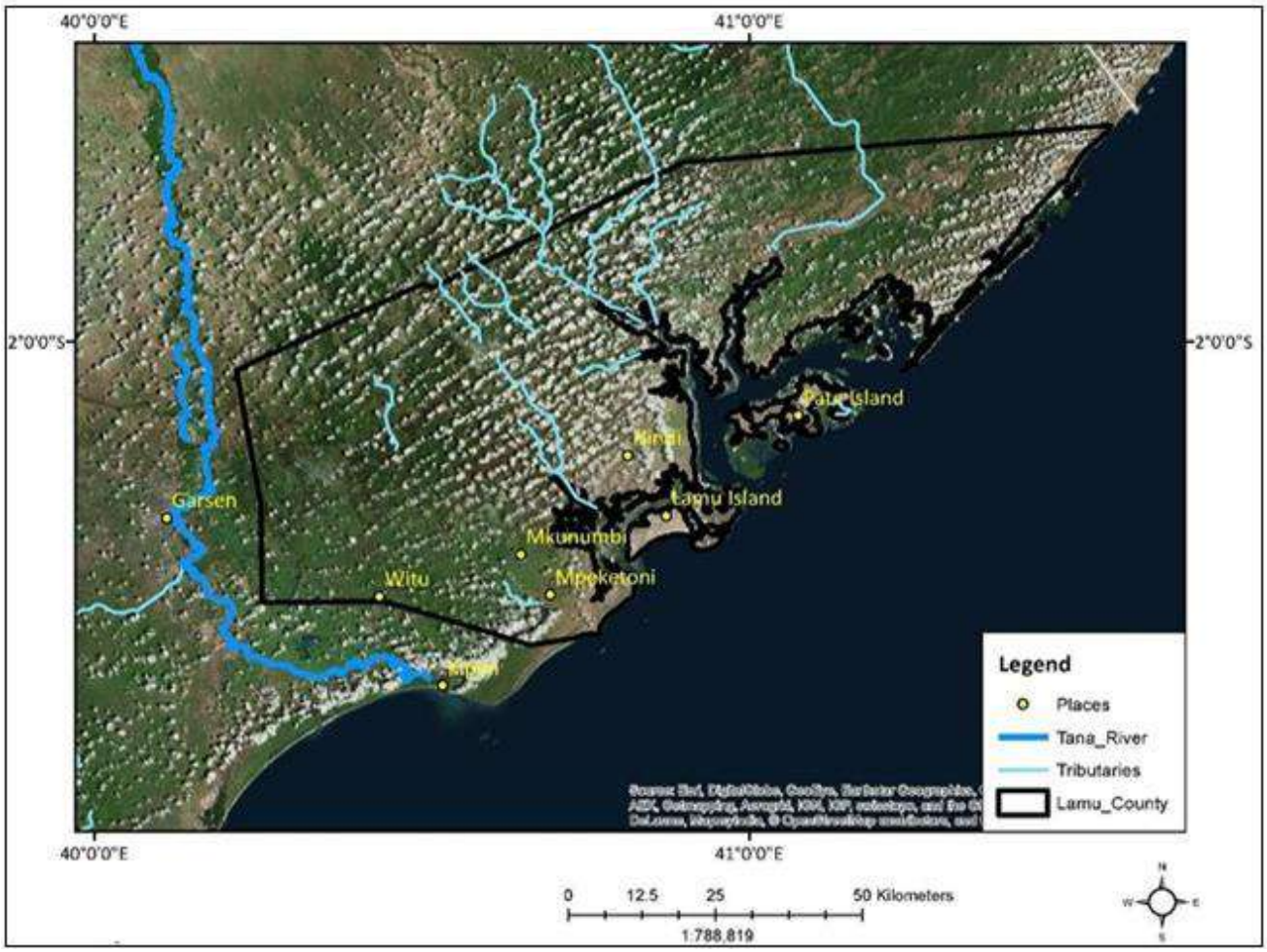

Figure 10: Seasonal rivers Lamu (after ESF Consultants, 2016)

Other water features include the Kibokoni Lakes. Most of these lakes are small and shallow and are typical ox-bow lakes such as Lake Boa, Kenyatta and Dide Waride, which are remnants of various meanders of the Tana

River. Some of the lakes, especially the smaller ones, have marsh characteristics and are recharged by rain water.

Lagoons are found in the Kiunga, Mikokoni and Kiwayu areas. A lagoon is a stretch of sea water partly separated from the sea by low, narrow, elongated strips of land, reef crests or sand bars that can separate beaches and cliffs from fringing coral reefs. The depths of lagoons vary from a few centimetres to over 10 m depending on the shore topography and presence of tidal channels.

There are four tidal crossings along the LLCOP route that are all in Lamu County from about KP780. The Geohazard Desk Study (Wood Group, 2018) indicates that these may be alternatively wet or dry following the tidal cycles, and that the geomorphological and hydrogeological conditions along the coast are complex due to the considerable rise and fall of water caused by the tides.

1.4.3 River Flows

As highlighted in Section 1.4.2, there are three perennial rivers along the LLCOP route; the Kerio River and the Suguta River as they pass through Turkana County, and the Ewaso Ng'iro River as it passes through Isiolo County just south of Archers Post near the border with Samburu County. In addition to these, the LLCOP route crosses 14 seasonal rivers and around one hundred ephemeral streams (Wood Group, 2018). These seasonal/ephemeral watercourses have surface flow either seasonally or after individual intense rainfall events. Some watercourses can be dry for prolonged periods and the presence of surface flow and the flow velocities, therefore, can be flashy and unpredictable.

Water may still be present, however, beneath the bed of the watercourse during the dry seasons despite no surface flows. Baseline field work undertaken as part of the ESIA aquatic baseline in June and October 2018 (Golder, 2018 and 2019b) included measurements of sub-soil wetness up to 30 cm to 60 cm below the surface of some of the luggas. These measurements showed that Barsaloi and Seiya lugga had 100% saturation at this depth range during the dry season field work. Nachola (Baragoi) lugga measurements showed that approximately 67% of the lugga was very wet and 33% was moderately wet. Suiyan lugga measurements showed that 89% was moderately wet and 11% was very wet. The luggas in Koiting and Rahole were very dry and no moist soil was observed in the subsurface.

Flow data are generally scare (Wood Group, 2018). There is a gauging station (Station 2C8) at Lokori. Based on measurements between 1970 and 1973 at this station, the mean inter-annual flow was estimated to be 10.5 m^3/sec.

The Ewaso Ng'iro River flows are less dependent on climate in area of LLCOP. Water comes from over 200 km away in Nyandarua Mountains and most of the flow is from tributaries from Mt. Kenya. The river experiences long periods of drought (Wood Group, 2018). With respect to the Ewaso Ng'iro River in Garissa County, the Water Resources Assessment for Decision Making in Garissa County (Kinconsult Associates Ltd, 2016) states that river does not have surface flow through Garissa County except during flooding upstream. Field data from a flow gauge in the Ewaso Ng'iro River (Wood Group, 2019) shows that the maximum annual flow discharge during the period 1960 to 1978 ranged from a low of 220 m^3/s in 1960 to a high of 1,752 m^3/s in 1961, but that the maximum annual flow discharge for most years fell between 400 m^3/s and 700 m^3/s.

The ESIA aquatic ecosystems baseline work (Golder, 2018 and 2019b) included the collection of data on watercourse width and height, and flow velocities, in selected luggas and in the areas of the proposed Kerio, Suguta and Ewaso Ng'iro river crossings. Estimates of discharge rates were made from measurements of flow velocity and the width and height of the watercourses. This information is presented in Table 2. The locations are shown on Drawings 1a to 1h. Surface water flow during the dry season was only observed in permanent rivers (i.e. Ewaso Ng'iro, Suguta and Kerio Rivers). Luggas had no surface water flows during the dry season.

Table 2: Flow Characteristics of Luggas

River/Lugga	Low surface flow					High surface flow				
	Width (m)	Height (m)	Time (s) per 20m	Velocity (m/s)	Discharge (m3/s)	Width (m)	Height (m)	Time (s) per 20m	Velocity (m/s)	Discharge (m3/s)
Nachola (Lugga near Station 3)	7.5	0.7	4.4	3.6	19.1	13.5	0.9	3.4	5.8	71.0
Baragoi River/lugga	24	0.25	12.3	1.3	7.8	64	1.8	1.7	11.7	1346.5
Marti Lugga 1 (New 07)	11.5	0.2	15.4	1.0	2.4	18	0.6	5.1	3.9	42.1
Marti Lugga 2 (New 06)	6	0.1	30.8	0.5	0.3	10	0.35	8.8	2.3	8.0
Ngwasi Lugga (New 01)	13	0.2	15.4	1.0	2.7	15	2.1	1.5	13.6	429.5
Kaolet Lugga (New 05)	11	0.09	34.2	0.5	0.5	16	1.4	2.2	9.1	203.6
Siteti Lugga (New 04)	4.5	0.06	51.3	0.3	0.1	15	1.2	2.6	7.8	140.3
Bonyeke Lugga (New 03)	22	0.1	30.8	0.5	1.1	50	1	3.1	6.5	324.7
Archers Post Lugga	22	0.1	30.8	0.5	1.1	50	1	3.1	6.5	324.7
Koiting (near Station 6)	0.85	0.25	12.3	1.3	0.3	2.35	2	1.5	13.0	61.0
Suyan (S10)	30	0.08	22.0*	0.4	0.9	45	1	3.1	6.5	292.2
Barsaloi	27	0.05	21.0*	0.4	0.5	75	1.2	2.6	7.8	701.3
Seiya Lugga (S17)	95	0.3	8.8*	0.9	25.9	100	0.5	6.2	3.2	162.3
Baa lugga Ngaroni (S18)	19	0.62	5.0	3.2	37.9	56	1.9	1.6	12.3	1312.7
Silanga-Nanyukie (S19)	30	0.2	15.4	1.0	6.2	40	0.6	5.1	3.9	93.5

River/Lugga	Low surface flow					High surface flow				
	Width (m)	Height (m)	Time (s) per 20m	Velocity (m/s)	Discharge (m3/s)	Width (m)	Height (m)	Time (s) per 20m	Velocity (m/s)	Discharge (m3/s)
Ewaso Ng'iro - Wet Season (S05)	50	0.4	7.7*	2.1	41.6	110	2.2	1.4	14.3	3457.1
Ewaso Ng'iro - Dry Season (S05)	22	0.35	7.5	2.08	16.0	n/a				
Naathu (near Station 8)	5	0.07	44.0	0.4	0.1	8	0.25	12.3	1.6	3.2
Kula Mawe	10	0.08	38.5	0.4	0.3	30	1.2	2.6	7.8	280.5
Kerio River - Wet Season (S04)	No data collected									
Kerio River - Dry Season (S04)	62	0.11	15	0.53	3.64	n/a				
Suguta River - Wet Season (S09)	No data collected									
Suguta River - Dry Season (S09)	15	0.19	20	1.00	2.85	n/a				

**Observed data*

In addition to the field data available, the Wood Group report (2019) presents a range of peak flows for the Ewaso Ng'iro River during different return periods, and the results of modelling and calculations to predict peak flows during 1 in 100-year return period events in the watercourses crossed by the LLCOP. The predicted peak flows are presented in Table 3.

Table 3: Summary of Predicted 1 in 100-year Peak Flows

Watercourse	Type	KP (km from start of LLCOP)	Return Period	Predicted Flow Peak (m^3/s)
Kerio River	Main River	49.2	1 in 100	1040 *
Suguta River	Main River	91.6	1 in 100	1450 *
Ewaso Ng'iro River	Main River	299.5	1 in 20	1131 ^
			1 in 50	1370 ^
			1 in 100	1540 *
			1 in 200	1729 ^
			1 in 500	1965 ^
Kalabata	Seasonal River	6.2	1 in 100	Not presented in report
Nakwakal	Seasonal River	39.5	1 in 100	190 *
Barangoi	Seasonal River	120.7	1 in 100	240 *
GH_SR_007	Seasonal River	171.6	1 in 100	Not presented in report
GH_SR_008, GH_SR_009	Seasonal River	173.1	1 in 100	Not presented in report
Seya	Seasonal River	207.4	1 in 100	540 *
Nolgsin	Seasonal River	233.4	1 in 100	Not presented in report
Wamba	Seasonal River	247.5	1 in 100	Not presented in report
GH_SR_014	Seasonal River	288.2	1 in 100	Not presented in report
1	Stream	0.75	1 in 100	72.5
2	Stream	1.4	1 in 100	18.8
3	Stream	1.9	1 in 100	32
4	Stream	2.1	1 in 100	0.9
5	Stream	2.5	1 in 100	3.2
6	Stream	7.6	1 in 100	37.2
7	Stream	15.5	1 in 100	27.8
8	Stream	16.9	1 in 100	43.1

Watercourse	Type	KP (km from start of LLCOP)	Return Period	Predicted Flow Peak (m^3/s)
9	Stream	17.7	1 in 100	11.5
10	Stream	21.1	1 in 100	1.5
11	Stream	21.6	1 in 100	3.1
12	Stream	21.8	1 in 100	3.9
13	Stream	22.0	1 in 100	5
14	Stream	22.6	1 in 100	3.1
15	Stream	22.9	1 in 100	2.7
16	Stream	24.1	1 in 100	2.4
17	Stream	24.4	1 in 100	6
18	Stream	25.1	1 in 100	5.8
19	Stream	26.2	1 in 100	2.7
20	Stream	26.7	1 in 100	3.4
21	Stream	29.2	1 in 100	7.1
22	Stream	30.9	1 in 100	11.9
23	Stream	33.2	1 in 100	10.6
24	Stream	35.1	1 in 100	17.7
25	Stream	46.0	1 in 100	63.3
26	Stream	53.1	1 in 100	74.9
27	Stream	53.6	1 in 100	38.6
28	Stream	60.7	1 in 100	77
29	Stream	65.6	1 in 100	4.1
30	Stream	74.2	1 in 100	3.7
31	Stream	77.3	1 in 100	22.3
32	Stream	84.5	1 in 100	85.3
33	Stream	101.8	1 in 100	7
34	Stream	102.4	1 in 100	1.8
35	Stream	103.4	1 in 100	11.2
36	Stream	104.1	1 in 100	3.4

Watercourse	Type	KP (km from start of LLCOP)	Return Period	Predicted Flow Peak (m^3/s)
37	Stream	104.5	1 in 100	1.7
38	Stream	105.6	1 in 100	39.6
39	Stream	109.1	1 in 100	22
40	Stream	115.4	1 in 100	23.7
41	Stream	106.3	1 in 100	10.2
42	Stream	125.1	1 in 100	1
43	Stream	125.4	1 in 100	0.7
44	Stream	125.9	1 in 100	1.6
45	Stream	126.4	1 in 100	2.4
46	Stream	126.8	1 in 100	3.2
47	Stream	127.2	1 in 100	1.1
48	Stream	127.5	1 in 100	1
49	Stream	128.2	1 in 100	7.5
50	Stream	129.7	1 in 100	8.5
51	Stream	130.7	1 in 100	2.3
52	Stream	131.9	1 in 100	12.9
53	Stream	133.8	1 in 100	5.6
54	Stream	134.3	1 in 100	3.8
55	Stream	136.1	1 in 100	29.7
56	Stream	141.7	1 in 100	8.1
57	Stream	142.5	1 in 100	4.4
58 (‘Stream 2’)	Stream	146.2	1 in 100	65 *
59	Stream	146.7	1 in 100	24.2
60	Stream	147.8	1 in 100	2.7
61	Stream	148.6	1 in 100	12
62	Stream	149.1	1 in 100	4.1
63	Stream	149.5	1 in 100	0.9
64	Stream	152.5	1 in 100	36.7

Watercourse	Type	KP (km from start of LLCOP)	Return Period	Predicted Flow Peak (m^3/s)
65	Stream	153.5	1 in 100	20.9
66	Stream	153.8	1 in 100	5.1
67	Stream	155.08	1 in 100	3.5
68	Stream	155.3	1 in 100	2.6
69	Stream	156.1	1 in 100	2.2
70	Stream	160.5	1 in 100	214.9
71	Stream	161.9	1 in 100	4.3
72	Stream	162.5	1 in 100	11.5
73	Stream	164.5	1 in 100	3
74	Stream	168.2	1 in 100	31.4
75	Stream	174.0	1 in 100	7.2
76	Stream	175.4	1 in 100	9.2
77	Stream	176.2	1 in 100	10.8
78	Stream	200.1	1 in 100	50.6
79	Stream	209.4	1 in 100	1
80	Stream	209.8	1 in 100	0.5
81	Stream	214.2	1 in 100	79.1
82	Stream	213.3	1 in 100	5.4
83	Stream	225.2	1 in 100	9.2
84	Stream	224.3	1 in 100	1.5
85	Stream	228.4	1 in 100	38.3
86	Stream	229.2	1 in 100	5.2
87	Stream	231.6	1 in 100	9.3
88	Stream	239.6	1 in 100	19
89	Stream	240.6	1 in 100	26.2
90	Stream	241.0	1 in 100	15.1
91	Stream	246.3	1 in 100	15.5
92	Stream	250.9	1 in 100	36.5

Watercourse	Type	KP (km from start of LLCOP)	Return Period	Predicted Flow Peak (m^3/s)
93	Stream	255.3	1 in 100	19.3
94	Stream	257.6	1 in 100	5.4
95	Stream	263.7	1 in 100	0.4
96	Stream	279.0	1 in 100	300.5
97	Stream	293.8	1 in 100	72.9
98	Stream	294.6	1 in 100	33.2
99	Stream	295.7	1 in 100	2.8
100	Stream	329.7	1 in 100	107.5
101	Stream	330.3	1 in 100	4.9
102	Stream	337.5	1 in 100	44.7
103	Stream	341.1	1 in 100	62.1
104	Stream	341.4	1 in 100	16.6
105	Stream	346.1	1 in 100	52.8
106	Stream	347.6	1 in 100	21.2
107	Stream	350.2	1 in 100	17.1
108 (‘Stream 1’)	Stream	376.6	1 in 100	160 *
109	Stream	379.2	1 in 100	188.7
110	Stream	380.0	1 in 100	190.7
111	Stream	399.2	1 in 100	62.6
112	Stream	416.3	1 in 100	10.5
113	Stream	418.7	1 in 100	9.1

** Modelled using FLO2D. ^ Calculated based on measured flow data and applying a distribution to estimate peaks flows at different return periods. All other watercourses calculated using the Rational method.*

1.4.4 Flood and Erosion Risk

Desk study data collated as part of the geohazard baseline work (Wood Group, 2018) highlights the following principal statements about flooding along the LLCOP route:

- Flooding follows intense rainfall that are either seasonal or because of changes to normal weather patterns due to climate change.
- Seasonal flooding typically occurs over a long period when a river breaks its banks.

- Compacted soil during dry periods (including droughts) can reduce soil capacity to absorb rain, further increasing runoff and flooding.
- Flash floods usually occur in arid and semi-arid areas such as the Turkana basin. These result from sources such as increased run-off after sudden rainfall events or dam failures.
- Coastal flooding results from surges (tidal, storm, tsunami) and wave action. The coastal area close to Lamu port is densely vegetated and characterised by the presence of wetland areas and tidal creeks prone to flooding.

There is a documented occurrence of a recent major flood in Lokori on March/April 2010 that caused the Turkana-Marich road to be cut off and at least 600 households were displaced (Wood Group, 2018).

The Ewaso Ng'iro experiences long periods of drought separated by short, but often major flooding periods (Wood Group, 2018). The Archers Post area is considered to have the highest risk of flooding for the whole of the Northern Ewaso Ng'iro River's course. Floods near Archer's Post have been recorded in March 2010, November 2011, April 2013 and October 2014. Moderate floods are experienced once every seven months and severe flooding once every 18 months. Peak flood discharges are expected to be about 800 m^3/s, although historical records show discharges up to 1500 m^3/s.

A fluvial dynamic and hazard study (Wood Group, 2018) has investigated the hazard flooding presents. Fluvial hazard is associated with either high discharge or pulsed flow regimes. High flow events could drive peaks in sediment movements along the channel, while the infrequent flow gives the resulting sediment movement an episodic and pulsed pattern. The study concluded that the main hazards to the LLCOP are flood, bank and channel erosion, bed scour and avulsion (i.e. the rapid abandonment of a river channel and the formation of a new river channel).

The Wood Group (2018) study states that the LLCOP route is subject to 'medium' to 'very high' river flood hazards. There is also a risk of coastal flooding. The report states that the tidal creeks do not pose an erosion risk, but that crossing wetlands is an area of uncertainty because of their seasonal variability. The study did not recommend further studies on the creeks to inform the project design due to the desk study conclusion that they do not present a risk of erosion.

Further work has been undertaken to understand flood, erosion and souring risks (Wood Group, 2019) to inform the design pipeline conditions; namely burial depth at watercourse crossings. The study focussed on the three main river crossings (Kerio, Suguta and Ewaso Ng'iro), but also considered nine seasonal rivers and 113 streams. Two model scenarios were developed for the three main rivers 1) to consider flooding during a 1 in 100-year event, and 2) to model the general erosion behaviour under long-term low discharge/flows. For all other watercourse crossings, the erosion depths have been predicted using an empirical equation. The results of the study are summarised below.

1.4.4.1 Kerio River

The modelled 1 in 100-year return period flooding extent (based on the peak flow presented in Table 3) is shown on the water depth map reproduced as Figure 11 (after Wood Group, 2019). The flood model indicates erosion takes place on the outside of bends in the river and near narrowing sections. Sedimentation occurs where the river widens, and flow velocities decrease. Immediately downstream of the pipeline crossing, a maximum erosion of 4 m (from river bed bottom) has been be estimated. A maximum erosion of 3 m (from surface) has been estimated in the floodplain.

Under the low flow scenario (using a discharge of 20 m^3/s) erosion and deposition areas alternate along the river channel. The deposition/erosion under these conditions is predicted to be +1 m / -1 m generally, and up to a maximum of 2 m.

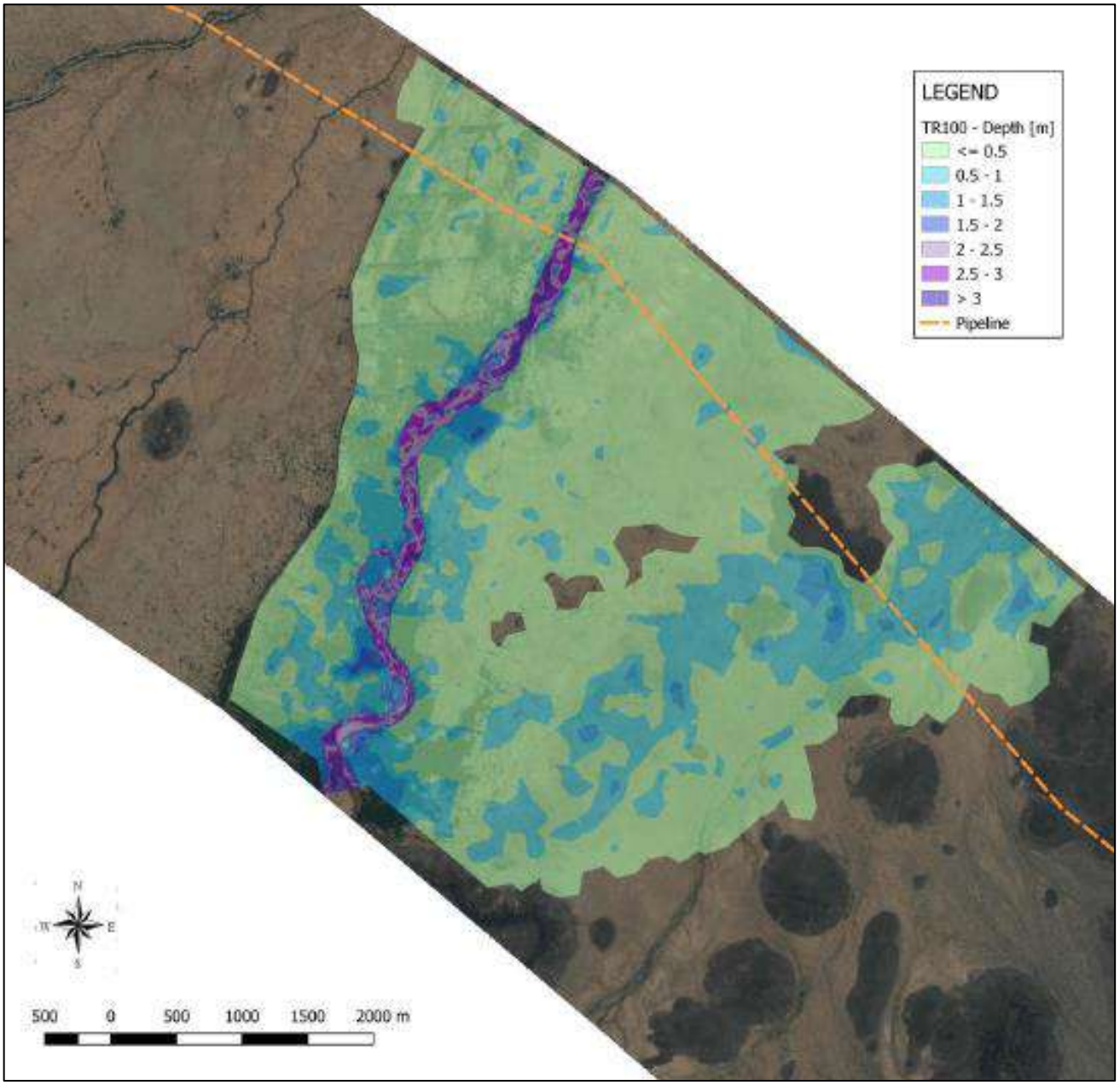

Figure 11: Kerio River 1 in 100-year flood extent and depth predictions

1.4.4.2 Suguta River

The modelled 1 in 100-year return period flooding extent (based on the peak flow presented in Table 3) is shown on the water depth map reproduced as Figure 12 (after Wood Group, 2019). The model predicts flooding will extend to the full floodplain out to 6.5 km from the river channel.

The flood model predicts that erosion takes place near narrowing sections of the river channel. Sedimentation occurs where the river widens, and flow velocities decrease. Immediately downstream of the pipeline crossing, a maximum erosion of 5 m (from river bed bottom) has been be estimated. A maximum erosion of 3.5 m (from surface) has been estimated in the floodplain. Within the floodplain it is predicted that erosion will have the tendency to create new channels.

Under the low flow scenario (using a discharge of 5 m^3/s) erosion and deposition areas alternate along the river channel. The deposition/erosion under these conditions is predicted to be +1 m / -1 m generally, and up to a maximum of 2 m.

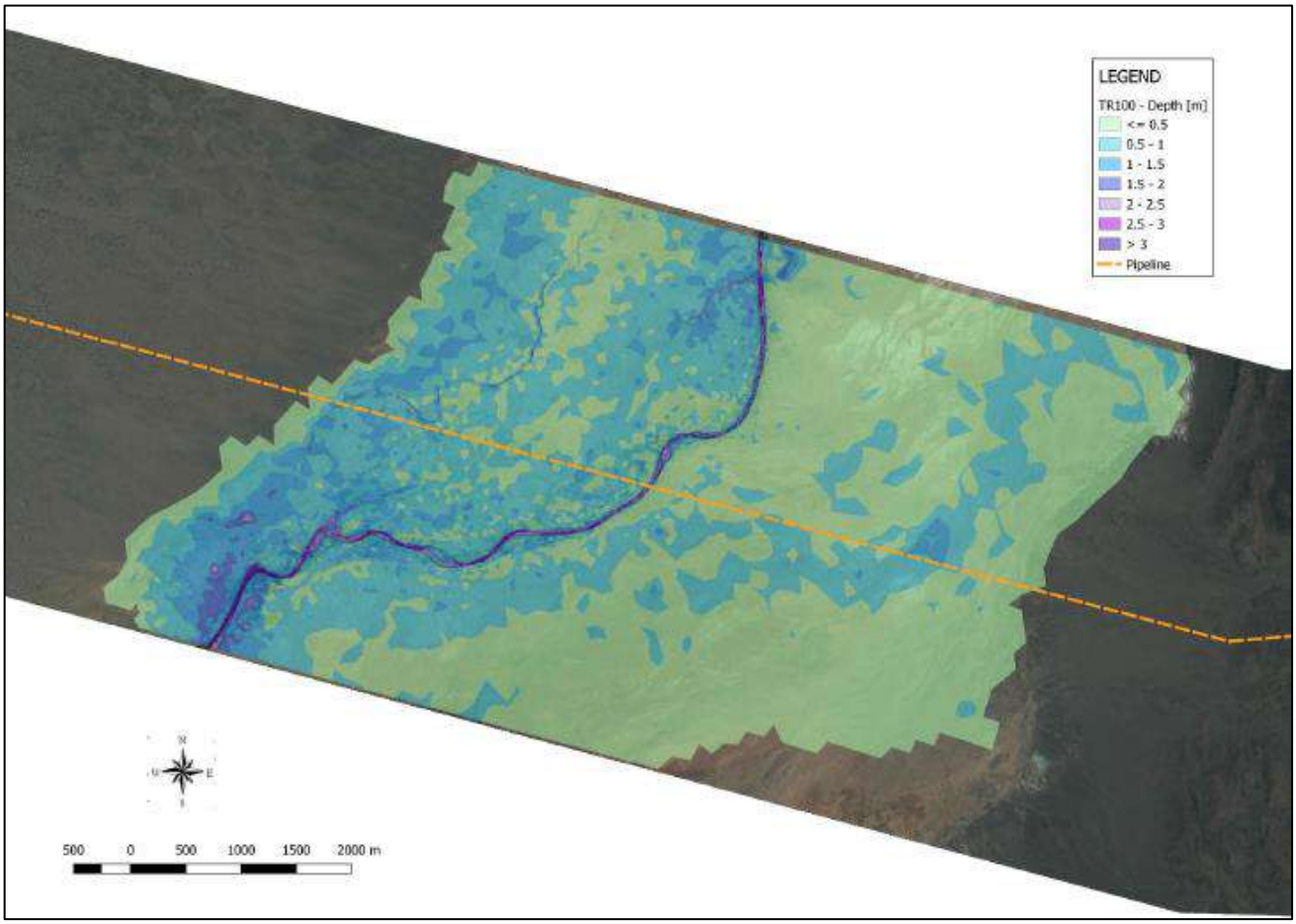

Figure 12: Suguta River 1 in 100-year flood extent and depth predictions

1.4.4.3 Ewaso Ng'iro River

The modelled 1 in 100-year return period flooding extent (based on the peak flow presented in Table 3) is shown on the water depth map reproduced as Figure 13 (after Wood Group, 2019). The model predicts flooding will be within the floodplain and will particularly occur upstream of the bridge to the village of Archers Post.

The flood model predicts that erosion takes place until bedrock is reached, which was set at 3 m below riverbed level in the model. Therefore, the erosion capacity shown in the model was limited by this input parameter. If bedrock is deeper in other areas along the river then greater erosions depth are possible.

Under the low flow scenario (using a discharge of 20 m^3/s) erosion and deposition areas alternate along the river channel. The deposition/erosion under these conditions is predicted to be +1 m / -1 m generally, and up to a maximum of 2 m.

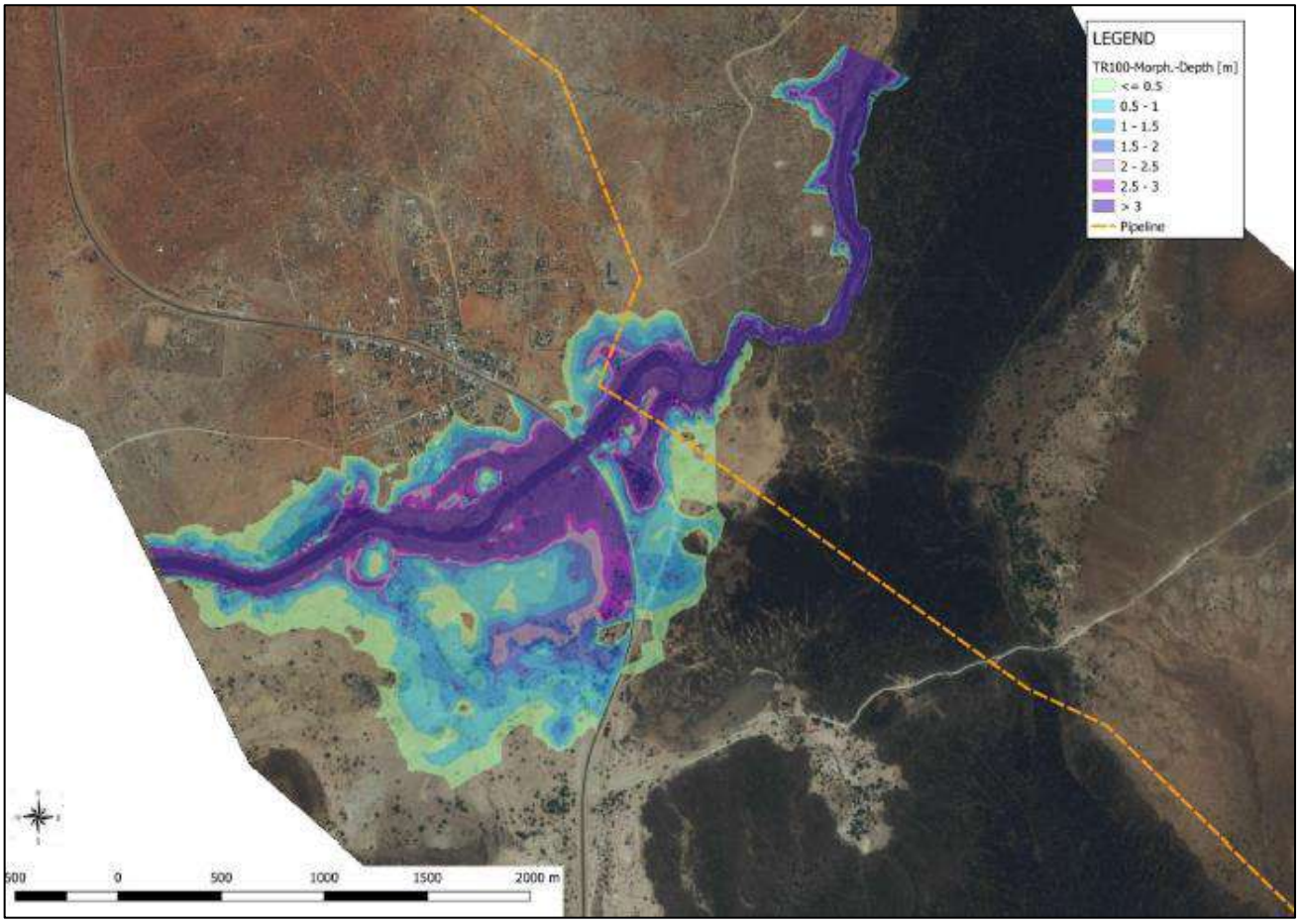

Figure 13: Ewaso Ng'iro River 1 in 100-year Flood Extent and Depth Predictions

1.4.4.4 Other Seasonal Rivers and Streams

A scour assessment for seasonal rivers and streams under 1 in 100-year return period flow conditions has also been undertaken to inform the LLCOP design. Using the empirical Blench approach that assumes uniform flow conditions, the estimated erosion scour depths and a minimum pipeline sagbend setbacks has been estimated (Wood Group, 2019) and summarised in Table 4.

Table 4: Summary of estimated scour depths and recommended minimum pipeline setbacks

Watercourse	Type	KP (km from start of LLCOP)	Scour Depth (m)	Recommended Sagbend Setback (m)
Kalabata	Seasonal River	6.2	3.6	2.5
Nakwakal	Seasonal River	39.5	4.9	3
Barangoi	Seasonal River	120.7	5.1	3
GH_SR_007	Seasonal River	171.6	2.7	2
GH_SR_008, GH_SR_009	Seasonal River	173.1	6.3	2
Seya	Seasonal River	207.4	8.3	3
Nolgsin	Seasonal River	233.4	7.8	1.5

Watercourse	Type	KP (km from start of LLCOP)	Scour Depth (m)	Recommended Sagbend Setback (m)
Wamba	Seasonal River	247.5	4	2.5
GH_SR_014	Seasonal River	288.2	2.9	3
1	Stream	0.75	2.5	2.5
2	Stream	1.4	3.3	1
3	Stream	1.9	3.6	1
4	Stream	2.1	1.6	<0.5
5	Stream	2.5	2.9	<0.5
6	Stream	7.6	1.8	2
7	Stream	15.5	2.7	1.5
8	Stream	16.9	1.6	2
9	Stream	17.7	1.4	1.5
10	Stream	21.1	2.1	<0.5
11	Stream	21.6	2.1	<0.5
12	Stream	21.8	2.1	<0.5
13	Stream	22.0	1.4	1
14	Stream	22.6	2.5	<0.5
15	Stream	22.9	1.4	<0.5
16	Stream	24.1	1.2	<0.5
17	Stream	24.4	1.6	1
18	Stream	25.1	2.1	1
19	Stream	26.2	1.6	<0.5
20	Stream	26.7	2.5	<0.5
21	Stream	29.2	2.4	<0.5
22	Stream	30.9	2.1	1
23	Stream	33.2	3	1
24	Stream	35.1	3.3	1

Watercourse	Type	KP (km from start of LLCOP)	Scour Depth (m)	Recommended Sagbend Setback (m)
25	Stream	46.0	2.3	2
26	Stream	53.1	2.1	2.5
27	Stream	53.6	1.8	2
28	Stream	60.7	2.8	2.5
29	Stream	65.6	1.7	1
30	Stream	74.2	1.6	1
31	Stream	77.3	2.5	1
32	Stream	84.5	2.5	2
33	Stream	101.8	2.3	1
34	Stream	102.4	2.2	<0.5
35	Stream	103.4	2.3	1
36	Stream	104.1	1.6	<0.5
37	Stream	104.5	2.2	<0.5
38	Stream	105.6	2.7	1.5
39	Stream	109.1	2.5	1
40	Stream	115.4	2.1	1
41	Stream	106.3	2.9	1
42	Stream	125.1	1.5	<0.5
43	Stream	125.4	1.8	<0.5
44	Stream	125.9	2.5	<0.5
45	Stream	126.4	1.4	<0.5
46	Stream	126.8	1.2	<0.5
47	Stream	127.2	1.6	<0.5
48	Stream	127.5	1.8	<0.5
49	Stream	128.2	2.1	1
50	Stream	129.7	1.9	1

Watercourse	Type	KP (km from start of LLCOP)	Scour Depth (m)	Recommended Sagbend Setback (m)
51	Stream	130.7	1.9	<0.5
52	Stream	131.9	1.5	1
53	Stream	133.8	1.8	<0.5
54	Stream	134.3	1.6	<0.5
55	Stream	136.1	1.8	1
56	Stream	141.7	2.1	<0.5
57	Stream	142.5	1.6	<0.5
58 (‘Stream 2’)	Stream	146.2	2.8	2
59	Stream	146.7	1.6	2
60	Stream	147.8	1.6	<0.5
61	Stream	148.6	2.1	<0.5
62	Stream	149.1	1.2	<0.5
63	Stream	149.5	1.6	<0.5
64	Stream	152.5	7.6	<0.5
65	Stream	153.5	1.8	2
66	Stream	153.8	2.7	<0.5
67	Stream	155.08	2.1	<0.5
68	Stream	155.3	2.1	<0.5
69	Stream	156.1	2.2	<0.5
70	Stream	160.5	6.8	2
71	Stream	161.9	2.3	<0.5
72	Stream	162.5	4.7	<0.5
73	Stream	164.5	2.2	<0.5
74	Stream	168.2	2.5	1.5
75	Stream	174.0	5.1	<0.5
76	Stream	175.4	2.9	<0.5

Watercourse	Type	KP (km from start of LLCOP)	Scour Depth (m)	Recommended Sagbend Setback (m)
77	Stream	176.2	2.5	<0.5
78	Stream	200.1	2.3	2
79	Stream	209.4	2.5	<0.5
80	Stream	209.8	1.5	<0.5
81	Stream	214.2	1.6	2
82	Stream	213.3	3.6	1
83	Stream	225.2	2	<0.5
84	Stream	224.3	2.5	<0.5
85	Stream	228.4	3	1.5
86	Stream	229.2	2.1	<0.5
87	Stream	231.6	2.5	1
88	Stream	239.6	2.3	1.5
89	Stream	240.6	3.1	1
90	Stream	241.0	1.7	1
91	Stream	246.3	2.3	1
92	Stream	250.9	1.2	2.5
93	Stream	255.3	1.6	1
94	Stream	257.6	2.2	<0.5
95	Stream	263.7	1.9	<0.5
96	Stream	279.0	2.9	4
97	Stream	293.8	2.9	2.5
98	Stream	294.6	2.5	1
99	Stream	295.7	2.5	<0.5
100	Stream	329.7	2.2	3
101	Stream	330.3	2.3	<0.5
102	Stream	337.5	2.2	2.5

Watercourse	Type	KP (km from start of LLCOP)	Scour Depth (m)	Recommended Sagbend Setback (m)
103	Stream	341.1	4	1.5
104	Stream	341.4	3.3	1
105	Stream	346.1	4.1	1.5
106	Stream	347.6	4	1
107	Stream	350.2	4.6	1
108 ('Stream 1')	Stream	376.6	4	2.5
109	Stream	379.2	4	3
110	Stream	380.0	4	3
111	Stream	399.2	4.6	3
112	Stream	416.3	5.8	<0.5
113	Stream	418.7	6.3	1

1.4.5 Water Quality

Much of the surface water along the LLCOP route is not of potable quality due to bacterial contamination. Water near the coast in tidal creeks will be saline. Surface water quality data along the LLCOP has been collected as part of the baseline studies programme (Golder, 2018, 2019a and 2019b). Surface water quality data in the area near the start of the LLCOP was also collected as part of the EOPS baseline studies programme (Golder, 2017). This section presents a summary of that data.

1.4.5.1 Data Collection Approach

The ESIA advanced aquatic ecosystems baseline work (Golder, 2018) included the collection of water quality field parameters in selected luggas and at the Ewaso Ng'iro proposed crossing zone near Archers Post to capture data in June 2018 during the long wet-season. The locations are shown on Drawings 1a to 1h. The field parameters measured were pH, electrical conductivity (EC), temperature and total dissolved solids (TDS). The majority of the same locations, plus some additional locations, were visited in October 2018 during the dry season as part of additional baseline aquatic fieldwork (Golder, 2019b). Total suspended solid (TSS) concentrations were also determined for selected October 2018 samples.

As part of the water baseline data collection for the LLCOP, surface water quality sampling has also been undertaken at each of the main three river crossing locations; the Kerio, the Suguta and Ewaso Ng'iro rivers (Golder, 2019a). The sampling was undertaken on the following dates:

- Kerio and Suguta rivers – 5 December 2018 to 7 December 2018; and
- Ewaso Ng'iro River – 8 December 2018 to 10 December 2018.

Two sample locations were selected in the area of each crossing. Upstream and downstream sampling was planned, but due to LLCOP river crossing location changes that occurred after the sampling locations were identified, the Kerio and Suguta River sampling location were 1.5 km and 0.2 km downstream of the crossing

locations, respectively. The samples were spot samples that represent a single moment in time, so although they were not in the locations planned, they are representative of the general water quality conditions in the area of the LLCOP. The locations are shown on Drawings 1a to 1h.

Field parameter measurements were taken for pH, EC and temperature. Sample bottles were also filled at each location and send to SGS laboratory for analysis of general physio-chemical parameters (EC, pH, suspended solids, alkalinity), sulphate, chloride, phosphate, fluoride, nitrate, metals, Total Petroleum Hydrocarbon (TPH: C6-C44), Polycyclic Aromatic Hydrocarbons (PAH: 16) and BTEX (i.e. benzene, toluene, ethylbenzene and xylene).

In addition to the baseline data collected for the LLCOP, baseline data was also collected as part of the Early Oil Pilot Scheme (EOPS). All data collected for the EOPS was from the oil field area in Turkana County. The data was gathered by Golder and Golder's subcontractors EMC, or was provided by Tullow, and included surface water flow monitoring. Field trips by Golder and/or EMC were completed during the following periods:

- 23 to 27 November 2015;
- 25 May 2016 to 1 June 2016; and
- 24 to 31 August 2016.

The two 2016 field surveys were completed to cover the wet season and post-wet season. The Golder surface water monitoring points included:

- SW1 – position on the southern lugga that drains the area of the Ngamia and Amosing wellfields and feeds into the Kalabata River;
- SW2 – position on the Kalabata River downstream of the wellfields;
- SW3 - position on the Kalabata River downstream of the wellfields; and
- N1 – located downstream of the Ngamia wellfield.

The locations are shown on Drawings 1a to 1h. Data from these locations have been included in this baseline to provide general information about watercourses in the area of the start of the pipeline. Flow in surface watercourses included in the EOPS project is ephemeral and the watercourses were commonly dry. Therefore, surface water quality sampling was taken from near-surface groundwater in dry luggas, equivalent to that used as water resources for local communities.

1.4.5.2 Results

The surface water quality field parameter measurements made during the aquatic baseline work in June and October 2018 (Golder, 2018 and 2019b) are presented in Table 5. The locations are shown on Drawings 1a to 1h. The values presented are the average of three measurements of temperature, pH, EC, TDS and TSS at each location from each season. The following observations were presented with regard to the water quality field parameter measurements (Golder, 2019b):

- Water temperatures are higher during the dry season than the wet season.
- During the wet season, the surface water features have similar average pH measurements along the LLCOP corridor of around 8.
- The highest EC and TDS measurements in dry season were observed in borehole water, surface streams in lugga and marine water. During the wet season, the highest EC and TDS were observed in water pools in luggas. By comparison, dry season measurements of EC and TDS are higher than those in the wet season.

- Ewaso Ng'iro River TSS concentrations are four times more than in Kerio River and eight times more than in Suguta River.

The water quality field parameter measurement results taken in the area of each of the three main LLCOP river crossings are presented in Table 6. The locations are shown on Drawings 1a to 1h. In comparison to the data collected as part of the aquatic ecology baseline work, the following observations can be made:

- The pH measurements for the three main rivers taken during both sets of field data collection are consistent for each river location (i.e. all three measurements taken in the Ewaso Ng'iro River are around pH 8 and all three measurements taken in the Suguta River are around pH 9).
- All pH measurements are slightly alkaline and the pH of the Suguta River is slightly more alkaline than the Kerio and Ewaso Ng'iro rivers.
- The river temperature is reflective of air temperature for the seasons, so dry season surface water temperatures are higher than wet season temperatures.
- The EC and TDS measurements in the Suguta River are higher than in either the Kerio River or the Ewaso Ng'iro River. This may be a reflection of the composition of the geology over which the rivers pass.

Table 5: Field Parameter Measurements

Location Name (Site Code)	Season	Date	Water Feature Type	Temperature (°C)	Electrical Conductivity (µs/cm)	Total Dissolved Solids (ppm)	pH	TSS
Suiyan lugga (S10)	Wet	14/06/2018	Flowing water	24.8	543	352	8.00	-
	Dry	21/10/2018	No water	No water				
Barsaloi lugga	Wet	15/06/2018	Flowing water	25	574	403	8.00	-
	Dry	24/10/2018	Dugout Well	34	610	308	8.73	-
Seiya lugga (S17)	Wet	17/06/2018	Flowing water	24.6	278	195	8.01	-
	Dry	26/10/2018	Dugout Well	27.7	486	243	7.85	-
Ewaso Ng'iro River (S05)	Wet	20/06/2018	Flowing water	24.5	174	121.5	8.01	-
	Dry	11/10/2018	Flowing water	28.1	434	217	8.52	2163
Silanga-Nanyukie Lugga (S19)	Wet	18/06/2018	Water pool	25.0	489	293	8.00	-
	Dry	29/10/2018	Surface stream (2cm deep)	30.3	4000	2000	7.36	-
	Dry	29/10/2018	Borehole	29.5	3562	1764	7.13	-
Ngaroni - Baa lugga (S18)	Wet	19/06/2018	Water pool	27.0	933	644	7.96	-
	Dry	28/10/2018	Dugout Well	25.0	1472	734	7.78	-
Dam Point 8 - North Marti	Wet	27/06/2018	Earthpan	24.9	247	171	8.00	-
	Dry	23/10/2018	Earthpan	No water				

Location Name (Site Code)	Season	Date	Water Feature Type	Temperature (°C)	Electrical Conductivity (µs/cm)	Total Dissolved Solids (ppm)	pH	TSS
Garbatula - Water Pan (S08)	Wet	02/07/2018	Earthpan	24.5	118	60.5	8.01	-
	Dry	16/10/2018	Earthpan	No water				
Ziwa - Tana River	Wet	05/07/2018	Ox-bow lake	25.6	644	439	7.99	-
	Dry	Not visited	-	-	-	-	-	-
Nakukulas Lugga (S01)	Wet	Not visited	-	-	-	-	-	-
	Dry	02/10/2018	Dugout well in lugga	28.5	373	186	7.90	-
	Dry	02/10/2018	Cattle Trough Water	28.2	614	291	7.46	-
Kangthethein Lugga (S02)	Wet	Not visited	-	-	-	-	-	-
	Dry	03/10/2018	Dugout Well	33.3	1160	582	8.39	-
Karuko (S03)	Wet	Not visited	-	-	-	-	-	-
	Dry	05/10/2018	Oasis	32.7	1323	653	9.29	-
Kerio River (S04)	Wet	Not visited	-	-	-	-	-	-
	Dry	06/10/2018	Flowing water	30.5	271	135	8.42	500
Suguta River (S09)	Wet	Not visited	-	-	-	-	-	-
	Dry	18/10/2018	Flowing water	35.6	4000	2000	9.51	275

Location Name (Site Code)	Season	Date	Water Feature Type	Temperature (°C)	Electrical Conductivity (µs/cm)	Total Dissolved Solids (ppm)	pH	TSS
Gerille – Ijara (S27)	Wet	Not visited	-	-	-	-	-	-
	Dry	09/11/2018	Earthpan	31.6	1670	828	9.52	-
Mradeni - Dipu Dam, Lamu (S31)	Wet	Not visited	-	-	-	-	-	-
	Dry	15/11/2018	Earthpan	34.7	158	76	7.71	-
Lamu Port Area (S32)	Wet	Not visited	-	-	-	-	-	-
	Dry	16/11/2018	Marine Water	30.4	4000	2000	8.34	-

Table 6: Main River Crossing Field Parameter Data – December 2018

Sample Number	Sample Location	Sample Date	Time	Temperature (°C)	Electrical Conductivity (µS/cm)	pH
SW01	Suguta River – approx. 200 m downstream to southwest of current LLCOP alignment	06/12/2018	12.51	35.1	5,440	9.11
SW02	Suguta River – approx. 200 m downstream to southwest of current LLCOP alignment	06/12/2018	13.24	35.4	5,490	9.23
SW03	Kerio River - approx. 1.5 km downstream to southwest of current LLCOP alignment	06/12/2018	14.28	35.7	340	8.20
SW04	Kerio River – approx. 1.5 km downstream to southwest of current LLCOP alignment	06/12/2018	14.40	36.0	340	8.05
SW08	Ewaso Ng'iro River - downstream of current LLCOP alignment	09/12/2018	11.10	28.5	460	8.02
SW09	Ewaso Ng'iro River - upstream of current LLCOP alignment	09/12/2018	11.28	29.4	460	7.89

The laboratory data (Golder, 2019a) show that no TPH, PAH or BTEX have been detected at concentrations above the laboratory limit of detection (LOD) in any of the samples. The metals cadmium, chromium, copper nickel, lead, mercury and zinc were also not detected in surface water at concentrations above the laboratory above the LOD.

The data have also been screened against the project standards, which have been derived from National Kenyan standards, where available, or from internationally recognised guidelines; whichever is lowest.

Concentrations of sodium, chloride, electrical conductivity, nitrate, phosphate and fluoride, and the pH, in the Suguta River water were all higher than in the Kerio and Ewaso Ng'iro rivers and exceed the project water quality standards. These concentrations are likely to be natural and reflect the volcanic geology in the Suguta Valley where the river originates. The iron concentration in the Kerio River exceeds the project standards at the one of the two sample locations (SW03).

The water in the Ewaso Ng'iro River has the highest suspended solids concentrations and they exceed the project water quality standards. The high concentrations of suspended solids compared to the other rivers reflects the findings of the aquatic baseline field measurements.

The surface water quality data collected are part of the EOPS project (Golder, 2017 – included as Appendix A) and relevant to the northern end of the LLCOP were collated and the laboratory results screened against the project water quality standards. The project standards have been developed by Golder from National Kenyan standards, where available, or from internationally recognised guidelines where national standards were not defined. Key findings of the EOPS water quality baseline were as follows:

- Samples of surface water had a typical temperature of around 30°C to 35°C.
- The pH of surface water, taken from both field and laboratory measurements, was close to neutral and ranged from 7.37 to 7.85. These are mainly within the range of the Project quality standard (>6.5 and <8.5). As the pH of rainwater is typically slightly acidic, the pH is likely to be a reflection of contact with soils/sediments.
- Electrical conductivity values, taken from both field and laboratory measurements, range between 0.274 mS/cm and 0.575 mS/cm. Values are variable over time with no apparent temporal/seasonal trends.
- Dissolved oxygen measurements ranged from 2.02 mg/l to 5.02 mg/l. The values indicate that the water was not completely saturated, but that the water was also not depleted in oxygen. The dissolved oxygen concentrations were higher during the wet season.
- Oxygen Redox Potential (ORP) calculated around the time of the short wet season (November) was negative, indicating a reducing environment. All of the measurements made in May/June (towards the end of the longer wet season) were positive, indicating an oxidising environment.
- Water quality across the study area can be described as good with no inexplicable exceedances of water quality standards.
- The concentrations of major ions were generally below the Project water quality standards. Fluoride concentrations at SW1 marginally exceed the Project water quality standards.
- Metal concentrations in most surface water samples were below the laboratory limit of detection (LOD). Barium, boron and zinc were all detected in surface water samples, but at concentrations below the defined Project water quality standards.

- There was some evidence of human or animal waste in surface water as indicated by the coliform count (total and faecal). Other indicators of potential anthropogenic influences include the exceedances of the project standards for ammonia and PAH.

1.5 Hydrogeology

1.5.1 Main Aquifers

As shown in Figure 14 (after Hydrogeology of Kenya BGS, 2018), the main hydrogeological environments in the surface geology in Kenya are volcanic or basement in the inland areas and tend to be more unconsolidated materials or intergranular and fractured sedimentary rocks towards the coast. The flow and storage characteristics are typically fracture dominated in the inland areas basement and volcanic areas and intergranular towards the coast. Aquifer productive (yields) are typically low to moderate, but some un- or semi-consolidated aquifers towards the coast can yield higher volumes of water. A summary of typical aquifer characteristics (BGS, 2018) is presented in Table 7.

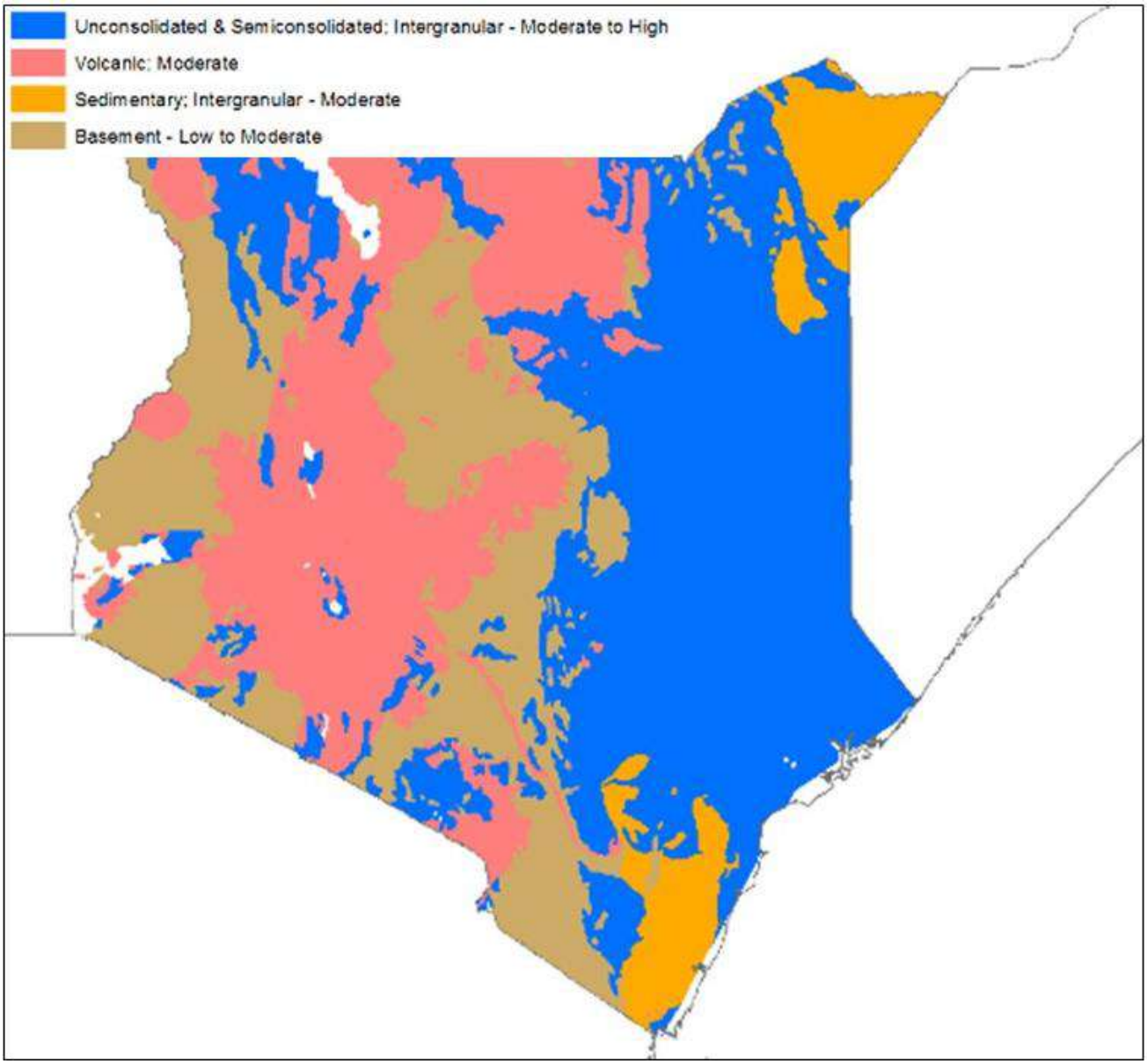

Figure 14: Main Hydrogeological Environments in Kenya

Table 7: Summary of Typical Aquifer Characteristics based on Type

Hydrogeological Environment	Summary of Characteristics
Basement aquifers	Crystalline basement rocks (metamorphic and igneous) most of which are Precambrian in age. These rocks develop distinctive local weathered (also called regolith) and fractured aquifers. Groundwater occurs where the rocks have been significantly weathered and/or in fracture zones, most of which are usually shallower than a few tens of metres depth. The flow and storage regime is, therefore, dominated by the presence or absence of fractures and weathering. Fracture flow is more significant in unweathered parts of very low porosity (<0.01). Some intergranular flow and storage is possible in weathered zones. Aquifers are typically low productivity that can provide small rural water supplies. Water quality is typically moderate to poor.
Igneous aquifers	Mostly volcanic, but in some areas can also include intrusive igneous rocks, such as granites, that are younger than the Precambrian. These rocks form fractured, weathered aquifers that are often strongly controlled by the geometry and weathering of former lava flows. Vary from a few metres to several hundred metres thick. Groundwater flow and storage occur in fractures and weathered zones, often along the sub-horizontal boundaries between successive lava flows, which at one time were land surfaces (palaeosols). Regimes are dominated by fracture flow and storage, with insignificant intergranular permeability and porosity. Borehole may encounter multiple discrete aquifer layers that are often confined. Aquifer yields can be high, but vary significantly. Springs originating from these aquifers are important sources in highland areas.
Consolidated sedimentary aquifers	These are usually of Tertiary to Cambrian age but can include some older Precambrian sedimentary rocks that have not been highly metamorphosed. Because of their variable ages, origins and properties, groundwater flow and storage type can be fracture, intergranular, or a combination of fracture and intergranular. Can form thick, highly productive aquifers (especially sandstone aquifers), which can be exploited for large urban, as well as rural, supplies. Mudstones, however, contain little groundwater.
Unconsolidated sedimentary aquifers	Mostly Quaternary in age, but also includes some Tertiary sediments. They are highly variable in their distribution, thickness, geometry and lithology; therefore, their hydrogeological characteristics are also highly variable. These deposits are often highly permeable and can store large volumes of groundwater at shallow depths, which is easy to exploit by traditional shallow wells and boreholes. Typically, intergranular flow and storage.

The WRA classifies Kenya's aquifers in the grades presented in Table 8 (After BGS, 2018).

Table 8: Kenyan Aquifer Classes

Class	Description	Example Aquifers
Strategic aquifer	Aquifer used to supply significant amounts/ proportions of water in a given area and for which there are no available alternative resources, or where such resources would take time and money to develop; significant transboundary aquifers.	Tiwi, Nairobi, Sabaki, Nakuru, Kabatini, Lake Naivasha, Lamu Island
Major aquifer	High-yield aquifer systems with good quality water.	Daua and Elgon volcanics
Minor aquifer	Moderate-yield aquifer systems with variable water quality.	Mandera Jurassics
Poor aquifer	Low- to negligible-yield aquifer systems with moderate to poor water quality.	Basement System
Special aquifer	Aquifer systems designated as such by WRMA.	Isinya

Groundwater governance follows the same boundaries as the surface water catchments (see Section 1.4.1). The groundwater basins that the LLCOP passes through are, therefore, the Rift Valley Basin Area, the Ewaso Ng'iro North Basin Area and the Tana Basin Area.

In the RVBA the LLCOP route passes over the Kerio Volcanics, which are classified as a poor aquifer, the Lodwar Alluvial Aquifer, which is classified as a special aquifer, and the Lodwar Aquifer, also classified as a special aquifer (WRA, 2018a). Information on the sedimentary Lodwar Aquifers (BGS, 2018) is presented in Table 9.

Through the ENNBA the LLCOP passes over the Mt. Kenya and Aberdares Volcanics, Colluvial Deposits, the Basement System Aquifer and the Merti Aquifer. The Basement System Aquifer is classified as a poor aquifer. The Mt. Kenya and Aberdares Volcanics aquifer is classified as a major aquifer. No information is available on the classification of the Colluvial Deposits (WRA, 2018a).

The Merti Aquifer is the largest aquifer in Kenya and underlies part of the Ewaso Ng'iro North and Tana Basin Areas. Figure 15 shows the extent of the Merti aquifer relative to the proposed pipeline route. Parts of the aquifer also extend into Somalia (see Section 1.3.4.1). It is classified as a special aquifer. Information on the Merti Aquifer (BGS, 2018; and World Bank, 2011) is presented in Table 9. It is a strategic resource that provides water for rural centres (Habaswein and Dadaab being the largest) and for the refugee camps in the Dadaab area (World Bank, 2011).

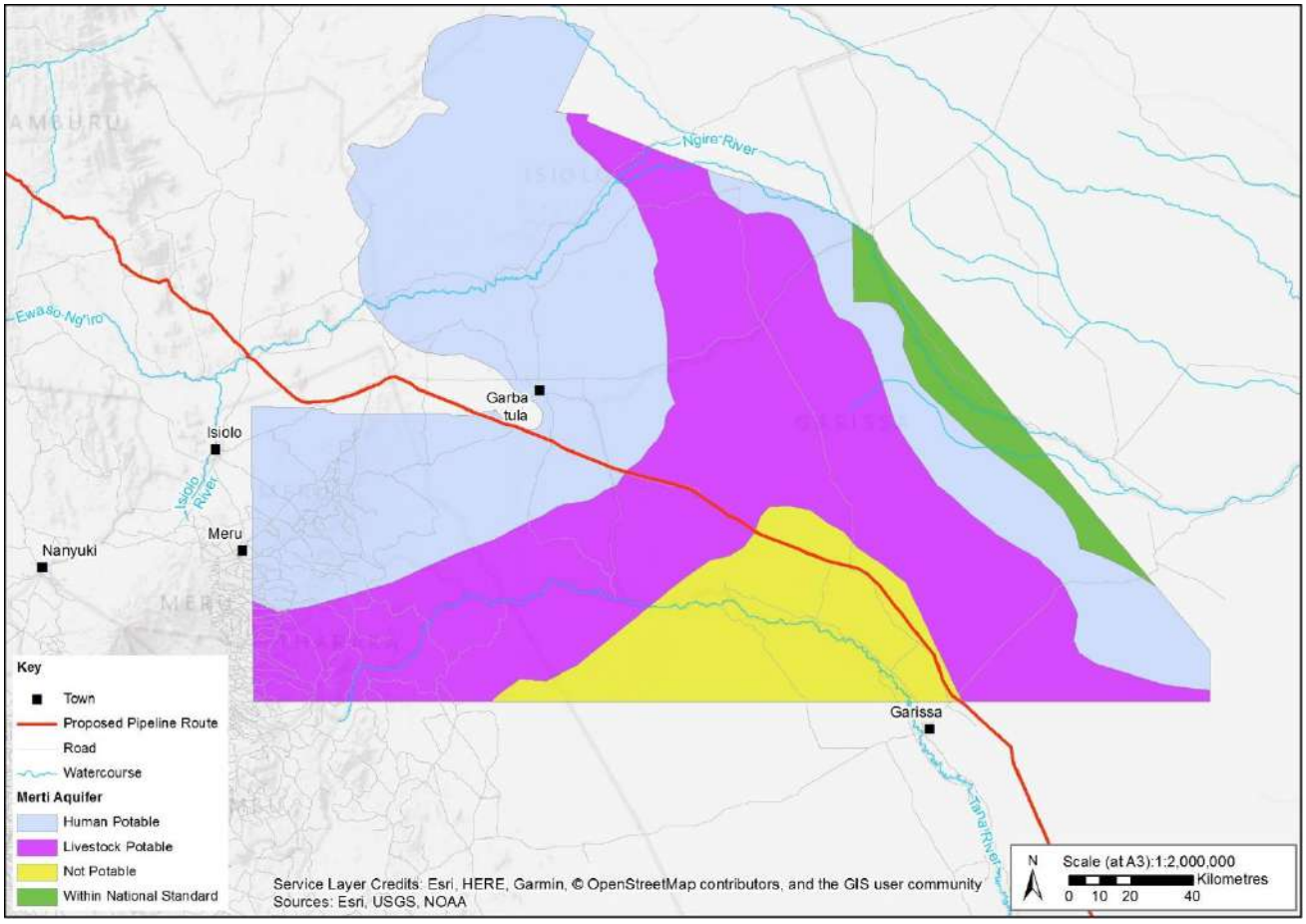

Figure 15: Merti Aquifer Extent and Potability

Parts of the Merti Aquifer have high electrical conductivity values (greater than 8,000 µS/cm) or include fine facies that are less productive, so the effective extent of the useable aquifer is estimated to be 61,000 km^2 (World Bank, 2011). Groundwater in the aquifer is warm (36°C to 40°C) and is typically of a calcium bicarbonate type. However, intense abstraction results in the groundwater tending towards a sodium chloride dominance and the water can become brackish or saline. Trace metals can be present and are likely to be natural in origin (World Bank, 2011).

There is little or no modern recharge to the Merti Aquifer expect during significant floor events along the Ewaso Ng'iro River, so the water that is abstracted from this aquifer is fossil water and is a finite resource. At Dadaab, depletion of groundwater resources has occurred, and continues, and water quality has deteriorated over time. Electrical conductivities have approximately doubled since the early 1970s (World Bank, 2011).

The Merti Aquifer is largely or wholly confined. This means there is little or no hydraulic connection between the surface and the groundwater at depth. There may be some occasional recharge from flooding along the Ewaso Ng'iro River. Due to the limited recharge from the surface, the aquifer has low/no vulnerability to pollution. It also means it is fairly resistant to climate change; as little modern recharge occurs, changes in storage will reflect natural and anthropogenic discharge and not changes in climate (World Bank, 2011).

A Lamu Sand Dunes Aquifer has been proposed as a Groundwater Conservation Area because saline intrusion into the previously freshwater zone has been taking place and some wells have dried up. This sand aquifer is considered to be high vulnerability and is threatened by anthropogenic influences. The WRA has put in measures under Water Act 2016 to manage aquifer to ensure protection, conservation and sustainable use (WRA, 2018a).

Table 9: Lodwar and Merti Aquifer Information

Named Aquifers	General Description	Water Quantity Issues	Water Quality Issues	Recharge
Lotikipi and Lodwar aquifers	Alluvial sands and sediments, which can be up to 80 m deep. They can have high groundwater potential where dominated by coarse grained sediments (sand and gravel), but elsewhere, groundwater potential is typically limited.		Groundwater in the Lotikipi aquifer is very saline, with conductivity values exceeding 8000 uS/cm.	Recharge occurs both by direct rainfall infiltration and, to the Lodwar aquifer, by leakage from the River Turkwel.
Merti Aquifer	The Merti Aquifer comprises semi-consolidated clays, sands, sandstones and limestones. Groundwater is usually confined, flow is intergranular, and water is found at fairly uniform depths of between 110 m and 180 m below ground level. The aquifer is thought to be between 80 m and 280 m thick. Transmissivity ranges from 0.2 m^2/d to 840 m^2/d (median 275 m^2/d, n=20) depending on the facies; higher transmissivities are in coarse grained materials. Storage coefficients range from 4.3×10^{-5} to 6.7×10^{-4} (n=6). The hydraulic gradient ranges from 0.001 in the western part of the aquifer, falling to 0.0001 to 0.005 toward the border with Somalia.	Locally subject to over-exploitation	Highly variable. Freshest in the centre of the aquifer, becoming more mineralised to north and south. Saline water has been noted in the Merti Aquifer and is also believed to underlie the fresh water layer. Water quality in the Dadaab refugee camps has deteriorated over time, mainly due to increasing salinity. In Habaswein there is evidence of some salinisation as a result of long-term abstraction.	Modern recharge is periodic and limited. Most abstraction is of fossil water. No, or extremely limited, surface water interaction with the Ewaso Ng'iro Rvier – possinly only during significant flood events.

1.5.2 Aquifer Recharge

During heavy rain-storms, large volumes of water fall onto the ground over short periods of time and water input can exceed evapotranspiration and recharge aquifers where the ground is permeable, but will run-off as drainage to surface water where the ground is less permeable (Price, 2016). Recharge to aquifers or extensive surface run-off and drainage does not occur regularly and may only occur every few years or decades (Price, 2016). The average effective precipitation (i.e. the precipitation that is not lost by evaporation or transpiration) is estimated in Price (2016) to be less than 20 mm/yr (which is ~8 % of annual average rainfall).

Baseline data on infiltration rates to ground was collected as part of the EOPS. All data collected for the EOPS was from the oil field area in Turkana County. Infiltration rates to the ground from tests were calculated to be between 0.063 cm/min and 0.663 cm/min. The saturated vertical hydraulic conductivity is calculated to range from 8.3 x 10^{-6} m/s to 2.6 x 10^{-5} m/s.

Permeability (hydraulic conductivity) tests have been undertaken on soil samples taken from the top 2 m of ground in trail pits located in Samburu and Garissa Counties (Treavic Geosystem and Engineering Ltd., 2018/2019). The average permeability from these tests ranged from 0.027 m/d to 64 m/d.

The soils overlying the volcanic aquifers are typically thin and permeable, so it is possible that more than 50% of rainfall in the wet season can contribute to direct recharge. However, due to the arid climate, high evaporation potential, soil moisture deficits recharge to aquifers is generally much less (Samoka, 2010). The estimate of average annual recharge in the Upper Ewaso Ng'iro is presented in that report as 168 mm. Confined aquifers in the basin are recharged by rainfall in the highlands of Mt. Kenya and Aberdare, and some infiltration through sandy riverbeds.

It is stated in the study by Samoka (2010) that the volcanic deposits of the Ewaso Ng'iro Basin (including parts of Meru Country) have the following properties:

- Drainable porosity ranges from <1% to 8%;
- Hydraulic conductivity ranges from 0.01 to 10,000 m/day; and
- Transmissivity values range from 0.1 to 100,000 m^2/d.

The lowest values presented were for rhyolites, phonolites and pyroclastic, and the highest values were for recent basaltic formations and alluvial materials derived from the volcanics.

1.5.3 Groundwater Quality

Some aquifers are excellent groundwater sources (BGS, 2018). These are mostly the aquifers recharge from fresh water rivers (e.g. the Lodwar Aquifer recharged by the River Turkwel; the Merti Aquifer recharged by the River Ewaso; the Gongoni Aquifer recharged by the Mkurumudzi River and the Baricho Aquifer recharged by the River Galena) (BGS, 2018).

Not all groundwater in Kenya is chemically safe for human consumption or pleasant to taste. The reasons for this may be natural or anthropogenic. Groundwater in Kenya is known to have, amongst other elements, high concentrations of arsenic, boron and fluoride originating from the natural geology that could be present in concentrations that are unacceptable for human consumption (Price, 2014b). For example, groundwater in the volcanic aquifers typically has low total dissolved solids and high bicarbonate, and the volcanic deposits of the East African Rift System are rich in fluoride, which leads to high groundwater fluoride concentrations (BGS, 2018). The Nairobi Aquifer has high fluoride concentrations, which mostly exceed WHO standards, especially towards the Embakasi area. The Lotikipi Aquifer is very saline with conductivity exceeding 8000 µS/cm. The Mombasa Island Pleistocene sands and limestones and related aquifers are impacted by pollution and saline intrusion. The Mumias granites are impacted by pollution and salinisation (BGS, 2018).

In the Rift Valley area at the northern end of the LLCOP the groundwater is unlikely to be saline (Price, 2014a). This is because, since the onset of formation of the Rift Valley, the region has been landlocked and sediment deposition has mainly been fluvial or lacustrine in origin, so the water trapped in pore spaces in the rocks is fresh. Solute concentrations in groundwater may be higher than expected in pure rainfall due to evaporation from the soil zone concentrating the solid content in the rainfall (and therefore the solid content of aquifer recharge) or by direct evaporation from groundwater where the water table is shallow. Even at low concentrations, sodium chloride can make water taste brackish (Price, 2014b). Most of the groundwater encountered during exploration for sources of injection water in the area has been fresh, although some of the groundwater encountered in the volcanics is slightly brackish (Price, 2014a).

TDS concentrations have also been analysed in samples taken from five of the Lamu Marine Terminal area (LMT-B, LMT-E, LMT-F, LMT-G and LMT-J) (Treavic Geosystem and Engineering Ltd., 2018/2019). The results indicate that TDS concentrations in this area are mainly within the range expected of fresh water (these results ranged from 293 mg/l to 421 mg/l). However, two additional samples were taken from locations LMT-E and LMT-G. Whilst one set of samples from these locations returned results within the fresh water range, the second samples returned concentrations between 28,860 mg/l and 35,165 mg/l, which is above the Project water quality standard of 1000 mg/l.

Two further water samples have also been taken from locations SRVX122A (also called SRVX-113A) and SRVX135A (also called SRVX-123A), which are at watercourse crossing locations in Samburu County. The TDS results for these locations range from 395 mg/l to 1,479 mg/l (Treavic Geosystem and Engineering Ltd., 2018/2019). The concentration of 1,479 mg/l from the sample taken at location SRVX135A is above the Project water quality standard of 1000 mg/l.

Baseline groundwater quality data was also collected as part of the EOPS. All data collected for the EOPS was from the oil field area in Turkana County. The data were gathered by Golder and Golder's subcontractors EMC, or was provided by Tullow, and included groundwater quality monitoring. As part of a wider scheme of groundwater monitoring that is undertaken by Tullow, Golder collected water quality samples from selected groundwater wells, including:

- GW1 (also known as East Lokichar WBHC);
- GW2 (also known as Ngamia East);
- GW3 (also known as Nakukulas 9); and
- GW5.

The locations are shown on Drawings 1a to 1h. The groundwater quality data collected are part of the EOPS project (Golder, 2017 – included in Appendix A) and relevant to the northern end of the LLCOP were collated and the laboratory results screened against the Project water quality standards (Appendix B). The Project standards were developed by Golder from National Kenyan standards, where available, or from internationally recognised guidelines where national standards were not defined. Key findings of the EOPS water quality baseline were as follows:

- Samples taken of groundwater typically had temperatures of around 30°C to 35°C.
- The pH of groundwater, taken from both field and laboratory analysis, was close to neutral. The pH of groundwater ranged from 7.34 to 8.92. These are mainly within the range of the Project quality standard (>6.5 and <8.5). As the pH of rainwater is typically slightly acidic, the pH is likely to be a reflection of contact with soils/sediments.

- Electrical conductivity values, taken from both field and laboratory measurements, ranged between 0.6 mS/cm and 3.5 mS/cm in groundwater. Values were noted as being variable over time with no apparent temporal/seasonal trends. The highest of the electrical conductivity measurements in groundwater were mainly, but not exclusively, from deeper boreholes. Groundwater typically has a higher electrical conductivity than surface water because it has been in contact with soils/sediments that can increase the presence of dissolved material that conducts electrical current.
- Total Dissolved Solids (TDS) results from groundwater field measurements ranged from 263 mg/l to 625 mg/l and are within the range expected for fresh water. TDS in groundwater samples measured in the laboratory ranged from 255 mg/l to 4,150 mg/l. TDS concentrations are higher than the quality standard in groundwater samples taken from Kengomo 1, Ekunyuk and Nabolei.
- The dissolved oxygen concentrations measured in groundwater ranged from 0.7 mg/l to 5.51 mg/l. The values indicate that the water is not completely saturated, but that the water is also not depleted in oxygen. The dissolved oxygen concentrations were higher during the wet season.
- Water quality in general was described as good with no inexplicable exceedances of the Project water quality standards.
- The concentrations of major ions are generally below the Project water quality standards. Sodium concentrations were commonly found to be elevated compared to the Project standard of 50 mg/l at all monitoring locations, which is likely to result from natural interactions between water and the geology. Fluoride concentrations were also elevated compared to the Project standard of 1.5 mg/l in samples from most locations. Elevated concentrations of fluoride were measured most often in samples taken from Kengomo 1, Kengomo 2, Ewoi, Ekunyuk and Nabolei. Occasional exceedances of the chloride standard were also noted in samples taken from Nakukulas 9, GW5, Kengomo 1, Ekunyuk and Nabolei. It is considered likely that these fluoride and chloride levels are indicative of the prevailing conditions within the areas of the Ngamia and Amosing oil fields.
- Most of the metal concentrations were below the laboratory limit of detection (LOD). Boron, vanadium, zinc and strontium were most commonly detected at concentrations greater than the LOD. Aluminium, barium, copper, manganese and iron were also detected at concentrations greater than the LOD, but in a smaller proportion of samples taken. Occasional copper, manganese and zinc concentration exceedances of the Project water quality standards have occurred in samples taken from East Lokichar C (GW1); aluminium, copper, iron and manganese in samples taken from Nakukulas 9 (GW3); and copper, iron and manganese in samples taken from Kengomo 1.
- Poly-aromatic hydrocarbons (PAHs) and total petroleum hydrocarbon (TPH) concentrations were occasionally detected in groundwater at concentrations equal to or just above the LOD of 0.01 mg/l. Where PAHs were detected, the concentrations exceed the Project water quality standard.
- There was some evidence of human or animal waste in groundwater. Nitrate (as NO3) was commonly measured in groundwater samples at concentrations above the standard of 10 mg/l. Total coliform counts in groundwater samples were frequently greater than the LOD, but usually lower than the counts in surface water samples.

1.5.4 Groundwater Levels, Flow and Hydraulic Properties

There is little reliable long-term groundwater monitoring data available along the LLCOP route. This is because most existing boreholes that are used as monitoring wells are also production wells, so obtaining reliable data is often not possible because production would have to be stopped for data collection to allow groundwater levels to re-equilibrate (WRA, 2018a). The Water Resources Situation Report for 2017/2018 (WRA, 2018a) states that exploratory boreholes have been installed in a range of places including: the Marsabit aquifer at

Laisamis, Kargi and Awaiye and El-adi and Loiyangalani; the Turkana aquifer at Loperot, Lokichar, Lopur, Meyan and Kapsor; and in Garissa at Abdisemed, Hagarbul, Hagarjareer, Welkajof and Barazaben. The purpose of these wells is to study groundwater conditions in a more structured way. However, no data are presented in report.

Within the Ewaso Ng'iro North Catchment Area, the groundwater level between July 2017 and June 2018 was consistently taken from four monitoring stations: Aikman, Nanyuki Childerns Home, Lolmalick and Kibwi Farm (WRA, 2018c). Groundwater levels were measured around 25 m bgl to 35 m bgl. The exception to this was at the Aikman borehole where groundwater levels were measured as over 50 m bgl. However, the ground elevation at these locations is not presented, so these different depths to groundwater could represent similar groundwater elevations and the Aikman borehole may just be at a higher ground elevation. Trends are difficult to identify because the scale of the graph is not sufficiently detailed, but the report states that groundwater levels at these locations were relatively stable during the year. A slight reduction in depth to groundwater (i.e. groundwater levels get closer to the ground surface) in one of the boreholes between around November 2017, which could correspond with the rains.

Groundwater levels in the Merti Aquifer in the area of Habaswein (over 200 km east of Archer's Post and the proposed pipeline crossing) were struck at around 130 m bgl. Overall, groundwater levels in the Merti Aquifer are encountered at between 110 m bgl and 180 m bgl. Most successful boreholes that exploit the more permeable zone of the Merti Formation are commonly installed between 105 m to 150 m bgl and water levels (Acacia Water, 2014).

Records of groundwater encounters have been made during the excavation of trail pits and drilling of boreholes that is being undertaken as part of the geotechnical studies for the LLCOP. These studies were still underway at the time of reporting. The locations are shown on Drawings 1a to 1h.

No groundwater was encountered in the LLCOP trail pit locations that were excavated to investigate the top 1.5 m to 2.0 m of ground (Treavic Geosystem and Engineering Ltd., 2018/2019). The locations of these trial pits are shown on Drawings 6.4-1 to 6.4-8. Groundwater strikes recorded in eight ground investigation boreholes in the Lamu marine terminal area (LMT-A, LMT-B, LMT-E, LMT-F, LMT-G, LMT-H, LMT-I and LMT-J) ranged from 1 m bgl to 4 m bgl (Treavic Geosystem and Engineering Ltd., 2018/2019). Piezometers were installed in five of these locations to enable the monitoring of resting groundwater levels to take place (LMT-B, LMT-E, LMT-G, LMT-H and LMT-J). Daily groundwater monitoring in both the morning and the afternoon was undertaken at these five locations for between 68 and 173 days. The resting groundwater level data in this coastal region typically show that after installation the resting groundwater levels were lower than the initial strikes and ranged from around 2.3 m bgl at location LMT-B to nearly 5 m bgl at LMT-J.

Piezometer data is also available for boreholes located at some river crossing locations in Samburu County (Treavic Geosystem and Engineering Ltd., 2018/2019). Boreholes SRVX135A (also called SRVX-123A), SRVX123C and SRVX124B are located at watercourse crossing points on a tributary of the Ewaso Ng'iro, west of the town of Wamba and between approximately 45 km and 60 km north west of Archer's Post. This tributary joins the Ewaso Ng'iro upstream of Archer's post. Borehole SRVX-122A (also called SRVX-113A) is located at the crossing of the Nigire River approximately 85 km north west of Archer's Post. This watercourse does not flow into any of the three largely perennial/permanent watercourses along the Project route. Daily groundwater monitoring in both the morning and the afternoon was undertaken at these locations for between 20 and 71 days. The data indicates that after stabilising the resting groundwater levels in these locations are typically between 1 m and 3 m bgl.

In addition to the baseline data being collected for the LLCOP, baseline data was also collected as part of the EOPS. All data collected for the EOPS (included in Appendix A) was from the oil field area in Turkana County. The data were gathered by Golder and Golder's subcontractors EMC, or was provided by Tullow, and included

groundwater level monitoring. From that work, the following information on groundwater levels, flows and aquifer properties was collated:

- The primary data collected for the EOPS study indicates that groundwater is typically encountered at depth of 5 m to 20 m bgl in the wells located in the east of the basin in which the EOPS study area was located;
- The depth to groundwater is greatest where the topographic elevation is highest (~ 30 m bgl at Kapese) and in the area just to the north of the study area (35-40 m bgl in Nabolei and Kengomo 1);
- The groundwater flow direction indicated by both secondary and primary data sources is towards the northeast, which corresponds with drainage towards the Kalabata River;
- The estimated regional hydraulic gradient towards the northwest is 0.0053, which falls within the range of gradients estimated in Price, 2015 (0.0026 to 0.0076);
- Vertical hydraulic gradients in groundwater are reportedly downwards under non-pumping conditions. An estimate of the vertical downwards hydraulic gradient at East Lokichar WBHA is 0.035 and the vertical conductivity was estimated to be approximately 0.0001 m/d;
- Measurements made in wells in the Miocene volcanic sequence indicate the transmissivity is highly variable and test results have a range from <1 m/d to >750 m/d. Transmissivity values measured in wells in the alluvial deposits range from >600 m/d to >5,000 m/d;
- Wells drilled in the Auwerwer Volcanics as part of a study into water supplies (Unknown, 2014) indicated typical production rates of approximately 8 m^3/hr to 12 m^3/hr with a maximum of 23 m^3/hr. The most productive wells come from those that encounter the sandy sedimentary interflow deposits; those wells that only intersected the lavas have been found to be unproductive (Price, 2016).; and
- Wells drilled into the river gravels of the Kerio Valley indicate the presence of fresh water and had production rates up to 50 m^3/hr. Wells drilled in surface sands encountered little groundwater and the sand was often well cemented reducing its permeability.

1.6 Water Resources and Use

Baseline data about water supplies has been collated as part of the health baseline included in the social baseline report. This section includes a summary of the findings of that baseline data collection as well as information from other secondary data sources.

1.6.1 Resource Overview

1.6.1.1 Country Overview

Kenya relies on both surface water resources and on groundwater. Dependence on groundwater is highest in rural areas and in the coastal zone, but urban areas also rely on groundwater (BGS, 2018). Surface water sources include perennial or seasonal rivers and streams (luggas), lakes, springs, oases and dammed reservoirs. Groundwater sources below the surface might be accessed through boreholes or hand-dug wells (including those dug into river beds during the dry season).

Information collated by the FAO (2015) indicates that internal renewable surface water resources for Kenya are estimated at 20,200 million m^3/year and renewable groundwater resources at around 3,500 million m^3/year. However, 3,000 million m^3/year of this is an overlap between surface water and groundwater, which gives a value of total internal renewable water resources of 20,700 million m^3/year. External water resources are estimated at 10,000 million m^3/year, which results from the inflow from Lake Omo from Ethiopia into Lake Turkana. Surface water leaving the country is estimated at 8,900 million m^3/year through Lake Victoria to Uganda (8,400 million m^3/year) and through the Ewaso Ng'iro river (also called Lagh Dera) into Somalia, 500

million m³/year). The dependency ratio is around 33 percent and the total renewable water resources are 30,700 million m³/year, or 692 m³/year per capita in 2014. This per capita value is projected to fall under the absolute water scarcity threshold of 500 m³/year by 2030 due to population increase.

The Kenya Groundwater Governance Case Study (World Bank, 2011) presents data on water resource availability in each of the main catchments in Kenya. The statistics for the three catchments that the LLCOP route passes through are reproduced in Table 10.

Table 10: Catchment Water Resources Availability

Catchment	Area (km^2)	Surface Water (10^6 m^3/yr)	Groundwater (10^6 m^3/yr)
Rift Valley	130,452	2,784	126
Tana	126,026	3,744	147
Ewaso Ng'iro	210,226	339	142

Public water supply in the coastal strip is almost entirely dependent on groundwater (World Bank, 2011). Many domestic, commercial, and industrial water users rely on groundwater in the South Coast, Mombasa, and the North Coast (Kilifi and Malindi). Many towns in Kenya rely largely or exclusively on groundwater for public and private water supply (e.g. Naivasha, Nakuru, Wajir, Mandera, and Lodwar).

There are six hydrogeological formations that influence the distribution and availability of the groundwater resources in Kenya: the eastern quaternary sediment areas, the bedrock areas, the western quaternary areas, the volcanic rock areas in the Rift valley, the volcanic areas outside the Rift valley, and the older sedimentary areas (FAO, 2015). The volcanic and quaternary geological formations are most rich in groundwater. The country's safe yield of surface water has been assessed at 7,400 million m³ per year while that of groundwater is about 1,000 million m³ per year. However, five new deep aquifers were identified in 2013 in Turkana country (including the Lotikipi aquifer west of Lake Turkana and the smaller Lodwar basin near Lodwar) that could provide groundwater reserves accounting for about 250,000 million m³ and mean that these numbers may be underestimates.

As already indicated, some of Kenya's surface water resources are 'external' that flow into Kenya from other countries. Surface water transboundary matters are discussed in Section 1.4.1. There are also some shared groundwater aquifers that are considered to be 'transboundary' (World Bank, 2011). The World Bank identifies five significant transboundary aquifer groups: the Rift Valley aquifers, the Elgon aquifer, the Merti aquifer, the Kilimanjaro aquifer, and the Coastal sedimentary aquifers. There are reportedly efforts to develop cooperative frameworks for the Mara River Basin between Kenya and Tanzania (including the establishment of a transboundary water resources users association) and for the Sio-Malaba-Malakisi River Basin between Kenya and Uganda. In both these cases, the catchment area has been defined on the basis of surface water catchment areas, and not on the basis of groundwater basins. There are no arrangements under way to develop a cooperative framework for the management of shared groundwater resources, such as the Merti, which is shared with Somalia.

1.6.1.2 County Overview

The NDMA reports for February 2018 to January 2019 (NDMA, 2019) indicate that drought alerts or alarms were issued in the Counties that the proposed pipeline passes through in the months of February and March. Alerts were also issued in Garissa and Samburu in December and January, and in Isiolo in January. The NDMA reports also provide information on the main sources of water supply in each county throughout the year. From

the information presented for February 2018 to January 2019 (NDMA, 2019), the following key points can be made:

- In Turkana County a range of water sources are used for domestic supply and for livestock, including rivers, springs, lakes, pans and dams, river wells, shallow wells and boreholes. Surface water sources are the main source of supply during the rainy season and boreholes are used more when surface supply availability declines.
- A wide range of types of water supply are used in Samburu County. Rivers provide between 5% and 10% of the supply in most months; as do springs. Although exact proportions vary through the year, the rest of the water supply is sourced from a mixture of shallow wells, dams and pans, river wells and boreholes.
- In Isiolo County boreholes provide over a third of the supply between June and January, which indicates groundwater is an important resource in this county. In the other months, rivers, dams and pans, and shallow wells have increased importance. Rivers provide over a third of the water supply in March and April.
- In Meru County water from boreholes and rivers make up the majority of the water supply. The proportion of water from each varies throughout the year. River sources dominate in April to June and in December after the rains, and borehole sources dominate in September, October, November and February when river flows are less. Springs, and pans and dams are occasional used.
- In Garissa County the dominant water supplies throughout the year are dams and pans, boreholes and river. The proportion from each of these varies through the year. River water is particularly important, and the percentage of supply rivers provide can range from about 15% to nearly 60% deepening on availability of river water and other sources. Little information is provided about which rivers provide this supply, but the River Tana is the main river in this county. More minor sources in this county include natural ponds, shallow wells and piped water.
- In Lamu County the main sources of water throughout the year are shallow wells, dams and pans, boreholes and rivers. The proportion of water that comes from each source varies throughout the year, with an increase in the proportion taken from rivers in May and June after the rains and associated flooding that typically takes place in April and May. As river water use declines, traditional river wells become a more important water source. Additional sources that form small and occasion sources of water during the year include lakes, springs and piped water supplies.

Turkana County water resources (Turkana County Government, 2013) are mainly from hand dug shallow wells and river water, and some boreholes and springs. The distances travelled from the communities to sources of water typically range from 0.5 km to 15 km (Tullow, 2015).

River water is the main source in the wet seasons. The Seiya and Barsaloi were identified as very important lugga for the provision of water in the dry lands (Golder, 2018) and can be used for water provision for the livestock and domestic uses.

During the dry seasons, groundwater is commonly accessed by shallow hand-dug wells that are dug in the riverbed or next to the river. The shallow wells dug in the riverbed are used during the dry season and are, therefore, temporal. The shallow wells dug next to the river can be permanent sources of water, but tend to dry up with prolonged drought.

There are some boreholes used for water supply in the area of the oil fields. Between 2012 and 2014, Tullow Kenya, B. V. initiated a regular supply of water for local communities for watering livestock, potable and non-potable supplies. The supply comes from tanks that are mainly filled by tankering water from a series of Water

Resource Management Authority permitted abstraction boreholes, although a few tanks are filled by pipe as they are close to the supply well.

In Samburu County, surface water is available in small quantities from the Ewaso Ng'iro River, which is the only major perennial river in the county. Most rivers in Samburu County are ephemeral and flow for short periods after rainfall. Dams and pans are common, but their storage capacities have been reduced by siltation. The chemical quality of the surface water is generally good; however, bacterial contamination is common. Most of the water sources are subsurface such as boreholes, shallow wells and pans.

In Isiolo County, urban centres and other settlements in the project area (e.g. Modogashe, Skanska, Habasweini, Lagdima, Kanjara and Guticha) receive their water from a combination of sources, including the Ewaso Ng'iro River, River Galana Gof, fresh water luggas, boreholes and water pans. Groundwater is fresh in some areas, but saline in others. Percolation of water into the sandy flood plains provides water for local communities during much of the year. During the wet seasons water collects in earth dams forming localised reservoirs of water for people and their livestock.

In Meru County water sources include groundwater from boreholes and surface water from rivers. The Tana and Ewaso Ng'iro rivers form the main source of water for both domestic and agricultural use.

In Garissa County various sources of water are used that include the River Tana, luggas, boreholes, dams, pans and springs. Groundwater is the main water resource (Kinconsult Associates Ltd, 2016).

1.6.2 *Access to Drinking Water*

According to the 2014 Kenya Demographic and Health Survey Atlas (Kenya National Bureau of Statistics, 2016), access to an improved drinking water source is varied, as shown in Figure 16. Improved water sources include piped water; a public tap/standpipe or borehole; a protected well or protected spring water; rainwater; and bottled water. Within the Project area, access to safe drinking water was highest in Isiolo County (82%) and lowest in Garissa County (40%) while the rest of the counties recorded coverage between 49% and 71%.

The Health Baseline for the LLCOP includes the following informing on drinking water access in the project area:

- Ground water (boreholes and shallow wells) were noted to be the most common source of drinking water in the Project area.
- Use of unsafe surface water (dams, seasonal rivers, lagoons) was reported, especially in Samburu and Garissa and more so in rural areas.
- Most fresh water springs are situated within game reserves, and as such, not accessible to people.
- High water salinity was reported in Isiolo (affecting 58% of water sources) and Lamu (affecting the bulk of ground water sources).
- The counties considered access to safe drinking water a priority area and were implementing initiatives such as construction of public boreholes. In Meru county alone, 25 public boreholes were sunk in the 2017/18 financial year. A further hundred boreholes are planned to be sunk every year. Each of the counties has a water and sewerage company in place but the supply of piped water was mostly erratic and only limited to large urban areas.

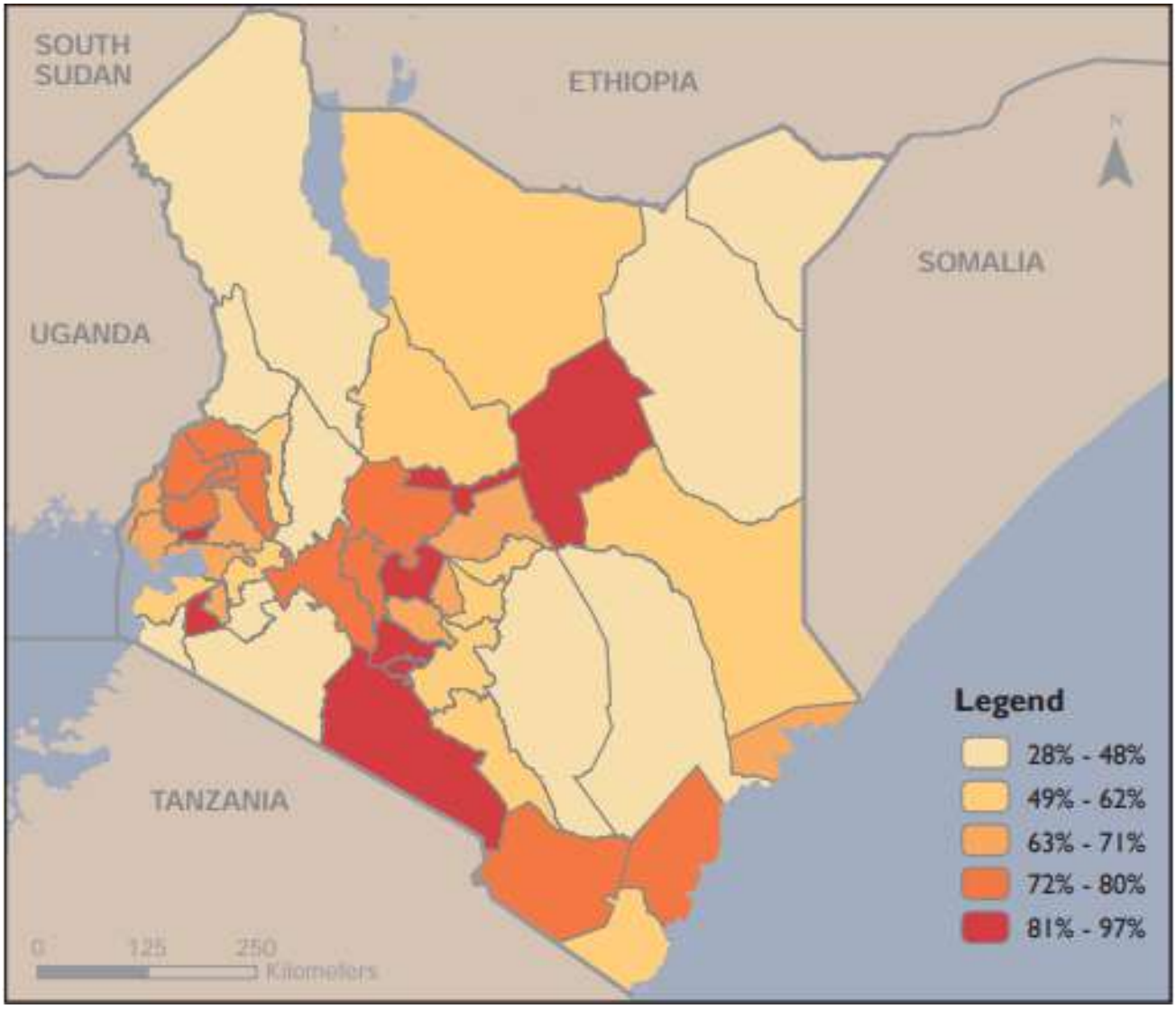

Figure 16: Access to Improved drinking water in Kenya (2014/15)

1.6.3 Water Sources along the LLCOP Route

Information on the sources of water along the pipeline route in each County, and when they are typically used, was collated as part of the health baseline and a summary is presented in Table 11. During the data collection it was noted that the water users were typically not able to locate the source of their water on a map; therefore, the type of water course and its general location only are presented.

Table 11: Community and Livestock Water Supply in the Project-Area Communities

County	Community	Water Sources	Season
Turkana	Lokichar	■ Water points at Kalapata, Lokichada, Kamanu-Kwee, Kaimegur, and Elelea-Nabolei	Dry
		■ Traditional wells for livestock Kaakali, Kamarese (until it rains) ■ Natural water pans, *Ngataparin,* (Lokulubech, Apa-lolemu and Askim) can hold water for about six months	Rainy
		■ Water points Karipun, Kanging'olemogin, Riami-riame, Lokuno	n/a
	Lokori	■ Kerio River; ■ Water points at Lohurerei and Lokwamosing ■ Oases at Kaachola, Napeitom, Naskeny, Kanapot, Kangiesei, Kalomesek Sil, and Agolet	Rainy and Dry for Oases
	Kalapata	■ Kareko, Elelea, Nabolei are the major wells	Mid-Rainy
		■ Borehole (Nakiling'a at Loperot) shared by school, community and pastoralists	Dry
		■ Water points at Loturerei, Lokwamosing, Nabolei water well, Kaimegur, and Kaidima ■ Kerio River	n/a
		■ Wells at Lokichada are a central source of water for pastoralists in the different regions of Loperot, Nakukulas, Lokiroe-liwo, Kaching'angar, and Ikalale Akeraan.	n/a
	Katilia	■ Wells, springs, boreholes ■ Water catchment (*ngiburin)* and oasis (*ngichwae)* ■ Water (*Eriong'a)* is used on the farms	n/a

County	Community	Water Sources	Season
Samburu	Nachola	■ Nachola River ■ Dams	River is seasonal Rainy season (dams)
	Suyian	■ Suyian River used by community and livestock	n/a
	Baragoi	■ Water point	n/a
	Barsaloi	■ Barsaloi River	n/a
	Swari	■ Seyia River used by community and livestock	Dry and rainy seasons
Isiolo	n/a	■ Shallow pans dug at dry river beds ■ Reserve boreholes	n/a
Meru	Kaichuru	■ Springs at Magado, Waso and Chapo ■ Boreholes at Barajadi and Gachuru	n/a
	Laare	■ Diocese of Meru (Turo Water Project) and water trucks ■ Springs at Laare, Kitawaa, Atununu and Kithingangu ■ Boreholes in Laare, Ntune and Kiridora	May to August (water trucks)
	Kandabene	■ Borehole at Kandabene and Matabithi ■ Dams at Batalo, Kungu, Karuya and Kandabene ■ Lanyiru Stream ■ Rikindu and Wasinara River	n/a rainy seasons (dams) stream runs all year rivers are seasonal

County	Community	Water Sources	Season
Garissa	Bouralgy	■ Water pans at Bukurey ■ Water trucks bring water from Tana River	n/a
	Garissa Town	■ Traditional wells and piped water	n/a
	Korakora	■ Water pans and boreholes	n/a
	Sankuri	■ Piped water ■ Local River	n/a
	Kamuthe	■ Water pans (e.g. Daad Seinab, Adnaan, Kalagose and Eey Dure) ■ Boreholes (e.g. Daad Buuce) ■ Piped water from Tana River	n/a
	Saka	■ Tana River ■ Taps (paid) ■ Borehole	n/a
	Masalani	■ Water pans	n/a
	Dagoob	■ Earth dam and seasonal dams ■ River	River is seasonal

County	Community	Water Sources	Season
Lamu	Mokowe	■ Boreholes ■ Seasonal dams ■ Ponds	n/a
	Jipe	■ Boreholes ■ Wells and pipelines to elevated tanks (distribution line runs for 10 km from main tanks to consumers) ■ Water tracking system in Mkondoni, Sina Mbio, Bora Imani, Mokowe and Barigoni. Draw water at HIMWA in Hindi Station, water tanks	n/a
	Hindi	■ Seasonal dams used by pastoralists ■ Hindi Magogoni Water Association (HIMWA) where herders buy water for livestock in dry season ■ Piped water is available for the town and surrounding area ■ Kiosks (KSh 4 / 20 litres)	Rainy season (seasonal dams) Dry season (HIMWA)

n/a = data not available

1.7 Information Limitations

The limitations of the available primary water data are as follows

- The field data coverage from the ongoing site investigation works along the LLCOP route is incomplete at this stage. Borehole data are only available in the Lamu Marine Terminal area and selected river crossing locations;
- Only TDS groundwater quality data is available from the ongoing site investigation works along the LLCOP route;
- The groundwater level data collected during the ongoing site investigation works along the LLCOP route predominantly includes groundwater strikes (single date logged strikes only) and there is little longer-term monitoring data that could provide information on seasonal changes;
- The surface water flow and quality data collected at the main river crossing locations is limited to a single data and there is no longer-term monitoring data that could provide information on seasonal changes; and
- The grid reference locations of wells/boreholes and water sources used by the local pullulation are typically unknown.

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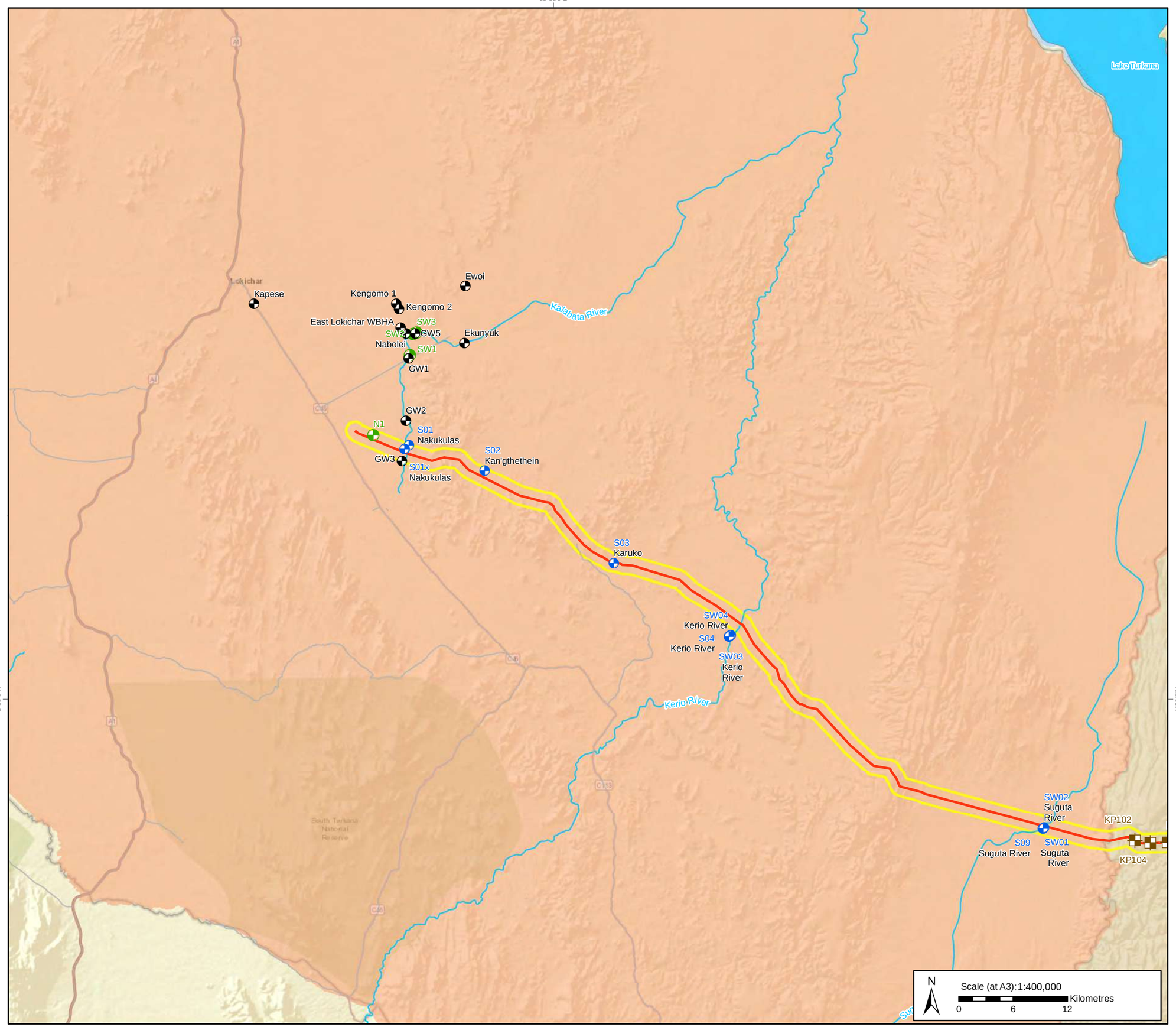
DRAWINGS

Groundwater and surface water monitoring locations

Drawing 1a
Groundwater and Surface Water Monitoring Locations

Mid-Stream Development

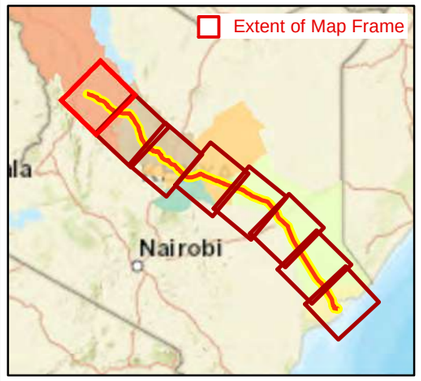


Key

- LLCOP Surface Water Monitoring Location
- EOPS Groundwater Monitoring Location
- EOPS Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse
- Waterbody

Counties

- Turkana
- Samburu



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 20-02-2019	LD 20-02-2019	TM 20-02-2019

GOLDER

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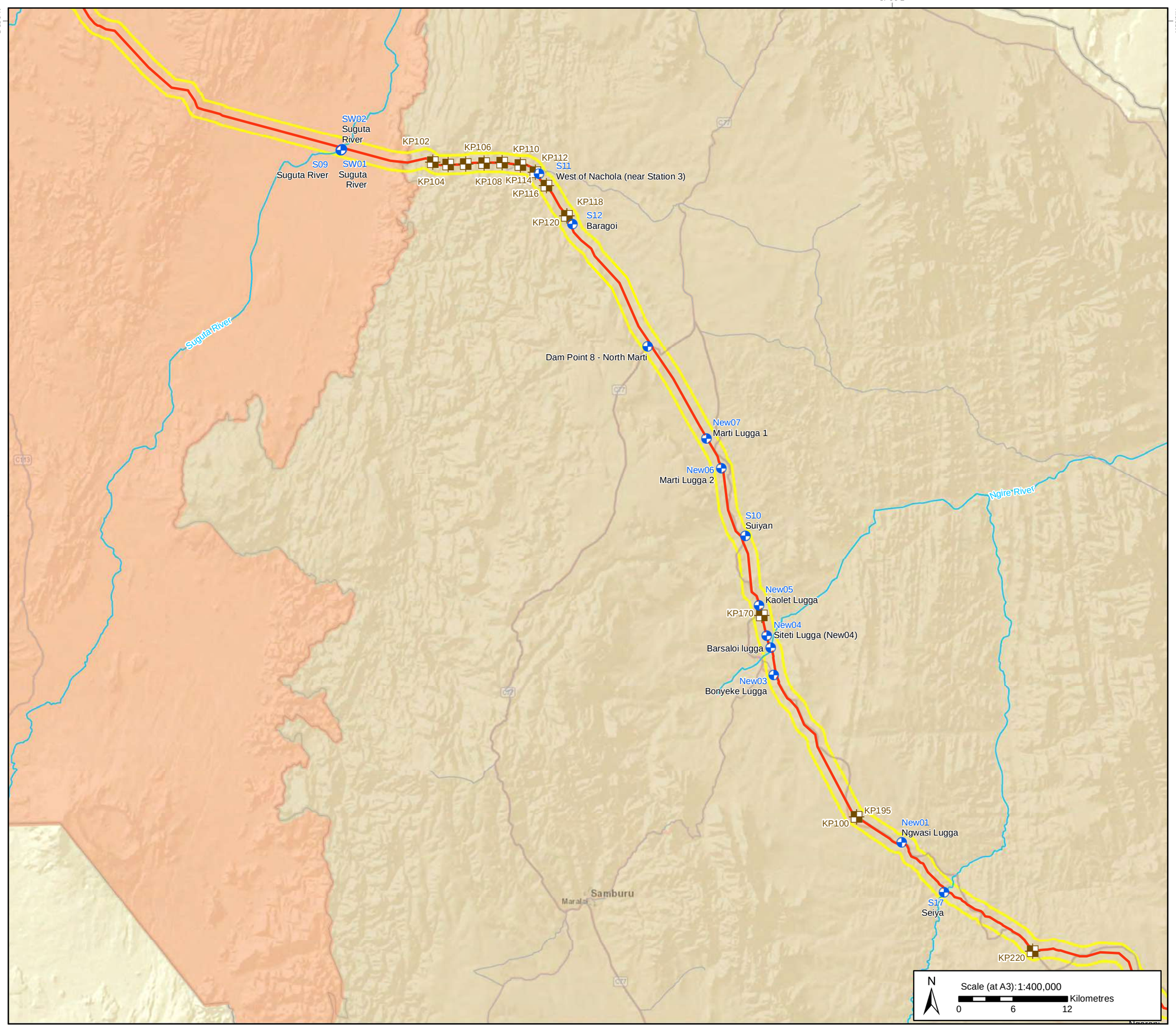
Drawing 1b
Groundwater and Surface Water Monitoring Locations

Mid-Stream Development

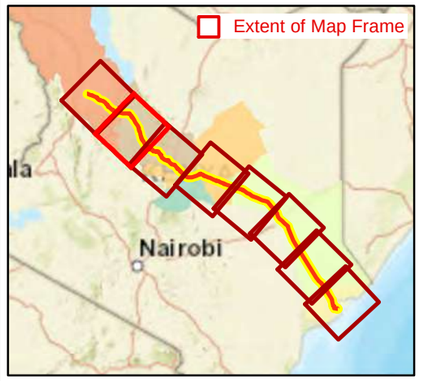


Key

- LLCOP Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Turkana
- Samburu



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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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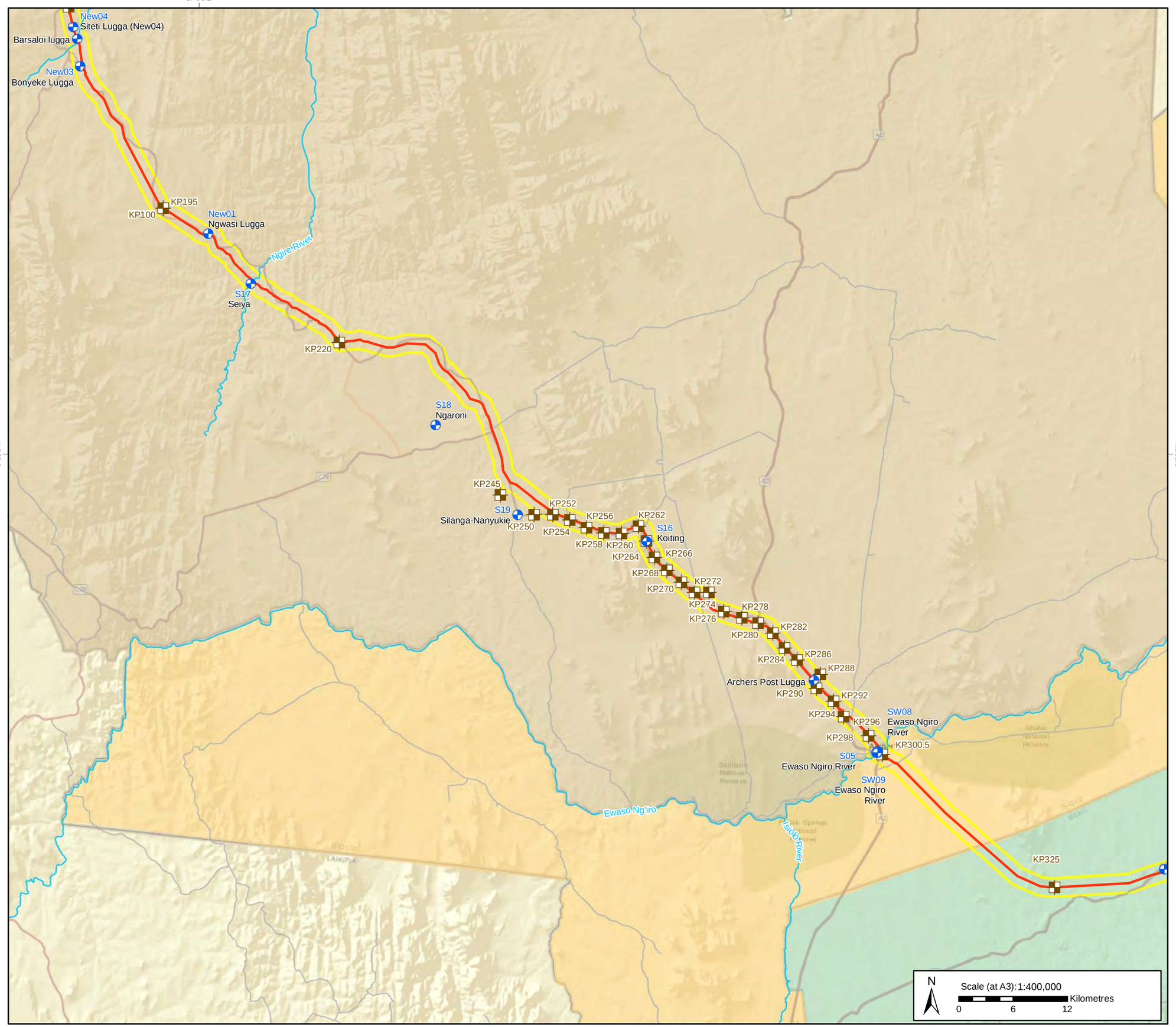
Drawing 1c Groundwater and Surface Water Monitoring Locations

Mid-Stream Development

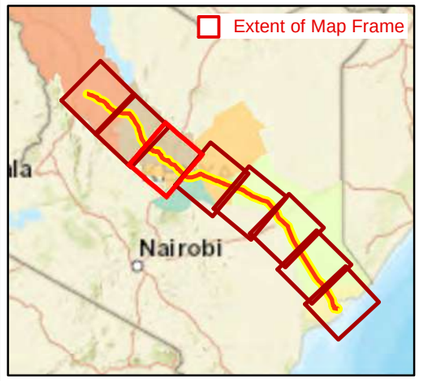


Key

- LLCOP Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru



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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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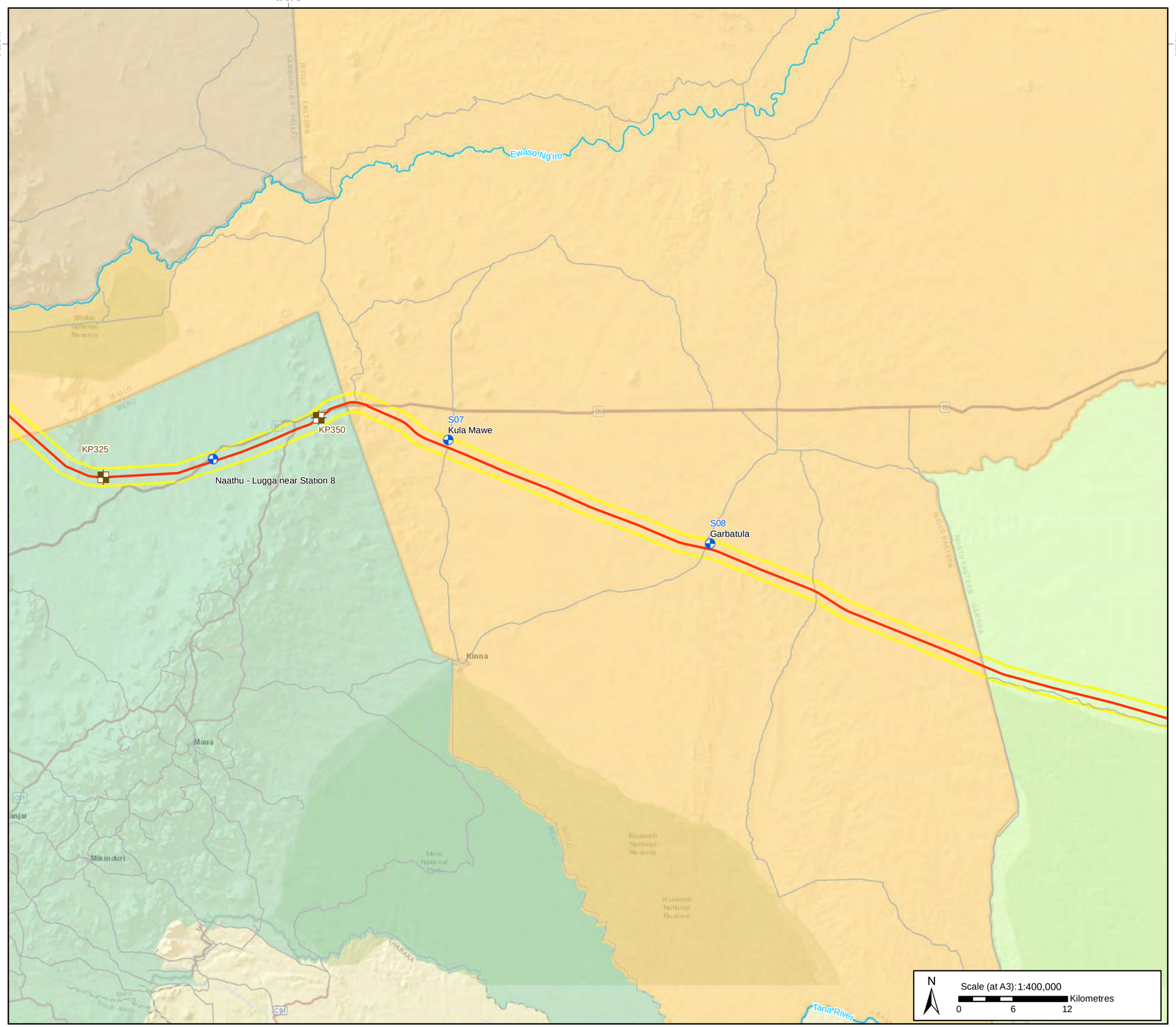
Drawing 1d Groundwater and Surface Water Monitoring Locations

Mid-Stream Development

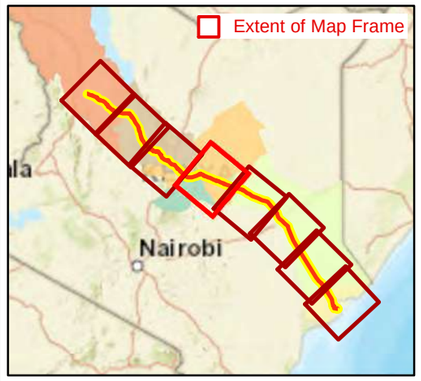


Key

- LLCOP Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru
- Garissa



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39°4'0"E

0°6'0"S

S22
Rahole

S26
Shimbir

S20
Sankuri

S21
Sankuri

Tana River

Garissa

N

Scale (at A3): 1:400,000

0 6 12 Kilometres

Drawing 1e Groundwater and Surface Water Monitoring Locations

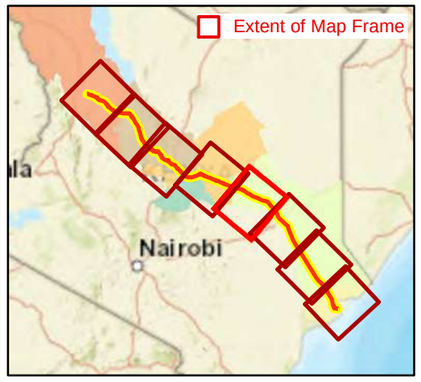
Mid-Stream Development

Key

- LLCOP Surface Water Monitoring Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Isiolo
- Garissa



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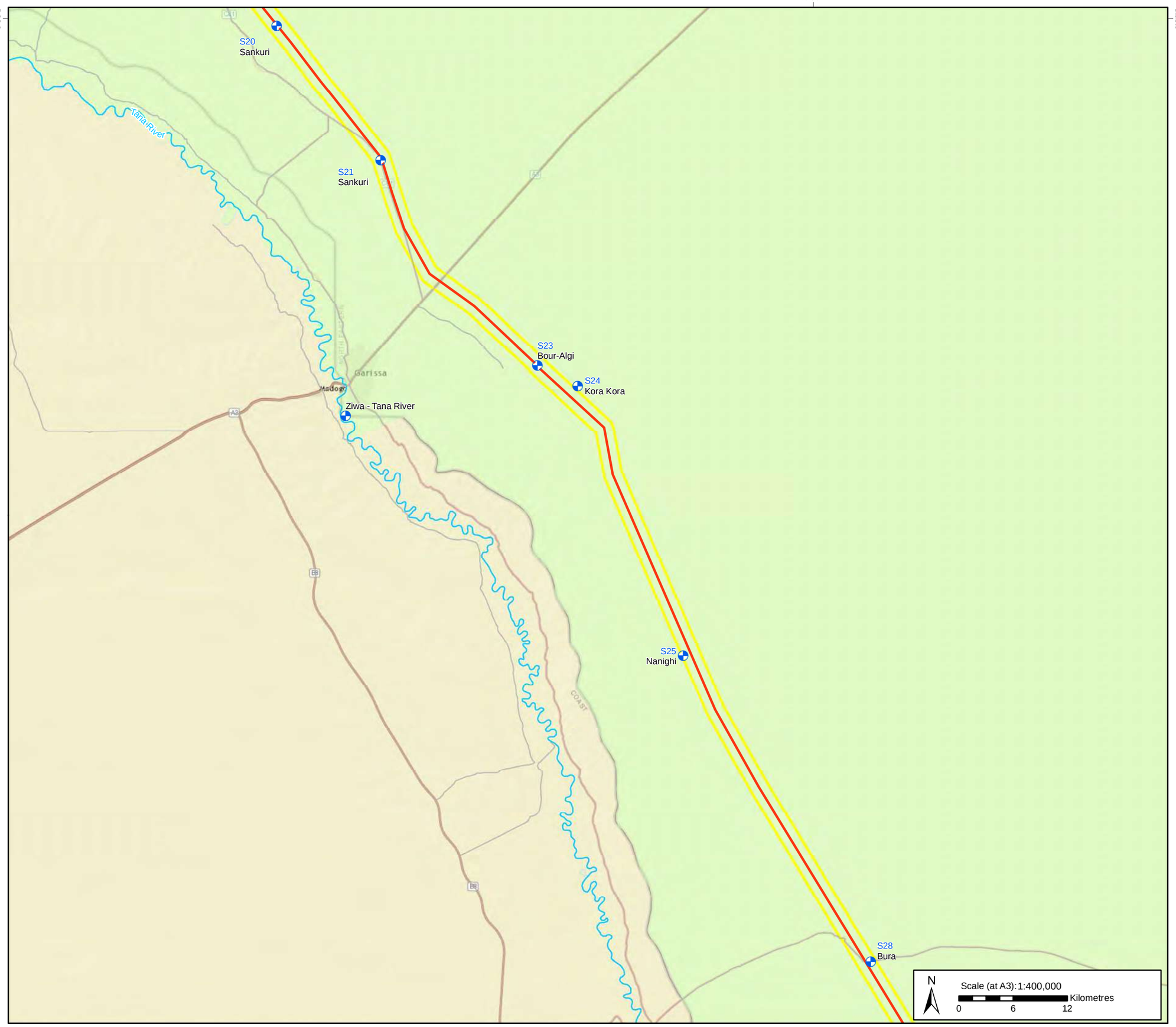


Drawing 1f Groundwater and Surface Water Monitoring Locations

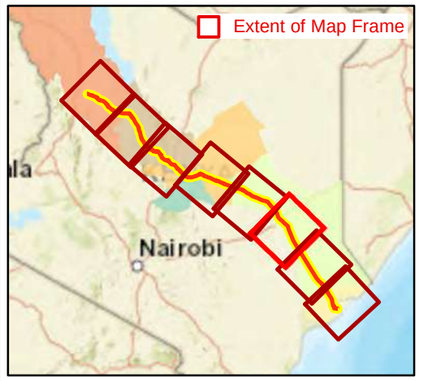
Mid-Stream Development

Key

- LLCOP Surface Water Monitoring Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Garissa



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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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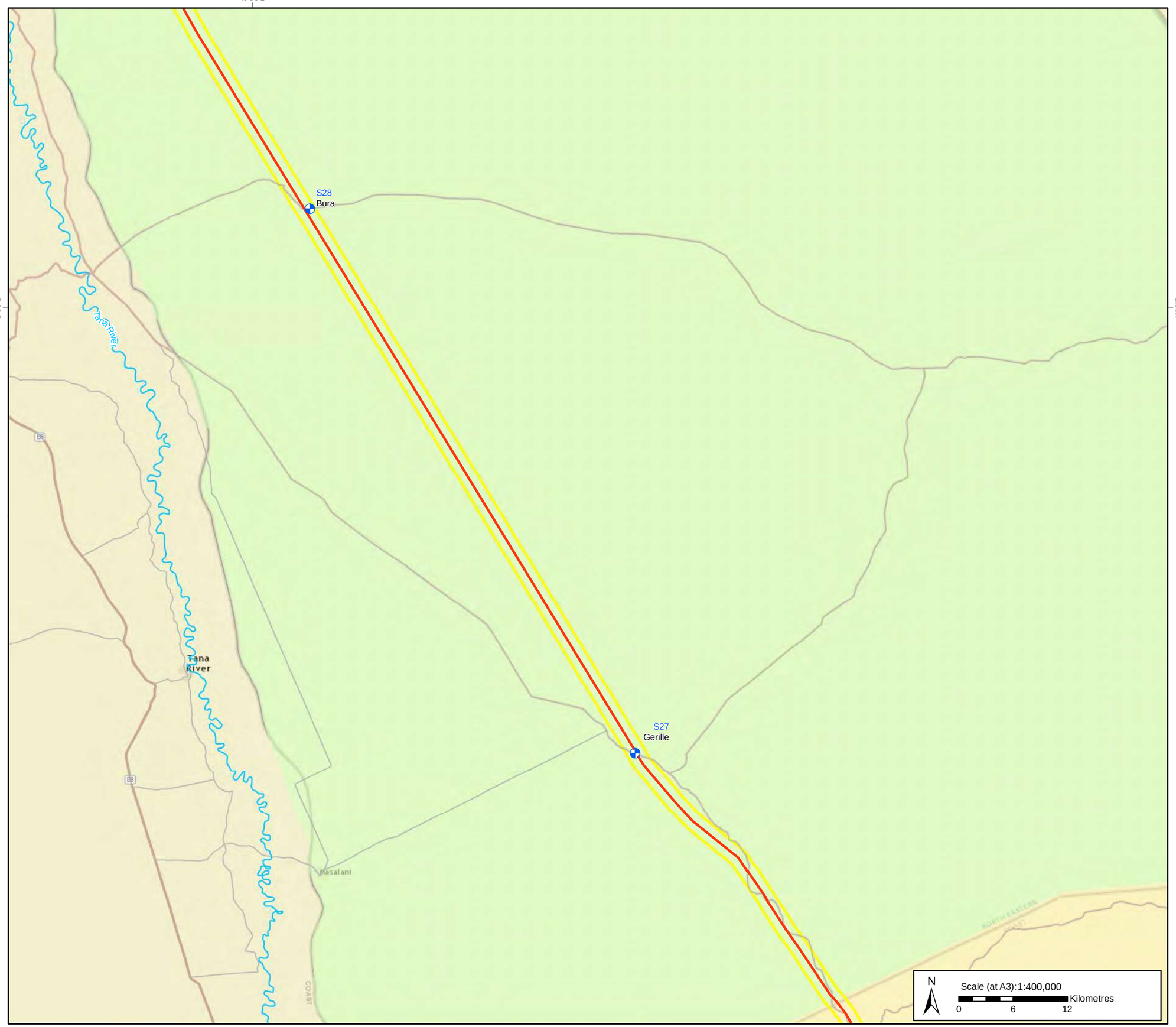


Drawing 1g Groundwater and Surface Water Monitoring Locations

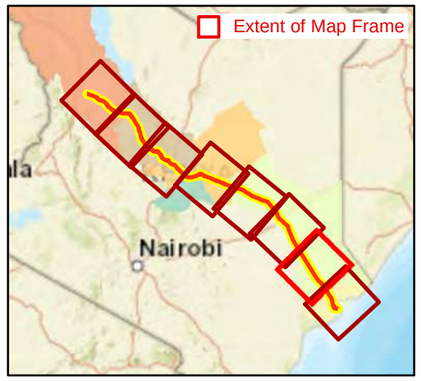
Mid-Stream Development

Key

- LLCOP Surface Water Monitoring Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Garissa
- Lamu



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41°8'0"E

2°10'0"S

S30
Bargoni

S31
Mradeni - Dipu Dam, Lamu

S32
Port area

S29
Mokowe

Hindi

Mkunumbi

Indian Ocean

Tana River

Kipini

LMT-E

LMT-A LMT-I

LMT-B

LMT-F

LMT-G

LMT-H

LMT-J

N

Scale (at A3):1:400,000

0 6 12 Kilometres

Drawing 1h Groundwater and Surface Water Monitoring Locations

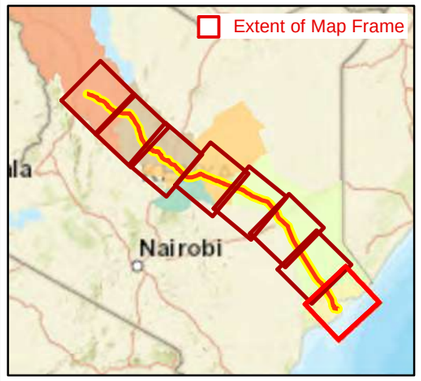
Mid-Stream Development

Key

- LLCOP Surface Water Monitoring Location
- LLCOP Borehole Location
- Proposed Pipeline Route
- Study Area
- Road
- Watercourse

Counties

- Garissa
- Lamu



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Coordinate System: GCS WGS 1984 (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 20-02-2019	LD 20-02-2019	TM 20-02-2019

GOLDER

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APPENDIX A

Early Oil Pilot Scheme - Water Monitoring Data

Parameter	Units	Requested Detection Limit	Water Quality Standard		29/05/2016 SW1	28/05/2016 SW3
Major Ions						
Calcium	mg/l	0.2	150		77.74	35.3
Magnesium	mg/l	0.1	100		10.15	4.41
Potassium	mg/l	0.1	50		8.41	6.12
Sodium	mg/l	0.1	200		22.69	20.09
Fluoride	mg/l	0.3	1.5		**1.65**	1.24
Sulphate	mg/l	0.05	400		28.54	34.46
Chloride	mg/l	0.3	250		108.72	64.86
Alkalinity (HCO3)	mg/l	1	No project standard			
Nutrients						
Ortho Phosphate as PO4	mg/l	0.03	2.2		1.86	1.89
Nitrate as N03	mg/l	0.2	10		2.54	4.18
Nitrite	mg/l	0.02	0.9		<	<
Ammonia as NH3	mg/l	0.07	0.5		**1.16**	**1.78**
Physico-chemical						
Total Alkalinity as CaCO3	mg/l	1	No project standard		140	35
Electrical Conductivity	mS/cm	2	2.5		0.655	0.348
pH (lab)	pH units	0.01	8.5	6.5	6.85	7.56
Redox (Eh)	mV	not specified	No project standard			
Temperature	°C	0.5	No project standard		25	24.8
Dissolved Oxygen	mg/l	1	No project standard		7.71	6.8
TDS	mg/l	35	1500		429.16	226.2
TSS	mg/l	10	0		**4**	**345**
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		235.9	106.3
Silica	mg/l	0.01	No project standard		10.87	8.52
Organics and Oils						
TPH CWG - Aliphatics						
>C5-C6 #	mg/l	0.005	No project standard			
>C8-C10 #	mg/l	0.005	No project standard			
>C6-C8 #	mg/l	0.005	No project standard			
>C10-C12#	mg/l	0.005	No project standard			
>C12-C16#	mg/l	0.01	No project standard			
>C16-C21#	mg/l	0.01	No project standard			
>C21-C35#	mg/l	0.01	No project standard			
Total aliphatics C5-35	mg/l	0.01	No project standard			
TPH CWG - Aromatics						
>C5-EC7 #	mg/l	0.005	No project standard			
>EC7-EC8 #	mg/l	0.005	No project standard			
>EC8-EC10 #	mg/l	0.005	No project standard			
>EC10-EC12#	mg/l	0.005	No project standard			
>EC12-EC16#	mg/l	0.01	No project standard			
>EC16-EC21#	mg/l	0.01	No project standard			
>EC21-EC35#	mg/l	0.01	No project standard			
Total aromatics C5-35	mg/l	0.01	No project standard			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard			
Benzene	mg/l	0.0005	0.01		<0.01	<0.01
Toluene	mg/l	0.0005	0.7		<0.01	<0.01
Ethylbenzene	mg/l	0.0005	0.3		<0.01	<0.01
m/p-Xylene	mg/l	0.001	No project standard			
o-Xylene	mg/l	0.001	No project standard			
Polyaromatic Hydrocarbons						
Naphthalene	mg/l	0.00001	No project standard		<0.01	4
Acenaphthylene	mg/l	0.00001	No project standard		<0.01	<0.01
Acenaphthene	mg/l	0.00001	No project standard		<0.01	<0.01
Fluorene	mg/l	0.00001	No project standard		<0.01	<0.01
Phenanthrene	mg/l	0.00001	No project standard		<0.01	<0.01
Anthracene	mg/l	0.00001	No project standard		<0.01	<0.01
Fluoranthene	mg/l	0.00001	No project standard		<0.01	<0.01
Pyrene	mg/l	0.00001	No project standard		0.03	<0.01
Benzo(a)anthracene	mg/l	0.00001	No project standard		<0.01	<0.01
Chrysene	mg/l	0.00001	No project standard		<0.01	<0.01
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard		<0.01	<0.02
Benzo(a)pyrene	mg/l	0.00001	0.0007		<0.01	<0.01
Indeno(123cd)pyrene	mg/l	0.00001	No project standard		<0.01	<0.01
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard		<0.01	<0.01
Benzo(ghi)perylene	mg/l	0.00001	No project standard		<0.01	<0.01
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007		**0.03**	**4**
Inorganics and Trace Metals						
Aluminium	mg/l	0.2	0.2		<0.04	<0.04
Arsenic	mg/l	0.0009	0.01		<	<
Barium	mg/l	0.003	0.7		0.07	0.02
Beryllium	mg/l	0.005	No project standard		<0.003	<0.003
Boron	mg/l	0.002	2.4		0.1	0.08
Cadmium	mg/l	0.00003	0.003		<	<
Chromium	mg/l	0.0002	0.05		<0.007	<0.007
Copper	mg/l	0.003	0.05		<0.006	<0.006
Iron (Ferrous)	mg/l	0.00002	No project standard			
Iron (Feric)	mg/l	0.00002	No project standard			
Iron (total)	mg/l		0.3		<0.007	<0.007
Lead	mg/l	0.0004	0.01		<	<
Manganese	mg/l	0.00002	0.1		<0.002	0.01
Mercury	mg/l	0.0005	0.001		<	<
Nickel	mg/l	0.0002	0.02		<0.015	<0.015
Selenium	mg/l	0.0012	0.01		<0.01	<0.01
Vanadium	mg/l	0.0006	No project standard		0.01	0.01
Zinc	mg/l	0.0015	1.5		0.02	<0.002
Strontium	mg/l	0.005	No project standard		0.9	0.36
Sanitary						
BOD	mg/l	1	No project standard		36.54	54.98
COD	mg/l	7	No project standard		64.78	109.76
Total nitrogen	mg/l	0.5	No project standard		2.86	3.68
Total phosphorous	mg/l	0.5	No project standard		0.01	0.08
Total coliform bacteria	MPN/100ml	not specified	0		**>1800**	**>1800**
Fecal coliforms	MPN/100ml	not specified	No project standard		>1800	>1800

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Water Quality Standard		11/08/2014	26/07/2015	21/09/2015	02/11/2015	26/11/2015	27/11/2015	30/12/2015	08/04/2016	28/05/2016	15/06/2016	29/08/2016	30/08/2016	31/10/2016	Number of Analyses	Number of Analyses with Numerical Result	Result		
					East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	East Lokichar C	GW1	East Lokichar C	East Lokichar C	GW1	East Lokichar C	GW1	East Lokichar C	East Lokichar C			Min	Mean	Max
Major Ions																						
Calcium	mg/l	0.2	150		16.9	20.14	18.95	14.12	17.7	10.32	6.53	2.58	28.05	7.66	20.41	8.29	1.58	13	13	1.58	13.33	28.05
Magnesium	mg/l	0.1	100		10.9	11.82	11.26	9.38	11.02	7.52	8.15	2.58	11.49	1.6	11.02	11.64	2.43	13	13	1.6	8.52	11.82
Potassium	mg/l	0.1	50		3.2	3.63	3.88	3.48	3.65	2.16	2.56	2.35	4.93	7.03	3.82	4.21	3.06	13	13	2.16	3.69	7.03
Sodium	mg/l	0.1	200		128	125.94	109.23	121.57	116.47	**265.72**	**315.62**	**328**	146.42	6.42	132.68	**339**	25.17	13	13	6.42	166.17	339
Fluoride	mg/l	0.3	1.5			1.08	0.79	0.66	1.2	0.54	1.3	1.4	0.76	1.07	**1.71**	<	<	12	10	0.54	1.05	1.71
Sulphate	mg/l	0.05	400		17	19.14	19.1	18	16.05	11.87	21.8	15.89	17.86	7.28	21.33	23.5	3.23	13	13	3.23	16.31	23.5
Chloride	mg/l	0.3	250		34	38	33.75	34.32	41.49	**>30**	26.59	87.5	243.65	55.3	29.01	50.14	35.39	13	12	26.59	59.10	243.65
Alkalinity (HCO3)	mg/l	1	No project standard															0	0			
Nutrients																						
Ortho Phosphate as PO4	mg/l	0.03	2.2							0.01			0.75		0.87			3	3	0.01	0.54	0.87
Nitrate as N03	mg/l	0.2	10		**28**	**22.6**	2.51	**59.5**	**17.5**	1.2	**18**	2.9	4.07	2.94	2.13	**43.75**	**31.47**	13	13	1.2	18.20	59.5
Nitrite	mg/l	0.02	0.9			<	<	**3**	<	<	<	<0.001	<	<0.001	0.05	<0.001	<0.01	12	2	0.05	1.53	3
Ammonia as NH3	mg/l	0.07	0.5							0.41			**3.45**		0.03			3	3	0.03	1.30	3.45
Physico-chemical																						
Total Alkalinity as CaCO3	mg/l	1	No project standard			290	290	244	270	250	550	172	80	211	100	516	148.68	12	12	80	260.14	550
Electrical Conductivity	mS/cm	2	2.5			0.72	0.749	0.666	0.657	0.814	1.086	0.7	1.061	0.77	0.831	0.7	0.7	12	12	0.657	0.79	1.086
pH (lab)	pH units	0.01	8.5	6.5	8.3	7.71	7.75	7.56	7.57	8.39	7.89	8.49	7.84	7.72	7.73	8.02	7.77	13	13	7.56	7.90	8.49
Redox (Eh)	mV	not specified	No project standard															0	0			
Temperature	^{o}C	0.5	No project standard							26.4			25.1		23.7			3	3	23.7	25.07	26.4
Dissolved Oxygen	mg/l	1	No project standard							3.14			7.06		7.8			3	3	3.14	6.00	7.8
TDS	mg/l	35	1500		595	468	486.85	432.9	427	569.8	705.9	350	690.08	386	540	350	350	13	13	350	488.58	705.9
TSS	mg/l	10	0							**2**			**2**		**3**			3	3	2	2.33	3
Total Hardness Dissolved (as CaCO3)	mg/l	1	600			98.98		73.87	89.58	56.73	49.85	15.98	117.34	26	96.36	68	13.95	11	11	13.95	64.24	117.34
Silica	mg/l	0.01	No project standard		26	15.71	15.19	20.21	2.15	2.24	3.02	<0.001	24.85	<0.001	2.33	<0.001		12	9	2.15	12.41	26
Organics and Oils																						
TPH CWG - Aliphatics																						
>C5-C6 #	mg/l	0.005	No project standard															0	0			
>C8-C10 #	mg/l	0.005	No project standard															0	0			
>C6-C8 #	mg/l	0.005	No project standard															0	0			
>C10-C12#	mg/l	0.005	No project standard															0	0			
>C12-C16#	mg/l	0.01	No project standard															0	0			
>C16-C21#	mg/l	0.01	No project standard															0	0			
>C21-C35#	mg/l	0.01	No project standard															0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard															0	0			
TPH CWG - Aromatics																						
>C5-EC7 #	mg/l	0.005	No project standard															0	0			
>EC7-EC8 #	mg/l	0.005	No project standard															0	0			
>EC8-EC10 #	mg/l	0.005	No project standard															0	0			
>EC10-EC12#	mg/l	0.005	No project standard															0	0			
>EC12-EC16#	mg/l	0.01	No project standard															0	0			
>EC16-EC21#	mg/l	0.01	No project standard															0	0			
>EC21-EC35#	mg/l	0.01	No project standard															0	0			
Total aromatics C5-35	mg/l	0.01	No project standard															0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard							<0.01					0.67			2	1	0.67	0.67	0.67
Benzene	mg/l	0.0005	0.01							<0.01			<0.01		**0.02**			3	1	0.02	0.02	0.02
Toluene	mg/l	0.0005	0.7							<0.01			<0.01		0.03			3	1	0.03	0.03	0.03
Ethylbenzene	mg/l	0.0005	0.3							<0.01			<0.01		<0.01			3	0			
Xylene (total)	mg/l		0.5							<0.01								1	0			
m/p-Xylene	mg/l	not analysed	No project standard															0	0			
o-Xylene	mg/l	not analysed	No project standard															0	0			
Polyaromatic Hydrocarbons																						
Naphthalene	mg/l	0.00001	No project standard							<0.01			<0.01		0.01			3	1	0.01	0.01	0.01
Acenaphthylene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Acenaphthene	mg/l	0.00001	No project standard							<0.01			0.04		<0.01			3	1	0.04	0.04	0.04
Fluorene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Phenanthrene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Anthracene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Fluoranthene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Pyrene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Chrysene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.02			3	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007							<0.01			<0.01		<0.01			3	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007							0			**0.04**		**0.01**							
Inorganics and Trace Metals																						
Aluminium	mg/l	0.2	0.2		<0.3	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.001	<0.04	0.2	<0.04	<0.001	0.1	13	2	0.1	0.15	0.2
Arsenic	mg/l	0.0009	0.01			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Barium	mg/l	0.003	0.7		<0.1	<0.002	<0.002	<0.002	<0.002	0.01	<0.002	<0.001	0.01	<0.001	<0.002	<0.001	<0.01	13	2	0.01	0.01	0.01
Beryllium	mg/l	0.005	No project standard							<0.0003			<0.003		<0.003			3	0			
Boron	mg/l	0.002	2.4		<0.5	<0.005	0.06		0.08	<0.005	0.24	<0.001	0.09	<0.001	<0.005	<0.001	<0.01	12	4	0.06	0.12	0.24
Cadmium	mg/l	0.00003	0.003			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Chromium	mg/l	0.0002	0.05			<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.007	<0.001	<0.007	<0.001	<0.01	12	0			
Copper	mg/l	0.003	0.05		<0.2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	**0.26**	<0.006	**0.41**	<0.006	<0.001	<0.01	13	2	0.26	0.34	0.41
Iron (Ferrous)	mg/l	0.00002	No project standard															0	0			
Iron (Feric)	mg/l	0.00002	No project standard															0	0			
Iron (total)	mg/l		0.3		<0.1	<0.007	<0.007	0.02	<0.007	<0.007	<0.007	0.19	0.02	0.22	<0.007	0.01	0.08	13	6	0.01	0.09	0.22
Lead	mg/l	0.0004	0.01			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Manganese	mg/l	0.00002	0.1		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.14**	<0.002	**0.62**	<0.002	**0.15**	0.02	13	4	0.02	0.23	0.62
Mercury	mg/l	0.0005	0.001			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Nickel	mg/l	0.0002	0.02			<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.015	<0.001	<0.015	<0.001	<0.01	12	0			
Selenium	mg/l	0.0012	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01	12	0			
Vanadium	mg/l	0.0006	No project standard							0.04			0.02		0.03			3	3	0.02	0.03	0.04
Zinc	mg/l	0.0015	1.5		<0.05	<0.002	0.04	0.02	<0.002	<0.002	0.01	**1.58**	0.02	<0.001	0.01	<0.001	0.21	13	7	0.01	0.27	1.58
Strontium	mg/l	0.005	No project standard		0.3	0.35	0.34	0.26	<0.005	0.21	0.23	<0.001	0.35	<0.001	0.34	<0.001	<0.01	13	8	0.21	0.30	0.35
Sanitary																						
BOD	mg/l	1	No project standard							3.26			28.16		28.6			3	3	3.26	20.01	28.6
COD	mg/l	7	No project standard							8.76			49.76		54.61			3	3	8.76	37.71	54.61
Total nitrogen	mg/l	0.5	No project standard							0.22			3.07		1.23			3	3	0.22	1.51	3.07
Total phosphorous	mg/l	0.5	No project standard							0.01			0.03		<0.01			3	2	0.01	0.02	0.03
Total coliform bacteria	MPN/100ml	not specified	0							**33**			**1600**		**17**			3	3	17	550.00	1600
Fecal coliforms	MPN/100ml	not specified	No project standard							<			1600		7			3	2	7	803.50	1600

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Water Quality Standard		17/02/2015	26/07/2015	21/09/2015	27/10/2015	27/11/2015	27/11/2015	30/12/2015	Number of Analyses	Number of Analyses with Numerical Result	Result		
					Ngamia East	Ngamia East	Ngamia East	Ngamia East	Ngamia East	GW2	Ngamia East			Min	Mean	Max
Major Ions																
Calcium	mg/l	0.2	150		5.52	11.02	9.79	10.65	11.22	6.54	31.6	7	7	5.52	12.33	31.6
Magnesium	mg/l	0.1	100		6.14	8.17	7.79	8.46	8.3	7.8	17.33	7	7	6.14	9.14	17.33
Potassium	mg/l	0.1	50			2.08	2.3	2.2	2.18	2.59	1.55	6	6	1.55	2.15	2.59
Sodium	mg/l	0.1	200			**237.57**	**212.68**	**224.18**	**214.19**	**376.85**	65.15	6	6	65.15	221.77	376.85
Fluoride	mg/l	0.3	1.5		1.11	1.2	0.9	0.63	0.82	0.41	0.83	7	7	0.41	0.84	1.2
Sulphate	mg/l	0.05	400		44	37.46	38.3	30	34.57	8.43	5.4	7	7	5.4	28.31	44
Chloride	mg/l	0.3	250		102.73	66.5	72.32	56.58	67.89	**>30**	8.86	7	6	8.86	62.48	102.73
Alkalinity (HCO3)	mg/l	1	No project standard									0	0			
Nutrients																
Ortho Phosphate as PO4	mg/l	0.03	2.2							0.03		1	1	0.03	0.03	0.03
Nitrate as N03	mg/l	0.2	10			**12.2**	3.2	**47.7**	9.9	1.4	**12.9**	6	6	1.4	14.55	47.7
Nitrite	mg/l	0.02	0.9			<	<	<	<	0.08	<	6	1	0.08	0.08	0.08
Ammonia as NH3	mg/l	0.07	0.5							**0.96**		1	1	0.96	0.96	0.96
Physico-chemical																
Total Alkalinity as CaCO3	mg/l	1	No project standard			430	430	350	480	350	230	6	6	230	378.33	480
Electrical Conductivity	mS/cm	2	2.5			1.073	1.128	1.032	0.994	1.201	0.448	6	6	0.448	0.98	1.201
pH (lab)	pH units	0.01	8.5	6.5	7.76	7.91	7.87	7.74	7.81	**8.75**	7.84	7	7	7.74	7.95	8.75
Redox (Eh)	mV	not specified	No project standard									0	0			
Temperature	°C	0.5	No project standard							26.3		1	1	26.3	26.30	26.3
Dissolved Oxygen	mg/l	1	No project standard							2.45		1	1	2.45	2.45	2.45
TDS	mg/l	35	1500		852	697.45	733.2	670.8	646.1	840.7	291.2	7	7	291.2	675.92	852
TSS	mg/l	10	0							**2**		1	1	2	2.00	2
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		39.09	61.16		61.4	62.21	48.45	150.28	6	6	39.09	70.43	150.28
Silica	mg/l	0.01	No project standard			16.7	15.82	22.56	2.29	2.13	3.51	6	6	2.13	10.50	22.56
Organics and Oils																
TPH CWG - Aliphatics																
>C5-C6 #	mg/l	0.005	No project standard									0	0			
>C8-C10 #	mg/l	0.005	No project standard									0	0			
>C6-C8 #	mg/l	0.005	No project standard									0	0			
>C10-C12#	mg/l	0.005	No project standard									0	0			
>C12-C16#	mg/l	0.01	No project standard									0	0			
>C16-C21#	mg/l	0.01	No project standard									0	0			
>C21-C35#	mg/l	0.01	No project standard									0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard									0	0			
TPH CWG - Aromatics																
>C5-EC7 #	mg/l	0.005	No project standard									0	0			
>EC7-EC8 #	mg/l	0.005	No project standard									0	0			
>EC8-EC10#	mg/l	0.005	No project standard									0	0			
>EC10-EC12#	mg/l	0.005	No project standard									0	0			
>EC12-EC16#	mg/l	0.01	No project standard									0	0			
>EC16-EC21#	mg/l	0.01	No project standard									0	0			
>EC21-EC35#	mg/l	0.01	No project standard									0	0			
Total aromatics C5-35	mg/l	0.01	No project standard									0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard							<0.01		1	0			
Benzene	mg/l	0.0005	0.01							<0.01		1	0			
Toluene	mg/l	0.0005	0.7							<0.01		1	0			
Ethylbenzene	mg/l	0.0005	0.3							<0.01		1	0			
Xylene (total)	mg/l		0.5							<0.01		1	0			
m/p-Xylene	mg/l	not analysed	No project standard									0	0			
o-Xylene	mg/l	not analysed	No project standard									0	0			
Polyaromatic Hydrocarbons																
Naphthalene	mg/l	0.00001	No project standard							<0.01		1	0			
Acenaphthylene	mg/l	0.00001	No project standard							<0.01		1	0			
Acenaphthene	mg/l	0.00001	No project standard							<0.01		1	0			
Fluorene	mg/l	0.00001	No project standard							<0.01		1	0			
Phenanthrene	mg/l	0.00001	No project standard							<0.01		1	0			
Anthracene	mg/l	0.00001	No project standard							<0.01		1	0			
Fluoranthene	mg/l	0.00001	No project standard							<0.01		1	0			
Pyrene	mg/l	0.00001	No project standard							<0.01		1	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard							<0.01		1	0			
Chrysene	mg/l	0.00001	No project standard							<0.01		1	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard							<0.01		1	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007							<0.01		1	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard							<0.01		1	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard							<0.01		1	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard							<0.01		1	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007							0			0		0	
Inorganics and Trace Metals																
Aluminium	mg/l	0.2	0.2			<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	6	0			
Arsenic	mg/l	0.0009	0.01			<	<	<	<	<	<	6	0			
Barium	mg/l	0.003	0.7		0.02	<0.002	<0.002	<0.002	<0.002	0.01	<0.002	7	2	0.01	0.02	0.02
Beryllium	mg/l	0.005	No project standard							<0.0003		1	0			
Boron	mg/l	0.002	2.4			<0.005	0.1		0.1	<0.005	0.16	5	3	0.1	0.12	0.16
Cadmium	mg/l	0.00003	0.003			<	<	<	<	<	<	6	0			
Chromium	mg/l	0.0002	0.05			<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	6	0			
Copper	mg/l	0.003	0.05			<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	6	0			
Iron (Ferrous)	mg/l	0.00002	No project standard									0	0			
Iron (Feric)	mg/l	0.00002	No project standard									0	0			
Iron (total)	mg/l		0.3		0.007	<0.007	0.05	0.01	<0.007	<0.007	<0.007	7	3	0.007	0.02	0.05
Lead	mg/l	0.0004	0.01			<	<	<	<	<	<	6	0			
Manganese	mg/l	0.00002	0.1		0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	7	1	0.002	0.00	0.002
Mercury	mg/l	0.0005	0.001			<	<	<	<	<	<	6	0			
Nickel	mg/l	0.0002	0.02			<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	6	0			
Selenium	mg/l	0.0012	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6	0			
Vanadium	mg/l	0.0006	No project standard							0.05		1	1	0.05	0.05	0.05
Zinc	mg/l	0.0015	1.5		0.01	<0.002	0.03	<0.002	0.01	<0.002	0.01	7	4	0.01	0.02	0.03
Strontium	mg/l	0.005	No project standard			0.23	0.21	0.22	<0.005	0.24	0.46	6	5	0.21	0.27	0.46
Sanitary																
BOD	mg/l	1	No project standard							4.56		1	1	4.56	4.56	4.56
COD	mg/l	7	No project standard							10.23		1	1	10.23	10.23	10.23
Total nitrogen	mg/l	0.5	No project standard							0.18		1	1	0.18	0.18	0.18
Total phosphorous	mg/l	0.5	No project standard							0.03		1	1	0.03	0.03	0.03
Total coliform bacteria	MPN/100ml	not specified	0							**14**		1	1	14	14.00	14
Fecal coliforms	MPN/100ml	not specified	No project standard							<		1	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Water Quality Standard		11/08/2014	26/07/2015	21/09/2015	02/11/2015	27/11/2015	27/11/2015	30/12/2015	08/04/2016	29/05/2016	15/06/2016	29/08/2016	30/08/2016	31/10/2016	Number of Analyses	Number of Analyses with Numerical Result	Result		
					Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	Nakukulas 9	GW3	Nakukulas 9	Nakukulas 9	GW3	Nakukulas 9	GW3	Nakukulas 9	Nakukulas 9			Min	Mean	Max
Major Ions																						
Calcium	mg/l	0.2	150		7.7	6.3	6.21	6.29	6.58	49.86	20.62	14.85	11.77	6.83	6.9	<0.001	0.62	13	12	0.62	12.04	49.86
Magnesium	mg/l	0.1	100		8.5	7.91	8.25	8.32	8.42	17.49	11.15	2.85	7.9	1.19	7.77	4.69	0.09	13	13	0.09	7.27	17.49
Potassium	mg/l	0.1	50		<2	2.23	2.52	2.57	2.51	5.49	3.85	2.98	3.39	4.76	2.43	0.69	1.37	13	12	0.69	2.90	5.49
Sodium	mg/l	0.1	200		**321**	**318.9**	**291.13**	**324.84**	**297.83**	74.76	126.16	**619**	**347.19**	5.64	**327.06**	**553**	148.56	13	13	5.64	288.85	619
Fluoride	mg/l	0.3	1.5			1.5	1.1	0.68	1.5	0.54	1.1	1.5	0.68	**1.73**	**1.72**	0.82	0.05	12	12	0.05	1.08	1.73
Sulphate	mg/l	0.05	400		24	25.31	26.1	21	23.67	8.94	16.3	10.57	52.06	2.82	21.57	2.2	27.71	13	13	2.2	20.17	52.06
Chloride	mg/l	0.3	250		30	47.5	33.74	30.18	42.43	**>30**	33.68	87.9	**536.86**	40.55	38.37	42.77	39.82	13	12	30	83.65	536.86
Alkalinity (HCO3)	mg/l	1	No project standard															0	0			
Nutrients																						
Ortho Phosphate as PO4	mg/l	0.03	2.2							0.02			0.54		0.65			3	3	0.02	0.40	0.65
Nitrate as N03	mg/l	0.2	10		**22**	**17**	4.1	**82.3**	**20.6**	3.1	**20.5**	**10.5**	3.65	1.62	3.22	**12**	**16.56**	13	13	1.62	16.70	82.3
Nitrite	mg/l	0.02	0.9			<	<	<	<	<	<	<0.001	<	<0.001	0.03	<0.001	<0.01	12	1	0.03	0.03	0.03
Ammonia as NH3	mg/l	0.07	0.5							**0.71**			**0.54**		0.02			3	3	0.02	0.42	0.71
Physico-chemical																						
Total Alkalinity as CaCO3	mg/l	1	No project standard			640	650	552	550	540	250	309	28	195	210	186	70	12	12	28	348.33	650
Electrical Conductivity	mS/cm	2	2.5			1.332	1.448	1.276	1.267	1.423	0.591	1.27	1.913	1.28	1.436	1.28	1.26	12	12	0.591	1.31	1.913
pH (lab)	pH units	0.01	8.5	6.5	8.5	7.96	7.53	7.65	7.88	**8.84**	7.74	8.39	7.24	8	7.87	7.9	8.01	13	13	7.24	7.96	8.84
Redox (Eh)	mV	not specified	No project standard															0	0			
Temperature	°C	0.5	No project standard							26.1			25.5		23.2			3	3	23.2	24.93	26.1
Dissolved Oxygen	mg/l	1	No project standard							4.81			7.54		6.4			3	3	4.81	6.25	7.54
TDS	mg/l	35	1500		1246	865.8	941.2	829.4	823.55	996.1	384.15	635	1245.26	640	399.4	640	630	13	13	384.15	790.45	1246
TSS	mg/l	10	0							**2**			**2**		**2**			3	3	2	2.00	2
Total Hardness Dissolved (as CaCO3)	mg/l	1	600			48.29		49.99	51.1	196.53	97.42	47.9	61.9	22	49.25	19	1.91	11	11	1.91	58.66	196.53
Silica	mg/l	0.01	No project standard		25	15.48	15.12	21.48	2.15	2.53	2.99	<0.001	25.21	<0.001	2.33	<0.001		12	9	2.15	12.48	25.21
Organics and Oils																						
TPH CWG - Aliphatics																						
>C5-C6 #	mg/l	0.005	No project standard															0	0			
>C8-C10 #	mg/l	0.005	No project standard															0	0			
>C6-C8 #	mg/l	0.005	No project standard															0	0			
>C10-C12#	mg/l	0.005	No project standard															0	0			
>C12-C16#	mg/l	0.01	No project standard															0	0			
>C16-C21#	mg/l	0.01	No project standard															0	0			
>C21-C35#	mg/l	0.01	No project standard															0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard															0	0			
TPH CWG - Aromatics																						
>C5-EC7 #	mg/l	0.005	No project standard															0	0			
>EC7-EC8 #	mg/l	0.005	No project standard															0	0			
>EC8-EC10 #	mg/l	0.005	No project standard															0	0			
>EC10-EC12#	mg/l	0.005	No project standard															0	0			
>EC12-EC16#	mg/l	0.01	No project standard															0	0			
>EC16-EC21#	mg/l	0.01	No project standard															0	0			
>EC21-EC35#	mg/l	0.01	No project standard															0	0			
Total aromatics C5-35	mg/l	0.01	No project standard															0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard							<0.01					0.63			2	1	0.63	0.63	0.63
Benzene	mg/l	0.0005	0.01							<0.01			<0.01		**0.05**			3	1	0.05	0.05	0.05
Toluene	mg/l	0.0005	0.7							<0.01			<0.01		0.02			3	1	0.02	0.02	0.02
Ethylbenzene	mg/l	0.0005	0.3							<0.01			<0.01		<0.01			3	0			
Xylene (total)	mg/l		0.5							<0.01								1	0			
m/p-Xylene	mg/l	not analysed	No project standard															0	0			
o-Xylene	mg/l	not analysed	No project standard															0	0			
Polyaromatic Hydrocarbons																						
Naphthalene	mg/l	0.00001	No project standard							<0.01			0.04		0.01			3	2	0.01	0.03	0.04
Acenaphthylene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Acenaphthene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Fluorene	mg/l	0.00001	No project standard							<0.01			0.04		<0.01			3	1	0.04	0.04	0.04
Phenanthrene	mg/l	0.00001	No project standard							<0.01			0.03		<0.01			3	1	0.03	0.03	0.03
Anthracene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Fluoranthene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Pyrene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Chrysene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.02			3	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007							<0.01			<0.01		<0.01			3	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard							<0.01			<0.01		<0.01			3	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007							0			**0.11**		**0.01**							
Inorganics and Trace Metals																						
Aluminium	mg/l	0.2	0.2		<0.3	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.001	0.12	**0.28**	<0.04	<0.001	0.1	13	3	0.1	0.17	0.28
Arsenic	mg/l	0.0009	0.01			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Barium	mg/l	0.003	0.7		<0.1	<0.002	<0.002	<0.002	<0.002	0.04	<0.002	<0.001	<0.002	<0.001	<0.002	<0.001	<0.01	13	1	0.04	0.04	0.04
Beryllium	mg/l	0.005	No project standard							<0.0003			<0.003		<0.003			3	0			
Boron	mg/l	0.002	2.4		<0.5	<0.005	0.1		0.1	<0.005	0.2	<0.001	0.13	<0.001	<0.005	<0.001	<0.01	12	4	0.1	0.13	0.2
Cadmium	mg/l	0.00003	0.003			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Chromium	mg/l	0.0002	0.05			<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.007	<0.001	<0.007	<0.001	<0.01	12	0			
Copper	mg/l	0.003	0.05		<0.2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	**0.1**	<0.006	**0.27**	<0.006	<0.001	<0.01	13	2	0.1	0.19	0.27
Iron (Ferrous)	mg/l	0.00002	No project standard															0	0			
Iron (Feric)	mg/l	0.00002	No project standard															0	0			
Iron (total)	mg/l		0.3		<0.1	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.007	0.16	<0.007	**0.34**	0.12	13	3	0.12	0.21	0.34
Lead	mg/l	0.0004	0.01			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Manganese	mg/l	0.00002	0.1		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.022	<0.002	**0.44**	<0.002	**0.15**	0.02	13	4	0.02	0.16	0.44
Mercury	mg/l	0.0005	0.001			<	<	<	<	<	<	<0.001	<	<0.001	<	<0.001	<0.01	12	0			
Nickel	mg/l	0.0002	0.02			<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.015	<0.001	<0.015	<0.001	<0.01	12	0			
Selenium	mg/l	0.0012	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01	12	0			
Vanadium	mg/l	0.0006	No project standard							0.04			0.05		0.06			3	3	0.04	0.05	0.06
Zinc	mg/l	0.0015	1.5		<0.05	<0.002	<0.002	<0.002	<0.002	<0.002	0.03	0.04	<0.002	<0.001	<0.002	0.45	0.04	13	4	0.03	0.14	0.45
Strontium	mg/l	0.005	No project standard		0.2	0.24	0.24	0.23	<0.005	0.69	0.33	<0.001	0.21	<0.001	0.24	<0.001	<0.01	13	8	0.2	0.30	0.69
Sanitary																						
BOD	mg/l	1	No project standard							2.74			24.56		28.21			3	3	2.74	18.50	28.21
COD	mg/l	7	No project standard							7.42			48.07		57.23			3	3	7.42	37.57	57.23
Total nitrogen	mg/l	0.5	No project standard							0.21			4.69		1.61			3	3	0.21	2.17	4.69
Total phosphorous	mg/l	0.5	No project standard							0.02			<		<0.01			3	1	0.02	0.02	0.02
Total coliform bacteria	MPN/100ml	not specified	0							**70**			**1600**		**17**			3	3	17	562.33	1600
Fecal coliforms	MPN/100ml	not specified	No project standard							23			2		<			3	2	2	12.50	23

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Water Quality Standard		27/11/2015	29/05/2016	29/08/2016	Number of Analyses	Number of Analyses with Numerical Result	Result		
					GW5	GW5	GW5			Min	Mean	Max
Major Ions												
Calcium	mg/l	0.2	150		0.08	45.88	48.87	3	3	0.08	31.61	48.87
Magnesium	mg/l	0.1	100		<0.03	24.31	27.22	3	2	24.31	25.77	27.22
Potassium	mg/l	0.1	50		<0.01	1.88	0.77	3	2	0.77	1.33	1.88
Sodium	mg/l	0.1	200		2.48	122.3	110.55	3	3	2.48	78.44	122.3
Fluoride	mg/l	0.3	1.5		0.49	0.25	1.84	3	3	0.25	0.86	1.84
Sulphate	mg/l	0.05	400		0.09	34.85	39.07	3	3	0.09	24.67	39.07
Chloride	mg/l	0.3	250		>30	282.17	58.02	3	2	58.02	170.10	282.17
Alkalinity (HCO3)	mg/l	1	No project standard					0	0			
Nutrients												
Ortho Phosphate as PO4	mg/l	0.03	2.2		0.04	2.14	0.41	3	3	0.04	0.86	2.14
Nitrate as N03	mg/l	0.2	10		1	3.05	2.64	3	3	1	2.23	3.05
Nitrite	mg/l	0.02	0.9		<	<	0.04	3	1	0.04	0.04	0.04
Ammonia as NH3	mg/l	0.07	0.5		0.47	1.07	0.04	3	3	0.04	0.53	1.07
Physico-chemical												
Total Alkalinity as CaCO3	mg/l	1	No project standard		346	45	130	3	3	45	173.67	346
Electrical Conductivity	mS/cm	2	2.5		0.762	1.234	1.101	3	3	0.762	1.03	1.234
pH (lab)	pH units	0.01	8.5	6.5	8.83	7.16	7.55	3	3	7.16	7.85	8.83
Redox (Eh)	mV	not specified	No project standard					0	0			
Temperature	°C	0.5	No project standard		26.5	24.9	23.1	3	3	23.1	24.83	26.5
Dissolved Oxygen	mg/l	1	No project standard		4.12	6.44	8	3	3	4.12	6.19	8
TDS	mg/l	35	1500		533.4	800.75	715.65	3	3	533.4	683.27	800.75
TSS	mg/l	10	0		2	3	1	3	3	1	2.00	3
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		0.26	214.66	234.1	3	3	0.26	149.67	234.1
Silica	mg/l	0.01	No project standard		1.25	39.52	3.64	3	3	1.25	14.80	39.52
Organics and Oils												
TPH CWG - Aliphatics												
>C5-C6 #	mg/l	0.005	No project standard					0	0			
>C8-C10 #	mg/l	0.005	No project standard					0	0			
>C6-C8 #	mg/l	0.005	No project standard					0	0			
>C10-C12#	mg/l	0.005	No project standard					0	0			
>C12-C16#	mg/l	0.01	No project standard					0	0			
>C16-C21#	mg/l	0.01	No project standard					0	0			
>C21-C35#	mg/l	0.01	No project standard					0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard					0	0			
TPH CWG - Aromatics												
>C5-EC7 #	mg/l	0.005	No project standard					0	0			
>EC7-EC8 #	mg/l	0.005	No project standard					0	0			
>EC8-EC10 #	mg/l	0.005	No project standard					0	0			
>EC10-EC12#	mg/l	0.005	No project standard					0	0			
>EC12-EC16#	mg/l	0.01	No project standard					0	0			
>EC16-EC21#	mg/l	0.01	No project standard					0	0			
>EC21-EC35#	mg/l	0.01	No project standard					0	0			
Total aromatics C5-35	mg/l	0.01	No project standard					0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard		<0.01		0.61	2	1	0.61	0.61	0.61
Benzene	mg/l	0.0005	0.01		<0.01	<0.01	<0.01	3	0			
Toluene	mg/l	0.0005	0.7		<0.01	<0.01	0.03	3	1	0.03	0.03	0.03
Ethylbenzene	mg/l	0.0005	0.3		<0.01	<0.01	<0.01	3	0			
Xylene (total)	mg/l		0.5		<0.01			1	0			
m/p-Xylene	mg/l	not analysed	No project standard					0	0			
o-Xylene	mg/l	not analysed	No project standard					0	0			
Polyaromatic Hydrocarbons												
Naphthalene	mg/l	0.00001	No project standard		<0.01	<0.01	0.01	3	1	0.01	0.01	0.01
Acenaphthylene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Acenaphthene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Fluorene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Phenanthrene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Anthracene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Fluoranthene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Pyrene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Chrysene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard		<0.01	<0.02	<0.02	3	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007		<0.01	<0.01	<0.01	3	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard		<0.01	<0.01	<0.01	3	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007		0	0	0.01			0.01		0	0
Inorganics and Trace Metals												
Aluminium	mg/l	0.2	0.2		<0.04	0.08	<0.04	3	1	0.08	0.08	0.08
Arsenic	mg/l	0.0009	0.01		<	<	<	3	0			
Barium	mg/l	0.003	0.7		<0.002	0.01	<0.002	3	1	0.01	0.01	0.01
Beryllium	mg/l	0.005	No project standard		<0.0003	<0.003	<0.003	3	0			
Boron	mg/l	0.002	2.4		<0.005	0.09	<0.005	3	1	0.09	0.09	0.09
Cadmium	mg/l	0.00003	0.003		<	<	<	3	0			
Chromium	mg/l	0.0002	0.05		<0.007	<0.007	<0.007	3	0			
Copper	mg/l	0.003	0.05		<0.006	<0.006	<0.006	3	0			
Iron (Ferrous)	mg/l	0.00002	No project standard					0	0			
Iron (Feric)	mg/l	0.00002	No project standard					0	0			
Iron (total)	mg/l		0.3		<0.007	<0.007	0.03	3	1	0.03	0.03	0.03
Lead	mg/l	0.0004	0.01		<	<	<	3	0			
Manganese	mg/l	0.00002	0.1		<0.002	0.01	<0.002	3	1	0.01	0.01	0.01
Mercury	mg/l	0.0005	0.001		<	<	<	3	0			
Nickel	mg/l	0.0002	0.02		<0.015	<0.015	<0.015	3	0			
Selenium	mg/l	0.0012	0.01		<0.01	<0.01	<0.01	3	0			
Vanadium	mg/l	0.0006	No project standard		<0.008	0.07	0.07	3	2	0.07	0.07	0.07
Zinc	mg/l	0.0015	1.5		<0.002	<0.002	0.03	3	1	0.03	0.03	0.03
Strontium	mg/l	0.005	No project standard		<0.005	0.34	0.37	3	2	0.34	0.36	0.37
Sanitary												
BOD	mg/l	1	No project standard		2.58	22.46	27.9	3	3	2.58	17.65	27.9
COD	mg/l	7	No project standard		9.69	39.48	52.01	3	3	9.69	33.73	52.01
Total nitrogen	mg/l	0.5	No project standard		0.12	1.58	1.91	3	3	0.12	1.20	1.91
Total phosphorous	mg/l	0.5	No project standard		0.04	0.06	<0.01	3	2	0.04	0.05	0.06
Total coliform bacteria	MPN/100ml	not specified	0		110	1600	7	3	3	7	572.33	1600
Fecal coliforms	MPN/100ml	not specified	No project standard		<	<	<	3	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Parameter	Units	Requested Detection Limit	Water Quality Standard		09/08/2014	28/07/2015	21/09/2015	27/10/2015	27/11/2015	30/12/2015	31/10/2016	Number of Analyses	Number of Analyses with Numerical Result	Result		
					Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10	Nakukulas 10			Min	Mean	Max
Major Ions																
Calcium	mg/l	0.2	150		31.97	29.19	29.4	29.5	29.69	6.63	1.87	7	7	1.87	22.61	31.97
Magnesium	mg/l	0.1	100		16.5	17.17	16.77	16.76	17.25	4.91	0.21	7	7	0.21	12.80	17.25
Potassium	mg/l	0.1	50			1.95	1.57	1.59	1.62	1.16	1.54	6	6	1.16	1.57	1.95
Sodium	mg/l	0.1	200			81.7	104.41	60.23	62.13	129.65	71.74	6	6	60.23	84.98	129.65
Fluoride	mg/l	0.3	1.5		1.38	0.92	0.64	0.44	0.87	1	<	7	6	0.44	0.88	1.38
Sulphate	mg/l	0.05	400		5.4	7.41	6.8	3	5.35	18.9	7.15	7	7	3	7.72	18.9
Chloride	mg/l	0.3	250		9.15	19	9.64	11.32	9.43	26.59	11.79	7	7	9.15	13.85	26.59
Alkalinity (HCO3)	mg/l	1	No project standard									0	0			
Nutrients																
Ortho Phosphate as PO4	mg/l	0.03	2.2									0	0			
Nitrate as N03	mg/l	0.2	10			7.7	1.8	49.5	5.1	11.8	<0.01	6	5	1.8	15.18	49.5
Nitrite	mg/l	0.02	0.9			<	<	<	<	<	<0.01	6	0			
Ammonia as NH3	mg/l	0.07	0.5									0	0			
Physico-chemical																
Total Alkalinity as CaCO3	mg/l	1	No project standard			280	300	240	240	200	47.98	6	6	47.98	218.00	300
Electrical Conductivity	mS/cm	2	2.5			0.583	1.38	0.512	0.511	0.476	0.51	6	6	0.476	0.66	1.38
pH (lab)	pH units	0.01	8.5	6.5	7.95	7.82	7.66	7.55	7.63	7.83	7.65	7	7	7.55	7.73	7.95
Redox (Eh)	mV	not specified	No project standard									0	0			
Temperature	°C	0.5	No project standard									0	0			
Dissolved Oxygen	mg/l	1	No project standard									0	0			
TDS	mg/l	35	1500		320	378.95	427.7	332.8	332.15	309.4	255	7	7	255	336.57	427.7
TSS	mg/l	10	0									0	0			
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		147.78	143.59		142.69	145.17	36.74	5.55	6	6	5.55	103.59	147.78
Silica	mg/l	0.01	No project standard			18.29	17.43	24.09	2.51	2.1		5	5	2.1	12.88	24.09
Organics and Oils																
TPH CWG - Aliphatics																
>C5-C6 #	mg/l	0.005	No project standard									0	0			
>C8-C10 #	mg/l	0.005	No project standard									0	0			
>C6-C8 #	mg/l	0.005	No project standard									0	0			
>C10-C12#	mg/l	0.005	No project standard									0	0			
>C12-C16#	mg/l	0.01	No project standard									0	0			
>C16-C21#	mg/l	0.01	No project standard									0	0			
>C21-C35#	mg/l	0.01	No project standard									0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard									0	0			
TPH CWG - Aromatics																
>C5-EC7 #	mg/l	0.005	No project standard									0	0			
>EC7-EC8 #	mg/l	0.005	No project standard									0	0			
>EC8-EC10 #	mg/l	0.005	No project standard									0	0			
>EC10-EC12#	mg/l	0.005	No project standard									0	0			
>EC12-EC16#	mg/l	0.01	No project standard									0	0			
>EC16-EC21#	mg/l	0.01	No project standard									0	0			
>EC21-EC35#	mg/l	0.01	No project standard									0	0			
Total aromatics C5-35	mg/l	0.01	No project standard									0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard									0	0			
Benzene	mg/l	0.0005	0.01									0	0			
Toluene	mg/l	0.0005	0.7									0	0			
Ethylbenzene	mg/l	0.0005	0.3									0	0			
Xylene (total)	mg/l		0.5									0	0			
m/p-Xylene	mg/l	not analysed	No project standard									0	0			
o-Xylene	mg/l	not analysed	No project standard									0	0			
Polyaromatic Hydrocarbons																
Naphthalene	mg/l	0.00001	No project standard									0	0			
Acenaphthylene	mg/l	0.00001	No project standard									0	0			
Acenaphthene	mg/l	0.00001	No project standard									0	0			
Fluorene	mg/l	0.00001	No project standard									0	0			
Phenanthrene	mg/l	0.00001	No project standard									0	0			
Anthracene	mg/l	0.00001	No project standard									0	0			
Fluoranthene	mg/l	0.00001	No project standard									0	0			
Pyrene	mg/l	0.00001	No project standard									0	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard									0	0			
Chrysene	mg/l	0.00001	No project standard									0	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard									0	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007									0	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard									0	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard									0	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard									0	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007							0			0		0	
Inorganics and Trace Metals																
Aluminium	mg/l	0.2	0.2			<0.04	<0.04	<0.04	<0.04	<0.04	0.13	6	1	0.13	0.13	0.13
Arsenic	mg/l	0.0009	0.01			<	<	<	<	<	<0.01	6	0			
Barium	mg/l	0.003	0.7		0.06	<0.002	<0.002	<0.002	<0.002	<0.002	<0.01	7	1	0.06	0.06	0.06
Beryllium	mg/l	0.005	No project standard									0	0			
Boron	mg/l	0.002	2.4			<0.005	0.03		0.05	0.17	<0.01	5	3	0.03	0.08	0.17
Cadmium	mg/l	0.00003	0.003			<	<	<	<	<	<0.01	6	0			
Chromium	mg/l	0.0002	0.05			<0.007	<0.007	<0.007	<0.007	<0.007	<0.01	6	0			
Copper	mg/l	0.003	0.05			<0.006	<0.006	<0.006	<0.006	<0.006	<0.01	6	0			
Iron (Ferrous)	mg/l	0.00002	No project standard									0	0			
Iron (Feric)	mg/l	0.00002	No project standard									0	0			
Iron (total)	mg/l		0.3			0.11	<0.007	0.02	<0.007	0.06	0.09	6	4	0.02	0.07	0.11
Lead	mg/l	0.0004	0.01			<	<	<	<	<	<0.01	6	0			
Manganese	mg/l	0.00002	0.1			<0.002	<0.002	<0.002	<0.002	<0.002	0.04	6	1	0.04	0.04	0.04
Mercury	mg/l	0.0005	0.001			<	<	<	<	<	<0.01	6	0			
Nickel	mg/l	0.0002	0.02			<0.015	<0.015	<0.015	<0.015	<0.015	<0.01	6	0			
Selenium	mg/l	0.0012	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6	0			
Vanadium	mg/l	0.0006	No project standard									0	0			
Zinc	mg/l	0.0015	1.5			<0.002	0.01	<0.002	<0.002	0.04	0.07	6	3	0.01	0.04	0.07
Strontium	mg/l	0.005	No project standard			0.46	0.46	0.45	<0.005	0.15	<0.01	6	4	0.15	0.38	0.46
Sanitary																
BOD	mg/l	1	No project standard									0	0			
COD	mg/l	7	No project standard									0	0			
Total nitrogen	mg/l	0.5	No project standard									0	0			
Total phosphorous	mg/l	0.5	No project standard									0	0			
Total coliform bacteria	MPN/100ml	not specified	0									0	0			
Fecal coliforms	MPN/100ml	not specified	No project standard									0	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Parameter	Units	Requested Detection Limit	Water Quality Standard		27/07/2015	21/09/2015	27/10/2015	27/11/2015	30/12/2015	07/04/2016	21/06/2016	30/08/2016	31/10/2016	Number of Analyses	Number of Analyses with Numerical Result	Result		
					Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1	Kengomo 1			Min	Mean	Max
Major Ions																		
Calcium	mg/l	0.2	150		6.83	12.64	6.66	7.55	7.29	15.2	7.61	<0.001	0.45	9	8	0.45	8.03	15.2
Magnesium	mg/l	0.1	100		7.03	7.12	7.25	8.25	7.87	6.64	1.96	2.47	0.93	9	9	0.93	5.50	8.25
Potassium	mg/l	0.1	50		4.52	5.19	5.49	4.8	4.85	1.58	10.26	1.55	3.46	9	9	1.55	4.63	10.26
Sodium	mg/l	0.1	200		**690.33**	**491.51**	**789.61**	**599.89**	**632.09**	**413.5**	5.98	**573**	52.29	9	9	5.98	472.02	789.61
Fluoride	mg/l	0.3	1.5		**3.8**	**3.7**	**3.3**	**4.3**	**4**	1.25	**1.93**	0.24	0.23	9	9	0.23	2.53	4.3
Sulphate	mg/l	0.05	400		169.99	177	170.4	129.65	125.7	158	9.88	34.2	20.69	9	9	9.88	110.61	177
Chloride	mg/l	0.3	250		**532.03**	**964.24**	**535.61**	**386.62**	**354.5**	**268**	162.22	**294.94**	**355.41**	9	9	162.22	428.17	964.24
Alkalinity (HCO3)	mg/l	1	No project standard											0	0			
Nutrients																		
Ortho Phosphate as PO4	mg/l	0.03	2.2											0	0			
Nitrate as N03	mg/l	0.2	10		**25.6**	**12.6**	**17**	**32**	**34.85**	1.25	**10.62**	**22.26**	**63.84**	9	9	1.25	24.45	63.84
Nitrite	mg/l	0.02	0.9		<	<	<	<	<	<0.001	<0.001	<0.001	<0.01	9	0			
Ammonia as NH3	mg/l	0.07	0.5											0	0			
Physico-chemical																		
Total Alkalinity as CaCO3	mg/l	1	No project standard		680	890	552	620	660	592	216	88	201.35	9	9	88	499.93	890
Electrical Conductivity	mS/cm	2	2.5		**3.38**	**3.48**	**3.3**	**2.792**	2.477	**2.8**	0.82	**2.8**	**2.72**	9	9	0.82	2.73	3.48
pH (lab)	pH units	0.01	8.5	6.5	7.95	7.81	7.7	7.87	7.88	8.44	7.65	8.13	7.9	9	9	7.65	7.93	8.44
Redox (Eh)	mV	not specified	No project standard											0	0			
Temperature	°C	0.5	No project standard											0	0			
Dissolved Oxygen	mg/l	1	No project standard											0	0			
TDS	mg/l	35	1500		**2197**	**2262**	**2145**	**1814.8**	**1610.05**	1400	410	1400	1360	9	9	410	1622.09	2262
TSS	mg/l	10	0											0	0			
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		46.01		46.47	52.81	50.63	48.56	27	10	4.96	8	8	4.96	35.81	52.81
Silica	mg/l	0.01	No project standard		23.07	22.52	31.54	3.74	5.21	4.62	<0.001	<0.001		8	6	3.74	15.12	31.54
Organics and Oils																		
TPH CWG - Aliphatics																		
>C5-C6 #	mg/l	0.005	No project standard											0	0			
>C8-C10 #	mg/l	0.005	No project standard											0	0			
>C6-C8 #	mg/l	0.005	No project standard											0	0			
>C10-C12#	mg/l	0.005	No project standard											0	0			
>C12-C16#	mg/l	0.01	No project standard											0	0			
>C16-C21#	mg/l	0.01	No project standard											0	0			
>C21-C35#	mg/l	0.01	No project standard											0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard											0	0			
TPH CWG - Aromatics																		
>C5-EC7 #	mg/l	0.005	No project standard											0	0			
>EC7-EC8 #	mg/l	0.005	No project standard											0	0			
>EC8-EC10 #	mg/l	0.005	No project standard											0	0			
>EC10-EC12#	mg/l	0.005	No project standard											0	0			
>EC12-EC16#	mg/l	0.01	No project standard											0	0			
>EC16-EC21#	mg/l	0.01	No project standard											0	0			
>EC21-EC35#	mg/l	0.01	No project standard											0	0			
Total aromatics C5-35	mg/l	0.01	No project standard											0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard											0	0			
Benzene	mg/l	0.0005	0.01											0	0			
Toluene	mg/l	0.0005	0.7											0	0			
Ethylbenzene	mg/l	0.0005	0.3											0	0			
Xylene (total)	mg/l		0.5											0	0			
m/p-Xylene	mg/l	not analysed	No project standard											0	0			
o-Xylene	mg/l	not analysed	No project standard											0	0			
Polyaromatic Hydrocarbons																		
Naphthalene	mg/l	0.00001	No project standard											0	0			
Acenaphthylene	mg/l	0.00001	No project standard											0	0			
Acenaphthene	mg/l	0.00001	No project standard											0	0			
Fluorene	mg/l	0.00001	No project standard											0	0			
Phenanthrene	mg/l	0.00001	No project standard											0	0			
Anthracene	mg/l	0.00001	No project standard											0	0			
Fluoranthene	mg/l	0.00001	No project standard											0	0			
Pyrene	mg/l	0.00001	No project standard											0	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard											0	0			
Chrysene	mg/l	0.00001	No project standard											0	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard											0	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007											0	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard											0	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard											0	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard											0	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007							0			0		0			
Inorganics and Trace Metals																		
Aluminium	mg/l	0.2	0.2		<0.04	<0.04	<0.04	<0.04	<0.04	0.02	0.09	<0.001	0.09	9	3	0.02	0.07	0.09
Arsenic	mg/l	0.0009	0.01		<	<	<	<	<	<0.001	<0.001	<0.001	<0.01	9	0			
Barium	mg/l	0.003	0.7		<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.01	9	0			
Beryllium	mg/l	0.005	No project standard											0	0			
Boron	mg/l	0.002	2.4		<0.005	0.19		0.18	0.4	<0.001	<0.001	<0.001	<0.01	8	3	0.18	0.26	0.4
Cadmium	mg/l	0.00003	0.003		<	<	<	<	<	<0.001	<0.001	<0.001	<0.01	9	0			
Chromium	mg/l	0.0002	0.05		<0.007	<0.007	<0.007	<0.007	<0.007	<0.001	<0.001	<0.001	<0.01	9	0			
Copper	mg/l	0.003	0.05		<0.006	<0.006	<0.006	<0.006	<0.006	<0.001	**0.52**	<0.001	<0.01	9	1	0.52	0.52	0.52
Iron (Ferrous)	mg/l	0.00002	No project standard											0	0			
Iron (Feric)	mg/l	0.00002	No project standard											0	0			
Iron (total)	mg/l		0.3		<0.007	<0.007	<0.007	<0.007	<0.007	0.008	0.24	**0.38**	0.02	9	4	0.008	0.16	0.38
Lead	mg/l	0.0004	0.01		<	<	<	<	<	<0.001	<0.001	<0.001	<0.01	9	0			
Manganese	mg/l	0.00002	0.1		<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	**0.45**	**0.2**	0.06	9	3	0.06	0.24	0.45
Mercury	mg/l	0.0005	0.001		<	<	<	<	<	<0.001	<0.001	<0.001	<0.01	9	0			
Nickel	mg/l	0.0002	0.02		<0.015	<0.015	<0.015	<0.015	<0.015	<0.001	<0.001	<0.001	<0.01	9	0			
Selenium	mg/l	0.0012	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.01	9	0			
Vanadium	mg/l	0.0006	No project standard											0	0			
Zinc	mg/l	0.0015	1.5		<0.002	0.01	<0.002	<0.002	<0.002	0.01	<0.001	0.44	0.28	9	4	0.01	0.19	0.44
Strontium	mg/l	0.005	No project standard		0.29	0.29	0.29	<0.005	0.3	<0.001	<0.001	<0.001	<0.01	9	4	0.29	0.29	0.3
Sanitary																		
BOD	mg/l	1	No project standard											0	0			
COD	mg/l	7	No project standard											0	0			
Total nitrogen	mg/l	0.5	No project standard											0	0			
Total phosphorous	mg/l	0.5	No project standard											0	0			
Total coliform bacteria	MPN/100ml	not specified	0											0	0			
Fecal coliforms	MPN/100ml	not specified	No project standard											0	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Parameter	Units	Requested Detection Limit	Water Quality Standard		17/02/2015	27/07/2015	21/09/2015	27/10/2015	27/11/2015	30/12/2015	Number of Analyses	Number of Analyses with Numerical Result	Result		
					Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2	Kengomo 2			Min	Mean	Max
Major Ions															
Calcium	mg/l	0.2	150		11.57	12.72	6.47	11.93	12.13	12.23	6	6	6.47	11.18	12.72
Magnesium	mg/l	0.1	100		16.8	16.86	17.52	16.3	16.29	15.77	6	6	15.77	16.59	17.52
Potassium	mg/l	0.1	50			5.34	5.98	6	5.49	5.69	5	5	5.34	5.70	6
Sodium	mg/l	0.1	200			**390.57**	**357.25**	**406.16**	**353.42**	**378.19**	5	5	353.42	377.12	406.16
Fluoride	mg/l	0.3	1.5		**1.83**	**3.16**	**2.5**	**2.5**	**3**	**3.4**	6	6	1.83	2.73	3.4
Sulphate	mg/l	0.05	400		61	60.3	52.7	54	57.01	51.7	6	6	51.7	56.12	61
Chloride	mg/l	0.3	250		97.84	95.01	94.01	115.04	103.73	93.06	6	6	93.06	99.78	115.04
Alkalinity (HCO3)	mg/l	1	No project standard								0	0			
Nutrients															
Ortho Phosphate as PO4	mg/l	0.03	2.2								0	0			
Nitrate as N03	mg/l	0.2	10			**14.3**	3.14	**12.4**	**16.4**	**16.8**	5	5	3.14	12.61	16.8
Nitrite	mg/l	0.02	0.9			<	<	<	<	<	5	0			
Ammonia as NH3	mg/l	0.07	0.5								0	0			
Physico-chemical															
Total Alkalinity as CaCO3	mg/l	1	No project standard			690	660	548	590	570	5	5	548	611.60	690
Electrical Conductivity	mS/cm	2	2.5			1.749	1.789	1.731	1.646	1.429	5	5	1.429	1.67	1.789
pH (lab)	pH units	0.01	8.5	6.5	7.54	8	7.72	7.76	7.76	7.81	6	6	7.54	7.77	8
Redox (Eh)	mV	not specified	No project standard								0	0			
Temperature	°C	0.5	No project standard								0	0			
Dissolved Oxygen	mg/l	1	No project standard								0	0			
TDS	mg/l	35	1500		1190	1136.85	1162	1125.15	1069.9	928.85	6	6	928.85	1102.13	1190
TSS	mg/l	10	0								0	0			
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		98.06	101.19		96.87	97.36	95.47	5	5	95.47	97.79	101.19
Silica	mg/l	0.01	No project standard			24.29	24.4	32.33	3.15	4.41	5	5	3.15	17.72	32.33
Organics and Oils															
TPH CWG - Aliphatics															
>C5-C6 #	mg/l	0.005	No project standard								0	0			
>C8-C10 #	mg/l	0.005	No project standard								0	0			
>C6-C8 #	mg/l	0.005	No project standard								0	0			
>C10-C12#	mg/l	0.005	No project standard								0	0			
>C12-C16#	mg/l	0.01	No project standard								0	0			
>C16-C21#	mg/l	0.01	No project standard								0	0			
>C21-C35#	mg/l	0.01	No project standard								0	0			
Total aliphatics C5-35	mg/l	0.01	No project standard								0	0			
TPH CWG - Aromatics															
>C5-EC7 #	mg/l	0.005	No project standard								0	0			
>EC7-EC8 #	mg/l	0.005	No project standard								0	0			
>EC8-EC10 #	mg/l	0.005	No project standard								0	0			
>EC10-EC12#	mg/l	0.005	No project standard								0	0			
>EC12-EC16#	mg/l	0.01	No project standard								0	0			
>EC16-EC21#	mg/l	0.01	No project standard								0	0			
>EC21-EC35#	mg/l	0.01	No project standard								0	0			
Total aromatics C5-35	mg/l	0.01	No project standard								0	0			
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard								0	0			
Benzene	mg/l	0.0005	0.01								0	0			
Toluene	mg/l	0.0005	0.7								0	0			
Ethylbenzene	mg/l	0.0005	0.3								0	0			
Xylene (total)	mg/l		0.5								0	0			
m/p-Xylene	mg/l	not analysed	No project standard								0	0			
o-Xylene	mg/l	not analysed	No project standard								0	0			
Polyaromatic Hydrocarbons															
Naphthalene	mg/l	0.00001	No project standard								0	0			
Acenaphthylene	mg/l	0.00001	No project standard								0	0			
Acenaphthene	mg/l	0.00001	No project standard								0	0			
Fluorene	mg/l	0.00001	No project standard								0	0			
Phenanthrene	mg/l	0.00001	No project standard								0	0			
Anthracene	mg/l	0.00001	No project standard								0	0			
Fluoranthene	mg/l	0.00001	No project standard								0	0			
Pyrene	mg/l	0.00001	No project standard								0	0			
Benzo(a)anthracene	mg/l	0.00001	No project standard								0	0			
Chrysene	mg/l	0.00001	No project standard								0	0			
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard								0	0			
Benzo(a)pyrene	mg/l	0.00001	0.0007								0	0			
Indeno(123cd)pyrene	mg/l	0.00001	No project standard								0	0			
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard								0	0			
Benzo(ghi)perylene	mg/l	0.00001	No project standard								0	0			
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007							0			0		0
Inorganics and Trace Metals															
Aluminium	mg/l	0.2	0.2			<0.04	<0.04	<0.04	<0.04	<0.04	5	0			
Arsenic	mg/l	0.0009	0.01			<	<	<	<	<	5	0			
Barium	mg/l	0.003	0.7			<0.002	<0.002	<0.002	<0.002	<0.002	5	0			
Beryllium	mg/l	0.005	No project standard								0	0			
Boron	mg/l	0.002	2.4			<0.005	0.12		0.16	0.36	4	3	0.12	0.21	0.36
Cadmium	mg/l	0.00003	0.003			<	<	<	<	<	5	0			
Chromium	mg/l	0.0002	0.05			<0.007	<0.007	<0.007	<0.007	<0.007	5	0			
Copper	mg/l	0.003	0.05			<0.006	<0.006	<0.006	<0.006	<0.006	5	0			
Iron (Ferrous)	mg/l	0.00002	No project standard								0	0			
Iron (Feric)	mg/l	0.00002	No project standard								0	0			
Iron (total)	mg/l		0.3		0.007	<0.007	<0.007	<0.007	<0.007	<0.007	6	1	0.007	0.01	0.007
Lead	mg/l	0.0004	0.01			<	<	<	<	<	5	0			
Manganese	mg/l	0.00002	0.1		0.002	<0.002	<0.002	<0.002	<0.002	<0.002	6	1	0.002	0.00	0.002
Mercury	mg/l	0.0005	0.001			<	<	<	<	<	5	0			
Nickel	mg/l	0.0002	0.02			<0.015	<0.015	<0.015	<0.015	<0.015	5	0			
Selenium	mg/l	0.0012	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	5	0			
Vanadium	mg/l	0.0006	No project standard								0	0			
Zinc	mg/l	0.0015	1.5		0.04	0.03	0.16	<0.002	<0.002	0.04	6	4	0.03	0.07	0.16
Strontium	mg/l	0.005	No project standard			0.65	0.67	0.6	<0.005	0.59	5	4	0.59	0.63	0.67
Sanitary															
BOD	mg/l	1	No project standard								0	0			
COD	mg/l	7	No project standard								0	0			
Total nitrogen	mg/l	0.5	No project standard								0	0			
Total phosphorous	mg/l	0.5	No project standard								0	0			
Total coliform bacteria	MPN/100ml	not specified	0								0	0			
Fecal coliforms	MPN/100ml	not specified	No project standard								0	0			

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for

Parameter	Units	Requested Detection Limit	Water Quality Standard		27/07/2015	27/07/2015	19/06/2014
					Ewoi	Ekunyuk	Nabolei
Major Ions							
Calcium	mg/l	0.2	150		0.41	2.81	7.11
Magnesium	mg/l	0.1	100		0.05	3.18	1.74
Potassium	mg/l	0.1	50		1.6	2.8	
Sodium	mg/l	0.1	200		**486.08**	**747.27**	
Fluoride	mg/l	0.3	1.5		**4.2**	**4.4**	**2.07**
Sulphate	mg/l	0.05	400		166.49	221.03	381.5
Chloride	mg/l	0.3	250		209.01	**323.02**	**1720**
Alkalinity (HCO3)	mg/l	1	No project standard				
Nutrients							
Ortho Phosphate as PO4	mg/l	0.03	2.2				
Nitrate as N03	mg/l	0.2	10		**14.6**	**15.5**	**75.8**
Nitrite	mg/l	0.02	0.9		<	<	
Ammonia as NH3	mg/l	0.07	0.5				
Physico-chemical							
Total Alkalinity as CaCO3	mg/l	1	No project standard		550	1030	
Electrical Conductivity	mS/cm	2	2.5		2.099	**3.23**	
pH (lab)	pH units	0.01	8.5	6.5	**8.75**	8.18	7.91
Redox (Eh)	mV	not specified	No project standard				
Temperature	°C	0.5	No project standard				
Dissolved Oxygen	mg/l	1	No project standard				
TDS	mg/l	35	1500		1364.35	**2099.5**	**4150**
TSS	mg/l	10	0				
Total Hardness Dissolved (as CaCO3)	mg/l	1	600		1.24	20.13	24.92
Silica	mg/l	0.01	No project standard		3.19	17.58	
Organics and Oils							
TPH CWG - Aliphatics							
>C5-C6 #	mg/l	0.005	No project standard				
>C8-C10 #	mg/l	0.005	No project standard				
>C6-C8 #	mg/l	0.005	No project standard				
>C10-C12#	mg/l	0.005	No project standard				
>C12-C16#	mg/l	0.01	No project standard				
>C16-C21#	mg/l	0.01	No project standard				
>C21-C35#	mg/l	0.01	No project standard				
Total aliphatics C5-35	mg/l	0.01	No project standard				
TPH CWG - Aromatics							
>C5-EC7 #	mg/l	0.005	No project standard				
>EC7-EC8 #	mg/l	0.005	No project standard				
>EC8-EC10 #	mg/l	0.005	No project standard				
>EC10-EC12#	mg/l	0.005	No project standard				
>EC12-EC16#	mg/l	0.01	No project standard				
>EC16-EC21#	mg/l	0.01	No project standard				
>EC21-EC35#	mg/l	0.01	No project standard				
Total aromatics C5-35	mg/l	0.01	No project standard				
Total aliphatics and aromatics(C5-35)	mg/l	0.01	No project standard				
Benzene	mg/l	0.0005	0.01				
Toluene	mg/l	0.0005	0.7				
Ethylbenzene	mg/l	0.0005	0.3				
Xylene (total)	mg/l		0.5				
m/p-Xylene	mg/l	not analysed	No project standard				
o-Xylene	mg/l	not analysed	No project standard				
Polyaromatic Hydrocarbons							
Naphthalene	mg/l	0.00001	No project standard				
Acenaphthylene	mg/l	0.00001	No project standard				
Acenaphthene	mg/l	0.00001	No project standard				
Fluorene	mg/l	0.00001	No project standard				
Phenanthrene	mg/l	0.00001	No project standard				
Anthracene	mg/l	0.00001	No project standard				
Fluoranthene	mg/l	0.00001	No project standard				
Pyrene	mg/l	0.00001	No project standard				
Benzo(a)anthracene	mg/l	0.00001	No project standard				
Chrysene	mg/l	0.00001	No project standard				
Benzo(bk)fluoranthene	mg/l	0.00001	No project standard				
Benzo(a)pyrene	mg/l	0.00001	0.0007				
Indeno(123cd)pyrene	mg/l	0.00001	No project standard				
Dibenzo(ah)anthracene	mg/l	0.00001	No project standard				
Benzo(ghi)perylene	mg/l	0.00001	No project standard				
Polynuclear Aromatic Hydrocarbons	mg/l		0.0007				
Inorganics and Trace Metals							
Aluminium	mg/l	0.2	0.2		<0.04	<0.04	
Arsenic	mg/l	0.0009	0.01		<	<	
Barium	mg/l	0.003	0.7		0.08	0.02	
Beryllium	mg/l	0.005	No project standard				
Boron	mg/l	0.002	2.4		<0.005	<0.005	
Cadmium	mg/l	0.00003	0.003		<	<	
Chromium	mg/l	0.0002	0.05		<0.007	<0.007	
Copper	mg/l	0.003	0.05		<0.006	<0.006	
Iron (Ferrous)	mg/l	0.00002	No project standard				
Iron (Feric)	mg/l	0.00002	No project standard				
Iron (total)	mg/l		0.3		<0.007	<0.007	
Lead	mg/l	0.0004	0.01		<	<	
Manganese	mg/l	0.00002	0.1		<0.002	<0.002	
Mercury	mg/l	0.0005	0.001		<	<	
Nickel	mg/l	0.0002	0.02		<0.015	<0.015	
Selenium	mg/l	0.0012	0.01		<0.01	<0.01	
Vanadium	mg/l	0.0006	No project standard				
Zinc	mg/l	0.0015	1.5		<0.002	<0.002	
Strontium	mg/l	0.005	No project standard		0.06	0.32	
Sanitary							
BOD	mg/l	1	No project standard				
COD	mg/l	7	No project standard				
Total nitrogen	mg/l	0.5	No project standard				
Total phosphorous	mg/l	0.5	No project standard				
Total coliform bacteria	MPN/100ml	not specified	0				
Fecal coliforms	MPN/100ml	not specified	No project standard				

< *non detection and no detection limit provided*

Note - Results represent dissolved concentrations. Samples not filtered in the field. Unpreserved and lab filtered.

not analysed for (either not requested or missed by laboratory)

Field Parameters 23 and 27 of November 2015

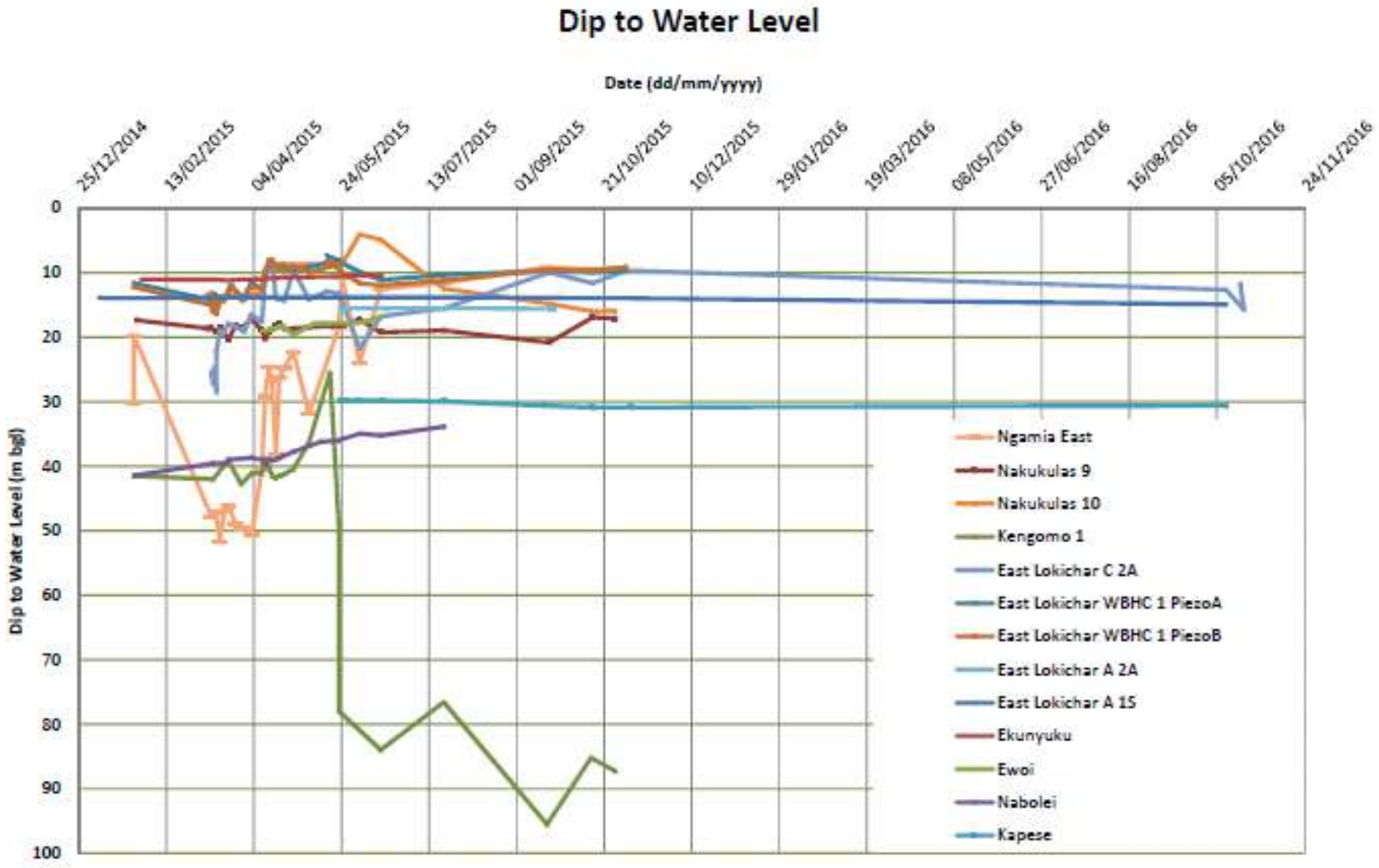
Parameter	Locations				
	GW1	**GW2**	**GW3**	**GW4**	**GW5**
Temp (° C)	39.1	34.7	35.2	31.6	34.5
DO (%)	16	10.7	31	34.1	23.7
DO (mg/l)	1.15	0.7	1.9	2	1.65
pH	7.73	7.96	7.7	6.6	7.39
ORP (mV)	-172.1	-203.9	-166.8	-120.7	-141.5
Conductivity (µS/cm)	910	1317	1663	890	924

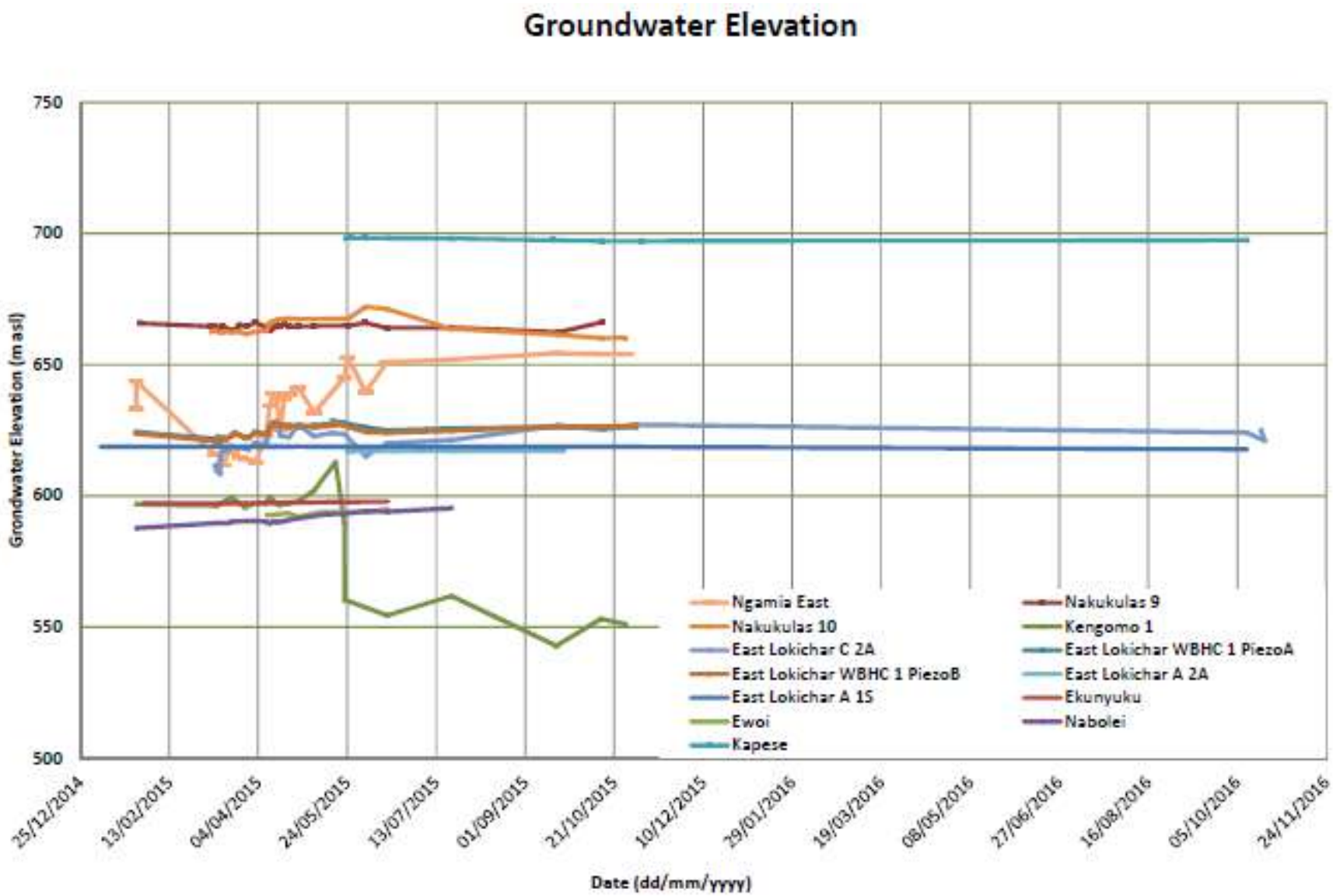
Field Parameters 25 May and 1 June 2016

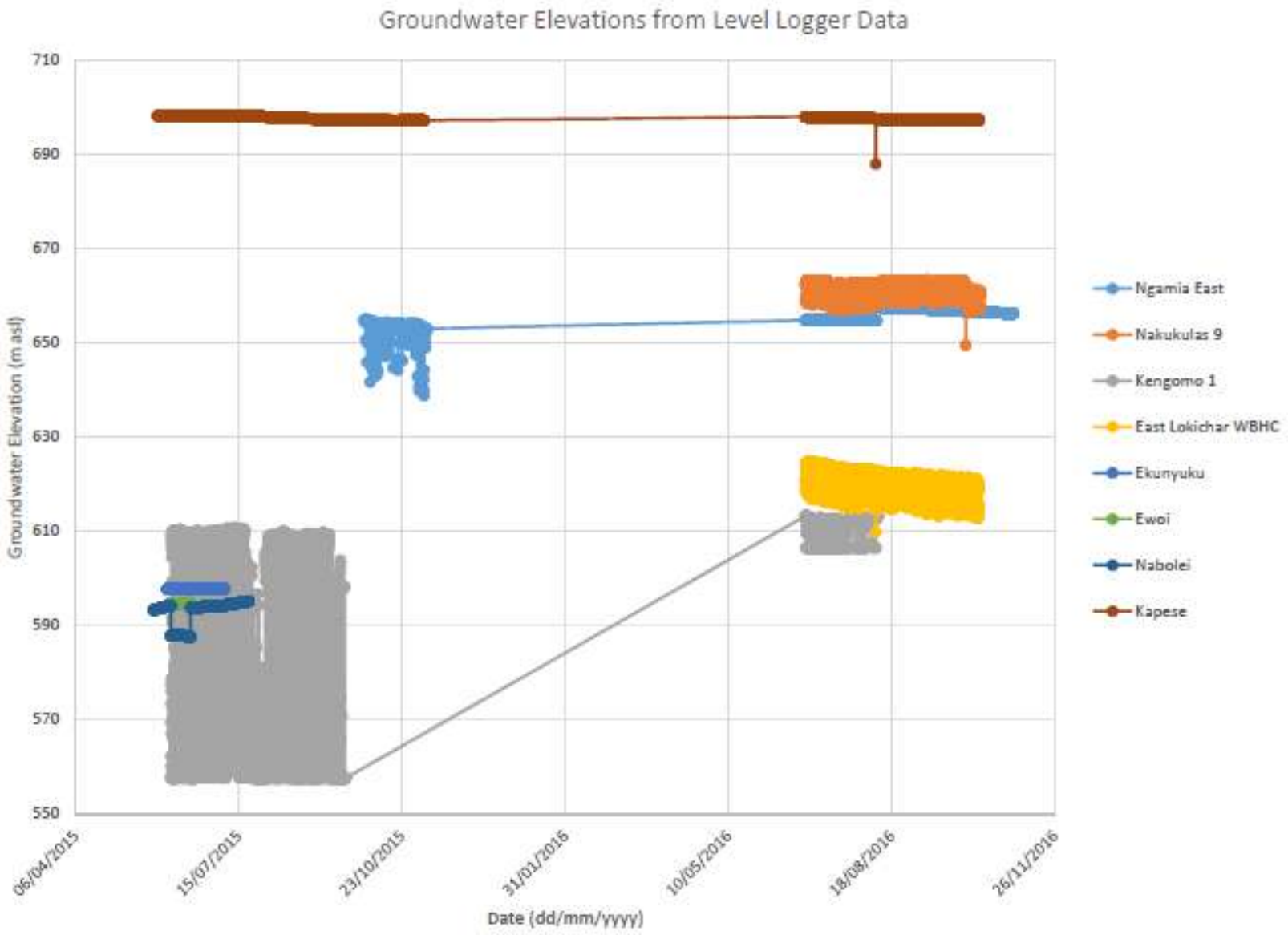
Parameter	Locations				
	SW1	**SW3**	**GW1**	**GW3**	**GW5**
Temp (° C)	30.1	28.7	34.6	34.7	34.2
DO (ppm)	2.02	5.02	5.51	3.66	3.11
pH	7.37	7.85	7.89	7.92	7.34
ORP (mV)	77.6	62.3	81.9	62.0	149.3
Conductivity (µS/cm)	575	273.5	955	1399	1083

Field Parameters 24 and 31 August 2016

Parameter	Locations				
	GW1	**GW2**	**GW3**	**GW4**	**GW5**
Temp (° C)	34.5	Pump removed	34.7	29.7	33.1
pH	7.95		8.92	8.59	7.41
Conductivity (µS/cm)	721		1248	525	928
TDS (mg/l)	360		625	263	465


Dip to Water Level
Date (dd/mm/yyyy)
25/12/2014
13/02/2015
04/04/2015
24/05/2015
13/07/2015
01/09/2015
21/10/2015
10/12/2015
29/01/2016
19/03/2016
08/05/2016
27/06/2016
16/08/2016
05/10/2016
24/11/2016
Dip to Water Level (m bgl)
0
10
20
30
40
50
60
70
80
90
100
Ngamia East
Nakukulas 9
Nakukulas 10
Kengomo 1
East Lokichar C 2A
East Lokichar WBHC 1 PiezoA
East Lokichar WBHC 1 PiezoB
East Lokichar A 2A
East Lokichar A 15
Ekunyuku
Ewoi
Nabolei
Kapese


Groundwater Elevation
750
700
650
600
550
500
Grondwater Elevation (m asl)
25/12/2014
13/02/2015
04/04/2015
24/05/2015
13/07/2015
01/09/2015
21/10/2015
10/12/2015
29/01/2016
19/03/2016
08/05/2016
27/06/2016
16/08/2016
05/10/2016
24/11/2016
Date (dd/mm/yyyy)
Ngamia East
Nakukulas 9
Nakukulas 10
Kengomo 1
East Lokichar C 2A
East Lokichar WBHC 1 PiezoA
East Lokichar WBHC 1 PiezoB
East Lokichar A 2A
East Lokichar A 1S
Ekunyuku
Ewoi
Nabolei
Kapese


Groundwater Elevations from Level Logger Data
710
690
670
650
630
610
590
570
550
Groundwater Elevation (m asl)
06/04/2015
15/07/2015
23/10/2015
31/01/2016
10/05/2016
18/08/2016
26/11/2016
Date (dd/mm/yyyy)
Ngamia East
Nakukulas 9
Kengomo 1
East Lokichar WBHC
Ekunyuku
Ewoi
Nabolei
Kapese

APPENDIX B

Project Water Quality Standards

Project Water Quality Standards

Effluent Discharge Standards to Surface Water

The IFC EHS Guidelines state that if sewage from an industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges is required. In their absence, the indicative guideline values provided below are applicable to sanitary wastewater discharges.

Table 1: Effluent Discharge Standards to the environment

Parameter	International Standard	Kenyan Standard [b]	Project Standard
1,1,1-trichloroethane	-	3 mg/l	3 mg/l
1,1,2-trichloethane	-	0.06 mg/l	0.06 mg/l
1,1-dichloroethylene	-	0.2 mg/l	0.2 mg/l
1,2-dichloroethane	-	0.04 mg/l	0.04 mg/l
1,3-dichloropropene	-	0.02 mg/l	0.02 mg/l
Alkyl Mercury compounds	-	Not Detectible	Not Detectible
Ammonia, ammonium compounds, NO3 compounds and NO2 compounds (Sum total of ammonia-N times 4 plus nitrate-N & Nitrite-N)	-	100 mg/l	100 mg/l
Arsenic	-	0.02 mg/l	0.02 mg/l
Arsenic and its compounds	-	0.1 mg/l	0.1 mg/l
Benzene	-	0.1 mg/l	0.1 mg/l
Biochemical Oxygen Demand (BOD 5days at 20C)	25 mg/l [c]	30 mg/l	25 mg/l
Boron	-	1.0 mg/l	1.0 mg/l
Boron and its compounds – non marine	-	10 mg/l	10 mg/l
Boron and its compounds – marine	-	30 mg/l	30 mg/l
Cadmium	-	0.01 mg/l	0.01 mg/l
Cadmium and its compounds	-	0.1 mg/l	0.1 mg/l
Carbon tetrachloride	-	0.02 mg/l	0.02 mg/l
Chemical Oxygen Demand (COD)	125 mg/l [a]	50 mg/l	50 mg/l
Chromium VI	-	0.05 mg/l	0.05 mg/l
Chloride	-	250 mg/l	250 mg/l
Chlorine free residue	-	0.10 mg/l	0.10 mg/l
Chromium total	-	2 mg/l	2 mg/l
Cis-1,2- dichloroethylene	-	0.4 mg/l	0.4 mg/l
Copper	-	1.0 mg/l	1.0 mg/l
Dichloromethane	-	0.2 mg/l	0.2 mg/l

Parameter	International Standard	Kenyan Standard [b]	Project Standard
Dissolved iron	-	10 mg/l	10 mg/l
Dissolved Manganese	-	10 mg/l	10 mg/l
E.coli	-	Nil Counts / 100 ml	Nil Counts / 100 ml
Fluoride	-	1.5 mg/l	1.5 mg/l
Fluoride and its compounds (marine and non-marine)	-	8 mg/l	8 mg/l
Lead	-	0.01 mg/l	0.01 mg/l
Lead and its compounds	-	0.1 mg/l	0.1 mg/l
n-Hexane extracts (animal and vegetable fats)	-	30 mg/l	30 mg/l
n-Hexane extracts (mineral oil)	-	5 mg/l	5 mg/l
Oil and grease	10 mg/l [a]	Nil mg/l	Nil mg/l
Organo-Phosphorus compounds (parathion,methyl parathion,methyl demeton and Ethyl parantrophenyl phenylphosphorothroate, EPN only)	-	1.0 mg/l	1.0 mg/l
Polychlorinated biphenyls, PCBs	-	0.003 mg/l	0.003 mg/l
pH (Hydrogen ion activity----marine)	6 – 9 (general) [a]	5.0-9.0	5.0-9.0
pH (Hydrogen ion activity--non marine)	6 – 9 (general) [a]	6.5-8.5	6.5-8.5
Phenols	-	0.001 mg/l	0.001 mg/l
Selenium	-	0.01 mg/l	0.01 mg/l
Selenium and its compounds	-	0.1 mg/l	0.1 mg/l
Hexavalent Chromium VI compounds	-	0.5 mg/l	0.5 mg/l
Sulphide	-	0.1 mg/l	0.1 mg/l
Simazine	-	0.03 mg/l	0.03 mg/l
Total Suspended Solids	35 mg/l [c]	30 mg/l	30 mg/l
Tetrachloroethylene	-	0.1 mg/l	0.1 mg/l
Thiobencarb	-	0.1 mg/l	0.1 mg/l
Temperature (in degrees Celsius) based on ambient temperature	-	± 3 degrees Celsius	± 3 degrees Celsius
Thiram	-	0.06 mg/l	0.06 mg/l
Total coliforms	400 (MPN per 100 ml) [a]	30 counts /100 ml	30 counts /100 ml
Total Cyanogen	-	ND	ND
Total Nickel	-	0.3 mg/l	0.3 mg/l
Total Dissolved solids	-	1200 mg/l	1200 mg/l

Parameter	International Standard	Kenyan Standard [b]	Project Standard
Colour in Hazen Units	-	15 H.U	15 H.U
Detergents	-	Nil mg/l	Nil mg/l
Total mercury	-	0.005 mg/l	0.005 mg/l
Trichloroethylene	-	0.3 mg/l	0.3 mg/l
Zinc	-	0.5 mg/l	0.5 mg/l
Whole effluent toxicity	-	No value	No value
Total Phosphorus	2 mg/l [a]	2 mg/l (Guideline value)	2 mg/l
Total Nitrogen	10 mg/l [a]	2 mg/l (Guideline value)	2 mg/l

(a) International Finance Corporation. EHS Guidelines: Environmental. 2007

(b) Kenyan Government, 2006. The Environmental Management and Coordination Act (Water Quality Regulation) Schedule 3 : Standards for Effluent Discharge into the Environment

(c) IFC EHS Guidelines for Onshore Oil and Gas Developments 2017

Drinking Water Quality

Table 2: Drinking Water Quality Standards

Parameter	Applicable International Standard [(a, b)]	Kenyan Standard [(c)]	Kenya Standard for potable water - natural [(d)]	Project Standard
Units (unless otherwise stated)	**µg/l**	**mg/l**	**mg/l**	
Acrylamide	0.5	-	-	0.5 µg/l
Alachlor	20	-	-	20 µg/l
Aldicarb	10	-	-	10 µg/l
Aldrin and dieldrin	0.03	-	0.00003	0.00003 mg/l
Aluminium	-	-	0.2	0.2 mg/l
Antimony	20	-	-	20 µg/l
Arsenic	10 (A,T)	0.01	0.01	0.01 mg/l
Atrazine and its chloro-striazine metabolites	100	-	-	100 µg/l
Barium	700	-	0.7	0.7 mg/l
Benzene	10	-	0.01	0.01 mg/l

Parameter	Applicable International Standard [a, b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Benzo[a]pyrene	0.7	-	-	0.7 µg/l
Boron	2400	-	2.4	2.4400 mg/l
Bromate	10 (A,T)	-	0.01	0.01 mg/l
Bromodichloromethane	60	-	-	60 µg/l
Bromoform	100	-	-	100 µg/l
Cadmium	3	0.01	0.003	0.003 mg/l
Carbofuran	7	-	-	7 µg/l
Carbon tetrachloride	4	-	0.002	0.002 mg/l
Chlorate	700 (D)	-	-	700 µg/l (D)
Chlordane	0.2	-	0.0003	0.0003 mg/l
Chlorine	5000 (C)	-	-	5000 µg/l (C)
Residual Chlorine	-	-	Absent	Absent
Chlorite	700 (D)	-	-	700 µg/l (D)
Chloroform	300	-	0.03	0.03 mg/l
Chlorotoluron	30	-	-	30 µg/l
Chlorpyrifos	30	-	-	30 µg/l
Chromium (total)	50 (P)	-	0.05	0.05 mg/l
Copper	2000	0.05	1	0.05 mg/l
Cyanazine	0.6	-	-	0.6 µg/l
Cyanide	-	-	0.01	0.01 mg/l
2,4-D	30	-	-	30 µg/l
2,4-DB	90	-	-	90 µg/l
DDT and metabolites	1	-	0.001	0.001 mg/l
Dibromoacetonitrile	70	-	-	70 µg/l
Dibromochloromethane	100	-	-	100 µg/l
1,2-Dibromo-3-	1	-	-	1 µg/l

Parameter	Applicable International Standard [a, b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
chloropropane				
1,2-Dibromoethane	0.4 (P)	-	-	0.4 µg/l (P)
Dichloroacetate	50 (D)	-	-	50 µg/l (D)
Dichloroacetonitrile	20 (P)	-	-	20 µg/l (P)
1,2-Dichlorobenzene	1000 (C)	-	-	1000 µg/l (C)
1,4-Dichlorobenzene	300 (C)	-	-	300 µg/l (C)
1,2-Dichloroethane	30	-	0.03	0.033 mg/l
1,1-Dichloroethene	-	-	0.03	0.03 mg/l
1,2-Dichloroethene	50	-	-	50 µg/l
1,1-Dichloroethylene	-	-	0.0003	0.0003 mg/l
Dichloromethane	20	-	-	20 µg/l
2,4-Dichlorophenoxyacetic acid	-	-	0.03	0.03 mg/l
1,2-Dichloropropane	40 (P)	-	-	40 µg/l (P)
1,3-Dichloropropene	20	-	-	20 µg/l
Dichlorprop	100	-	-	100 µg/l
Di(2-ethylhexyl) phthalate	8	-	-	8 µg/l
Dimethoate	6	-	-	6 µg/l
1,4-Dioxane	50	-	-	50 µg/l
Edetic acid	600	-	-	600 µg/l
Endrin	0.6	-	-	0.6 µg/l
Epichlorohydrin	0.4 (P)	-	-	0.4 µg/l (P)
Ethylbenzene	300 (C)	-	-	300 µg/l (C)
Fenoprop	9	-	-	9 µg/l
Fluoride	1500	1.5	1.5	1.5 mg/l
Heptachlor and Heptachlor	-	-	0.00003	0.00003 mg/l

Parameter	Applicable International Standard [a, b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Epoxide				
Hexachlorobenzene	-	-	0.001	0.001 mg/l
Hexachlorobutadiene	0.6	-	-	0.6 µg/l
Hydroxyatrazine	200	-	-	200 µg/l
Isoproturon	9	-	-	9 µg/l
Lead	10 (A,T)	0.05	0.01	0.01 mg/l
Lindane	2	-	0.002	0.002 mg/l
MCPA	2	-	-	2 µg/l
Mecoprop	10	-	-	10 µg/l
Mercury (total)	6	-	0.001	0.001 mg/l
Methoxychlor	20	-	0.02	0.02 mg/l
Metolachlor	10	-	-	10 µg/l
Microcystin-LR	1 (P)	-	-	1 µg/l (P)
Molinate	6	-	-	6 µg/l
Molybdenum	-	-	0.07	0.07 mg/l
Monochloramine	3000	-	-	3000 µg/l
Monochloroacetate	20	-	-	20 µg/l
Nickel	70	-	0.02	0.02 mg/l
Nitrate as NO_3	50000	10	45	10 mg/l
Nitrilotriacetic acid	200	-	-	200 µg/l
Nitrite	3000	3	0.9	0.9 mg/l
N-Nitrosodimethylamine	0.1	-	-	0.1 µg/l
Pendimethalin	20	-	-	20 µg/l
Pentachlorophenol	9 (P)	-	-	9 µg/l (P)
Phenols	-	-	0.002	0.002 mg/l
Phosphates (as PO_4)	-	-	2.2	2.2 mg/l

Parameter	Applicable International Standard [a, b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Selenium	40 (P)	0.01	0.01	0.01 mg/l
Simazine	2	-	-	2 µg/l
Sodium	-	-	200	200 mg/l
Sodium dichloroisocyanurate	50000	-	-	50000µg/l
Styrene	20 (C)	-	-	20 µg/l(C)
2,4,5-T	9	-	-	9 µg/l
Terbuthylazine	7	-	-	7 µg/l
Tetrachloroethene	40	-	0.04	0.04 mg/l
Toluene	700 (C)	-	0.7	0.7 mg/l
Trichloroacetate	200	-	-	200 µg/l
Trichloroethene	20 (P)	-	-	20 µg/l (P)
2,4,6-Trichlorophenol	200 (C)	-	0.2	0.2 mg/l
Trifluralin	20	-	-	20 µg/l
Trihalomethanes	The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1	-	-	The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1
Uranium	30 (P)	-	0.03	0.03 mg/l
Vinyl chloride	0.3	-	-	0.3 µg/l
Xylenes	500 (C)	-	0.5	0.5 mg/l
Polynuclear Aromatic Hydrocarbons	-	-	0.0007	0.0007 mg/l
Turbidity	-	-	25 NTU	25 NTU
Taste	-	-	Not objectionable	Not objectionable

Parameter	Applicable International Standard [a, b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
Odour	-	-	Not objectionable	Not objectionable
Colour	-	-	50 true colour units max.	50 true colour units max.
pH	-	6.5-8.5	5.5-9.5	6.5-8.5
Electrical Conductivity	-	-	2500 µS/cm	2500 µS/cm
Total filterable residue	-	-	-	-
Total hardness as $CaCO_3$	-	-	600	600 mg/l
Calcium	-	-	150	150 mg/l
Magnesium	-	-	100	100 mg/l
Magnesium and Sodium	-	-	-	-
Potassium			50	50 mg/l
Sulphate (SO_4)	-	-	400	400 mg/l
Chloride	-	-	250	250 mg/l
Iron (total)	-	-	0.3	0.3 mg/l
Manganese	-	-	0.1	0.1 mg/l
Zinc	-	1.5	5	1.5 mg/l
BOD_5	-	-	-	-
Absorbed Oxygen (as $KMnO_4$)	-	-	-	-
Ammonia NH_3	-	0.5	0.5	0.5 mg/l
Total Nitrogen (excluding NO_3)	-	-	-	
Surfactants (Alkyl Benzyl Sulphonates)	-	-	-	-
Surfactants (reacting with methylene blue)	-	-	0.2	0.2 mg/l
Total viable counts at 37°C	-	-	50 counts	50 counts at

Parameter	Applicable International Standard [a, b]	Kenyan Standard [c]	Kenya Standard for potable water - natural [d]	Project Standard
per ml				37°C per ml
Total viable counts at 22°C per ml			100 counts	100 counts at 22°C per ml
Total Coliforms (CFU/100 ml)	-	-	Nil	Nil
E.coli (CFU/100 ml)	-	Nil/100	Nil	Nil/100
Pseudomonas aeruginosa fluorescence (CFU/100 ml)	-	-	Nil	Nil
Salmonella (per 100 ml)	-	-	Nil	Nil
Shigella (per 100 ml)	-	-	Nil	Nil
Giardia (per 100 ml)			Nil	Nil
Cryptosporidium (per 100 ml)			Nil	Nil
Staphylococcus aureus (CFU/100 ml)	-	-	Nil	Nil
Streptococcus faecalis (CFU/100 ml)	-	-	Nil	Nil
Sulphate reducing anaerobes (CFU/100 ml)	-	-	Nil	Nil
Phenolic substances (as Phenol)	-	Nil	-	Nil
Gross alpha activity	-	-	0.5	0.5 Bq/L
Gross beta activity	-	-	1	1 Bq/L
Suspended Solids	-	30	Nil	Nil
Total dissolved solids	-	1200	1500	1500 mg/l
Organic matter	-	-	0.003	0.003 mg/l
Alkyl benzyl sulphonates	-	0.5	-	0.5 mg/l
Permangenate (PV)	-	1	-	1 mg/l

(a) World Health Organization (WHO), 2011. Drinking Water Quality Guidelines – 4th edition.

(b) P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited. T = provisional guideline value because calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, etc. A = provisional guideline value because calculated guideline value is below the achievable quantification level. D = provisional guideline value because disinfection is likely to result in the

guideline value being exceeded. C = concentrations of the substance at or below the health based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.

(c) Kenyan Government, 2006. Environmental Management and Coordination Act (Water Quality Regulation) Schedule 1: Quality Standards for Sources of Domestic Water.

(d) Kenya Bureau of Standards (KEBS), 2018. Kenya Standard KS EAS 12:2018 (ISC 13.060.20). Potable Water – Specification. Second Edition. The standard for natural potable water has been included for the purposes of screening natural baseline groundwater and surface water quality.

(e) Kenya standard for boric acid (H3BO3). WHO standard for boron selected for comparison to water quality results for boron.

(f) Under conditions of epidemic diseases, it may be necessary to increase the residual chlorine temporarily.

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REPORT

Soils, Geology and Geohazards Baseline

Lokichar to Lamu Crude Oil Pipeline Project

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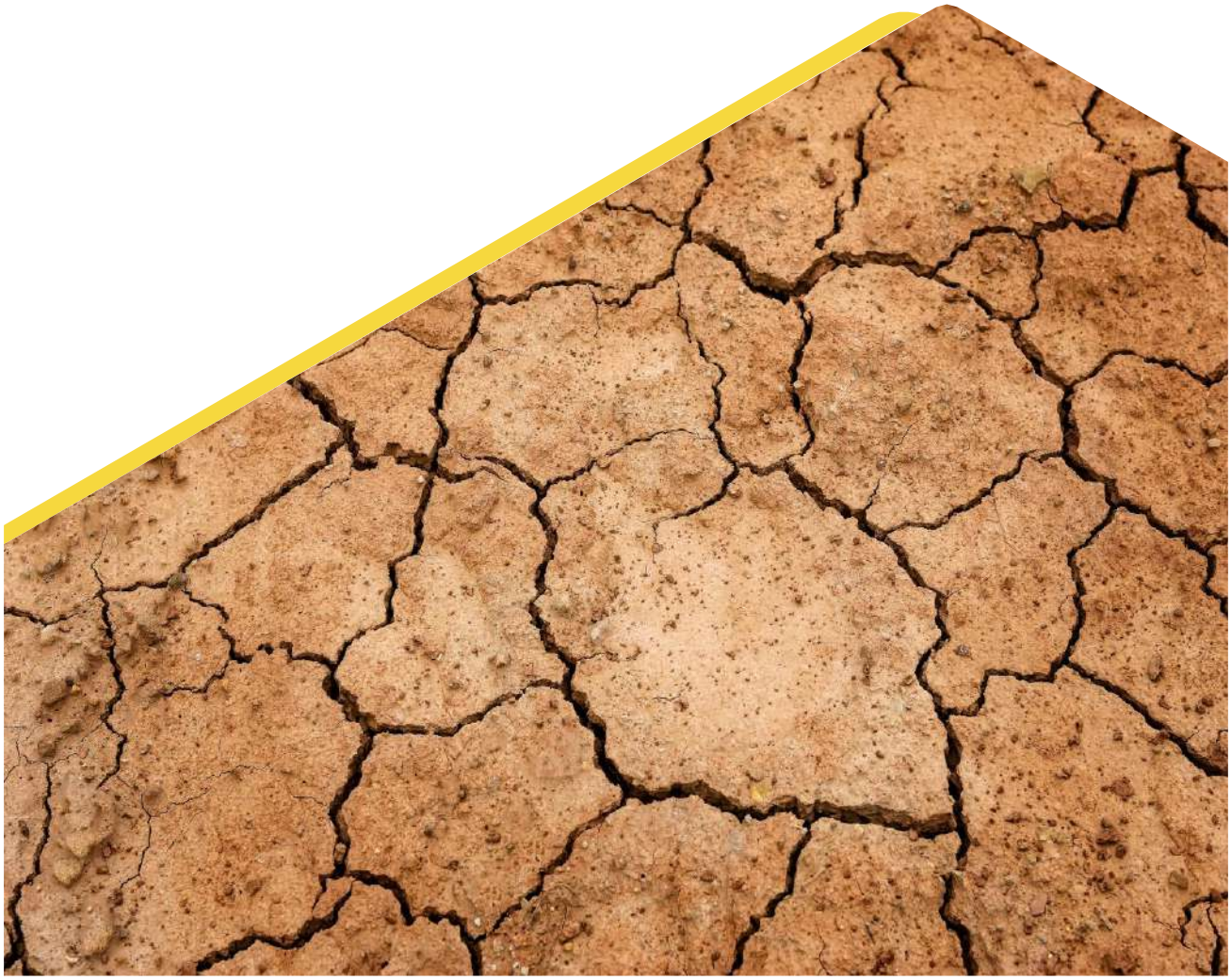

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1. Mapped soils along the LLCOP

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1.0 SOILS

1.1 Area of Influence

The AoI for the soils and geohazard assessment, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA.

The AoI has been selected to focus the baseline soils data collation efforts on the principal areas in which ground disturbance may take place during the Project development. It includes a 1 km buffer along the entire pipeline. The soils AoI is shown on Drawings 1a to 1f.

Because geohazards located outside this AoI have the potential to influence the Project, the geohazards baseline information (and the geology associated with the geohazards) has been collated for a wider region setting.

1.2 Introduction and Soils Mapping

Soils in Kenya are dependent on geology, relief and climate and most soils have serious limitations in terms of salinity/sodicity, acidity, fertility and drainage problems (Infornet Biodivision, 2019). The main types of soil present in Kenya are Andosols; Nitisols; Acrisols, Alisols, Lixisols and Luvisols; Ferralsols; and Planosols and Vertisols. Andosols are young volcanic soils that are porous, acidic and occur in areas of steep topography and high rainfall. Nitisols occur in the highlands and on volcanic steep slopes. They are developed from volcanic rocks, have an acidic pH and often have a high clay content. Acrisols, Alisols, Lixisols and Luvisols are all found on undulating topography, are not very porous, have an acidic pH, high concentrations of aluminium and manganese and low levels of nutrients. Ferralsols are old soils that are highly weathered and leached, nutrient deficient, and area rich in aluminium and iron. They occur on gently undulating terrain. Planosols and Vertisols occur on gently undulating to flat terrain. They have a high clay content leading to poor drainage.

The LLCOP route largely passes through areas of sandy soils that support arid and semi-arid environments, although the soil type changes closer to the coast. The Kenya Soil Survey general map of Kenyan soils (Infornet Biodivision, 2019) replicated in Figure 1 indicates that Planosols are the dominant soil type from the coast towards Meru. Further inland and towards Turkana, the soils are typically lixisols and luvisols, which have relatively poor structure and can require erosion control measures if disturbed.

The following sections discuss the main soil types on a County by County basis from the upstream end of the pipeline in Turkana to the crude oil export facilities in Lamu. For each County there is a regional description and then a more focussed description of the soils along the pipeline routs including the 1 km buffer zone.

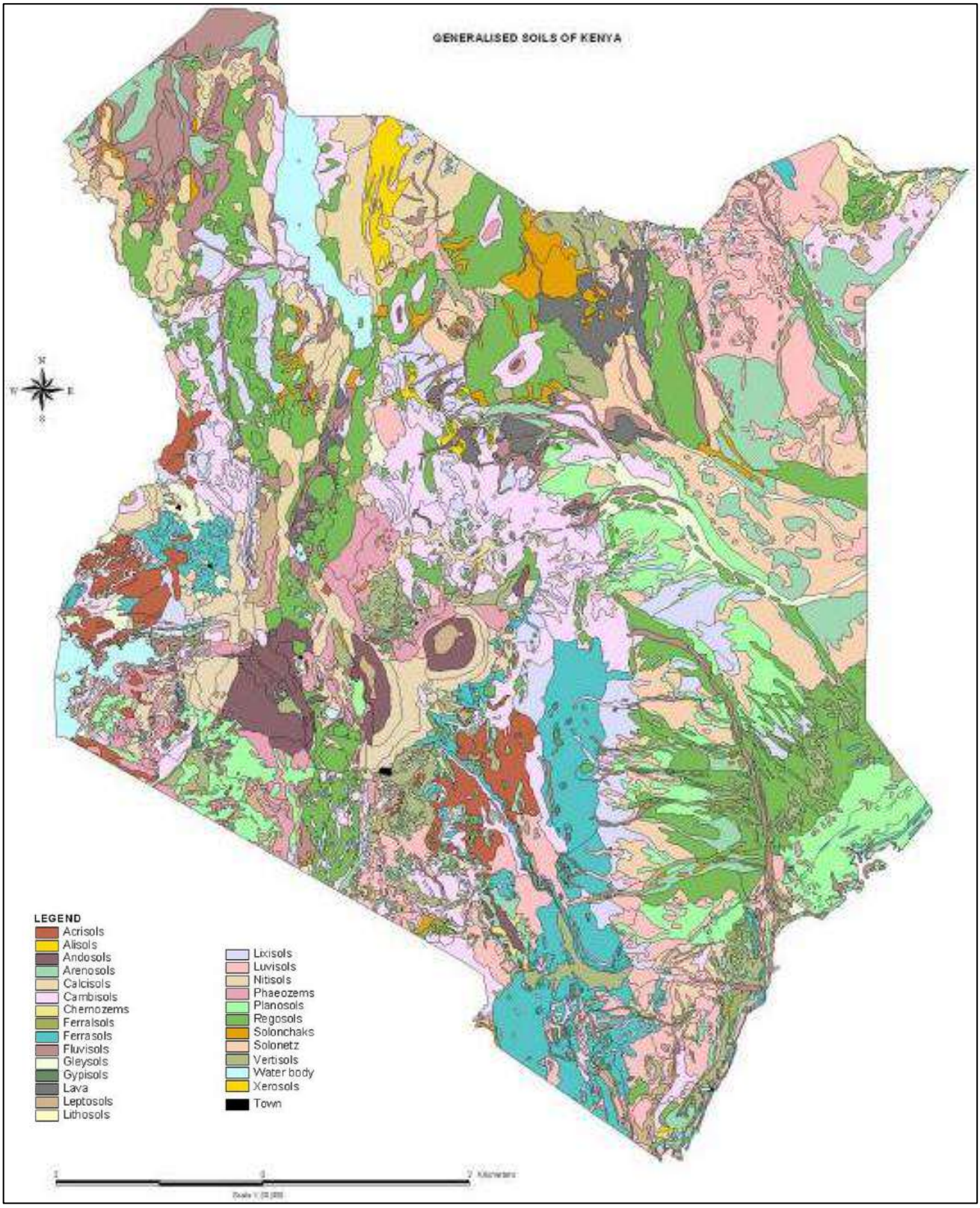

Figure 1: Generalised Soil Map of Kenya (KSS 2018)

1.3 Regional Soils Information - Turkana County

Soils in Turkana County are not well developed due to aridity and constant erosion by water and wind. The soil types are typical of desert-like environments, which are generally nutrient-poor, high pH, low in organic matter and clay content, and prone to rapid erosion by wind and water (RSK, 2014) due to the arid climate and limited vegetation. Erosion is greatest where less vegetation is present.

Soils tend to be reddish when located over the basement geology and grey buff or white when located over volcanics. Alluvial/fluvial soils range from coarse sands to flash flood silts, while black or brown clays occur locally in areas of impended drainage.

The soils are often capped by stone mantles. The modified remnants of the original end-Tertiary surface (i.e. the ancient soil cover) can be discernible in the higher-lying stone mantles about the central hill ranges. Ancient alluvial and Pleistocene lacustrine deposits provide the material for the stone mantle in other areas. The present surface of all these has been affected by more recent erosion and deflation.

On top of the stone mantles, or the stony soils from which they originated, a deep layer of Chestnut Sands was deposited once blanketed most of the Turkana plain. These dune sands derived from aeolian drift and were deposited during a period of active arid erosion, though their materials may have been derived from older surfaces. In many areas of Turkana County these sands have been totally eroded.

Redeposited Chestnut Sands, flash-flood deposits and sandy river alluvium originate from this latest phase of erosion. Areas of comparatively recent lacustrine sands and possible deltaic silts have been left in the east of the region because of the progressive retreat of Lake Turkana.

1.3.1 LLCOP Soil Information

Soils mapping presented in the Soils and Terrain database for Kenya (KENSOTER v2, Kenya Soil Survey, 1996) is shown in Mapped Soils Drawings 1a and 1b for the AoI as it passes through Turkana County. The soil types presented below are only those that are mapped within the AoI.

Regosols are shallow, medium to fine textured, very weakly developed unconsolidated mineral soils that are extensive in eroding lands, especially arid and semi-arid areas and in mountain regions. Regosols often show accumulations of calcium carbonate or gypsum in hot, dry climatic zones.

Planosols are light coloured soils that are characterized by a subsurface layer of clay. They are typically found in wet low-lying areas and support either grass or open forest vegetation. They are poor in plant nutrients and their clay content leads to both seasonal waterlogging and drought stress.

Solonetz are defined by an accumulation of sodium salts bound to soil particles in a layer below the surface, which contains a lot of clay. These soils require extensive reclamation works to be used for agriculture due to their high sodium content.

Solonchaks have high soluble salt accumulation and are formed from saline parent material under conditions of high evaporation.

Fluvisols are found on level topography that is flooded periodically by surface waters or groundwater. They derive from river, lake or marine sediments. In Turkana County these are associated with watercourses, including the River Kerio.

The soil classification prefix provides additional soil characteristic details. Calcaric soils are calcareous, calcic soils have a calcic horizon, and eutric soils have a saturation of 50% or more.

The information on the physical and chemical properties of the soils (Kenya Soil Survey, 1997) dataset indicates the soils along the LLCOP in Turkana County are loamy and well-draining between the Lokichar Export facility

and Station 1. The majority of the soils mapped between Station 1 and the border with Samburu County are described as clayey or very clayey and slow- to well-draining with an area of shallow, loamy well-drained soils about 11 km north-west of Station 2.

Infiltration tests were carried out by EMC as part of the EOPS project (Golder Associates, 2017)). Tests undertaken to the north east of the Ngamia well field gave infiltration rates of between 8 – 9 x 10^{-5} m/s, which is indicative of coarse sand material. A test to the north east of the Amosing well field resulted in a lower infiltration rate of 2.6 x 10^{-5} m/s which is more indicative of loamy clay soils (Stibinger, 2014).

1.4 Regional Soils Information - Samburu County

Samburu County includes areas of highlands, plateaus and lowlands including the Suguta Valley. Fault escarpments bound its sides while red clays, boulders and gravel fans cover the valley floors. The volcanic hills on the Lorroki Plateau are covered by shallow dark to dark brown rocky and stony soils, especially in the north of the plateau. In the south west and in high-altitude areas of Samburu County, rainfall is above 600 mm per annum and the soils are comparatively deep and are suitable for arable farming.

1.4.1 LLCOP Soils Information

Soils mapping presented in the Soils and Terrain database for Kenya (KENSOTER v2, Kenya Soil Survey, 1996) is shown in Mapped Soils Drawings 1b and 1c for the AoI as it passes through Samburu County. The soil types presented below are only those that are mapped within the AoI.

The general description for Regosols and Solonetz are presented under Turkana County where these soils are also present.

Cambisols have the texture of sandy loam or finer and form on medium- to fine-textured parent materials. They have no accumulated clay, humus (i.e. organic matter), soluble salts, or iron and aluminium oxides. Because of the soil structure and high content of weatherable minerals cambisols can usually be exploited for agriculture.

Luvisols have a mixed mineralogy and a high nutrient content due to a surface accumulation of humus. They form on flat or gently sloping topography. The good drainage of these soils makes them suitable for a wide range of agriculture.

Lixisols have a subsurface layer of clays. They develop in old landscapes in climates with a pronounced dry season. The age and mineralogy of Lixisols means they have low nutrient content and are highly erodible.

Calcisols have a layer of either soft and powdery or hard and cemented calcium carbonate in their profile. They are typically well-draining with a fine to medium texture and are reasonably fertile.

Haplic category soils are typical of the reference category for the soil type and have no additional characterisation. The definition of the added characterisations ‘calcaric’, ‘calcic’ and ‘eutric’ are described in the Turkana Country section.

The information on the physical and chemical properties of the soils (Kenya Soil Survey, 1997) dataset indicates the soils along the LLCOP in Samburu County are predominantly described as being clayey and well to extremely slow draining. An area of very clayey, extremely slowly draining sols is mapped around and to the south of Station 3. Loamy, poorly draining soils are mapped to the south of Station 4. Patches of sandy well-draining soils are mapped along the LLCOP route to the north and south of Station 6.

1.5 Regional Soils Information - Isiolo County

The general description for Regiosols and Planosols are presented under Turkana County where these soils are also present. The general description for Calcisols, Cambisols, Luvisols are presented under Samburu County.

The soils in Isiolo County are generally weak and affected by erosion during high floods. Gleysols form in conditions where the ground is saturated. These soils are iron rich and variable in colour depending on the oxidation state of the iron. Colours can include grey, blue, red, yellow and/or brown and the soils can have a mottled appearance.

The additional descriptor of 'chromic' indicates the hue (colour) of the soils is red/orange to orange/yellow. Petric indicates the soil is strongly cemented.

The definition of the added characterisations 'calcaric and 'eutric' are described in the Turkana County section. The definition of the added characterisation 'Haplic' is described in the Samburu County section.

1.5.1 LLCOP Soils Information

Soils mapping presented in the Soils and Terrain database for Kenya (KENSOTER v2, Kenya Soil Survey, 1996) is shown in Mapped Soils Drawing 1c for the AoI as it passes through Isiolo and Meru Counties. The soil types presented below are only those that are mapped within the AoI.

The information on the physical and chemical properties of the soils (Kenya Soil Survey, 1997) dataset indicates the soils along the LLCOP in Isiolo County are predominantly described as being clayey, but well-draining. Two localised areas of loamy slow draining soils are mapped; one south of Station 7 and just north of the border of Meru County and a second to the east of Station 8 near the border with Meru County. An area of very clayey, slow draining soils is mapped near Station 9.

1.6 Regional Soils Information - Meru County

Of the 21 soil categories identified in Kenya (Kenya Soil Survey, 1982), 17 are found in Meru. Soils in the region are closely related to the landforms and are, therefore, as diverse as the physiography of Meru County. A contrast exists between soils that have evolved in the highlands from recent volcanic parent rocks and those that are derived from basement rocks. Mount Kenya and Nyambene lavas and basalts give rise to clay soils, whereas the basement system granites and gneisses, usually create high quartz content, sandy soils. The different climate in the highland and lowland regions also affect the soils created. In the eastern lowlands there is little rainfall that does not decompose this parent material leading to thinner soil horizons. The mountain slopes, by contrast, receive comparatively heavy rainfall that contributes to well-developed soil horizons.

In the higher regions of Meru County, the soils are shallow to moderately deep, dark grey brown, friable and can be acid humic to peaty loam to clay loam. The soils are of variable fertility and drain poorly. Soils that have more rocky/mineral content rather than organic content are found where there are rock out-crops. In lower elevation areas, soils are shallow to moderately deep, well drained, dark reddish brown to dark brown and contain a mixture of mineral and organic materials.

The volcanic foothills are dominated by soils that are extremely deep, well drained, dark red brown to dark brown, friable to slightly clayey.

1.6.1 LLCOP Soils Information

Soils mapping presented in the Soils and Terrain database for Kenya (KENSOTER v2, Kenya Soil Survey, 1996) is shown in Mapped Soils Drawing 1c for the AoI as it passes through Isiolo and Meru Counties. The soil types presented below are only those that are mapped within the AoI.

The mapping indicates that the main classes of soils that are present along the LLCOP route are chromic cambisols and calcaric regosols. These soils types are described previously in the sections on the soils in Turkana, Samburu and Isiolo Counties.

The information on the physical and chemical properties of the soils (Kenya Soil Survey, 1997) dataset indicates the soils along the LLCOP in Meru County west of Station 8 are predominantly described as clayey, but well-draining. To the east of Station 8, the soils are described as loamy and slow draining.

1.7 Regional Soils Information - Garissa County

Hard red sandy and clayey soils overlie much of the Precambrian crystalline rocks in Garissa County. Solonetz, Ferralsols, and Planosols comprise approximately 56% of the total area of the Tana Basin. The soil classes present in Garissa County are shown in Figure 2 and the proportions of the different soils present throughout the County are presented in Table 1.

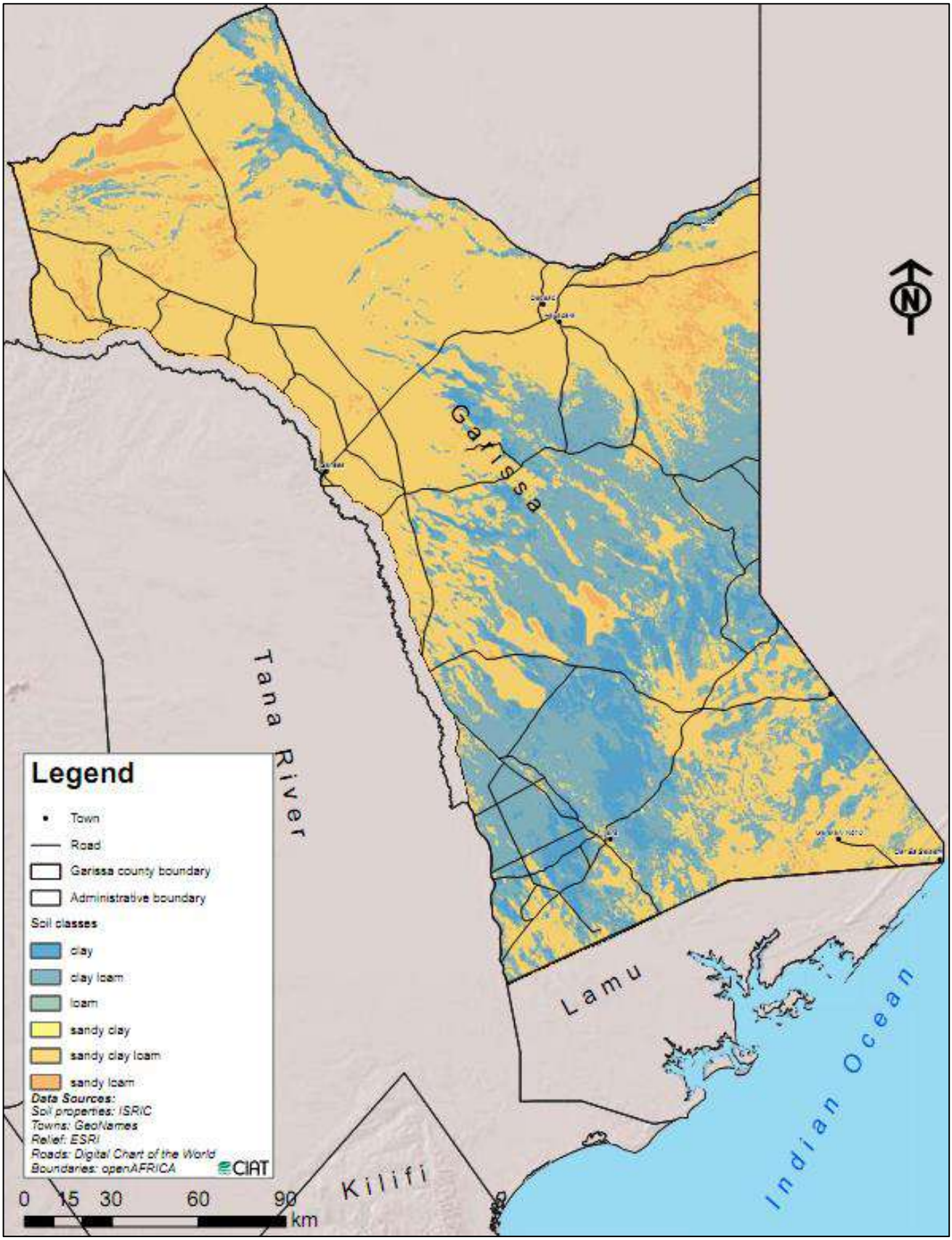

Figure 2: Soil Classes for Garissa (Source: Consortium of International Agricultural Research Centers)

Table 1: Soil Type Proportions in Garissa County

SOIL TYPE	AREA (km^2)	SOIL TYPE	AREA (km^2)
Solonetz	23,459	Leptosols	1,688
Ferralsols	19,930	Regosols	886
Planosols	9,849	Phaeozems	641
Lixisols	7,665	Histosols	559
Cambisols	7,211	Arenosolsl	558
Nitisols	6,920	Gleysols	498
Luvisols	5,290	Solonchaks	260
Vertisols	4,606	Acrisols	180
Fluvisols	2,447	Chernozems	32
Andosols	2,214	Calcisols	19

Source: International Water Management Institute 2015.

The dominant two soil types present in Garissa County are described as follows:

- Solonetz soils are alkaline or sodic and have high clay content in the surface horizon. Within the Tana Basin, these soils dominate the riparian areas and floodplains, and are commonly associated with coastal areas. These soils are slow to drain due to their high clay content, which creates difficulties for agriculture.
- Ferralsols are generally old and highly weathered. While these soils are deep and have clay materials and micro-aggregates diffused throughout their profile, giving them a good physical structure, they have low fertility. In addition to their low fertility, they exhibit poor hydrological function in that their high clay content results in water retention, while the presence of micro-aggregates decreases the soil's ability to hold available water.

1.7.1 LLCOP Soil Information

Soils mapping presented in the Soils and Terrain database for Kenya (KENSOTER v2, Kenya Soil Survey, 1996) is shown in Mapped Soils Drawing 1d and 1e for the AoI as it passes through Garissa County. The soil types presented below are only those that are mapped within the AoI.

Vertsols are typically dark coloured, have a moderate humus content, have a clay-sized particle content of more than 30% and exhibit wide cracking. They are typically found on flat to gently sloping topography and contain high concentrations of plant nutrients.

Phaeozems are permeable sols that have a humus rich layer that supports vegetation and agriculture.

The general description for Planosols and Solonetz are presented under Turkana County where these soils are also present. The general description for Lixisols are presented under the section on Samburu County.

The additional descriptor of 'gleyic' denotes a mottled appearance that can include various colours such as reds, browns, yellows and blue/greys. This occurs when soils are saturated, and reduction occurs. The descriptor 'ferric' is used where the soils type has an iron rich horizon in the top 1 m.

The definition of the added characterisation 'eutric' is described in the Turkana Country section and 'haplic' is described in the Samburu County section.

The information on the physical and chemical properties of the soils (Kenya Soil Survey, 1997) dataset indicates most soils along the LLCOP in Garissa County are predominantly described as clayey, but well-draining. Localised areas of sandy or loamy soils are mapped along the southern part of the LLCOP route (south of Station 13) as is passes through Garissa County. Areas of very clayey, extremely poorly draining soils are mapped between Stations 9 and 10, and Stations 12 and 13 in the northern part of Garissa County.

1.8 Regional Soils Information - Lamu County

Soils in the coastal region of Kenya are variable (United Nations Development Programme *et. al.*, 2006) because they derive from a range of parent rock types. Lamu County is covered in a range of Quaternary geological deposits (see Section 2.2) that comprise eroded coral reef, sands, coal limestones, palaeo beach deposits, deltaic deposits, alluvial deposits and estuarine deposits. These sedimentary parent rocks result in sandy and sandy loam soils that often have low fertility. Patches of higher fertility clayey and loamy soils are found where there are alluvial deposits (i.e. along rivers) that can support vegetation and crops.

In the coastal part of Lamu, and the islands in particular, the soils were formed from fossilized coral reefs. Soil information collated for Pate Island (ESF Consultants, 2016) indicates that the island has poor soils with relatively flat surface covered in white sand. The sand often forms dunes which can reach up to about 33 ft. (approximately 10 m) in height. The soils on Pate Island can be broadly divided into the following three types:

- Soils of the coastal plain developed on lagoonal deposits – consists of excessively drained to imperfectly drained, brown to very dark grey, loamy sand to sand in the topsoil and sandy clay loam to sandy clay in the subsoil. The soils become coarser textured as you move northwards from the sea.
- Soils of the bottomlands and swamps developed on infill from lagoonal deposits. They are light brownish grey to very dark brown sand in the topsoil and sandy clay loam to sandy clay in the subsoil. Some parts of these areas are seasonally waterlogged after rains whereas others are permanently water-logged, although the amount of water decreases during the dry season. Areas with permanent waterlogging have organic matter accumulated in the topsoil.
- Soils of the dunes and beach ridges developed on dune sands of Aeolian origin – Consists of excessively drained to well drained, dark red to yellowish brown, sandy to sandy clay loams. The colour and texture of these soils vary with topographic conditions. Higher areas have well drained, dark red sandy clay loams while relatively lower areas are excessively drained, yellowish brown sands to loamy sands.

1.8.1 LLCOP Soil Information

Soils mapping presented in the Soils and Terrain database for Kenya (KENSOTER v2, Kenya Soil Survey, 1996) is shown in Mapped Soils Drawing 1f for the AoI as it passes through Lamu County. The soil types presented below are only those that are mapped within the AoI.

The soils along the LLCOP route are all mapped as Eutric Planosols. Eutric soils have a saturation of 50% or more. Planosols are light coloured, coarse textured soils that are characterized by a subsurface layer of clay. They are typically found in wet low-lying areas and support either grass or open forest vegetation. They are poor in plant nutrients and their clay content leads to both seasonal waterlogging and drought stress. Given the low-lying and coastal nature of Lamu County the soils that are mapped along the LLCOP route are as might be expected.

The information on the physical and chemical properties of the soils (Kenya Soil Survey, 1997) dataset indicates most soils along the LLCOP in Lamu County are predominantly described as sandy in texture and well drained. There are areas of extremely slow draining clayey soils north of Station 16 near the boundary with Garissa

County and a small area of slow draining loamy soils mapped near the coast before the LLCOP reaches Lamu Marine Terminal.

1.9 Summary Mapped Soil Distribution in the AoI

The common soils (occupying greater than 8 % of the centreline) along the proposed route are Eutric Planosols, Calcaric Regosols, Gleyic Solonetz, Haplic Solonetz, Haplic Luvisols and Ferric Lixisols. Specific extents along the pipeline centre line for each soil are found in Table 2. Soils near the Lokichar Export Facility are more variable than the soils adjacent the Lamu Marine Terminal. Regosols and Solonetz are found sporadically along the route with few sections greater than 10 km in length. Fluvisols are found near water crossings and on flood plains of rivers.

Soil texture varies from sandy to clayey along the AoI. A summary of the extent of each soil texture determined from ICPAC (Kenya Soils Survey, 1997) mapping is presented in Table 2. Soils are typically finer textured at the beginning of the route Kilometre Post (KP) 0 and textures become coarser around KP650 until the Lamu Marine Terminal.

Table 2: Extent of Different Soil Textures Along the Pipeline Centreline

Soil Texture	Extent of Pipeline	
	Kilometre (km)	%
Sandy	88	10.7
Loamy	101	12.2
Clayey	513	62.5
Very Clayey	121	14.7
Total	825	100

1.10 Soil Erosion Risk

The Wood Geohazard report (Wood, 2018) includes information about the soil types present along pipeline and a qualitative erosion risk assessment. Based on common practice in the oil and gas industry, the report used a threshold of 10t/ha/year as acceptable upper limit, which was reduced to 5t/ha/year for sensitive sites (e.g. slopes along rivers). Most of the soils encountered were classified as medium or high erosion potential. Those classified as low had higher erosion potential when present on slopes. The erosion risk presented in the Wood Group report for each soil type is summarised in Table 3. The locations along the pipeline where these soil types are present is also indicated.

Table 3: Summary of Soil Erosion Risk Rating

Soil Reference Group	Risk Rating	Rationale	Pipeline Locations
Arenosols	High	Prone to wind erosion and easily turned to dunes.	0.00 km to 6.34 km
Calcisols	Medium/ High	Lack of vegetation makes prone to wind and water erosion.	110.50 km to 121.60 km 292.31 km to 300.40 km 414.39 km to 440.34 km

Soil Reference Group	Risk Rating	Rationale	Pipeline Locations
Cambisols	Medium/ High.	Erosion likely on slopes when surface is bare	121.60 km to 128.41 km 150.92 km to 181.73 km 202.08 km to 214.96 km 301.70 km to 335.37 km 358.24 km to 391.03 km
Fluvisols	Medium	Erosion potential in vicinity of rivers	43.70 km to 49.81 km 88.77 km to 95.15 km
Lixisols	High	Crust can develop leading to low rain infiltration, presenting an erosion risk from sudden overland flows and wind.	253.53 km to 262.65 km 268.95 km to 274.12 km 279.29 km to 287.09 km 468.22 km to 522.00 km 655.24 km to 677.91 km
Luvisols	Low/ Medium	Typically low, but erosion prone on slopes.	128.41 km to 150.92 km 181.73 km to 202.08 km 214.96 km to 253.53 km 287.09 km to 292.31 km 391.03 km to 414.39 km
Phaeozems	Low	Erosion by wind may occur after prolonged droughts.	811.17 km to 814.73 km
Planosols	Low	Wind erosion possible if soils allowed to dry out.	63.22 km to 75.38 km 631.03 km to 655.24 km 749.66 km to 811.17 km 814.73 km to 824 km (Lamu Marine Terminal)
Regosols	High	Weakly developed soil structure and horizons makes these soils prone to erosion	6.34 km to 36.02 km 56.89 km to 60.48 km 75.38 km to 77.92 97.78 km to 110.52 km 262.65 km to 268.95 km 281.60 km to 284.91 km 335.37 km to 358.24 km
Solonchaks	Medium	Erosion due to wind	49.81 km to 56.89 km
Solonetz	Medium	Erosion due to wind	36.02 km to 43.70 km 60.48 km to 63.77 km 77.92 km to 88.77 km 95.15 km to 97.00 km 97.00 km to 97.78 km 274.12 km to 279.29 km 440.34 km to 468.22 km 587.31 km to 631.03 km 677.91 km to 749.66 km

1.11 Geotechnical Survey Data

1.11.1 Methods

An investigation into ground conditions along the LLCOP route is ongoing. This baseline includes information obtained from 46 trail pit locations (35 with draft trial pit log sheets, 8 with draft log sheets and final logs, and 3

with final logs) and 13 boreholes (Treavic Geosystem and Engineering Ltd., 2018/2019). The locations of the trial pits and boreholes are shown on Drawings 2a to 2h.

The trial pits were excavated to depths between 1.5 m and 2 m below ground level (bgl) and were mainly located in Samburu County, but some were also in Meru County or Garissa County. The presence of soils was noted when encountered. Boreholes were also installed to depths of between 10 m and 15 m bgl in the Lamu Marine Terminal area and at selected watercourse crossing in Samburu County. They were drilled using a rotary auguring method and the ground conditions encountered were logged and cores taken were photographed.

1.11.2 Results

The presence of 'Topsoils' was noted at the surface in trial pits located at KP104, KP116, KP145, KP170, KP195, KP270, KP272, KP284, KP290, KP296 and KP298, which are all located in Samburu county. The thickness of the material identified as topsoils ranges from 0.2 m to 0.6 m. The material is typically described as silty clay, sandy silt or silty sand that is reddish, yellowy orange or yellowy brown in colour.

Laterites were occasionally encountered in the trail pits in Samburu County (KP100, KP116, KP195, KP245 and KP350). These were usually logged between 0.3 m and 1.2 m below the surface. Soils were not recorded in any of the other trial pit locations or in any of the boreholes. The surface geology was otherwise typically logged as comprising silty sands, silty clay, gravelly silt, gravelly sand and silty gravels.

1.11.3 Limitations

The limitations of the available primary soils data are as follows:

- The field data set is incomplete for the full chainage of the LLCOP. There is no data in Turkana County, or most of Isiolo, Meru, Garissa or Lamu Counties;
- The topsoils, where encountered, have not described or classified;
- There is no laboratory data to provide information on the composition or properties of the soils; and
- No infiltration testing has been undertaken to provide primary information on drainage.

2.0 GEOLOGY AND GEOHAZARDS

2.1 Area of Influence

Because geohazards located outside this AoI have the potential to influence the Project, the geohazards baseline information (and the geology associated with the geohazards) has been collated for a wider region setting.

2.2 Geology

2.2.1 Overview of the Regional Geology

Mapped rock formations in Kenya can be grouped into five major geological successions: the Archean (Nyanzian and Kavirondian), the Proterozoic (Mozambique Belt and Bukoban), Palaeozoic/Mesozoic sediments, Tertiary/Quaternary volcanics and Tertiary/Quaternary sediments (Wood, 2018).

The 1:10,000,000-scale geological map of Kenya with an overlay of the LLCOP route is presented in Figure 3 (background mapping from CGMW, 2016). This scale geological mapping provides an overview of the age and type of geological formation along the LLCOP and indicates that from the Lokichar Export Facility to Station 9 the surface geology comprises a complex sequence of Neoproterozoic metamorphic basement rocks, Quaternary sediments and volcanic deposits of various ages. From Station 9 near the Garissa County boundary

to the Lamu Marine Terminal (about half the length of the LLCOP) the surface geology comprises Quaternary sedimentary deposits.

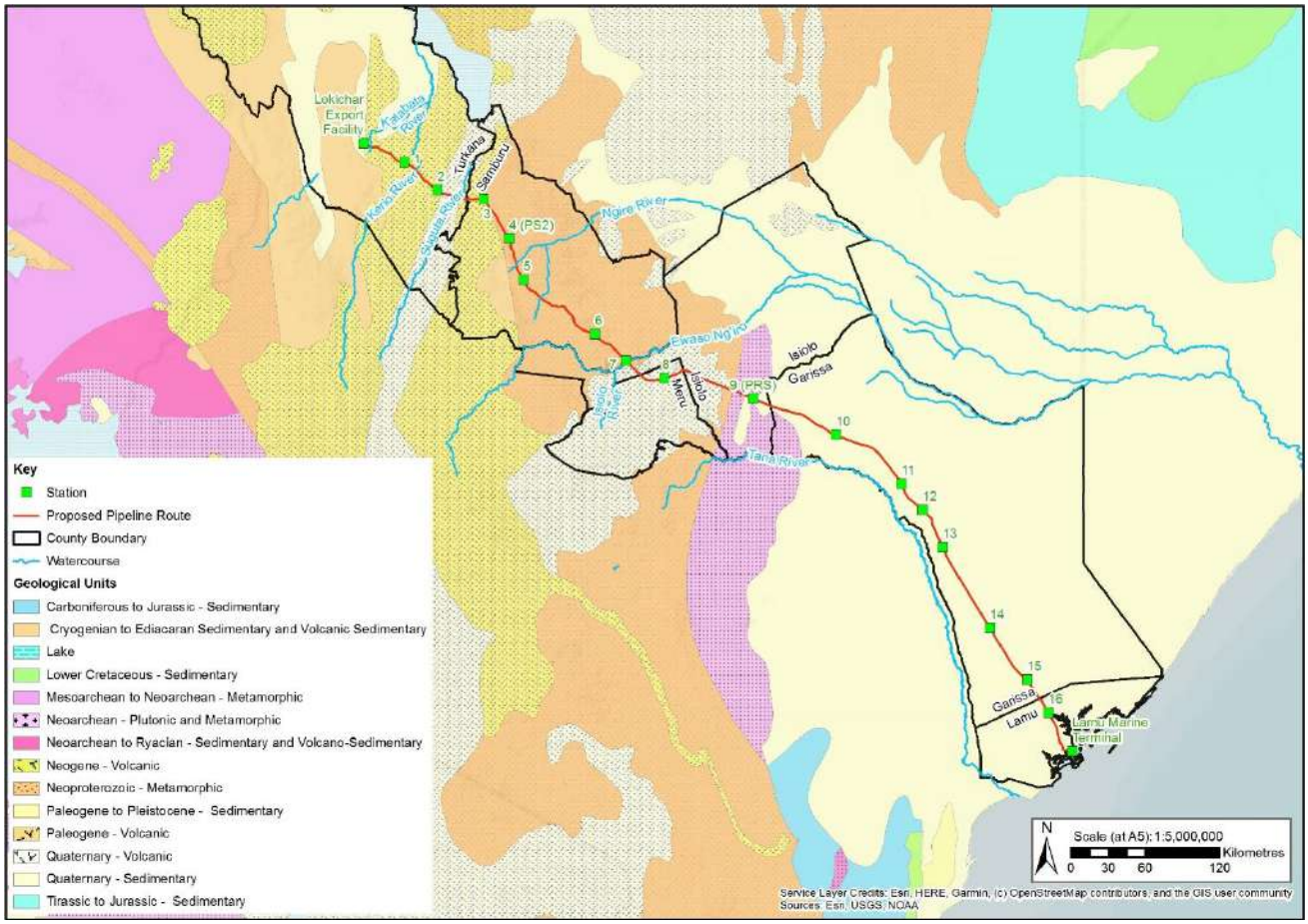

Figure 3: General Geology of Kenya (1:10,000,000 Scale)

As an overview, the proposed pipeline crosses the following geology:

- Tertiary and Quaternary sediments and volcanic rocks in Turkana County and Suguta valley;
- Palaeozoic/Mesozoic basement rocks of the Mozambique belt, locally overlain by more recent Quaternary volcanic lavas in the Samburu and Isiolo regions; and
- More recent Quaternary sediments in the Garissa, Tana and Lamu regions.

The Tertiary and Quaternary deposits are characterised by faulting and short-lived basins resulting in complex successions of volcanics, lacustrine (lake) and fluvial (river) sediments. Quaternary sediments found along the LLCOP route include alluvial (i.e. deposited by running water) and lacustrine sediments of the rift valley, and recent and paleo soils, alluvial beach sands, evaporites, fossil coral reefs and sandstones towards the coast. There are also young volcanic deposits of the rift valley. Older, tertiary sediments include coastal sediments, late Miocene and Pliocene volcanics, terrestrial and lacustrine inland sediments.

The old basement rocks mapped at the surface between Stations 3 and 7, and near Station 9, are of the Mozambique Belt. The Mozambique Belt is a structural unit within which a variety of metasedimentary and meta-igneous rocks are found. In most of these rocks, the degree of deformation is intense and is of high metamorphic grades. Within the Mozambique Belt basic igneous complexes are found and range in size from bosses to small dykes. Some of the older basic intrusions have undergone deformation and metamorphism to

give orthoamphibolites and charnockitic gneisses. Basic and granitic intrusions are known in the Mozambique Belt. The most characteristic feature of the Mozambique Belt is its structural trend, which is near north-south along the entire belt (Wood, 2018). The rocks of the Mozambique Belt are likely to underly the more recent volcanic deposits in Isiolo and Meru Counties.

The coastal geology is sedimentary in origin and deposits range in age from Triassic to recent. The Duruma Sandstone series is the oldest and was deposited under deltaic, lacustrine or neritic (shallow sea – low water down to 200 m depth) conditions. There are also upper Mesozoic sediments that comprise marine limestones and shales, with occasional sandstones. The Cenozoic to recent rocks mostly comprise marls and limestones. Also present are Quaternary wind-blown sands, limestones, cemented sands and coral sands. An extensive fossil reef is located a few metres above the current sea level along much of the Kenyan coast (United Nations Development Programme *et al.*, 2006).

Larger scale (1:2,00,000) mapping of the geology of Kenya with an overlay of the LLCOP route is presented in Mapped Geology Drawings 3a to 3f. This scale of mapping highlights the complexity of the geology particularly in the northern half of the LLCOP. The geology shown on this mapping is discussed further by County in the following sections.

2.2.2 Geology of Turkana County

An extract of the geology of Turkana County taken from the 1:2,000,000 scale geology of Kenya (compiled in 2004 by the Mines and Geology Department of Kenya) and overlain by the LLCOP route is shown on Mapped Geology Drawings 3a to 3b.

The crystalline basement rocks in Turkana County that underly the more recent surface geology are of Precambrian age and comprise gneisses, schists and granulites that were predominantly sedimentary grits, sandstones, limestones and shales before being subject to periods of intense heat and pressure around the beginning of the Cambrian Period that lead to their metamorphosis. In some areas there are considerable developments of migmatites, which have arisen by the injection of granitic magma into the gneisses and schists, or by their permeation by granitic fluids. Several granites of northern and north-western Kenya are the products of granitization of metasediments. Pegmatites of various types are frequently associated with the Basement System rocks, particularly where metasomatic action has been prominent. The metamorphic and granitic rocks are intensely folded giving the them a banded appearance.

From the early Cambrian until the Jurassic or Cretaceous periods the area formed part of the Pangaea ‘supercontinent’, which then broke apart during the Middle Jurassic and led to the development of a series of rifts running roughly east-west across Africa with the Anza Graben running northwest-southeast across what is now northern Kenya. During that time, the areas was above sea level and the land was subject to erosion and continental deposition. During the Eocene epoch (part of the Tertiary period), further rifting occurred in a roughly north-south direction and cut across the earlier rifting.

Later in the Tertiary period (late Oligocene to early Miocene epochs) a series of half grabens began to develop west and south-west of the current position of Lake Turkana. The rifting was preceded and accompanied by volcanism. Towards the middle Miocene a new series of inner half-grabens began to develop, which include the North Lokichar, Turkana and Kerio Basins.

The basins that resulted from the development of the grabens now contain Tertiary and Quaternary material, including volcanic rocks (predominantly alkaline lavas and tuffs) and a series of sedimentary deposits that were deposited by rivers or in ephemeral lakes. These Tertiary deposits include the Turkana Grits, and sandstones (including the Lower and Upper Auwerwer Sandstones) separated by shales. The Turkana Grits, which comprise grits, sandstones, silts and sandy limestones, are derived from the erosion of the Precambrian

basement rocks. The Turkana Grits are highly fractured and jointed. The volcanic sequence includes basalts of various composition and phonolites, which are fine grained extrusive rocks.

Unconsolidated alluvial material is also present in the valleys. The geology that underlies the position of the Lokichar Export Facility and dominates the area between the Kalabata River to the east and the ridge of crystalline basement to the west, is mapped as Alluvium. The alluvial material comprises Plio-Holocene unconsolidated alluvial fan material that have in places been redistributed by ephemeral stream, and fluvial sediments. There are localised outcrops within the Alluvium of the basement rock and Tertiary volcanics.

2.2.3 Geology of Samburu County

Samburu County lies on the eastern shoulder of the Rift Valley. The area has an average altitude of 2051 m above sea level and includes steep-dipping terrain, hills and flood plains. The undulating topography reflects the general geology of Samburu County, which can be divided in two broad zones: the eastern side covered mainly by the NeoProterozoic crystalline basement rocks (Mozambique Belt) with intrusive igneous materials, and the western side covered by basic lava of Paleogene-Neogene volcanics of the rift valley. More recent Quaternary sediments are also present at the surface in this County.

The NeoProterozoic crystalline basement rocks (Mozambique Belt) are metamorphosed sedimentary deposits that formed gneisses, schists, quartzites and marbles. The intrusive igneous materials are mainly granodiorites and granites, but also include pegmatites, quartz reefs, aplites and diorites.

Following successive stages of uplift and erosion of these basement rocks that lasted until the Paleogene, lavas were extruded producing basalts in the early stages of the volcanism and phonolites and trachytes in later stages.

The Quaternary sediments consist of alluvium and colluvium, calcareous and lacustrine sediments, agglomeratic ash and residual soils that have formed from weathering of the crystalline basement rocks and the Paleogene volcanics and subsequent deposition in the lower regions and river valleys. Sinuous and braided shallow channels created by sporadic flow after heavy rains are marked by medium grained sands with gravel bars which top the alluvium.

An extract of the geology of Samburu County taken from the 1:2,000,000 scale geology of Kenya (compiled in 2004 by the Mines and Geology Department of Kenya) and overlain by the LLCOP route is shown on Mapped Geology Drawings 3b and 3c.

2.2.4 Geology of Isiolo County

The geology of Isiolo County includes a combination of metamorphic rocks, sedimentary rocks and other more recent superficial deposits. Tertiary rocks (Olive Basalt) are found in the northern parts of the county where oil exploration has been going on. The areas covered with Tertiary marine sediments have a high potential for groundwater harvesting. The county has considerable deposits of limestone and sand that are used in the local building industry.

An extract of the geology of Isiolo County taken from the 1:2,000,000 scale geology of Kenya (compiled in 2004 by the Mines and Geology Department of Kenya) and overlain by the LLCOP route is shown on Mapped Geology Drawing 3c. This geological mapping shows that the LLCOP route predominantly passes over Quaternary colluvial (unconsolidated) deposits and extrusive igneous deposits. An outcrop of the Neoproterozoic bedrock of the Mozambique Belt is mapped approximately 18 km northwest of Station 9. The Mozambique Belt is an old basement, basic igneous complex (i.e. having a relatively low silica content between 45% and 52%) that has been subject to metamorphism and deformation.

2.2.5 Geology of Meru County

An extract of the geology of Meru County taken from the 1:2,000,000 scale geology of Kenya (compiled in 2004 by the Mines and Geology Department of Kenya) and overlain by the LLCOP route is shown on Mapped Geology Drawings 3c and 3d. The geology along the LLCOP route as it passes through Meru is mapped as comprising Quaternary and Plio-quaternary extrusive igneous rocks that are basaltic in composition.

These volcanic rocks are part of the Maua eruptive volcanic rock system. They mainly comprise volcanic ash, basalt flows, phonolites and tuffaceous material originating from pyroclastic events that occur in layers. These rocks weather to clays and laterites, which can be found in the Nyambene hills and Laare regions. Between the lava flows old land surfaces can be found that were subject to weathering, so can have a reasonable porosity and permeability and act as aquifers.

The volcanic rocks are underlain by the Neoproterozoic bedrock of the Mozambique Belt. The basement rocks are not mapped as being exposed at the surface along the LLCOP route within Meru County, but are exposed at the surface towards west. The basement rocks are folded and fractured coarse-grained gneisses and fine-grained schists that have been intruded by pink quartzo-felspathic pegmatites. Biotite, hornblende and quartz feldspar gneisses are abundant in the area. The fractured and weathered zones of these rocks can act as aquifers.

2.2.6 Geology of Garissa County

Most of the land in Garissa County is either fairly level or gently undulating. The topographic elevation rises to the north where the plains are broken up by isolated inselbergs or discontinuous hills and ridges of erosion-resistant rocks.

Garissa County is geologically part of the Anza rift basin, which can have an accumulation of up to 4000 m of Maastrichtian (late Cretaceous) to Paleogene (Tertiary) continental clastic deposits. The basin runs inland from the coast in a north-western direction and links the Lamu area of southern Kenya to the South Sudan rifts. Within Garissa, it constitutes the rift termination zone of the Central African Rift System in the northeast part of Kenya. Faulting in this basin was initiated in the Mesozoic period and has intermittently been activated through to Tertiary period. Fluvial-lacustrine, deltaic and marine sediments have infilled the basin.

Principal geological formations represented in the Tana River Basin are igneous, metamorphic, sedimentary, and unconsolidated rocks in the Tana Delta. Quaternary and Tertiary (Cenozoic) sedimentary deposits occupy the middle and lower areas of Garissa County and cover about two thirds of the basin. These include alluvial deposits with some pockets of Marine and Lacustrine sediments. River terrace deposits from past higher river levels can also be found in the Tana River Basin. Quaternary Volcanics are found in its upper reaches around Mount Kenya (Veldkamp et al., 2007). The Quaternary Volcanics comprise Phonolites, trachyphonolites, basalts, ignimbrites, and trachyte of different phases of volcanism (Hughes et al., 2012). The surface geology of the Tana Basin is partially underlain by the metamorphic gneisses, schists, migmatites, quartzites, and calc-silicate rocks of the Mozambique Belt (Schlüter, 2008).

An extract of the geology of Garissa County taken from the 1:2,000,000 scale geology of Kenya (compiled in 2004 by the Mines and Geology Department of Kenya) and overlain by the LLCOP route is shown on Mapped Geology Drawings 3d and 3e. This indicates that the LLCOP route passes over the Quaternary and Tertiary sedimentary materials along its entire length through Garissa County.

2.2.7 Geology of Lamu County

The geology of Lamu County taken from the 1:2,000,000 scale geology of Kenya (compiled in 2004 by the Mines and Geology Department of Kenya) is shown on Mapped Geology Drawing 3f.

Lamu County and the LLCOP route is covered with Quaternary deposits. The Quaternary deposits in Lamu County include estuarine deposits, sand, clay and coral limestone. These deposits have been categorized into eight different types (ESF Consultants, 2016) including:

- Barrier Island complex – these are modern beach deposits formed due to deposition of erosional material from coral reefs;
- Undifferentiated quaternary sands – these comprise Pleistocene sandstones and sands, grey or yellow in colour, and are also known as Kilindini sands. They cover large portions of Lamu County, vary in thickness and have inclusions of clay/marls and coral limestone;
- Near surface coral limestone – these deposits contain large proportions of coral breccia, calcite and quartz grains. Surface outcrops are uncommon, and they are typically overlain by quaternary sands, sand dunes or beach deposits. They have a maximum thickness of about 100 m, but are generally between 30 m and 50 m thick;
- Beach deposits – these are paleo-features overlying either quaternary sands or corals. They have variable composition ranging from clays and sand to coral breccia. Both consolidated and unconsolidated forms of beach deposits occur. They can be up to 10 m thick and are characterised by low ridges;
- Deltaic deposits – these are contemporary deposits predominantly clayey in texture;
- Offshore corals – these are contemporary coral reefs;
- Alluvial deposits – these comprise fine-grained material that is generally clayey with some sand. The Alluvial deposits are found in non-estuarine areas of the Duldul and Dodori Rivers; and
- Contemporary estuarine deposits – these are sand deposits with clay lenses and are very similar in composition to the Quaternary sands. These deposits are typically located in mangrove swamps.

The coastline of Lamu is characterized by sand dunes. The sand dunes formed over a long period of time by winds blowing from the Indian Ocean picking sand particles and depositing them in a linear formation along the coastline to form a barrier between the sea and the mainland. Three different age groups of sand dunes occur in the area. Firstly, there is the Mundane Range type composed of Pleistocene sands. These are often reddish in colour due to staining by ferrous oxides. Secondly, there are the near coastal sand dunes which occur predominantly south of Lamu Island. These are composed mainly of yellow and off-white sands and are of Holocene age. Finally, the recent sand dunes that fringe the coastline on Lamu Island and Kiongwe area on the mainland.

2.3 Geohazards

2.3.1 Regional Tectonic Setting and Faulting

The regional tectonic setting is detailed in the Geohazard Desktop Study (Wood, 2018) and is summarised in the section. The East African Rift System (EARS) is a zone of crustal extension where the Eastern African continent being pulled apart and split into the Nubian and Somalia Plates as it separates from the Arabian plate. It runs over 3000 km from Mozambique to the Afar depression. The crustal extension causes an elongated system of normal faults; the surface expression of which is a series of basins (rift valleys) that are separated from each other by uplifted sections that form escarpments.

As it extends southwards, the EARS splits into eastern (active) and western (passive) branches. The Kenya Rift is part of the active eastern branch of the EARS. The rifting at the Kenya Rift started from Turkana and extended southwards towards Magadi to Mozambique. In the area of Lake Turkana, the Kenya Rift is also referred to as the Turkana Rift. The northwest end of the LLCOP is in the Lokichar Basin that has formed within

the EARS. The main active rift with respect to the LLCOP is the Suguta Valley. A dramatic increase in topographic elevation around the boundary between the Turakana and Samburu counties marks the eastern edge of the EARS

The northern end of LLCOP is where most of the major faults shown on small scale mapping are present (see Figure 4). The mapped major faults become less frequent through Samburu and Isiolo Counties, and none are mapped where the pipeline passes through Meru, Garissa or Lamu Counties.

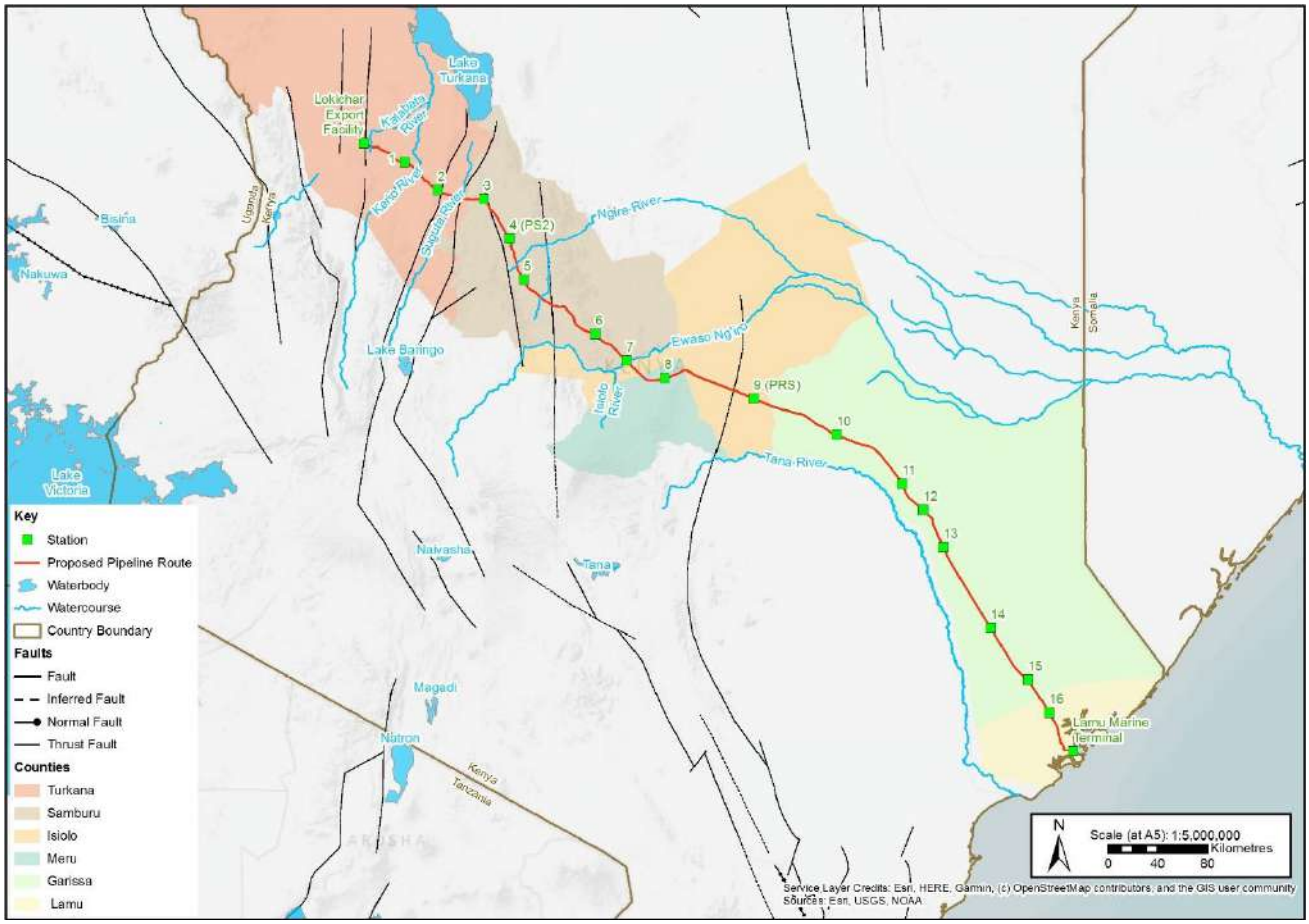

Figure 4: Major Mapped Faults

2.3.2 LLCOP Faulting and Tectonic Constraints

The Geohazard Desk Study (Wood Group, 2018) states that "*the closest and therefore most significant faults* [in relation to the LLCOP] *are those related to the Kenya Rift and in particular the Lokichar Fault and faults bounding the Suguta Valley*". Crossing active faults is a geohazard because their movement may cause permanent ground deformation and displacement or breaks of, and consequently damage to, the pipeline or other engineering facilities.

In order to establish the location of faults along the LLCOP and their activity, the Geohazard Desk Study (Wood Group, 2018) first identified structural lineaments and considered evidence of activity. The focus of the work was on the first 250 km of the LLCOP because this is where the Lokichar Fault and the faults bounding the Suguta Valley are located. The map of structural linearments in this area is reproduced in Figure 5. The review that was then undertaken of earthquake distribution provided no clear evidence of seismic events that could be directly attributed to these features. From this work, the Lokichar Fault was determined to be reportedly inactive.

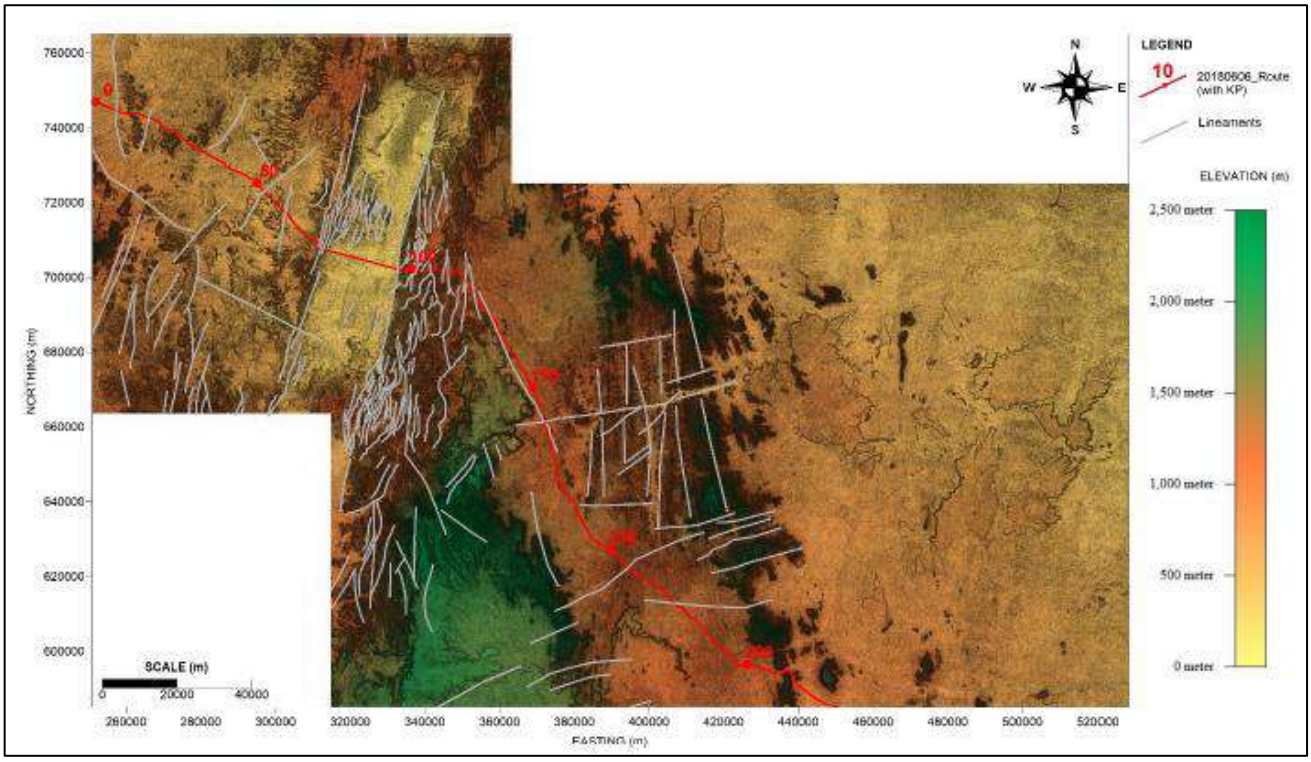

Figure 5: Structural Linearments in the Sugata Valley (after Wood Group, 2018)

This first stage was then ground-truthed to find evidence of recent sediment deformation and fracturing that could be associated with active techtonics and was considered in conjunction with geological mapping. The main active rift within the LLCOP project area was determined to be the Sugata Valley. The basin in which the valley is located was formed by normal faulting. The valley base has an elevation of approximately 300 m and is approximately17 km to 21 km wide. The work as part of the Geohazard Desk Study (Wood Group, 2018) observed and mapped up to 20 active and potentially active faults, mainly in the Turkana province and at the borders of the Suguta (Rift) valley. 20 locations were identified where the LLCOP route crosses a fault lineament indicating the pipeline is potentially at risk from active faulting.

2.3.3 Seismicity

Kenya is vulnerable to seismic activity associated with the presence of the active EARS. The overall earthquake hazard level is considered low in Kenya compared to neighbouring countries and the highest hazard levels within Kenya are in the northwest and southwest of Kenya (GSDRC, 2013).

The Geohazard Desk Study (Wood Group, 2018) presents collated information on seismicity. The World Health Organisation Seismic Distribution Map included in the desk study is presented in Figure 6. The location, magnitude and depth of earthquakes recorded in the region of the LLCOP between 1912 and 2018 are presented in Figure 7 and Figure 8.

The eastern branch of the EARS in which the Sugata Valley is located has been characterized by earthquake swarms of low magnitude. Seismicity is characterized by mainly shallow (<40 km) normal faults and volcano-tectonic earthquakes, with most events occurring between 10 km and 25 km depth.

Overall, the Geohazard Desk Study (Wood Group, 2018) concludes that the information collected shows a decrease of seismic hazard towards the coastal area (Lamu). It presents a conservative estimate based on a 4.5 mm/yr extension rate for the rift in the report's study area, that implies magnitude 7 seismic events have a recurrence interval between about 500 and 1000 years. The study also states that, in comparison to the whole of the EARS, the Kenya Rift shows a relatively low seismic activity.

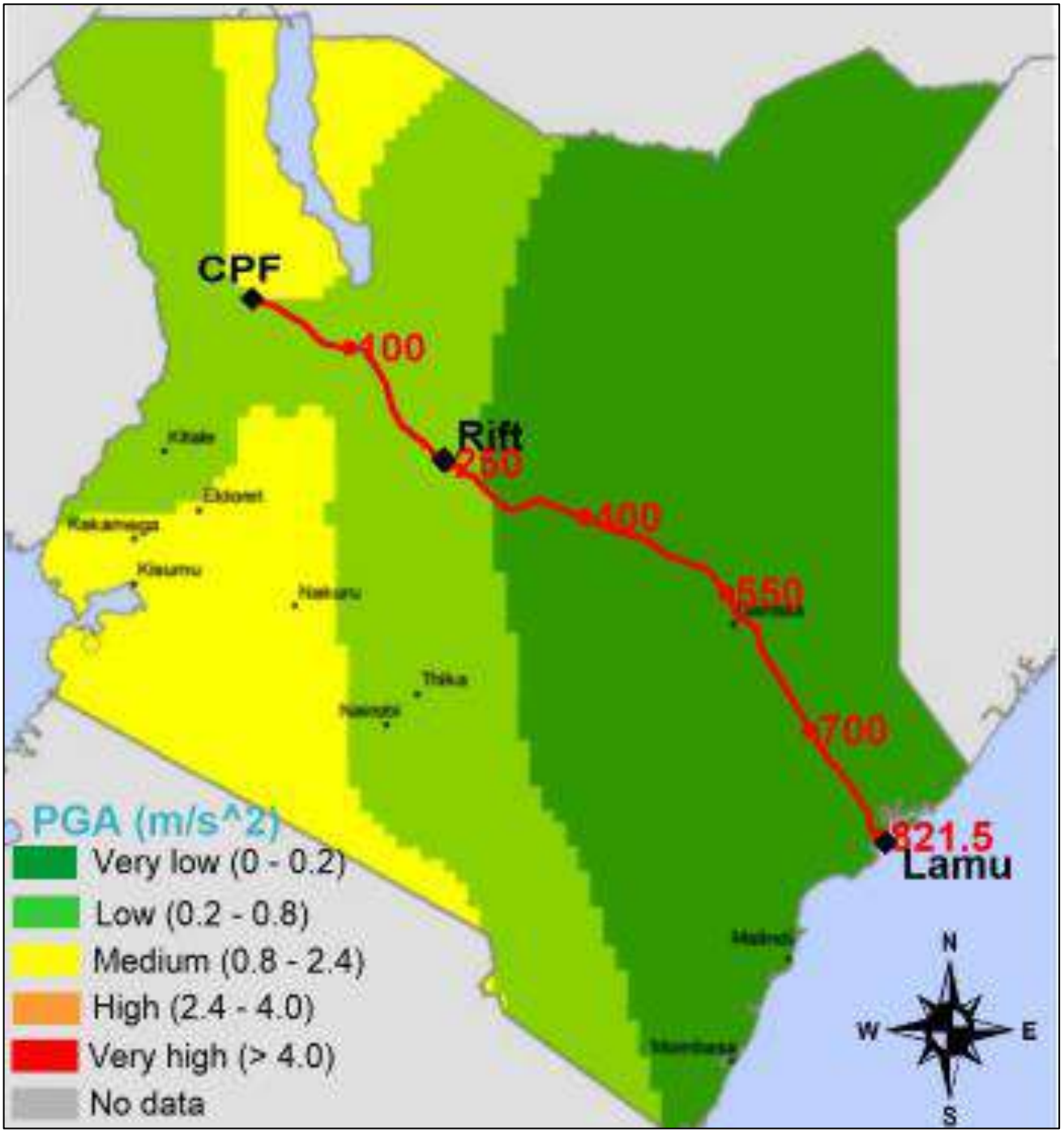

Figure 6: World Health Organisation Seismic Distribution Map (after Wood Group, 2018)

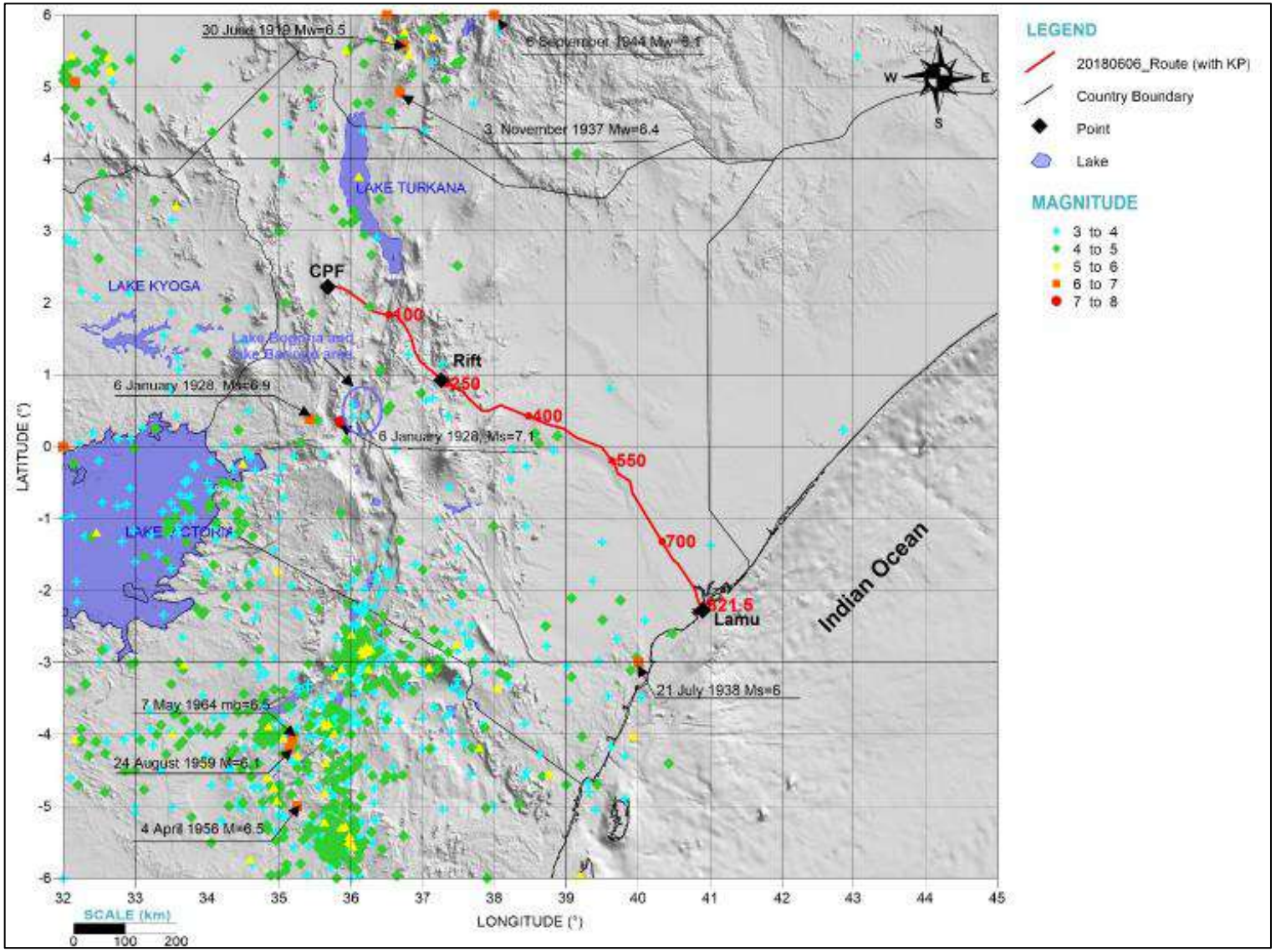

Figure 7: Earthquake locations and magnitude 1912-2018 (after Wood Group, 2018)

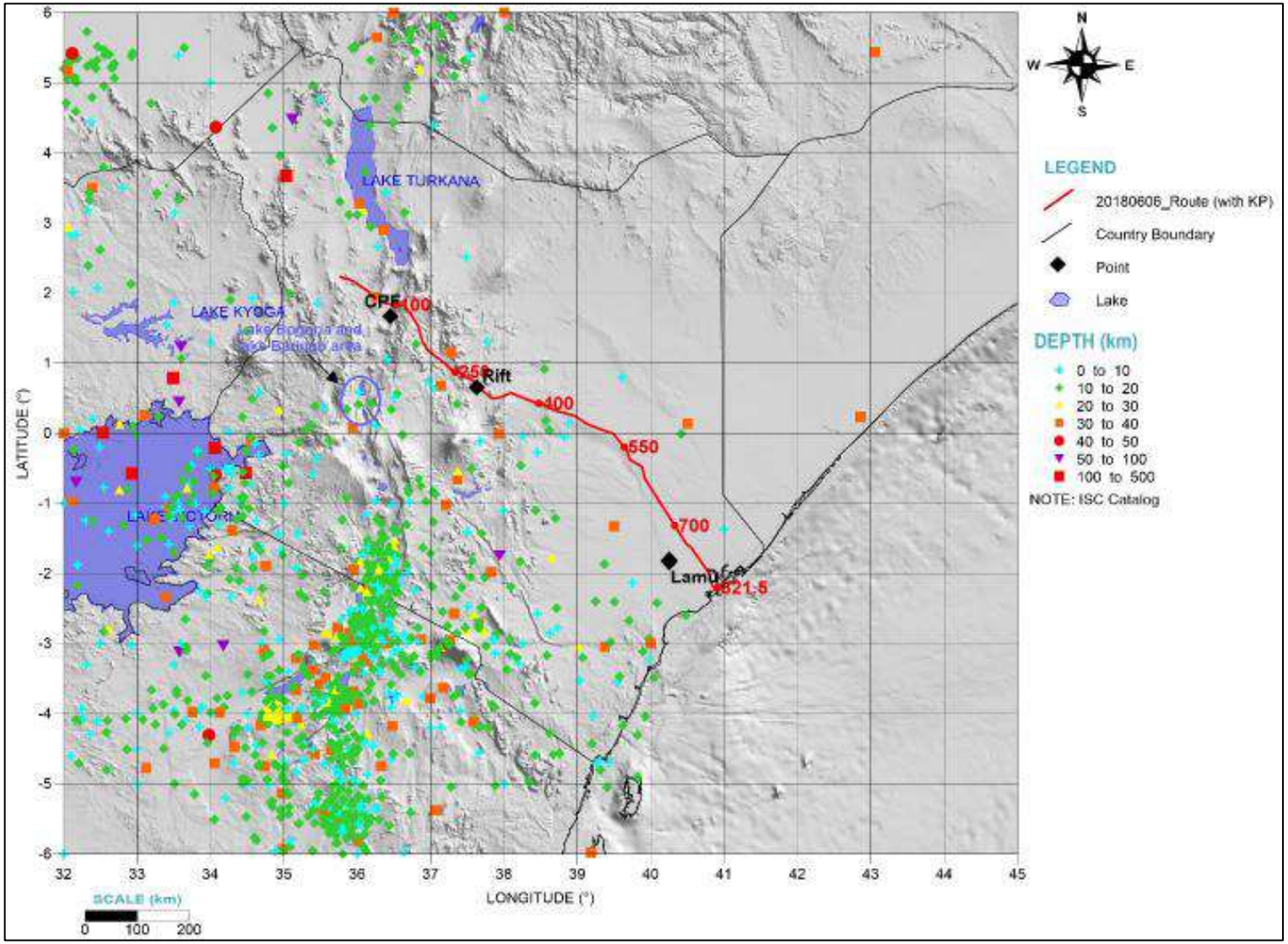

Figure 8: Earthquake depth distribution 1912 to 2018 (after Wood Group, 2018)

2.3.4 Volcanicity

Due to the extension of the EARS, active volcanoes are present. Active volcanoes are mapped along the eastern side of the EARS towards the northern end of the LLCOP (see Figure 9). Volcanoes represent potential sources of impact to the LLCOP because of lava flows and pyroclastic flows.

The Geohazard Desk Study (Wood Group, 2018) identified no active volcanicity along proposed LLCOP route. The closest volcano to the proposed route is the Namarunu, which last erupted c 8,500 years ago and is located in the Suguta valley about 15 km north. The next closest volcano is Emuruangogolak in the Sugata Basin, 26 km to the southeast. The active shield volcano “the Barrier” on the southern shore of Lake Turkana is 50 km to the north of the LLCOP. All of the volcanoes in proximity to the LLCOP are shield volcanoes and have been effusive and non-explosive eruptions.

No pyroclastic fall deposits have been observed along the corridor and the proposed pipeline does not cross any recent lava flows, with the exceptions of KP300 to KP304 where a relatively recent (age unknown, but perhaps Holocene) lava flow deposit was observed (Wood Group, 2018). The Geohazard Desk Study concludes that the risk of lava flow impact on the pipeline can be considered negligible.

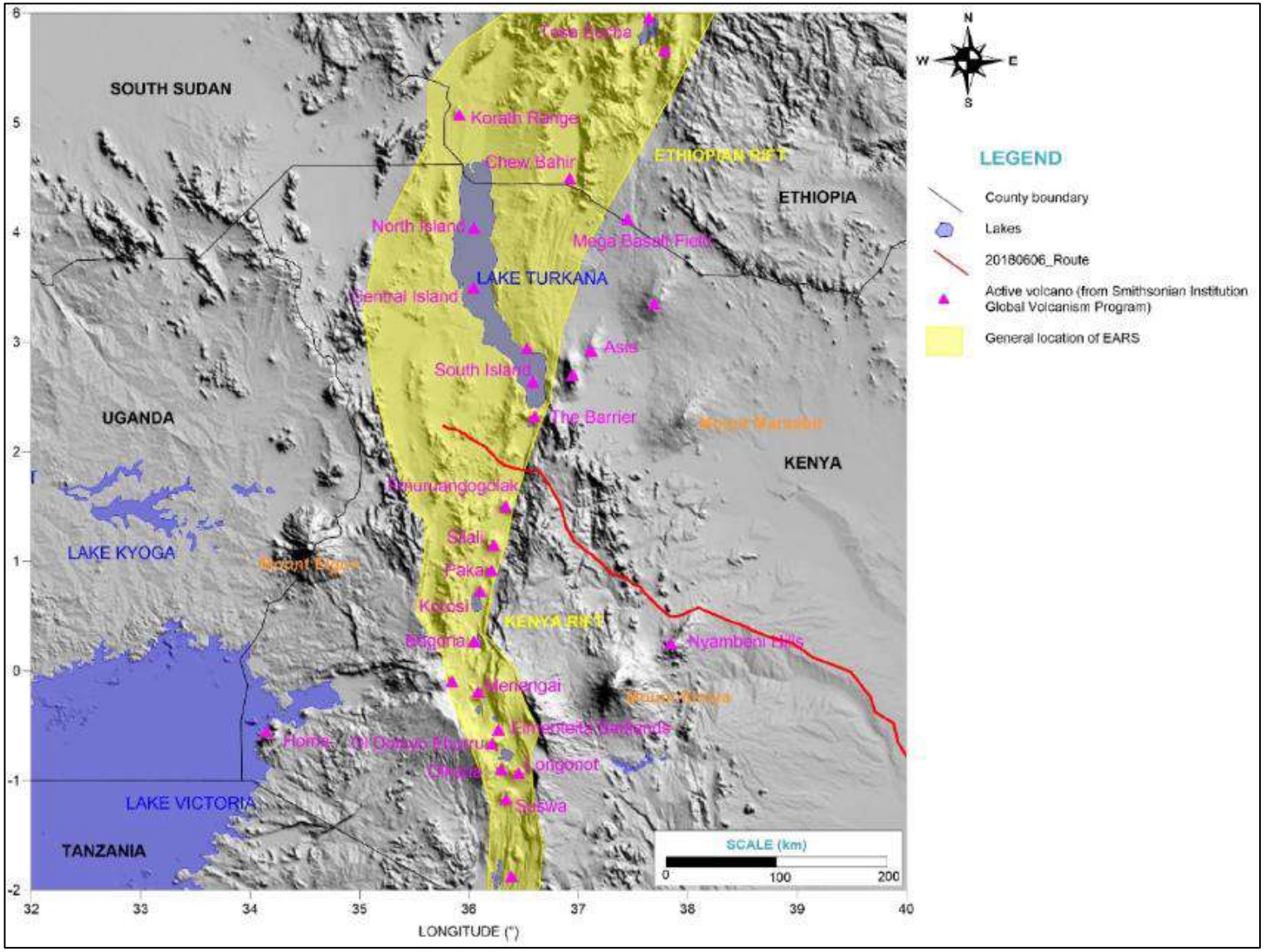

Figure 9: Active Volcanoes in the EARS (after Wood Group, 2018)

2.3.5 Landslides and Slope Stability

Landslides and slope instability can be caused by steep sloping topography. The majority of the landslides in Kenya are reportedly triggered by water and/or human activities, with slope saturation by water being the primary cause (Wood Group, 2018).

A map of landslide prone areas in Kenya (see Figure 10, taken from Wood Group, 2018; originally developed by the Kenya Mines and Geology Department) provides an indication on the distribution of observed landslides in the LLCOP region. However, the reporting of observed landslide will be biased to populated areas, so there could have been landslides along the less or un-populated parts of the LLCOP corridor that were not reported.

The Geohazard Desk Study (Wood Group, 2018) states that, although the LLCOP route unavoidably crosses areas of relatively steep topographic gradient, it does not appear to cross significant active landslides. Only one landslide crossing is listed in geohazards register. This is a very shallow potentially active landslide that was observed to cross the LLLCOP corridor at about KP97 and is located at the base of the Eastern Suguta valley escarpment. A second, well-defined landslide was observed near the LLCOP corridor at KP355. However, this landslide, did not directly intersect the LLCOP corridor. The Geohazard Desk Study (Wood Group, 2018) concludes that there it typically limited soil thickness along the LLCOP corridor, so the risk presented by landslides to the pipeline is negligible.

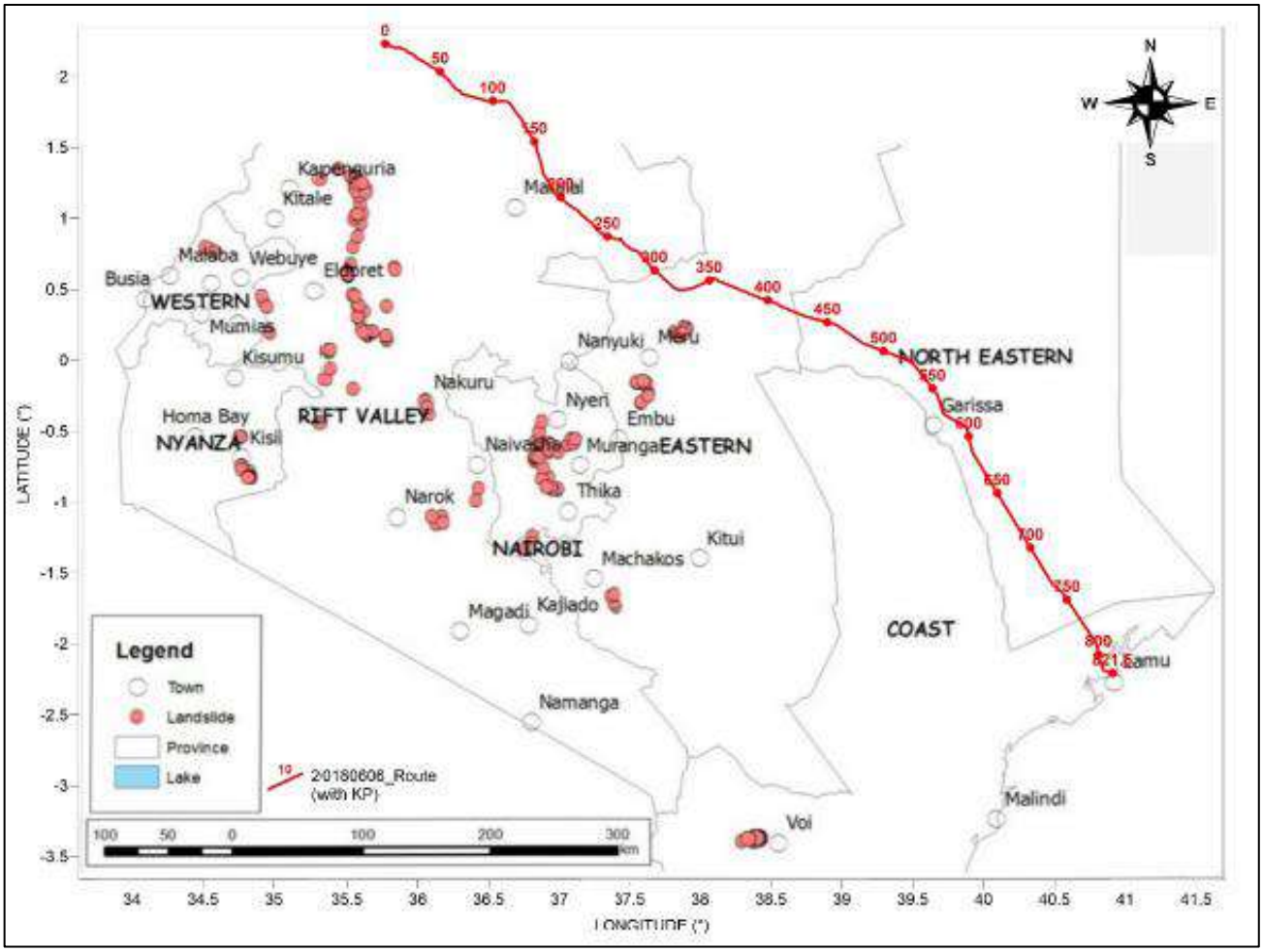

Figure 10: Landslide Prone Areas in Kenya (after Wood Group, 2018)

2.4 Geotechnical Survey

2.4.1 Methods

An investigation into ground conditions along the LLCOP route is ongoing. This baseline includes information obtained from 46 trail pit locations (35 with draft trial pit log sheets, 8 with draft log sheets and final logs, and 3 with final logs) and 13 boreholes (Treavic Geosystem and Engineering Ltd., 2018/2019). The locations of the trial pits and boreholes are shown on Drawings 2a to 2h.

The trial pits were excavated to depths between 1.5 m and 2 m below ground level (bgl) and were mainly located in Samburu County, but some were also in Meru County or Garissa County. The ground conditions that were encountered have been described, including the appearance and composition of the surface and bedrock geology. Boreholes were also installed to depths of between 10 m and 15 m bgl in the Lamu Marine Terminal area and at selected watercourse crossing in Samburu County. They were drilled using a rotary auguring method and the ground conditions encountered were logged and cores taken were photographed.

2.4.2 Results

The geology encountered in the boreholes drilled in Lamu Marine Terminal area did not encounter consolidated bedrock. All of the logged deposits comprise a combination of clayey sands and silty clayey sands. The mapped soils and geology in this area includes sandy montmorillonitic (clayey) planosols underlain by unconsolidated (colluvial) Quaternary sedimentary materials, which corresponds well with that encountered in the boreholes.

The trial pit logs indicate that the near surface ground conditions in Samburu County includes silty sands, silty clay, gravelly silt, gravelly sand and silty gravels. Bedrock was encountered in some trail pits where it was described as mica schist, limestone or basaltic rock. Most trail pits were dry. A selection of trial pit photographs along the LLCOP through Samburu County is presented in Figure 11. The material could represent the Quaternary alluvium or colluvium overlying NeoProterozoic crystalline basement rock that is shown by the geological mapping.

The two trail pits excavated in Meru County are at Kilometre Post (KP) 325 and KP350. The ground conditions encountered comprised reddish brown sandy silt material with cobbles or boulders overlying metamorphosed basalt and trachyticbasalt at KP325 and laterite at KP350. These descriptions are similar to the mapped soils and geology that indicated clayey or loamy soils over volcanics (extrusive igneous rocks).

The three trail pits located in Garissa County are KP450, KP500 and KP525. The ground conditions encountered were dry and comprised brown, orange-brown or red-brown silty sand and grey-brown sandy silt. These correlate well with the mapped red sandy and clayey soils. No bedrock was encountered.

KP100 - Dark brown cobbles with finer material to 0.6 m. Dark brown laterite to 1.2 m. Grey to white highly weathered mica schist to 1.8 m.

KP120 - Light grey silty clay with highly weathered limestone to 0.6 m. White to grey clayey silt with highly weathered limestone to 1.2 m. White to grey clayey silt with highly weathered limestone to 1.8 m with weathered schist in base.

KP170 - Columnar jointed basalt at surface. Brown sandy silt with thin layer of quartzite rocks to 0.6 m. Green slightly weathered mica schist to 1.2 m. Rock refusal below.

KP195 - Dark brown cobbles with finer material. Dark brown laterite to 1.2 m. Grey to white highly weathered mica schist to 1.8 m.

KP250 - Light brown silty sand to 0.6 m. Brown silty sand to 0.9 m. Grey brown cobbles and boulders, slightly gravelly with silt to 1.2 m. Whitish grey to black slightly weathered biotite schist to 1.8 m.

KP270 - Topsoil to 0.1 m. Light brown silty clay to 0.7 m. Dark brown silty clay with limestone to 1.9 m.

Figure 11: Selected Examples of Trail Pit Photographs from Samburu County

2.4.3 Limitations

The limitations of the available geological data are as follows:

- The field data set is incomplete for the full chainage of the LLCOP. There is no data in Turkana County, or most of Isiolo, Meru, Garissa or Lamu Counties;
- The majority of the geological information provided comes from shallow (typically less than 2 m deep) trail pits that do not confirm the mapped geology;
- The geological information provided from deeper intrusive investigations using boreholes is limited to Lamu Marine terminal and selected river crossing locations; and
- No geotechnical information or sampling results have been provided to understand the baseline conditions onto which the LLCOP facilities will be constructed.

ACRONYMS AND ABBREVIATIONS

bgl	below ground level
CGMW	Commission for the Geological Map of the World
kg	kilogram
km	kilometre
KSS	Kenyan Soil Survey
LLCOP	Lokichar to Lamu Crude Oil Pipeline
m	metre
mg	milligram
PSD	Particle Size Distribution
EOPS	Early Oil Pilot Scheme
EARS	East African Rift System

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Signature Page

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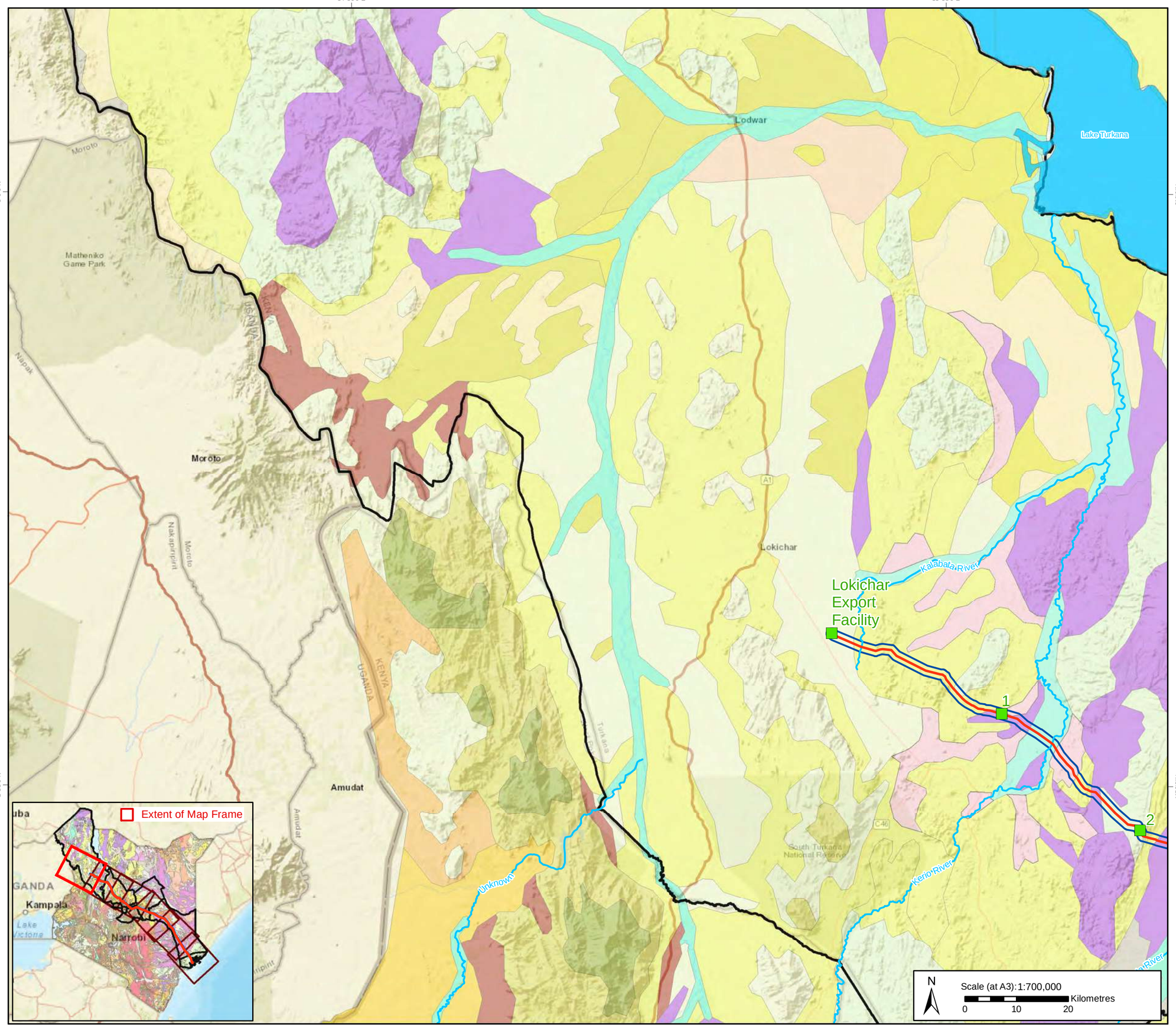
DRAWINGS

Mapped soils along the LLCOP

Groundwater and Surface Water Monitoring Locations

Mapped geology along the LLCOP



Drawing : 1a
Mapped Soils along the LLCOP

Mid-Stream Development

Key

- Station
- Proposed Pipeline Route
- Study Area
- County Boundary
- Waterbody
- Watercourse

Soils

- ACh - Haplic Acrisols
- ARb - Cambic Arenosols
- CLh - Haplic Calcisols
- CMc - Calcaric Cambisols
- CMd - Dystric Cambisols
- CMe - Eutric Cambisols
- CMu - Humic Cambisols
- FLc - Calcaric Fluvisols
- FLe - Eutric Fluvisols
- LPq - Lithic Leptosols
- LVx - Chromic Luvisols
- LXh - Haplic Lixisols
- PLe - Eutric Planosols
- RGc - Calcaric Regosols
- RGe - Eutric Regosols
- SCk - Calcic Solonchaks
- SNk - Calcic Solonetz
- No Data

Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License. The Soils datbase of Kenya KENSOTER dataset 1:1 million was compiled in 1996 by the Kenya Soil Survey with technical backstopping and training provided by ISRIC -World Soil Information 2019

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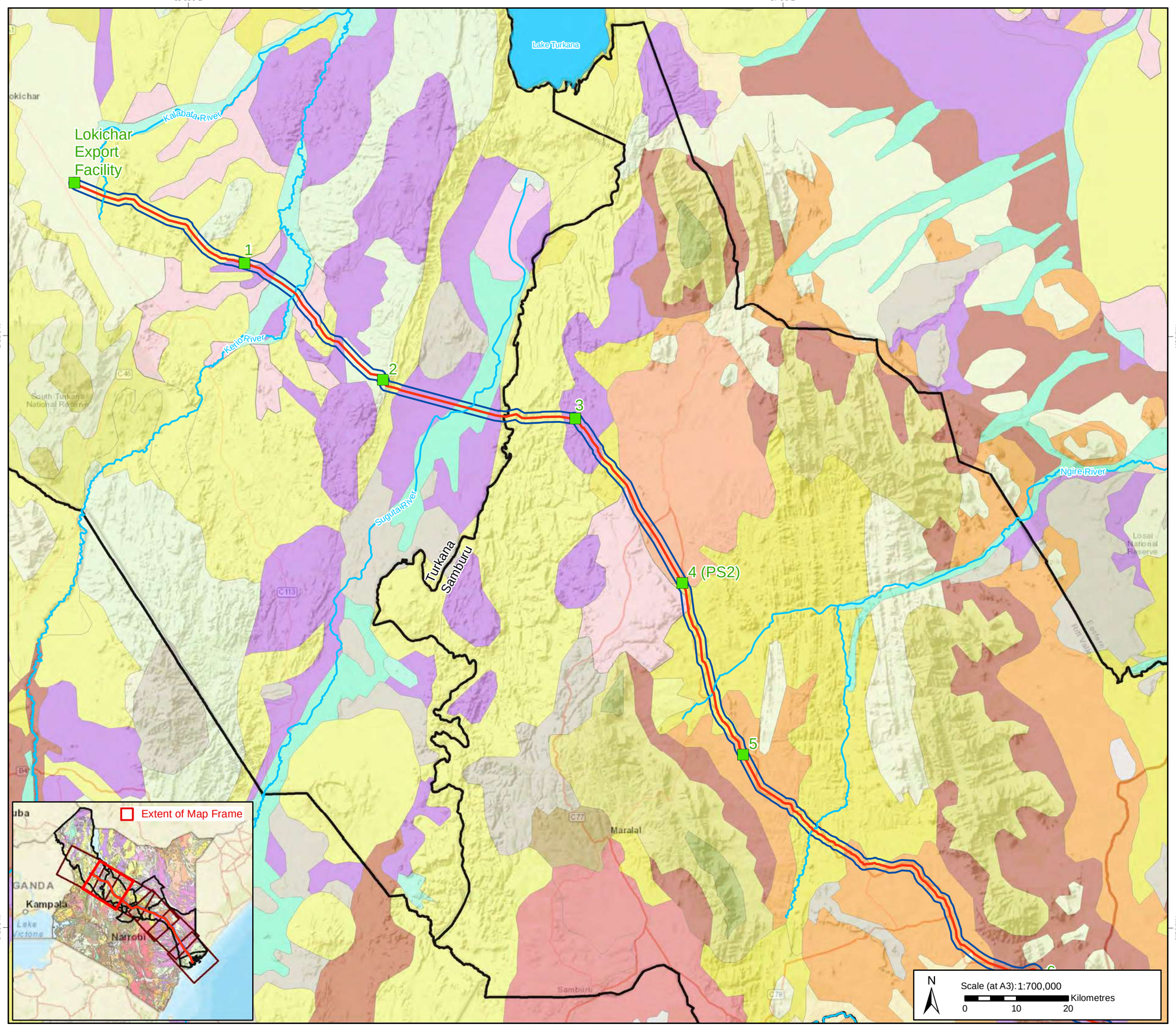

Drawing : 1b
Mapped Soils along the LLCOP

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- LVh - Haplic Luvisols
- LVk - Calcic Luvisols
- LVx - Chromic Luvisols
- LXh - Haplic Lixisols
- NTr - Rhodic Nitosols
- NTu - Humic Nitosols
- PHl - Luvic Phaeozems
- PLe - Eutric Planosols
- RGc - Calcaric Regosols
- RGe - Eutric Regosols
- SCg - Gleyic Solonchaks
- SCk - Calcic Solonchaks
- SNk - Calcic Solonetz
- VRe - Eutric Vertsols
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Drawing : 1c
Mapped Soils along the LLCOP

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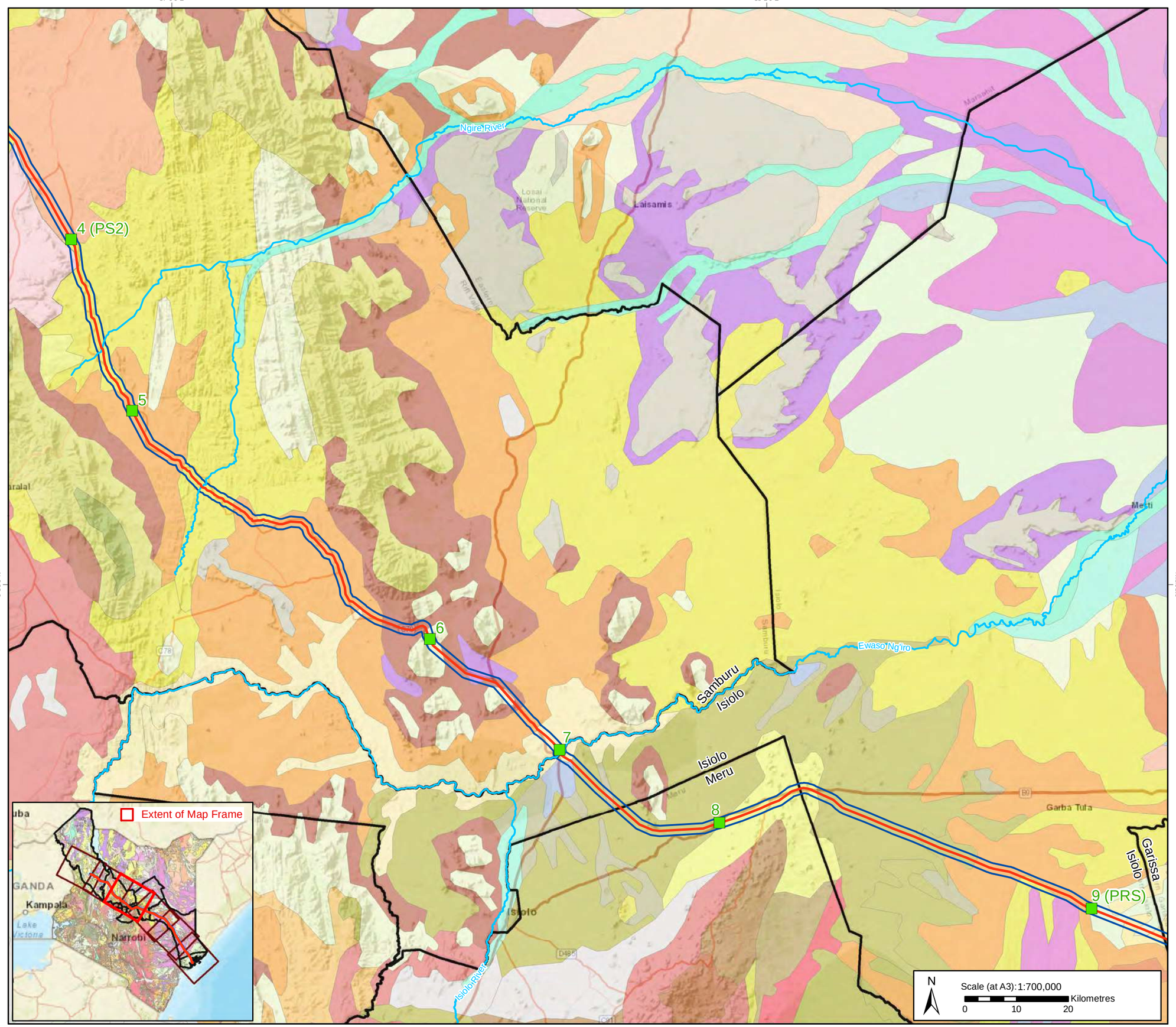

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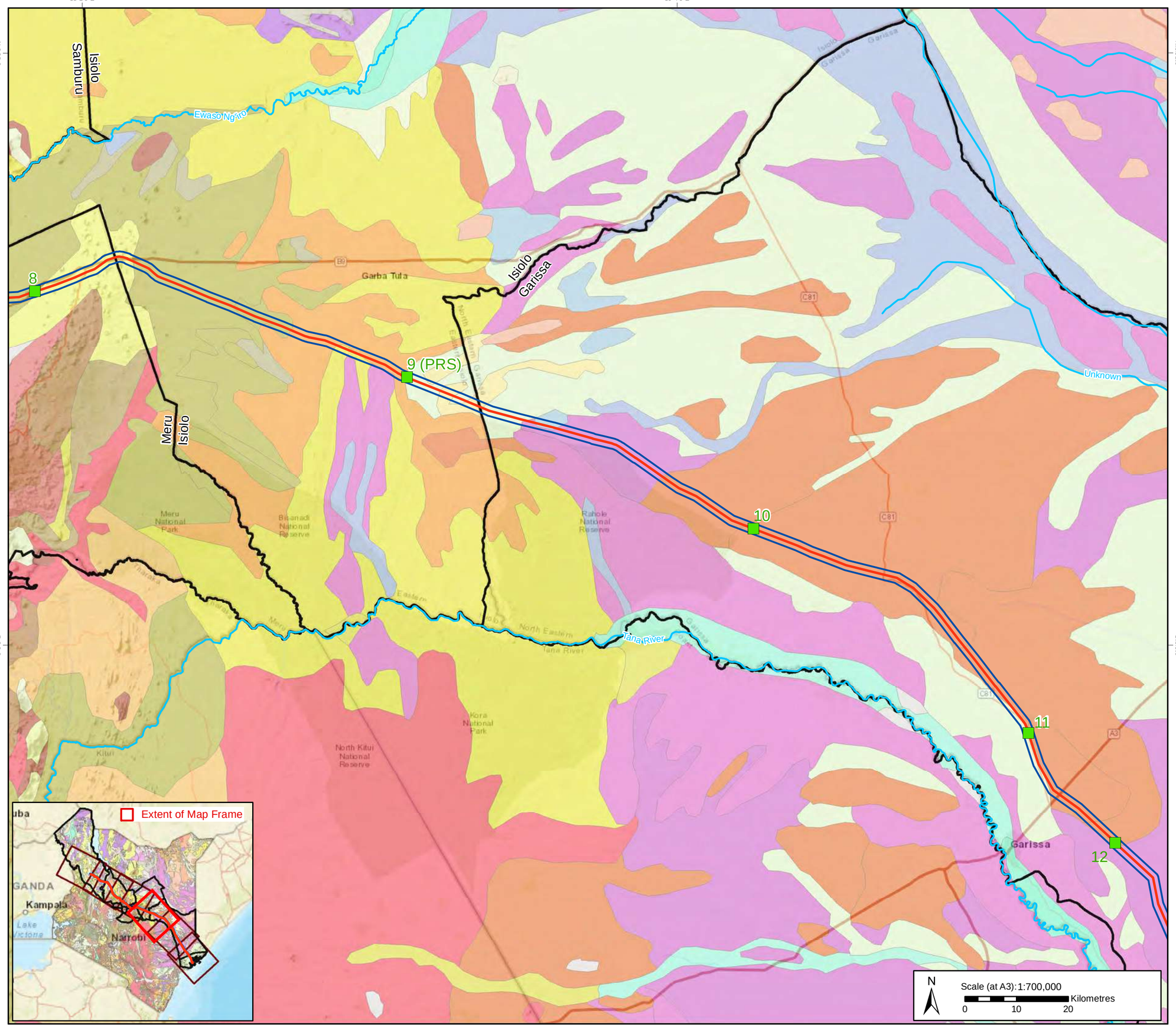
Drawing : 1d
Mapped Soils along the LLCOP

Mid-Stream Development



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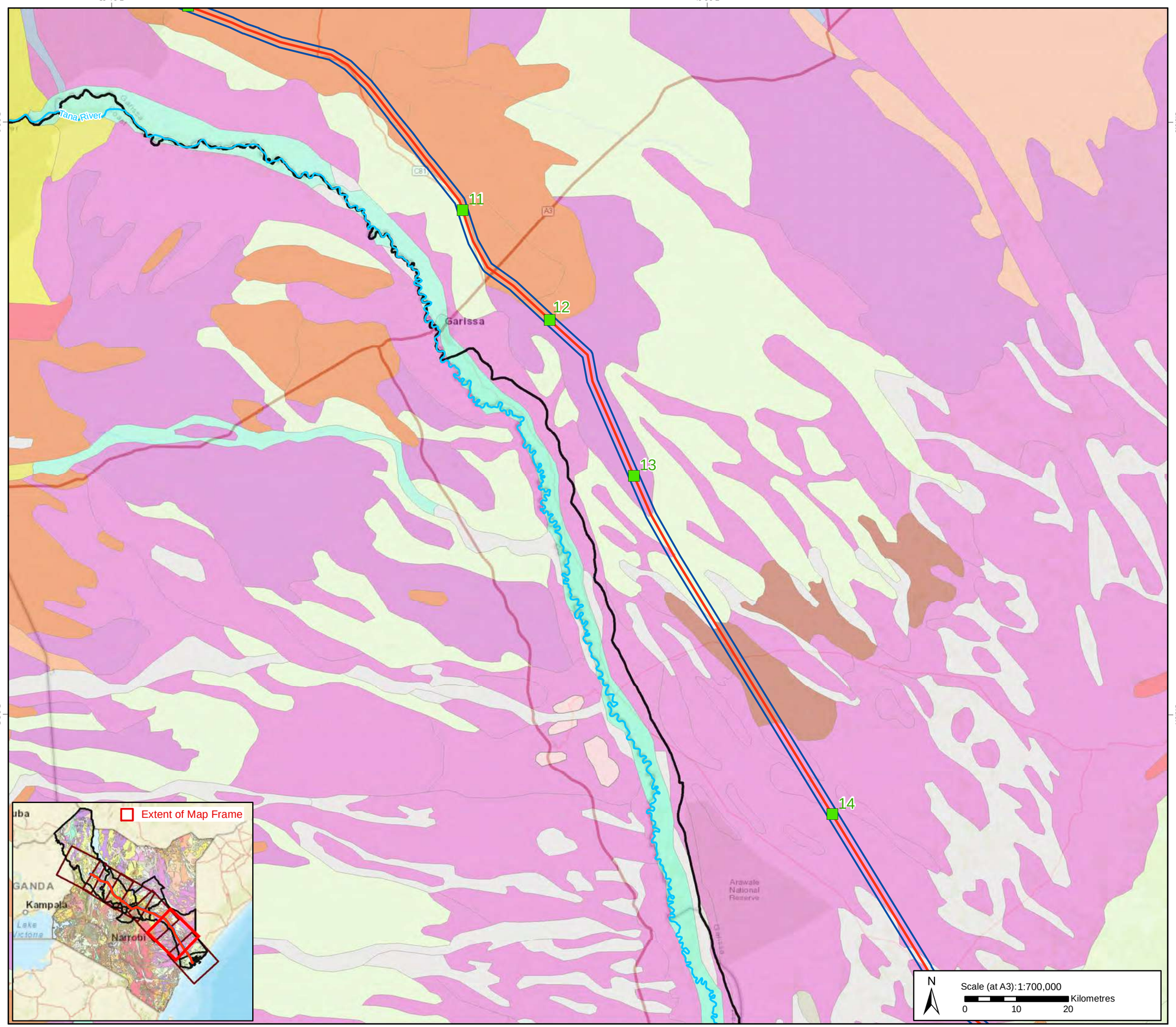


Drawing : 1e
Mapped Soils along the LLCOP

Mid-Stream Development

Key

- Station
- Proposed Pipeline Route
- Study Area
- County Boundary
- Watercourse

Soils

- ARo - Ferralic Arenosols
- CMc - Calcaric Cambisols
- CMe - Eutric Cambisols
- FLc - Calcaric Fluvisols
- FLe - Eutric Fluvisols
- FRr - Rhodic Ferralsols
- GLe - Eutric Gleysols
- LPq - Lithic Leptosols
- LVk - Calcic Luvisols
- LXf - Ferric Lixisols
- LXh - Haplic Lixisols
- PHg - Gleyic Phaeozems
- PLe - Eutric Planosols
- SCk - Calcic Solonchaks
- SNg - Gleyic Solonetz
- SNh - Haplic Solonetz
- VRe - Eutric Vertsols

Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License. The Soils datbase of Kenya KENSOTER dataset 1:1 million was compiled in 1996 by the Kenya Soil Survey with technical backstopping and training provided by ISRIC -World Soil Information 2019

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

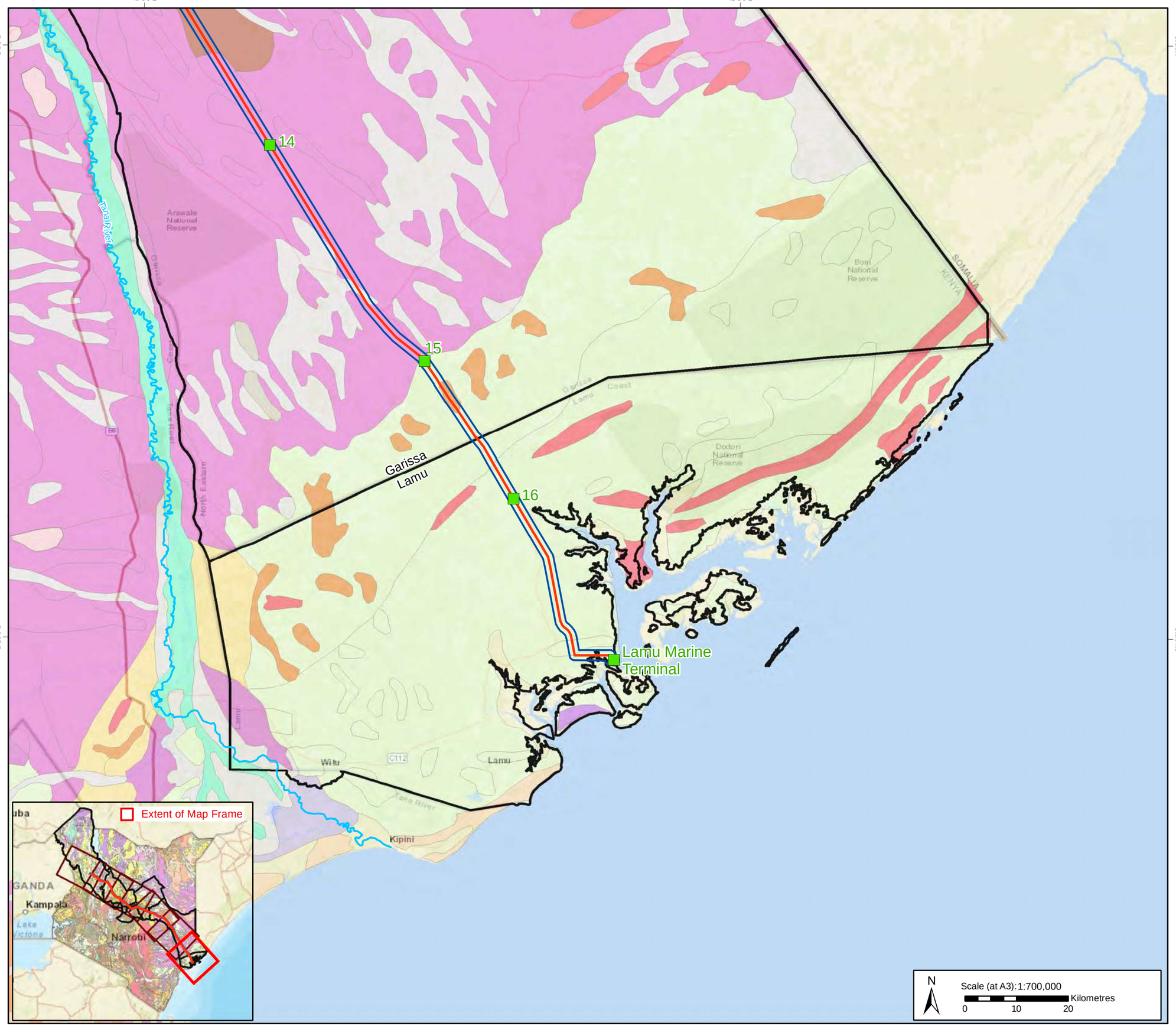
Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 21-02-2019	LD 21-02-2019	TM 22-02-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553\02_PRODUCTION\MXD\1772867_553_OG_529_D2_Soils_Mapbook.mxd



Drawing : 1f
Mapped Soils along the LLCOP

Mid-Stream Development

Key

- Station
- Proposed Pipeline Route
- Study Area
- County Boundary
- Watercourse

Soils

- ARb - Cambic Arenosols
- ARl - Luvic Arenosols
- FLe - Eutric Fluvisols
- FRh - Haplic Ferralsols
- FRr - Rhodic Ferralsols
- FRx - Xanthic Ferralsols
- GLm - Mollic Gleysols
- LPq - Lithic Leptosols
- LVg - Gleyic Luvisols
- LXh - Haplic Lixisols
- PHg - Gleyic Phaeozems
- PLe - Eutric Planosols
- SCk - Calcic Solonchaks
- SNg - Gleyic Solonetz
- SNh - Haplic Solonetz
- SNk - Calcic Solonetz
- VRe - Eutric Vertsols

Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License. The Soils datbase of Kenya KENSOTER dataset 1:1 million was compiled in 1996 by the Kenya Soil Survey with technical backstopping and training provided by ISRIC -World Soil Information 2019

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 21-02-2019	LD 21-02-2019	TM 22-02-2019

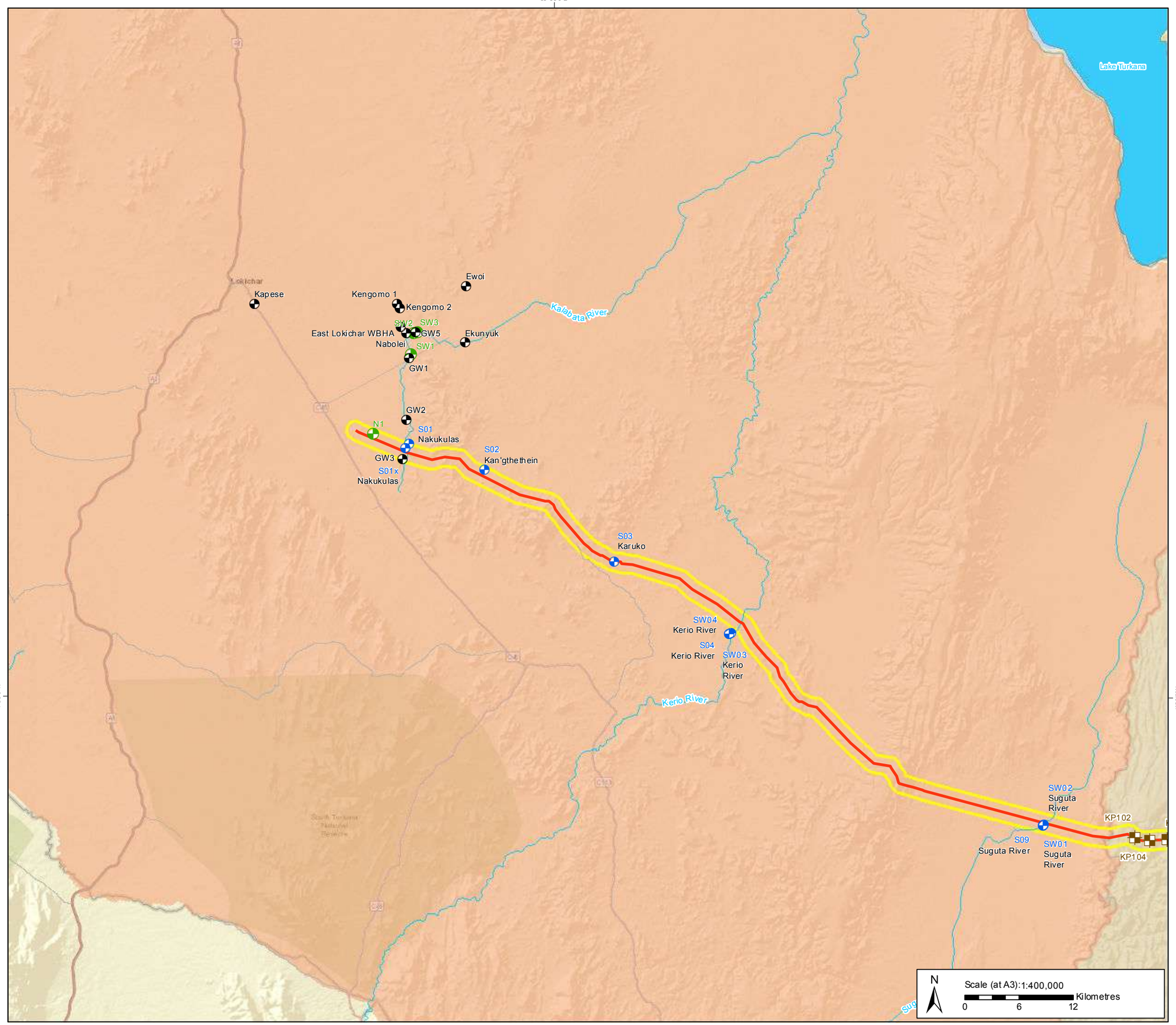
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553\02_PRODUCTION\MXD\1772867_553_OG_529_D2_Soils_Mapbook.mxd

Drawing 2a
Ground Investigation, Groundwater and Surface Water Monitoring Locations

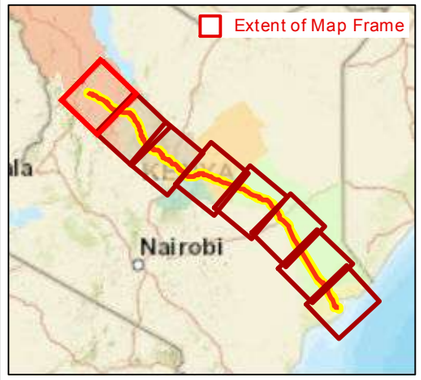


Key

- LLCOP Surface Water Monitoring Location
- Upstream Project Groundwater Monitoring Location
- Upstream Project Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Waterbody
- Watercourse

Counties

- Turkana
- Samburu



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

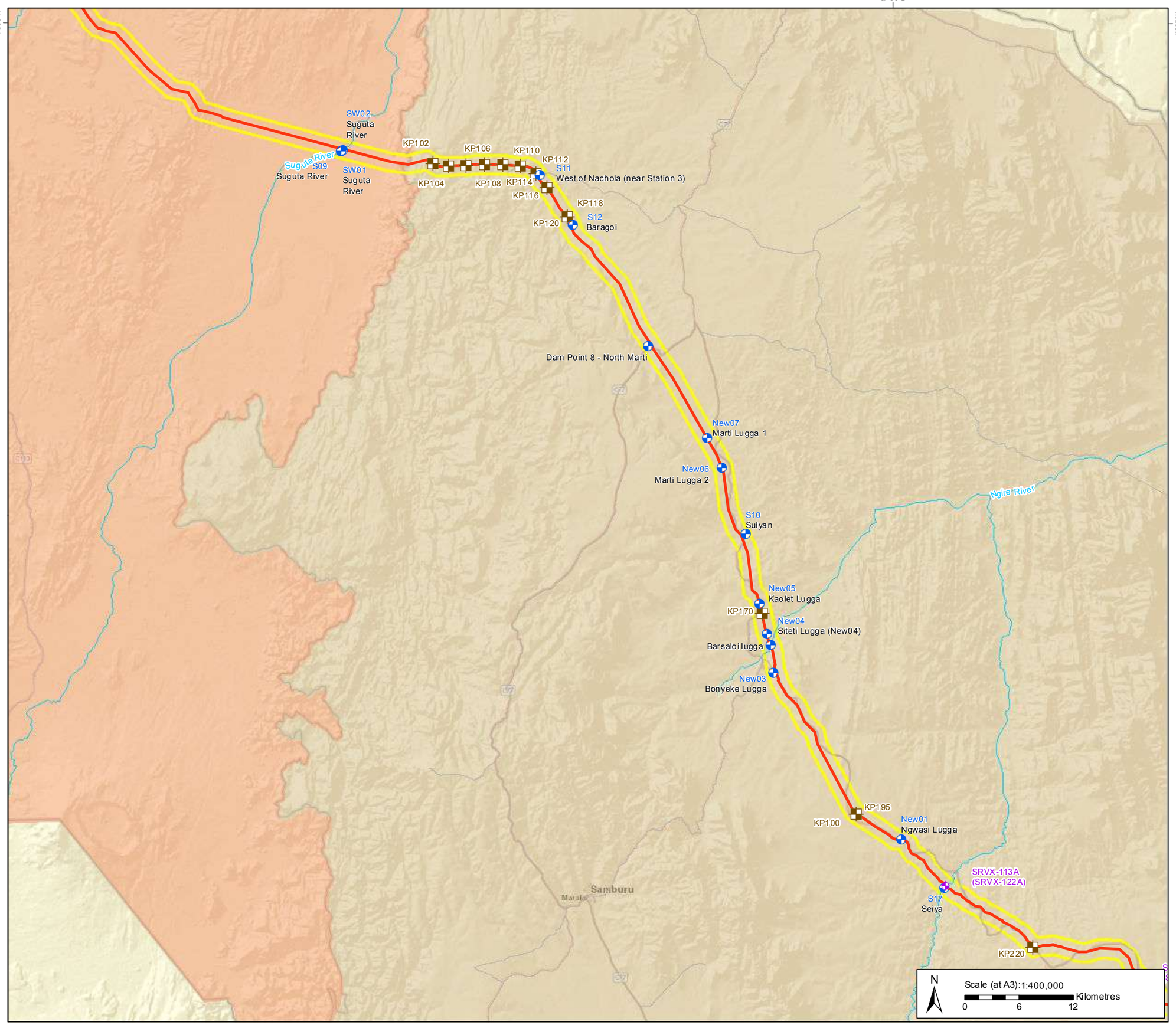
GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map path: \\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Water\1772867_554_OG_593_Water_Mapbook.mxd

Drawing 2b
Ground Investigation, Groundwater and Surface Water Monitoring Locations

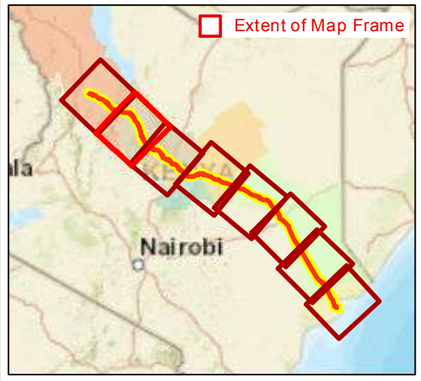


Key

- LLCOP Borehole Location
- LLCOP Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Turkana
- Samburu



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map path: \\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Water\1772867_554_OG_593_Water_Mapbook.mxd

Drawing 2c
Ground Investigation, Groundwater and Surface Water Monitoring Locations

37°0'0"E

0°56'0"N

New04
Siteti Lugga (New04)
Barsaloi Lugga
New03
Bonyeke Lugga
KP195
KP100
New01
Ngwasi Lugga
Ngire River
SRVX-113A
(SRVX-122A)
S17
Seiya
KP220
SRVX-123A
(SRVX-135A)
SRVX-123C
(SRVX-135C)
S18
Ngaroni
SRVX-124B
(SRVX-140B)
KP245
S19
Silanga-Nanyukie
KP250
KP252
KP254
KP256
KP258
KP260
KP262
S16
Koiting
KP264
KP266
KP268
KP270
KP272
KP274
KP276
KP278
KP280
KP282
KP284
KP286
KP288
Archers Post Lugga
KP290
KP292
KP294
KP296
KP298
SW08
Ewaso Ngiro
River
KP300.5
S05
Ewaso Ngiro River
SW09
Ewaso Ngiro
River
Ewaso Ng'iro
Isiolo River
KP325

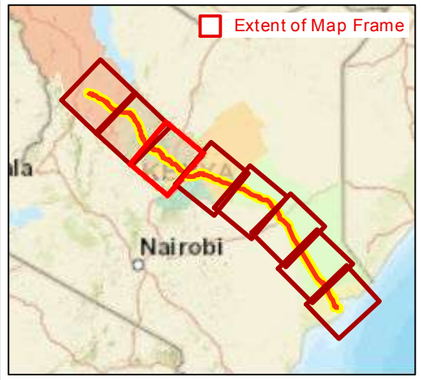
N
Scale (at A3):1:400,000
0 6 12 Kilometres

Key

- LLCOP Borehole Location
- LLCOP Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

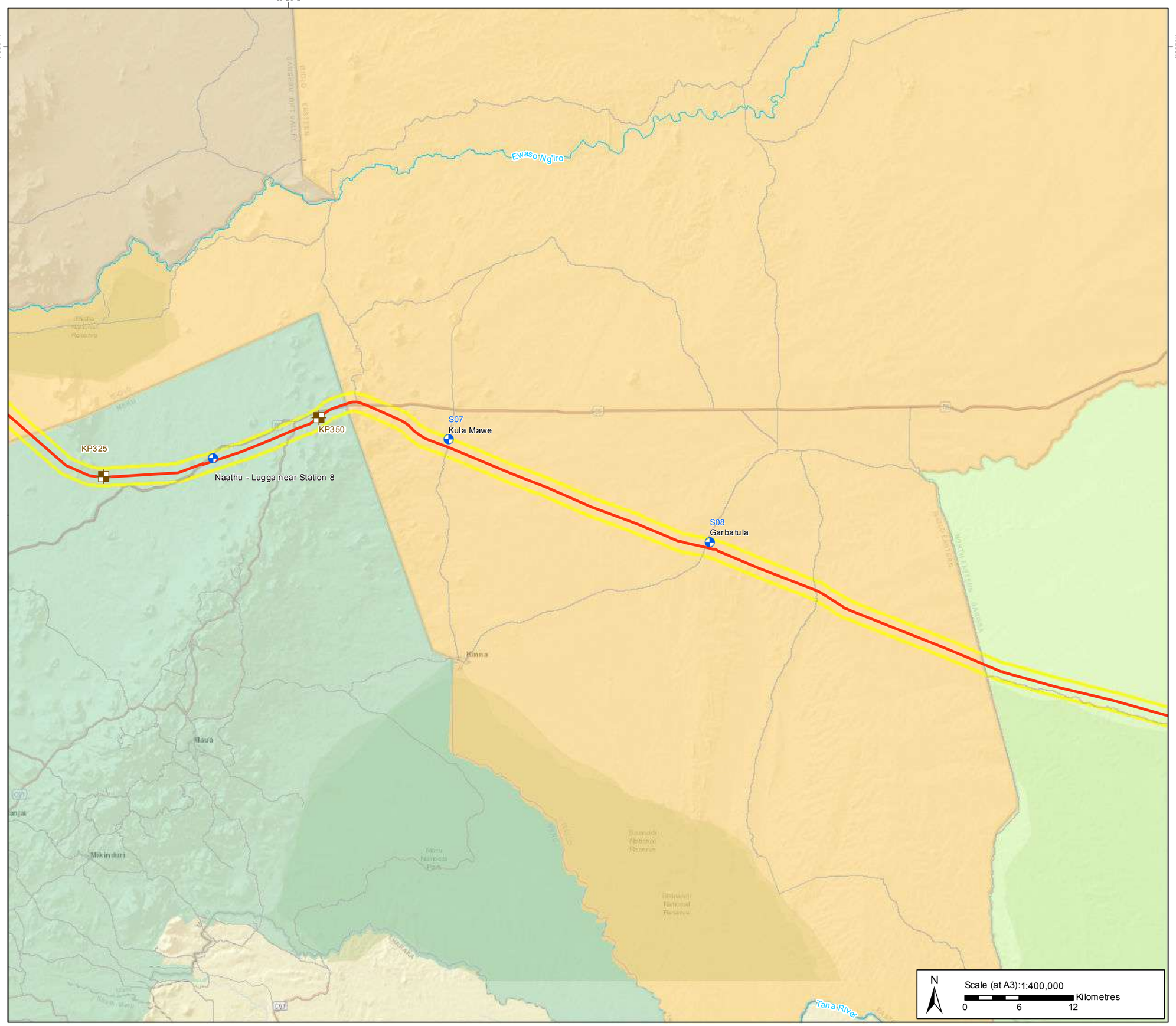
GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map path: \\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Water\1772867_554_OG_593_Water_Mapbook.mxd

Drawing 2d
Ground Investigation, Groundwater and Surface Water Monitoring Locations

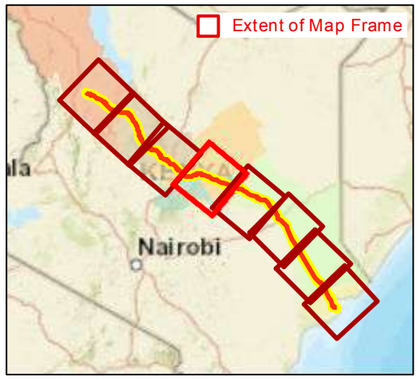


Key

- LLCOP Surface Water Monitoring Location
- LLCOP Trial Pit Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru
- Garissa



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Drawing 2e
Ground Investigation, Groundwater and Surface Water Monitoring Locations

39°4'0"E

0°0'0"

S22
Rahole

S26
Shimbir

S20
Sankuri

S21
Sankuri

Tana River

Garissa

Madogo

N

Scale (at A3):1:400,000

Kilometres

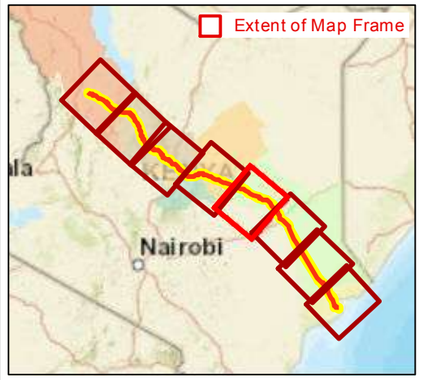
0 6 12

Key

- LLCOP Surface Water Monitoring Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Isiolo
- Garissa



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

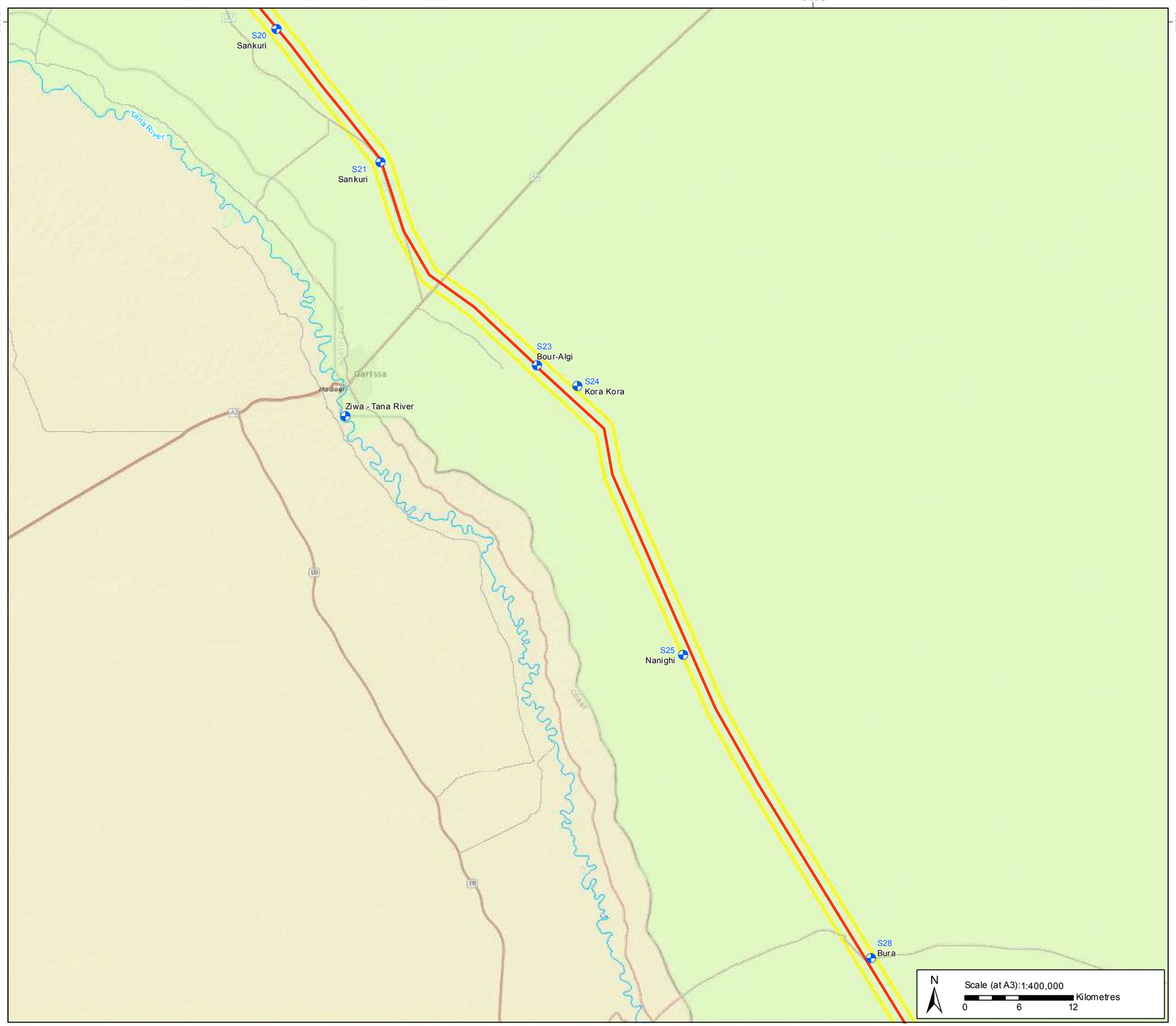
Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map path: \\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Water\1772867_554_OG_593_Water_Mapbook.mxd



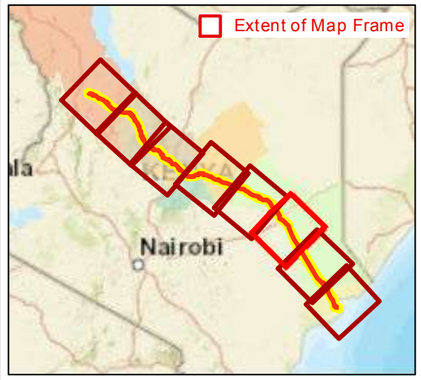
Drawing 2f
Ground Investigation, Groundwater and Surface Water Monitoring Locations

Key

- LLCOP Surface Water Monitoring Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Garissa



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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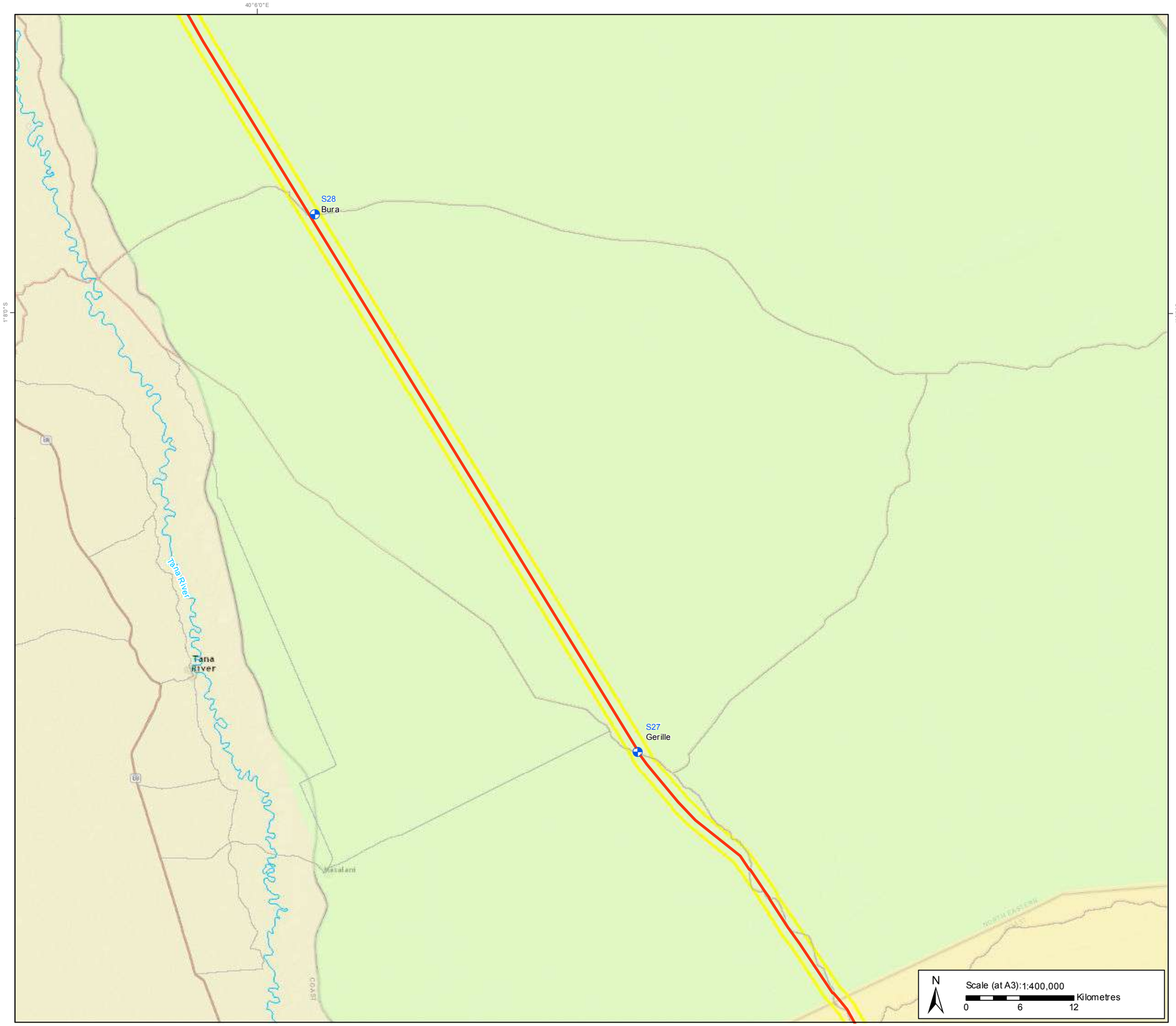
Drawing 2g
Ground Investigation, Groundwater and Surface Water Monitoring Locations

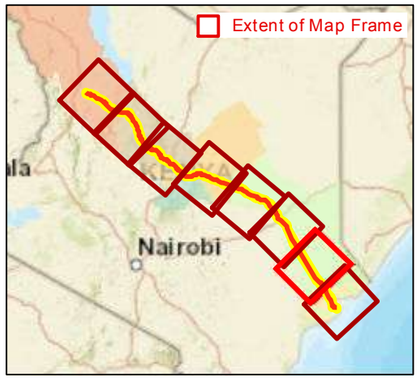


Key

- LLCOP Surface Water Monitoring Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Garissa
- Lamu



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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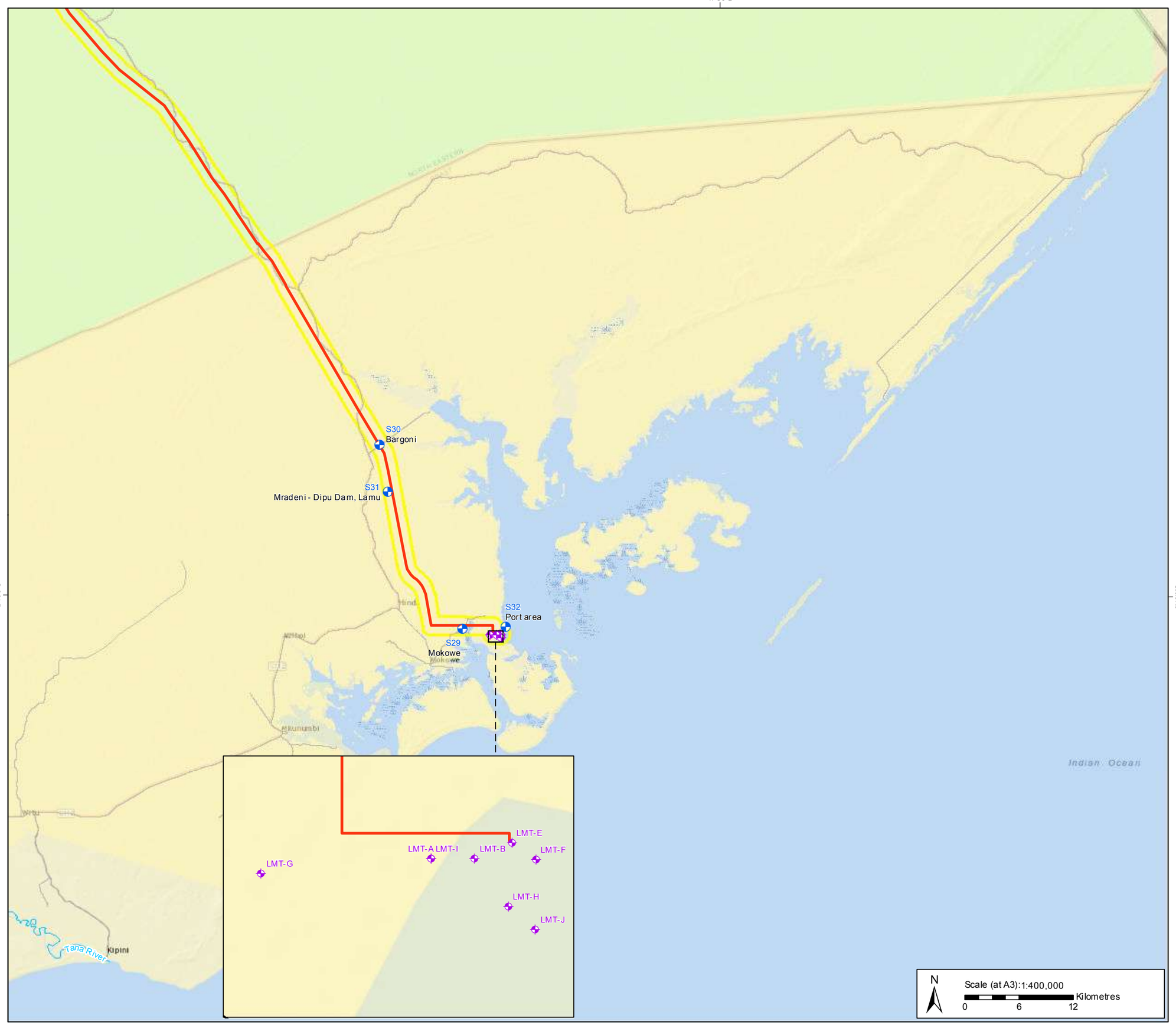
Drawing 2h
Ground Investigation, Groundwater and Surface Water Monitoring Locations

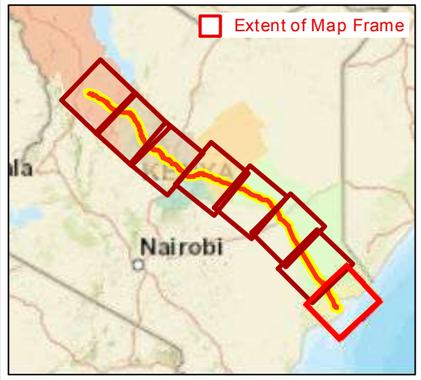


Key

- LLCOP Surface Water Monitoring Location
- LLCOP Borehole Location
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- Road
- Watercourse

Counties

- Garissa
- Lamu



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 09-05-2019	LD 09-05-2019	TF 09-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

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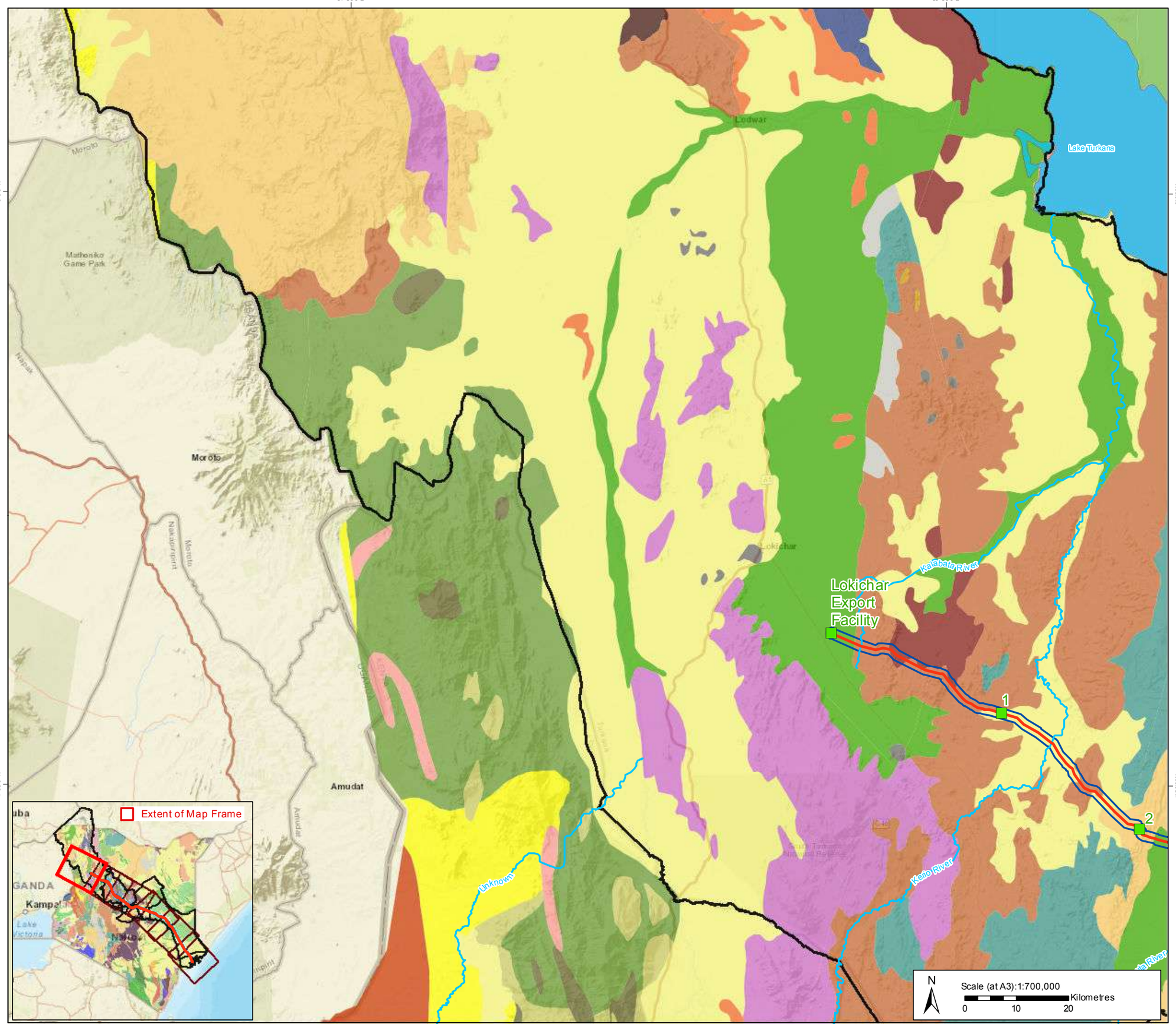
Drawing 3a
Mapped Geology along the LLCOP

Mid-Stream Development



Key

Station

- Station
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- County Boundary
- Waterbody
- Watercourse

Geology

- Alluvium, Eluvium
- Carbonate-Dominated
- Clastic-Dominated
- Felsic Volcanic and Volcano-Plutonic
- Granitoid Granite, Leucogranite, Granodiorite
- Gabbro, Norite,
- Gneiss
- Intermediate Volcanic and Volcano-Plutonic
- Mozambique Belt
- Ophiolite
- Paleogene-Neogene Marine Sedimentary
- Quaternary Sedimentary
- Quaternary & Plio-Quaternary Volcanic and Plutonic
- Sedimentary-Dominated
- Trachytes, Phonolites, Basalt
- Undifferentiated Cretaceous Sedimentary
- Volcano Sedimentary

Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

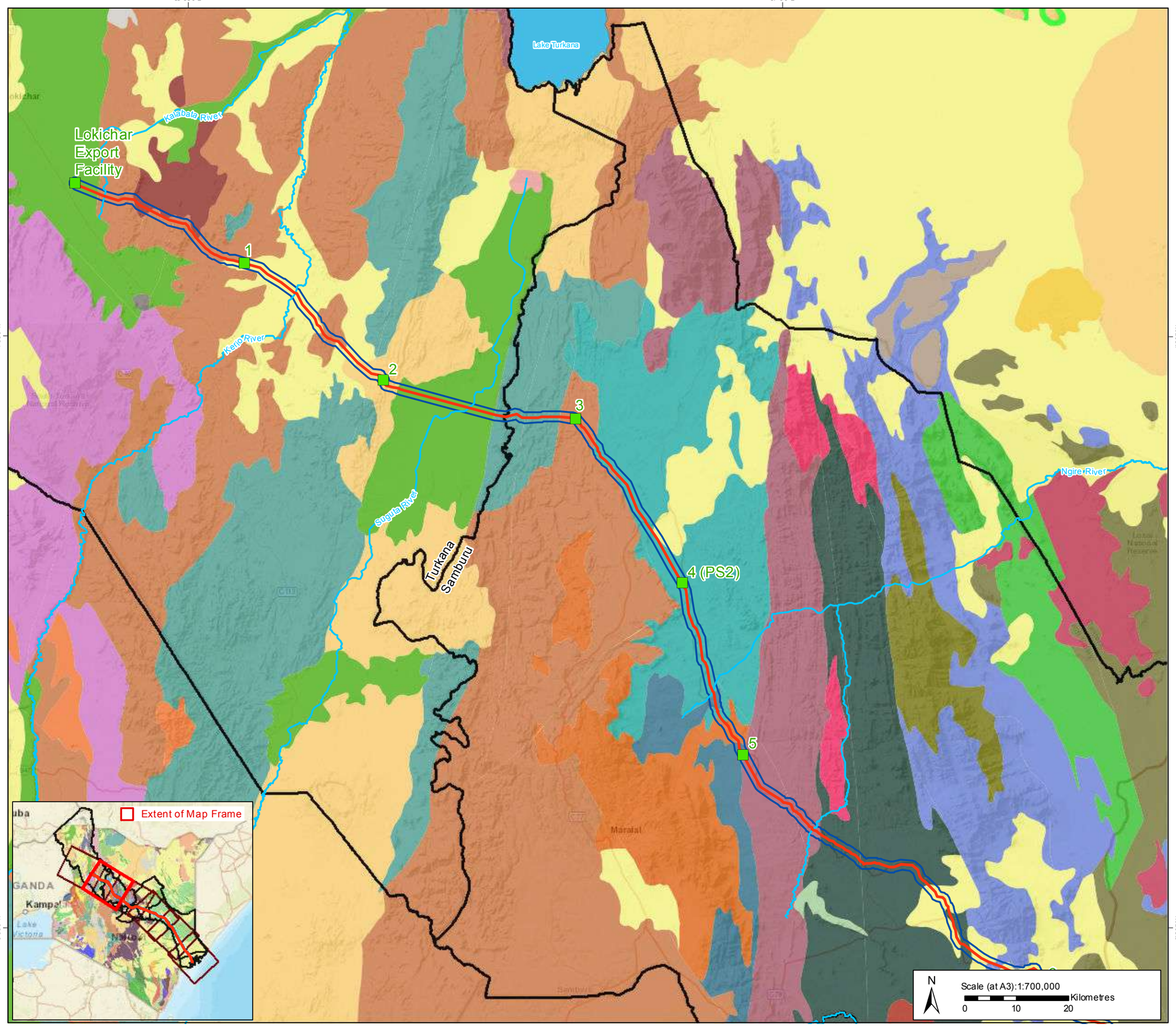
Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 30-05-2019	LD 30-05-2019	TM 30-05-2019

GOLDER

Cavendish House, Cores End Road, Bourne End, SL8 5AS, UK

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map path: \\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Geology\1772867_554_OG_762_D1_Geology_Mapbook.mxd



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Drawing 3b
Mapped Geology along the LLCOP

Mid-Stream Development

Key

Station

- Station
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- County Boundary
- Waterbody
- Watercourse

Geology

- Alluvium, Eluvium
- Carbonaceous
- Felsic Volcanic and Volcano-Plutonic
- Intermediate Volcanic and Volcano-Plutonic
- Kotim Gneisses
- Loroki Gneisses
- Lolkoitoi Gneisses
- Migmatitic Paragneisses
- Mafic volcanic and Volcano-Plutonic
- Migmatite, Anatectic
- Mozambique Belt
- Migmatite, Anatectic
- Mafic Volcanic and Volcano-Plutonic
- Paragneiss
- Quaternary Sedimentary
- Sedimentary-Dominated Sequence
- Trachytes, Phonolites, Basalt
- Neoproterozoic Metamorphic, Anatectic & Plutonic
- Ultramafic intrusive Rock, Serpentinite
- Trachytes, Basalts and Pyroclastic
- No Data

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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 30-05-2019	LD 30-05-2019	TM 30-05-2019

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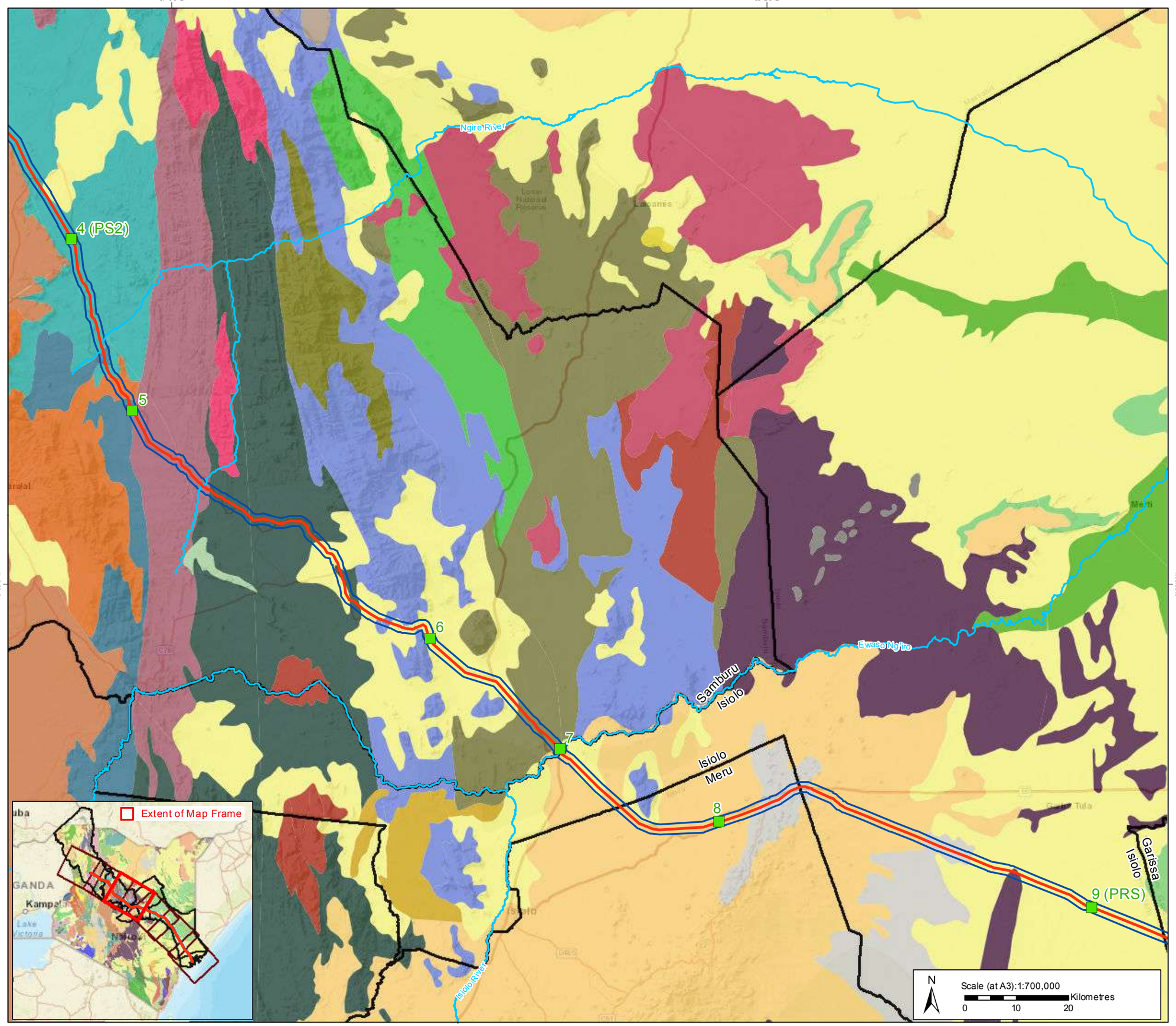
Drawing 3c
Mapped Geology along the LLCOP

Mid-Stream Development



Key

Station

- Station
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- County Boundary
- Watercourse

Geology

- Alluvium, Eluvium
- Basalt
- Carbonaceous
- Felsic Volcanic and Volcano-Plutonic
- Gneiss
- Intermediate Volcanic and Volcano-Plutonic
- Kotim Gneisses
- Lolkoitoi Gneisses
- Loroki Gneisses
- Mafic Volcanic and Volcano-Plutonic
- Migmatite, Anatectic
- Migmatitic Paragneisses
- Migmatite, Anatectic
- Migmatite
- Osirua Basalt
- Paragneiss
- Trachytes, Basalts and Pyroclastic
- Sedimentary-Dominated Sequence
- Quaternary Sedimentary
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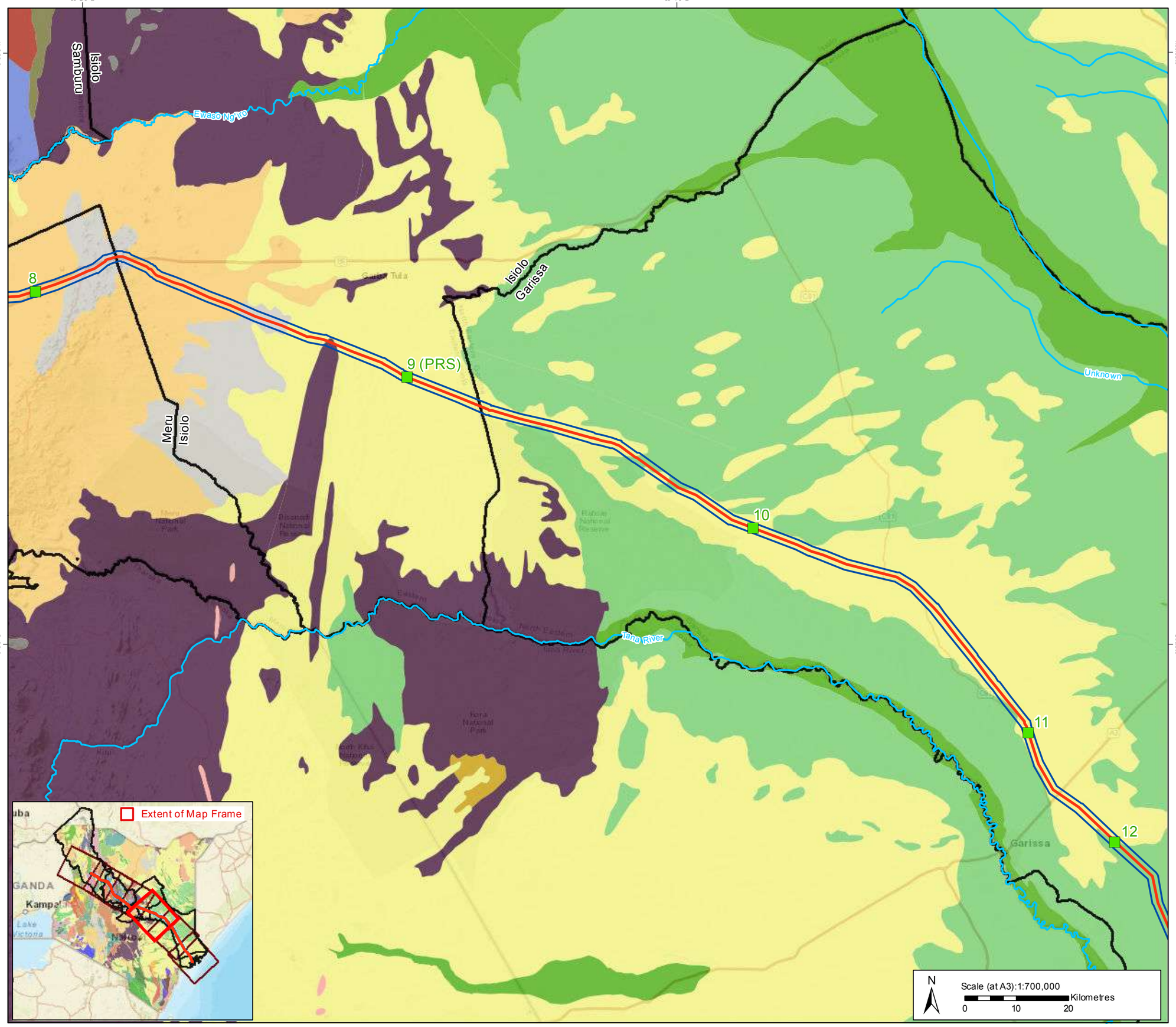
Drawing 3d
Mapped Geology along the LLCOP

Mid-Stream Development



Key

Station

- Station
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- County Boundary
- Watercourse

Geology

- Alluvium, Eluvium
- Basalt
- Crystalline limestone, Intercalation
- Gneiss
- Kotim Gneisses
- Lolkoitoi Gneisses
- Migmatite
- Neoproterozoic Plutonic
- Quaternary Sedimentary
- Sandstones, Sand
- Trachytes, Basalts and Pyroclastic

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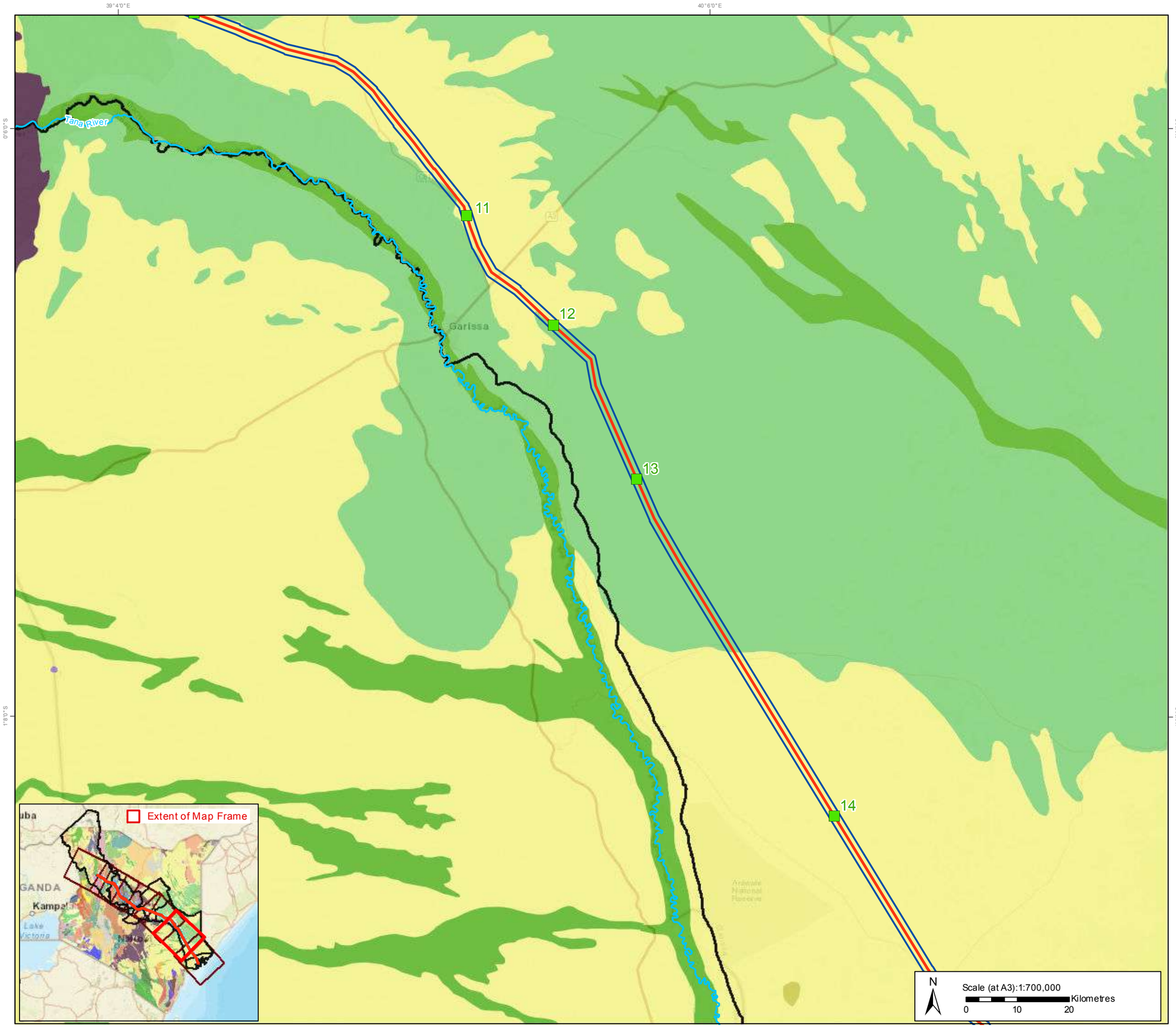
Drawing 3e
Mapped Geology along the LLCOP

Mid-Stream Development



Key

Station

- Station
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- County Boundary
- Watercourse

Geology

- Alluvium, Eluvium
- Gneiss
- Mesozoic Volcanoplutonic
- Quaternary Sedimentary
- Sandstones, Sand

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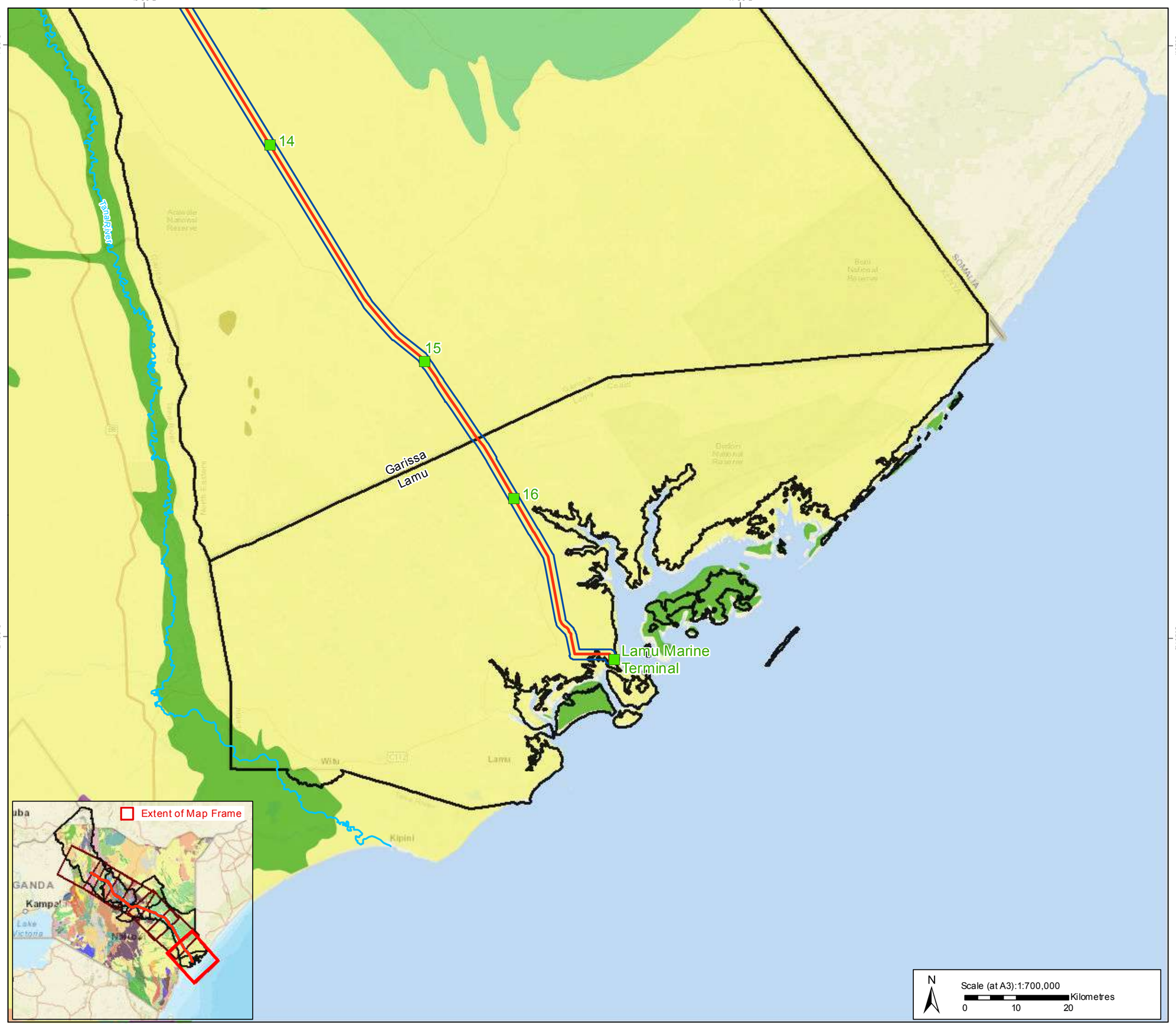

Drawing 3f
Mapped Geology along the LLCOP

Mid-Stream Development

Key

Station

- Station
- Proposed Pipeline Route
- Area of Influence (AoI) (1km)
- County Boundary
- Watercourse

Geology

- Alluvium, Eluvium
- Marbres, Limestones, Sand
- Quaternary Sedimentary
- Sandstones, Sand

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REPORT

Air Quality Baseline

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

Golder Associates (UK) Ltd

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August 2019

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1.0 AIR QUALITY

Baseline data gathering is focused on the approximate locations of seven stations along the pipeline route and one upstream location. The selection of the locations was based on planned generator locations, as sources of air emissions, and the location of settlements in proximity to the pipeline.

1.1 Area of Influence

The AoI for air quality within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a buffer area of 1 km radius around each station along the LLCOP route and a 250 m buffer area either side of the pipeline along the entire route length.

1.2 Monitoring Locations

Baseline data gathering has been completed at the locations defined in Table 1 below. The monitoring sites are in village locations and are therefore not truly representative of the more remote and less disturbed station locations. This means that the baseline data should be used as indicative of the conservative local background in the project area of influence (AoI) which may also include the contributions from local village sources. The monitoring locations are shown on Figure 1.

Table 1: Baseline Monitoring Locations

Station	Description	Parameter	Location	Notes
Ngamia	Ngamia 5/6	Particulate Matter		This location is within the upstream project footprint
		Dust Gauge and Tubes	**N:** 02°12'28.1" **E:** 35°45'48.6"	
4	Barsaloi Chief's Office	Particulate Matter		This area serves as the proxy for Station 4. It is located at the Chief's Office. There is a settlement with some commercial shops at the location. The area is along the Wamba-Suiyan Road.
		Dust Gauge and Tubes	**N:** 01°20'07.2" **E:** 36°51'48.2" Elev. 467m	
6	Wamba Lengisaka, in Koiting Location	Particulate Matter	**N:** 00°52'38.05" **E:** 37°19'01.24" Elev. 512m	This area serves as the proxy for Station 6. It is in Koting location and lies along the Archer's Post Barsaloi Road, at Lengusaka Town. The sampling location is at the village Chief's place. It is residential area with a small business centre and a road passing next to it. The Sionta river passes to the SE of this location.
		Dust Gauge and Tubes	**N:** 00°52'37.9" **E:** 37°19'01.3" Elev. 512m	

Station	Description	Parameter	Location	Notes
7	Archer's Post, Isiolo Muhajireen Children Centre. Waso Muslim School, Samburu Institute of Technology	Particulate Matter	**N:** 00º38'25.3" **E:** 37º40'12.5" Elev. 839	This area serves as the proxy for Station 7. It is next to the Ewaso Ng'iro river and the Isiolo Marsabit road. There is a shopping Centre and a police post near the sampling location.
		Dust Gauge and Tubes	**N:** 00º38'25.1" **E:** 37º40'12.7" Elev. 839	
9	Garba Tula - Homestead of Mzee Adow Biria . Four homes in the village. No other developments near the village	Particulate Matter	**N:** 00º30'46.5" **E:** 38º37'19.2" Elev. 466m	This area serves as the proxy for Station 9. It is in Isiolo south sub county. It is located along the Garissa-Benane Road There is a village settlement at the sampling location.
		Dust Gauge and Tubes	**N:** 00º31'46.3" **E:** 38º31'06.7" Elev. 467m (Relocated)	This area serves as the new proxy for Station 9. It is in Isiolo south sub county. The sampling location is a police station. Near the location are residential area and the sub county offices. Animosity at the initial sampling location (detailed above) advised the change.
10	Rahole National Reserve, Garissa - Ohio Village Settlement, Abdi Gab, Water Pan, Ohio Primary School	Particulate Matter	**N:** 00º05'43.2" **E:** 39º12'57.3" Elev. 337	This area serves as the proxy for Station 10. It is in the Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.
		Dust Gauge and Tubes	**N:** 00º05'43.2" **E:** 39º12'57" Elev. 335	
Lamu	Lamu Port - Homestead of Mzee Rajab Mohammed, Across the road from the Lamu Port, Part of Kililama Farmers Organization	Particulate Matter	**N:** 02º11'55.3" **E:** 40º54'33.1"	This area serves as the proxy for Lamu Port. It is a village located across the road from the port main entrance.
		Dust Gauge and Tubes	**N:** 02º11'56.6" **E:** 40º54'32.2"	

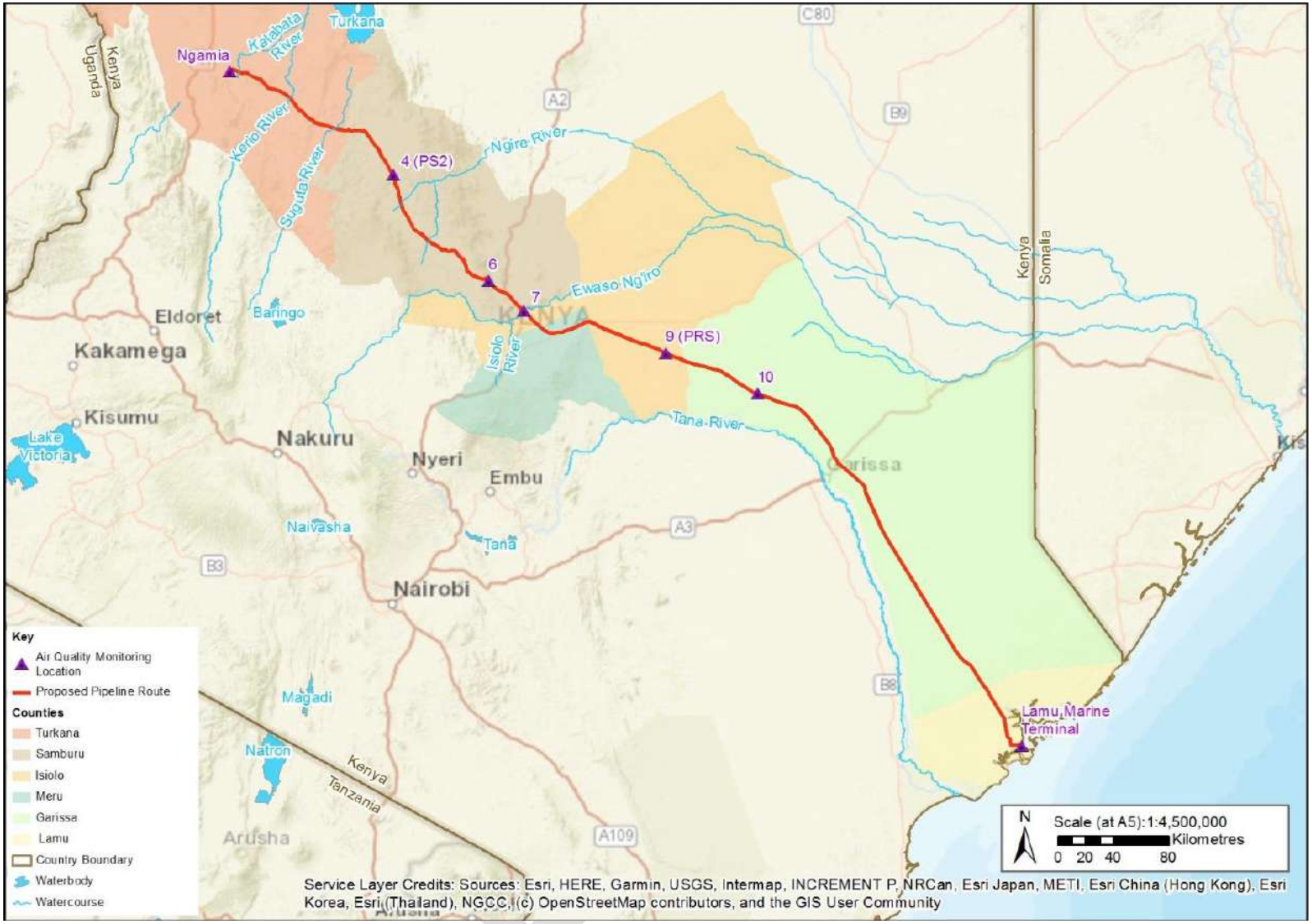

Figure 1: Location of Air Quality Monitoring Stations used for Baseline Characterisation

1.3 Key Pollutants

A summary for each key pollutant, data for which has been gathered during the baseline period, is described in the following sections along with details of the specific risks to human health and the environment (WHO, 2017). The following presents potential effect of key pollutants and justification for their inclusion in the baseline.

- Key pollutants Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Fine Particulates (PM_{10} and $PM_{2.5}$) will be emitted from the power generators which will be located at some of the station locations;
- Volatile Organic Compounds (VOCs) are gases emitted from a wide range of solids or liquid materials including crude oil;
- Vehicle emissions reacting with other chemicals such as VOCs could lead to the creation of ozone (O_3); and
- Deposited dust can be generated during groundworks, maintenance and from traffic on unsealed roads.

1.3.1 Nitrogen dioxide

Nitrogen dioxide (NO_2) typically arises via the oxidation of NO in air. The main effect of breathing NO_2 is the increased likelihood of respiratory problems. NO_2 is found to cause inflammation of the lungs and can reduce immunity to lung infections. This can cause respiratory problems such as wheezing.

Increased levels of NO_2 can affect people with asthma as it can cause more frequent attacks. Children with asthma and older people with heart disease are most at risk. Scientific studies have shown that symptoms of bronchitis and asthma in children increase in association with long-term exposure to NO_2 (WHO, 2005).

1.3.2 Sulphur dioxide

Sulphur dioxide (SO_2) is the by-product of burning fuel that contains sulphur. Excessive exposure to elevated concentrations of SO_2 is known to affect the human respiratory system and inhibit the function of the lungs. Inflammation of the respiratory tract causes coughing, aggravation of asthma, chronic bronchitis, and makes people more prone to infections of the respiratory tract (WHO, 2005).

When SO_2 combines with water, it forms sulphuric acid (H_2SO_4); this is the main component of acid rain which can result in loss of plants and deforestation (WHO, 2005).

1.3.3 Ozone

Excessive or elevated ozone (O_3) levels in the air can have implications for human health. O_3 has the potential to cause breathing problems, trigger asthmatic attacks, reduce lung function, and cause lung diseases. Several European studies have reported that daily mortality rises by 0.3% and likelihood of heart diseases by 0.4%, per 10 µg/m^3 increase in O_3 exposure (WHO, 2005).

1.3.4 BTEX

VOCs include a variety of chemicals, some of which may have short and long-term adverse health effects. VOCs have the potential to be emitted from all aspects of oil and gas operations and although no direct assessment standards are available, baseline VOCs are monitored purely to establish baseline (USEPA, 2012). No standards are available for assessing ambient VOCs to establish the quality or condition of a project baseline.

Benzene, Toluene, Ethylbenzene and xylene (BTEX) are the VOC species considered as a standard approach to ESIA baseline. As there are not standards for the BTEX species, Data are gathered to provide a baseline against which any change can be monitored during operations. The 24-hourly concentrations are compared against the total VOC standard however, this is only an indicative comparison.

1.3.5 Deposited dust

Deposited dust is generally not associated with human health issues but is considered a nuisance due to loss of amenity. Elevated dust levels may, however, affect visibility and thus cause a health and safety issue. Dust can also have effects on plants and their growth patterns. Deposited dust can settle on the surface of leaves and reduce the intake of sunlight, inhibiting the natural process of photosynthesis. This has the potential to result in stunted growth. Dependent on the source and quantity of deposited dust, it is also possible that dust fall can contaminate sensitive environments and affect the chemistry of sensitive soils.

1.3.6 Particulate matter (PM_{10} and $PM_{2.5}$)

The health effects from particulate matter (PM_{10} and $PM_{2.5}$) can occur at levels of exposure currently being experienced by most urban and rural populations in both developed and developing countries. Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as lung cancer (WHO, 2005). Particulates are internationally recognised as harmful to human health and the wider environment.

In developing countries, exposure to pollutants from indoor combustion of solid fuels on open fires or in traditional stoves increases the risk of acute lower respiratory tract infections and associated mortality amongst young children. Indoor air pollution from solid fuel use is also a major contributing factor in the development of chronic obstructive pulmonary disease and lung cancer among adults. The mortality in cities with high levels of pollution is greater than that observed in relatively cleaner cities by 15 to 20%. Even in the European Union, average life expectancy is 8.6 months lower due to exposure to $PM_{2.5}$ produced by human activities (WHO, 2018).

1.4 Secondary Data

There is no known air quality data in the Study area.

Due to the lack of industry and the sparse populations along the pipeline route, sources of changes to air quality are minimal.

1.5 Primary Data

1.5.1.1 Methods

Golder gathered air quality data at the six locations within the project AoI, defined in Table 2. Data were collected from December to January.

1.5.1.1.1 Diffusion Tubes

Substance specific diffusion tubes for NO_2, SO_2, O_3, Benzene, Toluene, Ethylbenzene and Xylene (BTEX) were deployed at the data gathering locations. The tubes were co-located with deposited dust gauges and placed at approximately 1.5 m above the ground level to sample within the average breathing zone of humans.

Passive diffusion tubes were exposed for approximately one-month intervals from December 2018 to February 2019. All samples were analysed by SGS Kenya Limited, located in Nairobi and results provided in µg/m^3. All VOC results are analysed as being below the limit of detection, this lower detection limit has been reported in this assessment, although the actual concentrations would be less than this.

1.5.1.1.2 Deposited Dust

Deposited dust samples were collected on a monthly basis alongside the passive air quality tubes using the Frisbee type deposit dust gauge collection method at the monitoring locations. As no international statutory assessment standards are available for this commonly utilised monitoring technique, gauges were deployed in accordance with the manufacturer's recommendations.

The gauges comprise a Frisbee type dust collection plate, connected to a rainwater collection vessel via a small tube. The gauge works by collecting ambient dust, which is deposited on the Frisbee plate and washed by rainwater through the tube into the collection vessel. The gauges were mounted on tripod stands and left at the monitoring locations for a period of approximately one month. Dust deposition analysis was also undertaken by SGS located in Kenya giving an average dust deposition rate in mg/m^2/day. An example of the deposited dust monitoring is included as Figure 2.

Figure 2: Dust gauge located at Station 4

1.5.1.1.3 Particulate Matter

Particulate monitoring was undertaken at each location using an Airmetrics minivol TAS to measure particle matter sizes 10µm (PM_{10}) and 2.5 µm ($PM_{2.5}$). Two units are run simultaneously to monitor both particle size fractions. Samples are collected on a pre- weighed filter paper and the monitoring period and the flow rate are recorded and at the end of the monitoring period the filters (which were pre-weighed prior to the monitoring period) are returned to the laboratory for analysis of the mass fraction. The µg/m^3 concentration is then calculated from the sample mass and sample details. The measured data covers the period December 2018 to January 2019. An example of a minivol monitoring station is shown in Figure 3.

Figure 3: Minivols monitoring station located in Lamu

1.6 Data Acquisition

One month of monitoring data have been collected, although there are some data gaps which are summarised in Table 2.

Baseline data collection is still ongoing and baseline concentrations and this baseline report will be revised during the ESIA.

Table 2: Air Quality data collection by month

Pollutant	Location	Dec 2018	Jan 2019	Feb 2019	Mar 2019
NO_2	Ngamia [e]	N	N	N	n/a
	Station 4	n/a	Y	Y	n/a
	Station 6	n/a	N [a]	Y	n/a
	Station 7	n/a	Y	Y	n/a
	Station 9	n/a	Y	Y	n/a
	Station 10	n/a	Y	Y	n/a
	Lamu	n/a	Y	Y	n/a
SO_2	Ngamia [e]	N	N	N	n/a
	Station 4	n/a	Y	Y	n/a
	Station 6	n/a	N [a]	Y	n/a
	Station 7	n/a	Y	Y	n/a
	Station 9	n/a	Y	Y	n/a
	Station 10	n/a	Y	Y	n/a
	Lamu	n/a	Y	Y	n/a
O_3	Ngamia [e]	N	N	N	n/a
	Station 4	n/a	Y	Y	n/a
	Station 6	n/a	N [a]	N [b]	n/a
	Station 7	n/a	Y	N [c]	n/a
	Station 9	n/a	Y	N [b]	n/a
	Station 10	n/a	Y	Y	n/a
	Lamu	n/a	Y	N [b]	n/a

Pollutant	Location	Dec 2018	Jan 2019	Feb 2019	Mar 2019
BTEX	Ngamia [e]	N	N	N	n/a
	Station 4	n/a	Y	Y	n/a
	Station 6	n/a	N [a]	Y	n/a
	Station 7	n/a	Y	Y	n/a
	Station 9	n/a	Y	Y	n/a
	Station 10	n/a	Y	Y	n/a
	Lamu	n/a	Y	Y	n/a
PM_{10} &$PM_{2.5}$	Ngamia	N	N	N	Y
	Station 4	N	Y	n/a	n/a
	Station 6	N	Y	n/a	n/a
	Station 7	Y	N	n/a	n/a
	Station 9	Y [d]	Y	n/a	n/a
	Station 10	Y	N	n/a	n/a
	Lamu	N	Y	n/a	n/a
Deposited Dust	Ngamia [e]	N	N	N	n/a
	Station 4	n/a	Y	Y	n/a
	Station 6	n/a	N [a]	Y	n/a
	Station 7	n/a	Y	Y	n/a
	Station 9	n/a	Y	Y	n/a
	Station 10	n/a	Y	Y	n/a
	Lamu	n/a	Y	Y	n/a

(a) Station 6 could not be accessed during December 2018 monitoring visit, therefore no diffusion tube or deposited dust data are available

(b) Broken tubes on collection

(c) Missing tube on collection

(d) Monitoring undertaken but data disregarded due to disruption of equipment

(e) Monitoring also undertaken for 12 previous non-consecutive months from November 2015, results are included in calculations but monitoring dates are not shown in this table

1.7 Results

The short-term air quality concentrations were calculated utilising the conservative Department for Environment, Food & Rural Affairs (DEFRA) and UK Environment Agency (EA) methodology for calculating averaging periods (DEFRA & EA, 2016) and for the 10 minute average utilised by the Ministry of Environment, Ontario, Canada (2008) methodology. In the absence of any international methodology or guidance relating to this, the following assumptions were applied:

- The annual average concentration is taken as the mean of the monitored data;
- Hourly average concentration = the annual average concentration x 2;
- Twenty-four hour average concentration = the hourly average concentration x 0.59;
- Eight-hour average concentration = the hourly average concentration x 0.7;
- Fifteen-minute average concentration = the hourly average concentration x 1.34; and
- Ten-minute average concentration = the hourly average concentration x 1.65.

As an example, the monitored long-term average SO_2 concentration for the period was 1.1 µg / m^3. The hourly average SO_2 concentration at station 4 was estimated to be 1.0 µg/m^3 (i.e. 0.5 µg/m^3 x 2). Similarly, the SO_2 concentrations for the other average times were estimated as follows:

- 24-hour average concentration = 0.6 µg/m^3 (i.e. 1.0 µg/m^3 x 0.59); and
- 10-minute average concentration = 1.6 µg/m^3 (i.e. 1.0 µg/m^3 x 1.65).

Baseline average air quality concentrations for the monitored pollutants are provided for each monitoring location. Data are presented for the BTEX species monitored and compared against the relevant AQS where relevant. Baseline data and the associated plots are included in Appendix F.

Tables 3 to 9 detail a summary of the monitoring results for each location.

Table 3: Baseline average air quality concentrations for pollutants monitored at Ngamia

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.9	40	2.2
	24-hour	1.0	188	0.6
	1 hour	1.8	200	0.9
SO_2	Annual	1.1	50	2.3
	24-hour	1.4	20	6.8
	10-minute	3.8	500	0.8
O_3	8-hour	37.4	100	37.4
	1-hour	53.4	235	22.7
Benzene	Annual	2.1	-	-
	24-hour	2.5	600 [(a)]	0.4
Toluene	Annual	2.3	-	-
	24-hour	2.7	600 [(a)]	0.5
Ethylbenzene	Annual	2.6	-	-
	24-hour	3.0	600 [(a)]	0.5
Xylene	Annual	2.4	-	-
	24-hour	2.9	600 [(a)]	0.5
PM^{10}	Annual	39.0	20	194.9
	24-hour	46.0	50	92.0
$PM^{2.5}$	Annual	35.6	10	355.9
	24-hour	42.0	25	168.0
Deposited Dust	Annual	93.0	200 mg/m^2/day	46.5

(a) AQS for Total VOC as this is the closest applicable

Table 4: Baseline average air quality concentrations for pollutants monitored at Station 4

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.7	40	1.6
	24-hour	0.8	188	0.4
	1-hour	1.3	200	0.7
SO_2	Annual	0.5	50	1.0
	24-hour	0.6	20	2.9
	10-minute	1.6	500	0.3
O_3	8-hour	11.2	100	11.2
	1-hour	16.0	235	6.8
Benzene	Annual	1.8	-	-
	24-hour	2.2	600 [(a)]	0.4
Toluene	Annual	2.0	-	-
	24-hour	2.3	600 [(a)]	0.4
Ethylbenzene	Annual	2.1	-	-
	24-hour	2.5	600 [(a)]	0.4
Xylene	Annual	2.9	-	-
	24-hour	3.5	600 [(a)]	0.6
PM^{10}	Annual	58.5	20	292.5
	24-hour	69.0	50	138
$PM^{2.5}$	Annual	0.0	10	0.0
	24-hour	0.0	25	0.0
Deposited Dust	Annual	145.9	200 mg/m^2/day	73.0

(a) AQS for Total VOC as this is the closest applicable

Table 5: Baseline average air quality concentrations for pollutants monitored at Station 6

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.5	40	1.3
	24-hour	0.6	188	0.3
	1-hour	1.0	200	0.5
SO_2	Annual	0.5	50	1.0
	24-hour	0.6	20	2.8
	10-minute	1.6	500	0.3
O_3	8-hour	- (a)	100	- (a)
	1-hour	- (a)	235	- (a)
Benzene	Annual	1.7	-	-
	24-hour	2.0	600 (b)	0.3
Toluene	Annual	1.8	-	-
	24-hour	2.2	600 (b)	0.4
Ethylbenzene	Annual	1.9	-	-
	24-hour	2.3	600 (b)	0.4
Xylene	Annual	2.7	-	-
	24-hour	3.2	600 (b)	0.5
PM^{10}	Annual	23.7	20	118.5
	24-hour	28.0	50	56.0
$PM^{2.5}$	Annual	0.0	10	0.0
	24-hour	0.0	25	0.0
Deposited Dust	Annual	118.7	200 mg/m^2/day	59.3

(a) Discussed in Section 6.7.3

(b) AQS for Total VOC as this is the closest applicable

Table 6: Baseline average air quality concentrations for pollutants monitored at Station 7

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.6	40	1.5
	24-hour	0.7	188	0.4
	1-hour	1.2	200	0.6
SO_2	Annual	0.5	50	1.0
	24-hour	0.6	20	2.9
	10-minute	1.6	500	0.3
O_3	8-hour	22.9	100	22.9
	1-hour	32.7	235	13.9
Benzene	Annual	1.6	-	-
	24-hour	1.9	600 [(a)]	0.3
Toluene	Annual	1.7	-	-
	24-hour	2.0	600 [(a)]	0.3
Ethylbenzene	Annual	1.8	-	-
	24-hour	2.1	600 [(a)]	0.3
Xylene	Annual	2.5	-	-
	24-hour	3.0	600 [(a)]	0.5
PM^{10}	Annual	22.0	20	110.0
	24-hour	26.0	50	52.0
$PM^{2.5}$	Annual	14.4	10	144.0
	24-hour	17.0	25	68.0
Deposited Dust	Annual	56.3	200 mg/m^2/day	28.1

(a) AQS for Total VOC as this is the closest applicable

Table 7: Baseline average air quality concentrations for pollutants monitored at Station 9

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.5	40	1.2
	24-hour	0.6	188	0.3
	1-hour	1.0	200	0.5
SO_2	Annual	0.5	50	1.0
	24-hour	0.6	20	2.9
	10-minute	1.6	500	0.3
O_3	8-hour	11.8	100	11.8
	1-hour	16.9	235	7.2
Benzene	Annual	1.8	-	-
	24-hour	2.1	600 [(a)]	0.4
Toluene	Annual	1.9	-	-
	24-hour	2.2	600 [(a)]	0.4
Ethylbenzene	Annual	2.0	-	-
	24-hour	2.4	600 [(a)]	0.4
Xylene	Annual	2.8	-	-
	24-hour	3.3	600 [(a)]	0.6
PM^{10}	Annual	23.7	20	118.5
	24-hour	28.0	50	56.0
$PM^{2.5}$	Annual	0.0	10	70.0
	24-hour	0.0	25	33.0
Deposited Dust	Annual	81.0	200 mg/m^2/day	40.5

(a) AQS for Total VOC as this is the closest applicable

Table 8: Baseline average air quality concentrations for pollutants monitored at Station 10

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.5	40	1.3
	24-hour	0.6	188	0.3
	1-hour	1.0	200	0.5
SO_2	Annual	0.4	50	0.9
	24-hour	0.5	20	2.6
	10-minute	1.4	500	0.3
O_3	8-hour	9.3	100	9.3
	1-hour	13.3	235	5.7
Benzene	Annual	1.6	-	-
	24-hour	1.9	600 [(a)]	0.3
Toluene	Annual	1.7	-	-
	24-hour	2.0	600 [(a)]	0.3
Ethylbenzene	Annual	1.8	-	-
	24-hour	2.2	600 [(a)]	0.4
Xylene	Annual	2.6	-	-
	24-hour	3.0	600 [(a)]	0.5
PM^{10}	Annual	23.7	20	118.5
	24-hour	28.0	50	56.0
$PM^{2.5}$	Annual	11.9	10	119.0
	24-hour	14.0	25	56.0
Deposited Dust	Annual	50.8	200 mg/m^2/day	25.4

(a) AQS for Total VOC as this is the closest applicable

Table 9: Baseline average air quality concentrations for pollutants monitored at Lamu

Pollutant	Averaging Period	Concentration (µg/m^3, unless stated)	AQS (µg/m^3, unless stated)	Concentration as % of AQS
NO_2	Annual	0.5	40	1.3
	24-hour	0.6	188	0.3
	1-hour	1.0	200	0.5
SO_2	Annual	0.4	50	0.9
	24-hour	0.5	20	2.6
	10-minute	1.5	500	0.3
O_3	8-hour	11.1	100	11.1
	1-hour	15.8	235	6.7
Benzene	Annual	1.6	-	-
	24-hour	1.9	600 [(a)]	0.3
Toluene	Annual	1.7	-	-
	24-hour	2.1	600 [(a)]	0.4
Ethylbenzene	Annual	1.8	-	-
	24-hour	2.2	600 [(a]	0.4
Xylene	Annual	2.6	-	-
	24-hour	3.0	600 [(a)]	0.5
PM^{10}	Annual	23.7	20	118.5
	24-hour	28.0	50	56.0
$PM^{2.5}$	Annual	0.0	10	0.0
	24-hour	0.0	25	0.0
Deposited Dust	Annual	48.1	200 mg/m^2/day	24.1

(a) AQS for Total VOC as this is the closest applicable

1.8 Discussion

The baseline air quality has been compared to the Air Quality Standards (AQS) selected for the Project, i.e. the Project Standards, which are defined in Annex I. Where Kenyan standards are absent or international guidelines are more stringent, the international guideline values are considered most appropriate as the Project AQS. In the following sections, where the Project AQS does not equal the Kenyan Standard, the Kenyan standard is also shown in the figures.

1.8.1 NO_2

Concentrations are similar at stations 6, 9, 10 and Lamu, with annual average concentrations of 0.5 µg/m³. Concentrations are slightly higher at Station 7, Station 4 and Ngamia, with annual average concentrations of 0.6 µg/m³ and 0.7 µg/m³ and 0.9 µg/m³ respectively. The average of the seven monitoring locations is 0.6 µg/m³. The maximum concentration recorded at any of these locations is 3.2 µg/m³ at Ngamia. The minimum concentration recorded at any station was 0.1 µg/m³ at Ngamia.

The average concentrations recorded at all stations are less than 2.2% of the standard for any of the relevant averaging periods. A plot of the data is included as Figure 4 and shows annual average concentrations of NO_2 at monitored stations compared to the relevant Project AQS, taken from the more stringent international standard (40 µg/m³) and the Kenyan AQS (0.05 ppm, which equates to approximately 94 µg/m³).

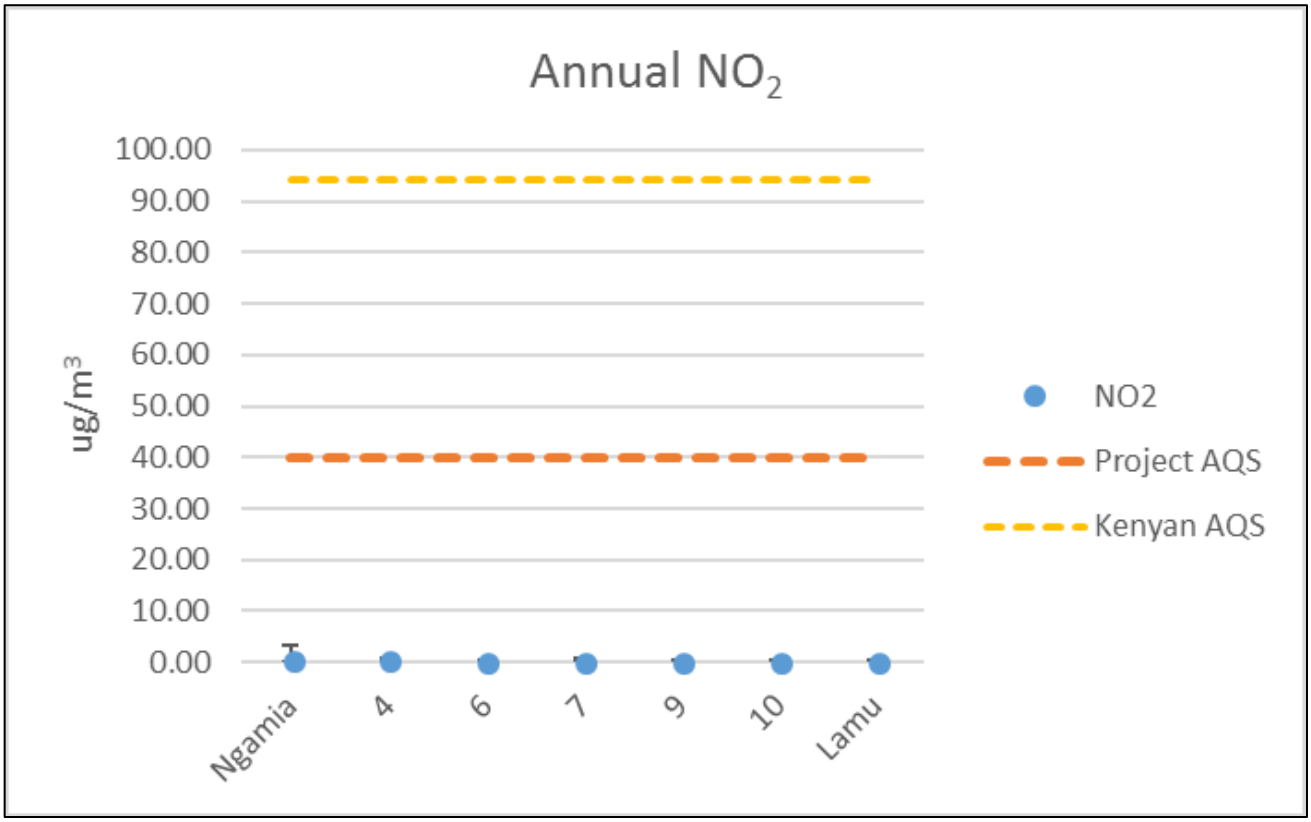

Figure 4: NO_2 annual average concentrations at monitored stations

1.8.2 SO_2

Concentrations are similar at both the stations 4, 6, 7 and 9, with an annual average concentration of 0.5 µg/m³. Concentrations are slightly lower at station 10 and Lamu, with annual average concentrations of 0.4 µg/m³, and are highest at Ngamia, with an annual average concentration of 1.1 µg/m³. The maximum concentration recorded at any of these locations is 5.4 µg/m³ at Ngamia. The minimum concentration recorded at any station was 0.4 µg/m³ at Lamu.

The average concentrations recorded at all stations are less than 2.3% of the standard for any of the relevant averaging periods. A plot of the data is included as Figure 5 and shows annual average concentrations of SO_2 at monitored stations compared to the relevant Project AQS, which is the Kenyan AQS of 50 µg/m³. There is no international AQS for annual SO_2.

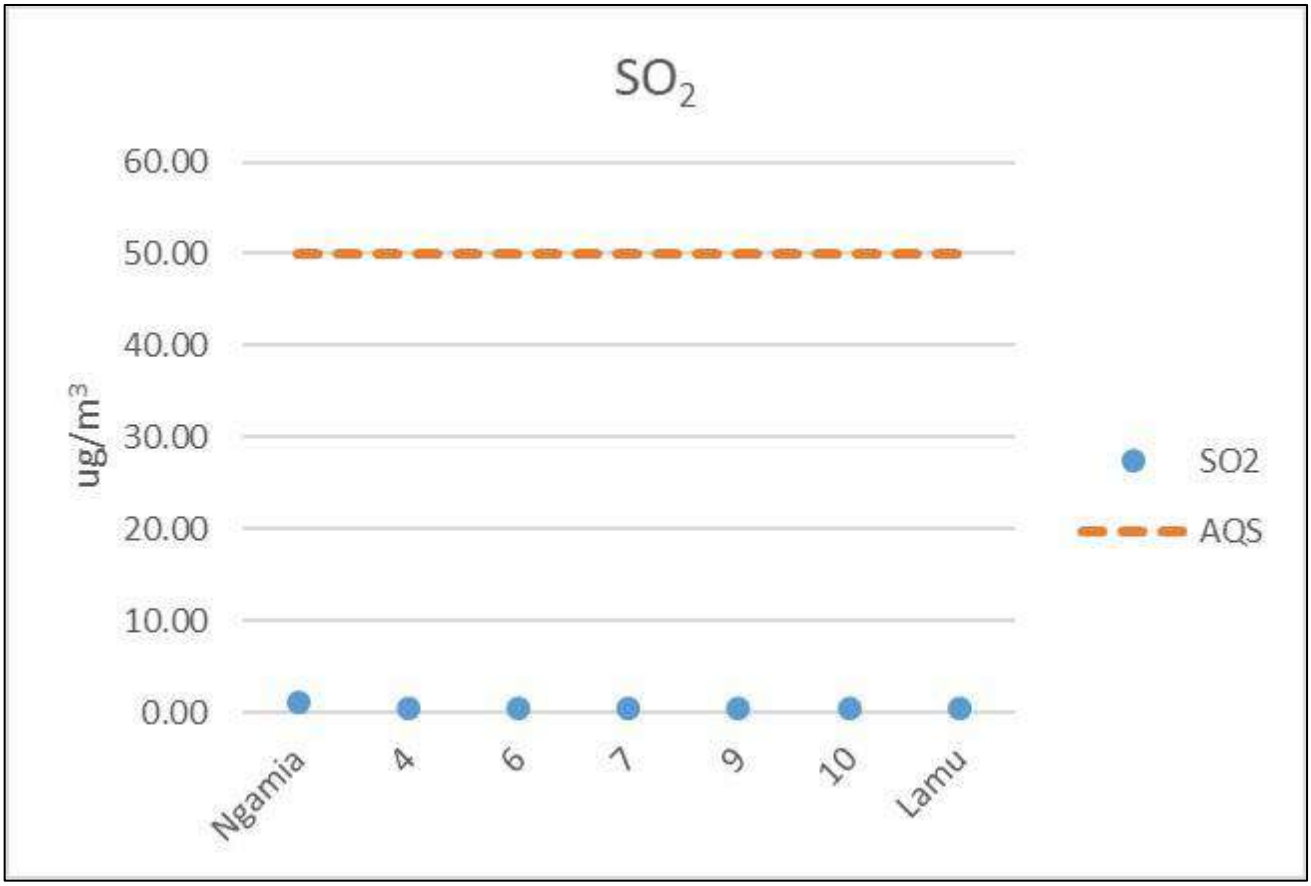

Figure 5: SO_2 annual average concentrations at monitored stations

1.8.3 O_3

Concentrations are similar at stations 4, 9 and Lamu, with an 8 hourly average concentration of 11.2 µg/m³ recorded at station 4, 11.8 µg/m³ at station 9 and 11.1 µg/m³ at Lamu. The 8 hourly average concentration is highest at Ngamia, at 37.4 µg/m³. The average of the seven monitoring locations is 12.3 µg/m³. The maximum 8 hourly concentration recorded at any of these locations is 39.4 µg/m³ at Ngamia. The minimum concentration recorded at any station was 9.3 µg/m³ at Station 10.

No data were recorded for Station 6 as it could not be accessed for the first round of monitoring, and for the second round the tube was broken on collection.

A plot of the data is included as Figure 6 which shows annual average concentrations of O_3 at monitored stations. There is no International or Kenyan standard for annual O_3 to compare the baseline concentrations against.

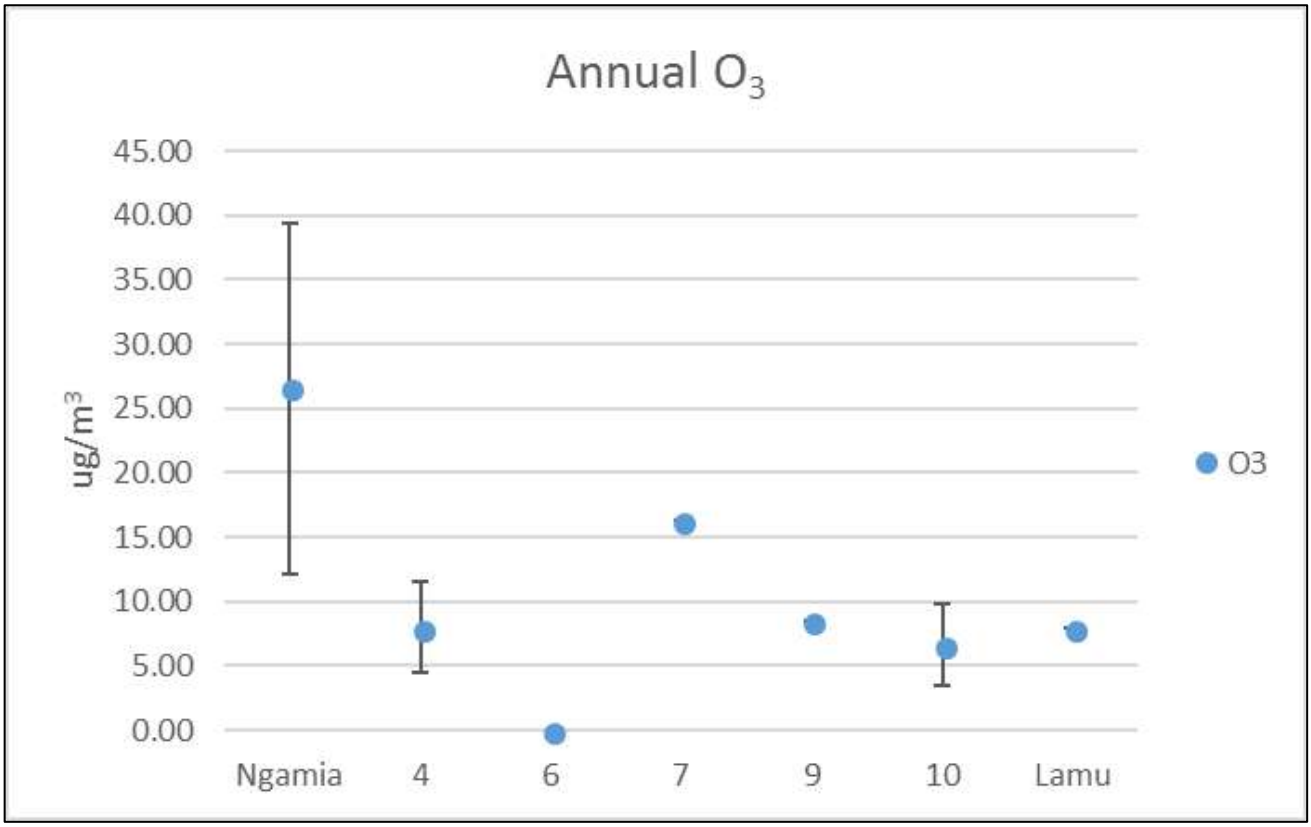

Figure 6: O_3 annual average concentrations at monitored stations

1.8.4 BTEX

There are no Kenyan or International AQS values for annual concentrations of either Benzene, Toluene, Ethylbenzene or Xylene. There is a 24-hour Kenyan AQS for 24-hour Total VOCs of 600 µg/m³ which is the closest applicable standard, however this would include all VOC species cumulatively and is applicable for a different averaging period than presented for the baseline. Although there is no relevant annual AQS for BTEX, the baseline data allows for a comparison to be made with the operational phase of the project.

For benzene, concentrations are very similar at stations 7, 10 and Lamu, with annual average concentrations of 1.6 µg/m³. The average of the seven monitoring locations is 1.7 µg/m³. The maximum concentration recorded at any station is 2.4 µg/m³ recorded at Ngamia. The minimum concentration recorded at any station was 1.5 µg/m³. There is no annual standard to compare the baseline values with, however the average 24 hourly concentrations recorded at all stations are less than 0.4% of the 24 hour VOC standard.

For toluene, concentrations are very similar at stations 7, 10 and Lamu, with annual average concentrations of 1.7 µg/m³. The average of the seven monitoring locations is 1.9 µg/m³. The maximum concentration recorded at any station is 2.6 µg/m³ recorded at Ngamia. The minimum concentration recorded at any station was 1.6 µg/m³. There is no annual standard to compare the baseline values with, however the average 24 hourly concentrations recorded at all stations are less than 0.5% of the 24 hour VOC standard.

For ethylbenzene, concentrations are very similar at stations 7, 10 and Lamu, with annual average concentrations of 2.6 µg/m³. The average of the seven monitoring locations is 2.0 µg/m³. The maximum concentration recorded at any station is 2.9 µg/m³ recorded at Ngamia. The minimum concentration recorded at any station was 1.7 µg/m³. There is no annual standard to compare the baseline values with, however the average 24-hourly concentrations recorded at all stations are less than 0.5% of the 24 hour VOC standard.

For xylene, concentrations are very similar at stations 10 and Lamu, with annual average concentrations of 1.6 µg/m³. The average of the seven monitoring locations is 2.7 µg/m³. The maximum concentration recorded at any station is 3.2 µg/m³ recorded at Station 4. The minimum concentration recorded at any station was 2.2 µg/m³. There is no annual standard to compare the baseline values with, however the average 24 hourly concentrations recorded at all stations are less than 0.5% of the 24 hour VOC standard.

Plots of the Benzene, Toluene, Ethylbenzene and Xylene data are included respectively as Figure 7, Figure 8, Figure 9 and Figure 10 below.

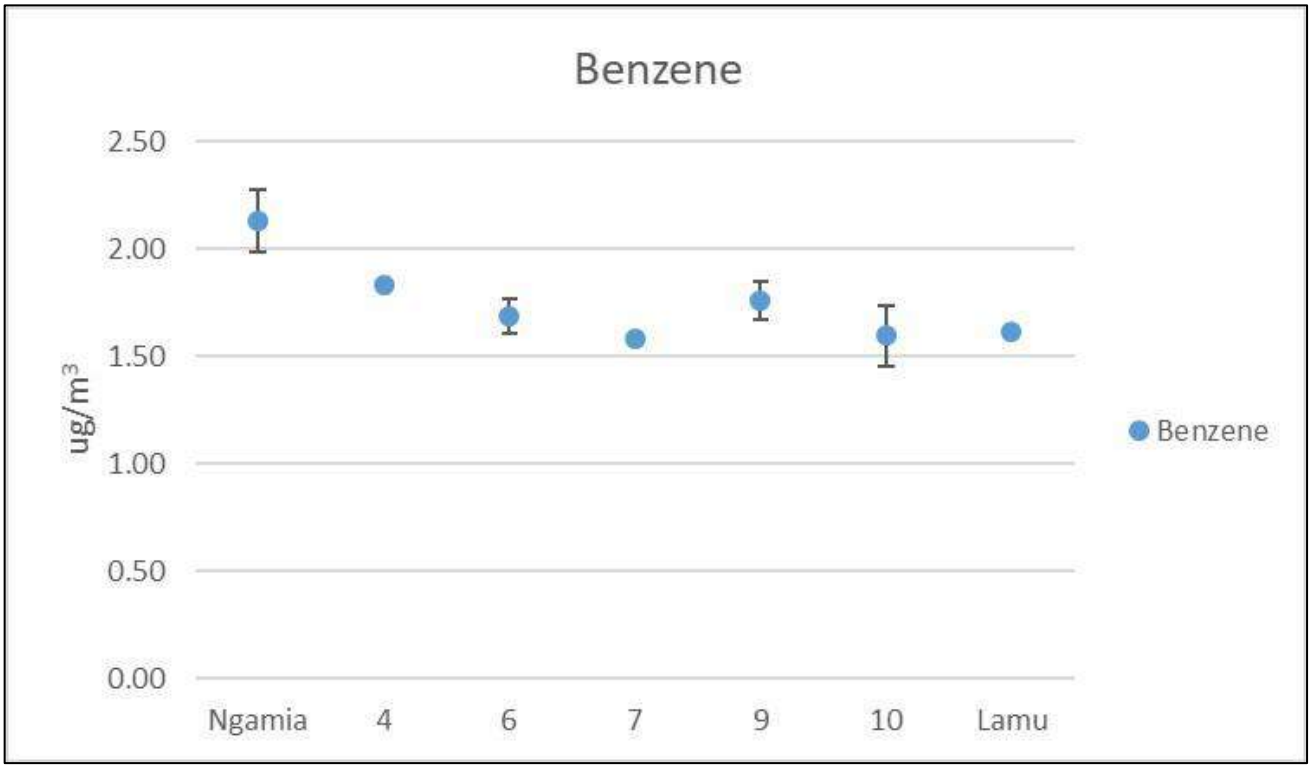

Figure 7: Benzene annual average concentrations at monitored stations

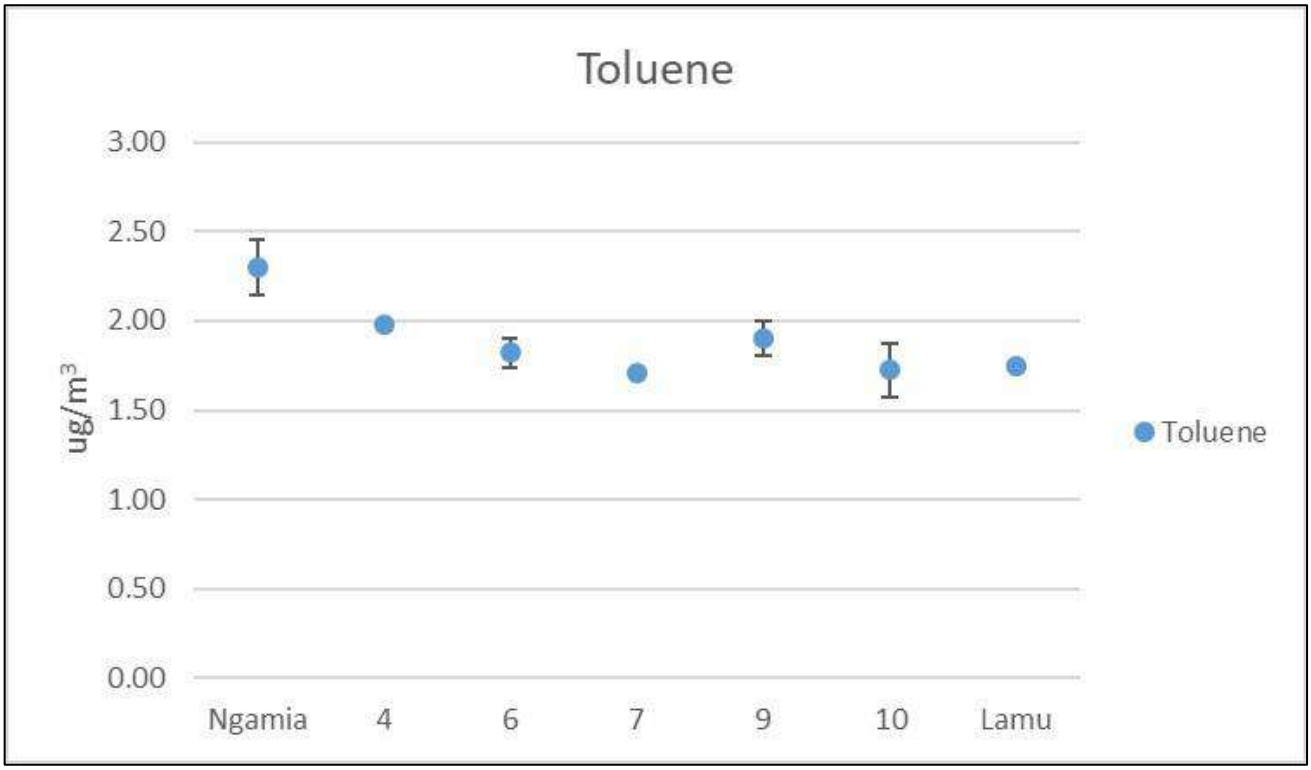

Figure 8: Toluene annual average concentrations at monitored stations

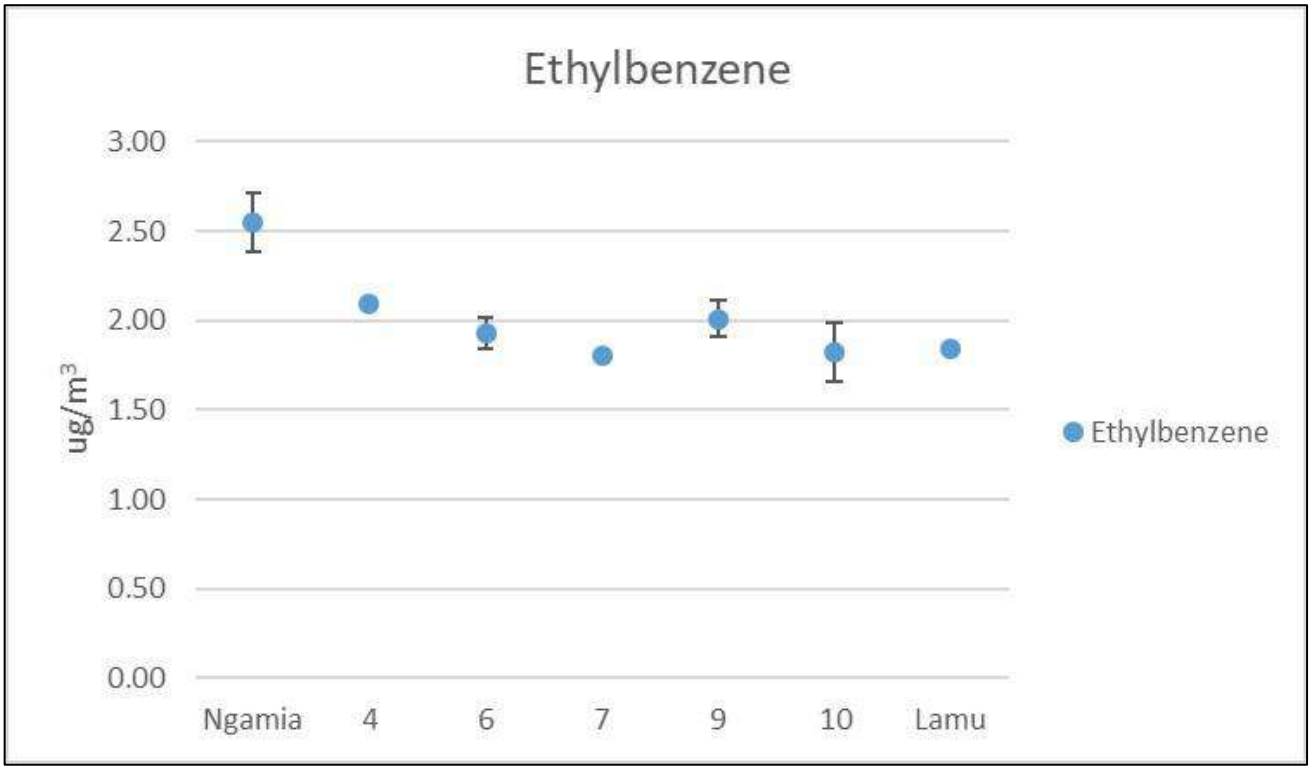

Figure 9: Ethylbenzene annual average concentrations at monitored stations

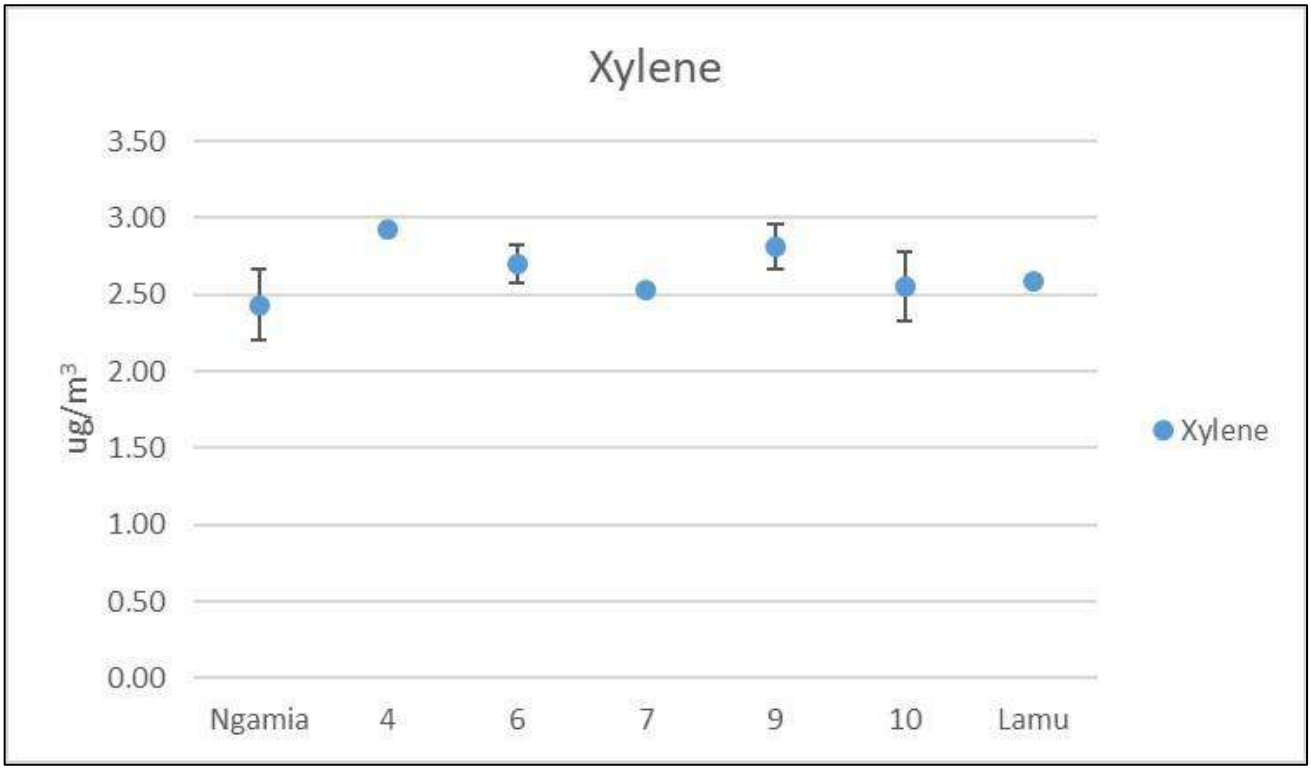

Figure 10: Xylene annual average concentrations at monitored stations

1.8.5 PM_{10}

Concentrations are similar at stations 6, 7, 9, 10 and Lamu, with an annual average concentration of 23.7 µg/m³ recorded at stations 6, 9, 10 and Lamu, and 22.0 µg/m³ at Station 7. The average of the seven monitoring stations is 36.1 µg/m³. The maximum concentration recorded at any of these locations is 69.0 µg/m³ at Station 4. The annual average concentration is approximately 181% of the AQS, although the 24-hour averaging period has an average concentration that is approximately 72% of the AQS. The minimum concentration recorded was 26.0 µg/m³ at Station 7.

A plot of the data is included as Figure 11 and shows annual average concentrations of PM_{10} at monitored stations compared to the relevant Project International AQS and Kenyan AQS values. The annual project AQS is the international standard of 20 µg/m³ which is more stringent that than Kenyan annual PM10 standard of 50 µg/m³.

With regard to the baseline for the annual average concentration being greater than the AQS (20 µg/m³), the AQS is the IFC Guideline value, which is most stringent. The IFC also has interim targets 1, 2 and 3 which have standards of 70, 50 and 30 µg/m³ respectively. These targets are seen as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high (WHO, 2005). Due to the background concentrations being so great, these interim targets could be applicable to this Project. The Kenyan standard for annual PM_{10} is 50 µg/m³ at both the boundary and off site which corresponds with the IFC interim target 2.

Elevated particle concentrations could relate to the dusty environment, meteorological events such as periods of high wind speeds or dry periods. They could also be related to elevated source conditions at the monitoring locations including burning and exhaust emissions. The locations are well established and have multiple potential emissions sources.

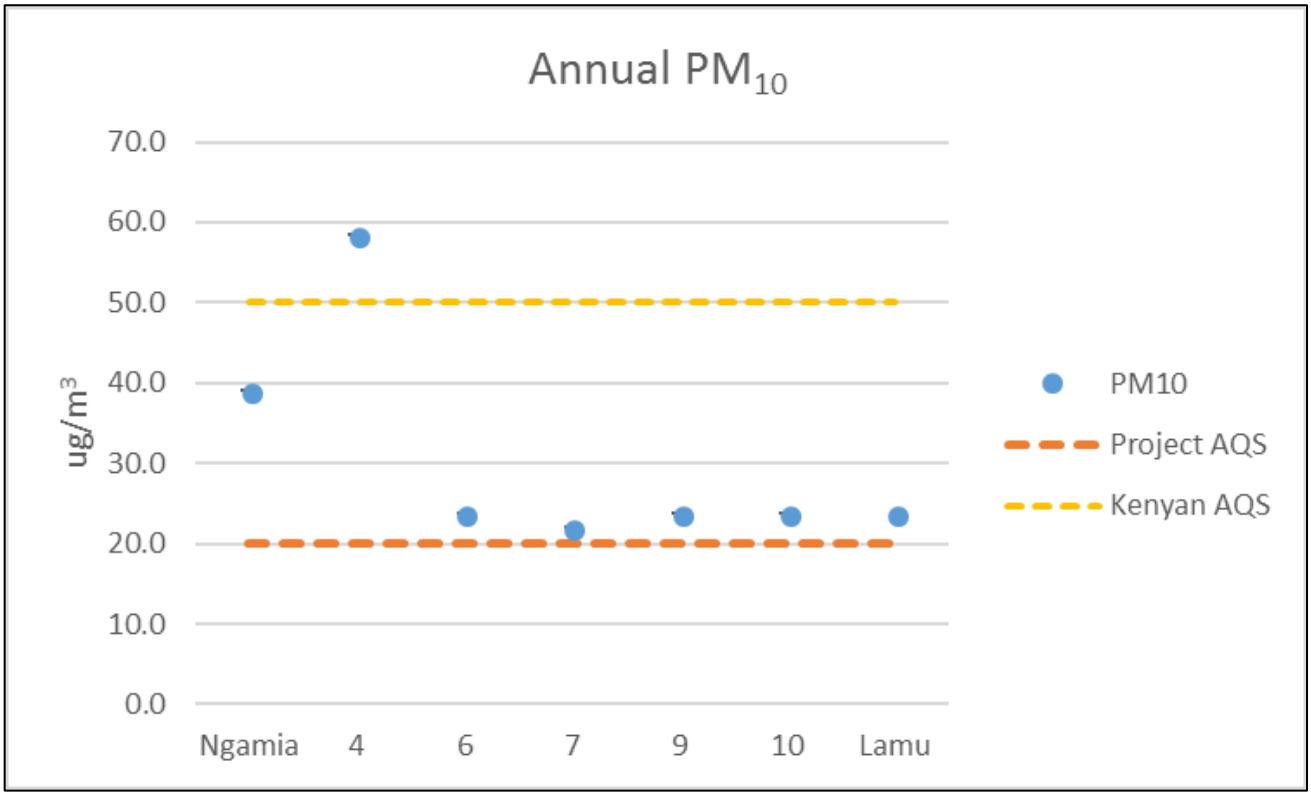

Figure 11: PM_{10} annual average concentrations at monitored stations

1.8.6 PM2.5

Concentrations are similar at Stations 4, 6 and Lamu. The average of the seven monitoring stations is 4.4 µg/m³. The maximum concentration recorded at any of these locations is 42.0 µg/m³ at Ngamia. The average concentration is 104% of the annual averaging period. The minimum concentration recorded was 0.0 µg/m³ at Stations 4, 6 and Lamu.

A plot of the data is included as Figure 12 below and shows annual average concentrations of $PM_{2.5}$ at monitored stations compared to the relevant Project International AQS and Kenyan AQS values. The annual project AQS is the international standard of 50 µg/m³ which is more stringent that than Kenyan annual PM2.5 standard of 70 µg/m³.

The IFC also has interim targets 1, 2 and 3 which have standards of 35, 25 and 15 µg/m³ respectively. These targets are seen as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high (WHO, 2005). Due to the background concentrations being so great, these interim targets could be applicable to this Project. The Kenyan standard for annual $PM_{2.5}$ is 35 µg/m³ at both the boundary and off site which corresponds with the IFC interim target 1.

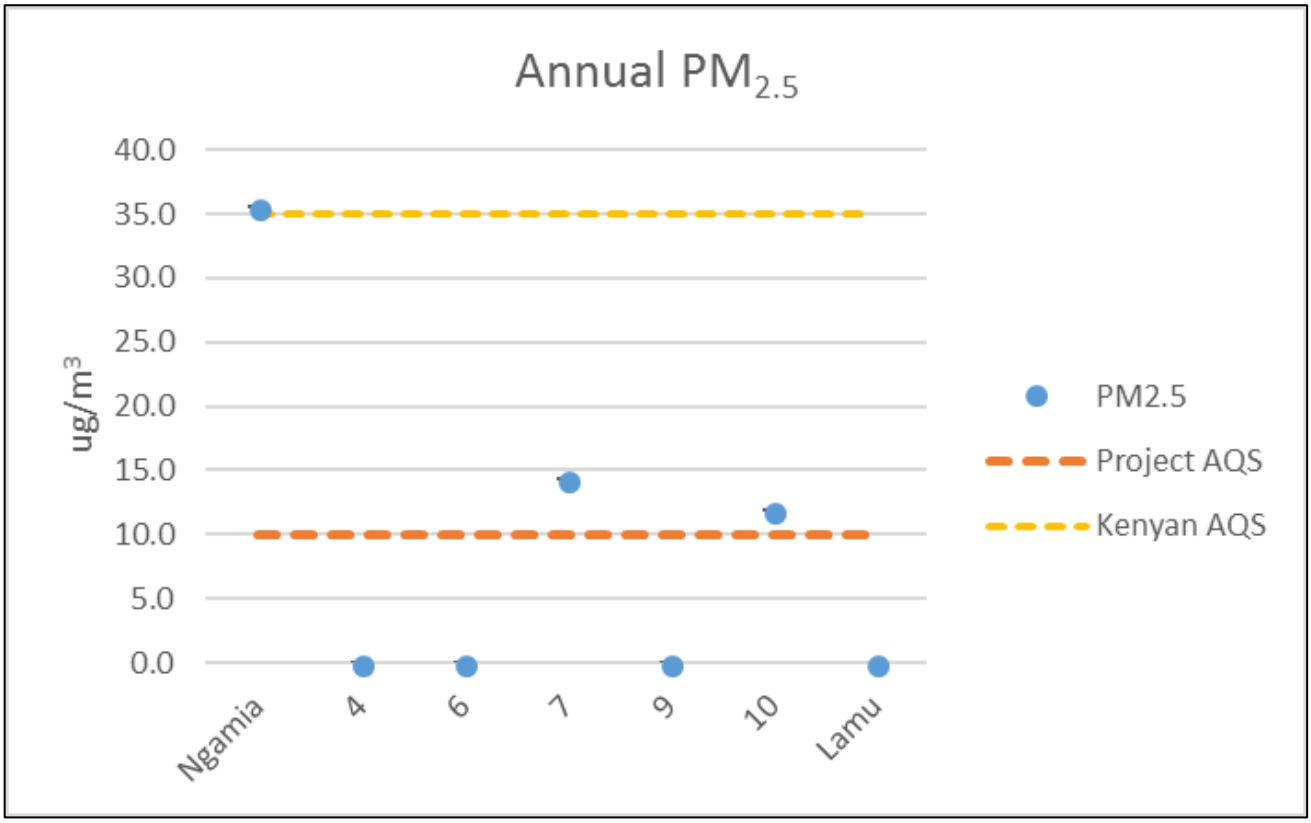

Figure 12: $PM_{2.5}$ annual average concentrations at monitored stations

1.8.7 Deposited Dust

Concentrations are similar at Stations 7, 10 and Lamu, with an average concentration of 56.3 mg/m^2/day recorded at station 7, 50.8 mg/m^2/day at Station 10 and 48.1 mg/m^2/day at Lamu. The average of the seven monitoring locations is 84.8 mg/m^2/day. The maximum concentration recorded at any of these locations is 470 mg/m^2/day at Ngamia. The minimum concentration recorded at any station was 24.2 mg/m^2/day at Lamu.

The average concentrations recorded at all stations are less than the relevant standard of 200 mg/m^2/day. The average concentration recorded at any station is less than 42% of the standard.

In the absence of any Kenyan Standard, the AQS is based on International standard. This standard is derived from the UK Institute of Air Quality Management (IAQM) 'Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites' (IAQM, 2012). In relation to perceived loss of amenity caused by dust, international guidelines advise that dust deposition levels should not exceed 130-350 mg/m^2/day to prevent amenity impacts due to dust soiling. Therefore the 200 mg/m^2/day standard is considered applicable.

A plot of the data is included as Figure 13 below.

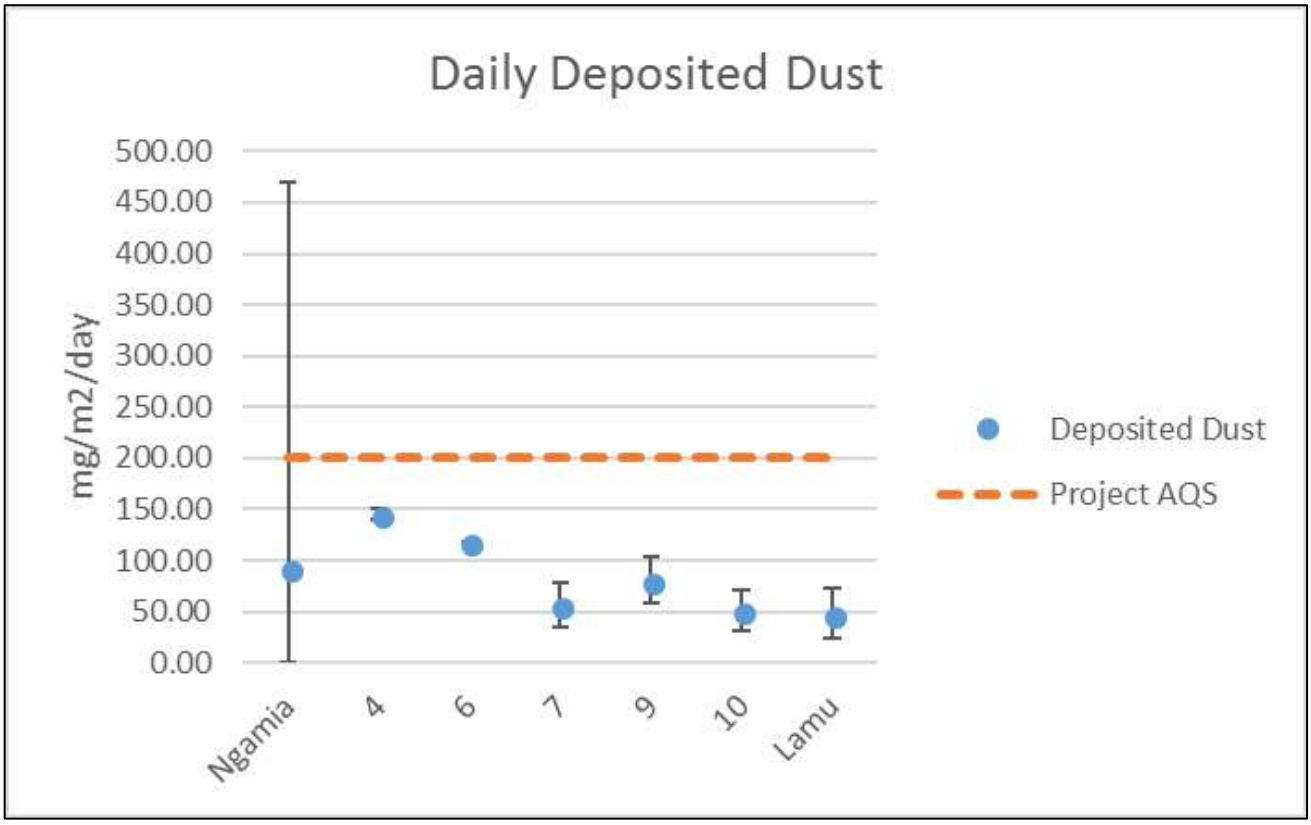

Figure 13: Deposited dust annual average concentrations at monitored stations

ACRONYMS AND ABBREVIATIONS

AQS	Air Quality Standard
PM_{10}	Particles less than or equal to 10 micrograms
PM2.5	Particles less than or equal to 2.5 micrograms
BTEX	Benzene, Toluene, Ethylbenzene & Xylene
NO_2	Nitrogen Dioxide
SO_2	Sulphur Dioxide
VOC	Volatile Organic Compounds
O_3	Ozone
TSP	Total suspended particles
$mg/m^2/day$	milligrams per square metre per day
$\mu g/m^3$	micrograms per cubic metre

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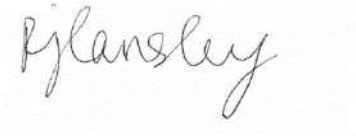

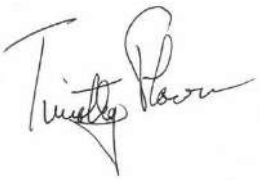

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REPORT

Noise Baseline

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

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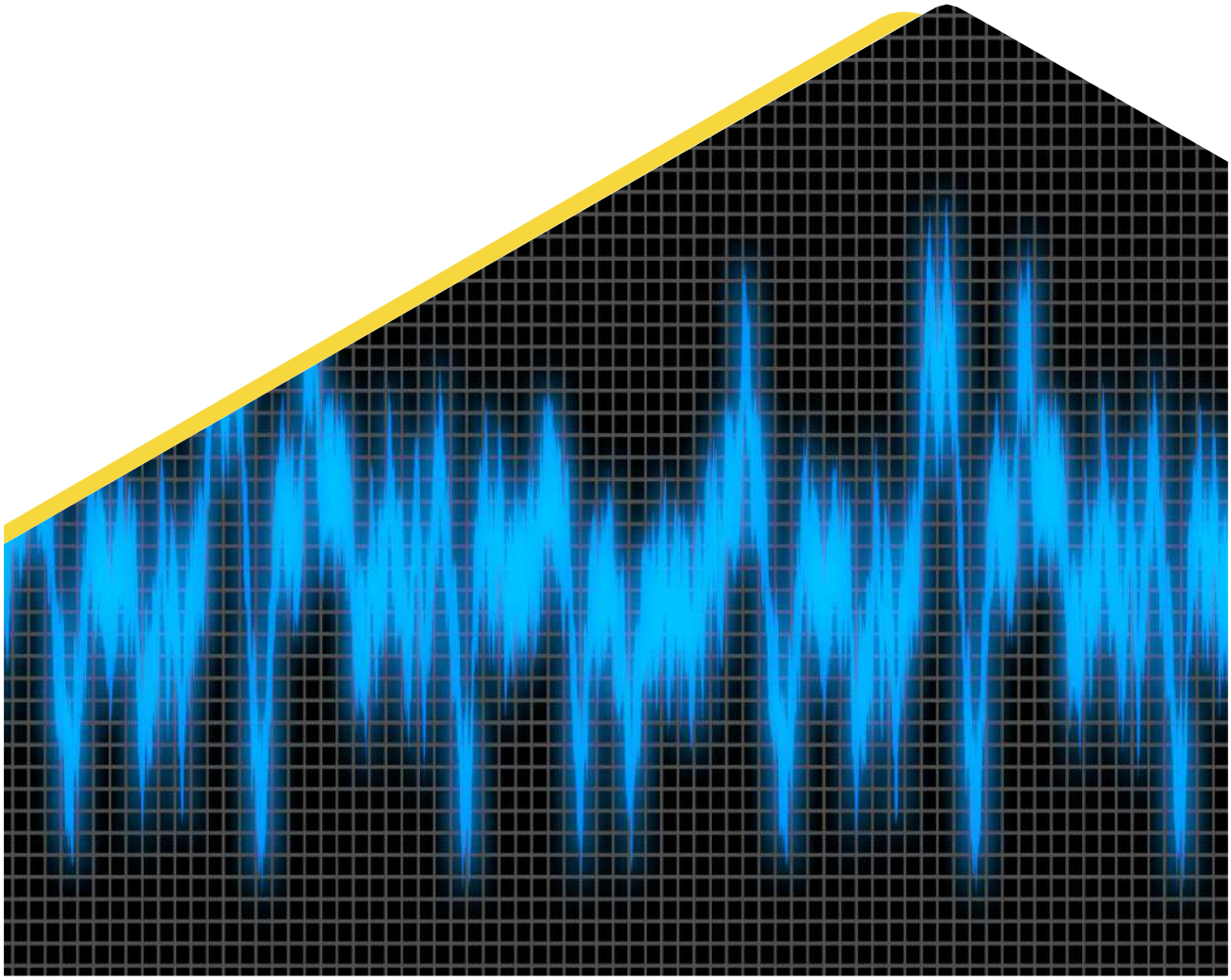

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1.0 INTRODUCTION

Noise baseline data gathering was completed during three separate field visits (December 2018, March 2019, and April 2019) and included seven monitoring locations. Additional data has been considered from the Upstream baseline data gathering program collected during a field visit in March 2019. Data from these locations characterise the baseline noise environment within the potential noise and vibration Area of Influence where permanent human activity is expected to occur near the Project.

No vibration data was gathered as part of the ESIA baseline. Due to the greenfield nature of the Area of Influence, the baseline vibration is assumed to be negligible. The effects assessment of changes in vibration will be completed as a comparative change based on predicted changes in activity associated to the Project.

The field reports for the baseline data collection are included in Annex II (ref. 1772867.553.104A-F).

1.1 Area of Influence

The AoI for the noise baseline within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a buffer area of 5 km radius surrounding each station along the LLCOP route and a 1.5 km buffer each side of the entire pipeline route (Figure 1).

2.0 NOISE GUIDELINES

Project standards for noise during Project operations have been derived based upon a review of Kenyan regulations and standards (NEMA, 2009), the International Finance Corporation (IFC) Noise Guideline (IFC, 2007), and consideration of the baseline environmental setting. A noise position paper prepared by Golder in November 2016 (Golder 2016) discusses Kenyan regulations and standards and the IFC Noise Guideline and goes on to select IFC Noise Guideline limits as those to be applied to the Project. TKBV confirmed with NEMA in a minuted meeting that the IFC Noise Guideline could be used as Project standards during operations in this ESIA. The Kenyan regulations provide construction noise level limits which are considered in the ESIA.

The receiving environment for the Project is best categorised as Residential under the IFC Noise Guideline. Therefore, the A-weighted one-hour equivalent sound level (L_{Aeq}) limit at Project receptors, represented by the baseline noise monitoring locations discussed below, is 55 dBA during the daytime (07:00 to 22:00) and 45 dBA during the nighttime (22:00 to 07:00) during Project operations.

The IFC Noise Guideline allows for either the sound level limits presented or a maximum increase in background levels of 3 dB at a given receptor location off-site. Since noise is expressed on a logarithmic scale (i.e. 45 dB + 45 dB = 48 dB), the 3 dB maximum increase in background levels considers the option for one to produce no more noise than what already exists at a receptor.

3.0 DATA

3.1 Secondary Data

There is no known baseline data for noise or vibration in the potential Area of Influence (AoI) other than the primary data gathered as part of the ESIA baseline data gathering associated with the Project.

3.2 Primary Data

3.2.1 Location

Baseline noise levels were measured in communities across the potential AoI which correspond to representative areas with permanent human receptors that have the potential to be impacted by Project noise. The baseline noise data gathering was designed in general accordance with the requirements of International Organisation for Standardisation (ISO) 1996 Parts 1 and 2 (ISO, 2003; ISO, 2007), which provides guidance on the equipment to be used, conditions under which noise measurements should be undertaken, measurement parameters and appropriate siting of monitoring equipment. Data was collected at seven locations within communities located near Project station locations along the LLCOP to characterise the sound levels along the pipeline (Figure 2).

The noise monitoring location for station 4 was Barsaloi Chief's Office, which lies at an elevation of 467 m and is a settlement with some commercial shops. The station 6 monitoring location was in Lengusaka, which lies at an elevation of 512 m and is a residential area with a small business centre and a road passing next to it. The Station 7 monitoring location was in Archer's Post in Isiolo, which is located at an elevation of 839 m and is next to the Ewaso Ng'iro river and the Isiolo Marsabit road, with a shopping centre, and police post nearby. Station 9 monitoring was conducted in Garba Tula, which lies at an elevation of 466 m and is a village settlement. Station 10 monitoring was conducted in Ohio Village in Rahole National Reserve in Garissa, with sampling elevations of both 337 m and 335 m. There is a village settlement, water pan, small kiosk and a school near the sampling location. The Load Out Facility monitoring location was in a village across the road from the entrance to Lamu Port.

Monitoring conducted at Amosing-5 as part of the Upstream ESIA is considered to be representative of baseline noise levels near LEF/PS1.

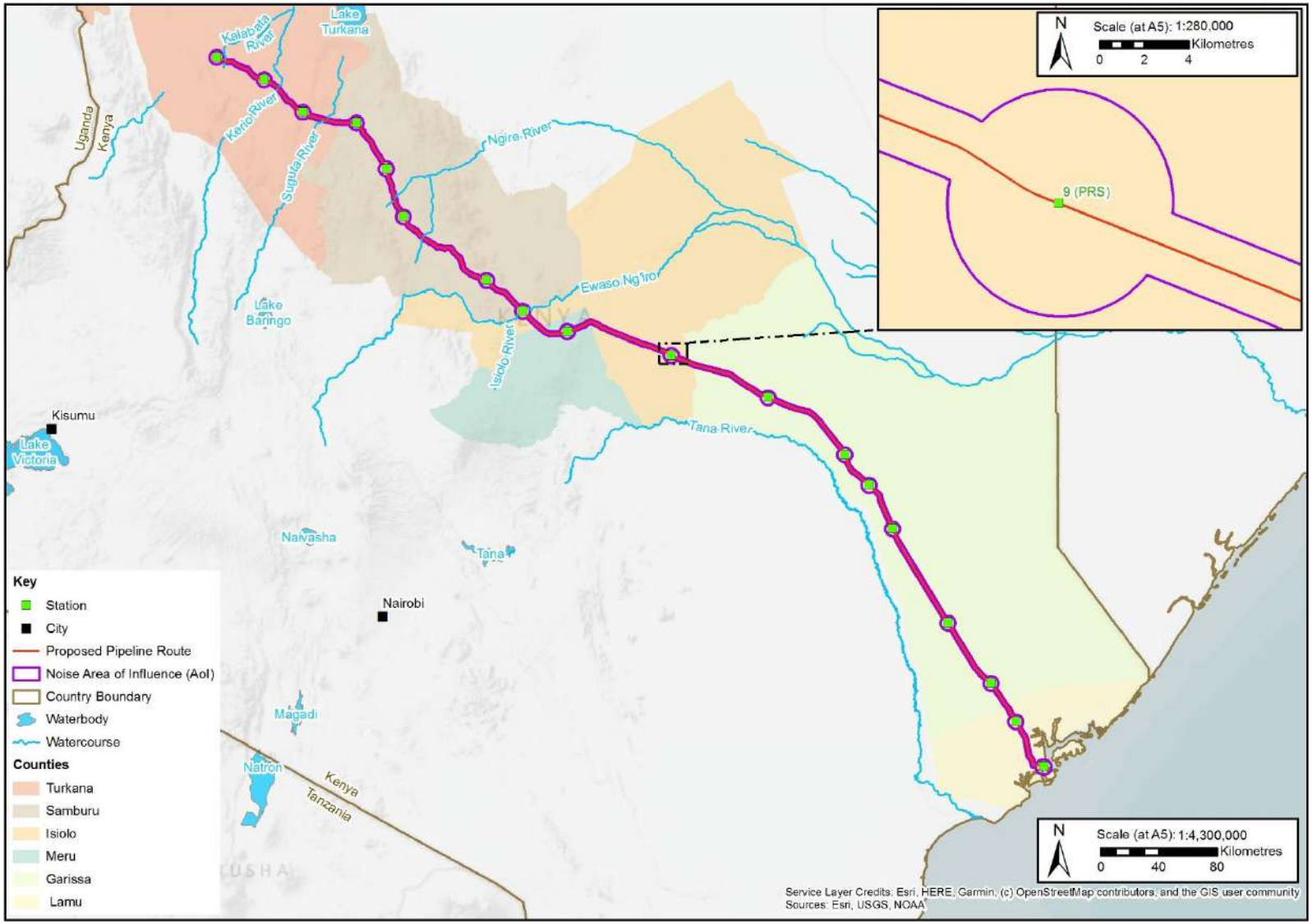

Figure 1: Noise AoI

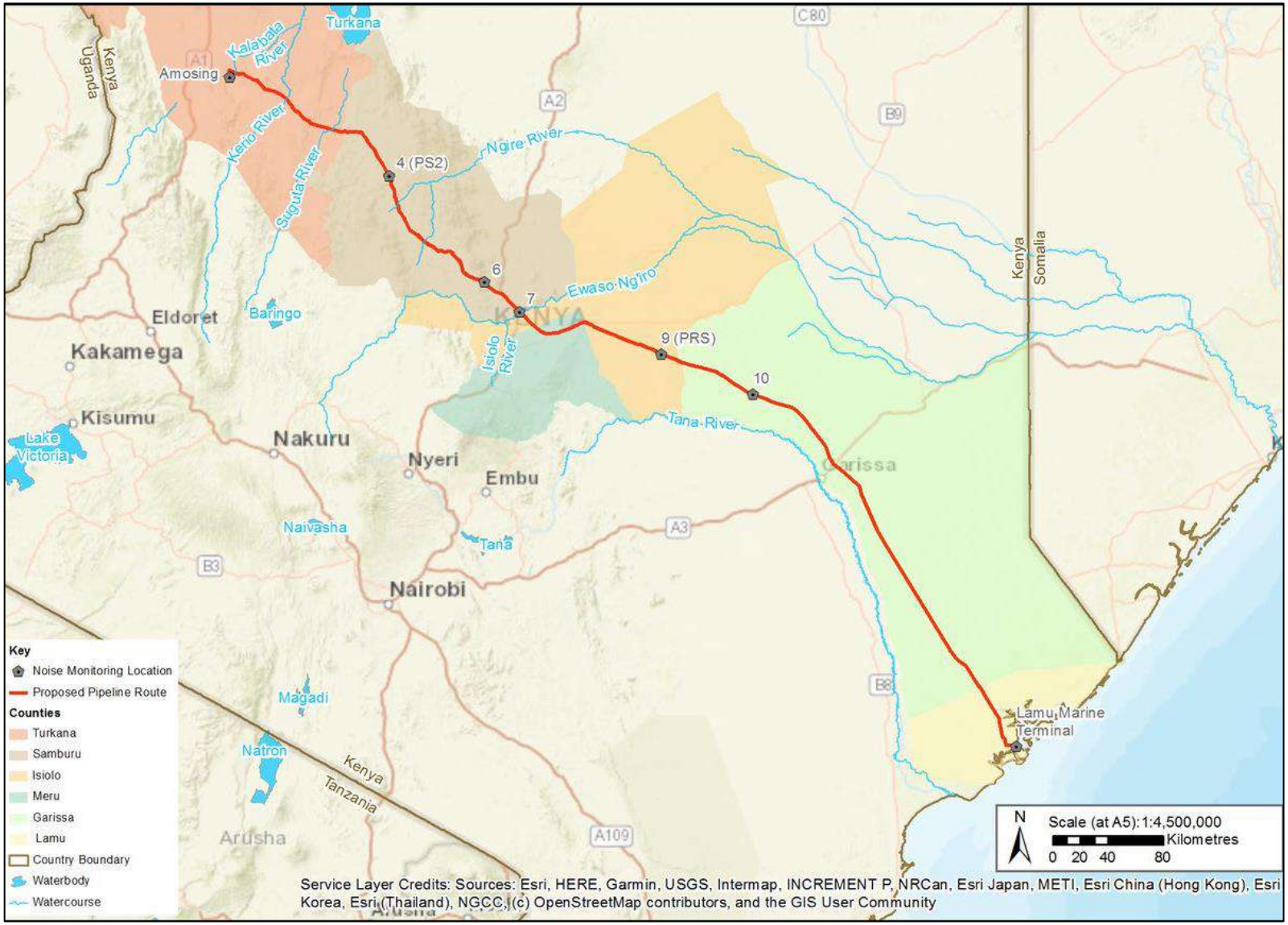

Figure 2: Baseline Noise Monitoring Locations

3.2.2 Methodology

The sound level meter (SLM) used for the noise monitoring programs was a Larson Davis SoundExpert® LxT SLM, which meets the IEC Type 1 classification. The microphone was protected with an environmental windscreen and mounted at a height of approximately 1.5 m above ground level. The microphone was connected by cable to the SLM which was housed in a weather-protected case. The SLM was calibrated on-site before each measurement with a portable calibrator. The SLM was within its required laboratory calibration period during the survey, as was the field calibrator. After each 24-hour measurement was complete, the equipment was removed from the respective location and the data were downloaded. Meteorological conditions were noted for each monitoring period. The "*noise floor*" of the SLMs, below which electronic "noise" in the instrument makes accurate measurement impossible, is below 20 dBA.

The data collected at each location included 10-minute equivalent sound levels (L_{Aeq}). The L_{Aeq} is the equivalent continuous sound level, which in a stated time and at a stated location has the same energy as the time varying noise level. It is common practice to measure L_{Aeq} sound levels in order to obtain a representative average sound level. Other parameters recorded on 10-minute intervals included L_{Apeak} (peak level measured in each 10-minute interval), L_{AFmax} (maximum level measured in each 10-minute interval with a fast time constant), and L_{AFmin} (the minimum level measured in each 10-minute interval with a fast time constant).

For the purposes of the noise assessment, the 10-minute L_{Aeq} data were aggregated to give hourly values as well as period averages for daytime and nighttime, for comparison with Project standards.

3.2.3 Results

The *International Finance Corporation Environmental, Health and Safety (EHS) Guidelines - Noise Management* dated 2007 (IFC Noise Guideline) and *Kenya Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations* dated 2009 (Kenya Noise Regulations) have been considered in defining the Project Standards.

Kenyan noise regulations for Zone C – Residential Outdoor are 50 dBA L_{eq} for daytime (06:01 to 20:00) and 35 dBA L_{eq} during night-time (20:01 to 06:00). However, in comparing standards to baseline data, it was observed that baseline values exceed Kenyan standards. Therefore, in line with the ESIA team justification on other projects in Kenya (Golder, 2016[1]) the IFC noise level limit for residential, institutional and educational receptors is considered more appropriate to the LLCOP Project and to this ESIA.

The specified IFC noise level limit for residential, institutional and educational receptors during daytime (07:00 to 22:00) is set at 55 dBA L_{eq}, and during night-time (22:00 to 07:00) at 45 dBA L_{eq}. These limits are adopted as the Project Standards for operational noise and presented on Figure 3 to Figure 9.[2]

The weather during most of the noise monitoring periods was dry with light winds. There was a short period of light rain (i.e. less than an hour) at the beginning of the noise monitoring period at Archer's Post on 10 December 2018; the noise monitoring data measured during this time were removed from the analysis. Meteorological conditions were not expected to have a significant effect on the remaining measured noise levels.

A summary of the noise monitoring results from the December 2018, March 2019 and April 2019 monitoring programs is provided in Table 1 During the noise monitoring programs, noise data were logged continuously on a 10-minute basis, summarised and reported as equivalent levels (L_{Aeq}) over a one-hour period of time. The noise levels presented in Table 1 below are for the daytime and nighttime periods, based on the one-hour data.

[1] Golder 2016 - Review of IFC noise Guideline and Kenya noise regulation sound level limits – South Lokichar Basin Project, 165017.511

[2] Note that the definition of daytime and nighttime for the construction limits in the Kenya Noise Regulations differs from the daytime and nighttime definition in the IFC Noise Guideline.

Figures 3 to 9 show the time series of the 10-minute L_{Aeq}, L_{Apeak}, L_{AFmax}, and L_{AFmin} measured at a selection of the noise monitoring locations[3].

Table 1:Summary of Measured Baseline Noise Levels

Noise Monitoring Location (Nearest Representative Station)	Latitude/ Longitude	Monitoring Period	Minimum One Hour L_{Aeq} (dBA)		Average One Hour L_{Aeq} (dBA)	
			Daytime [a]	Nighttime [b]	Daytime [a]	Nighttime [b]
Amosing-5 (LEF/PS1) [c]	**N:** 02°10'53.7" **E:** 35°47'01.9"	March 2019	25.4	20.7	44.1	29.3
Barsaloi (Station 4)	**N:** 01°20'07.2" **E:** 36°51'48.2"	April 2019	40.2	27.4	45.9	39.1
Lengusaka (Station 6)	**N:** 00°52'38.0" **E:** 37°19'01.3"	March 2019	46.1	32.9	49.2	40.9
Archer's Post (Station 7)	**N:** 00°38'24.6" **E:** 37°40'12.6"	December 2018	39.5	38.5	53.7	50.9
Garba Tula (Station 9)	**N:** 00°31'46.2" **E:** 38°31'06.8"	March 2019	42.0	33.7	49.6	42.2
Ohio Village (Station 10)	**N:** 00°05'42.9" **E:** 39°12'57.3"	December 2018	42.3	37.4	53.5	44.7
Lamu Port (Load Out Facility)	**N:** 02°11'56.6" **E:** 40°54'32.2"	March 2019	44.0	32.7	50.6	43.9

Note: *Daytime – 07:00 to 22:00; Nighttime – 22:00 to 07:00*

[a] *Baseline noise levels at Amosing-5 were measured as part of the Upstream baseline noise gathering and is further discussed in the Upstream ESIA*

[b] *Project Standard nighttime noise level limit, 45 dBA and Kenyan nighttime noise level limit 35 dBA*

[3] Amosing–5 summary data is presented in Table 1

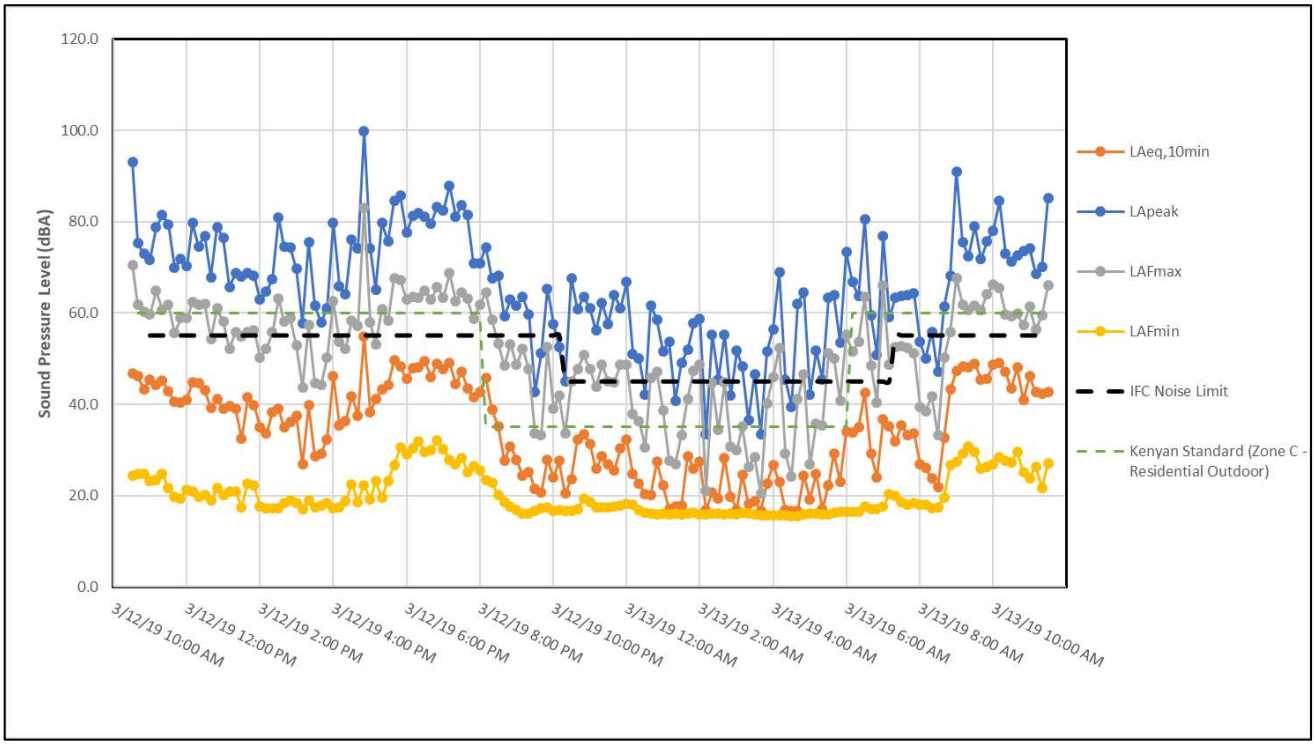

Figure 3: Time history graph of measured baseline noise levels at Amosing-5 (12 to 13 March 2019)

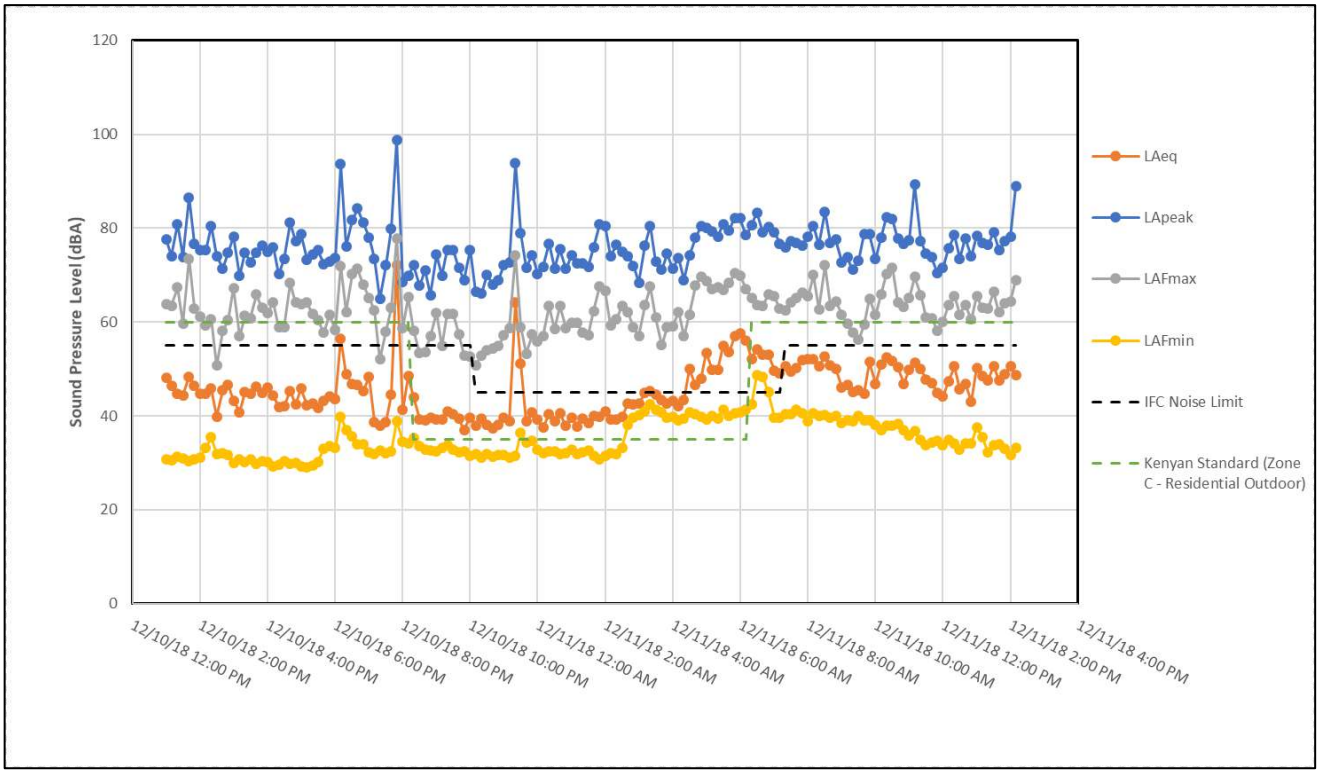

Figure 4: Time history graph of measured baseline noise levels at Archer's Post (10 to 11 December 2018)

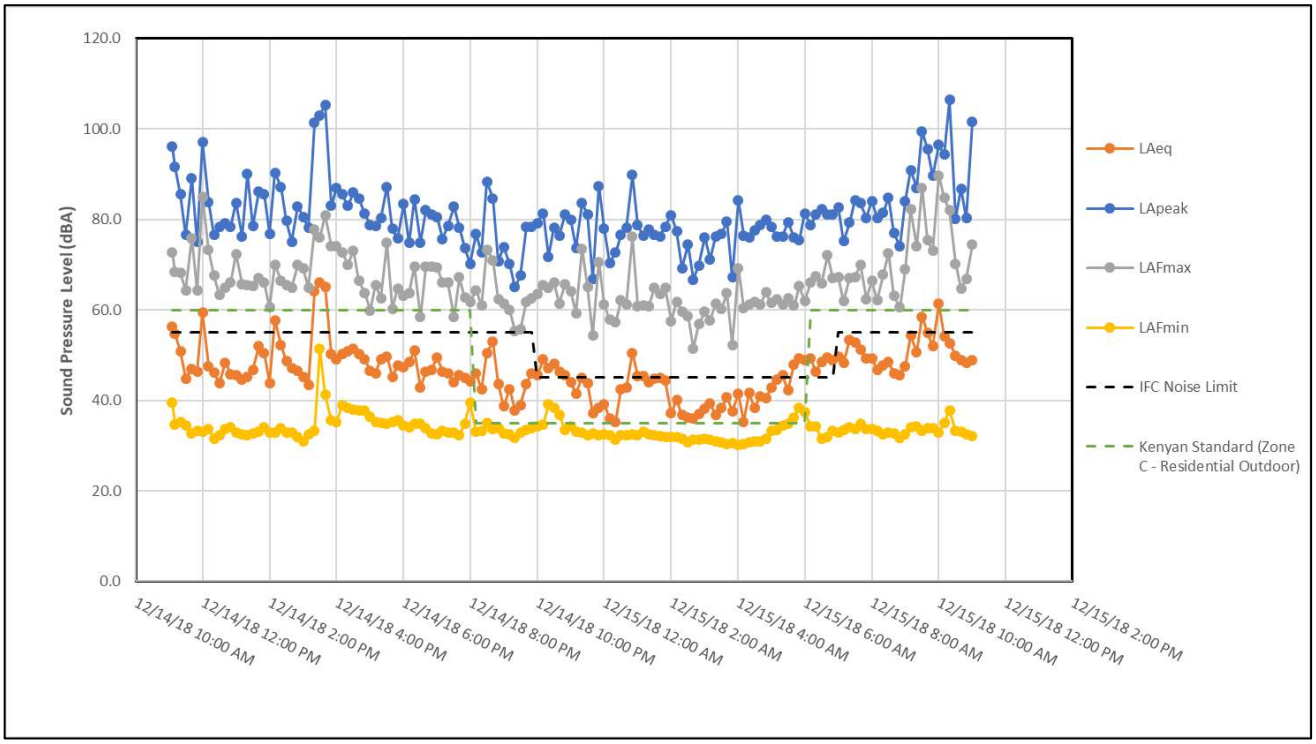

Figure 5:Time history graph of measured baseline noise levels at Ohio Village (14 to 15 December 2018)

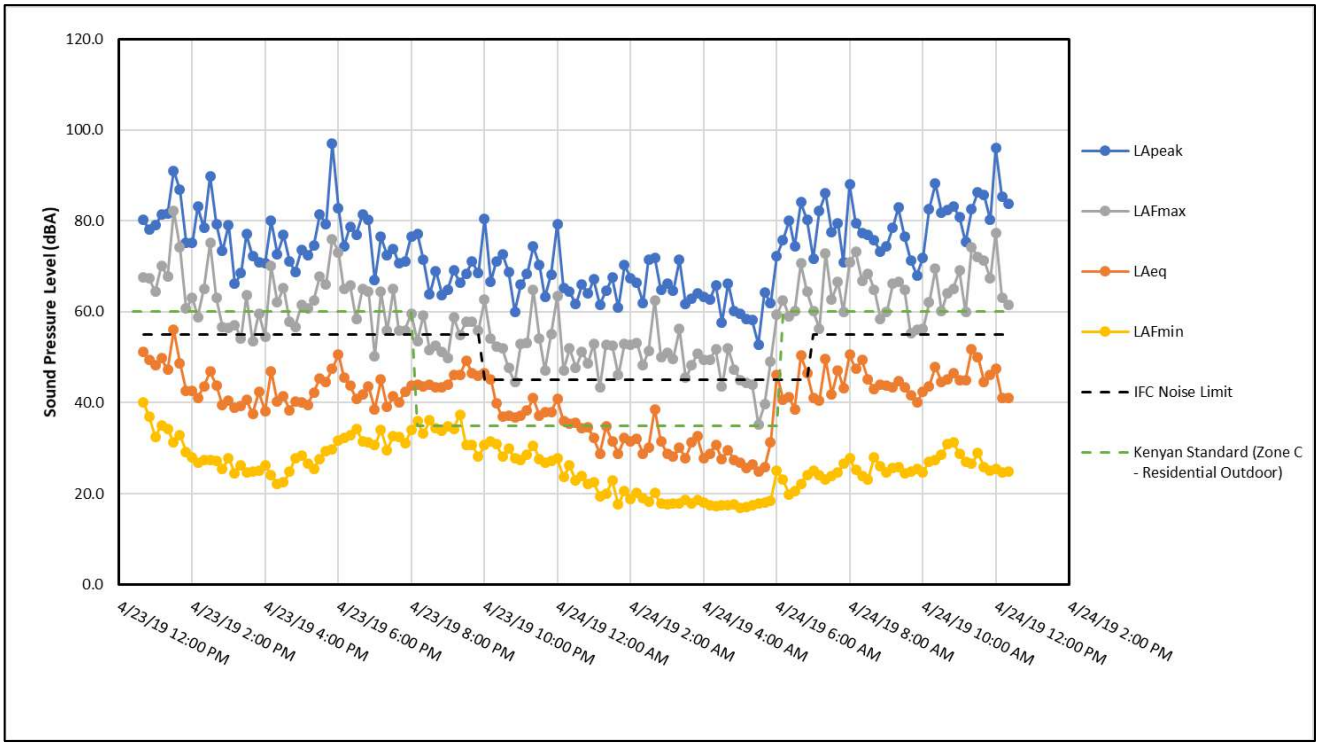

Figure 6: Time history graph of measured baseline noise levels at Barsaloi (23 to 24 April 2019)

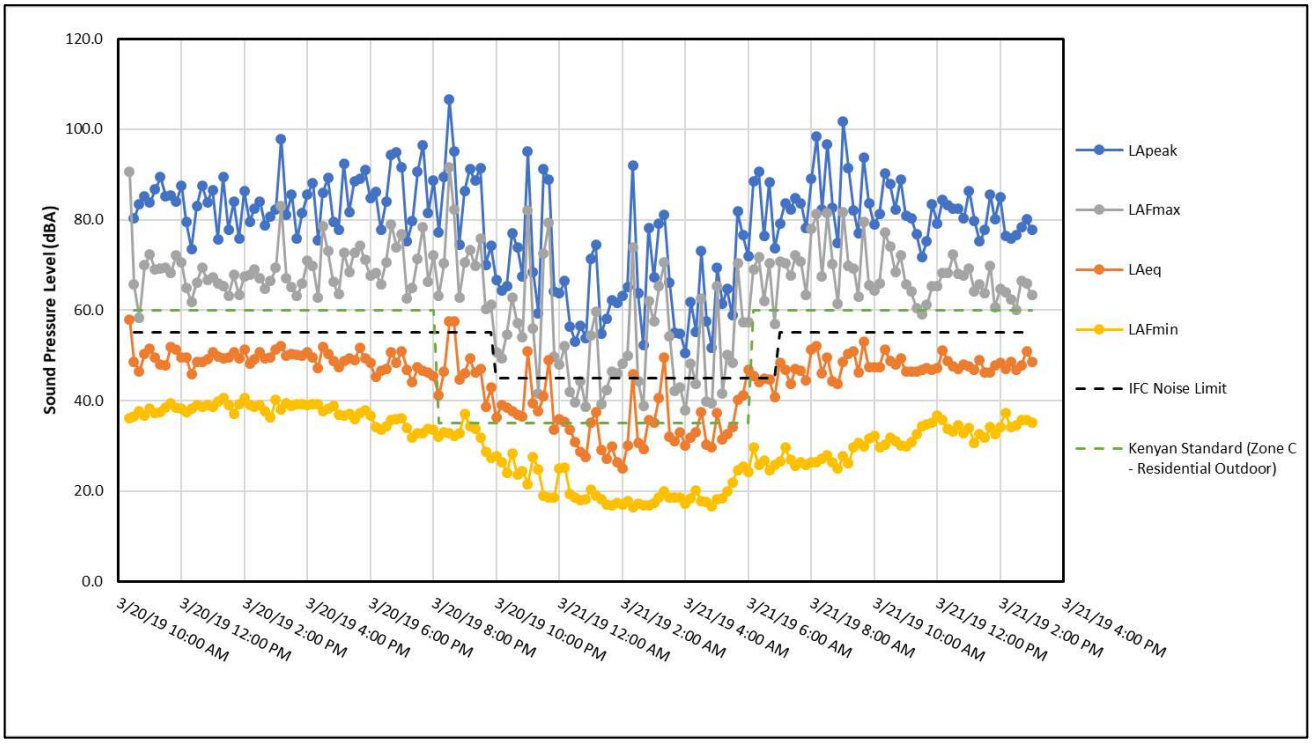

Figure 7: Time history graph of measured baseline noise levels at Lengusaka (20 to 21 March 2019)

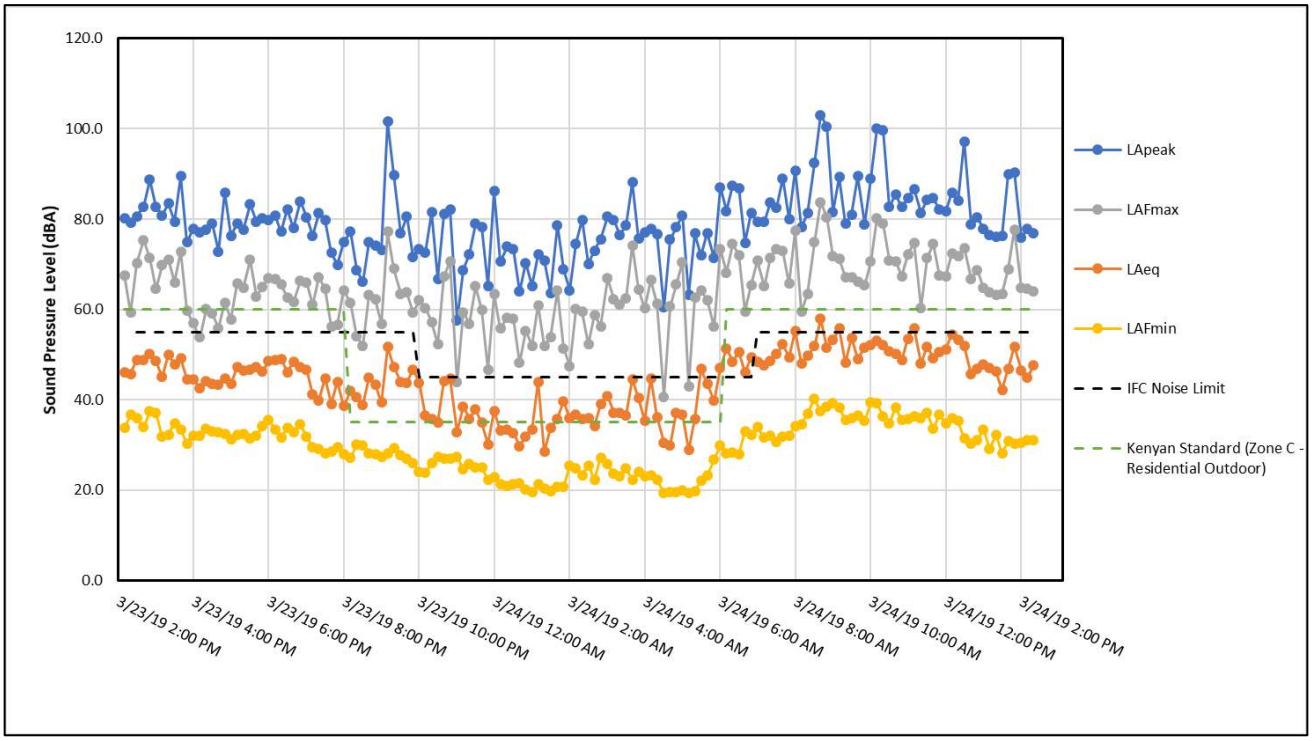

Figure 8: Time history graph of measured baseline noise levels at Garba Tula (23 to 24 March 2019)

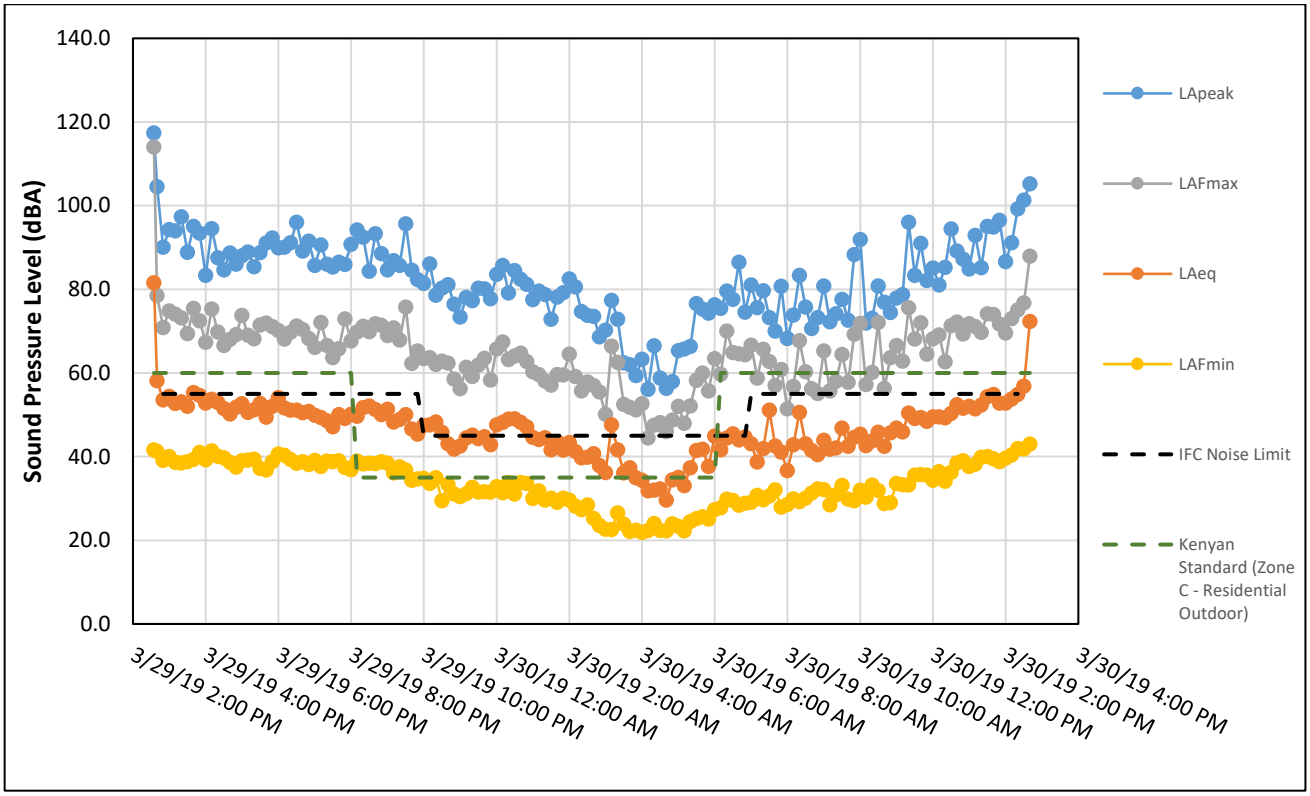

Figure 9: Time history graph of measured baseline noise levels at Lamu Port (29 to 30 March 2019)

4.0 DISCUSSION

The measured hourly minimum and average L_{Aeq} are summarised in Table 1 for all noise monitoring locations. Measured baseline noise levels are below the IFC limit values excluding Archer's Post (Station 7) during the nighttime period.

The Amosing-5 noise monitoring location was located adjacent to the Amosing exploration well pad in South Lokichar. Measured noise levels were influenced by occasional truck movements.

The Archer's Post noise monitoring location was in a school compound, 280 m north of Forest Road, near several other schools and a shopping centre; the schools were closed for holidays during the noise monitoring period. Measured noise levels were influenced by local residents and traffic on Forest Road. There were several religious buildings in the area, and the calls to prayer could have influenced the noise environment.

The Ohio Village noise monitoring location was next to the Rahole National Reserve, located within 30 m of Garissa-Bonane Road, which is used as a transport route during the nighttime period. West of the noise monitoring location was a water pan used by the community, and livestock was herded past the area by nomadic communities. Measured noise levels were influenced by local residents, wildlife, and traffic on the Garissa-Bonane Road.

The Lengusaka noise monitoring occurred at the Chief's residence, in a residential area with a small business centre. The location was within 200 m of the Archer's Post-Barsaloi Road. Measured noise levels were influenced by human activity within the community, vehicle traffic, and wildlife.

The Garba Tula noise monitoring was conducted at a police station, located near a residential area. Measured noise levels were influenced by wildlife, human activity and vehicle traffic.

The Lamu Port noise monitoring location was a homestead located approximately 400 m from the Lamu Port's main entrance. Measured noise levels were influenced by truck traffic associated with the Port, as well as human activity in the village and wildlife.

The Barsaloi noise monitoring was conducted at the Chief's office. It was located near a settlement with commercial shops, approximately 30 m from the Wamba-Suiyan Road. Measured noise levels were influenced by human activity within Barsaloi and wildlife.

There were peaks observed in the data measured at all locations but as these noise monitoring locations were unattended there was no information on the potential causes, and therefore they were still included in the analysis and in the results presented in Table 1. It is likely that the variability and range in consecutive data points throughout the noise monitoring period at the noise monitoring locations were due to localised human activity and/or the natural environment.

REFERENCES

The International Finance Corporation, 2007. *Environmental, Health and Safety (EHS) Guidelines - Noise Management*. Available at: <www.ifc.org/ehsguidelines> [accessed August 2019].

Government of Kenya, 2009. *Kenya Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations*. Available at: <https://www.nema.go.ke/images/Docs/Regulations/Noise%20regulations.pdf> [accessed August 2019].

ACRONYMS

AoI	Area of Influence
dBA	A-Weighted Decibels
EHS	Environmental, Health and Safety
EOPS	Early Oil Production Scheme
ESIA	Environmental and Social Impact Assessment
IFC	International Finance Corporation
ISO	International Organisation for Standardisation
LAeq	Equivalent Continuous Sound Pressure Level
LLCOP	Lockchar - Lamu Crude Oil Pipeline
NEMA	National Environment Management Authority
SLMs	Sound Level Meters

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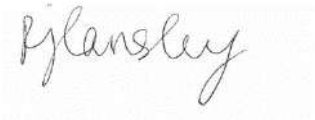

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REPORT

Landscape Character and Visual Baseline

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

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APPENDICES

APPENDIX A
Drawings

1.0 INTRODUCTION

The landscape and visual baseline desk study has been undertaken to:

- Establish the key characteristics of the landscape; and
- Assess the visual baseline by characterising baseline visibility from key locations.

The methodology employed for this assessment is primarily based on UK guidance (GLVIA, 2013) in the absence of Kenyan Legislation.

1.1 Area of Influence

The landscape and visual AoI), within which data has been gathered for the baseline, comprises the areas of potential visual effects during operations and construction of the Project based on analysis completed within the ESIA. It includes an area comprising a 10 km buffer around each station along the pipeline, based on visible infrastructure.

2.0 PRIMARY DATA

Primary data was captured during field survey in March 2019. The locations of a number, of stations, were visited to assess and record the existing visual and landscape character conditions. The locations visited were:

- Station 4;
- Station 5;
- Station 6;
- Station 7;
- Station 9;
- Station 10; and
- Lamu Port.

3.0 SECONDARY DATA

The following resources were used for the assessment:

- The following aerial imagery used to analyse the terrain and landscape features:
  - Airbus, 0.5 m resolution, date of capture: August 2018;
  - Landsat 8, 30 m resolution, date of capture: December 2010/January 2011;
  - Landsat 8, 30 m resolution, date of capture: February 2013; and
  - NVDI generated from Landsat 8 datasets;
- A virtual landscape created using numerous topographic datasets supplied by the client and analysed to provide the most realistic representation of the landscape[1]:

[1] No Digital Surface Models (DSM's) were used in the GIS analysis. DSM's are topographic coverages containing all elements of the landscape, including vegetation and trees

  - 1 m DSM (Digital Surface Model) – resampled from Airbus WorldDEM 12 m DSM. Date of capture: August 2018;
  - 12 m DSM – sourced from the Airbus WorldDEM 12 m DSM. Date of capture: August 2018; and
  - 90 m SRTM (Shuttle Radar Topography Mission) Topography – sourced from NASA on December 2017;
- Settlement locations supplied Open Street Mapping;
- Tullow's Kenya Pipeline: Review of Alternatives to Avoid Impacts on Natural and Critical Habitat, eCountability Ltd, January 2018;
- Protected Area dataset supplied by IBAT (Integrated Biodiversity Assessment Tool) under license;
- The following Points of Interest (POI) sourced from Magical Kenya, Northern Rangelands Trust and Kenya Wildlife Service websites on 23 January 2019 to determine potential receptor locations of visitors, tourists and travellers to the region:
  - Arawale National Reserve is a protected area;
  - Boni National Reserve is a biodiversity hotspot for plant species;
  - Dodori National Reserve;
  - Biliqo-Bulesa Community Conservancy was created to encourage tourism to the area;
  - Bisanadi National Reserve. Tourist activities include bird watching, fishing and game viewing;
  - Ishaqbini Hirola Community Conservancy;
  - Kenyatta House commemorates the place where negotiation for the country's independence took place;
  - Kora National Park;
  - Kiunga Marine Park is comprised of a chain of about 50 calcareous offshore islands and coral reefs in the Lamu Archipelago. Tourism activities include surfing, diving, snorkelling, water skiing and sunbathing;
  - Laikipia National Reserve hosts game viewing and a marathon, rock climbing and water activities;
  - Lamu Museum;
  - Lamu Island lies within Lamu Archipelago;
  - South Turkana National Reserve;
  - Mathews Range;
  - Manila Beach Hotel on Lamu Island, is a privately-owned beach hotel;
  - Maralal town is used as a point for tourists to explore the northern areas of Kenya;
  - Miebae Community Conservancy is exploring opportunities for tourism;
  - Meru National Park hosts tourism activities such as camping, game viewing and scenic views;
  - Mount Kenya National Park extends over an area of 2,124 square kilometres. It is a World Heritage Site. Tourist activities include camping, cave exploration, game viewing and mountain climbing;

- Mount Nyiru Forest Reserve;
- Mpus Kutuk Community Conservancy;
- Namunyak Wildlife Nature Reserve provides game watching opportunities;
- Ndera Community Conservancy;
- Ndotos Range Forest Reserve provides tourism opportunism for hikers, rock climbers and bouldering enthusiasts;
- Nyambene National Reserve;
- Rahole National Reserve provides game watching for tourists;
- Rift Valley, also known as the Great Rift Valley, spans over 6,000 km. It contains a mosaic of landscapes, including lakes, volcanoes, coral rifts, mountains and wide valley plains. It is famous for humanoid remains found near Lake Turkana. Tourism in the areas includes safaris, hiking, golfing and walking;
- Samburu National Reserve;
- Sera Community Conservancy;
- Shaba National Reserve;
- Siyu Fort, Lamu; and
- Takwa prehistoric site remains of a thriving 15th and 16th century Swahili trading town before being abandoned in the early 17th century. It also contains two mosques.

Protected areas and POIs are presented in Figure 1.

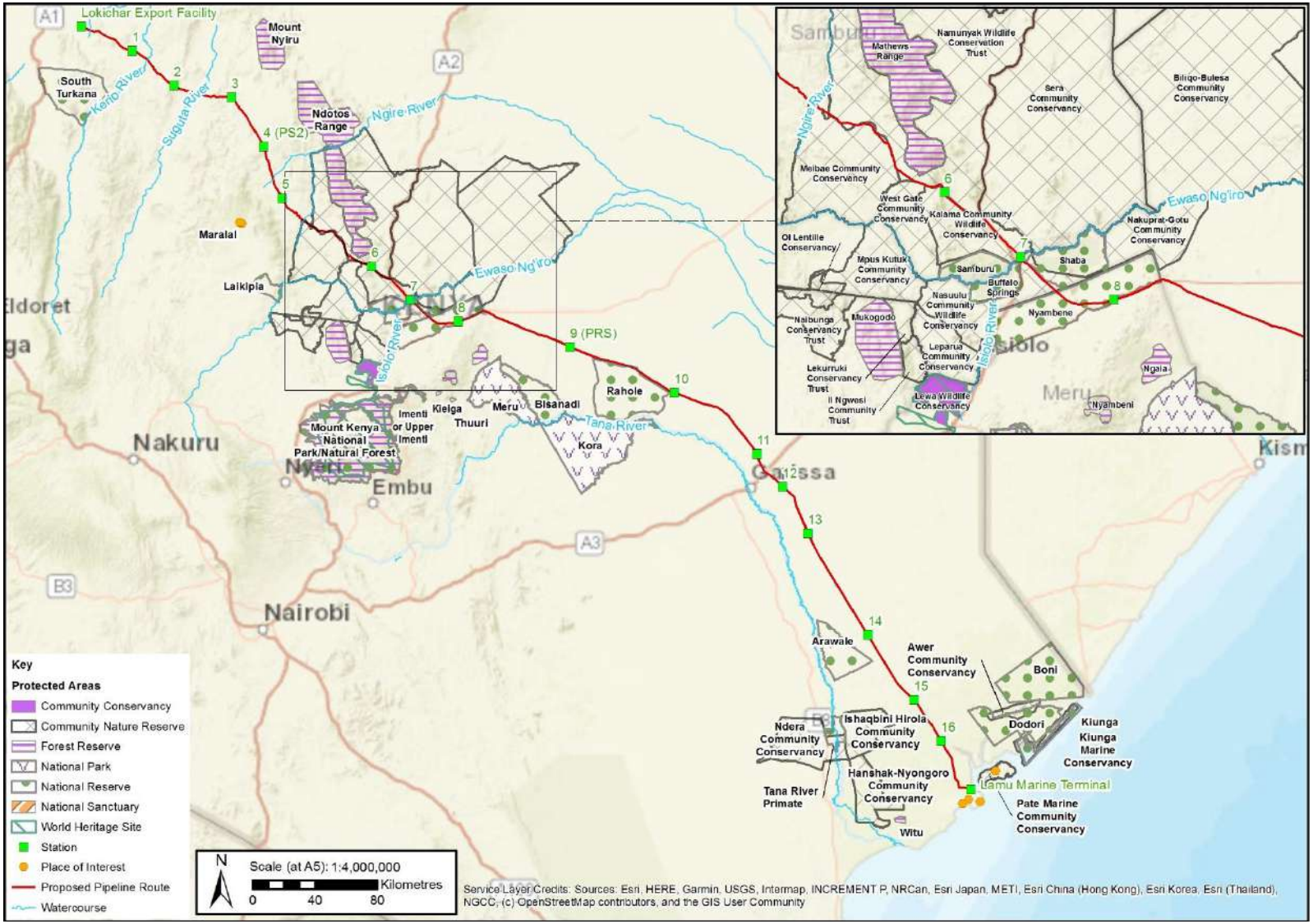

Figure 1: Protected Areas

4.0 METHODS

The AoI for the Landscape and Visual Baseline Assessment comprises the area from which infrastructure associated to the proposed development may be visible.

4.1 Landscape Character

It is a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another. The landscape assessment is a process of identifying and describing variation in the character of the landscape.

Areas displaying similar characteristics are referred to as 'Landscape Character Areas' (LCAs). LCAs are made up of recognisable patterns or elements (physical and perceptual) that occur consistently in a particular area and define its character, or 'sense of place'.

The sensitivity of the landscape was assessed in relation to its capacity to accommodate change without unacceptable adverse effects on the existing landscape character. The extent to which a landscape can accept such change is dependent on the physical characteristics of the landscape and the scale and nature of the change. Protected or designated areas are of particular importance in this respect, and a number of these are situated within the landscape and visual AOI.

The process of assessing the landscape character was based on review of available aerial photography and topographical maps as well as previous studies, in terms of:

- Natural elements;
- Human-made elements;
- The topographical character of the site and its surroundings and potential occurrence of landform;
- Features of interest;
- The presence of water bodies;
- The general nature and level of disturbance of existing vegetation cover; and
- The nature and level of human disturbance and transformation evident.

The landscape characterisation was digitised using the baseline vegetation and landcover datasets (eCountability Ltd January 2018). ArcGIS 10.4.1 was used to process the data to determine the landscape. The terrain datasets were used to create a realistic terrain within the study area.

The Landcape Character Area for each Station is presented in Drawings 1 to 18 in Appendix A.

4.2 Visual

During fieldwork undertaken in March 2019, photographs were taken from a selection of representative field viewpoints (see Figure 2).

The secondary data, aerial imagery and the DSM were assessed for the following within the AoI to ascertain the baseline visual characteristics:

- Settlements and homesteads;
- Luggas and vegetation types forming riparian habitat, which supported trees of heights up to 30 – 40 m;
- Access routes such as roads and trackways; and
- Terrain characteristics.

Residential dwellings are present in the vicinity of the LLCOP at Stations 5, 7, 13 and Lamu Marine Terminal. They vary in distance from the proposed route at the aforementioned stations, from within 44 m at Archer's Post, to a distance of 3 km at Lamu Marine Terminal.

The aerial imagery was used to identify luggas and vegetation types Trees, luggas and dense vegetation occur at many of the stations (primarily Stations 2, 3, 4, 5, 6, 13, 14, 15 and 16). Trees within the riparian habitat can reach of 30 – 40 m. The landscape is sparser along the plains of the Rift Valley – Station 1 and along the Somali Acacia-Commiphora bushlands and thicket ecoregion (Stations 1,7, 8 ,9 ,10,11 and 12).

Access routes such as roads and trackways are similarly visible on the imagery.

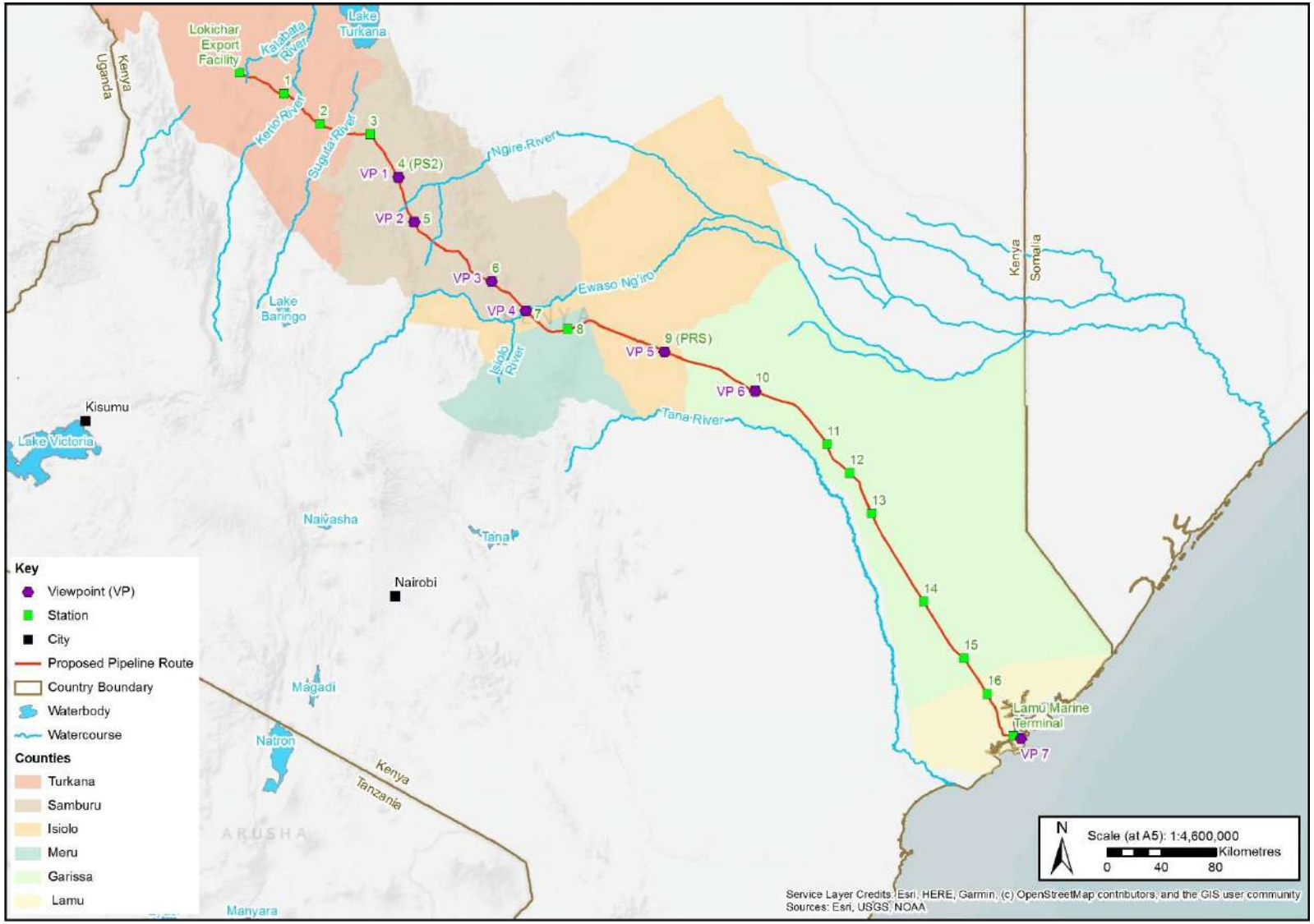

Figure 2: Photo location from baseline data gathering

5.0 RESULTS

5.1 Landscape Character

A number of LCAs are present along the pipeline route, from Lokichar to Lamu. LCA boundaries do not necessarily indicate an abrupt change in landscape characteristics; the transition between the different areas may be gradual, especially the boundaries between the undulating scrub bushland LCA and the dense bushland scrub LCA. These categorisations are not related to whether habitats are natural or modified.

In total four LCAs were identified within or adjacent to the AoI:

- LCA 1 – Dense Shrub
  - Dense scrub communities in the landscape. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA; and
  - Landscape or protected area designations present, including Namunyak Wildlife Conservation Trust, Matthews Range and Kalama Community Wildlife Conservancy.
- LCA 2 – Grassland
  - Grassy open expanse frequented by herders and farmers. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA. Seascape also present at LMT; and
  - Landscape or protected area designations present, including Samburu National Reserve, Buffalo Springs National Reserve Shaba National Reserve, Sera Community Conservancy.
- LCA 3 – Scattered Scrub
  - Extensive spread of scattered scrub in the landscape. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA; and
  - Landscape or protected area designations present, including, West Gate Community Conservancy, Nyambene National Reserve, Nakuprat-Gotu Community Conservancy and Rahole National Reserve.
- LCA 4 – Forest
  - Extensive nature of the forest in landscape. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA; and
  - There are no landscape or protected area designations present.

5.2 Visual

5.2.1 Field Survey

The results of the March 2019 field survey are presented in Table 2. Seven viewpoints were identified to provide a representative sample of the typical view experienced by the local population. The photo locations are identified in Table 2 below and the photographs are presented in Drawings 19 to 25 in Appendix A.

Table 1: Field Survey Results

Station	Photo Location	Visual Description	Corresponding LCA
Station 4	Adjacent to Station 4	Wide open vistas with the occasional large tree. The topography is flat to slightly undulating.	Grassland; Grassy expanse frequented by herders.
Station 5	Adjacent to Station 5	Mixture of dense and sparse vegetation offering natural screening and limited views.	Scattered Scrub; dominated by Acacia-Commiphora stunted bushland. Shrub species in these plant committees typically reach heights of 4 m.
Station 6	Garissa-Modogashe Road	Sparse vegetation offering natural screening and limited views.	Dense Scrub; dense scrub communities, such as Acacia-Commiphora / stunted bushland and Somalia-Masai Acacia-Commiphora deciduous bushland and thickets vegetation communities extend across the eastern and central parts of the AoI, scrub heights typically reach 4 m.
Station 7	200 m south of Station 7	Wide open vistas with scattered shrub and low-lying undergrowth. The topography is relatively flat.	Grassland; Grassy expanse frequented by herders and farmers. Archers Post village lies adjacent to the station location. The landscape is eroded due to the removal of natural vegetation and grazing pressures on the surrounding landscape.
Station 9	Adjacent to Station 9	Sparse vegetation offering some natural screening and relatively limited views.	Scattered Scrub; dominated by Acacia-Commiphora stunted bushland. Shrub species in these plant committees typically reach heights of 4 m. Grassland; Grassy expanse frequented by herders.
Station 10	Garissa-Modogashe Road adjacent to Station 10	Sparse vegetation offering some natural screening and relatively limited views.	Scattered Scrub; The westernmost portion of the AoI is dominated by Acacia-Commiphora stunted bushland. Shrub species in these plant committees typically reach heights of 4 m. Scattered scrub and thicket vegetation communities extend across the rest of the pipeline corridor; Plant species in this community include *Kigelia africana*, *Dichrostachys cinereal*, *Salvadora persica* and -*Sclerocarya birrea.* Tree and scrub heights range from 6 m to 18 m.
Lamu Port	Manda Bay Hotel	Wide open vistas from the Hotel of the seascape.	Coastal Marine; the landscape vegetation is a grassy expanse. The topography of the landscape is flat. Some tree species were observed during the biodiversity field survey. Species identified inlcuded *Combretum aculeatum*, *Dalbergia melanoxylon* and *Ziziphus mucronata*. Such species range in height from 4 m to 10 m.

6.0 ACRONYMS

LCA – Landscape Character Area

NVDI – Normalized Difference Vegetation Index

DSM – Digital Surface Model

SRTM – Shuttle Radar Topography Mission

IBAT – Integrated Biodiversity Assessment Tool

POI – Point of Interest

7.0 REFERENCES

Landscape Institute and Institute of Environmental Management and Assessment (IEMA), 2013. *Guidelines for Landscape and Visual Impact Assessment (GLVIA3)*. Routledge, 3rd Ed., 170 pgs

Signature Page

Golder Associates (UK) Ltd

Tim Flower
Technical Director

LD/TF/es

Date: 07 August 2019

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APPENDIX A

Drawings

Drawing 1 – Lokichar Export Facility AoI and Landscape Character Area

Drawing 2 – Station 1 AoI and Landscape Character Area

Drawing 3 – Station 2 AoI and Landscape Character Area

Drawing 4 – Station 3 AoI and Landscape Character Area

Drawing 5 – Station 4 AoI and Landscape Character Area

Drawing 6 – Station 5 AoI and Landscape Character Area

Drawing 7 – Station 6 AoI and Landscape Character Area

Drawing 8 – Station 7 AoI and Landscape Character Area

Drawing 9 – Station 8 AoI and Landscape Character Area

Drawing 10 – Station 9 AoI and Landscape Character Area

Drawing 11 – Station 10 AoI and Landscape Character Area

Drawing 12 – Station 11 AoI and Landscape Character Area

Drawing 13 – Station 12 AoI and Landscape Character Area

Drawing 14 – Station 13 AoI and Landscape Character Area

Drawing 15 – Station 14 AoI and Landscape Character Area

Drawing 16 – Station 15 AoI and Landscape Character Area

Drawing 17 – Station 16 AoI and Landscape Character Area

Drawing 18 – Lamu Marine Terminal AoI and Landscape Character Area

Drawing 19 – Panoramic Photograph Station 4

Drawing 20 – Panoramic Photograph Station 5

Drawing 21 – Panoramic Photograph Station 6

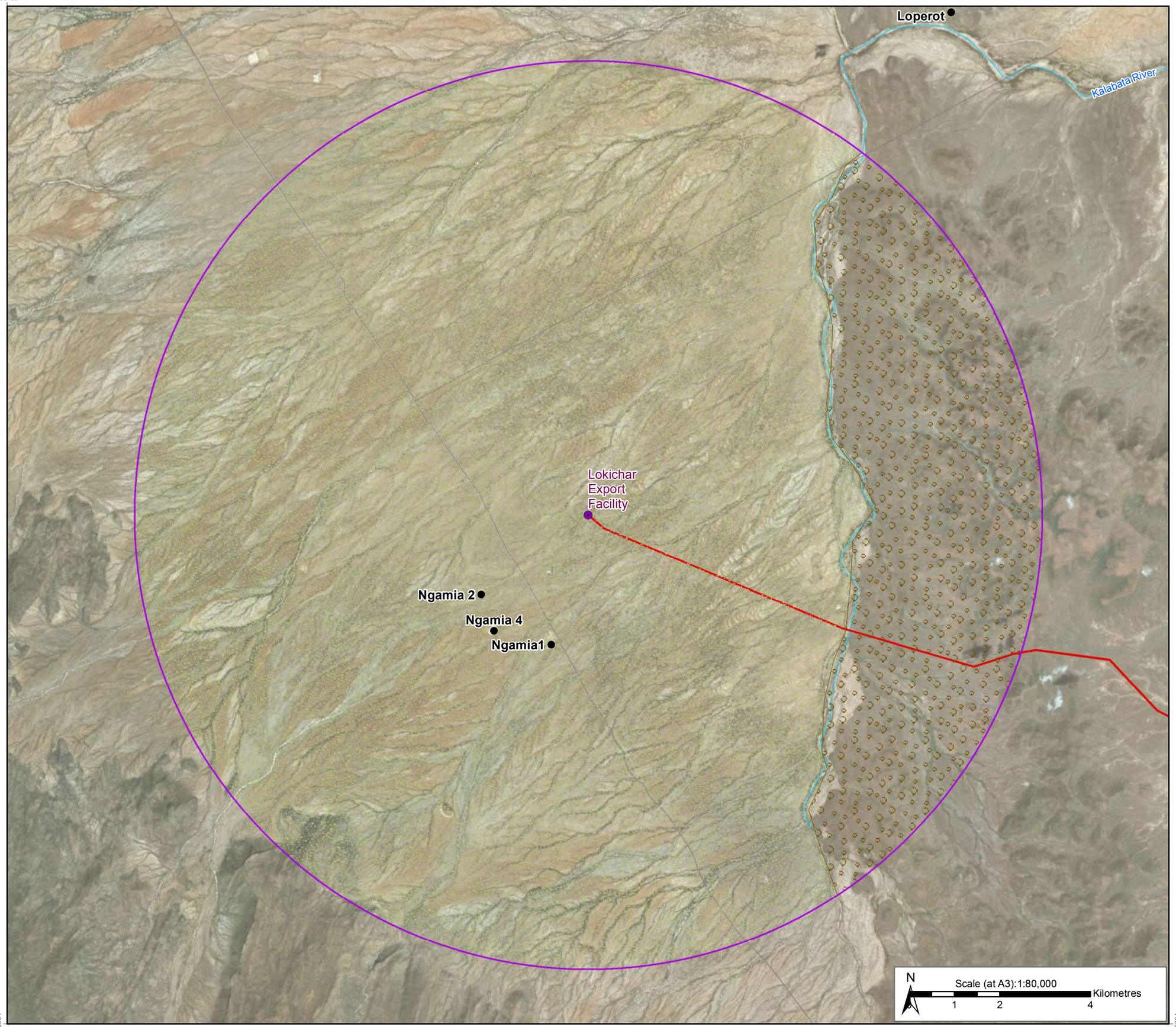
Drawing 22 – Panoramic Photograph Station 7

Drawing 23 – Panoramic Photograph Station 9

Drawing 24 – Panoramic Photograph Station 10

Drawing 25 – Panoramic Photograph Lamu Marine Terminal Facility

239138



Drawing 1: Landscape Character Area and Protected Area - Lokichar Export Facility

Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

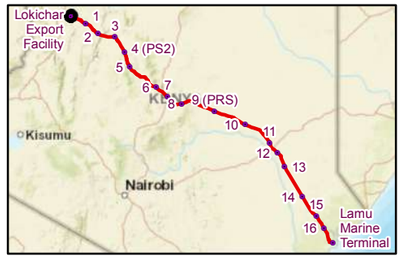
- Dense Scrub
- Scattered Scrub
- Settlement

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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GOLDER

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735804

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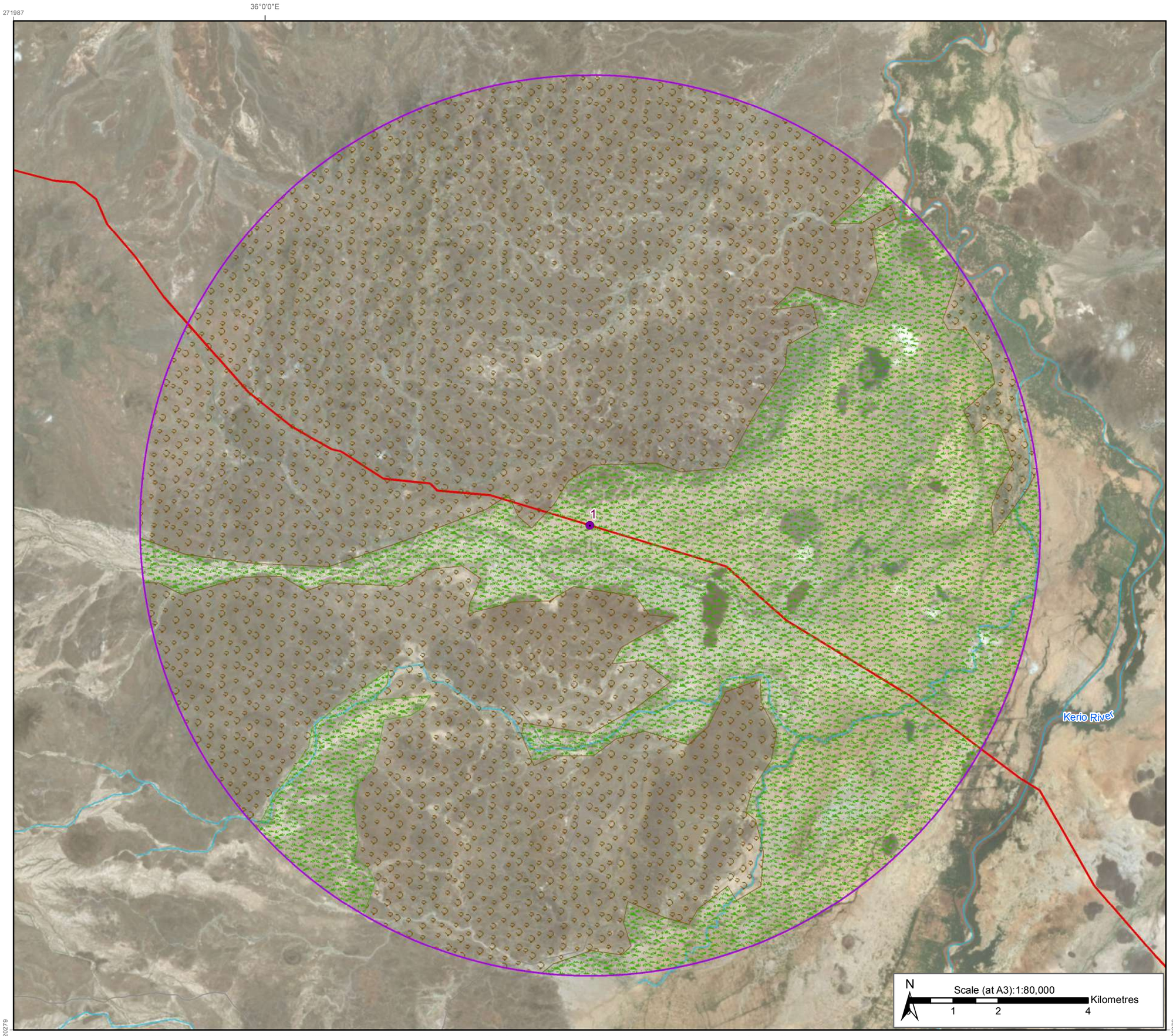


Drawing 2: Landscape Character Area and Protected Area - Station 1

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Grassland

Scattered Scrub

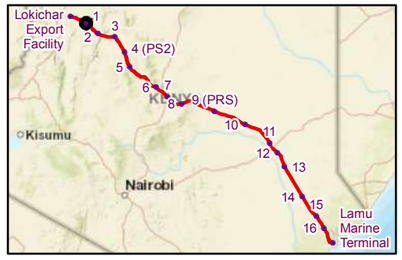
Proposed Facilities

Station

Proposed Pipeline Route

Surfacewater

Watercourse



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720279

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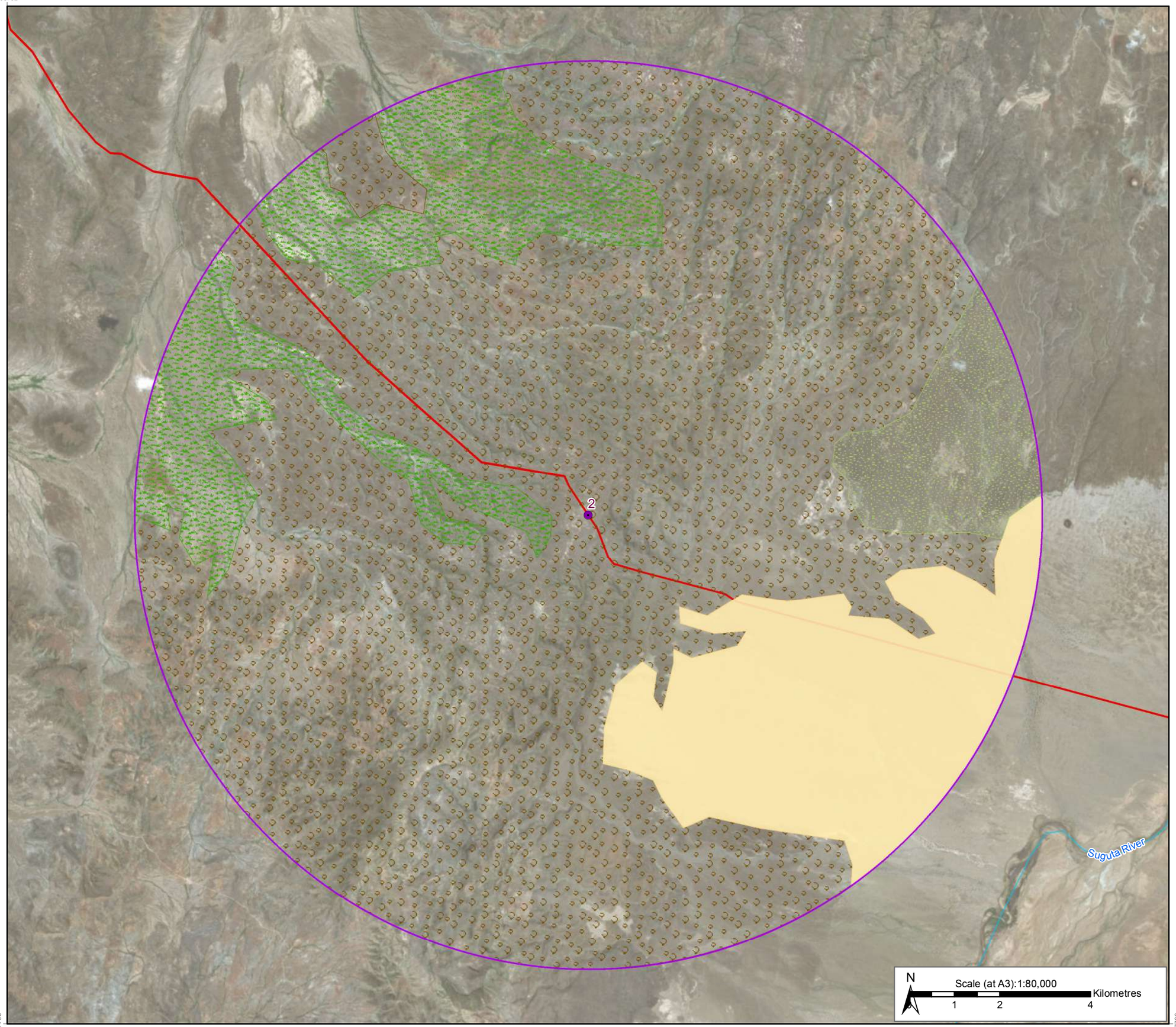


Drawing 3: Landscape Character Area and Protected Area - Station 2

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Dense Scrub

Desert

Grassland

Scattered Scrub

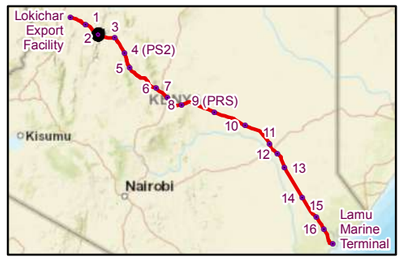
Proposed Facilities

Station

Proposed Pipeline Route

Surfacewater

Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

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697796

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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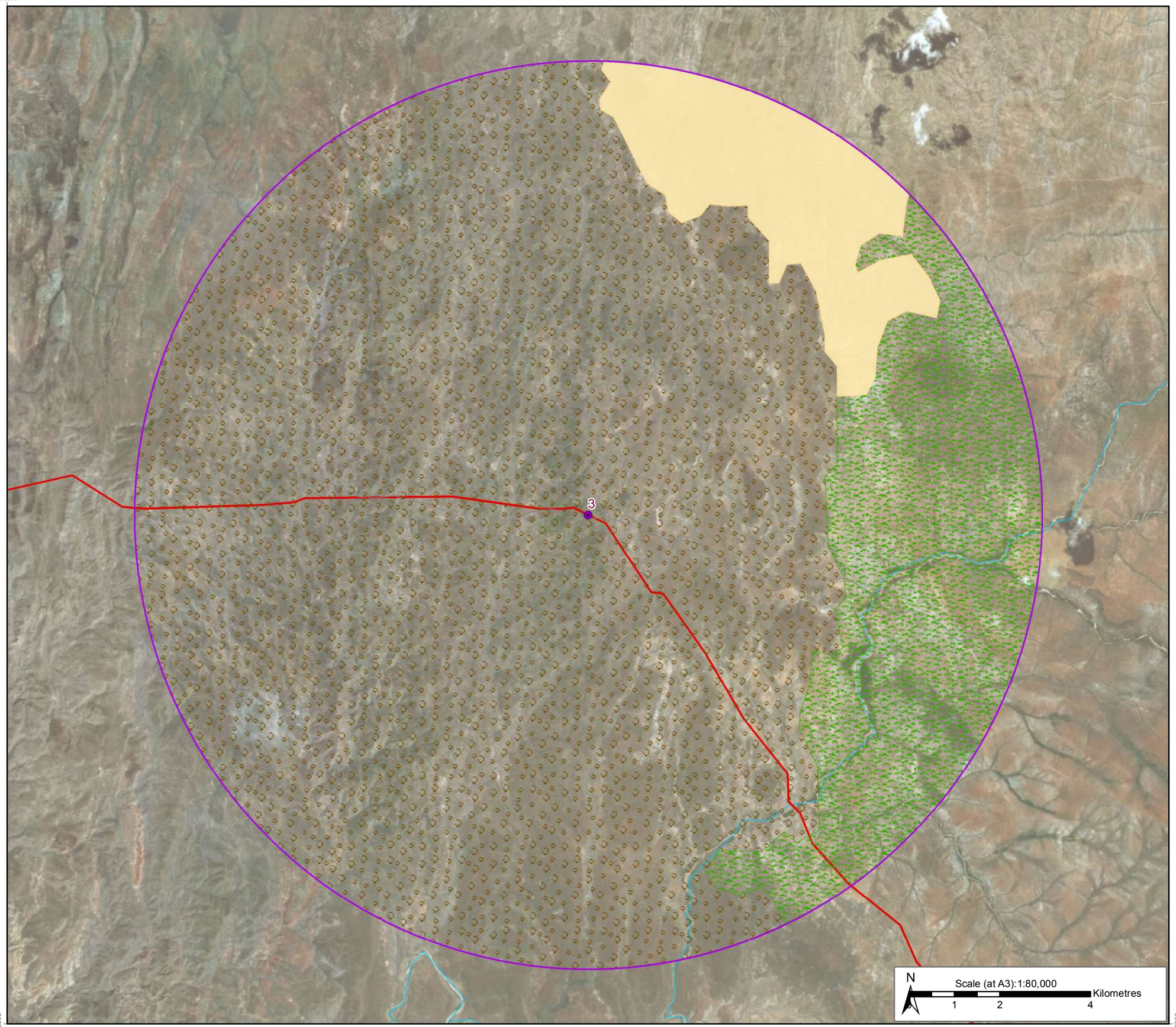
335863

Drawing 4: Landscape Character Area and Protected Area - Station 3



Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

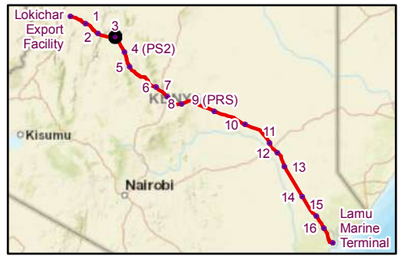
- Desert
- Grassland
- Scattered Scrub

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



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Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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690303

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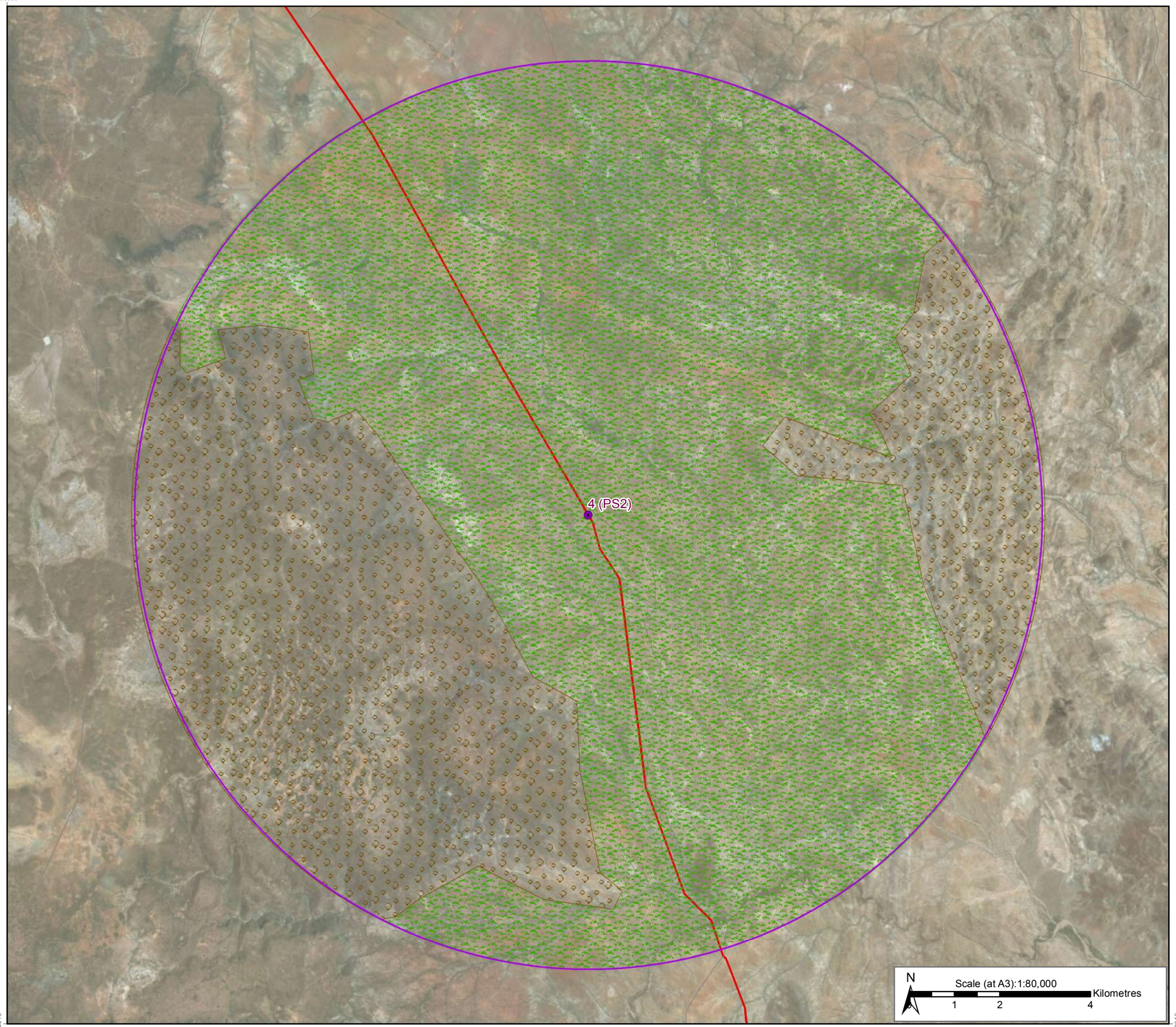


Drawing 5: Landscape Character Area and Protected Area - Station 4 (PS2)

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

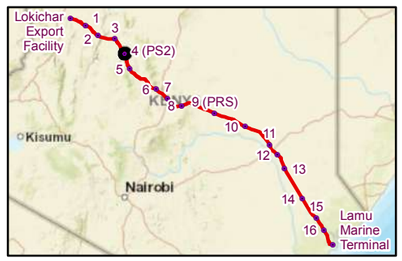
Grassland

Scattered Scrub

Proposed Facilities

Station

Proposed Pipeline Route



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658616

658616

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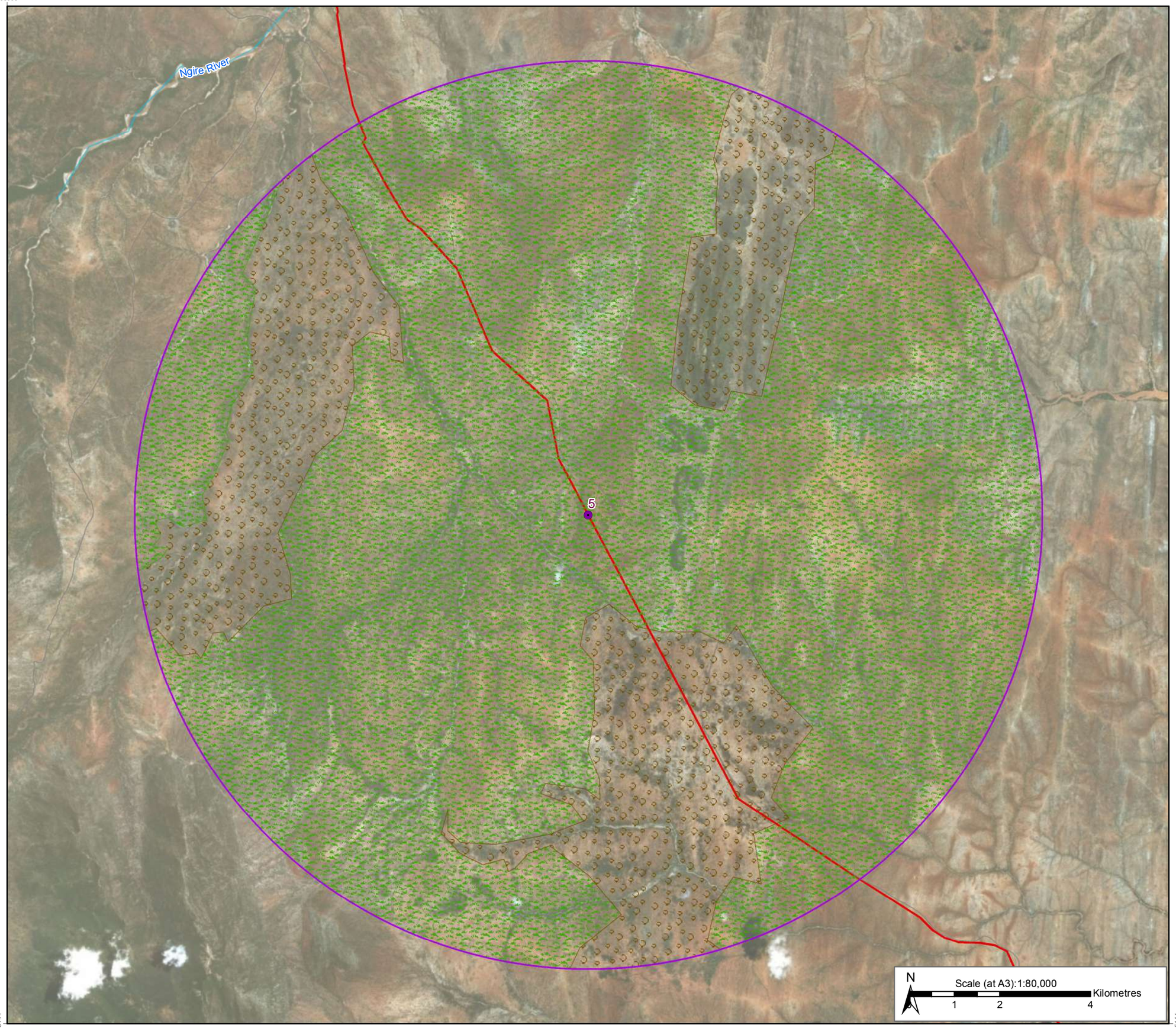


Drawing 6: Landscape Character Area and Protected Area - Station 5

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Grassland

Scattered Scrub

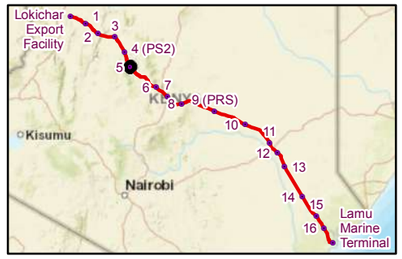
Proposed Facilities

Station

Proposed Pipeline Route

Surfacewater

Watercourse



Data sources:
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625444

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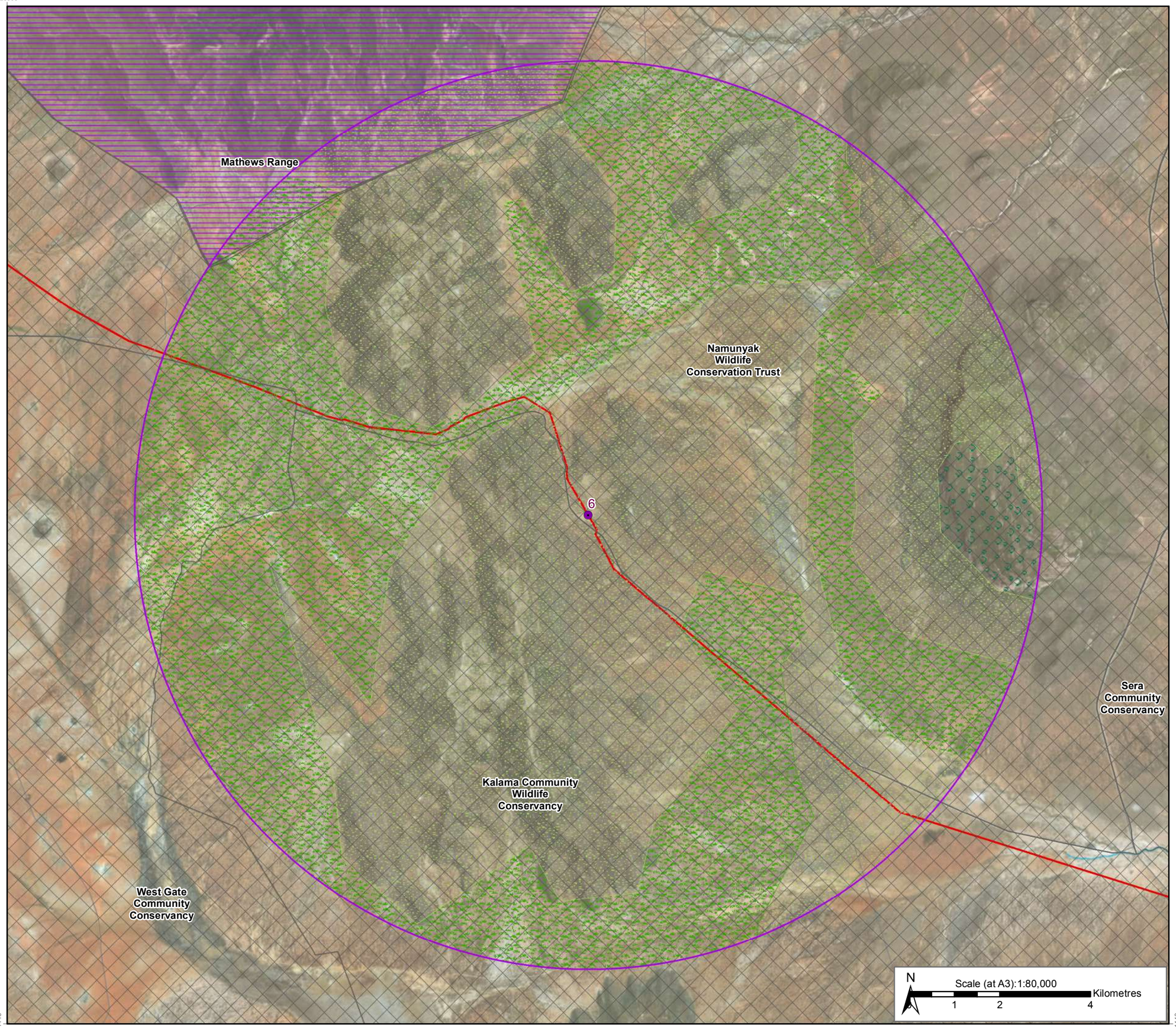
Drawing 7: Landscape Character Area and Protected Area - Station 6



Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

- Dense Scrub
- Forest
- Grassland

Protected Areas

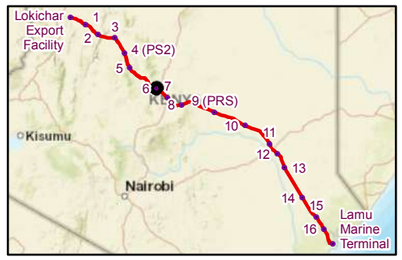
- Community Nature Reserve
- Forest Reserve

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



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581443

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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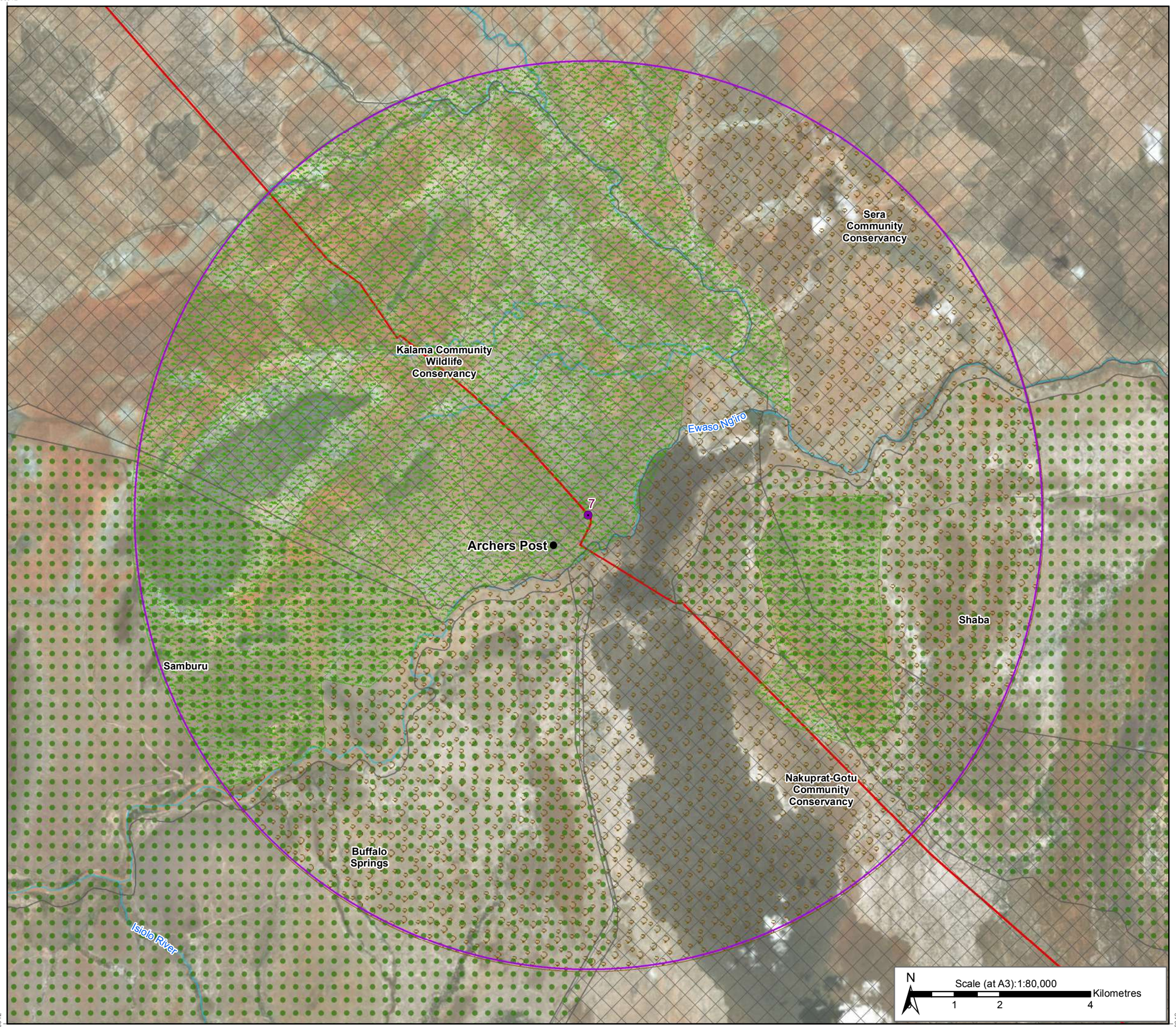
Drawing 8: Landscape Character Area and Protected Area - Station 7



Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

- Grassland
- Scattered Scrub
- Settlement

Protected Areas

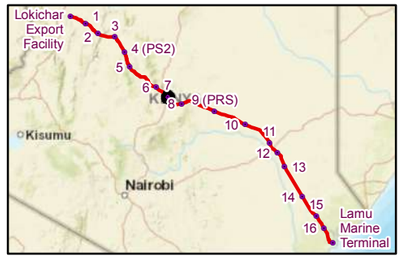
- Community Nature Reserve
- National Reserve

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



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560042

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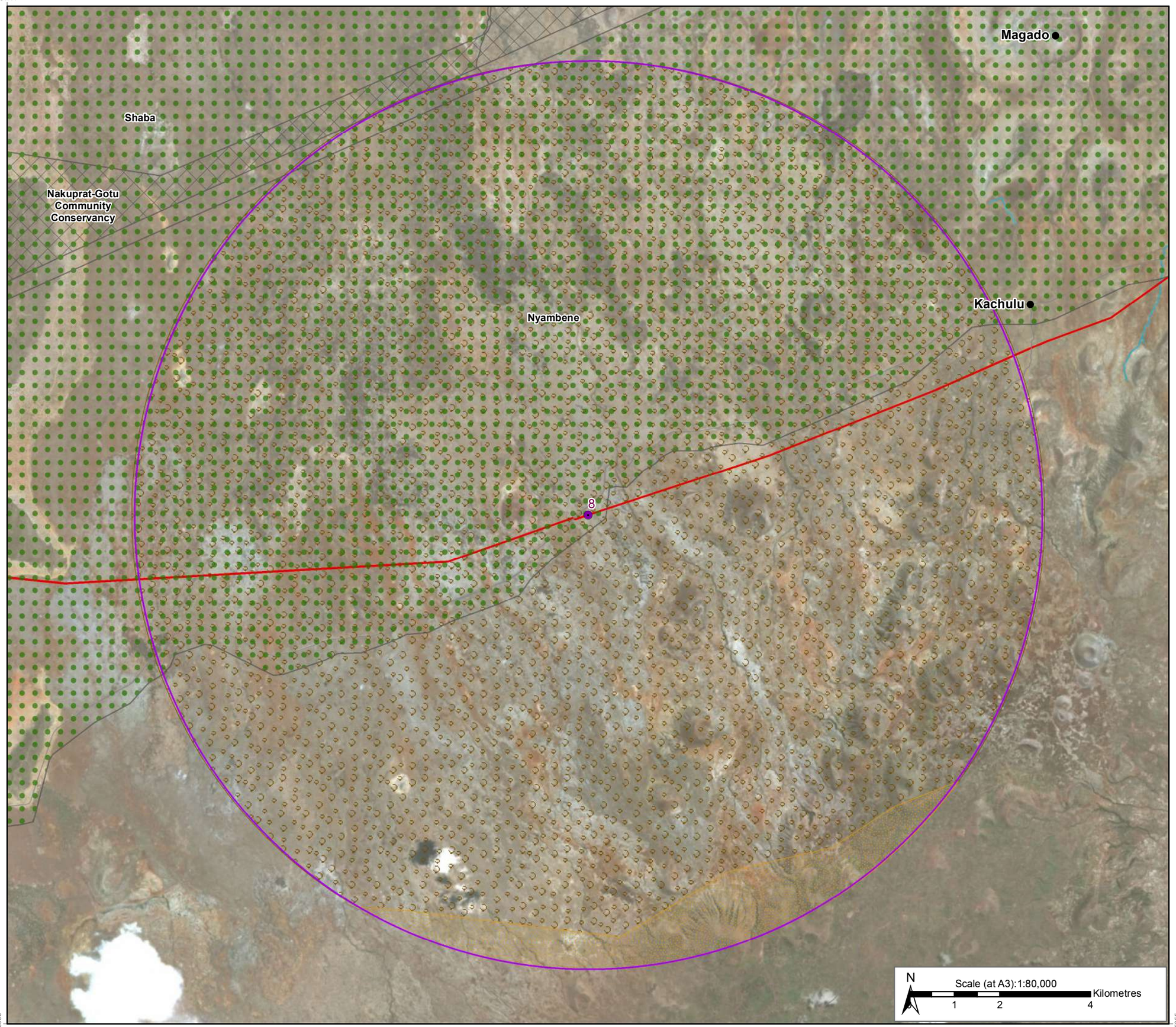


Drawing 9: Landscape Character Area and Protected Area - Station 8

Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

- Agricultural
- Scattered Scrub
- Settlement

Protected Areas

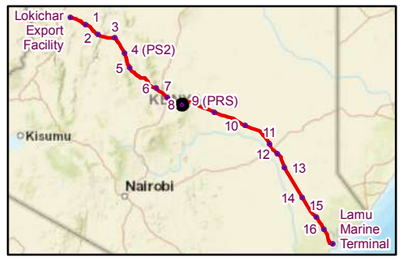
- Community Nature Reserve
- National Reserve

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

545955

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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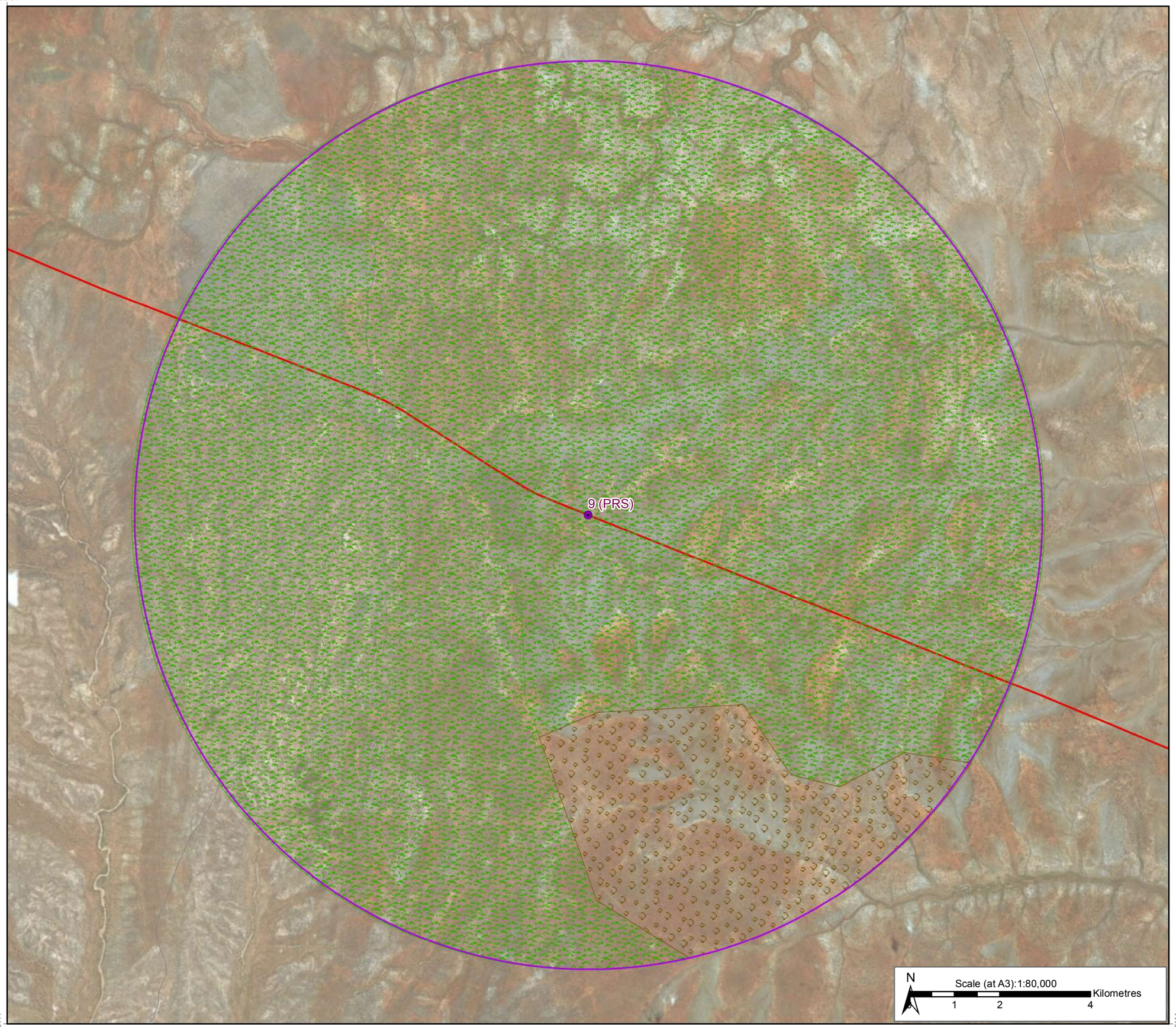
545955

553704



Drawing 10: Landscape Character Area and Protected Area - Station 9 (PRS)

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

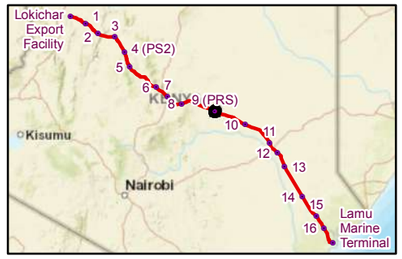
Grassland

Scattered Scrub

Proposed Facilities

Station

Proposed Pipeline Route



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

529414

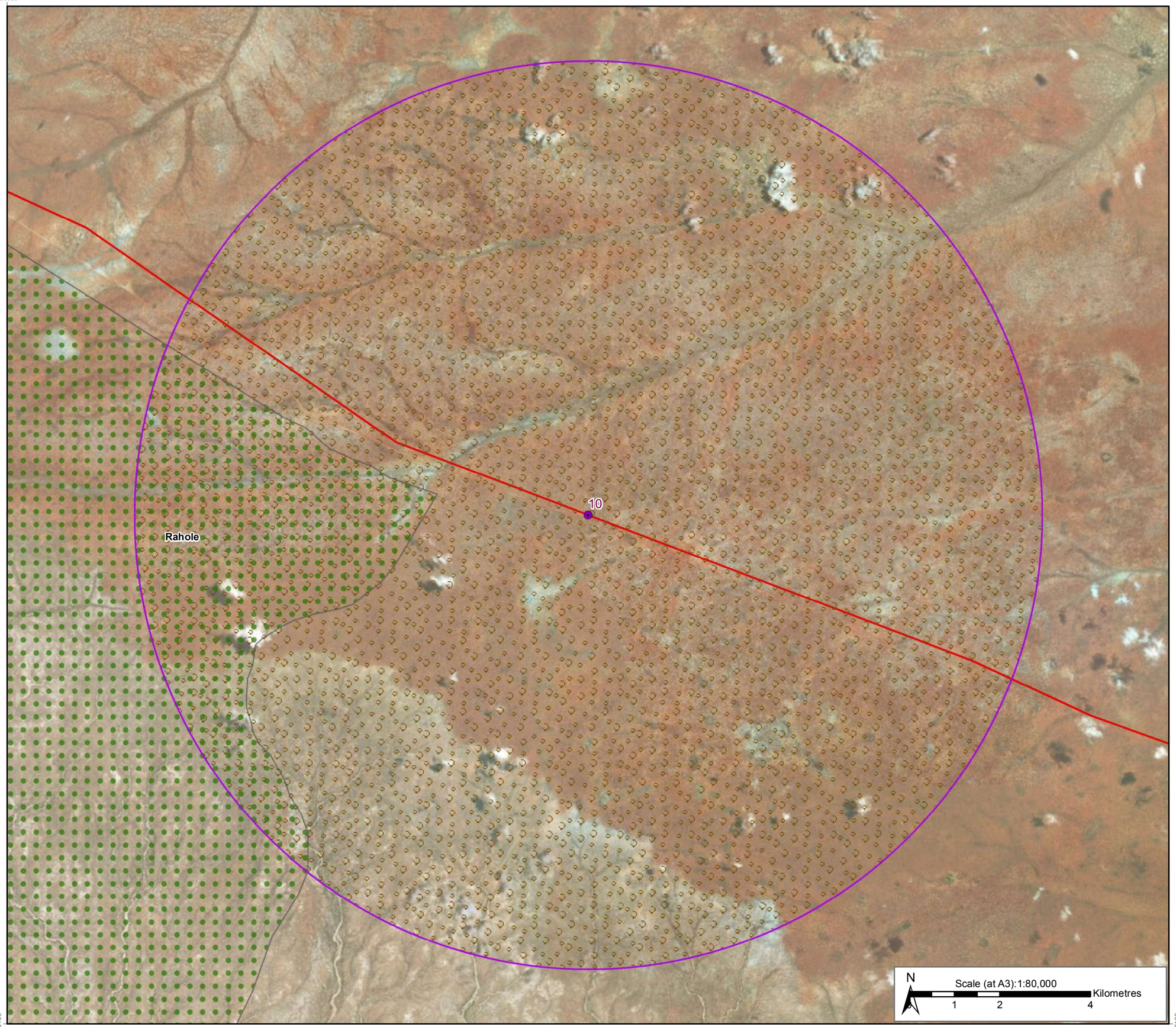
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\L_V\1772867_554_OG_734_D002_Stations_Mapbook_LCA.mxd

529414

620623

Drawing 11: Landscape Character Area and Protected Area - Station 10



Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Scattered Scrub

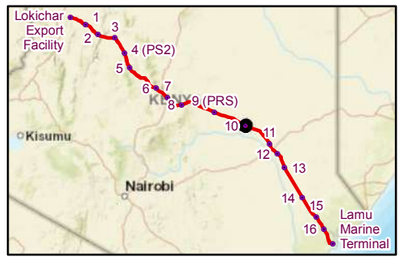
Protected Areas

National Reserve

Proposed Facilities

Station

Proposed Pipeline Route



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

500189

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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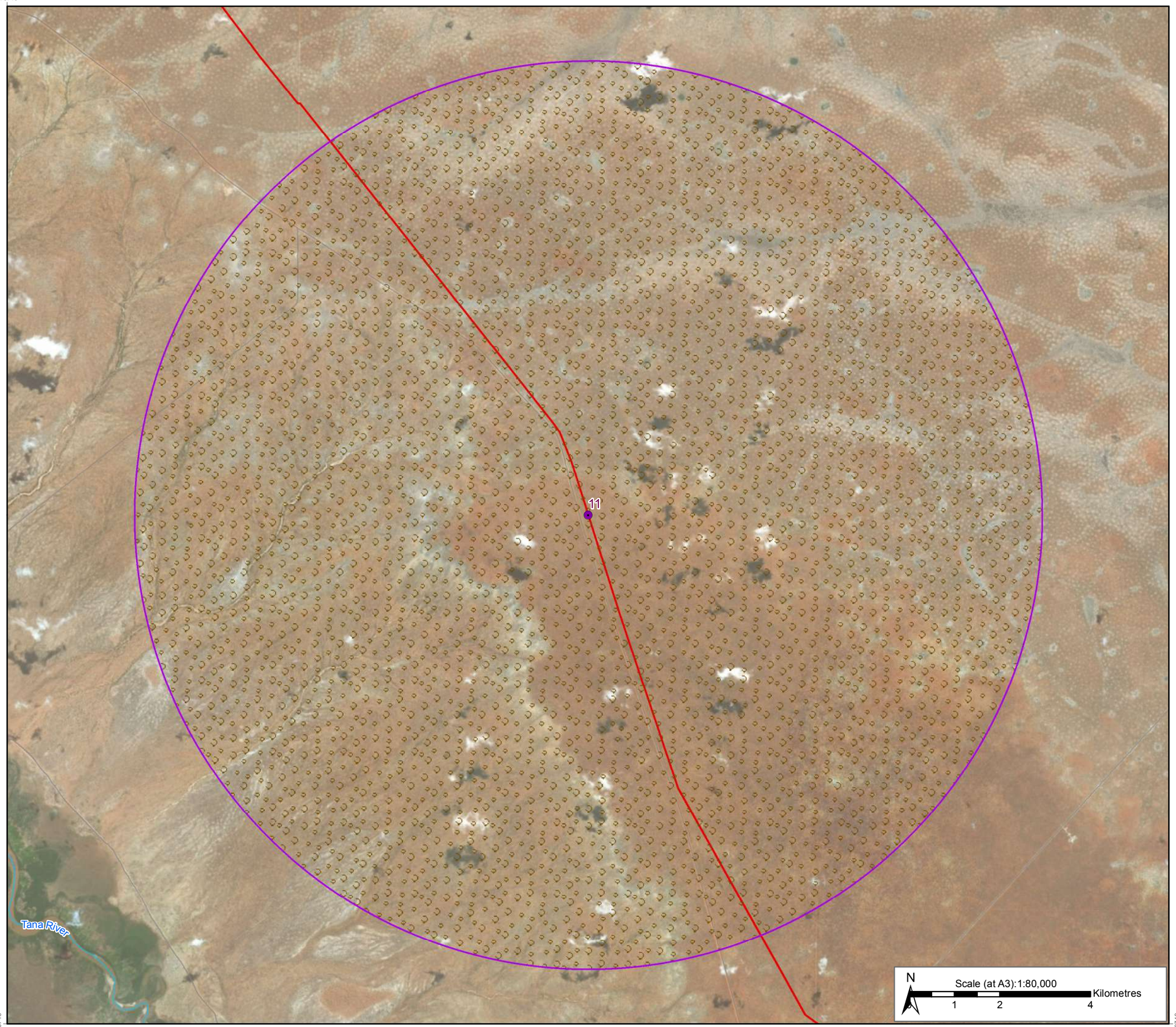
500189

673719



Drawing 12: Landscape Character Area and Protected Area - Station 11

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Scattered Scrub

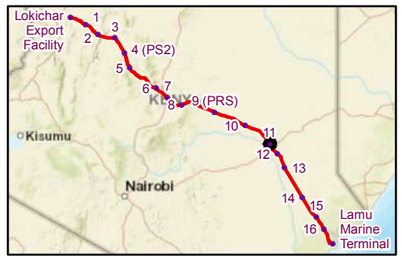
Proposed Facilities

Station

Proposed Pipeline Route

Surfacewater

Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

460748

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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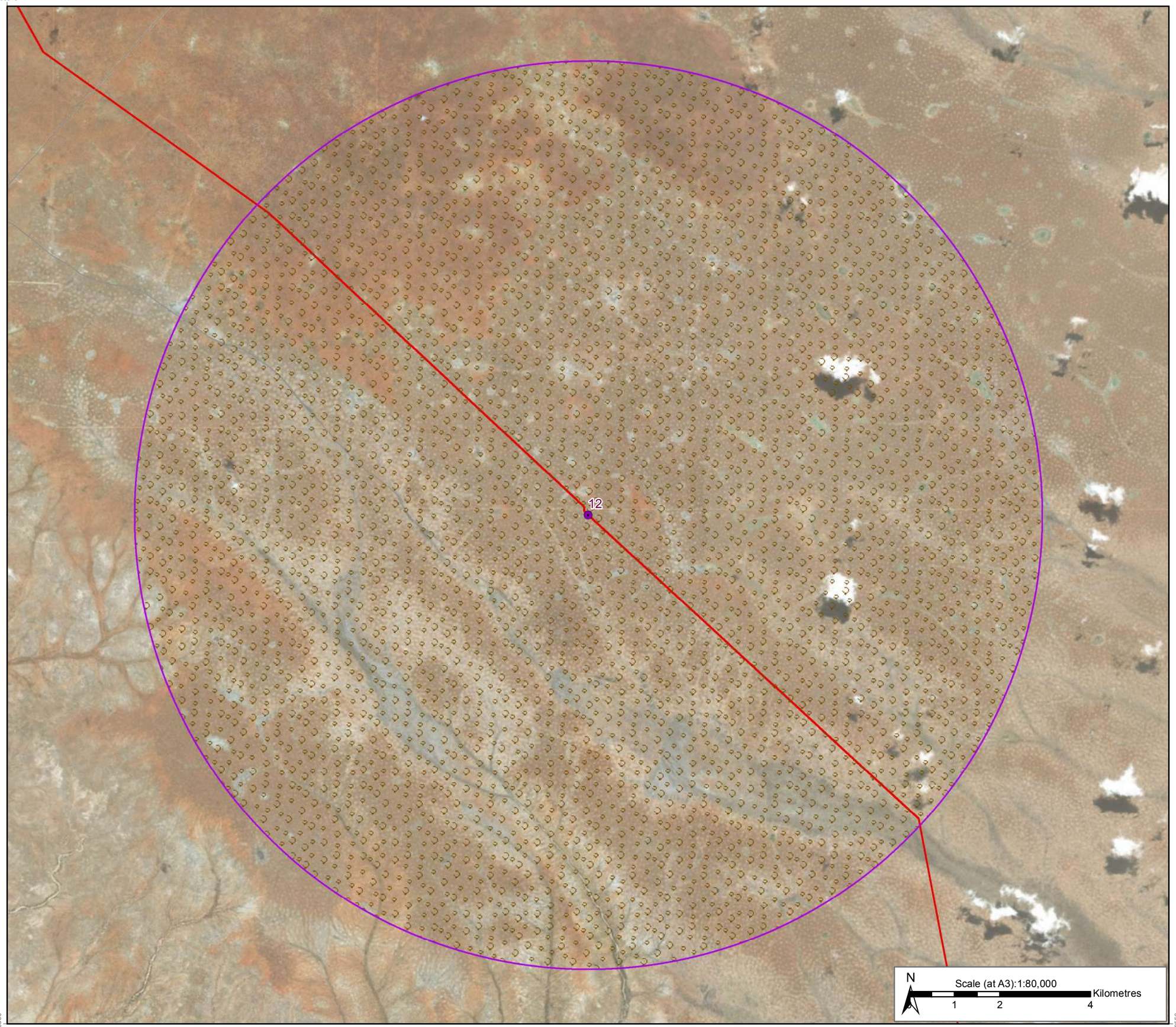


Drawing 13: Landscape Character Area and Protected Area - Station 12 (PS3)

Key

Landscape and Visual Area of Influence (AoI)

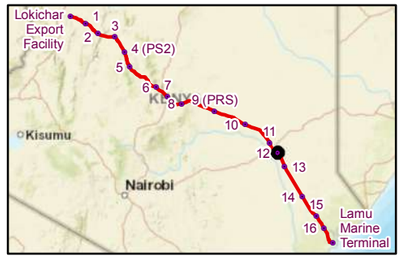
Landscape Character Area (LCA)

Scattered Scrub

Proposed Facilities

Station

Proposed Pipeline Route



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

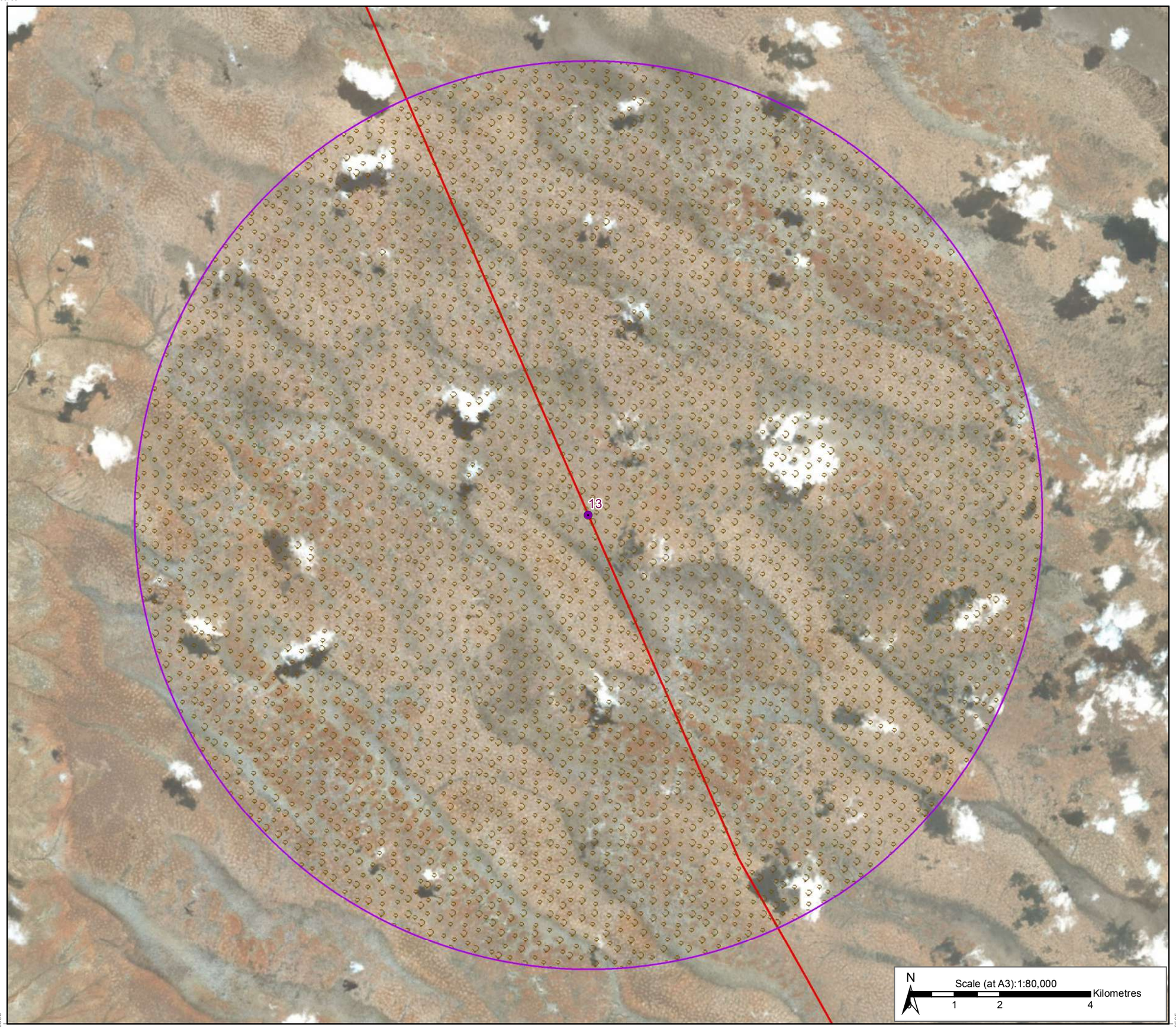
439556

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\L_V\1772867_554_OG_734_D002_Stations_Mapbook_LCA.mxd

439556

706765



Drawing 14: Landscape Character Area and Protected Area - Station 13

Key

Landscape and Visual Area of Influence (AoI)

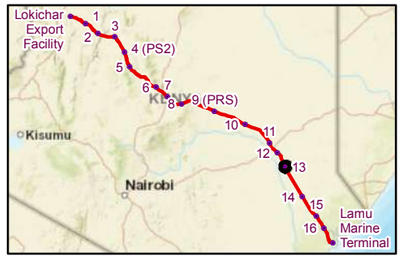
Landscape Character Area (LCA)

Scattered Scrub

Proposed Facilities

Station

Proposed Pipeline Route



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

409505

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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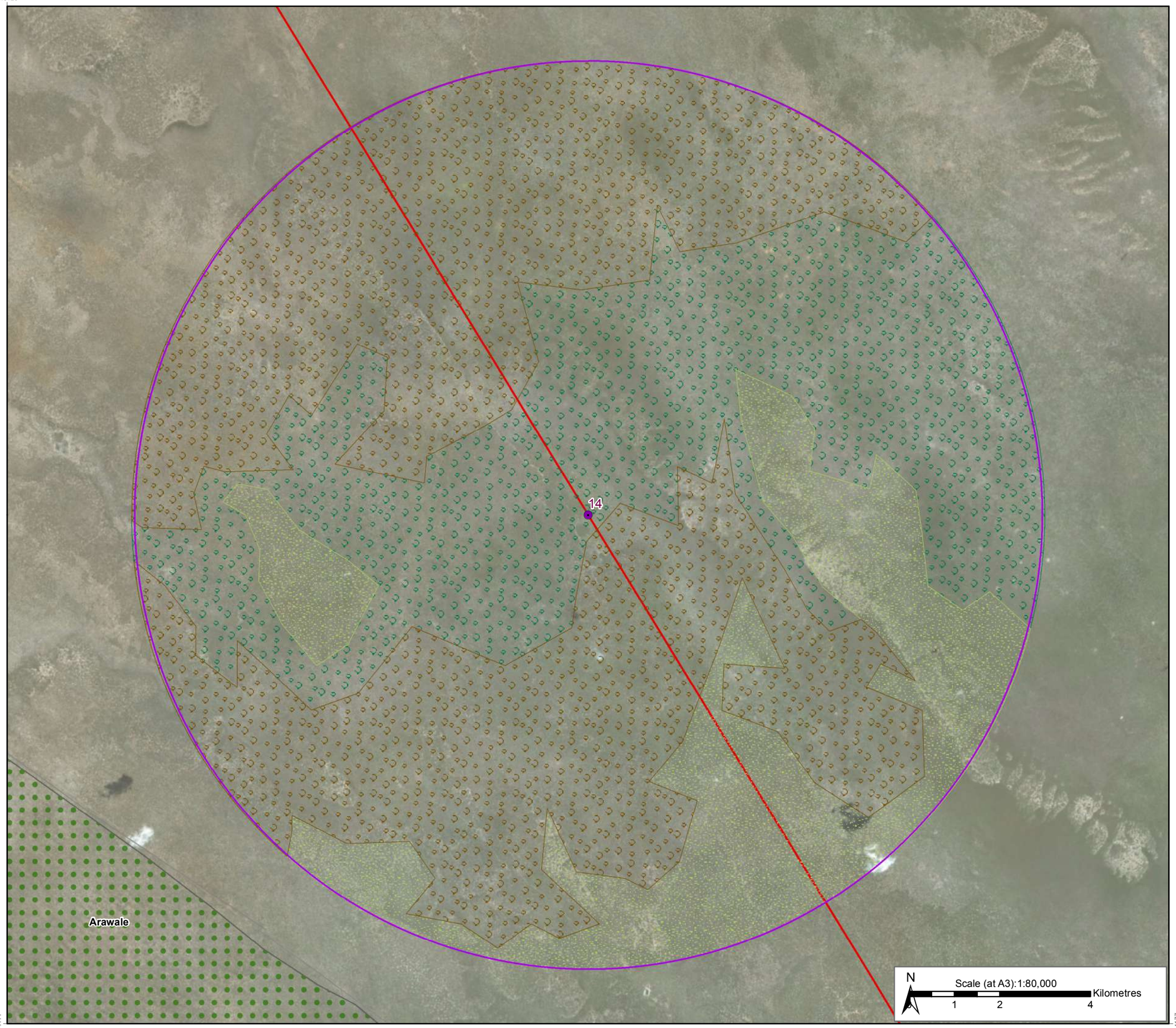
409505

745126

Drawing 15: Landscape Character Area and Protected Area - Station 14



Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Dense Scrub

Forest

Scattered Scrub

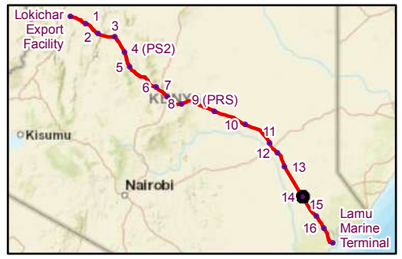
Protected Areas

National Reserve

Proposed Facilities

Station

Proposed Pipeline Route



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

344177

344177

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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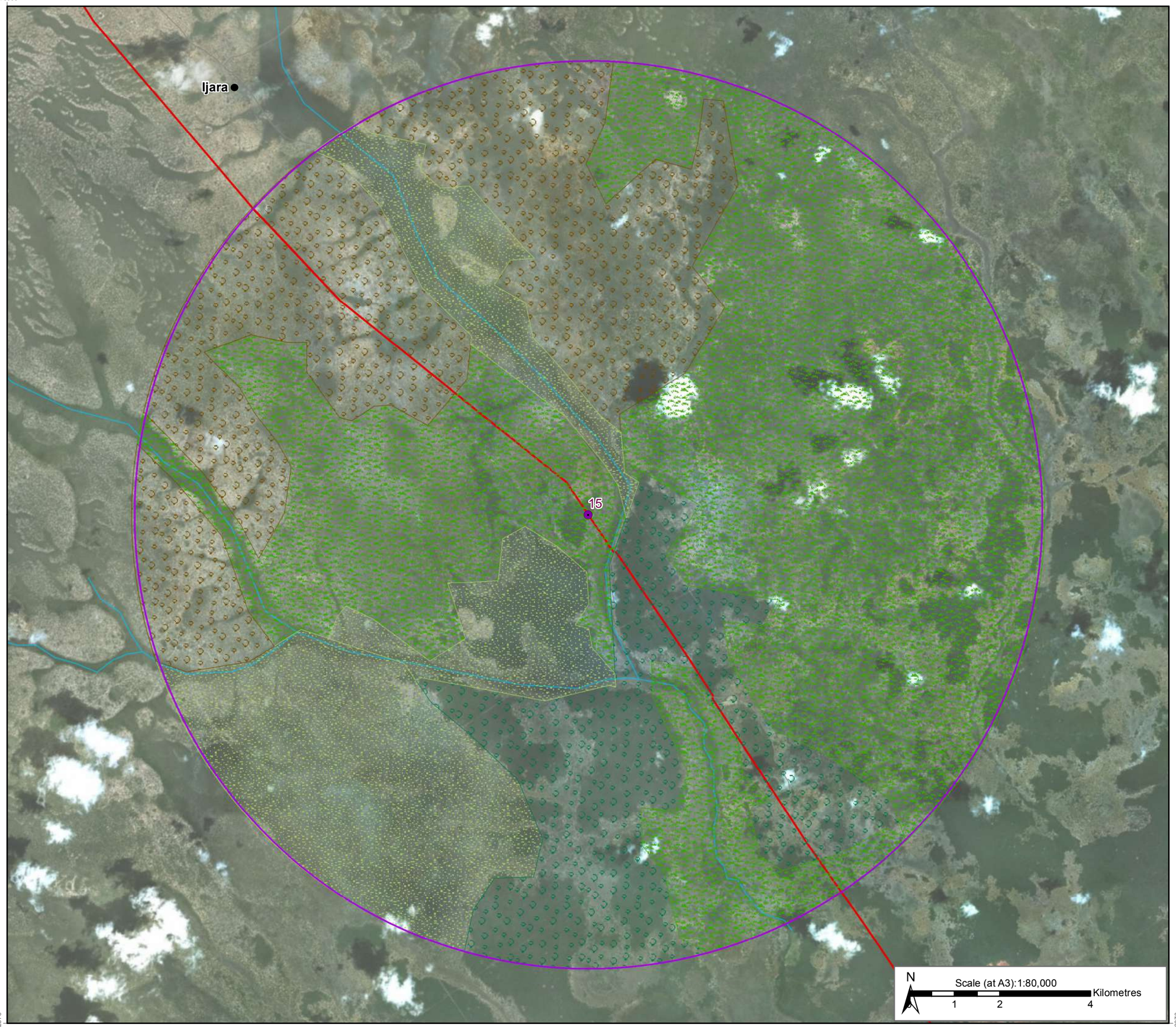
775003



Drawing 16: Landscape Character Area and Protected Area - Station 15

Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

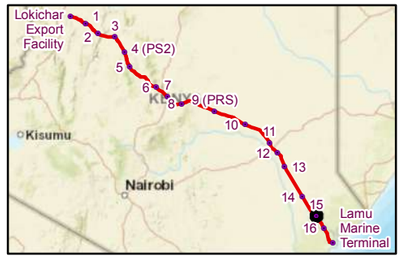
- Dense Scrub
- Forest
- Grassland
- Scattered Scrub
- Settlement

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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REPUBLIC OF KENYA

AfricaOil Corp.

TOTAL

TULLOW OIL

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

302273

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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302273

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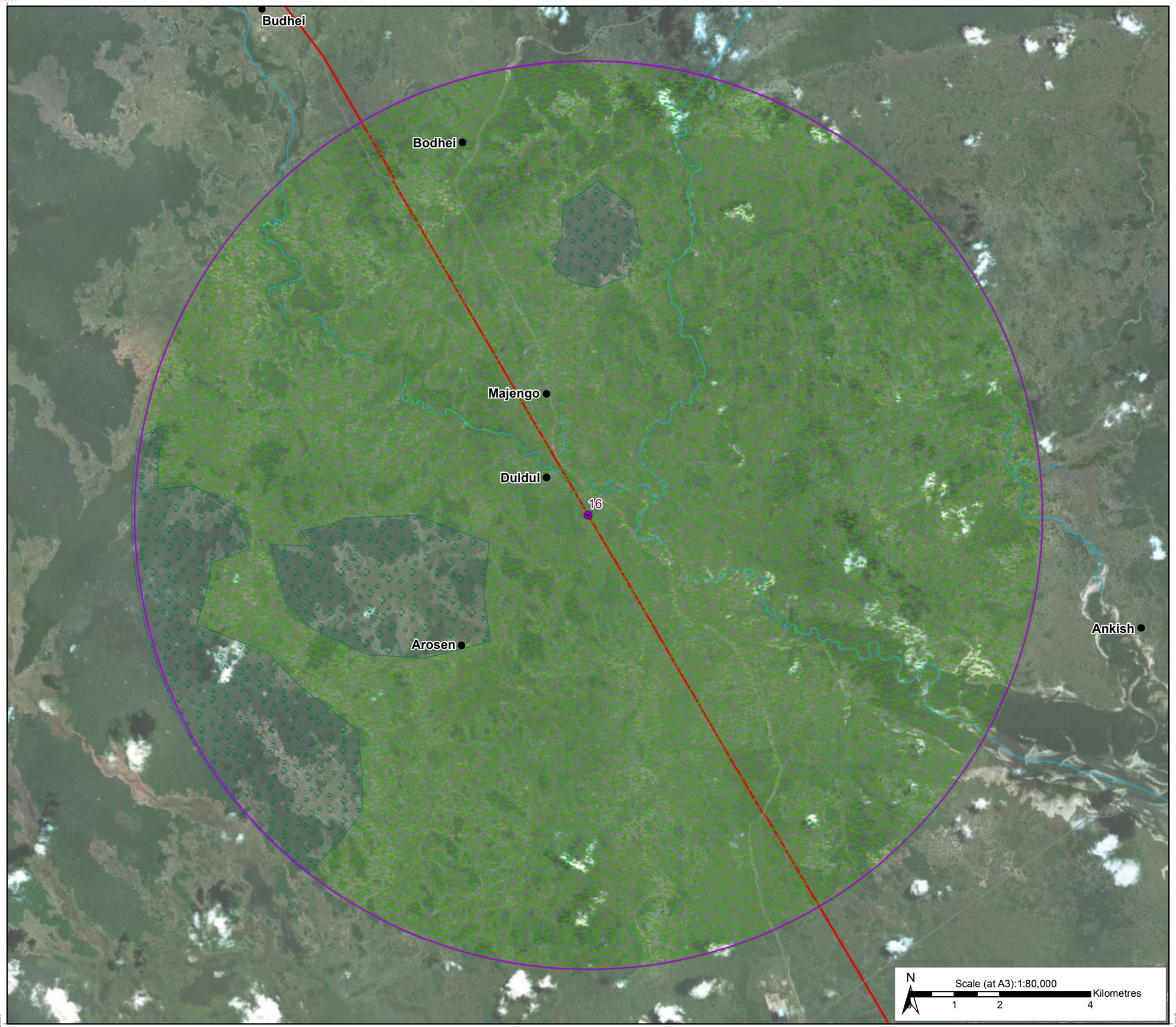


Drawing 17: Landscape Character Area and Protected Area - Station 16

Key

Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

Forest

Grassland

Settlement

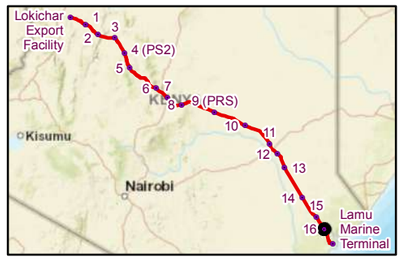
Proposed Facilities

Station

Proposed Pipeline Route

Surfacewater

Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	LD 22-05-2019	HR 22-05-2019	AM 22-05-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

275887

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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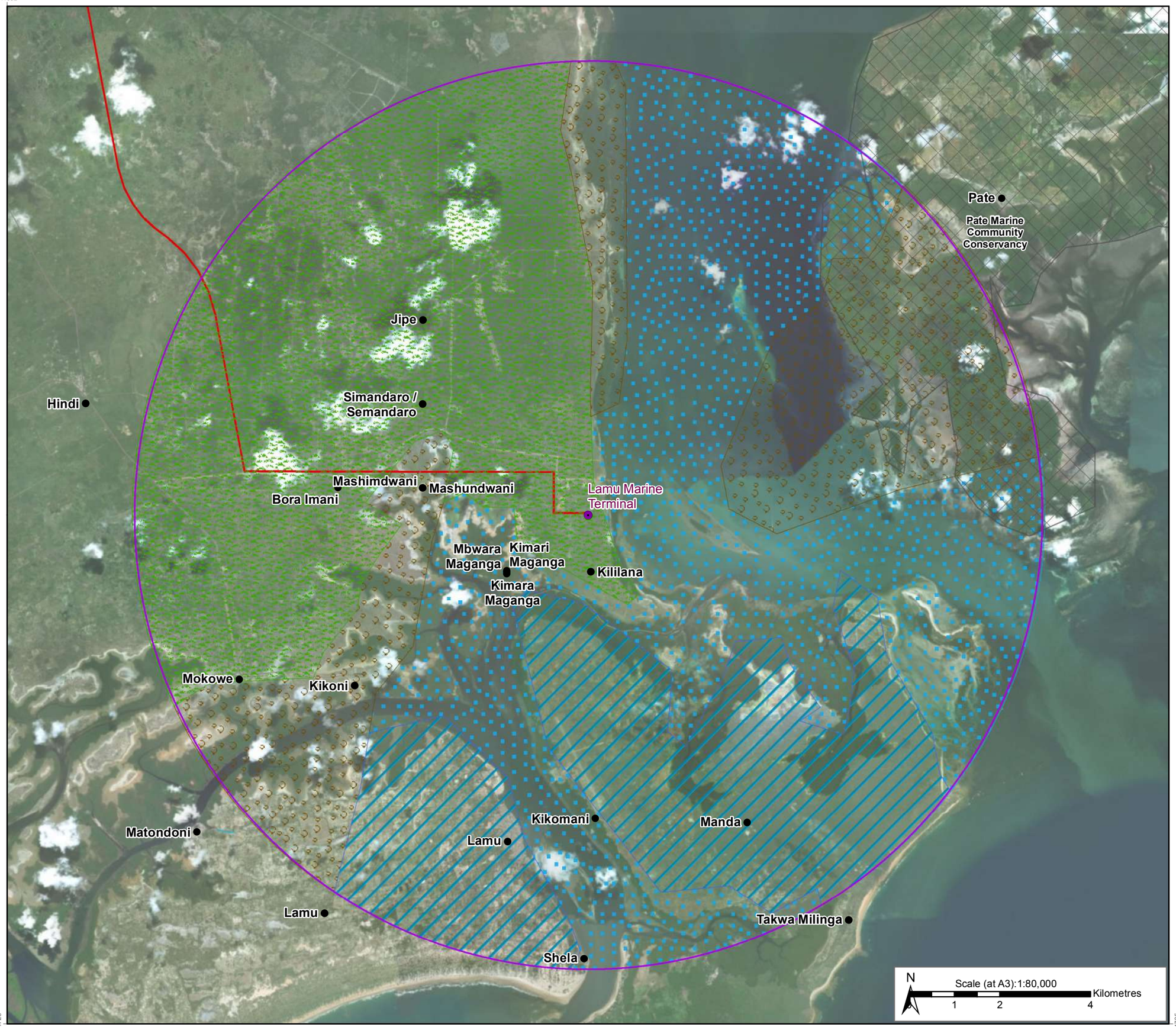
275887

811582

Drawing 18: Landscape Character Area and Protected Area - Lamu Marine Terminal



Key

- Landscape and Visual Area of Influence (AoI)

Landscape Character Area (LCA)

- Coastal Marine
- Grassland
- Marine
- Scattered Scrub
- Settlement

Protected Areas

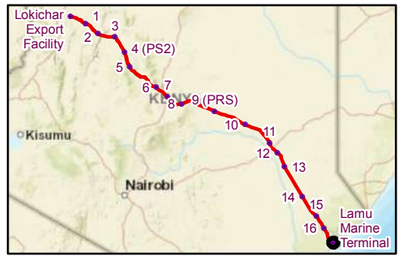
- Community Nature Reserve

Proposed Facilities

- Station
- Proposed Pipeline Route

Surfacewater

- Watercourse



Data sources:
Base data sourced fromTullow Kenya B.V. / PPMT/ Wood Group. Protected Areas available from IBAT 2018

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

244725

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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244725

CLIENT
TULLOW OIL

PROJECT
LOKICHAR LANDSCAPE CHARACTER AND VISUAL BASELINE REPORT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - STATION 4

PROJECT NO.	CONTROL	REV.	DRAWING
1772867	648-OG-553.205	B.1	19

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25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

CLIENT
TULLOW OIL

PROJECT
LOKICHAR LANDSCAPE CHARACTER AND VISUAL BASELINE REPORT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - STATION 5

PROJECT NO.	CONTROL	REV.	DRAWING
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CLIENT
TULLOW OIL

PROJECT
LOKICHAR LANDSCAPE CHARACTER AND VISUAL BASELINE REPORT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - STATION 6

PROJECT NO.	CONTROL	REV.	DRAWING
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CLIENT
TULLOW OIL

PROJECT
LOKICHAR LANDSCAPE CHARACTER AND VISUAL BASELINE REPORT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - STATION 7

PROJECT NO.	CONTROL	REV.	DRAWING
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CLIENT
TULLOW OIL

PROJECT
LOKICHAR LANDSCAPE CHARACTER AND VISUAL BASELINE REPORT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-04-16
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - STATION 9

PROJECT NO.	CONTROL	REV.	DRAWING
1772867	648-OG-553.205	B.1	23

Path: C:\Users\tsmith\Desktop\Tullow Lokichar LOCAL\99_PROJECTS\1772867\553.205_baseline\02_PRODUCTION\DWGS | File Name: 1772867-648-OG-553.205.dwg | Last Edited By: tsmith Date: 2019-04-18 Time:1:24:38 PM | Printed By: tsmith Date: 2019-04-18 Time:1:25:44 PM

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

CLIENT
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YYYY-MM-DD	2019-04-16
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - STATION 10

PROJECT NO.	CONTROL	REV.	DRAWING
1772867	648-OG-553.205	B.1	24

Path: C:\Users\tsmith\Desktop\Tullow Lokichar LOCAL\99_PROJECTS\1772867\553.205_baseline\02_PRODUCTION\DWG\ | File Name: 1772867-648-OG-553.205.dwg | Last Edited By: tsmith Date: 2019-04-18 Time:1:24:38 PM | Printed By: tsmith Date: 2019-04-18 Time:1:25:46 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25 mm
0

CLIENT
TULLOW OIL

PROJECT
LOKICHAR LANDSCAPE CHARACTER AND VISUAL BASELINE REPORT

CONSULTANT

GOLDER

YYYY-MM-DD	2019-04-18
DESIGNED	LD
PREPARED	TS
REVIEWED	LD
APPROVED	TF

TITLE
PANORAMIC PHOTOGRAPH - Lamu Marine Terminal Facility

PROJECT NO.	CONTROL	REV.	DRAWING
1772867	648-OG-553.205	B.1	25

Path: C:\Users\tsmith\Desktop\Tullow Lokichar LOCAL\99_PROJECTS\1772867\553.205_baseline\02_PRODUCTION\DWGs | File Name: 1772867-648-OG-553.205.dwg | Last Edited By: tsmith Date: 2019-04-18 Time:1:24:38 PM | Printed By: tsmith Date: 2019-04-18 Time:1:25:48 PM

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

GOLDER

golder.com

ANNEX II

B

Physical Environment Baseline Field Reports

B1 **Surface Water**

B2 **Air Quality**

B3 **Noise**

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.102.B0

TO PPMT

CC Anna Goodwin

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES – SURFACE WATER QUALITY FIELD REPORT

The following field report has been provided by the senior water resource specialist Mr. Dan Odero. Golder has provided minimal editing to maintain the sentiment and expert opinion of Mr. Odero.

1.0 INTRODUCTION AND SCOPE

This field report relates to the implementation of field studies defined in the plan of study (PoS) 1772867.537. The data collected as part of the water fieldwork is designed to support the Environmental and Social Impact Assessment (ESIA) for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Project to characterise the surface water quality profiles of the three main surface water receptors across the LLCOP pipeline route in the three main river crossings points, namely:

- Kerio River;
- Suguta River; and
- Ewaso Ngiro River.

The sampling locations for the rivers are shown on the map presented in Figure 1. The sampling locations were identified from the river crossings as identified from the pipeline route at the time of sampling. The river crossing location at Kerio and Suguta was revised in December 2018 and therefore the sampling locations are approximately 1.5 km (SW04) and 200 m (SW02) downstream (to the southwest) from the final river crossing location. However, Golder considers the samples to be representative of the crossing location considering they are single spot samples and therefore only represent a snapshot in time. The sample locations relative to the final LLCOP route are shown in Figure 1.

Sample submission forms for the three crossing points are attached to this report, Appendix A. Preliminary laboratory results from SGS are attached as part of Appendix B.

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2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The water fieldwork was completed by the following member(s) of the Golder team:

- Dan Odero (DO) – Hydrogeologist; and
- Farida Gitonga.

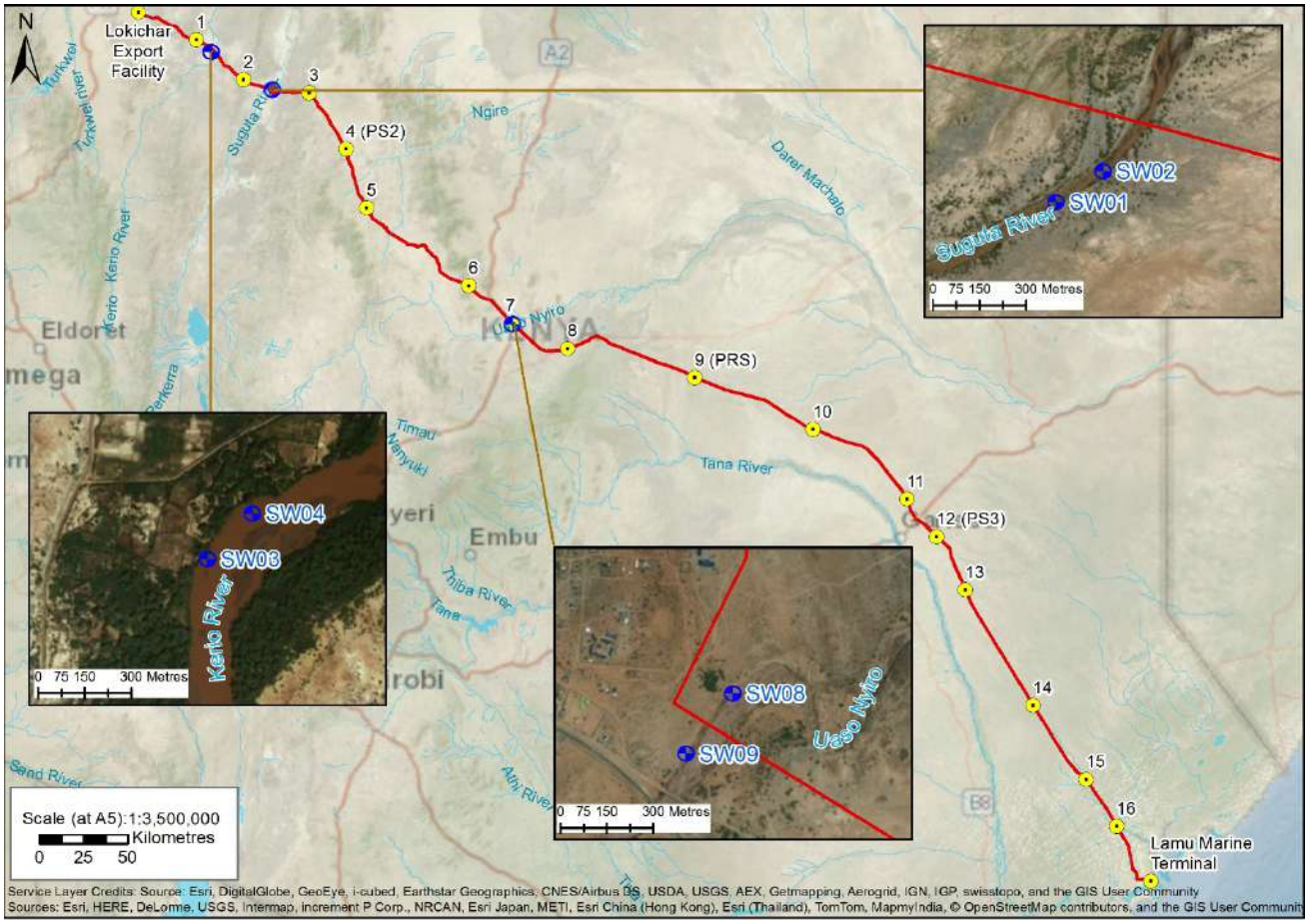

Figure 1: Location map of the sampling points

2.2 Tasks completed

Sampling was conducted in two legs, as follows:

- Kerio and Suguta rivers – 5/12 /18 to 7/12/18; and
- Ewaso Ngiro River– 8/12/18 – 10/12/18.

This was to facilitate delivery of samples to the laboratory in good time, rather than move around with the samples from the northern rivers to Archers Post where the Ewaso Ngiro site was.

The sampling field campaign was preceded by preparations, including:

- Delivery of adequate sampling bottles from the SGS laboratory in Mombasa;
- Calibration of pH/EC/Temp/TDS meter at the Water Resources Central Laboratory;

- Purchase of additional dry ice packs, labels, clear cellophane and water-resistant markers;
- Checking that appropriate PPE is available; and
- Transport logistics.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 Kerio-Suguta Sector

The team launched from Ol Malo lodge on 6 December via helicopter for ease of access to site. Sampling was conducted first on Suguta River between 12.30 and 13:30 hrs and thereafter Kerio River between 14:20 and 14:50 hrs. Samples were collected in amber glass bottles, labelled appropriately and labels sealed in clear cellophane to guard against smudging or peeling off due to moisture. The samples were split into two bottles per location – one for TPH-PAH-BTEX and the other for physico-chemical analysis. In situ measurements were taken and recorded as presented in Table 1.

Figure 2: Suguta River on the date of sampling

Table 1: Suguta and Kerio sampling data – 6 December 2018

Sample Number	Sample Name	pH	Temperature (°C)	Electrical Conductivity (µS/cm)	Time	Location (WGS84)	
						Easting	Northing
SW01	Suguta upstream	9.11	35.1	5,440	12.51	36.452440°	1.838330°
SW02	Suguta downstream	9.23	35.4	5,490	13.24	36.453803°	1.839233°
SW03	Kerio upstream	8.20	35.7	340	14.28	36.141431°	2.029025°
SW04	Kerio downstream	8.05	36.0	340	14.40	36.142738°	2.030359°
SW06	Duplicate Suguta				13.24		
SW07	Field blank				14.44		

A trip sample, SW05, was bottled on 5/12/2018 at 09:30 hrs in Nairobi before departure with de- ionized water. There was no time labelling nor location on the duplicate sample.

Figure 3: Labelling sample at Suguta River upstream

Samples were stored in a cool box and transported back to Ol Malo where they were re- packaged into another cool box with fresh dry ice cooled in the Ol Malo cold chain and stored in a cool ventilated space. The team travelled back by road to Nairobi on 7 December and delivered the samples on the same day to SGS. Submission records are attached in the Appendix A.

Ewaso Ngiro Sector

The sampling team was based at the Sarova Shaba, approximately 9 kilometres from the sampling location. Travel to location was on 8 December 2018 and sampling undertaken on the 9 December. During preparation for the sampling it was realized that some of the bottles from the laboratory were not clean, necessitating thorough cleaning before proceeding to the field.

Figure 4: Ewaso Ngiro on the date of sampling

Figure 5: Samples packed in green cool box ready for movement

Ewaso Ngiro is known to have crocodiles hence extra caution was taken to ensure the sampling location was safe. Samples were collected and labelled accordingly then delivered back to the hotel. A set of dry ice was frozen in the hotel cold chain and used on 10 December to transport the samples back to Nairobi.

Table 2: Ewaso Ngiro sampling data – 9 December 2018

Sample Number	Sample Name	pH	Temperature (°C)	Electrical Conductivity (µS/cm)	Time	Location (WGS84)	
						Easting	Northing
SW08	Ewaso downstream	8.02	28.5	460	11.10	37.673972	0.638917
SW09	Ewaso upstream	7.89	29.4	460	11.28	37.672617°	0.637156°
SW10	Ewaso field blank				11.30		

Figure 6: Ewaso Ngiro samples package for trip to Nairobi and on to laboratory

Samples were delivered to Nairobi and refrigerated overnight before delivery to SGS on 11 December 2018. Sample submission forms are included in the Appendix A. Samples were received cold, with dry ice intact.

3.2 Key Observations for ESIA

The area traversed by the proposed LLCOP is largely undeveloped, with no major infrastructure. This will be the first key infrastructure installation in the corridor. They are no large populations to be moved or impacted directly by the project. The main impacts that could be there would therefore be on the natural environment. In terms of environmental externalities unique to surface water that are intrinsic to the construction of the pipeline and during operation, the following observations are made:

- Kerio River is used for irrigation by farmers both upstream and downstream of the pipeline corridor. The farmers would therefore naturally want to know if there would be any negative effect of the pipeline during construction and operations (water diversions, coffer dams, etc);
- The community would also be interested to know whether people in the 1km corridor will be resettled or not; and
- On Suguta River the corridor traverses an unpopulated area, with no agricultural activity and no livestock grazing. The key ESIA issues here are the pristine environment with unique physical features that are a natural heritage and of touristic value. These include the ‘Painted Valley” and the barchans (sand dunes) in the corridor. These require minimum disturbance during construction stage and no obtrusive above ground structures like pumping stations that would otherwise spoil the natural environment.

Figure 7: Barchans are rare in Kenya and almost unique to this environment

Figure 8: Painted Valley

- On Ewaso Ngiro River the pipeline crosses within a semi-urban setting hence there could be disruptions to traffic and movement during construction phase. Noise and dust levels may also increase and there will be pressure for employment of residents on the project. A number of people may be resettled as well so there will be disruption to livelihoods. On surface water sources, the riverbed here is a hard Basement rock and there are two ways about the pipeline – either aerial crossing or tunnelled crossing below the riverbed. Aerial crossing has its challenges due to flood levels. In the past, certain floods have caused debris to block the road bridge, causing floodwater to spill over around the bridge. If the aerial crossing is not designed with proper flood and debris modelling, it could hold debris leading to widespread flooding of the area around the crossing.
- There is significant human activity such as washing; livestock watering; swimming and bathing on Kerio and Ewaso Ngiro Rivers. On the banks of Ewaso Nyiro River, some locals were seen cleaning their motor bikes and these are current sources of pollutants.

3.3 Health and Safety Learnings

Based on field-team coordination and personal field study experiences, Mr. Odero identified and communicated the following health and safety learnings:

- The Suguta area is especially hot, with shade temperatures hitting 45°C and normal river water (not hot springs) reaching 35°C in the day. It is therefore important to keep hydrated all the time and wear sun protection;
- There are few and sometimes no sources of safe water in the areas. It is necessary to provide ample drinking water supply for campsite staff during construction;
- Ewaso Ngiro River is crocodile-infested especially in the lower reaches after the pipeline crossing; these animals can migrate in search of food or breeding grounds hence one has to be on the look out for danger from crocodiles;
- Flash flooding of the semi-arid area rivers like Kerio, Suguta and Ewaso Ngiro is common; rainfall in upper catchments may bring unexpected flooding in the lower reaches like the pipeline crossings which may have no rainfall. It is therefore important to keep a weather chart of the river basins during construction to minimise the danger of staff being caught in flash floods;
- Kerio area is highly populated and the community is not necessarily well-informed about the pipeline activities or embracing the project fully. It is therefore important to keep authorities informed of any activities in the area and even after that, to be prudent and keep a low profile and try to be as open as possible with the community while on the ground, while at the same time getting buy-in from the local elders whose word is held in high regard; and
- Knowing the location of field staff at any one time is critical. This is because the area is vast and wild. Often the field teams will be the only people out there and who have not adapted to the environment. Air ambulance rescue is an important back up health and safety measure because the area is hardly accessible by vehicular transport. Personnel should be adequately briefed about the area and the risks and receive first aid training.

3.4 Gaps and Recommendations for Impact Assessment

Gaps

- The ESIA did not seek to establish baseline land use conditions along the river basins, especially next to the riparian areas and how far upstream or downstream of the corridor such a study would cover. This is because the water quality is influenced by the sum of land use impacts along the basin.
- Part of the are traversed by the corridor is in the belt of sites of anthropological importance. The pipeline is the only chance where the whole area will be traversed by trenching works, as shallow as that may be. Per chance discoveries of anthropological significance are found, how these would be dealt with should be clarified in the ESIA.

Recommendations

- It is recommended that stakeholders in the wildlife sector, such as the Ministry of Wildlife, Northern Rangelands Trust, Turkana Basin Institute, etc be consulted as part of the broad-based consultation in the event this has not been done.
- The water resources impact study should be seen to adequately cover concerns in a larger part of the river basin other than areas immediate to the crossings only.

Tim Flower
Technical Director

AG/TF/kc

APPENDIX A

Sample submission forms for Kerio, Suguta and Ewaso Ngiro Rivers

Sample Submission form Kerio – Suguta Samples

SGS

Laboratory Testing Services
SGS House, Shimanzi, Ali Punjani Street, P.O. Box 90264, Mombasa, 80100, Kenya
Tel: 254 41 2226677-8-9, Fax: +254 41 222670 Email: sampleregistry.ke@sgs.com

Document Ref.LAB/QAP4.3FM/98
Revision : 7.0
Author : QM
Approved : LM
Date Issued : 14.10.98
Revision date : Sept 2014
LAB JOB NO:

SAMPLE SUBMISSION & CONTRACT REVIEW FORM

Customer Name: GOLDER ASSOCIATES Postal Address: Cavendish House, Buckinghamshire, SL8 5AS, UK Contact Person: Kevin Arbizu

Email: KArbizu@golder.com ☒ Sample Submitted by Client ☐ Sampled & Submitted by SGS Staff ☐ Submitted by Internal SGS Division ☐ Other

SAMPLE DESCRIPTION: *(Indicate where applicable)*	River water		
No. of Samples:	7 samples	Sample Size (see below):	
Date/Time Sampled/Submitted:	7.12.18	Sampled/Submitted by:	Client
Sample(s) Condition/Temp:		Sampling Location:	Kerio River and Suguta R.
Source:		Special Marks Required:	
Tank(s):	-	Ship/Shore/Other:	-
Batch:	AS ON SAMPLES	Total Quantity Inspected:	-
Vessel/Truck:	-		
Analysis Reporting Requested:	☒ Normal TAT ☐ *Urgent 24Hrs ☐ Other (TAT):		

TEST(S) REQUESTED *(List or attach list of test parameters)*	INDICATE SPECIFICATIONS REQUIRED ON THE TEST REPORT. *(please tick (✓) where applicable below)*
	☐ Regulatory specifications required-KEBS/NEMA /EAS/CODEX/ EU
AS PER ORDER	☐ Customer specifications (Please attach)
	☐ Customer standing instructions (State contract ref.)
	☐ Only test results required –No specifications!
	☐ Other (Specify)

INDICATE TEST METHODS REQUIRED (IF KNOWN) *(please tick (✓) where applicable below)*

☐ AOAC	☐ GAFTA
☐ AOCS	☐ ICUMSA
☐ ISO/EN	☐ CIPAC
☐ ASTM	☐ ISTA
☐ IP	☐ EAS
☐ EPA	☐ KS
☐ APHA	☐ Other Combination

FOR SGS LAB OFFICIAL USE ONLY	
No. of Samples Received:	
Date & Time Received:	
Sample Condition at Receipt:	
Sample Size Received. Adequace?	☐ YES ☐ NO
Lab's Capability for Required Tests:	☐ YES ☐ PARTIAL ☐ NO
Subcontracting Required:	☐ NO ☐ YES
Client's Consent to Subcontract	☐ YES ☐ NO
Expected Date of Tests Completion:	
TESTING FEES/QUOTE ACCEPTED BY CLIENT?[EMAIL OR PURCHASE ORDER]	☐ YES ☐ NO
Client Category	☐ Small ☐ Medium ☐ Large
Internal Customer Job No/Dept:	
SGS BOSS Ref. No:	
Lab/Analyst 1 Assigned to Job	
Lab/Analyst 2 Assigned to Job	
Lab/Analyst 3 Assigned to Job	
LABORATORY REMARKS	

Authorized Client's Signature: for client Dan Odero Date: 07.12.18 Time: 4.45 pm Authorized Lab Officer /Signature:.....Date:.....Time:.....

IMPORTANT NOTICE !!! BELOW ARE MINIMUM SAMPLE SIZES REQUIRED FOR LABORATORY ANALYSIS. SMALLER SAMPLE SIZE MAY DELAY ANALYSIS PROCESS.

(1) Petroleum products – Diesel/Kerosine/Lubes-1 litre ; Gasoline -2 litres, JetA1-5 litres, Fuel Oil -2litres (2) Water/Waste Water - 2X1litre (in duplicate) (3) Food Products - 2X300g (in duplicate)
(4) Hygiene Audit Samples –Food (100g); Water (200mL) (5) Soil Samples - 2X250g (in duplicate) (6) Full MRLs on Fresh Produce - 1 kg (7) Other Products - 2X250g (in duplicate)

***Request for shorter TAT than stipulated may attract premium charges.**

Sample Submission form Ewaso Ngiro

SGS	Laboratory Testing Services SGS House, Shimanzi, Ali Punjani Street, P.O. Box 90264, Mombasa, 80100, Kenya Tel: 254 41 2226677-8-9, Fax: +254 41 222870 Email: sampleregistry.ke@sgs.com	Document Ref.:LAB/QAP4.3FM/98 Revision : 7.0 Author : QM Approved : LM Date Issued : 14.10.98 Revision date : Sept 2014 LAB JOB NO:

SAMPLE SUBMISSION & CONTRACT REVIEW FORM

Customer Name: GOLDER ASSOCIATES Postal Address: Cavendish House, Buckinghamshire, SL8 5AS, UK Contact Person: Kevin Arbizu

Email: KArbizu@golder.com ☒ **Sample Submitted by Client** ☐ **Sampled & Submitted by SGS Staff** ☐ **Submitted by Internal SGS Division** ☐ **Other**

SAMPLE DESCRIPTION: *(Indicate where applicable)*	River water		
No. of Samples:	**3 samples**	Sample Size (*see below*):	
Date/Time Sampled/Submitted:	**9.12.18**	Sampled/Submitted by:	**Client**
Sample(s) Condition/Temp:		Sampling Location:	**Ewaso Nyiro**
Source:		Special Marks Required:	
Tank(s):	-	Ship/Shore/Other:	-
Batch:	**AS ON SAMPLES**	Total Quantity Inspected:	-
Vessel/Truck:	-		
Analysis Reporting Requested:	☒ Normal TAT ☐ *Urgent 24Hrs ☐ Other (TAT):		

TEST(S) REQUESTED *(List or attach list of test parameters)*	**INDICATE SPECIFICATIONS REQUIRED ON THE TEST REPORT.** *(please tick (✓) where applicable below)*	
	☐	Regulatory specifications required-KEBS/NEMA /EAS/CODEX/ EU
AS PER ORDER	☐	Customer specifications (*Please attach*)
	☐	Customer standing instructions (*State contract ref.*)
	☐	Only test results required –No specifications!
	☐	Other (*Specify*)

INDICATE TEST METHODS REQUIRED (IF KNOWN) *(please tick (✓) where applicable below)*			
	☐	AOAC	☐ GAFTA
	☐	AOCS	☐ ICUMSA
	☐	ISO/EN	☐ CIPAC
	☐	ASTM	☐ ISTA
	☐	IP	☐ EAS
	☐	EPA	☐ KS
	☐	APHA	☐ Other Combination

FOR SGS LAB OFFICIAL USE ONLY	
No. of Samples Received:	
Date & Time Received:	
Sample Condition at Receipt:	
Sample Size Received. Adequate?	☐ YES ☐ NO
Lab's Capability for Required Tests:	☐ YES ☐ PARTIAL ☐ NO
Subcontracting Required:	☐ NO ☐ YES
Client's Consent to Subcontract:	☐ YES ☐ NO
Expected Date of Tests Completion:	
TESTING FEES/QUOTE ACCEPTED BY CLIENT?[EMAIL OR PURCHASE ORDER]	☐ YES ☐ NO
Client Category	☐ Small ☐ Medium ☐ Large
Internal Customer Job No/Dept:	
SGS BOSS Ref. No:	
Lab/Analyst 1 Assigned to Job	
Lab/Analyst 2 Assigned to Job	
Lab/Analyst 3 Assigned to Job	

LABORATORY REMARKS

Authorized Client's Signature: for client **Dan Odero** **Date: 11.12.18** Time:..... Authorized Lab Officer /Signature:..... ....Date:.....Time:.....

IMPORTANT NOTICE !!!_BELOW ARE MINIMUM SAMPLE SIZES REQUIRED FOR LABORATORY ANALYSIS. SMALLER SAMPLE SIZE MAY DELAY ANALYSIS PROCESS.

(1) Petroleum products – Diesel/Kerosine/Lubes-1 litre ; Gasoline -2 litres, JetA1-5 litres, Fuel Oil -2litres **(2)** Water/Waste Water - 2X1litre (in duplicate) **(3)** Food Products - 2X500g (in duplicate)
(4) Hygiene Audit Samples –Food (100g); Water (200mL) **(5)** Soil Samples - 2X250g (in duplicate) **(6)** Full MRLs on Fresh Produce - 1 kg **(7)** Other Products - 2X250g (in duplicate)

***Request for shorter TAT than stipulated may attract premium charges.**

Chain of Custody Form

SGS	Kenya Management System (KEMS) Manual	Doc Number: SGSK-COP-ENVI-003FM01 Revision: 00 Doc Type: Procedure Author/Owner: Samson Obiya Effective Date: 01/09/2010 Review Date: 01/12/2011 Number Pages: Page 1 of 2 Approved by: Philip Abuor
SGS Kenya Limited	TITLE: CHAIN OF CUSTODY FORM	

CLIENT: GOLDER ASSOCIATES
CONTACT: DAN ODERO PHONE NO: 0722748092
PROJECT: LLCOP SITE NAME: SUGUTA & KERIO
REPORTS TO: KEVIN ARBIZU FAX NO: KArbizu@golder.com
INVOICE TO: SGS P.O BOX:
SGS Reference:
PAGE 1 OF 2

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	SAMPLE TYPE (C - COMP, G - GRAB)	TESTS TO BE PERFORMED	REMARKS
	SUGUTA UPSTREAM		12:51		2	G	AS PER ORDER CONFIRMATION	Samples in amber bottles
	SUGUTA DOWNSTREAM		13.24		2	C		
	KERIO UPSTREAM		14.28		2	G		
	KERIO DOWNSTREAM		14.40		2	G		
	TRIP BLANK		9.30		1	G		
	DUPLICATE				1	G		

SGS Kenya Limited RECEIVED

SGS	Kenya Management System (KEMS) Manual	Doc Number: SGSK-COP-ENVI-003FM01 Revision: 00 Doc Type: Procedure Author/Owner: Samson Obiya Effective Date: 01/09/2010 Review Date: 01/12/2011 Number Pages: Page 1 of 2 Approved by: Philip Abuor
SGS Kenya Limited	TITLE: CHAIN OF CUSTODY FORM	

CLIENT: GOLDER ASSOCIATES
CONTACT: Dan Odero PHONE NO: 0722748092
PROJECT: LLCOP SITE NAME: Ewaso Nyiro
REPORTS TO: KEVIN ARBIZU FAX NO: KArbizu@golder.com
INVOICE TO: SGS P.O BOX:
SGS Reference:
PAGE ___ OF ___

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	SAMPLE TYPE (C - COMP, G - GRAB)	TESTS TO BE PERFORMED	REMARKS
	EWASO DOWNSTREAM	9/12	11.10		2	G		Samples in amber bottles
	EWASO UPSTREAM	9/12	11.28		1	G		
	EWASO FIELD BLANK	9/12	11.30		1	G		

SGS Kenya Limited RECEIVED

APPENDIX B

Analysis Report

Date: 10/01/2019

SGS Kenya Limited Laboratory Services

SGS Kenya Ltd.
SGS House
Ali Punjani Street
P.O. Box 90264
80100 Mombasa
Kenya

GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA19-00019.001

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE KERIO UPSTREAM FCA 6/12/18 14.28
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	12.00	mg/L
Phosphate as PO4	APHA 4500-P	0.03	mg/L
pH	APHA 4500 H+	7.56	
Conductivity at 25 °C	APHA 2510 B	388.00	µS/cm
Fluoride	APHA 4500 F- C	0.39	mg/L
Sulphate as SO4	APHA-4500-S04C	11.94	mg/L
Chloride	APHA-4500-CL B	8.51	mg/L
Total Alkalinity	APHA 2320B	659.10	mg/L
Nitrate as NO3	APHA-4500-NO3	4.2	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L
Chrysene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only (if non-perishable). This document is issued by the Company subject to its General Conditions of Service printed overleaf or available on request and accessible at http://www.sgs.com/terms_and_conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_e-document.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions , if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law .

SGS Kenya Ltd.

SGS House, Ali Punjani Street, P.O.Box 90264, Mombasa 80100 Kenya, t:+254(41)222 667-9| 722202145| 733611105, f:+254(41) 222 8703, e: lab.kenya@sgs.com

Member of the SGS Group (Société Générale de Surveillance)

Date: 10/01/2019

SGS Kenya Limited Laboratory Services
SGS Kenya Ltd.
SGS House
Ali Punjani Street
P.O. Box 90264
80100 Mombasa
Kenya

GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA19-00019.001

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE KERIO UPSTREAM FCA 6/12/18 14.28
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.03	mg/L
Calcium as Ca	APHA 3120 B	14.74	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.17	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	3.29	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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SGS Kenya Ltd.

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Member of the SGS Group (Société Générale de Surveillance)

Date: 10/01/2019

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TESTS	METHOD	RESULT	UNITS
Potassium as K	APHA 3120 B	3.30	mg/L
Sodium as Na	APHA 3120 B	11.68	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	4.56	mg/L
Iron as Fe	ISO 11885	3.36	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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SL8

Analysis Report MA19-00019.002

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE KERIO DOWNSTREAM HOOC 6/12/18 14.40
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	23.00	mg/L
Phosphate as PO4	APHA 4500-P	0.02	mg/L
pH	APHA 4500 H+	7.15	
Conductivity at 25 °C	APHA 2510 B	392.00	µS/cm
Fluoride	APHA 4500 F- C	0.41	mg/L
Sulphate as SO4	APHA-4500-S04C	12.14	mg/L
Chloride	APHA-4500-CL B	6.81	mg/L
Total Alkalinity	APHA 2320B	202.80	mg/L
Nitrate as NO3	APHA-4500-NO3	2.8	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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SGS ORDERNO:	524772
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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.03	mg/L
Calcium as Ca	APHA 3120 B	15.27	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.17	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Analysis Report MA19-00019.002

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE KERIO DOWNSTREAM HOOC 6/12/18 14.40
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	0.04	mg/L
Potassium as K	APHA 3120 B	2.58	mg/L
Sodium as Na	APHA 3120 B	10.38	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	4.26	mg/L
Iron as Fe	ISO 11885	0.04	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

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Analysis Report MA19-00019.003

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE SUGUTA UPSTREAM HOOC 6/12/18 12.51
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	27.00	mg/L
Phosphate as PO4	APHA 4500-P	5.78	mg/L
pH	APHA 4500 H+	8.90	
Conductivity at 25 °C	APHA 2510 B	6680.00	µS/cm
Fluoride	APHA 4500 F- C	31.10	mg/L
Sulphate as SO4	APHA-4500-S04C	201.68	mg/L
Chloride	APHA-4500-CL B	280.76	mg/L
Total Alkalinity	APHA 2320B	2129.40	mg/L
Nitrate as NO3	APHA-4500-NO3	71.4	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

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Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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SGS ORDERNO:	524772
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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.01	mg/L
Calcium as Ca	APHA 3120 B	1.55	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.07	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	0.06	mg/L
Potassium as K	APHA 3120 B	24.64	mg/L
Sodium as Na	APHA 3120 B	408.62	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	0.84	mg/L
Iron as Fe	ISO 11885	0.06	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Analysis Report MA19-00019.004

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE SUGUTA DOWNSTREAM FCA 6/12/18 1324
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	20.00	mg/L
Phosphate as PO4	APHA 4500-P	6.94	mg/L
pH	APHA 4500 H+	8.93	
Conductivity at 25 °C	APHA 2510 B	6730.00	µS/cm
Fluoride	APHA 4500 F- C	28.90	mg/L
Sulphate as SO4	APHA-4500-S04C	201.07	mg/L
Chloride	APHA-4500-CL B	272.26	mg/L
Total Alkalinity	APHA 2320B	2230.80	mg/L
Nitrate as NO3	APHA-4500-NO3	60.7	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Date: 10/01/2019

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA19-00019.004

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE SUGUTA DOWNSTREAM FCA 6/12/18 1324
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.01	mg/L
Calcium as Ca	APHA 3120 B	1.10	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.06	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA19-00019.004

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE SUGUTA DOWNSTREAM FCA 6/12/18 1324
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	0.09	mg/L
Potassium as K	APHA 3120 B	24.20	mg/L
Sodium as Na	APHA 3120 B	436.65	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	0.70	mg/L
Iron as Fe	ISO 11885	0.09	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA19-00019.005

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO DOWNSTREAM FCA 9/12/18 1110AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	233.00	mg/L
Phosphate as PO4	APHA 4500-P	1.22	mg/L
pH	APHA 4500 H+	7.26	
Conductivity at 25 °C	APHA 2510 B	531.00	µS/cm
Fluoride	APHA 4500 F- C	0.71	mg/L
Sulphate as SO4	APHA-4500-S04C	13.58	mg/L
Chloride	APHA-4500-CL B	20.42	mg/L
Total Alkalinity	APHA 2320B	202.80	mg/L
Nitrate as NO3	APHA-4500-NO3	5.9	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Analysis Report MA19-00019.005

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO DOWNSTREAM FCA 9/12/18 1110AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.04	mg/L
Calcium as Ca	APHA 3120 B	14.09	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.21	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Analysis Report MA19-00019.005

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO DOWNSTREAM FCA 9/12/18 1110AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	0.24	mg/L
Potassium as K	APHA 3120 B	4.50	mg/L
Sodium as Na	APHA 3120 B	19.84	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	6.34	mg/L
Iron as Fe	ISO 11885	0.24	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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UNITED KINGDOM
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Analysis Report MA19-00019.006

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO UPSTREAM FCA 9/1/18 1128AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	148.00	mg/L
Phosphate as PO4	APHA 4500-P	0.14	mg/L
pH	APHA 4500 H+	7.21	
Conductivity at 25 °C	APHA 2510 B	520.00	µS/cm
Fluoride	APHA 4500 F- C	0.68	mg/L
Sulphate as SO4	APHA-4500-S04C	12.35	mg/L
Chloride	APHA-4500-CL B	23.82	mg/L
Total Alkalinity	APHA 2320B	202.80	mg/L
Nitrate as NO3	APHA-4500-NO3	5.4	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Analysis Report MA19-00019.006

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO UPSTREAM FCA 9/1/18 1128AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.04	mg/L
Calcium as Ca	APHA 3120 B	13.93	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.21	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Analysis Report MA19-00019.006

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO UPSTREAM FCA 9/1/18 1128AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	0.23	mg/L
Potassium as K	APHA 3120 B	4.40	mg/L
Sodium as Na	APHA 3120 B	19.13	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	6.16	mg/L
Iron as Fe	ISO 11885	0.23	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA19-00019.007

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE EWASO NYIRO FIELD BLANK FCA 9/12/18 1130AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	6.00	mg/L
Phosphate as PO4	APHA 4500-P	<0.01	mg/L
pH	APHA 4500 H+	6.96	
Conductivity at 25 °C	APHA 2510 B	58.30	µS/cm
Fluoride	APHA 4500 F- C	0.16	mg/L
Sulphate as SO4	APHA-4500-S04C	2.06	mg/L
Chloride	APHA-4500-CL B	8.51	mg/L
Total Alkalinity	APHA 2320B	101.40	mg/L
Nitrate as NO3	APHA-4500-NO3	0.43	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Date: 10/01/2019

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TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Calcium as Ca	APHA 3120 B	0.31	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Potassium as K	APHA 3120 B	0.17	mg/L
Sodium as Na	APHA 3120 B	4.62	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	0.11	mg/L
Iron as Fe	ISO 11885	<0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE SUGUTA KERIO TRIP BLANK 5.12.18 9.00AM
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	<5.00	mg/L
Phosphate as PO4	APHA 4500-P	<0.01	mg/L
pH	APHA 4500 H+	6.62	
Conductivity at 25 °C	APHA 2510 B	56.80	µS/cm
Fluoride	APHA 4500 F- C	0.15	mg/L
Sulphate as SO4	APHA-4500-S04C	3.70	mg/L
Chloride	APHA-4500-CL B	8.51	mg/L
Total Alkalinity	APHA 2320B	50.70	mg/L
Nitrate as NO3	APHA-4500-NO3	0.26	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Calcium as Ca	APHA 3120 B	0.43	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	<0.005	mg/L

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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Potassium as K	APHA 3120 B	0.21	mg/L
Sodium as Na	APHA 3120 B	4.78	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	0.11	mg/L
Iron as Fe	ISO 11885	<0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

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ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE SUGUTA KERIO FIELD BLANK 6/12/18 1440
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	<5.00	mg/L
Phosphate as PO4	APHA 4500-P	<0.01	mg/L
pH	APHA 4500 H+	5.78	
Conductivity at 25 °C	APHA 2510 B	63.50	µS/cm
Fluoride	APHA 4500 F- C	0.14	mg/L
Sulphate as SO4	APHA-4500-S04C	10.08	mg/L
Chloride	APHA-4500-CL B	9.36	mg/L
Total Alkalinity	APHA 2320B	40.56	mg/L
Nitrate as NO3	APHA-4500-NO3	0.37	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Chrysene		<0.050	mg/L
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Calcium as Ca	APHA 3120 B	0.61	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	<0.005	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

Technical Signatory — Stephen Musyoka-Chemist

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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Potassium as K	APHA 3120 B	0.14	mg/L
Sodium as Na	APHA 3120 B	4.08	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	0.07	mg/L
Iron as Fe	ISO 11885	<0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 10/01/2019

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GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA19-00019.010

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE DUPLICATE SUGUTA - KERIO 6.12.18
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	25.00	mg/L
Phosphate as PO4	APHA 4500-P	7.69	mg/L
pH	APHA 4500 H+	8.89	
Conductivity at 25 °C	APHA 2510 B	6730.00	µS/cm
Fluoride	APHA 4500 F- C	30.90	mg/L
Sulphate as SO4	APHA-4500-S04C	210.95	mg/L
Chloride	APHA-4500-CL B	281.61	mg/L
Total Alkalinity	APHA 2320B	2281.50	mg/L
Nitrate as NO3	APHA-4500-NO3	75.8	mg/L
TPH C6 - C44	EPA 8015C	<0.100	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.050	mg/L
Acenaphthylene		<0.050	mg/L
Anthracene		<0.050	mg/L
Benzo(a)anthracene		<0.050	mg/L
Benzo(a)pyrene		<0.050	mg/L
Benzo(b)fluoranthene		<0.050	mg/L
Benzo(g,h,i)perylene		<0.050	mg/L
Benzo(k)fluoranthene		<0.050	mg/L
Chrysene		<0.050	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 10/01/2019

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GOLDER ASSOCIATES (UK) LTD
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SL8

Analysis Report MA19-00019.010

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE DUPLICATE SUGUTA - KERIO 6.12.18
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Dibenz(a,h)anthracene		<0.050	mg/L
Fluoranthene		<0.050	mg/L
Fluorene		<0.050	mg/L
Indeno(1,2,3-cd)pyrene		<0.050	mg/L
Naphthalene		<0.050	mg/L
Phenanthrene		<0.050	mg/L
Pyrene		<0.050	mg/L
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Barium as Ba	APHA 3120 B	0.01	mg/L
Calcium as Ca	APHA 3120 B	1.29	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Strontium as Sr	APHA 3120 B	0.06	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	0.09	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

Technical Signatory — Stephen Musyoka-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 10/01/2019

SGS Kenya Limited Laboratory Services

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Analysis Report MA19-00019.010

PRODUCT DESCRIPTION:	RIVER WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	11/12/2018
ANALYSIS STARTED:	13/12/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN AMBER BOTTLE DUPLICATE SUGUTA - KERIO 6.12.18
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Potassium as K	APHA 3120 B	24.15	mg/L
Sodium as Na	APHA 3120 B	475.23	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Magnesium as Mg	APHA 3120 B	0.74	mg/L
Iron as Fe	ISO 11885	<0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L

End of Analytical Results

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Stephen Musyoka-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

TECHNICAL MEMORANDUM

DATE 05 August 2019 1772867.553.104A.A0

TO Paul Mowatt, PPMT

CC

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES - NOISE AND AIR QUALITY FIELD REPORT

1.0 INTRODUCTION AND SCOPE

This Field Report covers the Air Quality and Noise baseline data collected for the LLCOP ESIA, in Isiolo, Samburu, Garissa and Lamu Counties. The purpose of the monitoring visit was to collect baseline data for noise, PM_{10} and $PM_{2.5}$ at selected stations. Data was collected for a period of 24 hours at each of the identified locations. Additionally, dust deposition gauges and passive sampling tubes for SO_x, NO_x, VOCs and Ozone were set up at the same locations.

2.0 9 TO 22 DECEMBER 2018

Report Date:	8 January 2019
Prepared By:	Samson Obiya
Submitted To:	Golder Associates (UK) Limited
Activity Period:	9 – 22 December 2018
Activity Parties:	Golder Associates, ESF Consultants
Attachments:	Noise Data Logs; Ambient Dust Calculations

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Table 1: Safety check-ins were conducted daily at beginning and end of all field visits.

Tasks	Environmental Activities
General	The following activities were conducted: ■ Survey of identified sampling points for the air and noise level measurements. Utilised GPS unit to identify sampling locations; ■ Measurements of 24-hour noise, PM_{10} and $PM_{2.5}$, (Replacement of batteries for every set of measurements); ■ Maintenance of field records and possible activities of influence at the locations; ■ Preparation of a Field Study Report.
Equipment	■ GPS, Camera, Notebook; and ■ Hire of 2 x MiniVol samplers, 1 x Noise Meter and 1 x Acoustic Calibrator.

Table 2: Time (nearest 15 min) & Locations of sampling

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description
Start	10/12/18	**ARCHER'S POST, ISIOLO** ■ Muhajireen Children Centre ■ Waso Muslim School ■ Samburu Institute of Technology	PM	**N:** 00º38'25.3" **E:** 37º40'12.5" Elev. 839	This area serves as the proxy for **Station 7 (KM 300).** It is next to the Ewaso ng'iro river and the Isiolo Marsabit road. There is a shopping Centre and a police post near the sampling location.
			Dust Gauge & Tubes	**N:** 00º38'25.1" **E:** 37º40'12.7" Elev. 839	
End	11/12/18		Noise	**N:** 00º38'24.6" **E:** 37º40'12.6" Elev. 839	
Start	14/12/18	**RAHOLE NATIONAL RESERVE, GARISSA** ■ Ohio Village Settlement ■ Abdi Gab, Water Pan ■ Ohio Primary School	PM	**N:** 00º05'43.2" **E:** 39º12'57.3" Elev. 337	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.
			Dust Gauge & Tubes	**N:** 00º05'43.2" **E:** 39º12'57" Elev. 335	
End	15/12/18		Noise	**N:** 00º05'42.9" **E:** 39º12'57.3" Elev. 336	

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description
Start	16/12/18	**LAMU PORT** ■ Homestead of Mzee Rajab Mohammed ■ Across the road from the Lamu Port ■ Part of Kililama Farmers Organisation	PM	**N:** 02º11'55.3" **E:** 40º54'33.1"	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.
			Dust Gauge & Tubes	**N:** 02º11'56.6" **E:** 40º54'32.2"	
End	17/12/18		Noise	**N:** 02º11'56.6" **E:** 40º54'32.2"	
Start	18/12/18	**GARBA TULA** ■ Homestead of Mzee Adow Biria ■ Four homes in the village ■ No other developments near the village	PM	**N:** 00º30'46.5" **E:** 38º37'19.2" Elev. 466m	This area serves as the proxy for **Station 9** It is in Isiolo south sub county. It is located along the Garissa-Benane Road There is a village settlement at the sampling location.
			Dust Gauge & Tubes	**N:** 00º30'46.4" **E:** 38º37'19.1" Elev. 467m (Relocated)	
End	19/12/18		Noise	**N:** 00º30'46.4" **E:** 38º37'19.4" Elev. 467m	

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description
Start	19/12/18	**GARBA TULA** ■ Garba Tula Police Station	PM		This area serves as the new proxy for **Station 9** It is in Isiolo south sub county. The sampling location is a police station. Near the location are residential area and the sub county offices. Animosity at the initial sampling location advised the change.
			Dust Gauge & Tubes	**N:** 00°31'46.3" **E:** 38°31'06.7" Elev. 467m (Relocated)	
			Noise		
	20/12/18	**SUYIAN PRIMARY SCHOOL**		*General Location of School* **N:** 01°32'14.9" **E:** 36°49'36.1" Elev. 1152m	This area was best suited to serve as the proxy for **Station 4** however there was no sign of activity at the primary school, and no settlements nearby prompting change of location. Area surrounded by bushes and sparse grassland.
Start	20/12/18	**BARSALOI CHIEF'S OFFICE**	PM	-	This area serves as the alternative proxy for **Station 4 (KM 150)** It is located at the Chief's Office. There is a settlement with some commercial shops at the location. The area is along the Wamba-Suyian Road.
			Dust Gauge & Tubes	**N:** 01°20'07.2" **E:** 36°51'48.2" Elev. 467m	
			Noise	**-**	

3.0 PHOTOGRAPHIC REPORT

ARCHER'S POST

Figure 1: Images of entrance to the measurement location of Station 7, Archer's Post

Figure 2: Noise measurement set up at Station 7

Figure 3: Dust Gauge Set up at Station 7

Figure 4: Mosque at Station 7

Figure 5: Samburu Technical Training Institute at Station 7

Figure 6: One of the settlements next to Station 7

Figure 7: Ewaso Ng'iro River at Archer's Post

Figure 8: Set up of MiniVols at Station 10-Ohio Village

Figure 9: Set up of Dust Gauge at Station 10

Figure 10: Set up of Noise Meter at Station 10

Figure 11: Set up of Noise Meter and Dust Gauge at village opposite Lamu Port

Figure 12: Set up of Minivols at village opposite Lamu Port

Figure 13: Set up of Noise Meter at Station 9

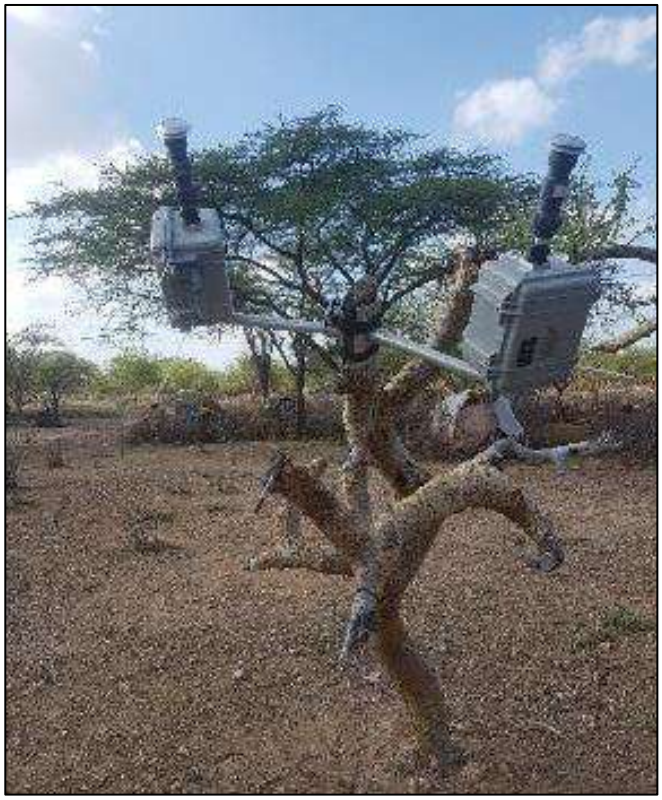

Figure 14: Set up of MiniVols at Station 9

Figure 15: Set up of Dust Gauge at Garba Tula Police Station for Station 9

Figure 16: Suyian Primary School - Initial location for Station 4

Figure 17: Suyian Primary School

Figure 18: Barsaloi Chief's Office - Alternative measurement location for Station 4

Tim Flower
Technical Director

RL/TF/es

TECHNICAL MEMORANDUM

DATE 05 August 2019 **Project No.** 1772867.553.104B.B0

TO Paul Mowatt, PPMT

CC

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES - NOISE AND AIR QUALITY FIELD REPORT

1.0 INTRODUCTION AND SCOPE

This Field Report covers the Air Quality and Noise baseline data collected for the LLCOP ESIA, in Isiolo, Samburu, Garissa and Lamu Counties. The purpose of the monitoring visit was to collect baseline data for PM_{10} and $PM_{2.5}$ at selected stations. Data was collected for a period of 24 hours at each of the identified locations. Additionally, dust deposition gauges and passive sampling tubes for SO_x, NO_x, VOCs and Ozone were set up at the same locations.

2.0 30 JANUARY TO 11 FEBRUARY 2019

Report Date:	21 February 2019
Prepared By:	Samson Obiya
Submitted To:	Golder Associates (UK) Limited
Activity Period:	30 January 2019 – 11 February 2019
Activity Parties:	Golder Associates, ESF Consultants
Attachments:	None

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Table 1: Safety check-ins were conducted daily at beginning and end of all field visits.

Tasks	Environmental Activities
General	The following activities were conducted: ■ Measurements of 24-hour Particulate Matter (PM10 and PM2.5), at Barsaloi, Wamba, Garba Tula and Lamu; ■ Maintenance of field records and possible activities of influence at the locations; and ■ Preparation of a Field Study Report.
Equipment	■ GPS, Camera, Notebook; and ■ Hire of 2 x MiniVol samplers

Table 2: Time (nearest 15 min) & Locations of sampling

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	10/12/18	**ARCHER'S POST, ISIOLO** ■ Muhajireen Children Centre ■ Waso Muslim School ■ Samburu Institute of Technology	Dust Gauge and Tubes	**N:** 00º38'25.1" **E:** 37º40'12.7" Elev. 839	This area serves as the proxy for **Station 7 (KM 300).** It is next to the Ewaso ng'iro river and the Isiolo Marsabit road. There is a shopping Centre and a police post near the sampling location.	Approximately 1L of water in dust gauge
End	03/02/19					
Start	14/12/18	**RAHOLE NATIONAL RESERVE, GARISSA** ■ Ohio Village Settlement ■ Abdi Gab, Water Pan ■ Ohio Primary School	Dust Gauge & Tubes	**N:** 00º05'43.2" **E:** 39º12'57" Elev. 335	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	Approximately 1L of water in dust gauge
End	07/02/19					
Start	16/12/18	**LAMU PORT** ■ Homestead of Mzee Rajab Mohammed ■ Across the road from the Lamu Port ■ Part of Kililama Farmers Organisation	PM	**N:** 02º11'55.3" **E:** 40º54'33.1"	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	Undertaken during 10-11th Feb 2019. 24Hr Monitoring achieved.
			Dust Gauge & Tubes	**N:** 02º11'56.6" **E:** 40º54'32.2"		Less than 0.5L of water in dust gauge
End	10/02/19					

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	18/12/18	**GARBA TULA** ■ Garba Tula Police Station	PM	**N:** 00º31'46.04" **E:** 38º31'07.79" Elev. 512m	This area serves as the new proxy for **Station 9** It is in Isiolo south sub county. The sampling location is a police station. Near the location are residential area and the sub county offices. Animosity at the initial sampling location advised the change.	Undertaken during 4th – 5th Feb 2019. 24 hour monitoring achieved
			Dust Gauge & Tubes	**N:** 00º31'46.3" **E:** 38º31'06.7" Elev. 512m		Less than 0.5L of water in dust gauge
End	04/02/2019					
Start	20/12/18	**BARSALOI CHIEF'S OFFICE**	PM	**N:** 01º20'07.4" **E:** 36º51'48.4" Elev. 467m	This area serves as the alternative proxy for **Station 4 (KM 150)** It is located at the Chief's Office. There is a settlement with some commercial shops at the location. The area is along the Wamba-Suyian Road.	Undertaken during Jan 31st- Feb 1st 2019. 24 hour monitoring achieved
			Dust Gauge & Tubes	**N:** 01º20'07.2" **E:** 36º51'48.2" Elev. 467m		No water in dust gauge
End						

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	02/02/2019	**WAMBA** ■ Lengusaka, in Koiting Location	PM	**N:** 00º52'38.05" **E:** 37º19'01.24" Elev. 512m	This area serves as the proxy for **Station 6.** It is in Koting Location and lies along the Archer's Post Barsaloi Road, at Lengusaka Town. The sampling location is at the Chief's place. It is residential area and with a small business center and a road passing next. The Sionta river passes to the SE of this location.	Undertaken during 2nd – 3rd Feb 2019. 24 hour monitoring achieved
End			Dust Gauge & Tubes	**N:** 00º52'37.9" **E:** 37º19'01.3" Elev. 512m		Dust gauge and tubes set up

3.0 PHOTOGRAPHIC REPORT

Figure 1: PM measurements at Barsaloi, Station 4

Figure 2: PM measurements at Lengusaka, Station 6

Figure 3: Dust gauge at Lengusaka, Station 6

Figure 4: PM measurements at Station 9

Figure 5: Entrance to Lamu Port opposite the monitoring location

Figure 6: Unpaved road at Lamu Port

Tim Flower
Technical Director

RL/TF/es

TECHNICAL MEMORANDUM

DATE 05 August 2019 **Project No.** 1772867.553.104C.B0

TO Paul Mowatt, PPMT

CC

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES - NOISE AND AIR QUALITY FIELD REPORT

1.0 INTRODUCTION AND SCOPE

This Field Report covers the Air Quality and Noise baseline data collected for the LLCOP ESIA, in Isiolo, Samburu, Garissa and Lamu Counties. The purpose of the monitoring visit was to collect baseline data for PM_{10} and $PM_{2.5}$ at selected stations. Data was collected for a period of 24 hours at each of the identified locations. Additionally, dust deposition gauges and passive sampling tubes for SO_x, NO_x, VOCs and Ozone were set up at the same locations.

2.0 19- 30 MARCH 2019

Report Date:	9 May 2019
Prepared By:	Samson Obiya
Submitted To:	Golder Associates (UK) Limited
Activity Period:	19 – 30 March 2019
Activity Parties:	Golder Associates, ESF Consultants
Attachments:	None

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Table 1: Safety check-ins were conducted daily at beginning and end of all field visits.

Tasks	Environmental Activities
General	The following activities were conducted: ■ Measurements of Ambient Noise (24-hour period) at Station 6, Station 9 & Lamu Port; ■ Maintenance of field records and possible activities of influence at all the locations; ■ Changeover of SOx, NOx, Ozone and VOC Tubes; ■ Changeover of Dust Deposition Gauges; and ■ Preparation of a Field Study Report.
Equipment	■ GPS, Camera, Notebook; and ■ Noise Meter.

Table 2: Time (nearest 15 min) & Locations of sampling

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	03/02/19	**ARCHER'S POST, ISIOLO** ■ Muhajireen Children Centre ■ Waso Muslim School ■ Samburu Institute of Technology	Dust Gauge and Tubes	**N:** 00º38'25.1" **E:** 37º40'12.7" Elev. 839 m	This area serves as the proxy for **Station 7 (KM 300).** It is next to the Ewaso ng'iro river and the Isiolo Marsabit road. There is a shopping Centre and a police post near the sampling location.	The O_3 tube at this location was found missing, and its diffusive body broken. Approximately 1L of water in dust gauge
End	23/03/19					
Start	07/02/19	**RAHOLE NATIONAL RESERVE, GARISSA** ■ Ohio Village Settlement ■ Abdi Gab, Water Pan ■ Ohio Primary School	Dust Gauge & Tubes	**N:** 00º05'43.2" **E:** 39º12'57" Elev. 335 m	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	Approximately 0.5L of water in dust gauge
End	27/03/19					
Start	10/02/19	**LAMU PORT** ■ Homestead of Mzee Rajab Mohammed ■ Across the road from the Lamu Port ■ Part of Kililama Farmers Organisation	Noise	**N:** 02º11'56.6" **E:** 40º54'32.2"	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	Undertaken during 29-30th Mar 2019. 24 hour monitoring achieved.
			Dust Gauge & Tubes	**N:** 02º11'56.6" **E:** 40º54'32.2"		Less than 0.5L of water in dust gauge
End	29/03/19					

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	04/02/2019	**GARBA TULA** ■ Garba Tula Police Station	Noise	**N:** 00°31'46.2" **E:** 38°31'06.8" Elev. 512 m	This area serves as the new proxy for **Station 9** It is in Isiolo south sub county. The sampling location is a police station. Near the location are residential area and the sub county offices. Animosity at the initial sampling location advised the change.	Undertaken during 23rd – 24th Mar 2019. 24 hour monitoring achieved
End	23/03/2019		Dust Gauge & Tubes	**N:** 00°31'46.3" **E:** 38°31'06.7" Elev. 512 m		Less than 0.5L of water in dust gauge. After dispatch to the Lab, the ozone tube from this site was found broken, and could not be analysed
Start	31/01/2019	**BARSALOI CHIEF'S OFFICE**	Dust Gauge & Tubes	**N:** 01°20'07.2" **E:** 36°51'48.2" Elev. 467 m	This area serves as the alternative proxy for **Station 4 (KM 150)** It is located at the Chief's Office. There is a settlement with some commercial shops at the location. The area is along the Wamba-Suyian Road.	No water in dust gauge
End	21/03/2019					
Start	02/02/2019	**WAMBA** ■ Lengusaka, in Koiting Location	Noise	**N:** 00°52'38.03" **E:** 37°19'01.25" Elev. 512 m	This area serves as the proxy for **Station 6.** It is in Koting Location and lies along the Archer's Post Barsaloi Road, at Lengusaka Town. The sampling location is at the Chief's place. It is residential area and with a small business center and a road passing next. The Sionta river passes to the SE of this location.	Undertaken during 20th – 21st Mar 2019. 24 hour monitoring achieved
End	20/03/2019		Dust Gauge & Tubes	**N:** 00°52'37.9" **E:** 37°19'01.3" Elev. 512 m		Less than 0.5L of water in dust gauge. After dispatch to the Lab, the ozone tube from this site was found broken, and could not be analysed

3.0 PHOTOGRAPHIC REPORT

Figure 1: Broken diffusion tube and missing ozone tube at Archers Post, Station 7

Figure 2: Broken tubes from various locations

Tim Flower
Technical Director

RL/TF/es

TECHNICAL MEMORANDUM

DATE 05 August 2019 **Project No.** 1772867.553.104D.B0

TO Paul Mowatt, PPMT

CC

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES - NOISE AND AIR QUALITY FIELD REPORT

1.0 INTRODUCTION AND SCOPE

This Field Report covers the Air Quality and Noise baseline data collected for the LLCOP ESIA, in Isiolo, Samburu, Garissa and Lamu Counties. The purpose of the monitoring visit was to collect baseline data for PM_{10} and $PM_{2.5}$ at selected stations. Data was collected for a period of 24 hours at each of the identified locations. Additionally, dust deposition gauges and passive sampling tubes for SO_x, NO_x, VOCs and Ozone were set up at the same locations.

2.0 22 – 27 APRIL 2019

Report Date:	9 May 2019
Prepared By:	Samson Obiya
Submitted To:	Golder Associates (UK) Limited
Activity Period:	22 – 27 April 2019
Activity Parties:	Golder Associates, ESF Consultants
Attachments:	None

Table 1: Safety check-ins were conducted daily at beginning and end of all field visits.

Tasks	Environmental Activities
General	The following activities were conducted: ■ Measurements of Ambient Noise (24-hour period) at Station 4; ■ Maintenance of field records and possible activities of influence at all the locations; ■ Changeover of SOx, NOx, Ozone and VOC Tubes; ■ Changeover of Dust Deposition Gauges; and ■ Preparation of a Field Study Report.
Equipment	■ GPS, Camera, Notebook; and ■ Noise Meter.

Table 2: Time (nearest 15 min) & Locations of sampling

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	23/03/19	**ARCHER'S POST, ISIOLO** ■ Muhajireen Children Centre ■ Waso Muslim School ■ Samburu Institute of Technology	Dust Gauge and Tubes	**N:** 00º38'25.1" **E:** 37º40'12.7" Elev. 839 m	This area serves as the proxy for **Station 7 (KM 300).** It is next to the Ewaso ng'iro river and the Isiolo Marsabit road. There is a shopping Centre and a police post near the sampling location.	Approximately 2L of water in dust gauge
End	24/04/19					
Start	27/03/19	**RAHOLE NATIONAL RESERVE, GARISSA** ■ Ohio Village Settlement ■ Abdi Gab, Water Pan ■ Ohio Primary School	Dust Gauge & Tubes	**N:** 00º05'43.2" **E:** 39º12'57" Elev. 335 m	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	No water in dust gauge The Ozone diffusive body was found broken with the tube missing.
End	26/04/19					
Start	29/03/19	**LAMU PORT** ■ Homestead of Mzee Rajab Mohammed ■ Across the road from the Lamu Port ■ Part of Kililama Farmers Organisation	Dust Gauge & Tubes	**N:** 02º11'56.6" **E:** 40º54'32.2"	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	Approximately 0.5L of water in dust gauge
End	27/03419					
Start	23/03/2019	**GARBA TULA**		**N:** 00º31'46.3"		

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
End	22/04/2019	■ Garba Tula Police Station	Dust Gauge & Tubes	**E:** 38°31'06.7" Elev. 512 m	This area serves as the new proxy for **Station 9** It is in Isiolo south sub county. The sampling location is a police station. Near the location are residential area and the sub county offices. Animosity at the initial sampling location advised the change.	Approximately 1.0L of water in dust gauge.
Start	21/03/2019	**BARSALOI CHIEF'S OFFICE**	Dust Gauge & Tubes	**N:** 01°20'07.2" **E:** 36°51'48.2" Elev. 467 m	This area serves as the alternative proxy for **Station 4 (KM 150)** It is located at the Chief's Office. There is a settlement with some commercial shops at the location. The area is along the Wamba-Suyian Road.	No water in dust gauge
End	23/04/2019		Noise	**N:** 01°20'07.2" **E:** 36°51'48.3" Elev. 467 m		Undertaken during 23rd – 24 April 2019. 24 hour monitoring achieved
Start	20/03/2019	**WAMBA** ■ Lengusaka, in Koiting Location	Dust Gauge & Tubes	**N:** 00°52'37.9" **E:** 37°19'01.3" Elev. 512 m	This area serves as the proxy for **Station 6.** It is in Koting Location and lies along the Archer's Post Barsaloi Road, at Lengusaka Town. The sampling location is at the Chief's place. It is residential area and with a small business center and a road passing next. The Sionta river passes to the SE of this location.	Less than 0.5L of water in dust gauge.
End	23/04/2019					

3.0 PHOTOGRAPHIC REPORT

Figure 1: Broken ozone diffusion tube at Garissa, station 10

Tim Flower
Technical Director

RL/TF/es

TECHNICAL MEMORANDUM

DATE 05 August 2019 **Project No.** 1772867.553.104E.B0

TO Paul Mowatt, PPMT

CC

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES - NOISE AND AIR QUALITY FIELD REPORT

1.0 INTRODUCTION AND SCOPE

This Field Report covers the Air Quality and Noise baseline data collected for the LLCOP ESIA, in Isiolo, Samburu, Garissa and Lamu Counties. The purpose of the monitoring visit was to collect and replace dust deposition gauges and passive sampling tubes (for SO_x, NO_x, VOCs and Ozone).

2.0 21 – 25 MAY 2019

Report Date:	29 May 2019
Field Activities	Obed Nairobi
Report By:	Samson Obiya
Submitted To:	Golder Associates (UK) Limited
Activity Period:	21 – 25 May 2019
Activity Parties:	Golder & Castor Vali Africa
Attachments:	None

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Table 1: Safety check-ins were conducted daily at beginning and end of all field visits.

Tasks	Environmental Activities
General	The following activities were conducted: ■ Maintenance of field records and possible activities of influence at all the locations; ■ Changeover of SO_x, NO_x, Ozone and VOC Tubes; ■ Changeover of Dust Deposition Gauges; and ■ Preparation of a Field Study Report.
Equipment	■ GPS, Camera, Notebook; and ■ Noise Meter.

Table 2: Time & Locations of sampling

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	24/04/19	**ARCHER'S POST, ISIOLO** ■ Muhajireen Children Centre ■ Waso Muslim School ■ Samburu Institute of Technology	Dust Gauge and Tubes	**N:** 00°38'25.1" **E:** 37°40'12.7" Elev. 839	This area serves as the proxy for **Station 7 (KM 300).** It is next to the Ewaso ng'iro river and the Isiolo Marsabit road. There is a shopping Centre and a police post near the sampling location.	Approximately 1L of water in dust gauge The SOx/NOx and Ozone tubes were found to be missing
End	22/05/19					
Start	26/04/19	**RAHOLE NATIONAL RESERVE, GARISSA** ■ Ohio Village Settlement ■ Abdi Gab, Water Pan ■ Ohio Primary School	Dust Gauge & Tubes	**N:** 00°05'43.2" **E:** 39°12'57" Elev. 335	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	No water in dust gauge The SOx/ NOx diffusive body was found broken with the tube missing.
End	24/05/19					
Start	27/04/19	**LAMU PORT** ■ Homestead of Mzee Rajab Mohammed ■ Across the road from the Lamu Port ■ Part of Kililama Farmers Organisation	Dust Gauge & Tubes	**N:** 02°11'56.6" **E:** 40°54'32.2"	This area serves as the proxy for **Station 10 (KM 490).** It is in Mbala Mbala constituency of Garissa County. It is located along the Garissa-Benane Road There is a village settlement, Water Pan, small kiosk and school near the sampling location.	> 5L of water in dust gauge
End	25/05/19					

Dd/mm/yy (24hr msnt)		Location	Parameter	GPS Location	Description	Comments
Start	22/04/2019	**GARBA TULA** ■ Garba Tula Police Station	Dust Gauge & Tubes	**N:** 00°31'46.3" **E:** 38°31'06.7" Elev. 512m	This area serves as the new proxy for **Station 9** It is in Isiolo south sub county. The sampling location is a police station. Near the location are residential area and the sub county offices. Animosity at the initial sampling location advised the change.	Approximately 3.0L of water in dust gauge. The ozone diffusion tube was missing
End	21/05/2019					
Start	23/04/2019	**BARSALOI CHIEF'S OFFICE**	Dust Gauge & Tubes	**N:** 01°20'07.2" **E:** 36°51'48.2" Elev. 467m	This area serves as the alternative proxy for **Station 4 (KM 150)** It is located at the Chief's Office. There is a settlement with some commercial shops at the location. The area is along the Wamba-Suyian Road.	Approximately 1.5L of water in dust gauge.
End	22/05/2019					
Start	23/04/2019	**WAMBA** ■ Lengusaka, in Koiting Location	Dust Gauge & Tubes	**N:** 00°52'37.9" **E:** 37°19'01.3" Elev. 512m	This area serves as the proxy for **Station 6.** It is in Koting Location and lies along the Archer's Post Barsaloi Road, at Lengusaka Town. The sampling location is at the Chief's place. It is residential area and with a small business center and a road passing next. The Sionta River passes to the SE of this location.	Approximately 3L of water in dust gauge.
End	22/05/2019					

Tim Flower
Technical Director

RL/TF/es

ANNEX II

C

Biodiversity Baseline Reports

C1 Terrestrial and Aquatic Biodiversity

C2 Marine Environment (including Biodiversity)

C3 Ecosystem Services

REPORT

Biodiversity Baseline

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

Golder Associates (UK) Ltd

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August 2019

Distribution List

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Golder - 1 copy (PDF)

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APPENDICES

APPENDIX A
Expected Species Lists

APPENDIX B
Recorded Species Lists

1.0 BIODIVERSITY

This section describes the baseline terrestrial and freshwater aquatic biodiversity in the around the proposed route of the Project. The baseline description has been based on a literature review and consultation with stakeholders and experts (secondary assessment) and the results of two baseline field surveys (primary assessment) conducted during the dry season (June 2018) and wet season (October and November 2018). The terrestrial and freshwater aquatic baseline, as described in this section, iss defined as:

- Terrestrial flora and fauna (birds, mammals, reptiles, amphibians and invertebrates); and
- Freshwater aquatic ecosystems (fish and aquatic macroinvertebrates).

1.1 Area of Influence

The AoI for the biodiversity assessment, within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA.

The AoI represents an ecologically relevant area that encompasses the anticipated extent of the Project's potential influence on biodiversity, including broader regional and landscape effects.

Potential direct impacts in the Project footprint may include disturbances to biota such as disturbance of habitat, noise, lights and the presence of people. These impacts could extend beyond the Project footprint and, therefore, the size of the buffer was extended beyond the direct footprint.

The Project footprint incorporates the areas where impacts from Project sources could be physically detectable for biodiversity receptors. It was defined to account for potential direct species and habitat receptor impacts, such as changes in habitat availability, composition and quality caused by land take, sensory disturbance (light, noise, vibration), air emissions and dust.

Primary data sources included land cover mapping and classification for the AoI, and a seasonal field sampling programme. The field sampling programme occurred from June to November 2018 to encompass the long and short wet seasons, and covered vegetation and flora, invertebrates, herpetofauna, birds and mammals.

1.2 Biodiversity Context

1.2.1 Rainfall Patterns

The north, north-east and east of Kenya is arid. These areas comprise approximately 65% of the surface area of Kenya, with average annual rainfall in these areas ranging from 200 to 600 mm.

Twenty percent of Kenya's surface area lies within higher rainfall zones. This includes the coastal climatic zone, a band some 16 km wide that extends from the Tanzanian border to Malindi. This zone is humid all year round, and experiences an average rainfall between 1,000 and 1,250 mm, and an average annual temperature range of 22°C to 30°C. The central and western highlands, and parts of the central Rift Valley areas, are Kenya's most temperate zones. Here annual rainfall levels average out at between 950 and 3,000 mm, and average annual temperatures range from 14°C to 28°C.

Average annual rainfall across the AoI is shown in Drawing 3. Except for portions of the pipeline within the Samburu, Isiola, Meru and Lamu counties, most of the pipeline is situated in arid areas receiving <500 mm rainfall per annum (Drawing 3).

1.2.2 WWF Ecoregions

The proposed 824 km pipeline crosses six ecoregions (World Wildlife Fund (WWF), 2019). Of these, three are listed as Critical/Endangered, and three as Vulnerable (WWF, 2019). A map of the pipeline in relation to the 6 ecoregions is provided in Drawing 4.

- Northern Zanzibar-Inhambane coastal forest mosaic (Ref: AT0125): listed as **Critical/Endangered;** much of the coastal section of the pipeline falls into this ecoregion (WWF, 2019). This ecoregion represents the northernmost extent of the eastern and southern African coastal forest belt, and is found in Somalia, Kenya and Tanzania (WWF, 2019). It supports many endemic species, at a density among the highest in the world, mostly concentrated in forest habitats (WWF, 2019).
  - Species richness is boosted by the combination of forest, savanna, woodland and wetland species that all occur in this ecoregion.
  - The forest habitats in this ecoregion have been severely fragmented, primarily by agricultural activities and continuously increasing human density.
  - There are few protected areas in this ecoregion.
- East African mangroves (Ref: AT1402): listed as **Critical/Endangered**, the eastern portion of the pipeline terminates in this ecoregion (WWF, 2019).
  - This habitat type provides nurseries for fish and prawns and enhances the biodiversity of surrounding marine habitats while providing vital habitat for migratory birds, marine turtles (including one CR and two Endangered (EN) species), dugongs, whales and dolphins.
  - Eastern African mangroves are threatened in many areas by overuse and conversion by a growing human population that utilises the mangroves for rice farming, shrimp aquaculture, and for construction materials and the timber trade (WWF, 2019).
  - There are several protected areas in this ecoregion.
- East African montane forests (Ref: AT0108): a portion of the western section of the pipeline route passes through this **Critical/Endangered** ecoregion, and further patches are found elsewhere within the AoI although not directly crossed by the pipeline.
  - This ecoregion is found at altitudes between approximately 1,000 to 3,500 m along a chain of isolated mountain ranges stretching along the Rift Valley from southern Sudan to northern Tanzania.
  - This ecoregion contains moderate levels of species richness and relatively low rates of endemism when compared to the other tropical forest ecoregions around the equatorial belt of Africa.
  - Avifaunal diversity and endemism rates are moderate.
  - Mammal endemism is more pronounced and includes a number of strictly endemic mammal species.
  - The herpetofaunal assemblage is of interest and contains several strictly endemic species, particularly chameleons.
  - There are several protected areas in this ecoregion. In most areas forest and montane grassland habitats outside of the protected areas have been converted to agricultural or other human use (WWF, 2019).

- Masai Xeric grasslands and shrublands (AT1313): listed as **Vulnerable**, a portion of the western section of the pipeline crosses through this ecoregion (WWF, 2019). This ecoregion covers most of north central Kenya and extends into south-western Ethiopia.
  - The ecoregion is moderately rich in species but has a low level of endemism.
  - Most habitats of this ecoregion have been considerably degraded by heavy grazing of domesticated livestock.
  - A comparatively small area of good quality habitat remains in the few protected areas (WWF, 2019).
- Northern Acacia-Commiphora bushlands and thickets (AT0711): listed as **Vulnerable;** most of the central and western portions of the pipeline lie in this ecoregion (WWF, 2019). This ecoregion covers much of lowland Kenya. In the north, it transitions into drier savanna and semi-desert. In the south it grades into wetter Southern Acacia-Commiphora bushland and thicket in the vicinity of the Kenya – Tanzania border. The fauna and flora reflect the transitional nature of the ecoregion, with a mixture of drought-adapted and tropical savanna species.
  - Mammalian species diversity in this ecoregion is high, but few species are strictly endemic.
  - Avifaunal diversity is high with low endemism levels.
  - This ecoregion is reasonably well-protected within a well-functioning system of national parks and other reserves (WWF, 2019).
- Somali Acacia-Commiphora bushlands and thickets (AT0715): listed as **Vulnerable;** a portion of the eastern section of the pipeline crosses this ecoregion (WWF, 2019). This ecoregion covers the largest portion of the Horn of Africa and extends into the north-eastern corner of Kenya. A high number of endemic, arid-adapted species are found in this ecoregion.
  - It is a centre of endemism for mammals, including the Critically Endangered (CR) hirola (*Damaliscus hunteri*).
  - Human population within this ecoregion is low due to the very limited agricultural potential.
  - Although much of this ecoregion remains unfragmented and intact, large mammal populations have been severely depleted due to hunting pressure associated with a lack of sufficient enforcement.
  - There are several protected areas in this ecoregion, some of which harbour the last remaining populations of desert-dwelling ungulates.

Table 1 presents a breakdown of the surface area of the AoI by ecoregion. Northern Acacia-Commiphora bushlands and thickets is the dominant ecoregion in the western and central portion of the AoI, (Table 1). Somalia Acacia-Commiphora bushlands and thickets is the dominant vegetation community in the eastern portion of the AoI.

Northern Zanzibar-Inhambane Coastal Forest Mosaic forms the dominant vegetation community along the Kenyan East coast, just inland of the mangrove communities. This vegetation community also extends inland along the Tana River. Masai Xeric Grasslands and Shrublands are also present within the AoI, but only intersects with the Project Footprint in the far north-west between the Kerio River and Suguta Valley (Drawing 4).

Table 1: Breakdown of WWF Ecoregions in terms of approximate area within the AoI

ECO Name	Area (Ha)
East African Montane Forests	224,488.6
Northern Zanzibar-Inhambane Coastal Forest Mosaic	634,509.9
Northern Acacia-Commiphora Bushlands and Thickets	3,508,753.6
Somali Acacia-Commiphora Bushlands and Thickets	962,165.1
Masai Xeric Grasslands and Shrublands	581,752.7
East African Mangroves	103,456.8
Unclassified	151,692.2
Total	***6,166,818.8***

1.3 Methods

1.3.1 Secondary Data Collection

1.3.1.1 Stakeholder Engagement and Interaction

In addition to the collection and review of published and unpublished data, consultation was held with local and regional experts to gather their input and knowledge of the area, identify additional data sources, and to gain expert opinions and advice. Table 2 presents the consultation undertaken which includes addressing concerns regarding biodiversity having consulted the Project Stakeholder engagement plan (SEP).

Table 2: Consultation and key informant interview details

NGO/Agency	Personnel	Date	Topics Covered
Kenya Wildlife Service (KWS)	Nehemiah Rotich and Mark Jenkins (KWS) Mark Dingley (Africa Oil), Mark Barragh (Pipeline Project Management Team, PPMT)	27 April 2018	Scope of baseline surveys
The National Environment Management Authority (NEMA)	Freddy Brookes and Simon Aldrich (Golder), James Kambo (Environnementalistses Sans Frontieres, (ESF) Consultants Ltd), Alex Mayhook Walker (PPMT) and NEMA personnel.	2 May 2018	Scope of baseline surveys
Kenya Wildlife Service (KWS)	Dr Shaddrack Ngene of KWS, Freddy Brookes and Simon Aldrich (Golder) and Bernard Agwanda (National Museum of Kenya, NMK).	8 June 2018	Scope of baseline surveys
Save the Elephant (informal unscheduled meeting along pipe route)	Dr Ben Okita, Sandy Oduor (Save the Elephant) and Bernard Agwanda (NMK)	14 Jun 2018	Scope of baseline surveys, migratory routes
Kenya Wildlife Service (KWS)	Dr Shaddrack Ngene of KWS and Bernard Agwanda of NMK	18 (face-to-face) and 21 (telephone) June 2018	Scope of baseline surveys secondary data acquisition
Merwell Wildlife Trust	Bernard Agwanda (NMK) and Dr Zeke (Merwell, discussions on Grevy Zebra in Samburu)	21 June 2018	Grevy zebra spatial distribution and key habitat
Grevy's Zebra Trust (GZT)	Andrew Letura of Grevy Zebra Trust and Bernard Agwanda of NMK	27 June 2018	Grevy zebra spatial distribution and key habitat
Grevy's Zebra Trust (scouts)	Bernard Agwanda (Swari location) to identify calving grounds	29 June 2018	Grevy zebra spatial distribution and key habitat e.g. calving grounds
Grevy's Zebra Trust (Westgate)	Andrew Letura of Grevy Zebra Trust and Bernard Agwanda of NMK	27 October 2018	Grevy zebra spatial distribution and key habitat e.g. calving grounds

NGO/Agency	Personnel	Date	Topics Covered
Grevy's Zebra Trust	Alex Mayhook Walker and Tom Lawrence (PPMT) and GZT. Maralal, Archers Post and Wamba.	5, 6, 7 and 8 December 2018	Grevy zebra spatial distribution and key habitat e.g. calving grounds
Lamu Marine Conservation Trust (LAMCOT); and Watamu Marine Association (WMA).	Giovanni Torchia and Gustavo Estrada (Golder), Duncan Oyaro (ESF), Atwaa Salim Mohamed (LAMCOT) and Steve Trott (WMA).	Email exchanges and phone calls during 2018. In addition, Duncan Oyaro and Atwaa Salim Mohamed met face to face on the 18 January 2018.	Acquisition of secondary turtle data
Kenya Marine Mammal Network (KMMN);	Neil Cousins (Bluedot associates).	May 2018	Informal engagement during the Critical Habitat marine screening
Local Ocean Trust	Neil Cousins (Bluedot associates).	May 2018	Informal engagement during the Critical Habitat marine screening
Northern Rangelands Trust	Neil Cousins (Bluedot associates).	May 2018	Informal engagement during the Critical Habitat marine screening

1.3.1.2 Biodiversity Patterns

The Map of Life (MoL) database is assembled and integrated from a wide range of sources, including the International Union for Conservation of Nature (IUCN), WWF and the Global Biodiversity Information Facility (GBIF) (Jetz & Guralnick, 2012). In addition to species distributions, MoL compiles maps representing aspects of biodiversity such as taxa richness and endemism rates. For this assessment, country maps were compiled for Kenya representing bird, mammal, reptile, amphibian and invertebrate (dragonfly) taxa richness. The objective of these maps was to show trends in taxa richness on a country-wide scale. Using these maps, the AoI could then be put in the context of biodiversity richness and endemism.

The Group on Earth Observations Biodiversity Observation Network (Geo Bon) is an initiative aimed at improving the availability of biodiversity-change data to decision makers and scientists in support of policy (Geo Bon, 2019). Geo Bon supports the application of the most recent scientific knowledge to advance biodiversity observations collection, integration and interpretation (Geo Bon, 2019). A limitation of achieving this goal has been the lack of a global harmonised observation system for delivering regular, timely data on biodiversity change (Pereira, 2013). The Geo Bon network implemented the use of Essential Biodiversity Variables (EBVs) that could form the basis of monitoring programmes worldwide in order to overcome this limitation. These EBVs are defined as the derived measurements required to study, report, and manage global biodiversity change. They provide the first level of abstraction between low-level primary observations and high-level indicators of biodiversity (Geo Bon, 2019).

The Essential Biodiversity Variables (EBVs) Portal depicts changes in average local terrestrial diversity for grid cells caused by land-use, land-use intensity, and human population density, estimated by the PREDICTS model (Purvis et al., 2018). It reports the number of species in each cell relative to a pristine baseline (percentage) and changes in species number (percentage) relative to 1900 (Geo Bon, 2019). This tool was used to plot changes in alpha diversity relative to a pristine baseline across Kenya. Alpha diversity refers to average species diversity in a habitat or specific area. From this map, the changes in alpha diversity for the AoI could be derived.

1.3.1.3 Expected Species & Communities

Expected species lists for the AoI were compiled using the sources:

- Potential natural vegetation of Eastern Africa (Van Breugel et. al., 2015);
- Global Biodiversity Information Facility (GBIF, 2019) https://www.gbif.org/;
- Integrated Biodiversity Assessment Tool (IBAT, 2019) https://ibat-alliance.org/;
- Map of Life species by location tool (MoL, 2019);
- National Museum of Kenya (NMK) herbarium records;
- Consultation with specialists in each of the specific disciplines; and
- Other published scientific studies, and historical and recent reports related to the Project and wider area.

1.3.1.4 Species of Conservation Concern

Using the expected species lists, a screening of the AoI was completed to identify species of conservation concern (SoCC) that could occur in the AoI that could interact with Project components.

The following attributes formed the basis of the screening:

- Globally threatened species: These include internationally recognised IUCN Red-Listed CR(EN) and Vulnerable (VU) species, as defined by the IUCN Red List guidelines;

- Nationally threatened species: These include species listed under the sixth schedule of the Kenyan Wildlife Conservation and Management Act (2013); priority species listed in the Kenya National Biodiversity Strategy and Action Plan (NBSAP) (Ministry of Environment and Natural Resources, 2000), and species identified by KWS as priorities for conservation action (KWS, 2017);
- Migratory/Congregatory species: Species listed on Appendix I and II of the Convention on Migratory Species (CMS), also known as the Bonn Convention. This convention, to which Kenya is a signatory, aims to conserve terrestrial, aquatic and avian migratory species throughout their range, and species whose individuals gather in large groups or colonies;
- Species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): As a signatory to the CITES convention, Kenya has obligations to protect species listed on Appendices I, II and III, from over-exploitation; and
- Restricted-range or endemic species: Restricted-range species are defined as species with global ranges (extent of occurrence (EOO) of 50,000 km^2 or less (Eken et al. 2004; Holland et al. 2012). For most terrestrial vertebrates (e.g. mammals, birds, reptiles and amphibians), and invertebrates (e.g. insects and arachnids), global ranges of 50,000 km^2 or less, are considered appropriate in global conservation practice (Eken et al. 2004). Thresholds for other invertebrates (particularly, aquatic and terrestrial molluscs) and aquatic species (e.g. fish) are typically set at 20,000 km^2 (Holland et al. 2012).

Species with the abovementioned attributes were identified using the following sources:

- IUCN (2018);
- IBAT (2019); and
- The Critical Habitat Assessment Screening Report for the Project (Golder, 2018).

1.3.1.5 Ecosystems of Conservation Concern

Ecosystems of importance to the public, government agencies, scientific community and Non-Governmental Organisations (NGOs)) occurring within the AoI were identified including:

- Internationally recognised sites of biodiversity importance, such as Important Bird Areas (IBA), Endemic Bird Areas (EBA), Key Biodiversity Areas (KBA), Ramsar sites, WWF Ecoregions;
- Nationally designated and protected areas, and other areas that may have specific conservation and management requirements, as set out in national Kenyan wildlife legislation and policy; and
- Important habitat types outside of protected areas, such as wetlands being crossed by the pipeline, or landscape features with importance in maintaining key ecological processes and functions needed to support and maintain important biodiversity attributes, such as forests forming ecological corridors between protected areas.

1.3.2 Primary Data Collection and Analysis

Two baseline data collection surveys were conducted for all specialist studies. The surveys were conducted during the:

- Dry season (June 2018); and
- Wet season (Oct and Nov 2018).

1.3.2.1 Data Analysis (Birds and Mammals Assessments)

1.3.2.1.1 Univariate Diversity Indices (UDIs)

Community data were analysed by means of the following indices:

- Margalef's Richness Index;
- Pielou's Evenness Index; and
- Shannon-Wiener's Diversity Index.

1.3.2.1.2 Multivariate Analysis

Avifaunal survey data was analysed by means of multivariate procedures using the Primer statistical software package (Version 6.1.6) (Plymouth Routines in Multivariate Ecological Research).

Cluster Analysis

Hierarchical clustering was conducted on the community data to investigate spatial patters in community structure

ANOSIM

A prerequisite of interpreting community differences between sites should be a demonstration that there are statistically significant differences to interpret (Clarke & Warwick, 1994). Analysis of Similarity (ANOSIM), a simple non-parametric procedure was used to create a summary statistic from the similarity matrix containing the community data.

1.3.2.2 Constraints

Access constraints were experienced during the June 2018 surveys south of Garissa. In addition, sections near Lamu, where the Project crosses an area near the Boni Forest, was also excluded in order to satisfy security concerns. In addition, the viability of installing short-term traps, such as pitfalls, was established during the planning phase and when within the AoI. The ability to pitfall trap was often governed by security and access. Habitual movement of ecologists along the pipeline route was avoided to minimise security risks. By its nature, the habitual checking of pitfall traps over an extended period of time presents risks as previously described. As such, the availability of pitfall data is limited as described herewith.

1.4 Results

1.4.1 Secondary Data – Literature Review and Consultation

The following sections describe the international and national context for biodiversity within the AoI, as determined through review of existing literature and databases.

1.4.1.1 Biodiversity Patterns

Error! Reference source not found. shows patterns of taxa richness across Kenya obtained from the MoL d atabase (MoL, 2019). A gradient of decreasing taxa richness is evident across Kenya, with the highest levels of bird, mammal, reptile and dragonfly diversity recorded in the equatorial and temperate south-east and south of the country in the vicinity of Lake Victoria and along the border with Tanzania (**Error! Reference source not f ound.**). Taxa richness decreases in a north-easterly direction reaching its lowest level in the arid north-east of the vicinity near to the border with Ethiopia and Somalia (**Error! Reference source not found.**).

The AoI is situated in the intermediate area between the areas of highest and lowest bird, mammal, reptile and dragonfly species richness in Kenya.

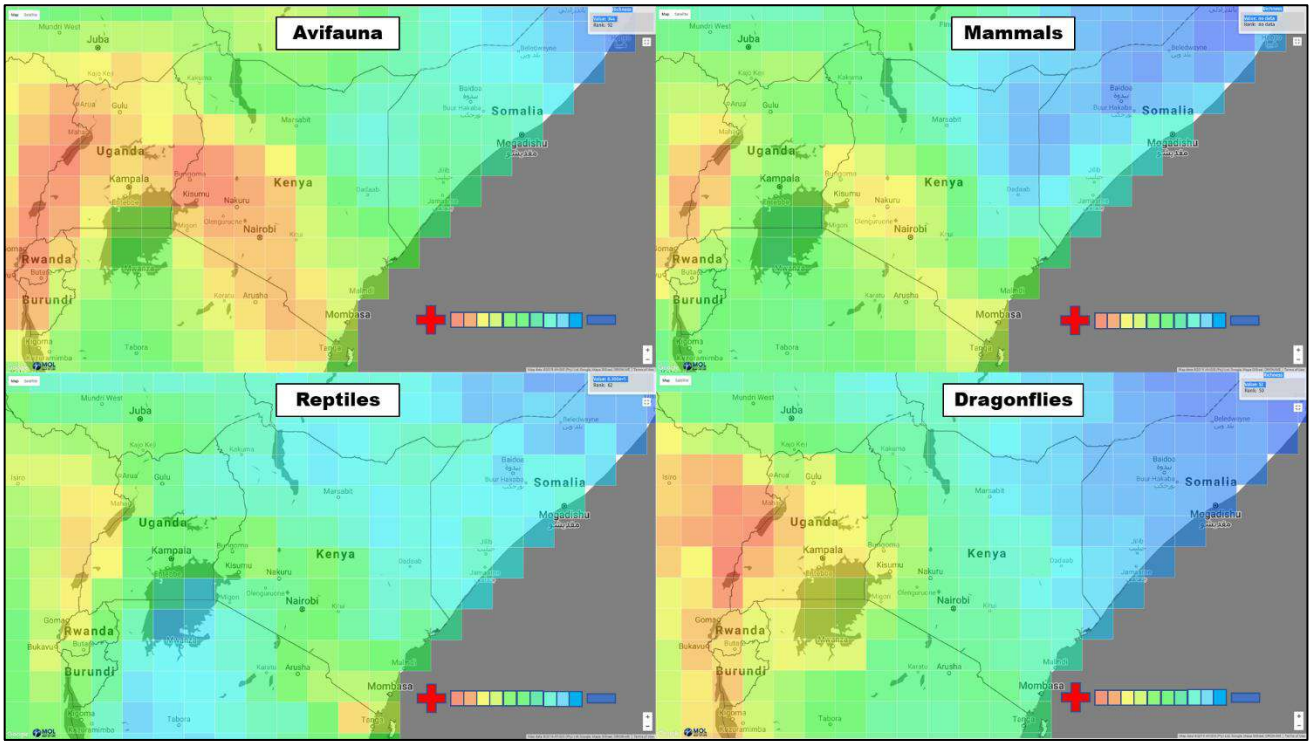

Figure 1: Patterns of avifaunal, mammal, reptile and dragonfly taxa richness across Kenya base on MoL (2019)

The largest deviation from the natural baseline ecosystem state is observed in the central and eastern portions of the country in the vicinity of Lake Victoria, around Nairobi and along the southern portion of the Kenyan coastline around Mombasa (Drawing 5). This distribution matches very closely the map of human density in Kenya. The north, north-west and south-eastern interior are the areas with the least deviation from the baseline. This corresponds to the arid and semi-arid ecoregions of the country where human density is lower and agricultural potential low. The AoI is situated in an area of low alpha diversity change relative to the natural baseline state (refer Table 3 below).

Table 3: Alpha diversity change from baseline within the AoI (baseline in this case refers to the overall baseline state that existed prior to largescale anthropogenic impacts)

Category	Approximate Area (Ha) of AoI
0.83 - 0.86	1966878.8
0.71 - 0.82	2440176.6
0.60 - 0.70	1382013.4
0.54 - 0.58	364952.0

1.4.1.2 Distribution of Species and Communities

1.4.1.2.1 Vegetation Communities

Habitats within the AoI are presented in Drawing 11. Based on Van Breugel *et. al*. (2015), the Project footprint directly impinges on nine vegetation communities (Table 4), with a further 12 communities occurring within the broader AoI.

Three communities dominate the AoI. The westernmost portion of the pipeline is dominated by Acacia-Commiphora stunted bushland (Bds). The central part of the pipeline and AoI is dominated by Somalia-Masai Acacia-Commiphora deciduous bushland and thicket (Bd), which is the dominant vegetation community within the AoI coinciding with approximately 440 km of the central portion of the pipeline alignment. The eastern part of the pipeline and AoI is dominated by coastal mosaic (CM).

Table 4: Vegetation communities directly crossed by the pipeline footprint or that occur within the AoI and Project Footprint (Van Breugel et al. 2015)

Vegetation Community
Project Footprint
Acacia-Commiphora stunted bushland
Coastal mosaic
Desert
Dry combretum wooded grassland
Edaphic grassland on drainage-impeded or seasonally flooded soils
Mangrove
Riverine wooded vegetation
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket
Somalia-Masai semi-desert grassland and shrubland
AoI
Acacia tortilis wooded grassland and woodland
Afromontane bamboo
Afromontane dry transitional forest
Afromontane moist transitional forest
Afromontane rain forest
Afromontane undifferentiated forest
Climatic grasslands
Edaphic wooded grassland on drainage-impeded or seasonally flooded soils
Evergreen and semi-evergreen bushland and thicket
Halophytic vegetation
Moist Combretum wooded grassland
Upland Acacia wooded grassland

1.4.1.2.2 Flora

Based on the literature review, 1,205 plant species are expected to occur within the AoI (full list provided in Appendix A). Of those species, eight are regarded as SoCC. These are summarised in Table 5. It should be noted that only one of these species is classified as VU priority by KWS.

1.4.1.2.3 Flora

Based on the literature review, 1,205 plant species are expected to occur within the AoI (full list provided in Appendix A). Of those species, eight are regarded as SoCC. These are summarised in Table 5. It should be noted that only one of these species is classified as VU priority by KWS.

Table 5: Plant species of conservation concern expected to occur in the AoI

Scientific Name	Common Name	Conservation Status				
		Kenya[1]	IUCN Red List[2]	CMS[3]	CITES[4]	Other
Acacia thomasii	-	-	-	-	-	-
Senegalia senegal		-	-	-	-	-
Aloe deserti	-	-	NT	-	II	-
Ethulia scheffleri	-	-	EN	-	-	-
Lagarosiphon hydrilloides	-	-	EN	-	-	-
Neuracanthus keniensis	-	-	LC	-	-	-
Prunus africana	Red Stinkwood	VU	VU	-	-	-
Sphaeranthus samburuensis	-	-	EN	-	-	-

[1] Priority species identified by Kenyan Wildlife Service

[2] IUCN Red List Conservation status

[3] Convention on Migratory Species - relevant annex

[4] CITES – relevant annex

1.4.1.2.4 Faunal Communities

Birds

Based on the literature review, 761 bird species are expected to occur within the AoI (full list provided in Appendix A). Of these, 47 are considered to be SoCC. These are summarised in Table 6.

Table 6: Bird SOCC expected to occur within the AoI

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Acrocephalus griseldis	Basra reed-warbler	EN	EN	I	-	-
Apalis chariessa	White-winged apalis	VU	VU	-	-	-
Aquila heliaca	Eastern Imperial eagle	VU	VU	I/II	I	EU Birds Directive I
Aquila nipalensis	Steppe eagle	-	EN	I/II	II	Bern Annex II
Ardeola idae	Madagascar pond-heron	EN	EN	I/II	-	-
Balaeniceps rex	Shoebill	-	VU	-	II	-
Balearica pavonina	Black crowned-crane	NT	VU	-	II	-
Balearica regulorum	Grey crowned-crane	-	EN	-	II	-
Bucorvus leadbeateri	Southern ground-hornbill	-	VU	-	-	-
Circus macrourus	Pallid harrier	NT	NT	-	II	Annex II Bonn & Bern EU Birds directive I
Cisticola restrictus	Tana River cisticola	-	DD	-	-	-
Coracias garrulus	European roller	-	LC	I/II	-	EU Birds directive I

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
						Bonn Annex I & Bern Annex II Appendix I
Crex crex	Corncrake	NT	LC	II	-	EU Birds directive I Bern Annex II
Falco cherrug	Saker Falcon	EN	EN	I/II	II	-
Falco fasciinucha	Taita Falcon	NT	VU	-	II	-
Falco naumanni	Lesser Kestrel	VU	LC	I/II	II	
Falco vespertinus	Red-footed Falcon	NT	NT	I/II	II	EU Birds directive I Bern Convention Appendix II
Ficedula semitorquata	Semi-collared Flycatcher	NT	LC	-	-	EU Birds directive I Bern Resolution 6
Gallinago media	Great Snipe	NT	NT	-	-	-
Geokichla guttata / Zoothera guttata	Spotted Ground-thrush	EN	EN	I	-	-
Glareola nordmanni	Black-winged pratincole	-	NT	-	II	EU Birds directive I Bern Annex II
Glareola ocularis	Madagascar Pratincole	VU	VU	-	-	-
Gyps africanus	White-backed Vulture	NT	CR	II	I/II	-
Gyps rueppelli	Ruepell's Vulture	NT	CR	II	I/II	-
Hirundo atrocaerulea	Blue Swallow	VU	VU	I/II	-	-

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Mirafra pulpa	Friedmann's Lark	-	DD	-	-	-
Mirafra williamsi	Williams's Lark	-	DD	-	-	-
Necrosyrtes monachus	Hooded Vulture	-	CR	I/II	II	-
Nectarinia johnstoni	Scarlet-tufted Sunbird	-	LC	-	-	-
Neophron percnopterus	Egyptian Vulture	EN	EN	I/II	II	-
Numenius arquata	Eurasian Curlew	NT	NT	-	-	EU Birds directive I/II
Phoeniconaias minor	Lesser Flamingo	NT	NT	-	II	
Polemaetus bellicosus	Martial Eagle	-	VU	-	II	-
Rynchops flavirostris	African Skimmer	NT	NT	II	-	-
Sagittarius serpentarius	Secretary bird	-	VU	-	II	-
Struthio molybdophanes	Somali Ostrich	-	VU	-	-	-
Tauraco fischeri	Fischer's Turaco	-	NT	-	II	-
Torgos tracheliotos	Lappet-faced Vulture	VU	EN	II	II	-
Trigonoceps occipitalis	White-headed Vulture	VU	CR	I/II	II	-
Turdoides hindei	Hinde's Babbler	VU	VU	-	-	-
Vanellus spinosus	Spur-winged lapwing	-	LC	-	-	EU Bird Directive II Bern Annex II
Zosterops kikuyuensis	Kikuyu White-eye	-	LC	-	-	-

Mammals

Based on the literature review 170 mammal species are expected to occur within the AoI (full list provided in Appendix A). Of these, 39 are considered to be SoCC (Table 7).

Table 7: Mammal SOCC expected to occur in the AoI

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Acinonyx jubatus	Cheetah	EN	VU	I	I	-
Bdeogale jacksoni	Jackson's Mongoose	VU	NT	-	-	-
Bdeogale omnivora	Sokoke Dog Mongoose	-	VU	-	-	-
Beatragus hunteri	Hirola	CR	CR	-	-	-
Cephalophus adersi	Aders' Duiker	CR	VU	-	-	-
Crocidura montis	Montane White-toothed Shrew	-	LC	-	-	-
Crocidura raineyi	Rainey Shrew	-	DD	-	-	-
Damaliscus lunatus (ssp tiang/ssp topi)	Topi	-	LC	-	-	-
Dendromus insignis	Montane African Climbing Mouse	-	LC	-	-	-
Diceros bicornis	Black Rhinoceros	CR	CR	-	I	-
Eidolon helvum	African Straw-coloured Fruit-bat	-	NT	II	-	-
Equus grevyi	Grevy's Zebra	EN	EN	I	I	-
Galagoides cocos	Kenya Coast Galago	-	LC	-	II	-

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Gerbillus cosensis	Cosens's Gerbil	-	DD	-	-	-
Giraffa c. rothschildi	Rothschild's Giraffe	EN	EN	II	-	-
Grammomys caniceps	Grey-Headed Thicket Rat	-	DD	-	-	-
Hippopotamus amphibius	Hippopotamus	VU	VU	-	II	-
Hyaena hyaena	Striped Hyaena	EN	NT	-	III	-
Kobus ellipsiprymnus	Waterbuck	-	LC	-	-	-
Litocranius walleri	Gerenuk	-	NT	-	-	-
Loxodonta africana	African Elephant	EN	VU	II	I/II	-
Lycaon pictus	African Wild Dog	EN	EN	II	-	-
Madoqua guentheri	Günther's Dik-dik	-	LC	-	-	-
Madoqua kirkii	Kirk's Dik-dik	-	LC	-	-	-
Nanger granti petersii	Peter's Gazelle	-	LC	-	-	-
Neoromicia helios	Samburu Pipistrelle bat	-	DD	-	-	-
Oryx beisa	Beisa Oryx	-	NT	-	-	-
Otolemur garnettii	Garnett's Greater Galago	-	LC	-	II	-
Otomops harrisoni	Harrison's Large-eared Giant Mastiff Bat	-	V	-	-	-
Panthera leo	Lion	EN	VU	II	I/II	-

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Panthera pardus	Leopard	EN	VU	II	I	-
Pipistrellus aero	Mount Gargues Pipistrelle	-	DD	-	-	-
Procavia capensis	Rock Hyrax	-	LC	-	-	-
Redunca fulvorufula	Mountain Reedbuck	-	EN	-	-	-
Scotoecus albofuscus	Light-winged Lesser House Bat	-	DD	-	-	-
Tadarida ventralis	African Giant Free-tailed Bat	-	DD	-	-	-
Taphozous hamiltoni	Hamilton's Tomb Bat	VU	DD	-	-	-
Taphozous hildegardeae	Hildegarde’s Tomb Bat	VU	VU	-	-	-
Tragelaphus imberbis	Lesser Kudu	VU	NT	-	-	-

Reptiles and Amphibians

Based on a review of available sources, 105 reptile and 36 amphibian species are expected to occur within the AoI (full list provided in Appendix A). Of these, six reptile and nine amphibian species are considered SoCC. These are summarised in Table 8.

Table 8: Reptile and amphibian SOCC expected to occur within the AoI

Scientific Name	Common Name	Conservation Status				
		Kenya[5]	IUCN Red List[6]	CMS[7]	CITES[8]	Other
Reptiles						
Aparallactus turneri	Malindi Centipede-eater	P	LC	-	-	-
Lygodactylus picturatus	White-headed Dwarf Gecko	-	LC	-	-	-
Kinyongia excubitor	Mount Kenya Sentinel Chameleon	-	V	-	II	-
Pelusios broadleyi	Lake Turkana Hinged Terrapin	NT	VU	-	-	-
Trioceros narraioca	Mount Kulal Stump-nosed Chameleon	-	NT	-	II	
Varanus albigularis	Savannah Monitor	P	LC	-	II	-

[5] Priority species identified by Kenyan Wildlife Service

[6] IUCN Red List Conservation status

[7] Convention on Migratory Species - relevant annex

[8] CITES – relevant annex

Scientific Name	Common Name	Conservation Status				
		Kenya[5]	IUCN Red List[6]	CMS[7]	CITES[8]	Other
Amphibians						
Boulengerula denhardti	Denhardt's African Caecilian	-	DD	-	-	-
Hyperolius cystocandicans	Tigoni Reed Frog / Montane Tree Frog	VU	NT	-	-	-
Hyperolius montanus	Mountain Reed Frog	-	LC	-	-	-
Phrynobatrachus keniensis	Kenya River Frog	-	LC	-	-	-
Ptychadena mahnerti	Mahnert's Ridged Frog	-	LC	-	-	-
Ptychadena nilotica	-	-	LC			
Schistometopum gregorii	Witu Caecilian	-	LC	-	-	-
Sclerophrys turkanae	Lake Turkana Toad	-	DD	-	-	-
Tomopterna gallmanni	Gallmann's Sand Frog	-	LC	-	-	-

Fish

Based on a review of available literature, 27 species are expected to occur within the AoI (full list provided in Appendix A). Of these, 22 are considered to be SoCC. These are summarised in Table 9.

Table 9: Fish SOCC expected to occur within the AoI

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Aplocheilichthys rudolfianus	Lake Rudolf Lampeye	-	LC	-	-	-
Bagrus docmak	Sudan catfish	-	LC	-	-	-
Barbus turkanae	Lake Turkana Barb	-	LC	-	-	-
Brycinus ferox	Large-toothed Lake Turkana Robber	-	LC	-	-	-
Brycinus minutus	Dwarf Lake Turkana Robber	-	LC	-	-	-
Chiloglanis sp. nov. 'Kerio'	-	-	DD	-	-	-
Chiloglanis sp. nov. 'Northern Ewaso Nyrio'	-	-	DD	-	-	-
Distichodus niloticus	Nile Distichodus	-	LC	-	-	-
Haplochromis macconneli	-	-	LC	-	-	-
Haplochromis rudolfianus	-	-	LC	-	-	-
Haplochromis turkanae	-	-	LC	-	-	-

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS	CITES	Other
Labeo aff. mesops	-	-	DD	-	-	-
Labeo sp. nov. 'Baomo'	-	-	VU	-	-	-
Labeo brunellii	-	-	DD	-	-	-
Lates longispinis	Rudolf Lates	-	DD	-	-	-
Lates niloticus	Nile Perch	-	LC	-	-	-
Malapterurus electricus	African Electric Catfish	-	LC	-	-	-
Marcusenius sp. nov. 'Turkwell"	-	-	V	-	-	-
Mormyrus kannume	Bottlenose	-	LC	-	-	-
Neobola stellae	-	-	LC	-	-	-
Oreochromis niloticus/Tilapia nilotica	Nile Tilapia	-	LC	-	-	-
Pantanodon stuhlmanni	Eastcoast Lampeye	-	DD	-	-	-

Invertebrates

Based on available literature, 255 macroinvertebrate species are expected to occur within the AoI (full list provided in Appendix A. Of these, ten are considered to be SoCC. These are summarised in Table 10.

Table 10: Invertebrate SOCC expected to occur in the AoI

Scientific Name	Common Name	Conservation Status					CH Trigger	Likelihood of occurrence in AoI
		Kenya	IUCN Red List	CMS	CITES	Other		
Belenois aurota	Brown-veined white butterfly	-	-	-	-	-	? - Criterion 3, Y – Criterion 8	Probable
Catopsilia florella	African Migrant	-	-	-	-	-	? – Criterion 3	Probable
Coptorhina nitefacta	-	-	DD	-	-	-	Y – Criterion 2	Probable
Gabbiella rosea	Unnamed mud snail	-	NT	-	-	-	Y – Criterion 2, Criterion 8	Possible
Mecistocephalus angusticeps	Geophilomorph Centipede	-	LC	-	-	-	Y – Criterion 2	Probable
Notogomphus maathaiae	Maathai's Longleg	-	EN	-	-	-	? – Criterion 1, Criterion 2	Possible
Potamonautes alluaudi	-	-	LC	-	-	-	Y – Criterion 2	Possible
Potamonautes neumanni	-	-	LC	-	-	-	Y – Criterion 2	Possible
Potamonautes odhneri	-	-	LC	-	-	-	Y – Criterion 2	Possible
Samba turkana	New bee species	-	-	-	-	-	? – Criterion 2, Y – Criterion 12	Probable

1.4.1.3 Ecosystems of Conservation Concern

1.4.1.3.1 Key Biodiversity Areas (KBAs)

Drawing 7 shows the location of KBAs in relation to the AoI. Ten KBAs are located within the AoI (Table 11). These include:

- One national park;
- Five national reserves; and
- Three forest reserves.

The triggers for the designation of these sites are listed in Table 11. These triggers include the presence of CR, EN and VU species, and endemic birds and large congregations of migratory species.

Table 11: Key Biodiversity Areas located within the AoI along with their IBA and KBA statuses and triggers for designation

Name	IBA Status	KBA Status	Triggers
Meru National Park	confirmed	-	VU, endemic, other
Kiunga Marine National Reserve	confirmed	-	migratory birds/congregations
Boni National Reserve	-	confirmed	CR/EN, VU
Shaba National Reserve	confirmed	-	endemic, other
Samburu and Buffalo Springs National Reserves	confirmed	-	other
Dodori National Reserve	-	confirmed	CR/EN, VU
Mount Nyiru Forest Reserve	-	confirmed	endemic
Matthews Range Forest Reserve	-	confirmed	VU, endemic
Lunghi Forest Reserve	-	confirmed	VU
Ol Donyo Sabache	confirmed		VU

In addition to the IBAs, two EBAs are also included in the AoI. The first comprises two portions of the Kenyan Mountains EBA. Endemic bird species associated with this EBA include the EN Sharpe's longclaw (*Macronyx sharpei*) and the VU Abbott's Starling (*Poeoptera femoralis*) (Birdlife International, 2019). The second EBA comprises the East African coastal forests. Four EN and endemic bird species are associated with this EBA, namely Sokoke Scops-owl (*Otus ireneae*), Amani Sunbird (*Hedydipna pallidigaster*), Clarke's Weaver (*Ploceus golandi*) and Sokoke Pipit (*Anthus sokokensis*) (Birdlife International, 2019). All four of these species are severely threatened by rapidly decreasing and fragmenting habitats within the East African coastal forests (BI, 2019; IUCN, 2019).

1.4.1.3.2 Ramsar Sites

Six wetland areas in Kenya have been designated as Ramsar Wetlands of International Importance; however, none are located within the AoI (RAMSAR, 2019).

1.4.1.3.3 Protected Areas

The World Database on Protected Areas (WDPA) was assessed in order to identify protected areas within the AoI. A map showing protected areas within the AoI (based on the WDPA) is provided in Drawing 8. twenty-nine protected areas are located within the AoI (Table 12). These protected areas range from national parks and reserves to community reserves and private ranches (Table 12) (Drawing 8).

All the protected areas are nationally designated reserves, except for Mount Kenya National Park/Natural Forest, which is a declared United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site. The World Heritage site includes the Lewa Wildlife Conservancy and Ngare Ndare Forest Reserve (LWC-NNFR), which is connected to Mount Kenya National Park via a wildlife corridor. This corridor provides connectivity for elephants moving between Mount Kenya and the larger conservation complex of the Somali/Maasai ecosystem (UNESCO, 2019).

A large conglomeration of protected areas is situated where the AoI crosses through the Samburu, Isiola, Laikipia and Meru Counties (Drawing 8).

Table 12: Protected Areas located with the AoI based on the WDPA along with their designations and designation types

Name	Designation	Designation Type
Rahole	National Reserve	National
Nyambene	National Reserve	National
West Gate Community Conservancy	Community Nature Reserve	National
Kalama Community Wildlife Conservancy	Community Nature Reserve	National
Meibae Community Conservancy	Community Nature Reserve	National
Namunyak Wildlife Conservation Trust	Community Nature Reserve	National
Nakuprat-Gotu Community Conservancy	Community Nature Reserve	National
Awer Community Conservancy	Community Nature Reserve	National
Arawale	National Reserve	National
Kiunga	National Reserve	National
Dodori	National Reserve	National
Shaba	National Reserve	National
Samburu	National Reserve	National
Buffalo Springs	National Reserve	National
Mathews Range	Forest Reserve	National
Nyambeni	Forest Reserve	National
Ngaia	Forest Reserve	National
Pate Marine Community Conservancy	Community Nature Reserve	National
Ngare Ndare Community Conservancy	Community Nature Reserve	National
Nasuulu Community Wildlife Conservancy	Community Nature Reserve	National

Name	Designation	Designation Type
Ol Lentille Conservancy	Community Nature Reserve	National
Sera Community Conservancy	Community Nature Reserve	National
Biliqo-Bulesa Community Conservancy	Community Nature Reserve	National
Kiunga Marine Conservancy	Community Nature Reserve	National
Ishaqbini Hirola Community Conservancy	Community Nature Reserve	National
Il Ngwesi Community Trust	Community Nature Reserve	National
Leparua Community Conservancy	Community Nature Reserve	National
Lekurruki Conservancy Trust	Community Nature Reserve	National
Mpus Kutuk Community Conservancy	Community Nature Reserve	National

1.4.1.3.4 WWF Global 200 Ecoregions

Building on the WWF's global ecoregions discussed and described in section 1.2.2, the WWF's Global 200 project analysed global patterns of biodiversity to identify a set of ecoregions that harbour exceptional levels of biodiversity (Olsen & Dinerstein, 2002).

Virtually the entire AoI is situated within an area that encompasses at least one ecoregion listed in the WWF's Global 200 project (Drawing 9). Four ecoregions coincide with the AoI:

- East African Acacia Savannas coincide with most of the eastern and central portions of the AoI;
- Horn of Africa Acacia Savannas comprise a portion of the eastern section of the AoI;
- East African Coastal Forests occur along the eastern extent of the AoI; and
- East African mangroves (Drawing 9).

1.4.1.3.5 Freshwater Ecoregions

The AoI overlaps with three freshwater ecoregions:

- Lake Turkana catchment;
- Shebelle-Juba catchments; and
- Kenyan Coastal River catchments (Drawing 10).

The Lake Turkana and Shebelle-Juba ecoregions form part of the Nilo-Sudan freshwater bioregion. The Kenyan coastal rivers ecoregion forms part of the eastern and coastal freshwater bioregion (Thieme *et al*., 2005). Key attributes of these ecoregions are listed in Table 13, which indicate:

- Moderate levels of overall aquatic biodiversity endemism in the Lake Turkana and Shebelle-Juba catchment ecoregions;
- Moderately high levels of fish species endemism in the Shebelle-Juba catchment and Kenyan coastal river ecoregions;
- High level of endemism of aquatic mollusc species in the Lake Turkana catchment ecoregion; and

- Moderately high level of aquatic herpetofauna endemism in the Lake Turkana catchment ecoregion.

Table 13: Attributes of the 3 freshwater ecoregions traversed by the AoI

Attribute	Lake Turkana	Shebelle-Juba catchments	Kenyan Coastal Rivers
Total species richness	75 - 131	31 – 74	75 - 131
Total number of endemic species	8 - 23	8 – 23	9 - 23
Percentage endemism	17 - 25%	17 - 25%	10 - 16%
Fish			
Species richness	20 - 62	20 – 62	20 - 62
Number of endemic species	7 - 18	7 – 18	7 - 18
Percentage endemism	12 - 22%	32 - 46%	23 - 31%
Aquatic molluscs			
Number of species	0 - 3	21 – 30	21 - 30
Number of endemic species	1 - 3	1 – 3	4 - 11
Percentage endemism	57 - 100%	1 – 12%	13 – 25%
Aquatic reptiles and amphibians			
Number of species	8 - 23	24 – 47	24 – 47
Number of endemic species	4 - 7	No endemics present	4 - 7
Percentage endemism	18 – 28%	0%	2 – 10%

Lake Logipi is an alkaline lake that is situated within the AoI. It falls outside of any protected areas and its surrounds suffer from a high degree of insecurity and overgrazing (Boere et al., 2006). Radio telemetry studies conducted on Lesser Flamingos (*Phoeniconaias minor*) showed that Lake Logipi is one of nine key sites for this Near Threatened (NT) species in East Africa (Boere et al., 2006).

Biological Distinctiveness

Species richness and endemism rates were combined for all the freshwater ecoregions in order to synthesize preliminary biological distinctiveness values (Thieme *et al*., 2005). These preliminary values were then combined with non-species metric value in order to develop an overall index of biological distinctiveness (Thieme *et al*., 2005). Non-species metrics that were assessed and scored included the presence of rare ecological or evolutionary phenomena and the presence of rare habitat types (Thieme *et al*., 2005). The final integrated index of biological distinctiveness was used to assess all the freshwater ecoregions in Africa. The final biological distinctiveness of the three ecoregions traversed is listed in Table 14. Based on this assessment the Lake Turkana and Kenyan Coastal Rivers ecoregions were rated as being of bioregionally outstanding biological distinctiveness, and the Shebelle-Juba catchments ecoregion of continentally outstanding distinctiveness (Table 14).

Table 14: Biological distinctiveness ratings of the 3 freshwater ecoregions traversed by the AoI

Index	Lake Turkana	Shebelle-Juba catchments	Kenyan Coastal Rivers
Biological Distinctiveness	Bioregionally outstanding	Continentally outstanding	Bioregionally outstanding

Conservation Status

The health of aquatic systems in Africa is under increasing pressure related to a variety of human induced impacts including construction of dams and reservoirs, overexploitation of resources, pollution particularly eutrophication and the introduction of invasive species (Thieme et al., 2005).

A snapshot of the level of threat to aquatic ecosystems was assessed by Thieme et al., (2005) based on the following categories:

- Land-based threats;
- Aquatic habitat threats; and
- Biota threats (Thieme et al., 2005).

The level of threat was then reassessed with the inclusion of a future threat assessment. Based on that nearly two-thirds of the ecoregions qualified for an elevation in conservation status level based on projected threats from climate change, planned developments, and human population growth (Thieme et al., 2005). The final conservation status of the 3 freshwater ecoregions traversed by the AoI is provided in Table 15.

Table 15: Conservation status of the 3 freshwater ecoregions traversed by the AoI

Index	Lake Turkana	Shebelle-Juba catchments	Kenyan Coastal Rivers
Conservation status	Endangered	Vulnerable	Endangered

1.4.2 Primary Data – Field Survey Results

This section presents the results of the field surveys conducted during the June 2018 advanced field work and the October and November 2018 full field surveys.

1.4.2.1 Vegetation and Flora

A map showing the locations of vegetation sampling sites is provided in Drawing 6.

The field surveys confirmed six broad vegetation communities along the pipeline footprint:

- Acacia-dominated communities;
- Commiphora-acacia communities;
- Pristine forest communities;
- *Vachellia tortilis* woodland communities;
- Riparian communities; and
- Disturbed shrubland community.

These communities are discussed below along the smaller sub-communities which comprised them.

1.4.2.1.1 Acacia Dominated Communities

These communities occurred along the full extent of the Project footprint except for the easternmost portion of the corridor (Drawing 11). These communities coincide with the Acacia-Commiphora stunted bushland and Somalia-Masai Acacia-Commiphora deciduous bushland and thickets vegetation communities delineated by Van Breugel *et. al.* (2015).

Sub-communities identified within this community included:

- Acacia woodland/shrubland;
- Acacia shrubland with ephemeral streams;
- Dwarf acacia shrubland;
- Acacia-commiphora woodland;
- Highly browsed acacia scrubland;
- *Vachellia tortilis* woodland; and
- *Vachellia reficiens* shrubland.

Acacia woodland/shrubland community

The Acacia woodland/shrubland vegetation community was recorded in the central and eastern portions of the Project footprint corresponding to the Samburu, Isiolo and Garissa counties (Drawing 11). One-hundred-and-twenty-nine plant species in 35 families were recorded in this vegetation community. The most diverse families in this community, together comprising more than 50% of the overall species diversity, are listed in Table 16.

Dominant plant species within this vegetation community included White Cross-berry (*Grewia tenax*), Desert Thorn (*Lycium shawii*), Black Thorn (*Senegalia mellifera*), Forest Burr (*Pupalia lappacea*) and Red-bark Acacia (*Vachellia reficiens*).

Table 16: Most diverse plant families within the Acacia woodland / shrubland vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	29	13.8
Malvaceae	22	10.5
Capparaceae	21	10.0
Poaceae	17	8.1
Acanthaceae	13	6.2
Solanaceae	13	6.2

Acacia shrubland with ephemeral streams community

The Acacia shrubland with ephemeral streams vegetation community was restricted to the far north-west of the Project footprint (Drawing 11).

Sixty-five species in 26 families were recorded in this community. The most diverse plant families were Poaceae (grass family) and Fabaceae (legume family), which includes the acacia species (*Senegalia* and *Vachellia* genera) (Table 17). Dominant plant species within this vegetation community included *Vachellia reficiens*, *Vachellia tortilis*, *Senegalia mellifera* and *Senegalia senegal*.

Table 17: Most diverse plant families within the Acacia shrubland with ephemeral streams vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Poaceae	10	15.4
Fabaceae	7	10.8
Capparaceae	6	9.2
Acanthaceae	4	6.2
Boraginaceae	4	6.2
Euphorbiaceae	4	6.2

Dwarf acacia shrubland community

The dwarf acacia shrubland vegetation community was recorded at a single site in the far north-west of the Project footprint (Drawing 11). This community was the most depauperate in terms of overall diversity, of all those comprising and comprised 24 plant species in 16 families. Five families comprised 50% of the overall plant species diversity (Table 18). The most diverse families in terms of species richness were Fabacaeae and Poaceae (Table 18).

Plant species contributing to the vegetation community included *Senegalia mellifera, Vachellia reficiens, Vachellia tortilis, Cymbopogon schoenanthus, Sporobolus ioclados* and *Stipagrostis hirtigluma*

Table 18: Most diverse plant families within the dwarf acacia shrubland vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	3	12.5
Poaceae	3	12.5
Acanthaceae	2	8.3
Amaranthaceae	2	8.3
Asteraceae	2	8.3

Acacia-commiphora woodland community

This vegetation community was recorded at a single site in the far eastern extent of the Project footprint near to the point where the Somali-Masai Acacia-Commiphora deciduous bushland and thickets vegetation transitions into the Coastal mosaic (Drawing 11).

This vegetation community was relatively depauperate and was comprised of 10 plant species and seven families. This community was dominated by grass species (family Poaceae) which comprised 40% of the overall plant species diversity.

Highly browsed acacia scrubland community

This vegetation community was recorded at a single location in the far north-west of the Project footprint (Drawing 11). The vegetation community was relatively depauperate, with 31 plant species in 17 families recorded. Four plant families comprised 51% of the overall diversity (Table 19).

Dominant plant species within this community included *Vachellia reficiens*, *Vachellia tortilis* and *Senegalia mellifera*.

Table 19: Most diverse plant families within the highly browsed acacia scrubland vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Poaceae	5	16.1
Amaranthaceae	4	12.9
Capparaceae	4	12.9
Boraginaceae	3	9.7

Broadleaf Woodland Community

This vegetation community was recorded at a site in Samburu county in the north of the Project footprint and at sites in the central portion of the corridor in the Garissa county (Drawing 11).

Eighty-seven plant species in 30 families were recorded in this vegetation community. Fabaceae was the most diverse family, with 11 species recorded (Table 20). Seven families comprised 54% of the species diversity.

Tree species comprising this vegetation community included *Ziziphus mucronata*, *Combretum aculeatum*, *Maerua oblongifolia*, *Vachellia horrida* and *Senegalia mellifera.*

Table 20: Most diverse plant families within the broadleaf woodland community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	11	12.6
Poaceae	8	9.2
Capparaceae	7	8.0
Solanaceae	7	8.0
Malvaceae	6	6.9
Amaranthaceae	4	4.6
Combretaceae	4	4.6

Vachellia reficiens shrubland community

This vegetation community was recorded at locations in the Samburu and Turkana counties in the central and north-western portions of the Project footprint (Drawing 11).

Forty-one plant species representing 22 families were recorded in this community. Six families contributed 51% of the overall plant species diversity, with the highest diversity recorded in the Fabaceae and Capperaceae (caper family) (Table 21).

Vachellia reficiens is the dominant plant species in this community. This hardy plant species usually grows in rocky areas in semi-desert and arid shrubland. It is an abundant dominant species of arid shrubland throughout Kenya.

Table 21: Most diverse plant families within the *Vachellia reficiens* vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	8	19.5
Capparaceae	4	9.8
Solanaceae	3	7.3
Acanthaceae	2	4.9
Amaranthaceae	2	4.9
Asparagaceae	2	4.9

1.4.2.1.2 Commiphora-Acacia Communities

This vegetation community was recorded at a single location in the central portion of the Project footprint in the Isiolo county (Drawing 11).

Three plant families contributed to 63.2% of the overall species diversity in this community (Table 22). Diversity was depauperate with 19 plant species recorded.

Commiphora baluensis was the dominant plant species in this vegetation community. This East African tree species occurs in Tanzania, Kenya and Ethiopia (POTW, 2019). It grows on rocky ground and can reach a height of 20 m.

Table 22: Most diverse plant families within the Commiphora dominated vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	4	21.1
Malvaceae	4	21.1
Poaceae	4	21.1

1.4.2.1.3 Pristine Forest Communities

This vegetation community was recorded at two locations in the eastern portion of the pipeline route and corresponds to the Coastal Mosaic vegetation community delineated by Van Breugel et. al. (2015) (Drawing 11).

A total of 67 plant species in 25 families were recorded in this vegetation community. Four (4) plant families contributed to 57% of the overall species diversity (Table 23). Nineteen (19) grass species were recorded in this community (Table 23).

Grass species recorded in this community included *Panicum maximum*, *Hyparrhenia filipendula*, *Heteropogon contortus* and three species of Eragrostis. Tree species observed during the field survey included *Combretum aculeatum*, *Dalbergia melanoxylon* and *Ziziphus mucronata*.

Table 23: Most diverse plant families within the Forest vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Poaceae	19	28.4
Fabaceae	8	11.9
Rubiaceae	6	9.0
Malvaceae	5	7.5

1.4.2.1.4 Riparian Vegetation Communities

These vegetation communities were recorded at various points in the northern half of the Project footprint and comprised the following sub-communities:

- Riparian gallery forest;
- Riparian heavily invaded by *Prosopis juliflora;*
- Riparian vegetation in grassland;
- Riparian scrubland;
- Riparian vegetation with sand dunes and *Hyphaene compressa*; and
- Riparian woodland.

Riparian gallery forest communities

This vegetation community was recorded at a site in the north of the Project footprint, west of Baragoi. Six plant families together contributed to 63% of the plant species diversity (Table 24). Nineteen plant species were recorded in this community.

Plant species recorded in this community included *Grewia tenax*, *Vachellia tortilis*, *Ziziphus mauritiana* and *Z. mucronata.*

Table 24: Most diverse plant families within the riparian gallery forest community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Amaranthaceae	2	10.5
Euphorbiaceae	2	10.5
Fabaceae	2	10.5
Malvaceae	2	10.5
Rhamnaceae	2	10.5
Solanaceae	2	10.5

Riparian heavily invaded by *Prosopis juliflora* community

This vegetation community was recorded on the western bank of the Kerio River in the north-western portion of the Project footprint.

Seven plant families contributed to 71% of the plant species diversity (Table 25). The highest plant species diversity was recorded in the Asteraceae, Fabaceae and Poaceae families (Table 25). Twenty-four plant species were recorded in this community.

This community was characterised in part by the presence of *Prosopis juliflora*, a highly invasive weed from Mexico, South America and the Caribbean. Other invasive plant species recorded in this community included *Datura stramonium*, also from Mexico and *Tagetes minuta*, from South America. The presence of these invasive plant species is indicative of a high degree of anthropogenic disturbance at the site.

Native plant species recorded in this community included *Vachellia tortilis*, *Ficus sur* and *Lannea rivae*.

Table 25: Most diverse plant families within the riparian heavily invaded with *Prosopis juliflora* community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Asteraceae	3	12.5
Fabaceae	3	12.5
Poaceae	3	12.5
Amaranthaceae	2	8.3
Capparaceae	2	8.3
Euphorbiaceae	2	8.3
Solanaceae	2	8.3

Riparian vegetation in grassland community

This vegetation community was recorded in the central portion of the Project footprint where the corridor passes through Meru county.

Twenty plant families were recorded at this site, but four families contributed 50% of the plant species diversity (Table 26). Thirty-two plant species were recorded at this site including *Balanites aegyptiaca*, *Boscia coriacea*, *Combretum aculeatum*, *Croton dichogamus* and *Diospyros scabra.*

Table 26: Most diverse plant families within the riparian vegetation in grassland community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	6	18.8
Capparaceae	4	12.5
Malvaceae	4	12.5
Anacardiaceae	2	6.3

Riparian scrubland community

This vegetation community was recorded at various sites in the central portion of the Project footprint. Plant species diversity in this community was high with 36 families and 173 species recorded.

Seven plant families contributed to 55% of the plant species diversity (Table 27). Fabaceae (legume family) which includes the two acacia genera (*Vachellia* and *Senegalia*) was the most diverse family, with 23 species recorded (Table 27). The Poaceae (grass family) was the second most diverse family, with 18 plant species recorded (Table 27).

The most abundant native plant species in this community were *Grewia tenax*, *Salvadora persica*, *Aerva lanata* and *Lycium shawii.* The alien invasive plant species *Prosopis juliflora*, *Datura stramonium* and *Tagetes minuta* were also recorded.

Grewia tenax is a slow growing deciduous and thorny shrub that grows in the drier parts of Africa, the Middle East, India, Pakistan and Sri Lanka (POTW, 2019). This plant produces an edible fruit and the wood is used for a wide variety of purposes. *Salvadora persica* (Mustard bush) is a small tree or shrub, seldom higher than 3 m, which occurs in the Middle East and Africa (POTW, 2019). It is known as drought resistant fodder plant for cattle and twigs and branches from this tree have been used for centuries as natural toothbrushes (POTW, 2019).

Table 27: Most diverse plant families within the scrubland community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	23	13.3
Poaceae	18	10.4
Malvaceae	13	7.5
Solanaceae	12	6.9

Family	Number of species	% contribution
Capparaceae	11	6.4
Amaranthaceae	9	5.2
Euphorbiaceae	9	5.2

Riparian vegetation with sand dunes and *Hyphaene compressa* community

This vegetation community had a limited extent and was only recorded at a single site in the Surguta valley in the north of the Project footprint. Plant species diversity in this community was low and comprised of seven families and eight species, including the alien invasive weed *Prosopis juliflora.*

This community was characterised by the presence *Hyphaene compressa*, the East African doum palm. This plant species is abundant and widespread in East Africa and is a vital socioeconomic resource for rural pastoralists and agro-pastoralists (Cosiaux et al., 2017).

Riparian woodland community

This vegetation community was recorded at locations in the far north-west of the Project footprint in Turkana county as well as in the central part of the corridor in Isiolo county.

Twenty-seven plant families and 67 plant species were recorded in this community. Nine plant families contributed 66% of the plant species diversity (Table 28). The most diverse plant families were Fabaceae and Poaceae with 10 and 6 species respectively (Table 28).

Abundant plant species in this community included: *Salvadora persica*, *Acalypha indica*, *Calotropis procera*, *Cordia sinensis*, *Grewia tenax*, *Solanum coagulans*, *Vachellia reficiens* and *Vachellia tortilis.*

Table 28: Most diverse plant families within the riparian woodland vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	10	14.9
Poaceae	6	9.0
Solanaceae	6	9.0
Amaranthaceae	5	7.5
Apocynaceae	5	7.5
Acanthaceae	3	4.5
Cleomeaceae	3	4.5
Malvaceae	3	4.5
Salvadoraceae	3	4.5

1.4.2.1.5 Disturbed Shrubland Communities

This vegetation community was recorded in the far eastern portion of the Project footprint in the vicinity of the new port. The vegetation community in this area has been extensively degraded by anthropogenic activities primarily the clearing of indigenous vegetation for the cultivation of crops.

Thirty-nine plant families and 72 species were recorded in this vegetation community. Six plant families contributed 50% of the overall plant species diversity (Table 29). Poaceae, Fabaceae and Malvaceae were the most diverse plant families with 10, eight and eight plant species recorded in these families respectively (Table 29).

Plant species recorded in this community included *Kigelia africana*, *Dichrostachys cinerea*, *Salvadora persica* and *Sclerocarya birrea*.

Table 29: Most diverse plant families within the disturbed shrubland vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Poaceae	10	13.9
Fabaceae	8	11.1
Malvaceae	8	11.1
Anacardiaceae	4	5.6
Asteraceae	3	4.2
Capparaceae	3	4.2

1.4.2.1.6 Plant Species of Conservation Concern (SoCC)

The SoCC encompasses two aspects, firstly, non-native plant species that pose a threat to indigenous vegetation communities and ecosystems due to their potential for encroachment. Secondly, native plant species that are of conservation concern because they are at risk of extinction due to anthropogenic impacts.

Non-Native Invasive Species

The list of recorded plant species was evaluated against a database of alien invasive plant species known to occur in Kenya (GISD, 2019). Seven invasive plant species were recorded during the surveys (Table 30). Invasive plant species were primarily recorded in riparian vegetation communities, with a few also recorded in acacia-dominated vegetation communities (Table 30, Drawing 12).

Common Prickly Pear (*Opuntia vulgaris*) is native to South America but has been translocated globally as a source of fruit and fodder (GISD, 2019; CABI, 2019). It is a large, spiny tree-like cactus that has a tendency to spread rapidly via seed and from broken cladodes ('leaves' or pads), forming impenetrable thickets that crowd out native plants and forage species and restrict the movement of people and livestock (CABI, 2019). Common Prickly Pear was recorded in the riparian woodland at a site in the central region of the Project in the vicinity of Archer's Post.

Jimsonweed (*Datura stramonium*) is an annual herb that reaches up to 2 m in height. It originated from tropical America and now has a global footprint (CABI, 2019). It competes aggressively with native plants and crops, forming dense monospecific stands. Jimsonweed was recorded in riparian vegetation communities at sites in the central and northern portions of the Project footprint.

Mesquite (*Prosopis juliflora*) is native to Colombia and Venezuela. It has shown itself to be a very aggressive invader, especially in frost-free arid and semi-arid natural grasslands. This has led to the declaration of Mesquite as an invasive and/or noxious weed in many African countries notably Kenya, Ethiopia and Sudan, Pakistan and other Asian countries, and in Australia and South Africa (CABI, 2019). Environmental disturbances typically caused by humans, such as over-grazing and increased bush fire rates (due to poor land management), stimulate Mesquite growth and aggravating its impacts (GISD, 2019). It has been shown that this plant promotes the transmission capacity of the malaria parasite by providing the *Anopheles* mosquitoes with sugar during dry periods when sugar sources from native plant species are largely unavailable (Muller et al., 2017). Mesquite was recorded in riparian vegetation communities and the *Vachellia reficiens* shrubland community at sites in the central and northern portion of the Project footprint. Eradication of Mesquite has proven to be extremely difficult or impossible once it has become established (GISD, 2019).

Bristly Foxtail (*Setaria verticillata*) in an invasive grass species that originated in Europe (GISD, 2019). It is often listed as one of the two or three most important weeds in a wide range of crops, within and outside its native range, and it can also become dominant in grassland (CABI, 2019). Bristly Foxtail has inflicted considerable environmental and economic costs in regions it has invaded (GISD, 2019). This species was recorded at sites in acacia woodland vegetation communities in the eastern portion of the Project footprint in Garissa country.

Bitter Apple (*Solanum campylacanthum*) is a small evergreen herbaceous shrub that originated in Africa, the Middle East and India. It is listed as introduced and invasive in Kenya (CABI, 2019). It typically grows in disturbed areas, such as roadsides and can form dense stands, to the detriment of native plants (CABI, 2019). The unripe fruits are toxic to livestock (CABI, 2019). Bitter Apple was recorded in riparian, acacia and disturbed shrubland vegetation communities in the central, northern and far eastern portions of the Project footprint.

Stinking Roger (*Tagetes minuta*) is an erect, woody annual herb with strongly odorous foliage (CABI, 2019). It originated in South America, and has been deliberately distributed across the tropics, subtropics and several temperate countries as an ornamental, medicinal or perfume plant as well as accidentally as a weed (CABI, 2019). Stinking Roger is primarily a weed of cultivated and disturbed areas.

The origin of Common Cocklebur (*Xanthium strumarium*) is uncertain but believed to be Central and South America. It is an annual much-branched herb that rapidly forms large stands, displacing other plant species (CABI, 2019). It is a major weed of row crops such as soybeans, cotton, maize and groundnuts in many parts of the world, including North America, southern Europe, the Middle East, South Africa, India and Japan (CABI, 2019). Common Cocklebur was recorded at a site in the dwarf acacia shrubland vegetation community in the far north-west of the Project footprint.

Table 30: Alien invasive plant species recorded along the Project footprint along with the vegetation communities they were recorded in

Family	Species	Vegetation Community
Cactaceae	*Opuntia vulgaris*	Riparian woodland
Solanaceae	*Datura stramonium*	Riparian woodland
		Riparian scrubland
		Riparian heavily invaded by *Prosopis juliflora*
Leguminosae	*Prosopis juliflora*	Riparian vegetation with sand dunes and *Hyphaene compressa*
		Vachellia reficiens shrubland
		Riparian woodland
		Riparian scrubland
		Riparian heavily invaded by *Prosopis juliflora*
Poaceae	*Setaria verticillata*	Acacia woodland/shrubland
Solanaceae	*Solanum campylacanthum*	Riparian scrubland
		Broadleaf woodland community
		Vachellia reficiens shrubland
		Riparian scrubland
		Acacia woodland/shrubland
		Disturbed shrubland community
Asteraceae	*Tagetes minuta*	Riparian scrubland
		Riparian heavily invaded by *Prosopis juliflora*
Asteraceae	*Xanthium strumarium*	Dwarf acacia shrubland

Whilst not recorded during baseline surveys Bitterweed (*Parthenium hysterophorus*), a native of Central America is spreading within East Africa. This species has been recorded in coffee plantations around Kiambu and Nyeri districts, around Nairobi city, Kajiado and Naivasha. Recent reports indicate that, *P. hysterophorus* has spread into Masai Mara and the Lake Victoria basin in Uganda and Kenya. This species is particularly virulent, the plant is unpalatable to livestock so its invasion results in grazing shortages. It also produces allelopathic substances that deters other plants from germinating and growing near it, as such it can quickly out compete native grassland species[9].

[9] https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Parthenium_hysterophorus_(Parthenium_Weed).htm Accessed 01/08/19

Native Species of Conservation Concern

Eight IUCN listed plant species were recorded during the baseline surveys.

- *Afrocanthium kilifiense* is a shrub or small tree that is confined to areas of dry lowland forest and *Brachystegia* woodland in Kenya. It is listed as VU by the IUCN due to the continuing degradation of lowland forest and woodland habitats associated with coastal development and small-scale agriculture (IUCN, 2019). During baseline surveys this plant species was recorded in the pristine forest vegetation communities in the far east of the Project footprint.
- *Eragrostis perbella* is a VU grass species that occurs in Kenya, Somalia and Tanzania (POTW, 2019). It grows in coastal bushland, woodland and grassland and during the baseline was only recorded in the pristine forest vegetation community in the east of the AoI. Along the Kenyan coast this species is threatened by mining activities and loss of habitat due to agriculture (IUCN, 2018).
- *Blepharis turkanae* is listed as VU by the IUCN (IUCN, 2018). This species was recorded in the far west of the Project footprint west of the Suguta Valley.
- *Uvaria kirkii* is a scrambling shrub that grows in coastal bushland, scrub, thickets, grassland, *Brachystegia* woodland, lowland forest and Hyphaene savanna along the African east coast (IUCN, 2019). It is listed as NT and threats include ecosystem conversion and degradation associated with coastal development and small-scale agriculture (IUCN, 2019). This plant species was only recorded in the pristine forest vegetation community in the far eastern extent of the Project footprint.
- *Dalbergia melanoxylon* is listed as NT in the IUCN Red list (IUCN, 2018). This species was recorded at two sites in the far eastern portion of the AoI.
- *Dialium orientale* is listed as NT in the IUCN Red list (IUCN, 2018). This species was recorded at two sites in the far eastern portion of the AoI in the vicinity of Lamu Port.
- *Senegalia thomasii* is a small tree or shrub endemic to the southern and central parts of Kenya (GBIF, 2018). Based on historical records, the core of its distributional range is situated in the south of Kenya just north of Kilimanjaro and the Tanzania border (Drawing 13). Outliers have been recorded to the north, east and west of this core range (Drawing 13). A second disjunct population core occurs in the central part of the country and overlaps with the AoI and Project footprint (Drawing 13). The EOO of these two core areas amounts to 17,472 km^2 therefore qualifying this species for CH status in terms of Criterion 2, however, the presence of outliers suggests that its actual EOO could be significantly larger. *S. thomasii* was recorded at two sites along the pipeline route, the first at Sware in Samburu County and at Kachiuru in Meru County. Both records were in riparian vegetation communities.
- *Aloe deserti* is a small succulent shrub that grows on sandy and stony soil in dry *Acacia* woodland and at the edge of deciduous thickets (IUCN, 2018). Its range is restricted to the southern and central parts of Kenya and north-eastern Tanzania (GBIF, 2019). Based on historical records, the core of this species distributional range is situated in the south of Kenya north of the Tanzania border but also extending into the northern part of Tanzania (Drawing 14). No previous records exist of this species within the AoI (Drawing 14). *A. deserti* was recorded at two sites along the Project footprint. At Nachola in the north of the Project footprint *A. deserti* was recorded in the broadleaf woodland vegetation community. At Archer's Post *A. deserti* was recorded in riparian scrubland along the Ewaso River. The baseline survey records of this species within the AoI represent a considerable range extension. The IUCN gives the EOO of this species as 53,481 km^2 (IUCN, 2018). Calculation of its EOO based on historical records obtained from GBIF (2019) put its EOO at 52,700 km^2.

1.4.2.2 Birds

A map showing the location of the bird monitoring sites is provided in Drawing 15.

Two hundred and thirty-five bird species were recorded along the proposed pipeline route. This represents 21% of the 1100 bird species expected in Kenya (EANHS, 2009).

A breakdown of the number of species recorded per survey is listed below:

- June 2018 survey: 114 species; and
- October & November 2018 survey: 182 species.

A full list of bird species recorded during the baseline biodiversity assessment is provided in Appendix B.

1.4.2.2.1 Univariate Diversity Indices (UDIs)

The number of bird species recorded per site during each of the two surveys is shown in Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2A. The highest number of bird species for a single site, 45, was recorded at site WAM WES_b during the dry season survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2A). Site WAM WES_b is situated on a non-perennial drainage line approximately 10 km west of the town of Wamba in Samburu County. The highest bird abundance, 189 individuals, was recorded at the same site (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2B). Average number of bird species per site was slightly higher during the dry season survey, with a mean of 19, against a mean of 13 for the Jun 2018 survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2A). Average abundance per site was slightly higher during the June 2018 survey, with a mean of 66, against a mean of 53 for the October and November 2018 survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2B).

The UDI results based on the baseline avifauna data is provided in Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3.

Based on Margalef's Index, the highest avifaunal richness was recorded at site BAR2_b during the dry season survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3A). Site WAM WES_b was only marginally behind BAR2_b in terms of richness (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3A). Site BAR2_b is situated approximately 60 km north of site WAM WES_b, near to the town of Barsoloi, also in Samburu County. The site is situated on the banks of a non-perennial river. Other sites with high Margalef's Index scores were:

- KUL MAW1_b – this site is situated between the small towns of Kula Mawe and Garba Tula in Isiola County;
- SWA LAG_b – this site is situated on a non-perennial riverbed or lagga in the vicinity of the Swari Catholic Church approximately halfway between Wamba and Baloi, Samburu County; and
- EWA NGI_b – situated on a dry river bed approximately 10 km north of the settlement of Archers Post in Samburu County.

Average richness scores were higher during the dry season survey with a mean of 5.1, compared to a mean of 2.9 for the June 2018 survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3A).

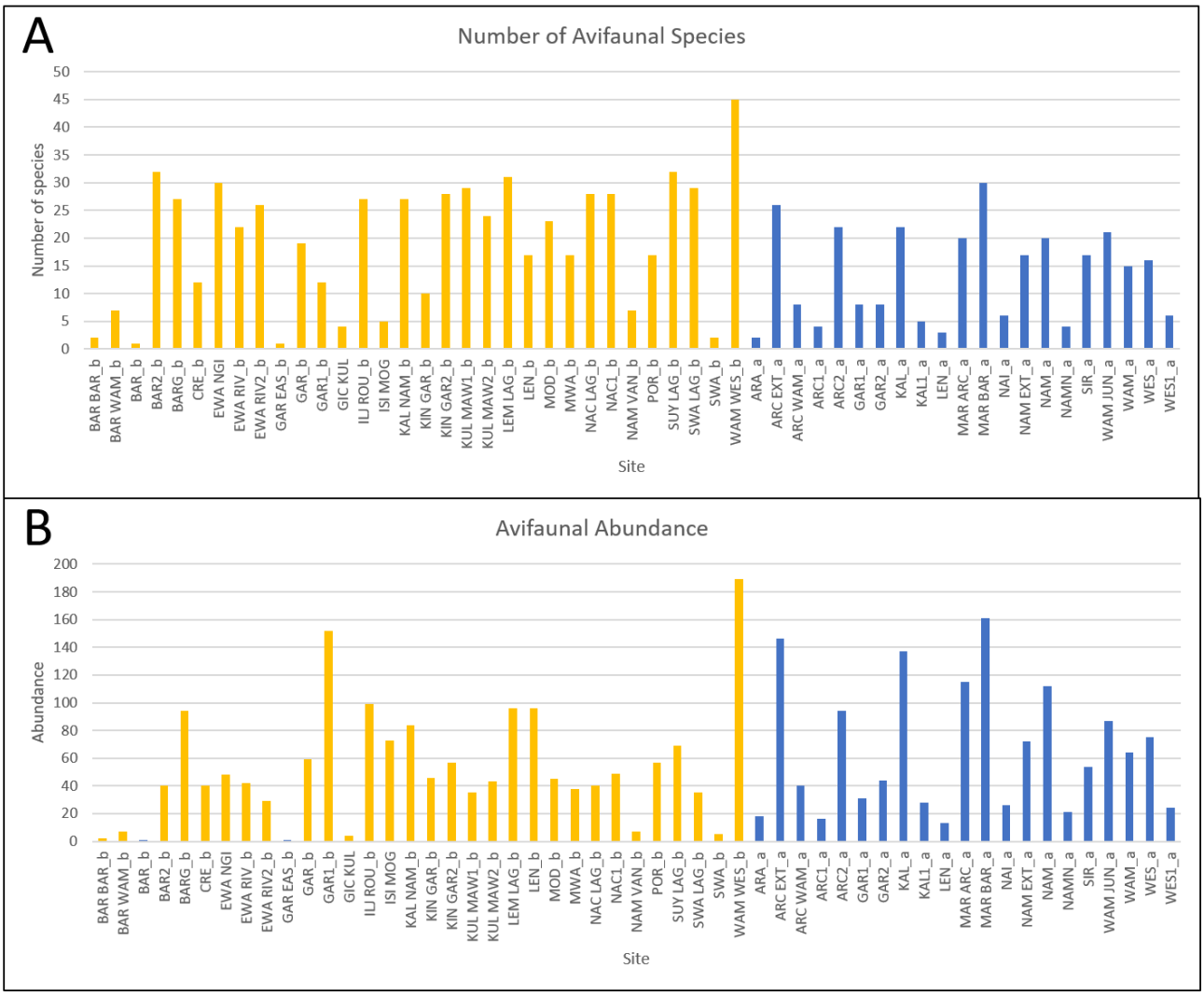

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2: Bird species (A) and number (B) recorded during the biodiversity baseline surveys (gold – Oct & Nov 2018 survey, blue – Jun 2018 survey)**

Pielou's Evenness Index (1986) indicates the evenness at which individuals are distributed over the species in a sample (Cyrus *et al*., 2000). According to Pielou's Evenness Index, ecosystems that are unimpacted show high degrees of evenness whereas ecosystems that are degraded showed reduced evenness due to the reduction in diversity and the increase in abundance of a few highly tolerant or opportunistic organisms. High levels of evenness were recorded at all the sites during the June 2018 survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3B). The average evenness score was slightly lower during the dry season survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3B). Average evenness scores were high (> 0.8) during both surveys indicating the presence of unimpacted ecosystems along the pipeline route.

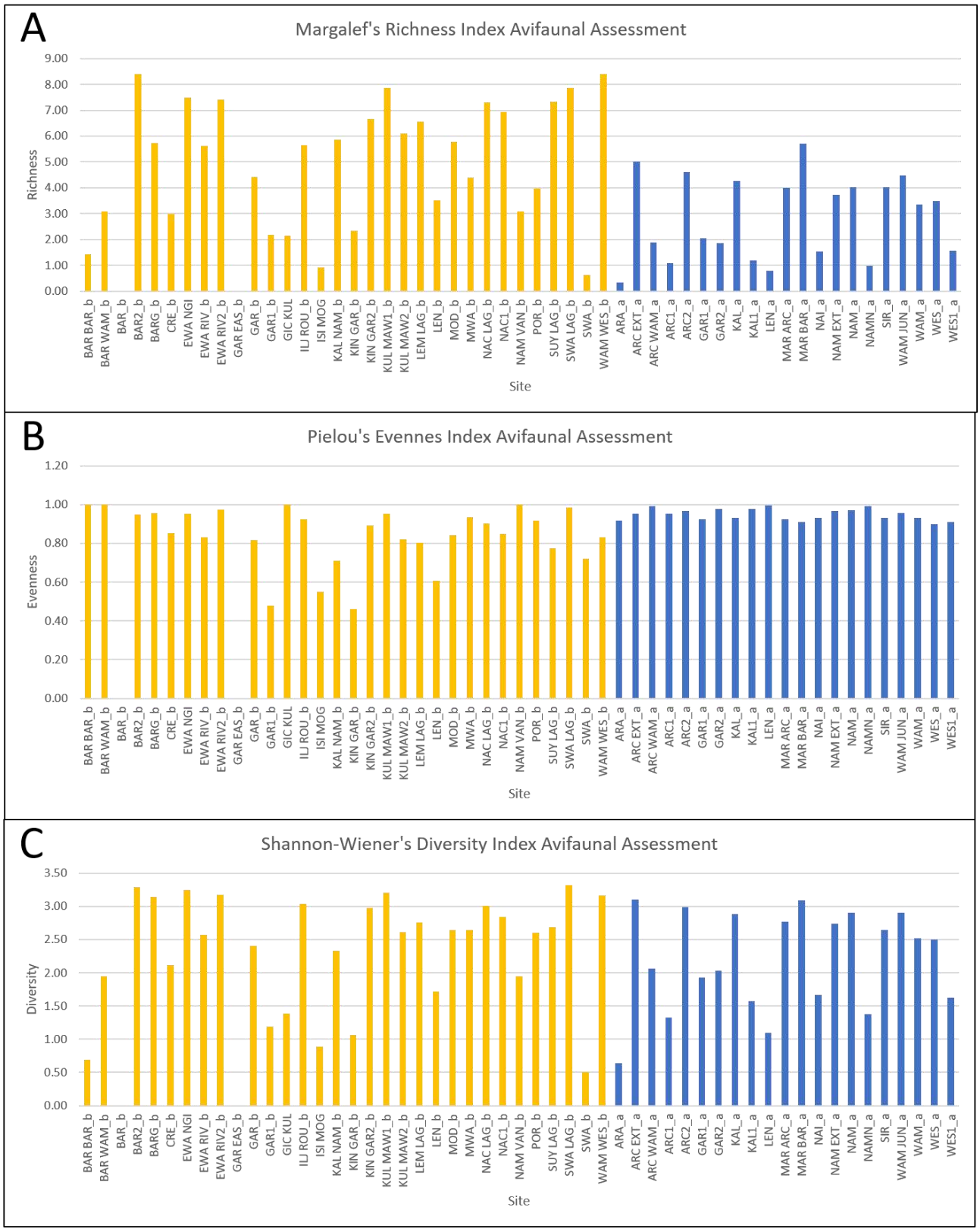

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3: Univariate Diversity Indices (UDI) results based on the avifaunal baseline survey results. A – Margalef's Richness Index, B – Pielou's Evenness Index, C – Shannon-Wiener's Diversity Index (gold – Oct & Nov 2018 survey, blue – Jun 2018 survey)**

Based on Shannon-Wiener's Index the highest avifauna diversity was recorded at site SWA LAG_b during the dry season survey (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3C). Other sites with high levels of avifaunal diversity were BAR2_b, EWA RIV2_b and WAM WES_b during the dry season survey and ARC EXT_a and MAR BAR_a during the wet season survey Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-3C). Site ARC EXT_a is situated on the southern bank of the Ewaso Ng'iro River near to Archers Post. Site MAR BAR_a is situated on a non-perennial river approximately 16 km south of the market town of Baragoi in the north of Samburu County. Average diversity scores for the 2 surveys were identical.

Assessment of the UDI results highlighted the importance of riparian habitats as the areas of high avifaunal biodiversity.

1.4.2.2.2 Multivariate Analysis

Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-4 shows the hierarchical cluster analysis of combined wet season and dry season baseline data.

The groupings of sites showed a high degree of seasonal adherence, i.e. the wet season survey results clustered together into groups of similar sites and the same for the dry season survey results, without a single exception (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-4). This highlights the seasonality of avifaunal results with sites grouped together firstly on a temporal basis and secondarily on a spatial basis (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-4).

Based on this the wet season and dry season survey results were split to run the hierarchical cluster independently for each of the surveys in order to assess the spatial relationship between sites.

Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5 shows the separate cluster analyses of the wet season and dry season bird surveys along the groupings of sites identified in each.

Five groupings were identified in the wet season survey data (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5A). The groups were comprised of the following site:

- Group I_a comprised of sites GAR2_a and WAM JUN_a;
- Group II_a comprised of sites WES1_a, KAL1_a and LEN_a;
- Group III_a comprised of sites ARC1_a, WES_a, NAI_a and NAMN_a;
- Group IV_a comprised of sites ARC WAM_a, GAR1_a, NAM_a, NAM EXT_a, SIR_a, ARC2_a and KAL_a; and
- Group V_a comprised of sites MAR ARC_a, MAR BAR_a (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5A).

Sites ARA_a, WAM_a and ARC EXT_a showed a very low level of similarity (< 20%) to any of the other sites (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5A).

The cluster analysis of the dry season survey data is provided in Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5B. The groupings comprised the following:

- Group I_b consisting of sites MWA_b, CRE_b, BARG_b and POR_b;
- Group II_b comprised of sites GAR_b, GAR1_b, ISI MOG_b and KIN GAR_b;

- Group III_b comprised of sites LEN_b, NAC LAG_b, KUL MAW2_b, KIN GAR2_b, KUL MAW1_b; EWA RIV_b, EWA NGI_b and EVA RIV2_b;
- Group IV_b consisting of sites KAL NAM_b, LEM LAG_b, WAM WES_b, SUY LAG_b, SWA LAG_b, BAR2_b and NAC1_b; and
- Group V_b comprised of sites ILJ ROU_b and MOD_b.

Sites SWA_b, BAR WAM_b, NAM VAN_b and showed very low levels (< 20%) similarity to any of the other sites (Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5B).

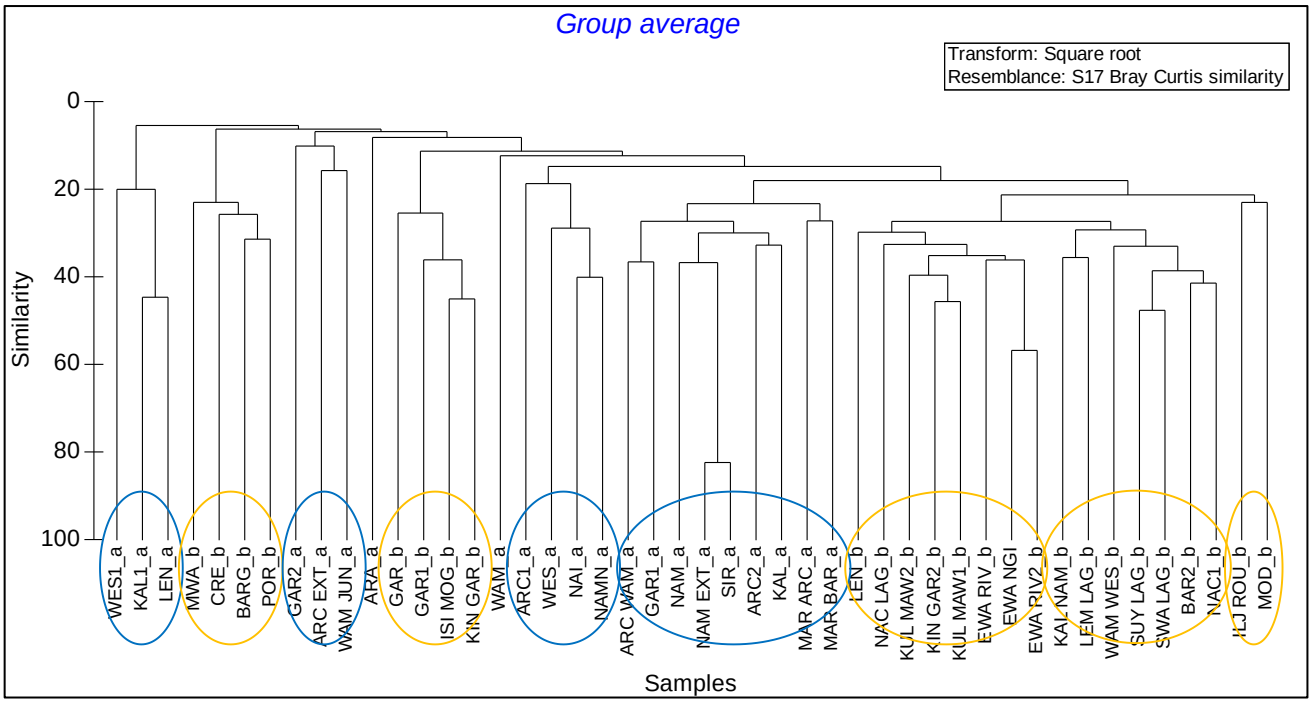

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-4: Hierarchical cluster analysis of avifaunal baseline data based on Bray Curtis ranked similarity (gold – Oct & Nov 2018 survey, blue – Jun 2018 survey)**

ANOSIM (Analysis of Similarity)

Many community data sets possess some *a priori* defined structure within the sets of samples. Analysis of Similarity (ANOSIM) was used to demonstrate statistically significant differences between the groups identified.

Table 31 shows the ANOSIM results based on the groupings identified in the wet season survey data. Based on the R statistic values obtained, statistically significant differences exist between the groupings. Highly significant differences (R > 0.9) exist between Group I a and all the other groups (Table 31). Highly significant differences (R > 0.9) exist between Group IV a and the remainder of all the groups (Table 31).

Significant differences exist between most of the dry season groupings (Table 31). Group I b showed highly significant differences (R = 1) with the remainder of the groups (Table 31).

Table 31: ANOSIM results based on the groupings identified in the June 2018 and October & November 2018 survey data

June 2018 survey		October & November 2018 survey	
Groups	R Statistic	Groups	R Statistic
III_a vs IV_a	0.75	I_b vs IV_b	1.00
I_a vs IV_a	0.98	III_b vs IV_b	0.57
II_a vs IV_a	0.96	II_b vs IV_b	0.87
IV_a vs V_a	0.60	IV_b vs V_b	0.91
I_a vs III_a	1.00	I_b vs III_b	1.00
II_a vs III_a	1.00	I_b vs II_b	1.00
III_a vs V_a	0.68	I_b vs V_b	1.00
I_a vs II_a	1.00	II_b vs III_b	0.99
I_a vs V_a	1.00	III_b vs V_b	0.81
II_a vs V_a	1.00	II_b vs V_b	0.89

Drawing 16 shows the spatial relations of the groupings identified in the June 2018 avifaunal survey data.

Group I a was composed of sites situated along the Tana River, a site located at Archers Post and a further site situated approximately 16 km north west of Archers Post (Drawing 16). Group II_a was composed of sites located in the area between Archers Post and Wamba (Drawing 16). Group III_a showed some spatial overlap with Group II a with its sites located in the area between Archers Post and Wamba (Drawing 16). The Group IV_ showed some spatial overlap with Group I_a with sites situated on the Tana River at Garissa and more sites situated in the vicinity of Archers Port and sites situated between Archers Post and Wamba (Drawing 16).

The Group V_a sites are concentrated around a dry river-bed approximately 16 km south-west of Baragoi with a single outlying site situated at Wamba (Drawing 16).

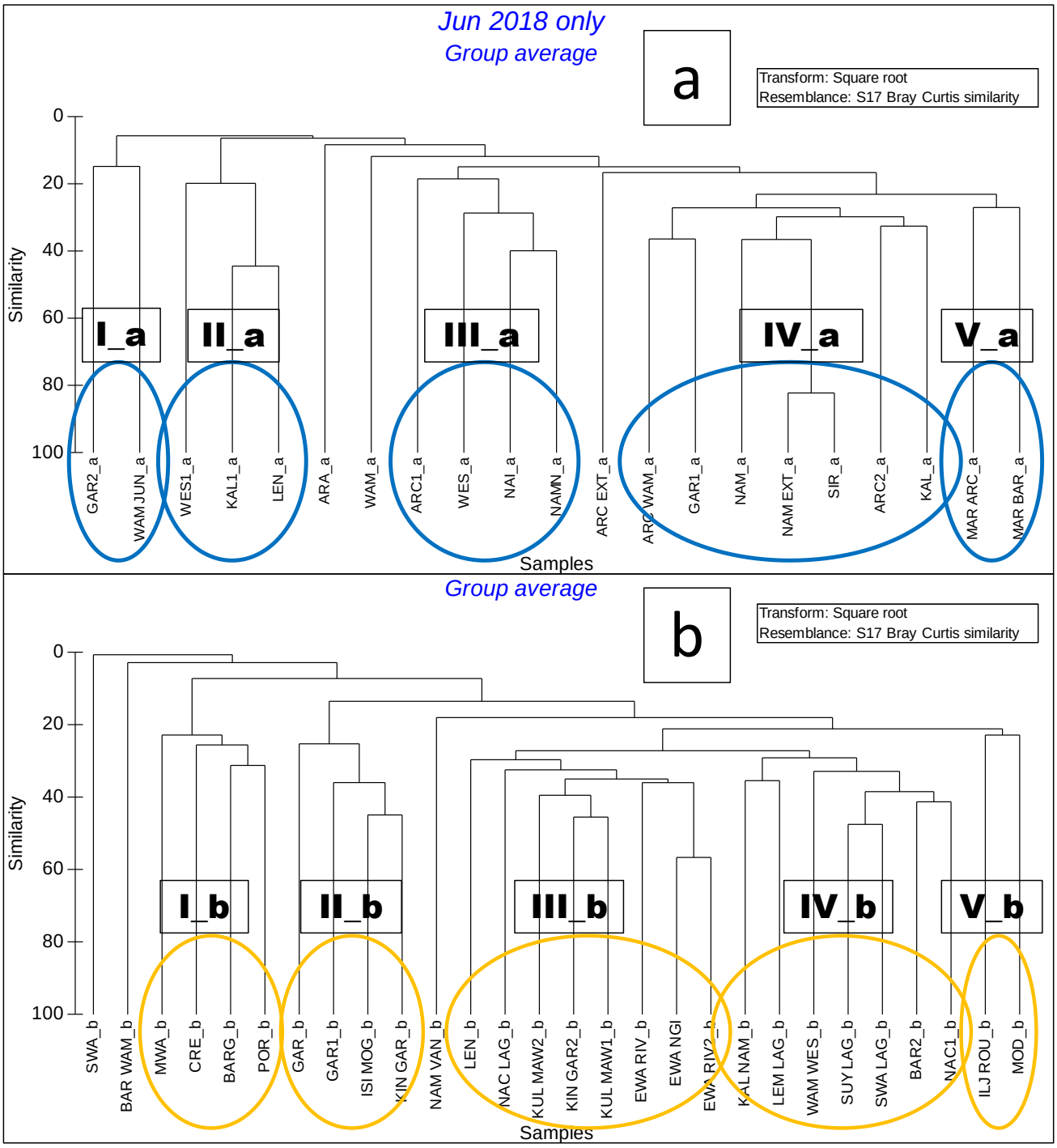

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-5: Hierarchical cluster analysis of a) June 2018 and b) October & November 2018 survey results along with groupings identified in each based-on Bray Curtis ranked similarity (gold – October & November 2018 survey, blue – June 2018 survey)**

The dry season survey groupings showed a high degree of spatial alignment (Drawing 17). Group I b is composed only of sites in the vicinity of the new port (Drawing 17). Group II b sites are located in the area between Garissa and Archers Post (Drawing 17). The sites in Group III b are located between Garba Tula and Wamba (Drawing 17). The sites comprising Group IV b are all situated between Wamba and Baragoi (Drawing 17). The Group V b sites are all located in an area approximately 10 km north-west of Garissa (Drawing 17).

1.4.2.2.3 Bird Species of Conservation Concern

The secondary data search identified 69 bird SoCC expected to occur in the AoI. Of these, eight SoCC were confirmed during the biodiversity baseline surveys (Table 32).

Steppe Eagle (*Aquila nipalensis*) is listed as EN in the IUCN Red List and was recorded at three sites in the AoI (KAL NAM_b, SWA LAG_b and WAM WES_b) during the dry season field survey (Table 32). This migratory species breeds in Eastern Russia and overwinters in parts of eastern and southern Africa (IUCN, 2018). The primary threat facing the Steppe eagle is loss of habitat both in its breeding and overwintering habitats, secondary threats include impacts with transmission lines, hunting and persecution and pollution (IUCN, 2018).

White-backed Vulture (*Gyps africanus*) has a widespread, but shrinking distribution across Sub-Saharan Africa (IUCN, 2018). Threats to this species include loss of wild ungulates leading to a reduced availability of carrion, hunting for trade, persecution, electrocution on transmission lines and poisoning (IUCN, 2018). This species was recorded at three sites in the central portion of the Project footprint between Garba Tula and Swari during both baseline surveys (Table 32).

Hooded Vulture (*Necrosyrtes monachus*) occurs primarily in southern, eastern and western Africa (IUCN, 2018). Its distributional range is decreasing due to non-target poisoning, capture for traditional medicine and bushmeat and direct persecution (IUCN, 2018).

Migratory species were also recorded namely Pallid Harrier (*Circus macrourus*), European Roller (*Coracias garrulus*), Semi-collared Flycatcher (*Ficedula semitorquata*) and Spur-winged Lapwing (*Vanellus spinosus*) (Table 32).

Somali ostrich (*Struthio molybdophanes*) was recorded at two locations during the dry season survey (Table 32). Somali Ostrich is an arid adapted species that occurs in north-east Africa, with its range incorporating Ethiopia, Somalia, Djibouti and Kenya (IUCN, 2018). Threats to this species include over harvesting of both adults and eggs as well as degradation of its habitats (IUCN, 2018).

Table 32: SoCC Bird species recorded during the wet and dry season baseline surveys

Scientific Name	Common Name	Conservation Status		Site	Survey	
		National Priority species	IUCN (2018)		June 2018	October & November 2018
Aquila nipalensis	Steppe Eagle	-	EN	KAL NAM_b		X
				SWA LAG_b		X
				WAM WES_b		X
Circus macrourus	Pallid Harrier	NT	NT	EWA RIV_b		X
				BAR2_b		X
				SWA LAG_b		X
Coracias garrulus	European Roller	-	LC	BARG_b		X
Ficedula semitorquata	Semi-collared Flycatcher	NT	LC	ARC2_a	X	
Gyps africanus	White-backed Vulture	NT	CR	KAL1_a	X	X
				KUL MAW1_b		X
				KUL MAW2_b		X
				EWA RIV2_b		X
				SWA LAG_b		X

Scientific Name	Common Name	Conservation Status		Site	Survey	
		National Priority species	IUCN (2018)		June 2018	October & November 2018
Necrosyrtes monachus	Hooded Vulture	-	CR	ARC EXT_a	X	
				WAM JUN_a	X	
				NAC LAG_b		X
				EWA RIV2_b		X
Struthio molybdophanes	Somali Ostrich	-	VU	GAR_b		X
				SWA_b		X
Vanellus spinosus	Spur-winged lapwing	-	LC	KIN GAR2_b		X
				EWA RIV2_b		X

Drawing 18 shows the location of observations of bird SoCC during both surveys. Although bird SoCC were observed widely across the Project footprint, including in the vicinity of the port in the east of the AoI, observations were concentrated in an area between Archers Post and Baragoi. European roller was the only bird SOCC which was not recorded at least once in this area.

Drawing 18 also shows the high density of bird SoCC in the area of the Project footprint between Archers Post and Baragoi in the north.

1.4.2.3 Mammals

A map of the mammal sampling locations is provided in Drawing 19.

Based on the literature 170 mammal species are expected to occur in the AoI. Eighty-four mammal species were recorded over the course of the Jun 2018 and Oct and Nov 2018 baseline field surveys representing 49.4% of the expected mammal diversity.

A breakdown of the number of species recorded per survey is listed below:

- June 2018 survey: 19 species; and
- October and November 2018 survey: 83 species.

Guenther's Dik-dik (*Madoqua guentheri*) and Spotted Hyaena (*Crocuta crocuta*) were the most widely recorded species within the AoI and were both recorded at 13 locations over the course of 2 surveys. Cape hare (*Lepus capensis*) was recorded at 12 locations over the course of the 2 baseline surveys.

Thirty-five species were only recorded at a single location over the course of the 2 baseline field surveys (Table 33). These species may occur in low densities within the AoI or may represent cryptic species that are difficult to detect.

Table 33: List of mammal species only recorded at a single location over the course of 2 baseline surveys

Common name	Species
Cheetah	*Acinonyx jubatus*
Impala	*Aepyceros melampus*
Neumann's grass rat	*Arvicanthis neumanii*
African grass rat	*Arvicanthis niloticus*
Bushy-tailed Mongoose	*Bdeogale crassicauda*
Sokoke Dog Mongoose	*Bdeogale omnivora*
Hirola	*Beatragus hunteri*
Large headed forest shrew	*Crocidura grandiceps*
Greater gray-brown musk shrew	*Crocidura luna*
Unidentified Musk shrew	*Crocidura sp. 3*
Unidentified Musk shrew	*Crocidura sp nov*

Common name	Species
Unidentified Musk shrew	*Crocidura sp.1*
Unidentified Musk shrew	*Crocidura sp. 2*
Common tsessebe	*Damaliscus lunatus*
Wahlberg's epauletted fruit bat	*Epomophorus wahlbergi*
Somali bushbaby	*Galago galarum*
Kenya coast galago	*Galagoides cocos*
Slender mongoose	*Herpestes sanguineus*
Common hippopotamus	*Hippopotamus amphibius*
White-tailed mongoose	*Ichneumia albicauda*
Zorilla	Ictonyx striatus
Side-striped jackal	*Canis adustus*
Suni	*Neotragus moschantus*
Klipspringer	*Oreotragus oreotragus*
East African oryx	*Oryx beisa*
Bat-eared fox	*Otocyon megalotis*
Northern greater galago	*Otolemur garnettii*
Lion	*Panthera leo*
Ochre bush squirrel	*Paraxerus ochraceus*
Four-toed elephant shrew	*Petrodromus tetradactylus*
Flat-headed bat	Platymops sp
Golden-rumped elephant shrew	*Rhynchocyon chrysopygus*
Shrews	*Suncus sp*
Emin's gerbil	*Taterillus c.f. emini*
Greater kudu	*Tragelaphus strepsiceros*

1.4.2.3.1 Univariate Diversity Indices (UDIs)

The number of mammal species recorded per site per survey is shown in Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-6A. The highest mammal diversity (16 species) was recorded at sites Garb b and Rahol b during the October and November 2018 survey (Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-6A). High levels of diversity were also recorded at sites Sugu_b, Ruq Ija b, Mrand Lam b and Uaso East b (Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-6A).

Sites with high mammal diversity corresponded with drainage lines and rivers including the Suguta Valley in the north of the Project area and the Uaso Nyiro River in the central part of the alignment, as well as protected areas such as Kalama Community Wildlife Conservancy, Nakuprat-Gotu Community Conservancy and Rahole National Reserve and as the forest mosaic vegetation community in the east of the AoI. This highlights the importance of these habitats as hotspots of mammal diversity.

Low mammal diversity was recorded around Nachola and Baragoi in the northern section of the AoI. Factors that may have contributed to this include aridity and the absence of protected areas.

Margalef's Richness Index mirrored that of the number of species with high levels of richness recorded around site Garb b in the vicinity of Garba Tula village, Rahol b in Rahole National Reserve, Sugu b in the Suguta Valley, Mrand Lam b in the forest mosaic vegetation community and Uaso East b along the Uaso Nyiro River (Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-6B).

Shannon-Wiener Diversity index matched that of Margalef's Richness index with high levels of diversity recorded around Garba Tula, Rahole National Reserve, the Suguta Valley and the Uaso Nyiro River (Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-6C).

1.4.2.3.2 Multivariate Analysis

Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-7 shows the hierarchical cluster analysis of combined June 2018 and October & November 2018 mammal baseline data as well as the groupings identified in the data.

The groupings did not show a high degree of seasonal adherence, i.e. sites from the June 2018 survey were mixed into groups of October and November 2018 survey sites suggesting that seasonality did not play a significant role in survey results (Figure -**Error! Use the Home tab to apply 0 to the text that you want to appear here.**-7).

Ten groups of sites were identified in the mammal baseline data:

- Group I consists of sites Basa b and West b in the vicinity of Baloi and West Gate Community Conservancy;
- Group II consists of sites Kala b, Stat_2 and Suiy b. These sites are all situated in the far north of the AoI at Suiyan River and at Kalabata;
- Group III consists of sites Basa_b, Kul Maw b, Ruq Ija b and Wamb b. These sites are spread over a large area from BaoIloi in the north, to Wamba and Ruqua-Ijara in the east of the AoI;
- Group IV consists of Rahol b and Garis Mod b. These sites are situated between Rahole National Reserve and Garissa in the central eastern interior;
- Group V consists of sites Garb b, Garis b, Sank b, Bur East b, Kul Maw a, Namu a and Swar a. As with Group IV this group covers a large geographical footprint from Swari in the north to the Namunyak Wildlife Conservancy to Bura and Fafi in the east of the AoI;

- Group VI consists of sites Swar b, Garis 22 b and Wamb a. These sites are concentrated in the area between Swari and Wamba with an outlier in the vicinity of Garissa;
- Group VII consists of sites East of Kala_b, Maru b and Sugu b. These sites are all situated in the far north of the AoI, north of the Suguta Valley;
- Group VIII consists of sites Uaso East b and Namu b. These sites are situated along the Uaso Nyiro River at Archers Post and in the Namunyak Wildlife Conservancy;
- Group IX consists of sites Uaso East a, Naku b and Uaso Nyi a. These sites are grouped around the Uaso Nyiro River with an outlier on the Kalabata River in the far north of the AoI; and
- Group X consists of sites Mrand Lam b and Lamu Port b in the east of the AoI in the vicinity of the port at Lamu.

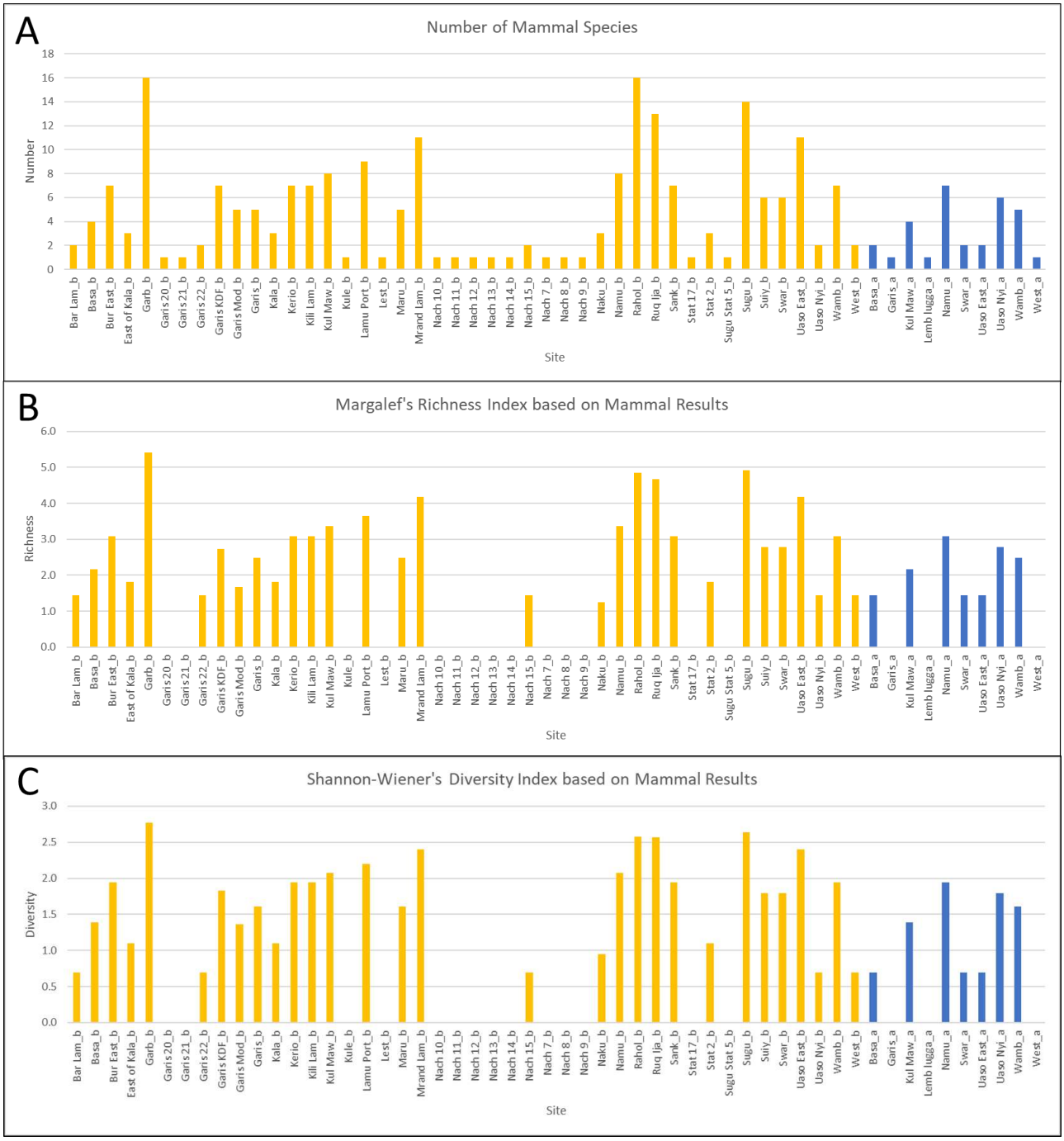

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-6: Number of mammal species (A), Margalef's Richness index results (B) and Shannon-Wiener's diversity index (C) based on the biodiversity baseline survey results**

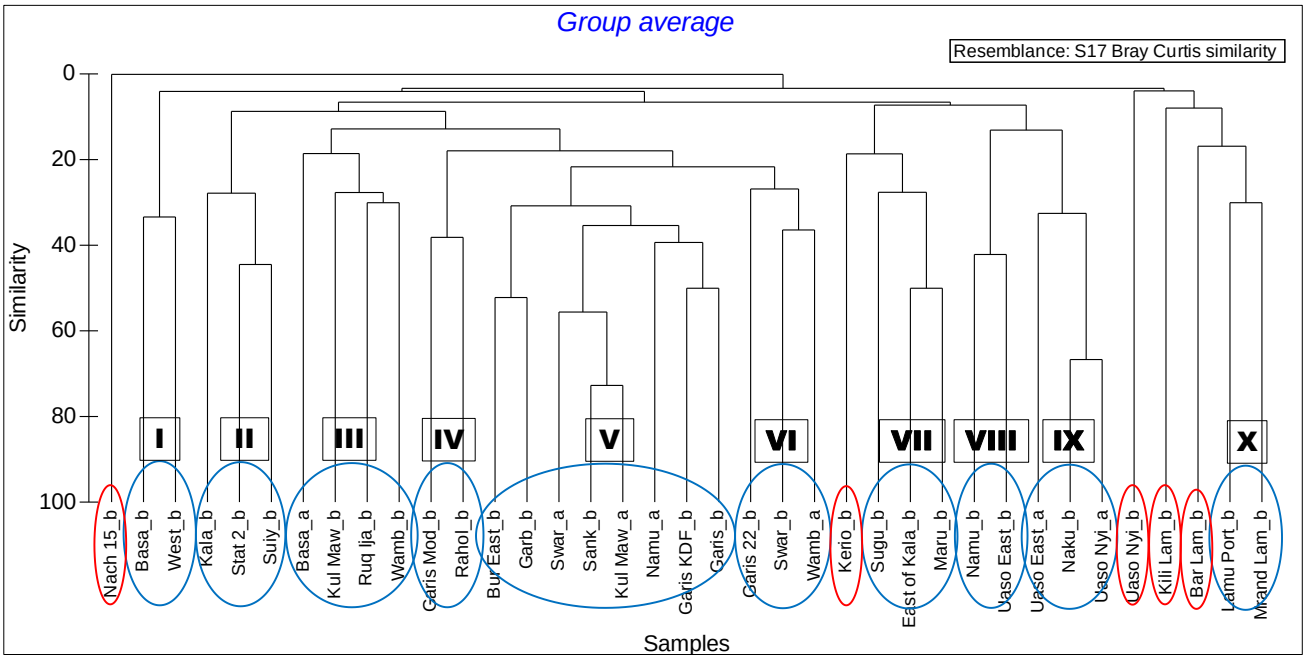

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-7: Hierarchical cluster analysis of mammal data based on Bray Curtis ranked similarity as well as groupings of similar sites (red denotes sites that didn't show similarity to other sites)**

ANOSIM (Analysis of Similarity)

Table 34 shows the ANOSIM results based on the groupings identified in the mammal baseline data. Based on the R statistic values, statistically significant differences (> 0.7) exist between most the groupings (Table 34).

Table 34: ANOSIM results based on the groupings identified in the June 2018 and October & November 2018 mammal baseline data

Groups	R Statistic	Groups	R Statistic
I, V	0.94	VII, VIII	0.83
I, VII	1.00	VI, IV	0.79
I, VI	0.88	VI, II	0.94
I, IV	1.00	VI, III	0.94
I, II	1.00	VI, X	1.00
I, III	0.77	VI, IX	0.83
I, X	1.00	VI, VIII	1.00
I, IX	0.96	IV, II	1.00
I, VIII	1.00	IV, III	0.89
V, VII	0.92	IV, X	1.00
V, VI	0.55	IV, IX	1.00

Groups	R Statistic	Groups	R Statistic
V, IV	0.67	IV, VIII	1.00
V, II	0.75	II, III	0.73
V, III	0.69	II, X	1.00
V, X	0.92	II, IX	1.00
V, IX	0.85	II, VIII	1.00
V, VIII	0.85	III, X	1.00
VII, VI	0.94	III, IX	0.95
VII, IV	1.00	III, VIII	0.98
VII, II	1.00	X, IX	1.00
VII, III	0.86	X, VIII	0.88
VII, X	1.00	IX, VIII	0.83
VII, IX	0.98		

Drawing 20 shows the spatial relationship between mammal groupings identified. The groupings showed a strong spatial alignment likely associated with high degrees of similarity between habitats and variables such as land use and degree of transformation between sites in close proximity to each other.

1.4.2.3.3 Mammal Species of Conservation Concern

Based on the literature review 39 mammal SoCC are expected to occur in the AoI (Drawing 24). Of these, sixteen were recorded during the baseline surveys (Table 35) including Striped Hyaena (*Hyaena Hyaena*).

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-8: Striped Hyaena. Photographed from a camera trap within the AoI. Courtesy of Bernard Agwanda.**

Table 35: Mammal SoCC recorded during the baseline surveys

Scientific Name	Common Name	Conservation Status					Site
		Kenya	IUCN Red List	CMS	CITES	Other	
Bdeogale omnivora	Sokoke Dog Mongoose	-	VU	-	-	-	Mrand Lam_b
Beatragus hunteri	Hirola	CR	CR	-	-	-	Ruq Ija_b
Cephalophus adersi	Ader's Duiker	CR	VU	-	-	-	Bar Lam_b Mrand Lam_b Lamu Port_b
Crocidura sp. (new)	White-toothed Shrew	-	-	-	-	-	Sugu_b
Equus grevyi	Grevy's Zebra	EN	EN	I	I	-	Basa_b West_b Wamb_b Lest_b
Galagoides cocos	Kenya Coast Galago	-	LC	-	II	-	Kili Lam_b
Gerbillus cosensis	Cosens's Gerbil	-	DD	-	-	-	East of Kala_b Maru_b Sugu_b
Rhynchocyon chrysopygus ssp. Mandelai (new)	Golden-rumped Sengi	-	EN	-	-	-	Bar Lam_b
Hyaena hyaena	Striped Hyaena	EN	NT	-	III		Naku_b Sugu_b Rahol_b
Loxodonta africana	African Elephant	EN	VU	II	I/II	-	Uaso East_b Namu_b West_b

Scientific Name	Common Name	Conservation Status					Site
		Kenya	IUCN Red List	CMS	CITES	Other	
Lycaon pictus	African Wild Dog	EN	EN	II	-	-	Ruq Ija_b
Oryx beisa	Beisa Oryx	-	EN	-	-	-	Sank_b
Otolemur garnettii	Garnett's Greater Galago	-	LC	-	II	-	Kili Lam_b
Panthera leo	Lion	EN	VU	II	I/II	-	Garb_b
Panthera pardus	Leopard	EN	VU	II	I	-	Uaso Nyi_b Uaso East_b Garb_b Bur East_b Mrand Lam_b
Acinonyx jubatus	Cheetah	EN	VU	II	I	-	Uaso Nyi_b Uaso East_b Garb_b Bur East_b Mrand Lam_b

Baseline survey within the AoI considered the presence or indeed likely absence of the critically endangered Hirola (Baetrugus hunter) in Garissa County which was once a stronghold for this species. Anecdotal evidence provided by local herdsmen indicated that Hirola were not just confined to the Ishaqbini Hirola Conservancy which is in effect a restricted (fenced) conservancy. The herdsmen indicated that a herd of Hirola exist some 5 km from the Project footprint. However, despite efforts to locate the herd or indeed any physical evidence such as dung from thi species, none was found.

Whilst the Project is technically within the extant natural range for this species the remaining population outside of the Ishaqbini Community Conservancy is likely to be virtually extinct. Indeed, surveys in 2011 suggested a population of 402-466 animals (ca 280-330 mature individuals) within their natural range (King et al. 2011). However, numbers have fallen steadily since; few if any remain in Arawale National Reserve. The population in Ishaqbini Community Conservancy outside the predator-proof sanctuary fell from 152 in 2008 to 63 in 2016, though some of this decline is accounted for by the 48 animals transferred into the sanctuary: these had increased to 97-103 in February 2016 (King et al. 2016).

The total population is now likely to contain <250 mature individuals. Consultation with the Hirola Conservation Program and review of the Abdullahi (2019) report indicates that one of the biggest threats to Hirola conservation is the spread of the invasive and alien Acacia reficiens tree which has transitioned former open grassland habitats into scrubby bare ground mosaic habitats of little conservation value (refer Figure 9 below). Habitat restoration for reducing fragmentation, and semi-captive breeding have been high on the list in efforts to recover the ailing population of Hirola. Sanctuary-bred Hirola are to be released in their historic range that includes current areas that form part of the AoI (Abdullahi, 2019).

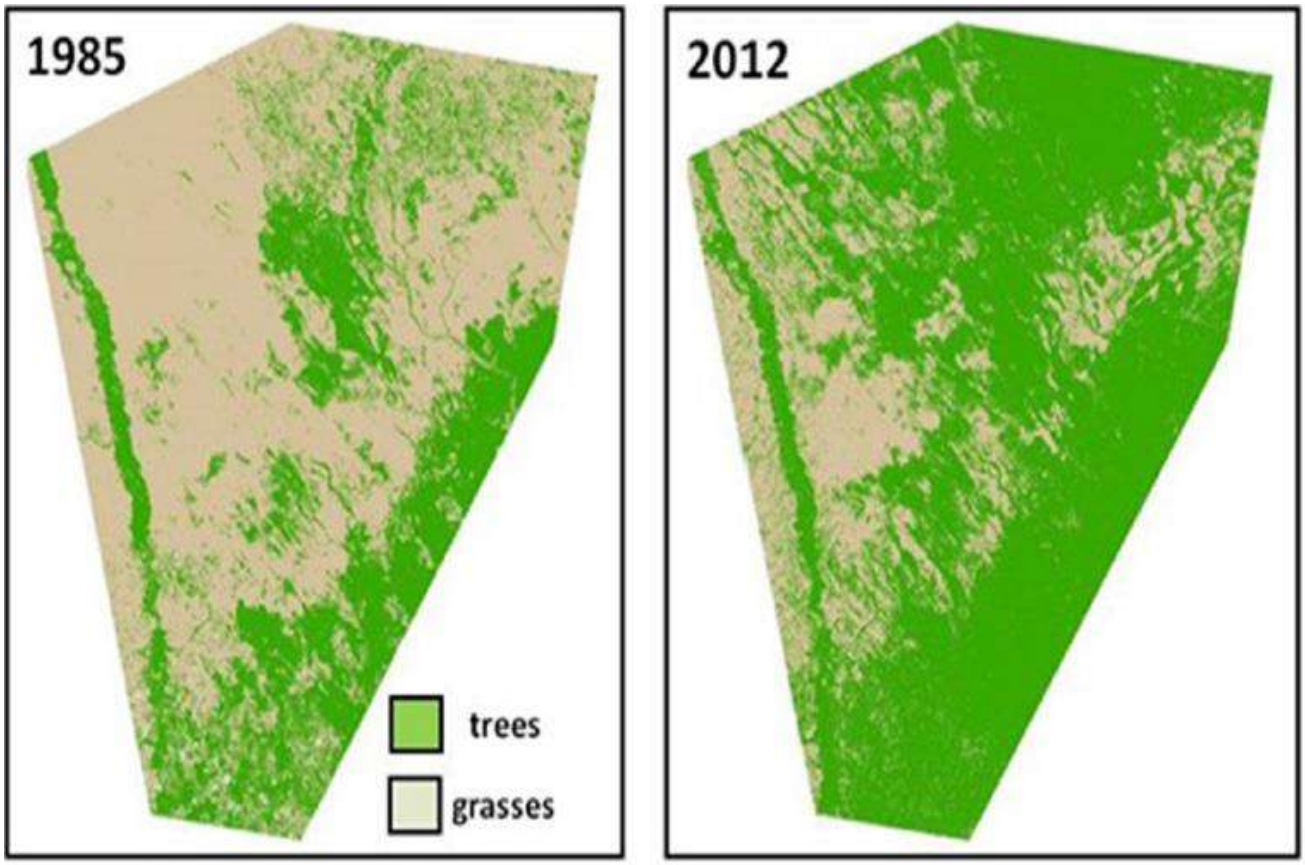

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-9: Changes in tree cover across the Hirola historic range from 1985 to 2012. Green represents tree cover and brown represents grasslands (Abdullahi, 2019).**

The endangered Grevy's Zebra (*Equus grevyi*) are known within the AoI. Kenya supports approximately 90% of the global population of Grevy's Zebra (KWS, 2012). Furthermore, habitat in and around the Wamba region is recognised as providing 'core' habitat for foaling and weaning (KWS, 2012). Within the Wamba and Samburu areas a number of Grevy's watering holes and nursery habitat was identified. Engagement between the Project team and the Grevy's Zebra Trust (GZT) occurred at length and this work is summarised below as emphasis was placed on these SoCC.

Suiyian Area

1) Suiyian Trough is an area used for pastoralists for animal watering in the dry season, Grevy's Zebra do not use it.

2) The Suiyian Well is used by Grevy's Zebra and is a significant distance from the pipeline crossing. We all agreed that separation distance was adequate and that with the depth of the lugga (10 m) it was unlikely that noise would be an issue.

3) Grevy's Zebras come to water at night, so a ban on night working and driving in sensitive areas is required. The transit corridors to the Suiyian Well will be affected by the pipeline ROW, so "sensitive area" mitigations should be applied throughout the "critical" areas.

4) There is an area used for communal water supply about 200 m down gradient from the pipeline crossing. This will require special mitigations and monitoring to ensure continuity of water supply.

5) It was concluded that the pipeline alignment was fine, but that mitigations will be required to protect down-gradient water users and that pipeline crossing should be undertaken as early as possible in the dry season (June-July).

Barsoloi Area

1) Due to the separation distances, this was not seen as an issue regarding Grevy's Zebras.

2) A movement corridor across the pipeline alignment to the water wells was identified. This reinforces the need for a set of "sensitive area" mitigations to be developed for the "critical areas" (such as minimise time of disturbance, minimise length of open cut, minimise time that trench left open, no night working/activity, ensuring no disruption to down gradient water quality/quantity).

Wamba Area – Project (Pipeline) Crossing

1) The "southern" option, as currently defined, is a non-starter as it passes very close to the critical dam identified from my field work and indicated on the map.

2) We verified the locations of the structures along the Baragoi-Archers Post Road and confirmed that a standalone pipeline could be constructed along the road with careful alignment.

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-10: Male Grevy's Zebra holding territory at Westgate Conservancy within heavily grazed sub-optimal habitat**

African Elephant (*Loxodonta Africana)* hold large migratory territories within the AoI. Elephants, and signs of elephant were recorded in many areas of the mid and upper AoI.

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-11: Elephant moving between Buffalo Springs and Shaba**

The Ewaso Nyiro provided a number of records of elephant as the river offers feeding and dispersal opportunities into the broader region. Elephant herds contained elder and juvenile individuals indicating that successful breeding and hierarchical development is being facilitated.

Baseline surveys within the Suguta valley were assisted by the use of helicopter to enable biodiversity experts to access areas otherwise impossible on foot or 4 wheel drive vehicle. SoCC mammals recoded in the Suguta valley included Cheetah (*Acinonyx jubatus)* (Figure 11) and Striped Hyaena.

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-12: Cheetah photographed from a helicopter in the Suguta Valley. Courtesy of Bernard Agwanda.**

1.4.2.3.4 Biodiversity Connectivity

Field survey, desk study and consultation with local experts and NGO's has revealed an ecological network of connectivity for medium and large mammals. A review of the KWS report on Wildlife Corridors and Dispersal Areas authored by Ojwang et al (2017) was a key source of information.

Elephants are migratory, and part of this regions population is known to move onto the Laikipia plateau at the beginning of the dry season, and then to disperse northward to pastoralist areas in Samburu, a distance of more than 100 km, with the advent of the short rains (Ojwang et al, 2017).

Consultation with local expert Bernard Agwanda of National Museum of Kenya (NMK) revealed that elephant dispersal routes occur between Maralal (West of Wamba) toward the Matthews Range. Seasonal preference for dispersal along these routes is understood to be during December to February and May to July. In addition, and notably, elephants also use dispersal habitat between Samburu and Matthews Range on the border of the

Kalama and Namunak Conservancy (B. Agwanda, Pers. Comm, 19th July 2019 and Mr. Tom Amisi Pers. Comm, KWS, 8th July Samburu Guest House) and as shown in Figure 12 below.

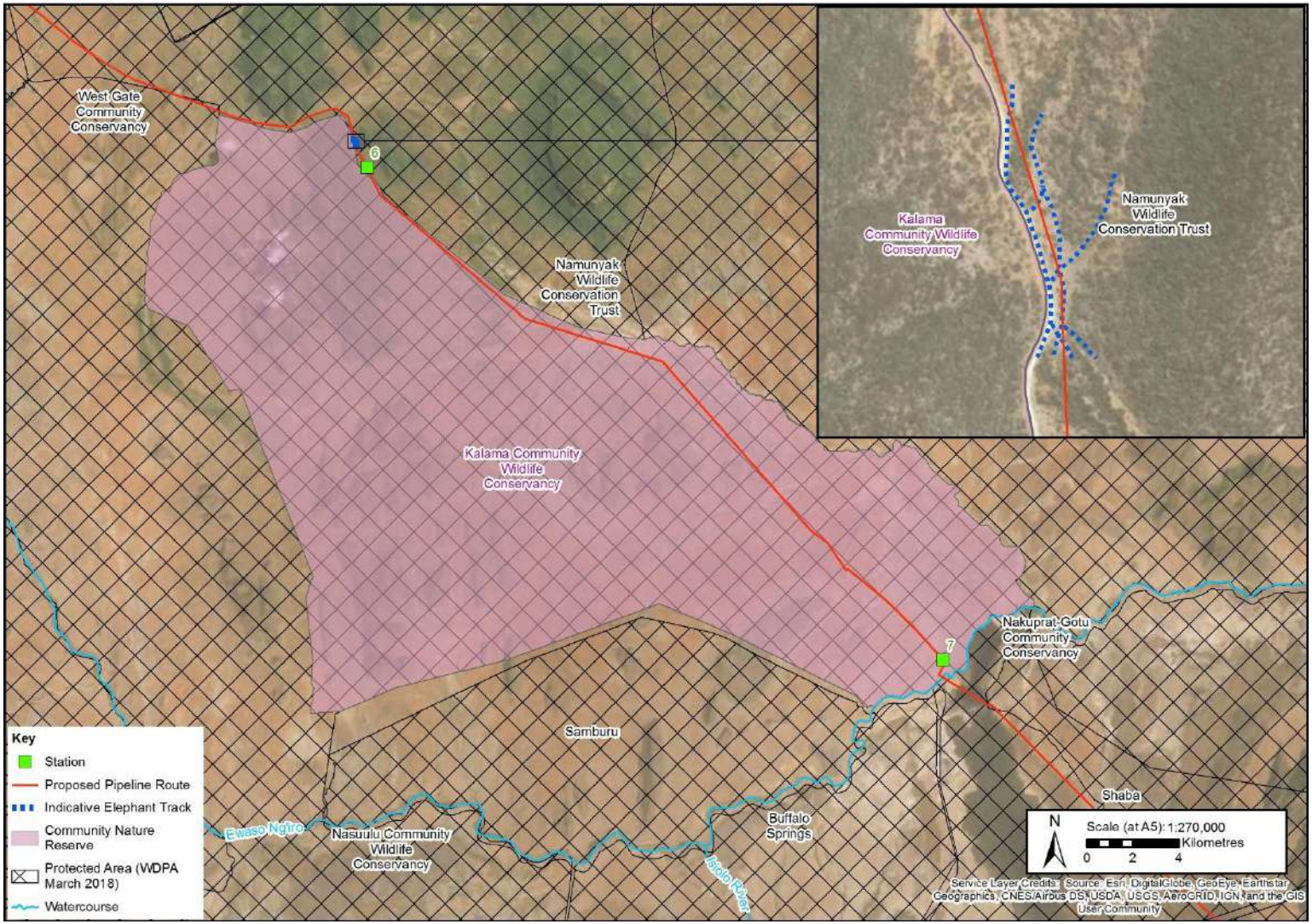

Figure -Error! Use the Home tab to apply 0 to the text that you want to appear here.**-13: Elephant tracks and field signs on the border of the Kalama and Namunyak Conservancy**

Elephants are migratory, and part of this regions population is known to move onto the Laikipia plateau at the beginning of the dry season, and then to disperse northward to pastoralist areas in Samburu, a distance of more than 100 km, with the advent of the short rains (Ojwang et al , 2017).

In addition, Grevy's Zebra are understood to disperse from their Samburu stronghold to the North West in the direction of Mlima Blue and toward Sibiloi some distance away. Similarly, African Wild Dog (Lycaon pictus) a species listed as endangered under Kenyan legislation is also known to habitually use dispersal areas around Samburu and within Kalama Conservancy. Specifically, when this species moves between Samburu Kalama or West Gate and Namunyak Wildlife Conservancy (Ojwang et al, 2017).

1.4.2.4 Reptiles and Amphibians

Drawing 21 shows the location of reptile and amphibian sampling sites.

Fifty-nine species were recorded within the AoI (44 reptile species, and 15 amphibian species). A full list of herpetofauna species recorded during the baseline biodiversity assessment is provided in Appendix B.

A breakdown of the number of species recorded within the AoI per survey is listed below:

- Wet season survey: 22 species (16 reptile and 6 amphibian); and
- Dry season survey: 56 species (42 reptile and 14 amphibian).

Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-14 shows the species accumulation curve for the herpetofauna recorded throughout the course of the survey work, through timed habitat searches. As can be seen from the figure, the asymptote was not reached during either of the field surveys. Therefore, additional survey time would likely have delivered additional herpetofauna species. Only 30% of the reptile species and 26% of the amphibian species expected to be present were recorded within the AoI. In addition, 16 species (12 reptile and 4 amphibian) were recorded within the AoI which were not identified as expected species (from the secondary data search), including two potentially new reptile species, discussed in further detail below.

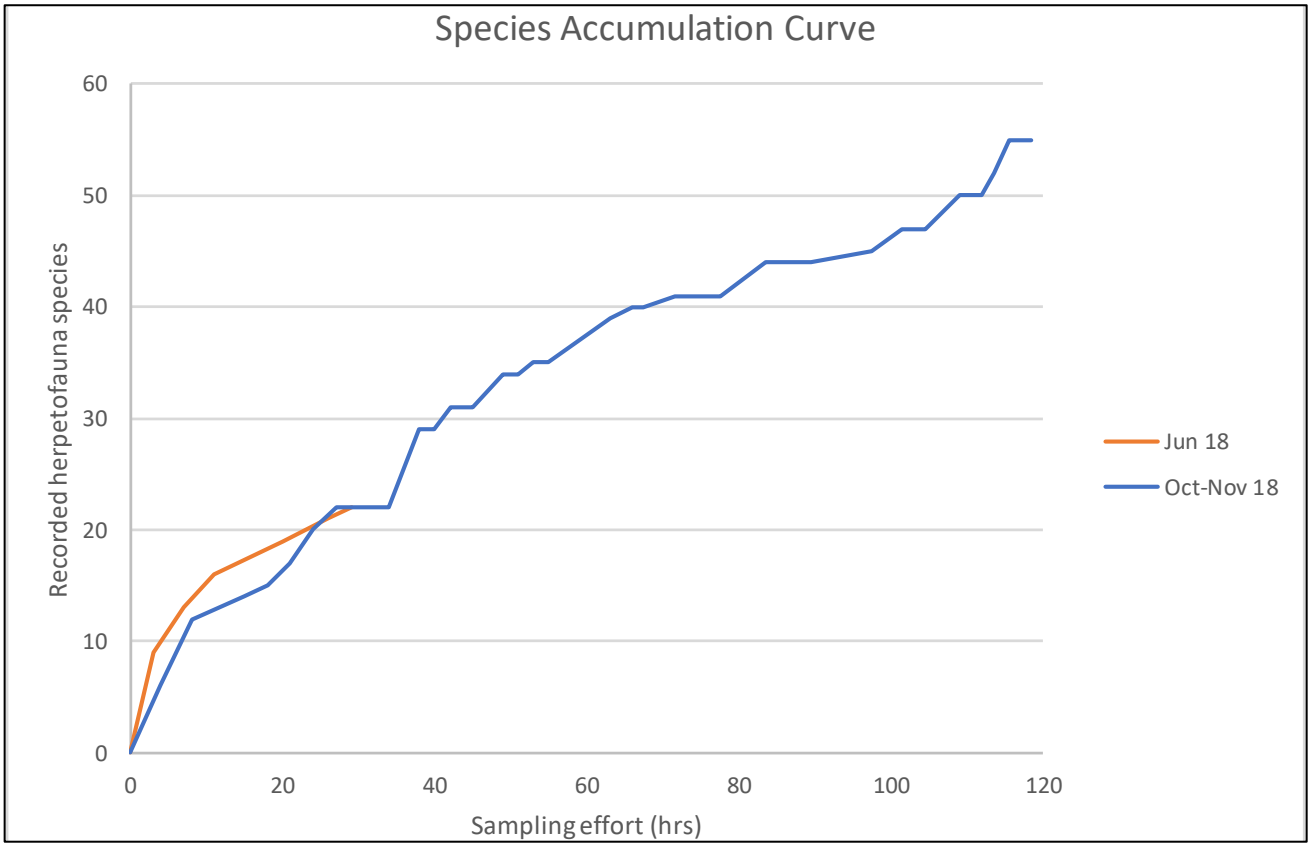

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-14: Herpetofauna species accumulation curve during the June and October and November 2018 field surveys (based on timed habitat searches)**

1.4.2.4.1 Regional Distribution

Herpetofauna communities are discussed in terms of the vegetation community in which they were recorded.

Somalia-Masai Acacia-Commiphora Deciduous Bushland and Thicket

Forty-two herpetofauna species were recorded in this vegetation community. This represents 71% of the herpetofauna diversity recorded over the course of the wet and dry season surveys.

The dominant species recorded are listed in Table 36. Dominant herpetofauna species included Five-lined Skink (*Trachylepis quinquetaeniata)* and Smith's Sand Lizard (*Pseuderemias smithii*), which each account for 10% of the herpetofauna individuals recorded (Table 36).

Table 36: Dominant herpetofauna species (each accounting for ≥ 5% of individuals recorded) in the Somalia-Masai Acacia-Commiphora deciduous bushland and thicket vegetation community during the June 2018 and October & November 2018 field surveys

Species	Common name	% of overall individuals recorded in the community
Reptiles		
Heliobolus spekii	Speke's Sand Lizard	6%
Lygodactylus keniensis	Parker's Dwarf Gecko	5%
Pseuderemias smithii	Smith's Sand Lizard	10%
Trachylepis quinquetaeniata	Five-lined Skink	10%
Amphibians		
Chiromantis petersii	Peter's Foam-nest Frog	9%
Ptychadena anchietae	Anchieta's Ridged Frog	9%
Tomopterna wambensis	Wamba Sand Frog	9%

The species recorded within the Somalia-Masai Acacia-Commiphora deciduous bushland and thicket vegetation community are all either listed as Least Concern, or not evaluated on the IUCN Red List.

Acacia-Commiphora Stunted Bushland

Twenty-seven species were recorded in this vegetation community during the surveys. This represents 46% of the expected herpetofauna diversity.

The dominant herpetofauna species of the Acacia-Commiphora stunted vegetation community in terms of abundance are listed in Table 37. Dominant herpetofauna species included Parker's Dwarf Gecko (*Lygodactylus keniensis*), Speke's Sand Lizard (*Heliobolus spekii*), and Uniform-scale Gecko (*Hemidactylus isolepis*) (Table 37).

Of the six dominant species, four were also dominant in the Somalia-Masai Acacia-Commiphora deciduous bushland and thicket vegetation community, indicating some similarity between these communities. Two species that were listed as dominant in the Acacia-Commiphora vegetation community were not dominant in the Somalia-Masai Acacia-Commiphora deciduous bushland and thicket vegetation community namely Uniform-scaled Gecko, and Long-tailed Sand Lizard (*Latastia longicaudata)*, Table 37).

Table 37: Dominant herpetofauna species (each accounting for ≥ 5% of individuals recorded) recorded in the Acacia-Commiphora stunted bushland during the October & November 2018 field surveys

Species	Common name	% of overall individuals recorded in the community
Reptiles		
Heliobolus spekii	Speke's Sand Lizard	15%
Lygodactylus keniensis	Parker's Dwarf Gecko	23%
Pseuderemias smithii	Smith's Sand Lizard	5%
Latastia longicaudata	Long-tailed Sand Lizard	7%
Hemidactylus isolepis	Uniform-scaled Gecko	13%
Amphibians		
Chiromantis petersii	Peter's Foam-nest Frog	6%

The species recorded within the Somalia-Masai Acacia-Commiphora deciduous bushland and thicket vegetation community are all either listed as Least Concern, Data Deficient or not evaluated on the IUCN red list. However, three are considered to potentially represent critical habitat triggers, as summarised below:

- One species is listed under Schedule 6 of the WCMA (2013) namely Savanna Monitor;
- Based on available sources one species may be considered range restricted, namely Gallmann's Sand Frog (*Tomopterna gallmanni)*; and
- One species is considered to represent a new species in the genus *Agama*.

Other vegetation communities

The remaining vegetation communities in which herpetofauna species were recorded include:

- Coastal Mosaic (11 species);
- Somalia-Masai Semi-desert grassland and shrubland (nine species);
- Mangrove (eight species);
- Riverine wooded vegetation (five species); and
- Desert (four species).

The dominant herpetofauna species recorded in the above communities are outlined in Table 38.

Table 38: Dominant herpetofauna species recorded in the coastal mosaic, Somali-Masai Semi-desert grassland and shrubland, mangrove, and riverine wooded vegetation communities during the wet and dry season surveys

Species	Common name
Amphibians	
Chiromantis petersii	Peter's Foam-nest Frog
Chiromantis xerampelina	Southern Foam-nest Frog
Phrynobatrachus acridoides	East African Puddle Frog
Phrynobatrachus keniensis	Upland Puddle Frog
Ptychadena anchietae	Anchieta's Ridged Frog
Ptychadena mascareniensis	Mascarene Ridged Frog
Tomopterna gallmanni	Gallmann's Sand Frog

The species recorded within these communities are all either listed as Least Concern, Data Deficient or not evaluated on the IUCN red list. However, six are considered to potentially represent critical habitat triggers, as summarised below:

- Two species are listed under Schedule 6 of the WCMA (2013), namely Savanna Monitor and Tree Gecko;
- Three species which (based on available data sources) may be considered as range restricted, namely Gallmann's Sand Frog, Upland Puddle Frog (*Phrynobatrachus keniensis)*, and Lake Turkana Toad *(Sclerophrys turkanae);* and
- One species is considered to represent a new species in the genus *Hemidactylus*.

1.4.2.4.2 Reptile and Amphibian Species of Conservation Concern

Two previously undescribed reptile species were recorded during the baseline surveys. Drawing 22 shows the locations of the herpetofauna SoCC recorded during the wet and dry season field surveys. The four range-restricted amphibian species were all recorded in the far northern section of the Project footprint (Drawing 22). Kenya River Frog was recorded to the west of the Suguta Valley. Lake Turkana Toad and the undescribed Agama species were both recorded in the vicinity of the Suguta Valley. Gallmann's Sand Frog was recorded to the south of Baragoi. The previously undescribed *Hemidactylus* sp. was recorded in the vicinity of Lamu in the east of the AoI.

Table 39: Herpetofauna SoCC recorded during the June 2018 & October and November 2018 baseline surveys

Scientific Name	Common Name	Conservation Status		Site	Survey	
		National (KWS, 2918)	Global (IUCN, 2018)		Jun-18	Oct & Nov 2018
Amphibians						
Phrynobatrachus keniensis	Kenya River Frog	-	LC	Kerio River	-	X
Sclerophrys turkanae	Lake Turkana Toad	-	DD	Suguta Valley	-	X
Tomopterna gallmanni	Gallmann's Sand Frog	-	LC	Nachola	-	X
				Merti-Nachola Conservancy	X	X
Reptiles						
Agama sp. (new)	Agama	-	-	Suguta Valley (Western Ridge)	-	X
Hemidactylus sp. (new)	Gecko	-	-	Bargoni	-	X
				Kililana	-	X

1.4.2.5 Invertebrates

Drawing 23 shows the location of invertebrate sampling sites within the AoI. A total of 203 invertebrate genera were recorded within the AoI, whilst 103 genera were identified to species level, with 155 species recorded. A full list of invertebrate species recorded during the baseline biodiversity assessment is provided in Appendix B.

A breakdown of the number of genera recorded within the AoI per survey is listed below:

- Wet season survey: 96 genera; and
- Dry season survey: 166 genera.

Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-15 shows the species accumulation curve for invertebrates (identified to species and genus level)[10]. As can be seen from Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**-15, the asymptote was not reached during either of the field surveys. Therefore, additional survey time would likely have delivered additional invertebrate species.

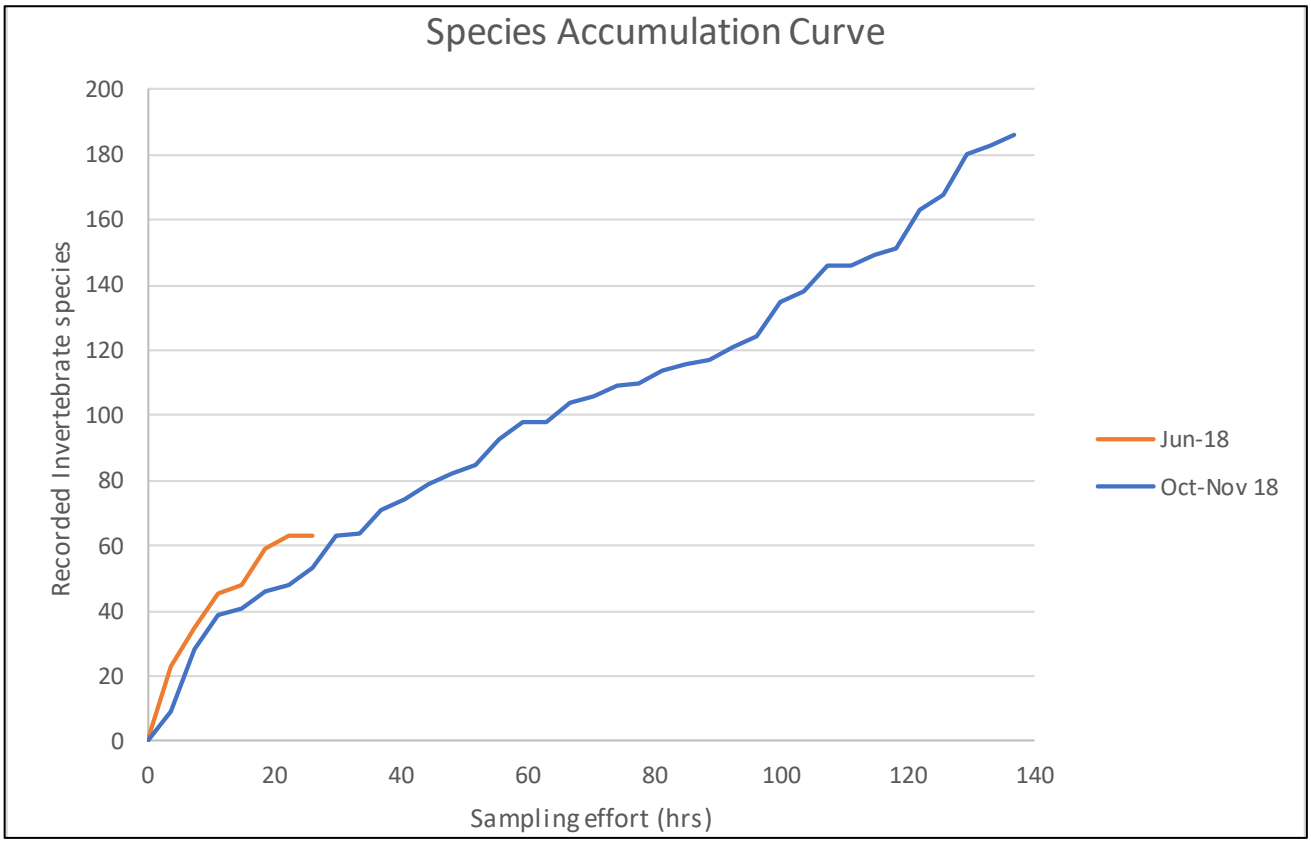

Figure Error! Use the Home tab to apply 0 to the text that you want to appear here.**-15: Invertebrate species accumulation curve during the June and October & November 2018 field surveys (based on general searches and sweep-netting)**

1.4.2.5.1 Invertebrate species diversity

Ten-thousand-and-sixty-seven invertebrate specimens were collected during the survey work. These included spiders (Class: Arachnida, Order: Araneae), centipedes (Class: Chilopoda), millipedes (Class: Diplopoda), woodlice (Class: Isopoda), camel spiders (Class: Arachnida, Order: Solifugae), scorpions (Class: Arachnida,

[10] Sample effort based upon the average time spent for herpetofauna surveys each day (3.7h/day), on the assumption that the surveyors spent the same amount of time at each location.

Order: Scorpionae), and insects (Class: Insecta). By far the most abundant and diverse invertebrates in the AoI were the insects, with 12 orders represented in the AoI, comprised of 193 genera.

Vegetation communities in which invertebrates were recorded during the survey work are set out at Table 40. The dominant vegetation community along most of the proposed pipeline route is Somalia-Masai Acacia-Commiphora deciduous bushland and thicket. As can be seen from Table 40, 161 invertebrate genera were recorded in this vegetation community, representing 79% of the invertebrate diversity recorded.

Table 40 sets out the vegetation communities in which invertebrates were recorded, the number of genera that were recorded in the vegetation community, along with a summary of the dominant genera.

Table 40: Vegetation communities in which invertebrates were recorded within the AoI, along with the number of genera recorded in each community, the dominant genera, or order specimens weren't identified to genus level (dominant genera / orders being those which account for ≥ 5% of individuals recorded)

Vegetation Community	Number of Genera	Dominant Genera	% contribution to community
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket	161	Pheidole	23%
		Camponotus	13%
		Hypotrigona	11%
		Monolepta	9%
Acacia-Commiphora stunted bushland	86	*Cytocanthacris*	19%
		Schistocerca	15%
		Camponotus	14%
		Lophyra	9%
		Tetramorium	5%
Coastal mosaic	40	*Crematogaster*	42%
		Haematopota	17%
		Mesoplatys	17%
Mangrove	35	*Crematogaster*	16%
		Camponotus	15%
		Littorina	15%
		Order Decapoda	12%
		Schistocerca	5%
Riverine wooded vegetation	32	*Crematogaster*	47%
		Dineutes	12%
		Camponotus	11%
		Polyrhachis	5%

Vegetation Community	Number of Genera	Dominant Genera	% contribution to community
Somalia-Masai semi-desert grassland and shrubland	14	*Labidura*	19%
		Lasioglossum	15%
		ORDER Araneae	11%
		Tachysphex	11%
		Tetragonoderus	11%
Desert	2	*Lophyra*	74%

As can be seen from Table 40, insects were generally the dominant class in every vegetation community with the exception of the mangrove community where two other classes, namely *Littorina* (Class Gastropoda), and Order Decapoda (Class Malacostraca) dominated. In the Somalia-Masai semi-desert grassland and shrubland community, the Order Araneae (Class Arachnid) was dominant.

Notably, Cocktail Ants (*Crematogaster* spp.) were the dominant genus across three of the vegetation communities, namely Riverine wooded vegetation, Mangroves, and Coastal Mosaic. Overall, 9% of the individuals recorded throughout survey work belong to the genus *Crematogaster.*

Carpenter Ants (*Camponotus* spp.) list among the dominant genera for four of the vegetation communities, namely Somalia-Masai Acacia-Commiphora deciduous bushland and thicket, Acacia-Commiphora stunted bushland, Mangrove, and Riverine Wooded Vegetation. Overall, 12% of the individuals recorded throughout survey work belong to the genus *Camponotus.*

The genus *Phediole* was only recorded as dominant within one vegetation community namely Somalia-Masai semi-desert grassland and shrubland. However, overall this genus was recorded more than any other throughout the survey work, with a total of 1,399 individuals recorded across five of the vegetation communities, representing 14% of the total individuals recorded throughout fieldwork.

1.4.2.5.2 Invertebrate Species of Conservation Concern

The literature review identified ten invertebrate SoCC. Of these species, two were recorded during the baseline field surveys, namely Brown-veined White Butterfly (*Belenois aurota*) and African Migrant Butterfly (*Catopsilia florella*), as detailed within Table 44.

Table 41: Invertebrate SoCC recorded during the baseline surveys

Scientific Name	Common Name	Survey	Site	Conservation Status	
				National (KWS,)	Global (IUCN, 2018)
Belenois aurota	Brown-veined white butterfly	Jun-18	Namunyak Wildlife Conservancy, Lokichar Maruangpei Nakukulas	-	-
		Oct-Nov 2018	Ewaso Nyiro, Bargoni/Mswakini, Kililana village		
Catopsilia florella	African Migrant	Jun-18	Baloi, Swari River, Nagor-Oworu River, Wamba Lembaras, Lokichar Nakukulas, Kerio River, Suguta Valley, Baragoi Suyan River	-	-
		Oct-Nov 2018	Rahole, Mondica, Mashidwani, Kililana Village, Kula Mawe, Kachiuru, Baragoi Suyan River		

1.4.2.6 Aquatic Ecosystems

Drawing 25 shows the location of the aquatic baseline survey sites.

Two aquatic baseline surveys were conducted at the locations of pipeline crossings along the Project footprint the first in June - July 2018, and the second in October - November 2018. The aquatic surveys included data gathering on water quality, presence of fish species, and presence of aquatic macroinvertebrate species, as discussed below.

1.4.2.6.1 Water Quality

Measurements of water quality parameters were recorded on rivers, water pools in luggas and dugout wells on lugga, earthpans/waterpans. The results of these measurements are set out at Table 42 below.

Table 42: Water quality parameters of drainage systems (luggas and rivers) for wet and dry season within the AoI

Location Name	Season	Date	Water Feature Type	Temp. (°C)	Conductivity (µs)	Total Dissolved Solids (ppm)	pH	Total Suspended Solids
Suiyan lugga	Wet	14/06/2018	Flowing water	24.8	543	352	8.00	-
	Dry	21/10/2018	No water	No data	No data	No data	No data	-
Baloi lugga	Wet	15/06/2018	Flowing water	25	574	403	8.00	-
	Dry	24/10/2018	Dugout Well	34	610	308	8.73	-
Seiya lugga	Wet	17/06/2018	Flowing water	24.6	278	195	8.01	-
	Dry	26/10/2018	Dugout Well	27.7	486	243	7.85	-
Ewaso Nyiro River	Wet	20/06/2018	Flowing water	24.5	174	121.5	8.01	-
	Dry	11/10/2018	Flowing water	28.1	434	217	8.52	2163
Silanga-Nanyukie lugga	Wet	18/06/2018	Water pool	25	489	293	8.00	-
	Dry	29/10/2018	surface stream (2 cm deep)	30.3	4000	2000	7.36	-
			Borehole	29.5	3562	1764	7.13	-
Ngaroni (Baa lugga)	Wet	19/06/2018	Water pool	27	933	644	7.96	-
	Dry	28/10/2018	Dugout Well	25.0	1472	734	7.78	-
Dam Point 8 (North Marti)	Wet	27/06/2018	Earthpan	24.9	247	171	8.00	-
	Dry	23/10/2018	Earthpan	No water	No water	No water	No water	-
Water Pan (Garbatula)	Wet	02/07/2018	Earthpan	24.5	118	60.5	8.01	-
	Dry	16/10/2018	Earthpan	No water	No water	No water	No water	-
Ziwa (Tana River)	Wet	05/07/2018	Ox-bow lake	25.6	644	439	7.99	-
	Dry	Not visited	Ox-bow lake	-	-	-	-	-

Location Name	Season	Date	Water Feature Type	Temp. (°C)	Conductivity (µs)	Total Dissolved Solids (ppm)	pH	Total Suspended Solids
Nakukulas Lugga	Wet	Not visited	-	-	-	-	-	-
	Dry	02/10/2018	Dugout well in lugga	28.5	373	186	7.9	-
	Dry	02/10/2018	Cattle Trough Water	28.2	614	291	7.46	-
Kangthethein Lugga	Wet	Not visited	-	-	-	-	-	-
	Dry	03/10/2018	Dugout Well	33.3	1160	582	8.39	-
Karuko	Wet	Not visited	-	-	-	-	-	-
	Dry	05/10/2018	Oasis	32.7	1323	653	9.29	-
Kerio River	Wet	Not visited	-	-	-	-	-	-
	Dry	06/10/2018	Flowing water	30.5	271	135	8.42	500
Suguta River	Wet	Not visited	-	-	-	-	-	-
	Dry	18/10/2018	Flowing water	35.6	4000	2000	9.51	275
Gerille (Ijara)	Wet	Not visited	-	-	-	-	-	-
	Dry	09/11/2018	Earthpan	31.6	1670	828	9.52	-
Dipu Dam (Lamu)	Wet	Not visited	-	-	-	-	-	-
	Dry	15/11/2018	Earthpan	34.7	158	76	7.71	-
Lamu Port Area	Wet	Not visited	-	-	-	-	-	-
	Dry	16/11/2018	Marine Water	30.4	4000	2000	8.34	-

As can be seen from Table 42 above, water temperatures were higher during the dry season than the wet season. During the dry season, temperatures ranged from 25˚C (in Ngaroni) to 35.6˚C (in Suguta River). The temperatures recorded during the wet season were less varied, ranging between 24.5˚C (in Ewaso Ngiro River and the Garbatula waterpan), to 29.5˚C in the Silanga-Nanyukie Lugga.

The pH levels were all in the neutral to slightly alkaline range. The lowest pH recorded was 7.13, recorded from the Silanga-Nanyukie Lugga in the dry season, whilst the highest pH recorded was 9.52, recorded from the Gerille earthpan during the dry season survey (Table 42).

The lowest Total Dissolved Solids (TDS) and Water Conductivity (WC) records were from the water pan in Garbatula, with a TDS of 60.5 ppm, and WC of 118 µs, both recorded in the wet season. The highest TDS and WC records were from the Silanga-Nanyukie Lugga, Suguta River, and Lamu Port area, with these features all supporting TDS value of 2000 ppm, and WC values of 4000 µs in the dry season.

Measurements of Total Suspended Solids (TSS) were conducted on three river systems; Ewaso Ngiro, Kerio and Suguta Rivers. Ewaso Ngiro River discharges the high amount of TSS, four times more than the discharge recorded in Kerio River, and almost eight times more than discharge in Suguta River (Table 42).

1.4.2.6.2 Aquatic species diversity

Ten fish species were recorded throughout the survey work within the AoI; these species are detailed in Table 43 below, together with their sampling locations.

Table 43: Fish species recorded throughout survey work, and their sampling locations

Species	Locality					
	Dipu Dam	Ewaso Ng'iro River	Kerio River	Suguta River	Ziwa (Tana River)	Total
Bagrus sp.	-	1	-	-	-	1
Clarias gariepinus	-	1	1	1	1	4
Enteromius neumayeri	-	-	1	-	-	1
Enteromius sp.	-	-	1	-	-	1
Labeo cylindricus	-	1	-	-	-	1
Oreochromis niloticus sugutae	-	-	-	1	-	1
Oreochromis sp.	-	1	1	1	-	3
Oreochromis spirulus spirulus	1	-	-	-	-	1
Protopterus affinis amphibius	1	-	-	-	-	1
Synodontis schall	-	-	1	-	-	1
Grand Total	2	4	5	3	1	15

The Kerio River supported the highest diversity of fish species, with 5 species recorded throughout the survey work. Conversely, Ziwa (an ox-bow lake) was recorded to have the lowest diversity of fish species, only recorded

to support African Catfish (*Clarius gariepinus)* (Table 43). The African Catfish was the most frequently recorded species throughout the survey work, found in four of the five water features where fish species were recorded. Species in the genus *Oreochromis* were similarly frequently recorded, again being found in four of the five water features where fish were recorded.

A number of aquatic macroinvertebrates were also recorded throughout the survey work, including specimens in the families Euarthropoda (Whirligig Beetles), Nepidae (Water Scorpions), Belostomatidae (Giant Water Bugs), and Dytiscidae (Diving Beetles). In addition, Molluscs were recorded in a number of locations, whilst two leech species were recorded, namely *Lethocerus* sp., and *Dytiscus marginalis.*

1.4.2.6.3 Aquatic Faunal Species of Conservation Concern

The literature review identified 4 aquatic macro-invertebrate species and 23 freshwater fish species potentially within the AoI. Of these, 2 species were recorded during the baseline field surveys, namely:

- Neumayer's Barb (*Enteromius neumayeri*), recorded in Kerio River; and
- A subspecies of Nile Tilapia (*Oreochromis niloticus sugutae*), recorded in Suguta River.

Further details of these species are provided within Table 44 below.

Table 44: Details of Aquatic SoCC found within the AoI

Scientific Name	Common Name	Conservation Status			Sampling locations		
		Kenya[11]	IUCN Red List[12]	CMS[13]	CITES[14]	Other	
Enteromius neumayeri	Neumayer's Barb	-	LC	-	-	-	Kerio River
Oreochromis niloticus sugutae	Subspecies of Nile Tilapia	-	LC	-	-	-	Suguta River

1.5 Conclusions

The following conclusions were reached based on the results of the Project biodiversity baseline assessment:

- Acacia dominated vegetation communities dominated the Project footprint with the exception of the easternmost portion of the AoI where it transitions to forest mosaic vegetation community;
  - The proposed pipeline traverses several Forest Reserves that are identified as Key Biodiversity Areas;
- The proposed Project traverses protected areas including:
  - Community Conservancies; and
  - National Reserves;
- The AoI coincides with 4 terrestrial ecosystems listed in the WWF's Global 200 project as areas of exceptional biodiversity;

[11] Species listed under Schedule 6 in the Kenya Wildlife Conservation and Management Act (WCMA) 2013

[12] IUCN Red List Conservation status

[13] Convention on Migratory Species - relevant annex

[14] CITES – relevant annex

- Despite being situated in an arid region with primarily non-perennial rivers, the three catchments that traversed by the pipeline route are regarded as biologically unique and either endangered or vulnerable;
- Eight bird SoCC were confirmed during the biodiversity baseline surveys;
- The bird survey results confirmed the importance of seasonal surveys when conducting baseline assessments with significant differences between dry season and wet season bird communities;
- The area of highest density of bird SoCC was between Garba Tula in the south and Baragoi in the north. This part of the pipeline overlaps with several community conservancies, forest reserves and national reserves highlighting the importance of protected areas for the conservation of bird diversity. The bird baseline also confirmed the importance of riparian habitats as areas of high bird diversity;
- The mammal assessment identified 16 SoCC including areas of core and critical habitat for the endangered Grevy's Zebra;
- Sites with high mammal diversity corresponded with drainage lines and rivers including the Suguta Valley in the north of the Project foortprint and the Uaso Nyiro River in the central part of the AoI, as well as protected areas such as Kalama Community Wildlife Conservancy, Nakuprat- Gotu Community Conservancy and Rahole National Reserve as well as the forest mosaic vegetation community in the east of the AoI. This highlights the importance of these habitats as hotspots of mammal diversity;
- Three range restricted amphibian species were recorded over the course of the baseline assessment;
- Two invertebrate SoCC were recorded over the course of the baseline field surveys namely Brown-veined White Butterfly (*Belenois aurota*) and African Migrant Butterfly (*Catopsilia florella);*
- Two SoCC fish species were recorded during the baseline field surveys, namely:
  - Neumayer's Barb (*Enteromius neumayeri*), recorded in the Kerio River; and
  - A subspecies of Nile Tilapia (*Oreochromis niloticus sugutae*), recorded in the Suguta River; and
- The presence of SoCC fish species further confirms the importance and sensitivity of rivers and drainage lines as key biodiversity habitats.

2.0 ACRONYMS AND ABBREVIATIONS

Abbreviation	Description
ABE	African Bush Elephant
BI	Birdlife International
CH	Critical Habitat
CHAA	Critical Habitat Area of Analysis
CITES	Convention on International Trade in Endangered Species of wild fauna and flora
CMS	Convention on Migratory Species
CR	Critically Endangered
DD	Data Deficient
EBA	Endemic Bird Areas
EBV	Essential Biodiversity Variable
EN	Endangered
EOO	Extent of Occurrence
ESF	Environnementalistes Sans Frontieres
GBIF	Global Biodiversity Information Facility
GZ	Grevy's Zebra
GZT	Grevy’s Zebra Trust
IBA	Important Bird Areas
IBAT	Integrated Biodiversity Assessment Tool
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Areas
KMMN	Kenya Marine Mammal Network
KWS	Kenya Wildlife Service
LAMCOT	Lamu Marine Conservation Trust
LC	Least Concern
LWC-NNFR	Lewa Wildlife Conservancy and Ngare Ndare Forest Reserve
MoL	Map of Life
NBSAP	Kenya National Biodiversity Strategy and Action Plan
NEMA	National Environment Management Authority
NGO	Non-Governmental Organisation

Abbreviation	Description
NMK	National Museums of Kenya
NT	Near Threatened
P	Protected
PPMT	Pipeline Project Management Team
SoCC	Species of Conservation Concern
SEP	Stakeholder Engagement Plan
TDS	Total Dissolved Solids
TKBV	Tullow oil Kenya Business Venture
TSS	Total Suspended Solids
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VU	Vulnerable
WC	Water Conductivity
WDKBA	World Database of Key Biodiversity Areas
WDPA	World Database on Protected Areas
WMA	Watamu Marine Association
WWF	World Wildlife Fund

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Signature Page

Golder Associates (UK) Ltd

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FB/TGF/es

Date: 07 August 2019

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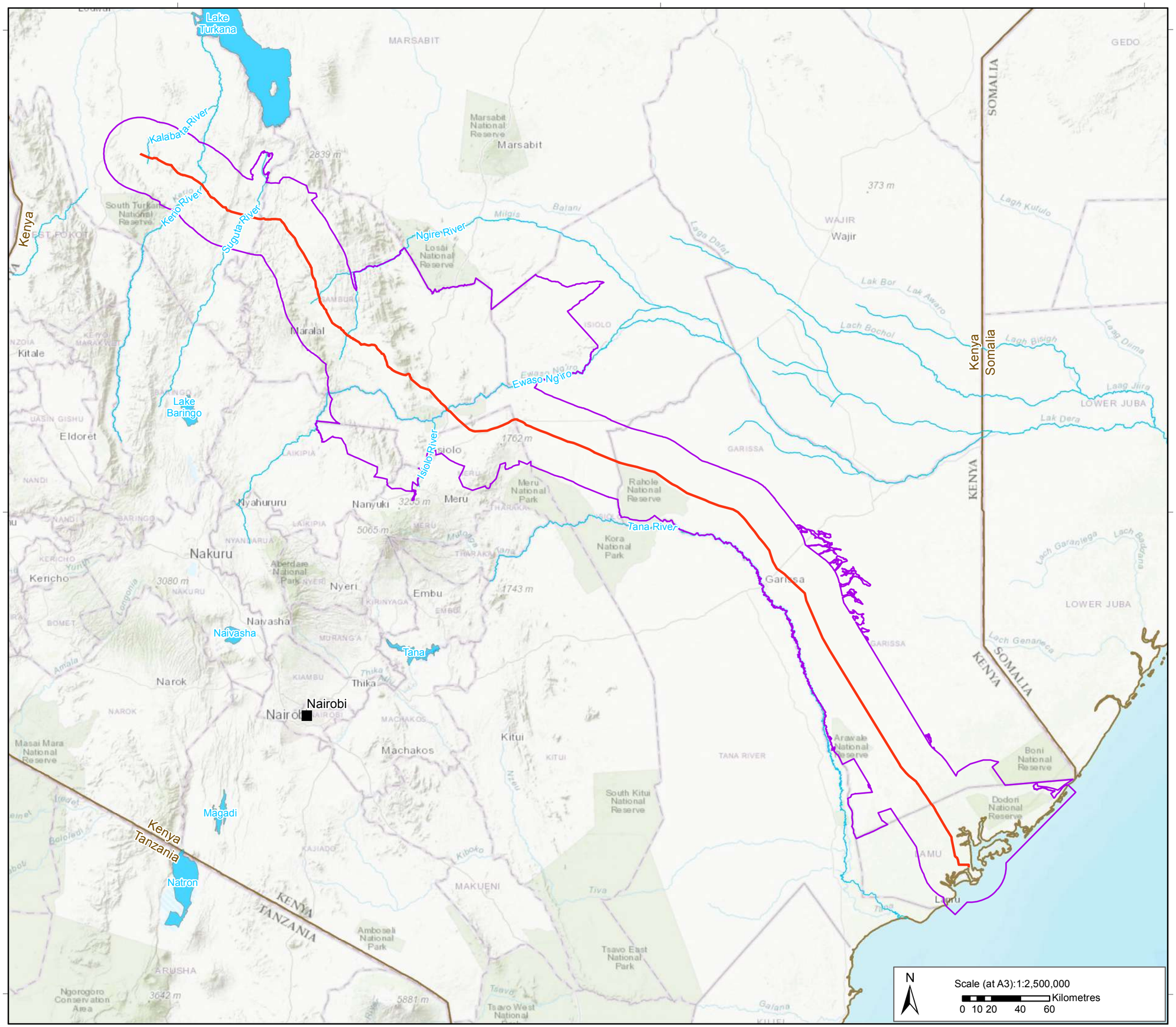
DRAWINGS

Drawing 1: Terrestrial Biodversity Area of Influence



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 29-01-2019	LD 30-01-2019	TF 06-08-2019

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Sources: Esri, USGS, NOAA

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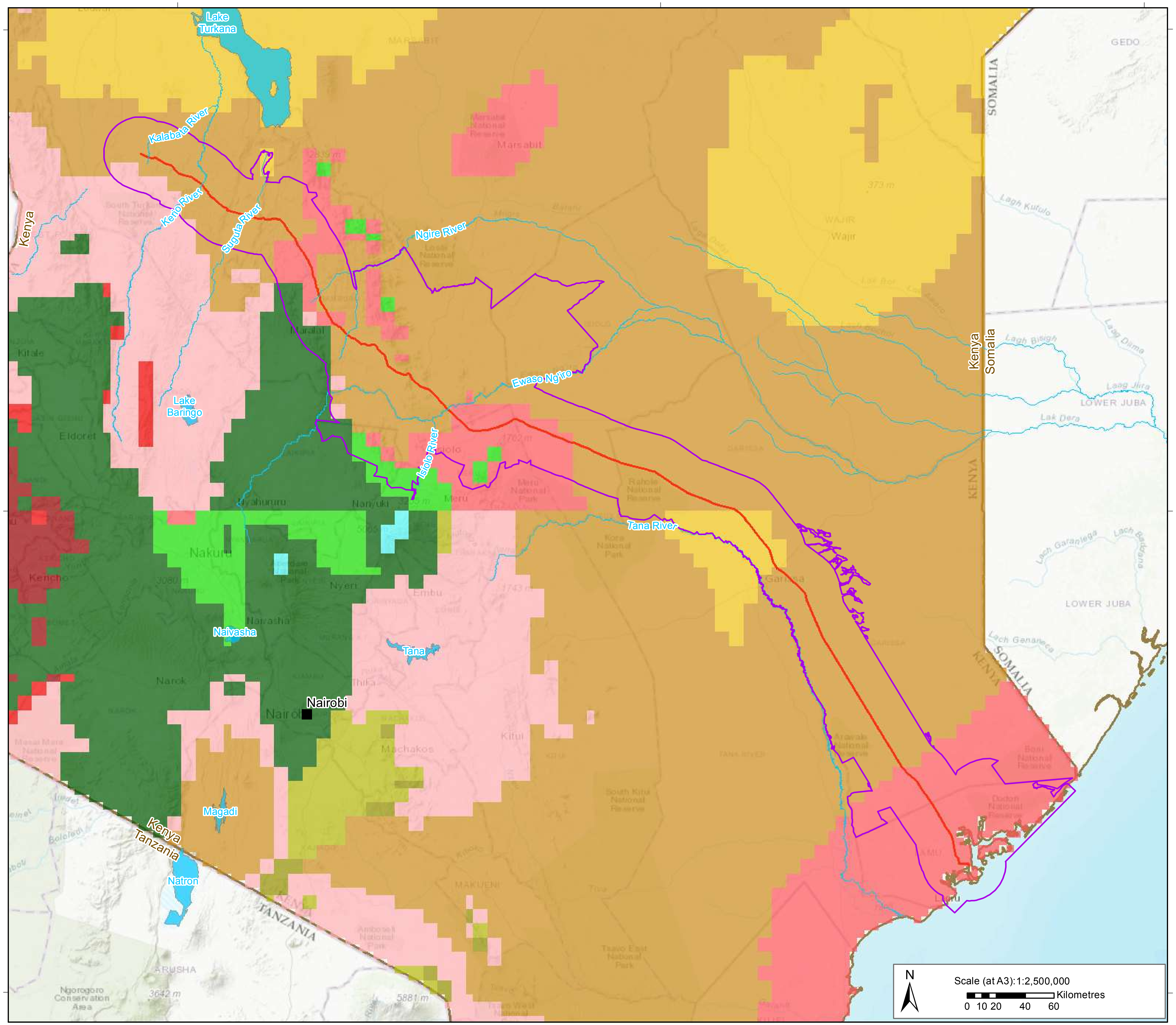

Drawing 2: Köppen-Geiger Climate Classification

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Köppen-Geiger Climate Classification

- Af
- Am
- As
- Aw
- Bsh
- BWh
- Cfb
- Csb
- Cwa
- Cwb
- ET

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Köppen-Geiger Climate Classification map available from World Maps Of Köppen-Geiger Climate Classification© 2019 | Climate Change & Infectious Diseases Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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Sources: Esri, USGS, NOAA

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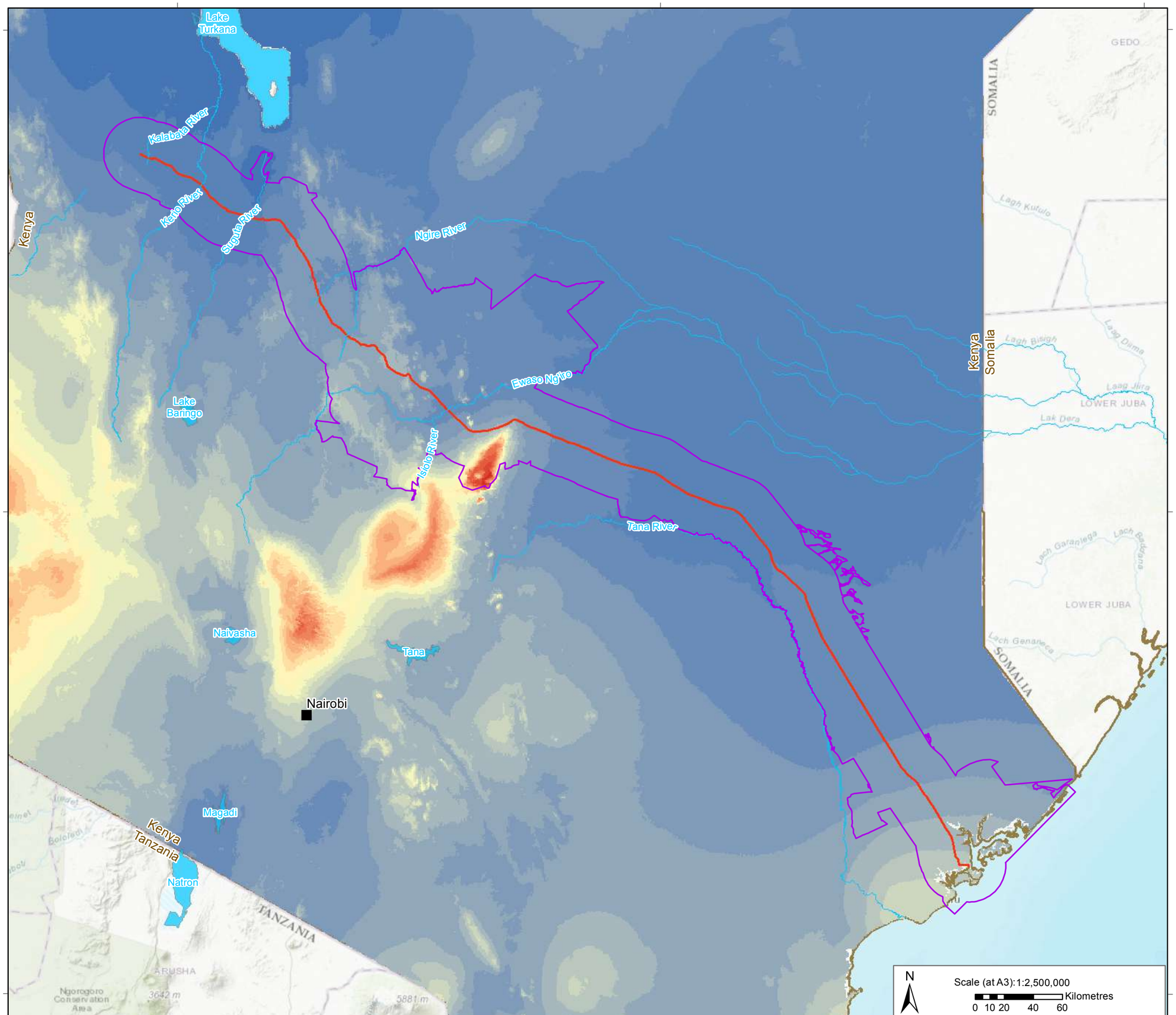
Drawing 3: Rainfall Map



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Sources: Esri, USGS, NOAA

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Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Rainfall (mm)

- 173 - 250
- 250 - 375
- 375 - 500
- 500 - 625
- 625 - 750
- 750 - 875
- 875 - 1,000
- 1,000 - 1,125
- 1,125 - 1,250
- 1,250 - 1,375
- 1,375 - 1,500
- 1,500 - 1,625
- 1,625 - 1,750
- 1,750 - 1,875
- 1,875 - 2,000
- 2,000 - 2,125
- 2,125 - 2,250
- 2,250 - 2,375
- 2,375 - 2,500
- 2,500 - 2,625

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Rainfall map available from World Resources Institute (WRI) under the Creative Commons license. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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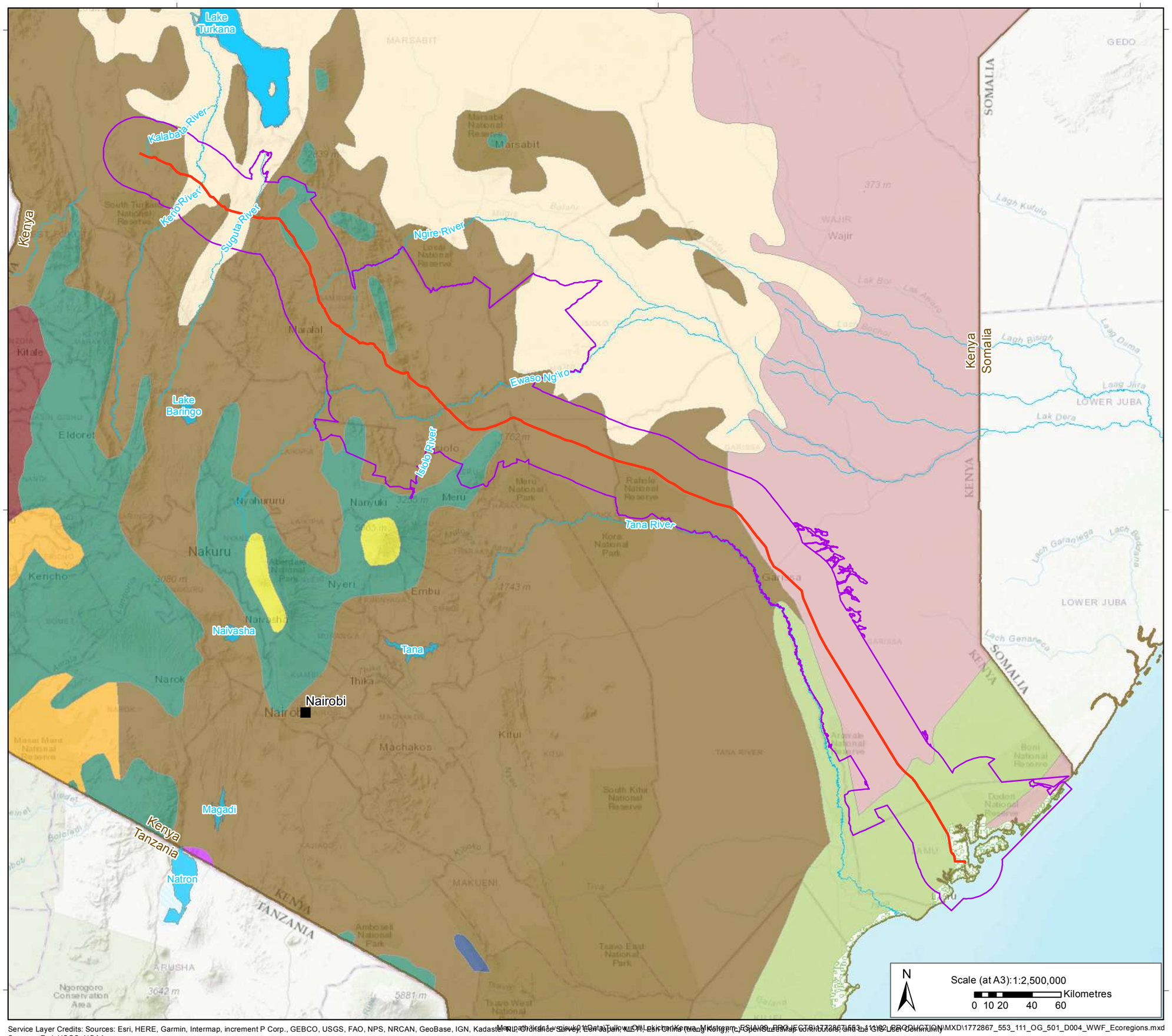
Drawing 4: WWF Ecoregions



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

WWF Ecoregions

- East African Halophytic
- East African Mangrove
- East African Montane Forest
- East African Montane Moorland
- Eastern Arc Forest
- Lake: Afrotropic
- Masai Xeric Grasslands And Shrubland
- Northern Acacia-Commiphora Bushland and Thicket
- Northern Zanzibar-Inhambane Coastal Forest Mosaic
- Somali Acacia-Commiphora Bushland and Thicket
- Southern Acacia-Commiphora Bushland and Thicket
- Victoria Basin Forest-Savanna Mosaic

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from WWF © 2019 World Wildlife Fund. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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Sources: Esri, USGS, NOAA

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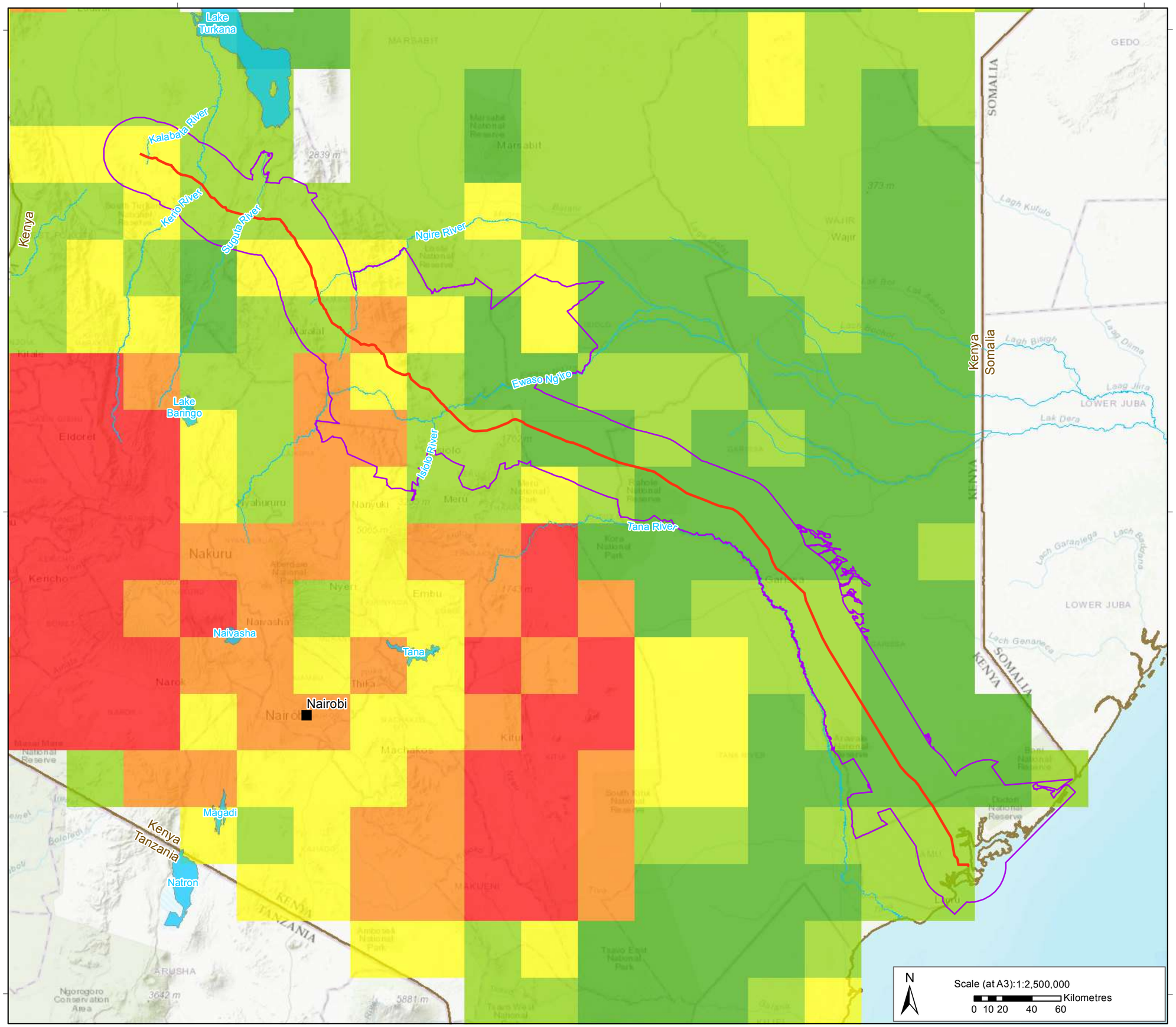
Drawing 5: Changes in Average Local Terrestrial Diversity



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Changes in Average Local Terrestrial Diversity

- 0.33 - 0.45
- 0.45 - 0.58
- 0.58 - 0.70
- 0.70 - 0.82
- 0.82 - 0.95

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from GEO BON
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Surface water data
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

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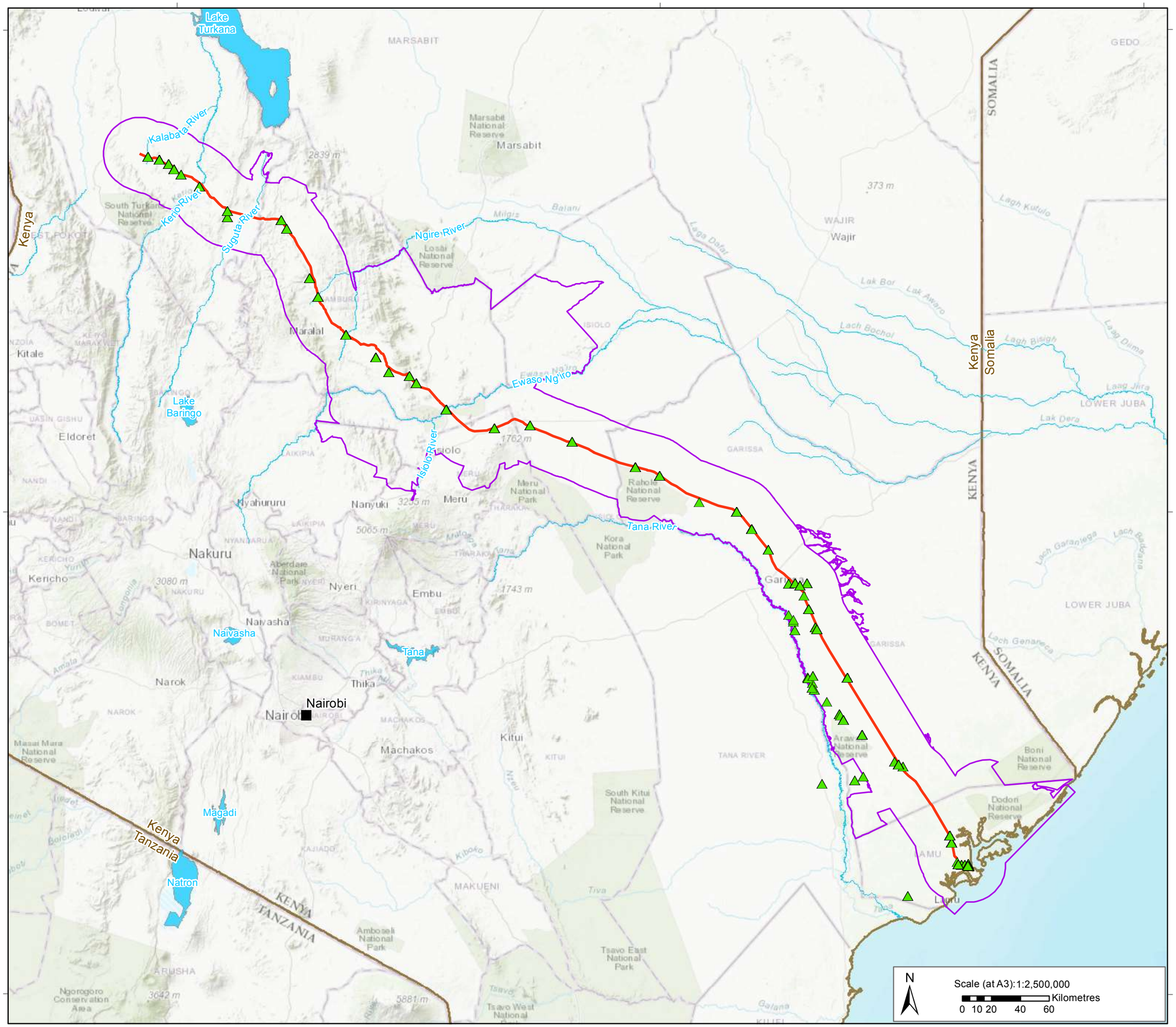

Drawing 6: Vegetation Sample Locations

Key

- Vegetation Sample Location
- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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Sources: Esri, USGS, NOAA

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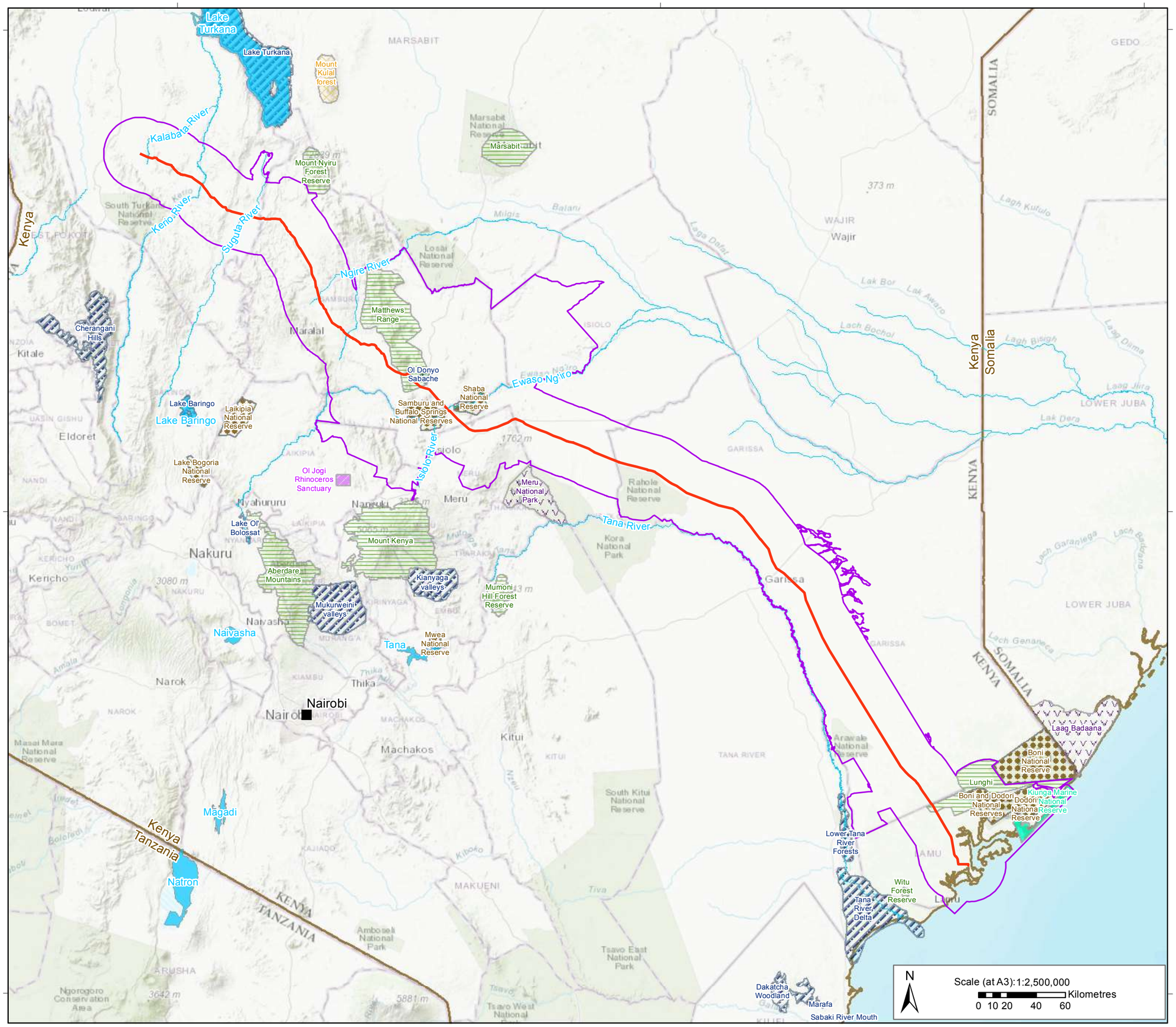
Drawing 7: Key Biodiversity Areas (KBA)



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Key Biodiversity Areas

- Conservancy
- Forest Reserve
- Important Bird Area (IBA)
- Marine National Reserve
- National Park
- National Reserve
- UNESCO Biosphere Reserve

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Key Biodiversity Data available from IBAT 2018. Surface water data available from Openstreet map under the Open Data Commons Open Database License

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Sources: Esri, USGS, NOAA

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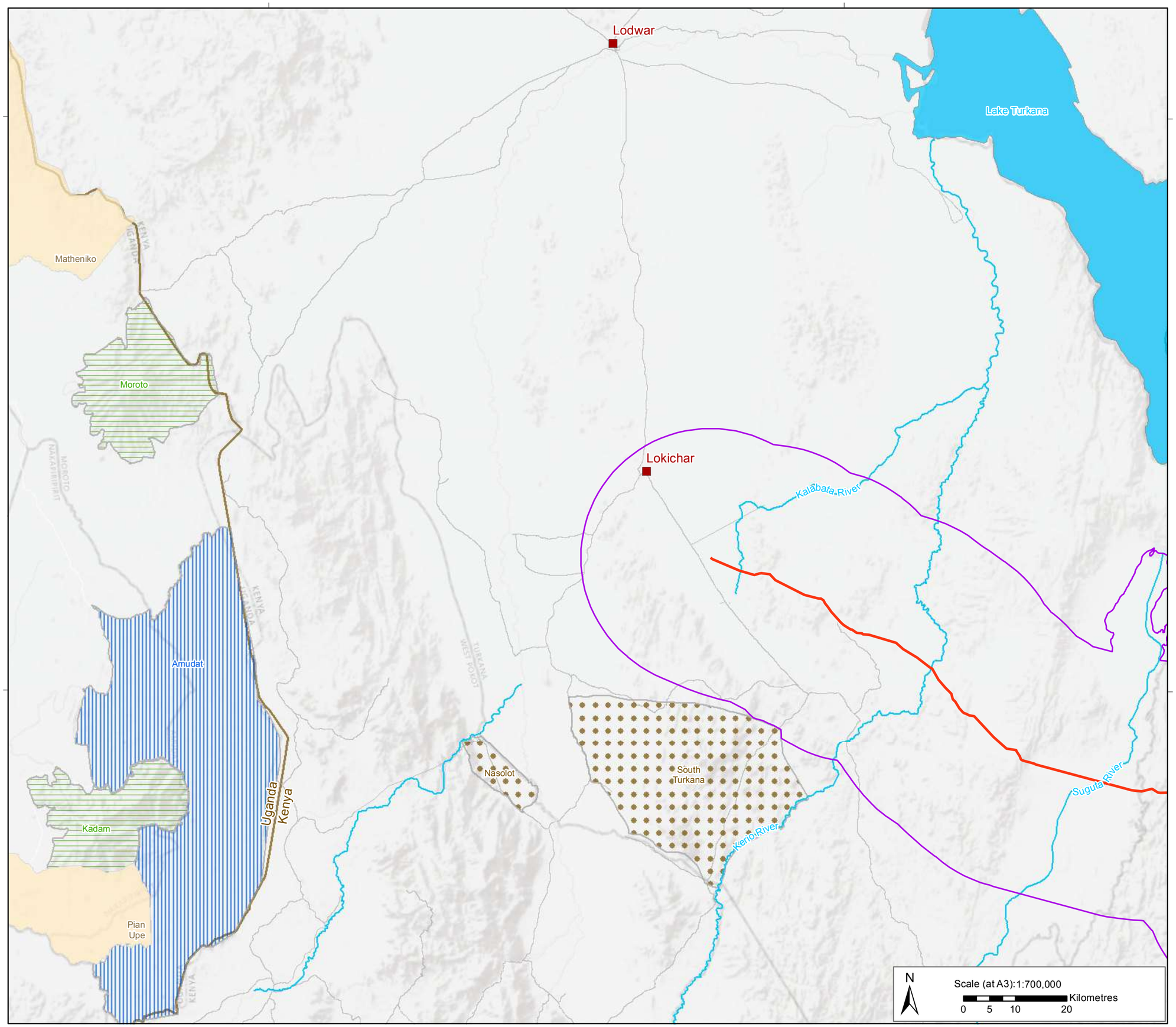
Drawing 8.1: World Database of Protected Areas

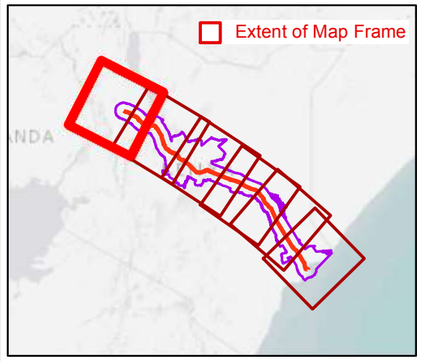


Key

- Town
- Planned Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Road
- Waterbody
- Watercourse

World Database of Protected Areas (March 2018)

- Community Wildlife Management Area
- Forest Reserve
- National Reserve
- Wildlife Reserve
- World Heritage Site



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from IBAT 2018. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

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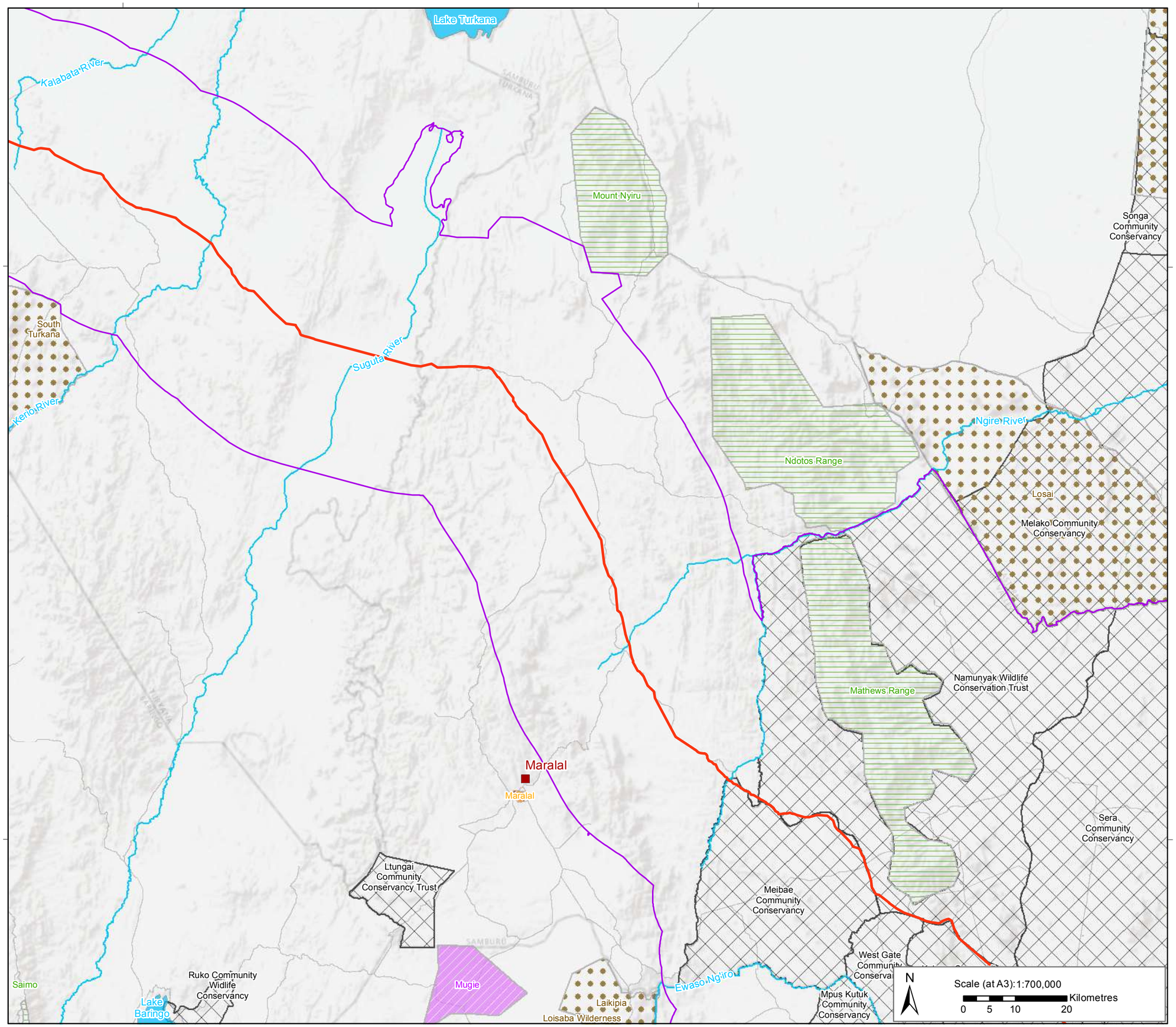
Drawing 8.2: World Database of Protected Areas

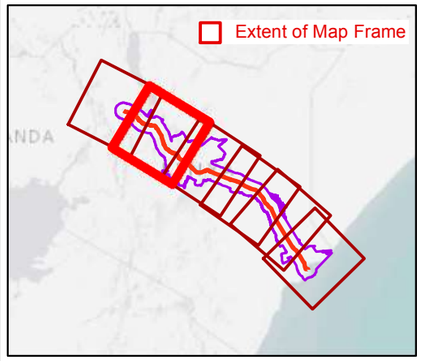


Key

- Town
- Planned Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Road
- Waterbody
- Watercourse

World Database of Protected Areas (March 2018)

- Community Conservancy
- Community Nature Reserve
- Forest Reserve
- National Reserve
- National Sanctuary
- Private Ranch



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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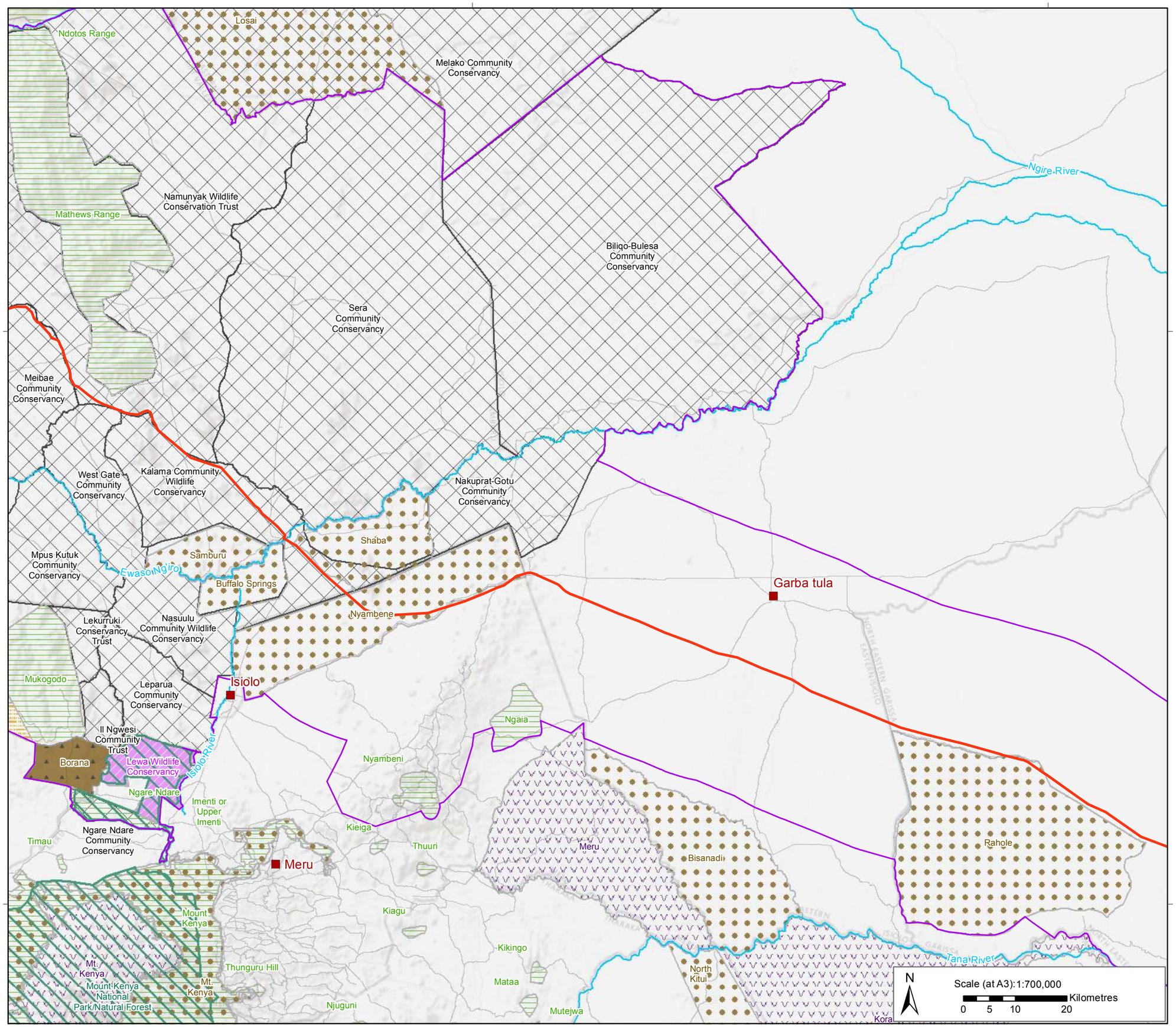
Drawing 8.3: World Database of Protected Areas

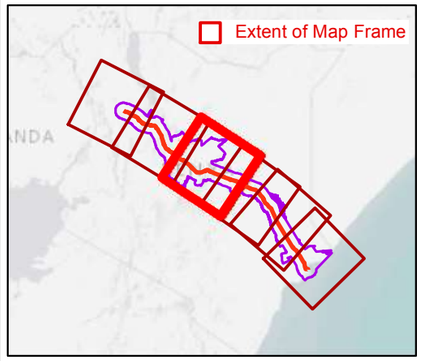


Key

- Town
- Planned Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Road
- Watercourse

World Database of Protected Areas (March 2018)

- Community Conservancy
- Community Nature Reserve
- Forest Reserve
- Group Ranch
- National Park
- National Reserve
- Private Ranch
- World Heritage Site



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

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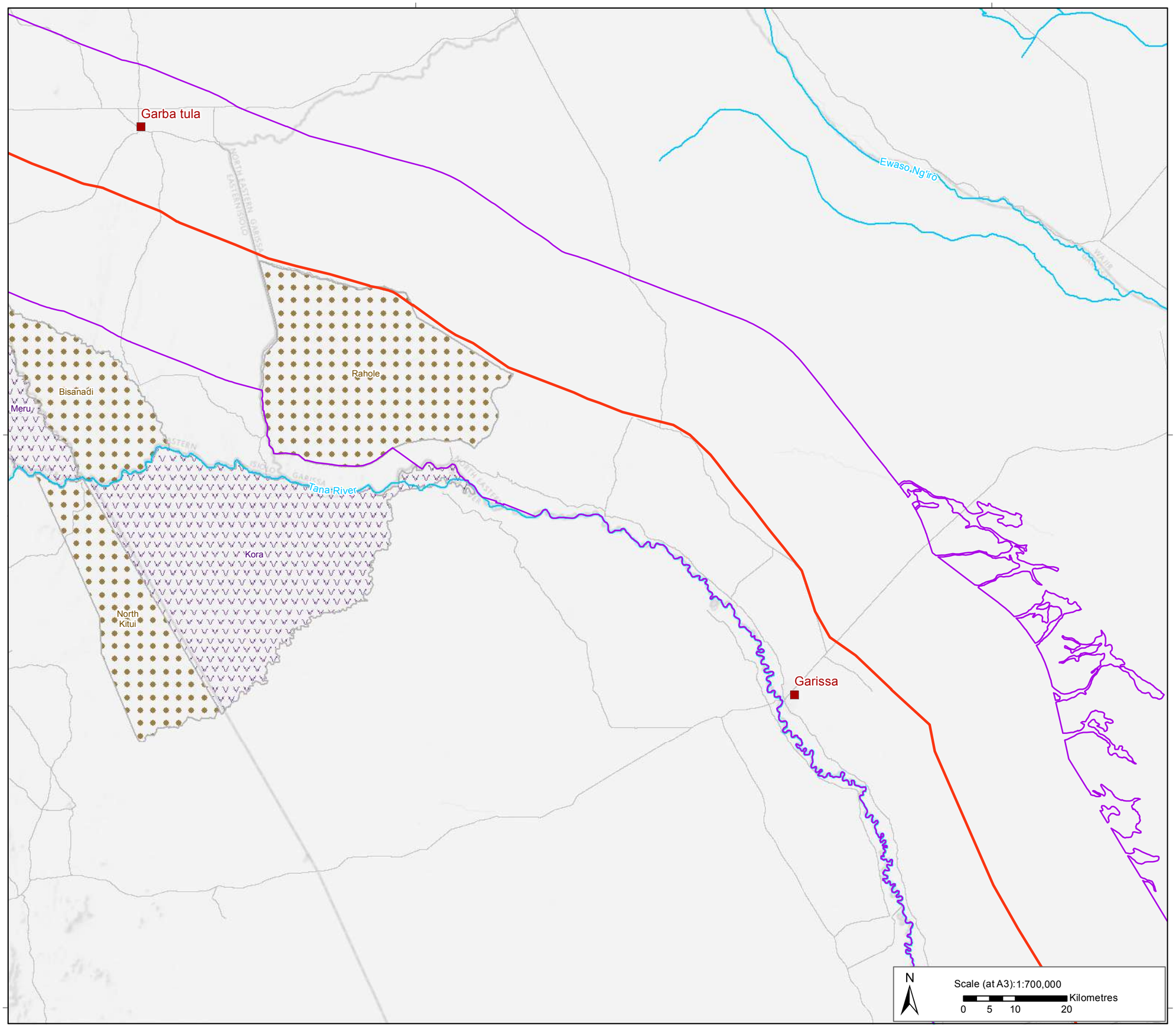
Drawing 8.4: World Database of Protected Areas

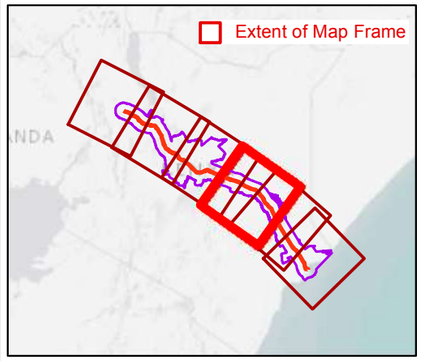


Key

- Town
- Planned Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Road
- Watercourse

World Database of Protected Areas (March 2018)

- National Park
- National Reserve



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from IBAT 2018. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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GOLDER

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Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

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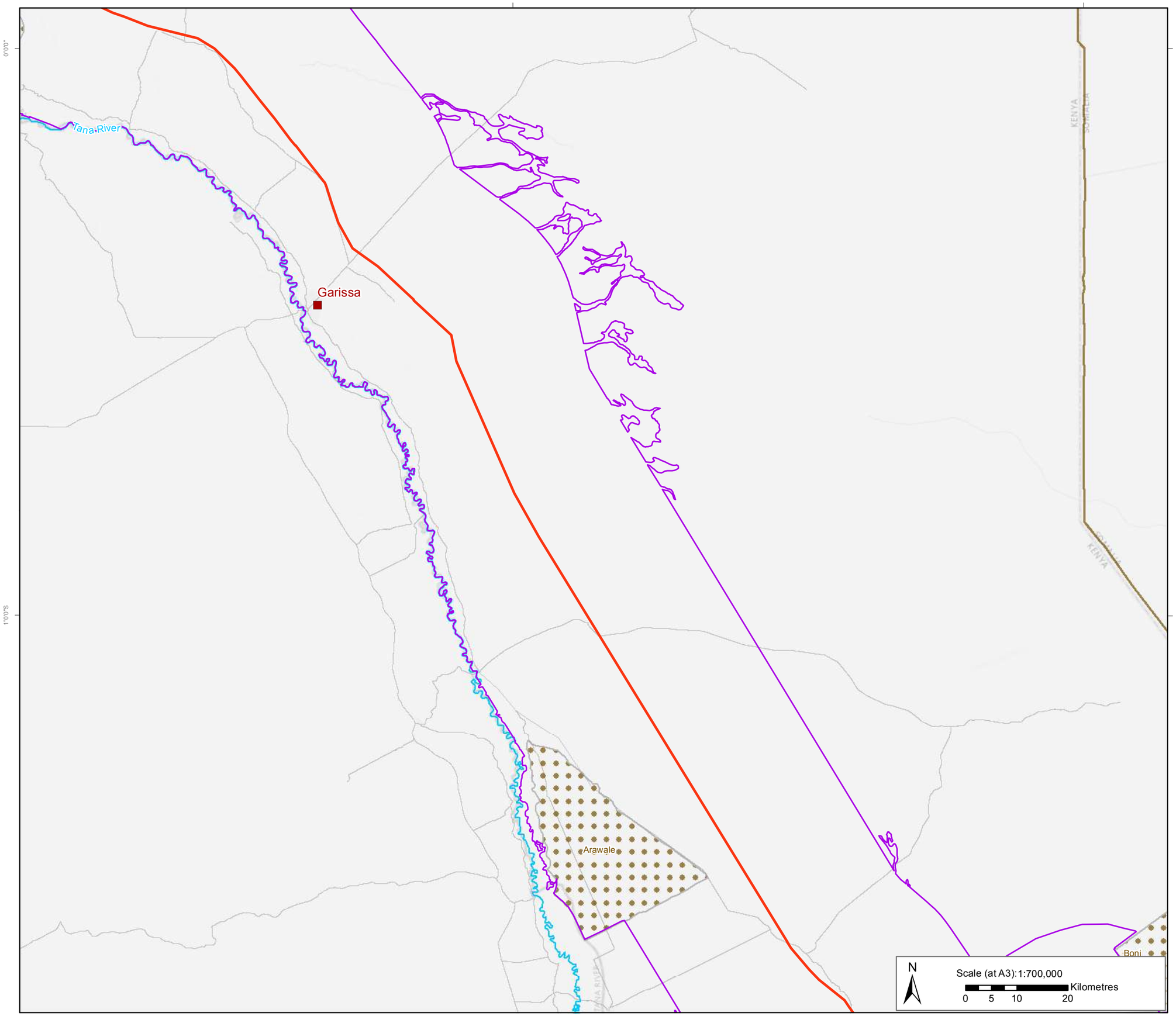
Drawing 8.5: World Database of Protected Areas

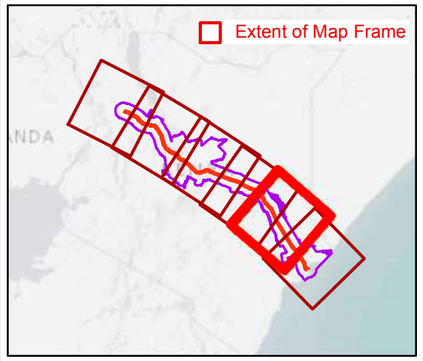


Key

- Town
- Planned Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Road
- Watercourse

World Database of Protected Areas (March 2018)

- National Reserve



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from IBAT 2018. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 29-01-2019	LD 01-02-2019	TF 07-08-2019

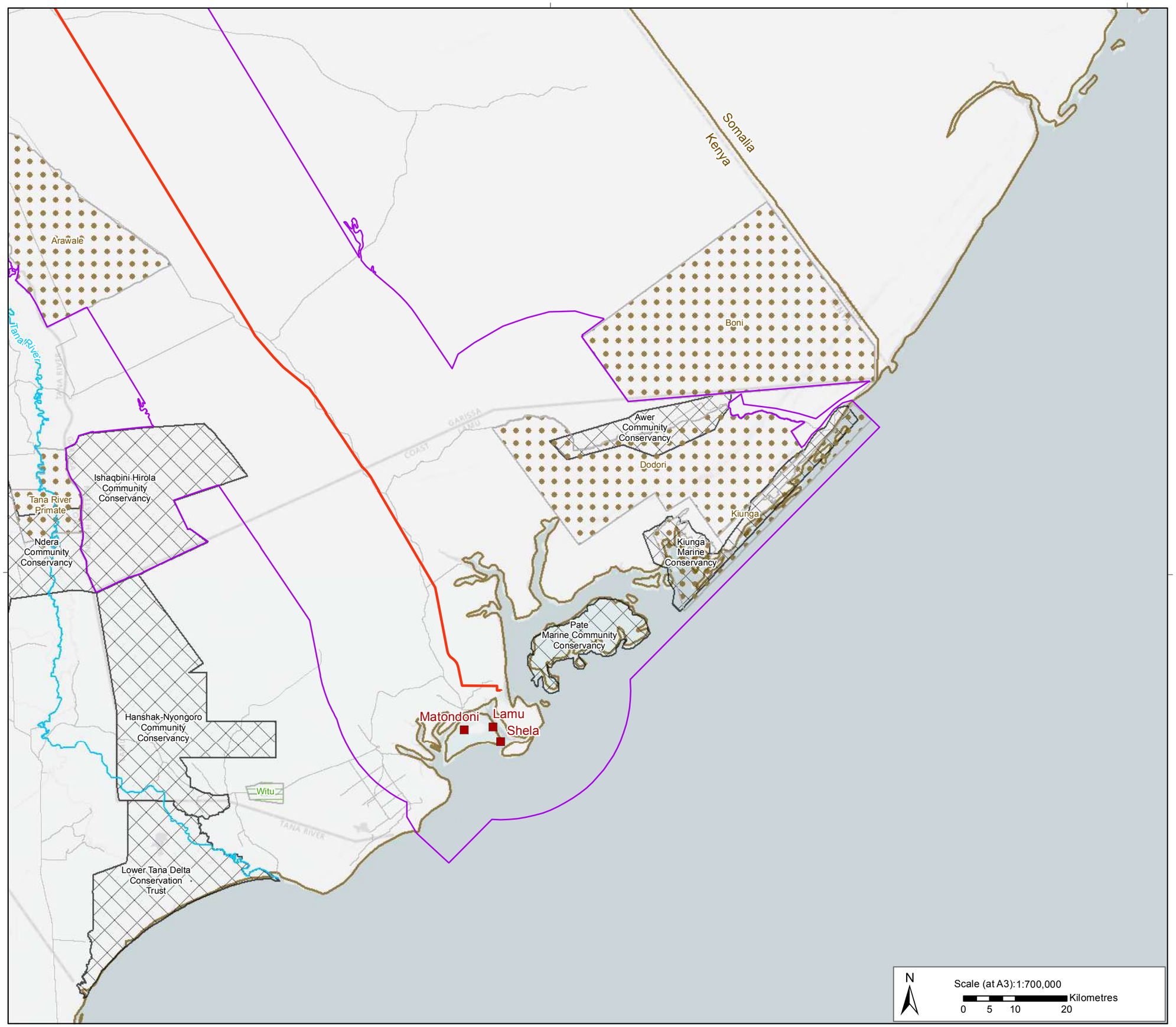
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_504_D008_Protected_Areas.mxd

Drawing 8.6: World Database of Protected Areas

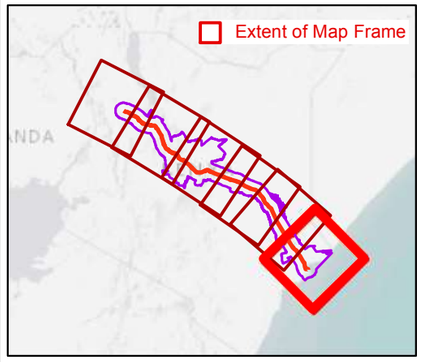


Key

- Town
- Planned Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Road
- Watercourse

World Database of Protected Areas (March 2018)

- Community Nature Reserve
- Forest Reserve
- National Reserve



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from IBAT 2018. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 29-01-2019	LD 01-02-2019	TF 07-08-2019

GOLDER

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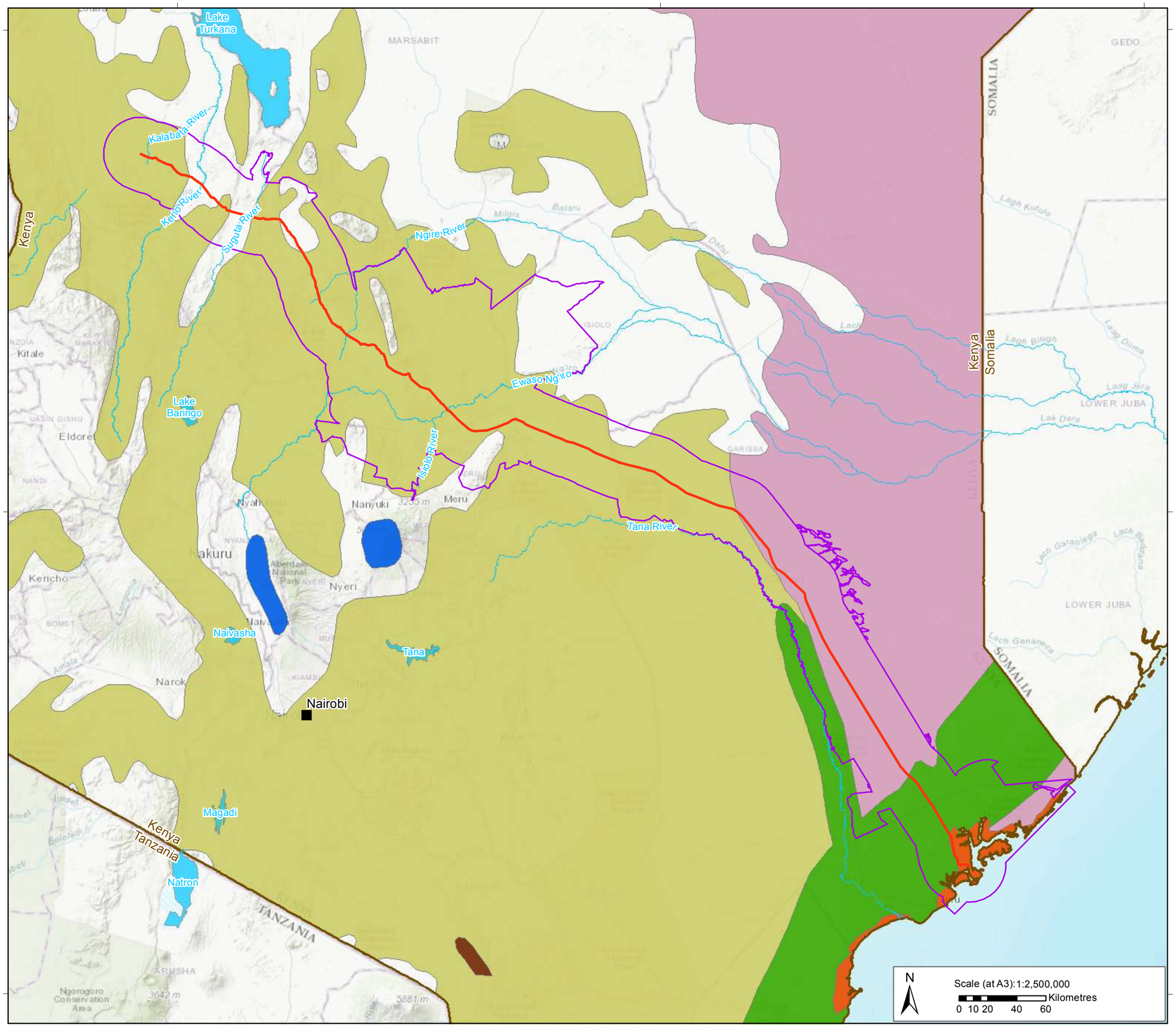
Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_504_D008_Protected_Areas.mxd

Drawing 9: Global 200 Ecoregions



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Global Ecoregions

- East African Acacia Savanna
- East African Coastal Forest
- East African Mangrove
- East African Moorland
- Eastern Arc Montane Forest
- Horn of Africa Acacia Savanna

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Data available from WWF © 2019 World Wildlife Fund. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 29-01-2019	LD 30-01-2019	TF 06-08-2019

GOLDER

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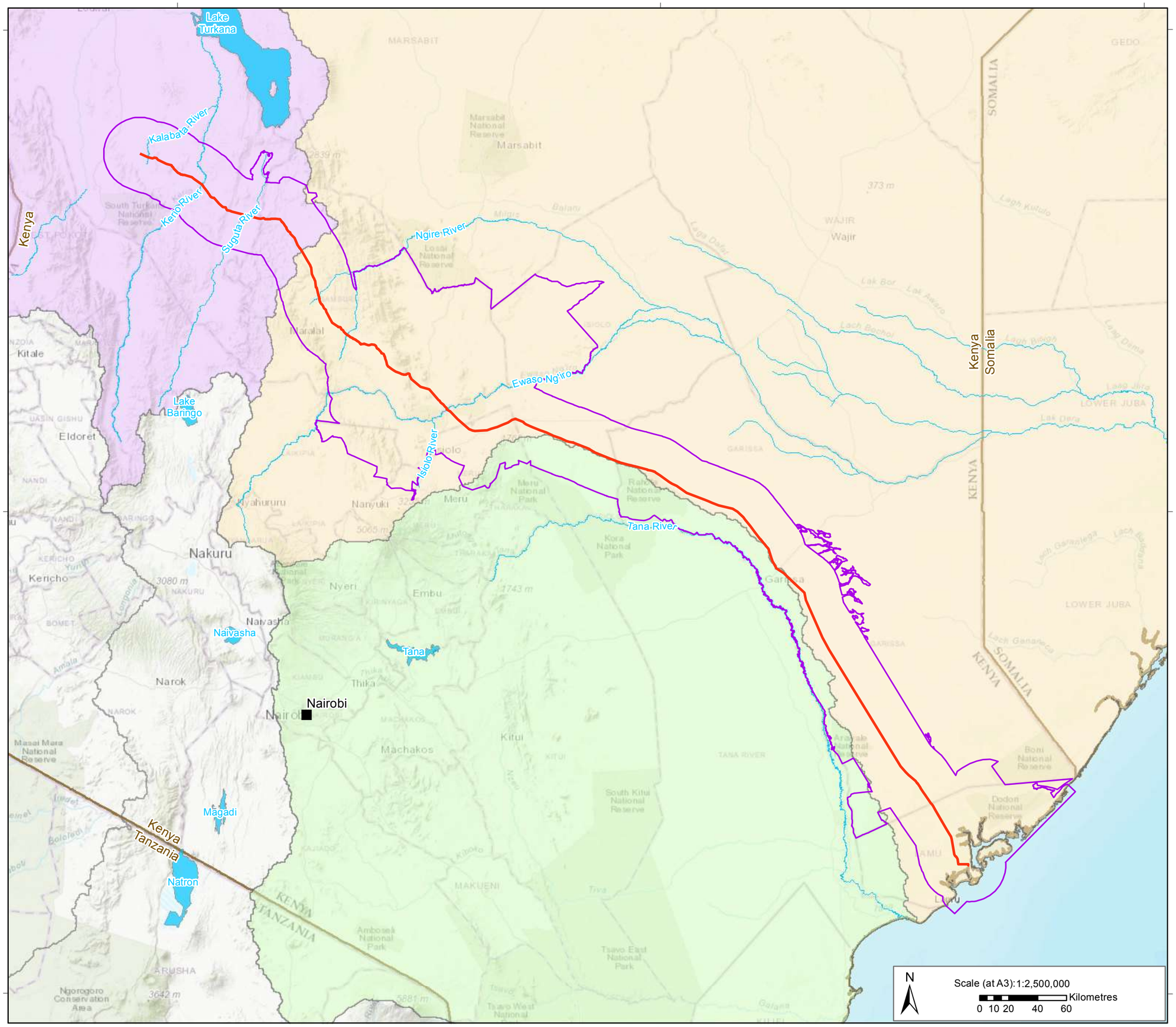
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Manpath\\rds1-gisuk01\Data\Tullow Oil\Lokichar Kenya Midstream - ESIA\09 - PROJECTS\1772867\553_111\08 - PRODUCTION\MXD\1772867_553_111_OG_503_D009_Global_Ecoregions.mxd

Drawing 10: Aquatic Ecoregions



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Catchments

- Lake Turkana
- Kenyan Coastal River
- Shebelle - Juba

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group.Hydroshed data available from Fresh Ecoregions of the World (FEOW) ©WWF/TNC 2013
Surface water data
available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 29-01-2019	LD 30-01-2019	TF 06-08-2019

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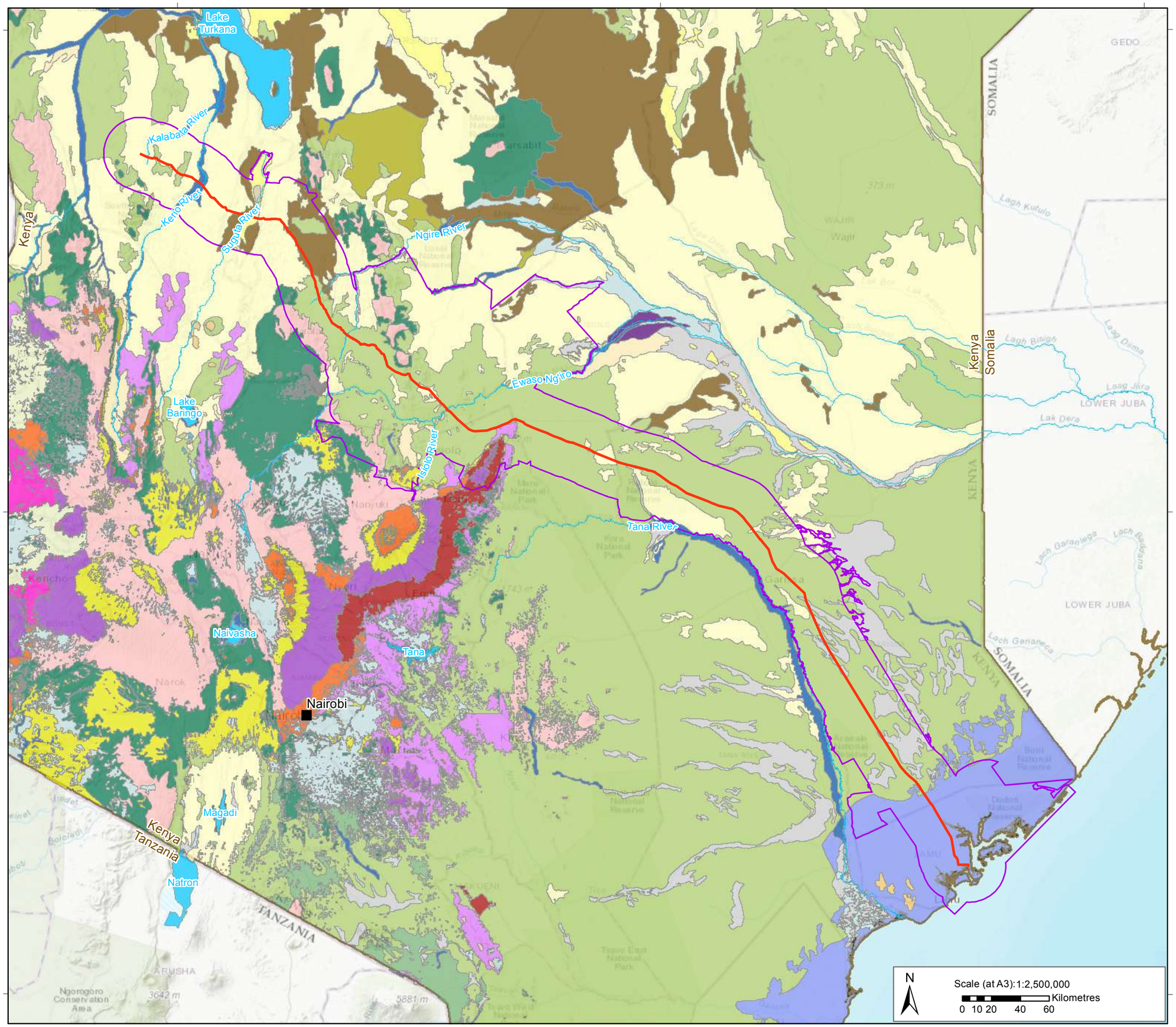
Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path: \\sta1-w-gisuk01\Data\Tullow_Oil\Lokisher\Kenya_Midstream_ESIA\08_PROJECTS\1772867553_USI02_PRODUCTION\MXD\1772867_553_111_OG_506_D010_Hydrosheds.mxd

Drawing 11: Vegetation of Kenya



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Vegetation of Kenya

- *Acacia Tortilis* Wooded Grassland and Woodland
- *Acacia Commiphora* Deciduous Wooded Grassland and Combretum Wooded Grassland
- *Acacia Commiphora* Stunted Bushland
- Afroalpine Vegetation
- Afromontane Bamboo
- Afromontane Desert
- Afromontane Dry Transitional Forest
- Afromontane Moist Transitional Forest
- Afromontane Rain Forest
- Afromontane Undifferentiated Forest
- Climatic Grasslands
- Coastal Mosaic
- Desert
- Dry Combretum Wooded Grassland
- Edaphic Grassland on Drainage-Impeded or Seasonally Flooded Soil
- Edaphic Grassland on Drainage-Impeded or Seasonally Flooded Soil & Freshwater Swamp
- Edaphic Grassland on Volcanic Soil
- Edaphic Wooded Grassland on Drainage-Impeded or Seasonally Flooded Soil
- Evergreen and Semi-Evergreen Bushland and Thicket
- Freshwater Swamp
- Halophytic Vegetation
- Lake Victoria Drier Peripheral Semi-Evergreen Guineo-Congolian Rain Forest
- Lake Victoria Transitional Rain Forest
- Mangrove
- Moist Combretum Wooded Grassland
- Montane Ericaceous Belt
- Palm Wooded Grassland
- Riverine Wooded Vegetation
- Sand
- Single-Dominant Hagenia Abyssinica Forest
- Somalia-Masai *Acacia Commiphora* Deciduous Bushland and Thicket
- Somalia-Masai *Acacia Commiphora* Shrubland and Somalia-Masai Semi-Desert Grassland and Shrubland
- Somalia-Masai Semi-Desert Grassland and Shrubland
- Upland *Acacia* Wooded Grassland
- Water Body

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Vegetation data available from VECEA project 2015. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 29-01-2019	LD 30-01-2019	TF 06-08-2019

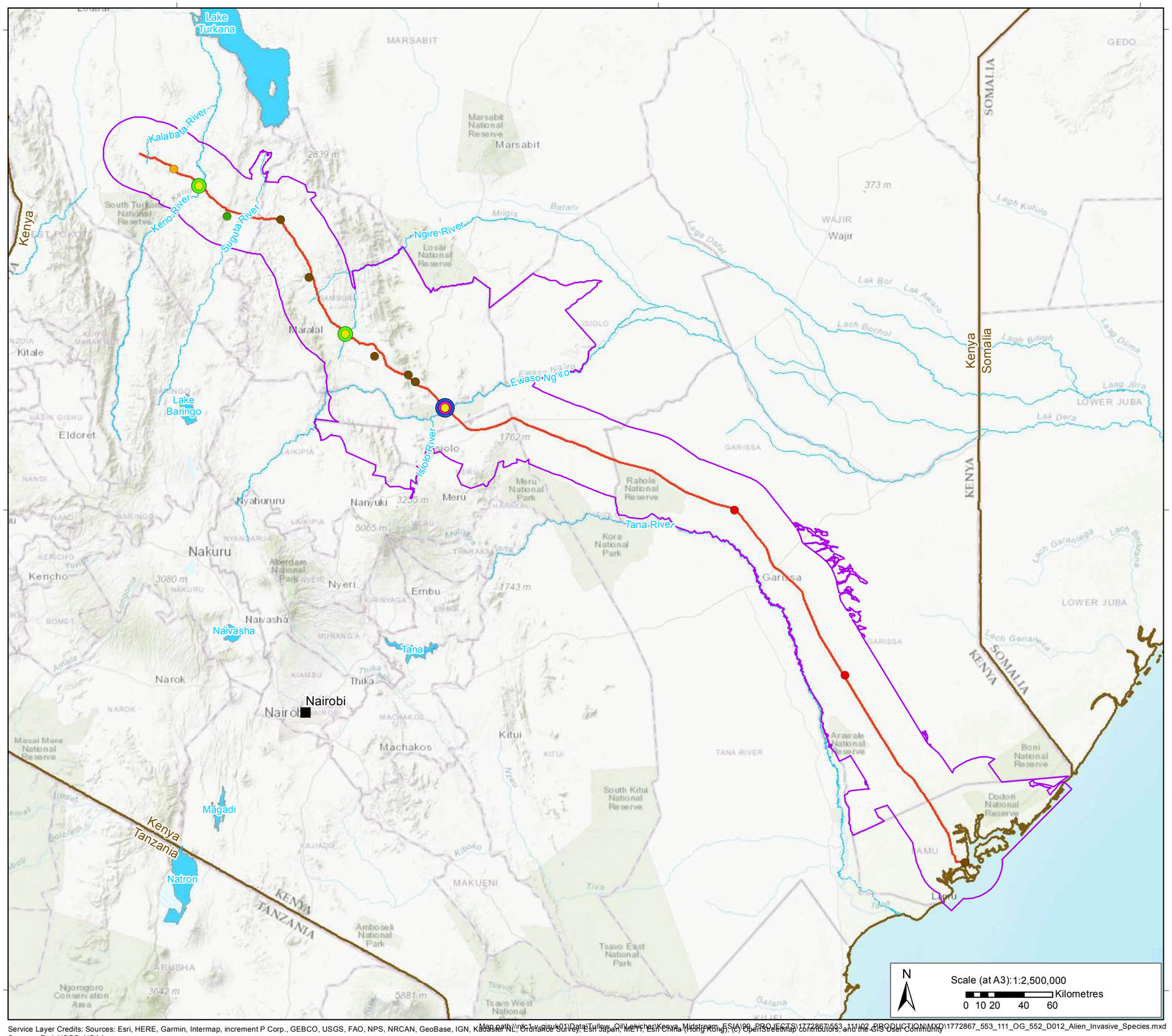
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path: Drawing_Kenya\01_Data\Tullow_OHL\Kenya_Hydrology_ESRI\99_SPOOL\GIS\1772867553_111021_PRODUCTION\MXD\1772867_553_111_OG_502_D011_Vegetation_of_Kenya.mxd

Drawing 12: Alien Invasive Plant species



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Alien Invasive Plant Species

- Datura Stramonium L.
- Prosopis Juliflora (Sw.) DC.
- Setaria Verticillata (L.) P. Beauv.
- Solanum Campylacanthum
- Xanthium Strumarium L.
- Opuntia Vulgaris Mill.
- Tagetes Minuta L.
- Opuntia Sp.

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

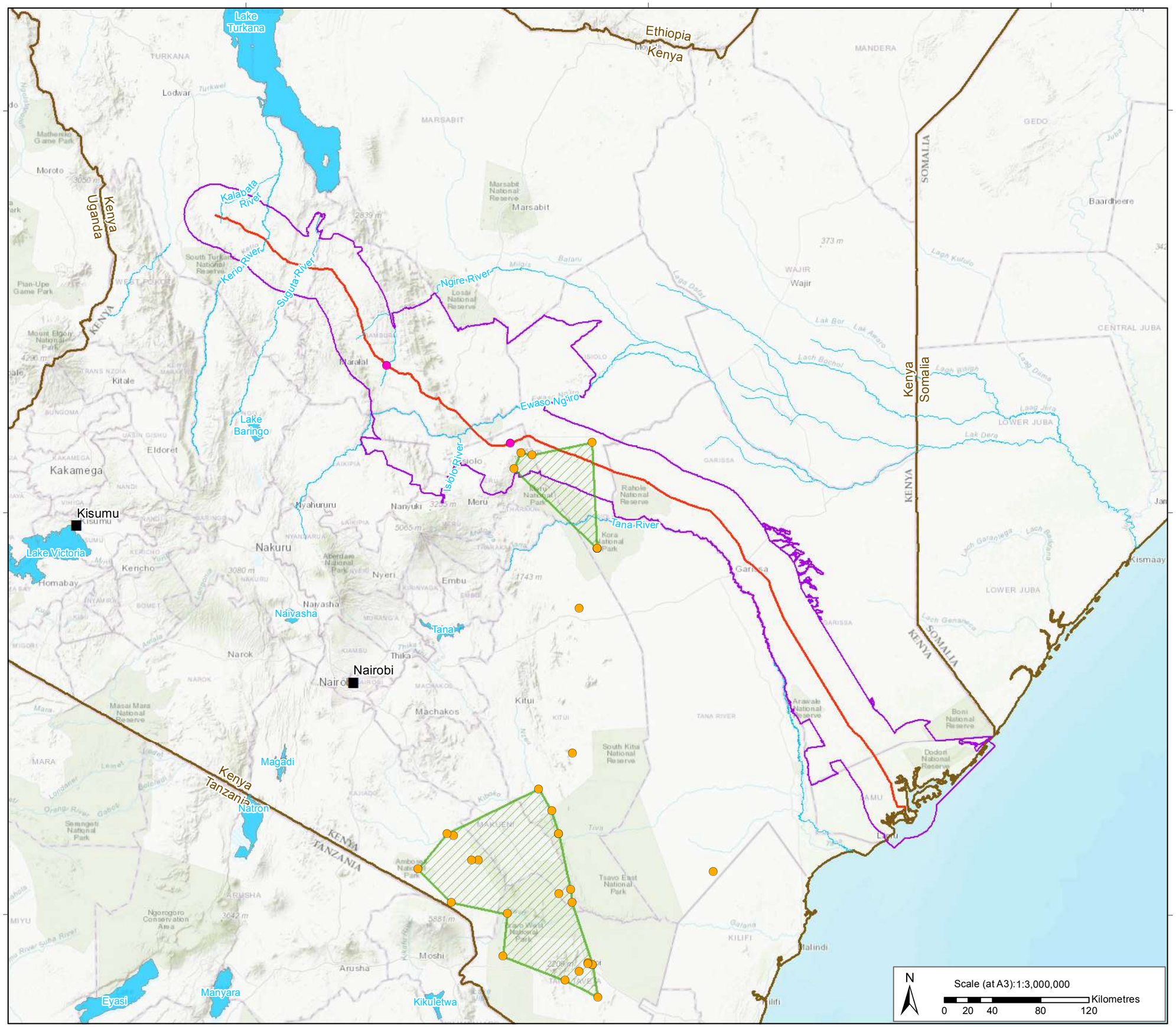
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Map path: \\rdc1-v-cisuk01\Data\Tullow_Oil\ekicher\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_552_D012_Alien_Invasive_Species.mxd

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Drawing 13: Distributional Range of Senegalia Thomasii



Key

- Senegalia Thomasii
- Historical Record of Senegalia Thomasii
- Senegalia Thomasii Core Range
- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

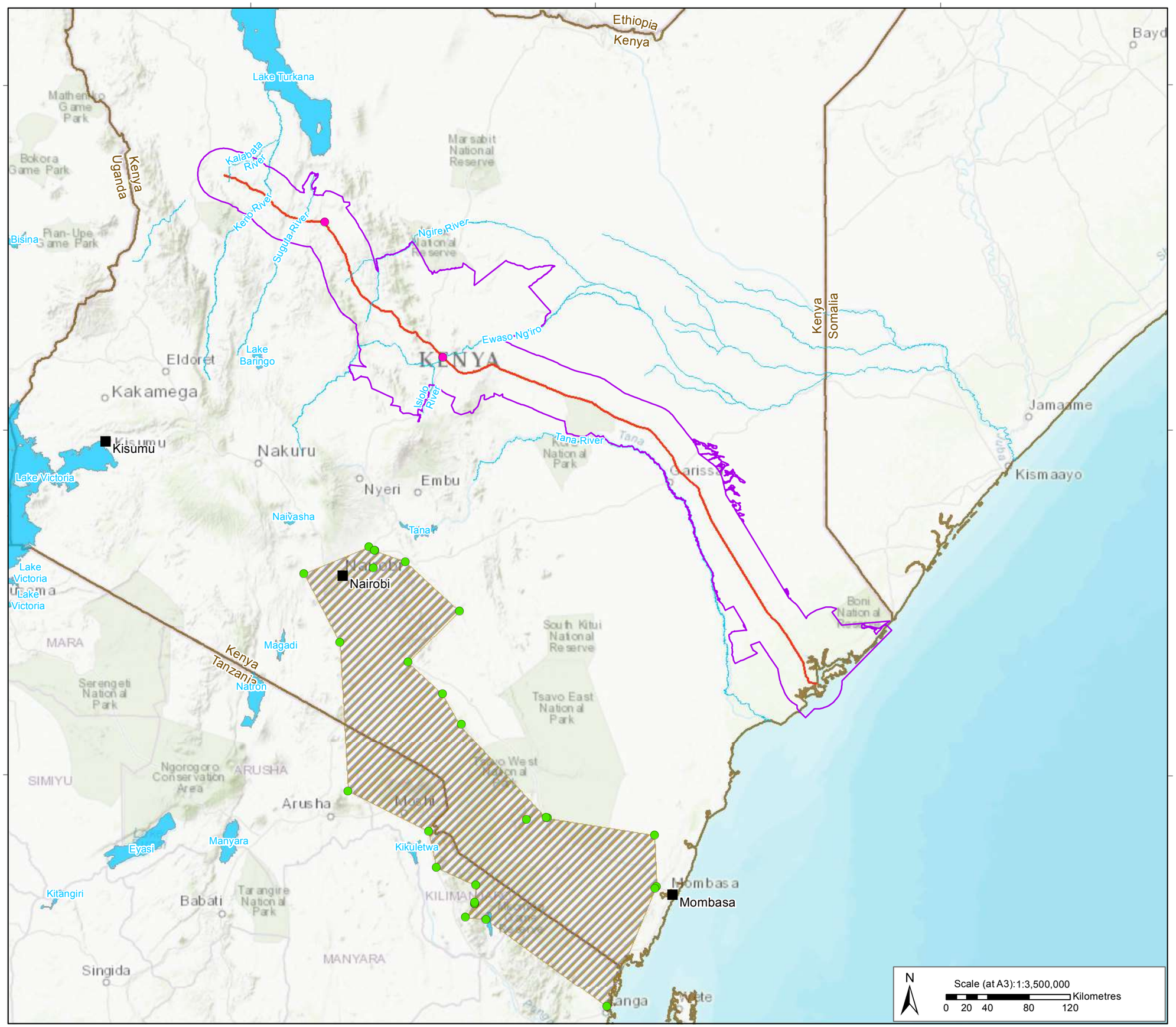
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path: O:\Drawing\1772867\553_111_02_PRODUCTION\MXD\1772867_553_111_OG_553_D013_Senegalia_thomasii.mxd

Drawing 14: Distributional Range of Aloe Deserti



Key

- Aloe Deserti Observation
- Historical Record of Aloe Deserti
- Aloe Deserti Core Range
- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

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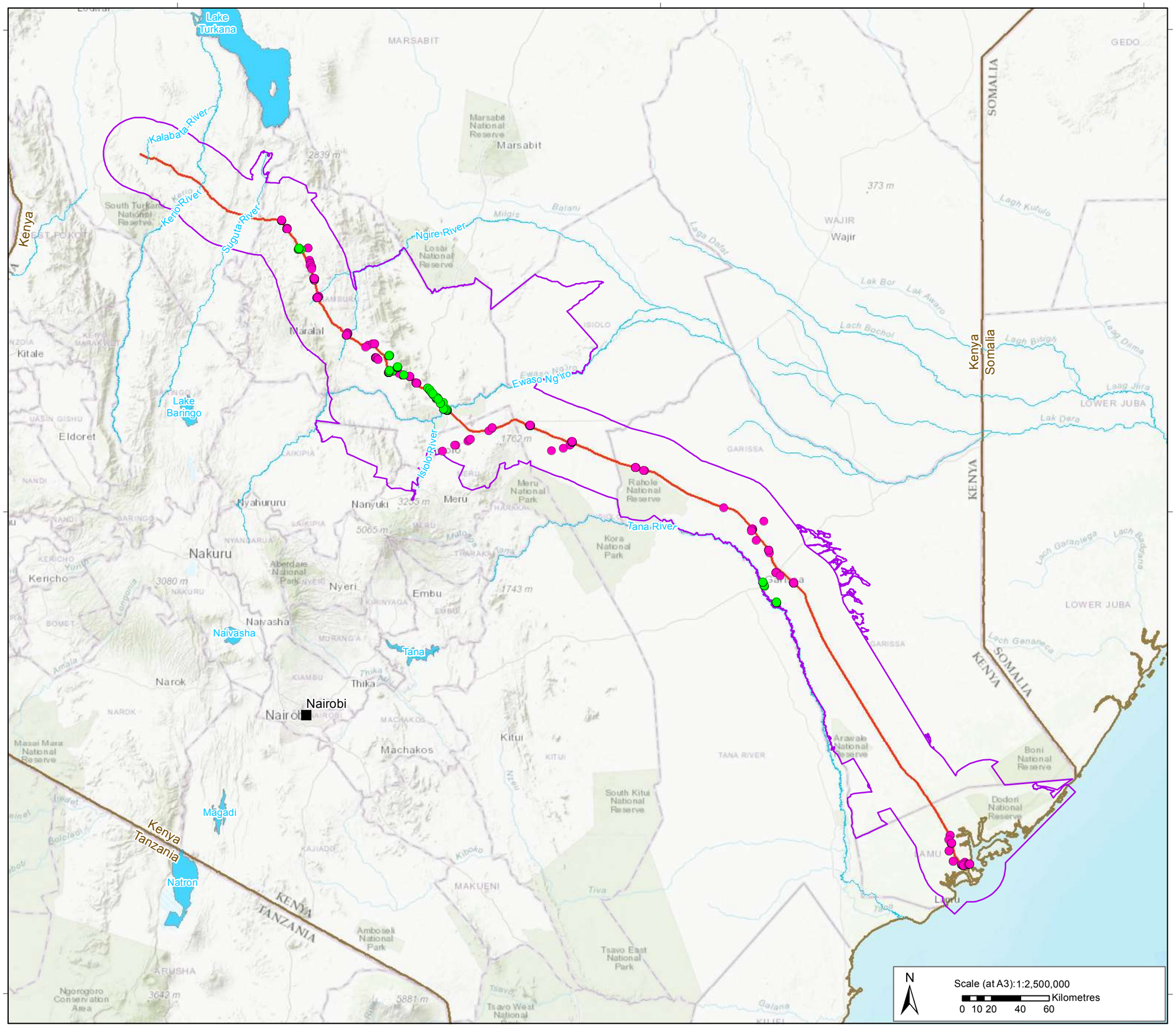
Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Master path: \\Golder.local\Data\Tullow Oil PLC - Earl Kenya (Mining) - 1772867 - Kenya Pipeline Project\Data\GIS\Maps\Master Maps\1772867_553_111_OG_554_D014_Aloe_Deserti_Species.mxd



Drawing 15: Avifaunal Sample Locations

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Avifaunal Sample Locations

- Avifaunal Sample Location (June 2018)
- Avifaunal Sample Location (October and November 2018)

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 15-02-2019	HR 06-08-2019	TF 06-08-2019

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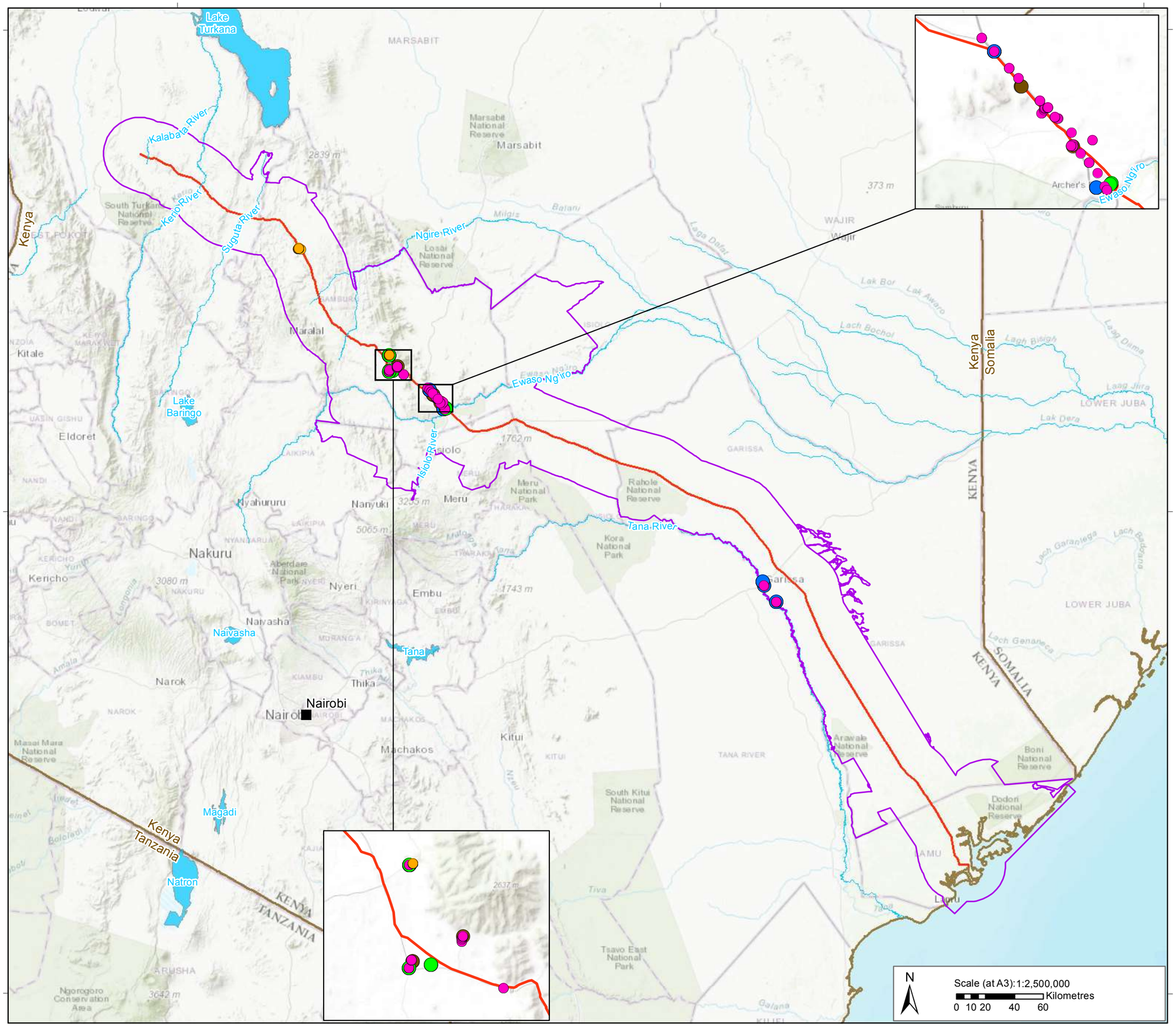
Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA



Drawing 16: Bird Groupings June 2018 Survey

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Bird Species Grouping

- Group I
- Group II
- Group III
- Group IV
- Group V

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

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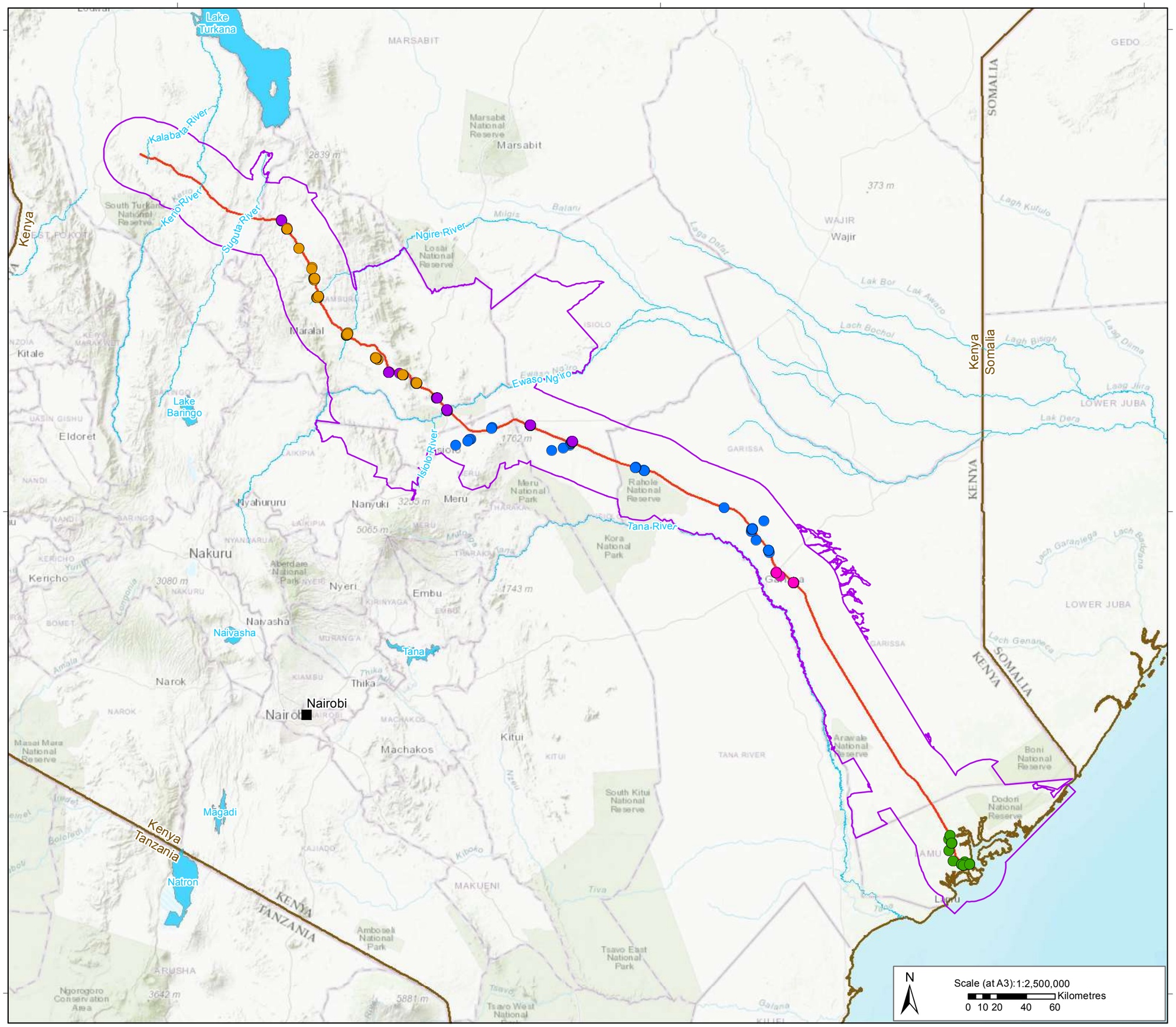
Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_555_D016_Bird_Species.mxd



Drawing 17: Bird Groupings October and Novovember 2018 Survey

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Bird Species Grouping

- Group I
- Group II
- Group III
- Group IV
- Group V

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

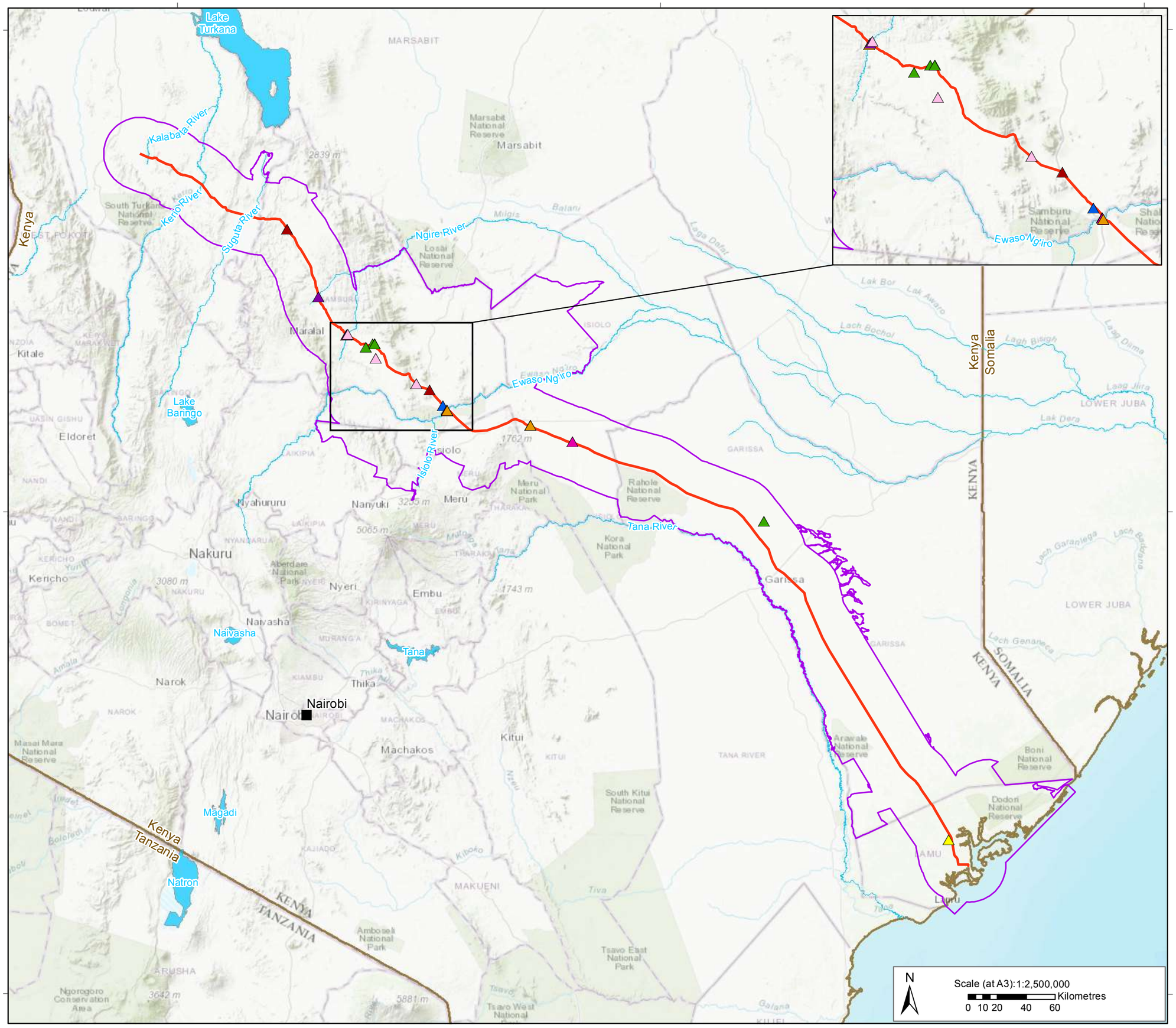
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path: \\ded1-v-gisak01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_556_D017_Bird_Species_Group.mxd

Drawing 18: Bird Species of Conservation Concern



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Bird Species of Conservation Concern

- Aquila Nipalensis
- Circus Macrourus
- Coracias Garrulus
- Ficedula Semitorquata
- Gyps
- Necrosyrtes Monachus
- Struthio Molybdophanes
- Vanellus Spinosus

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

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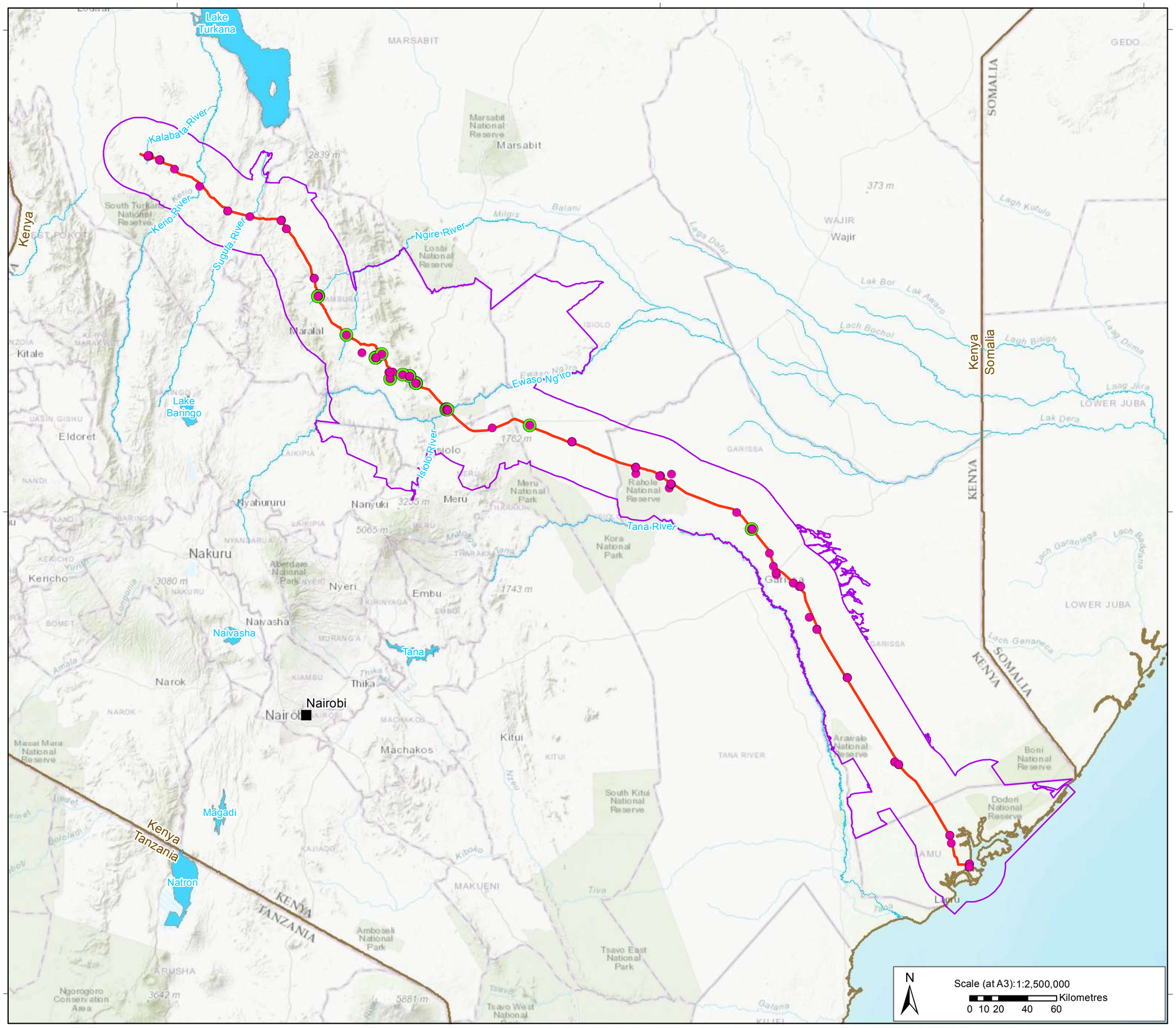

Drawing 19: Mammals Sample Locations

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Mammal Sample Locations

- Advanced Survey
- Full Survey

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 26-02-2019	HR 06-08-2019	TF 06-08-2019

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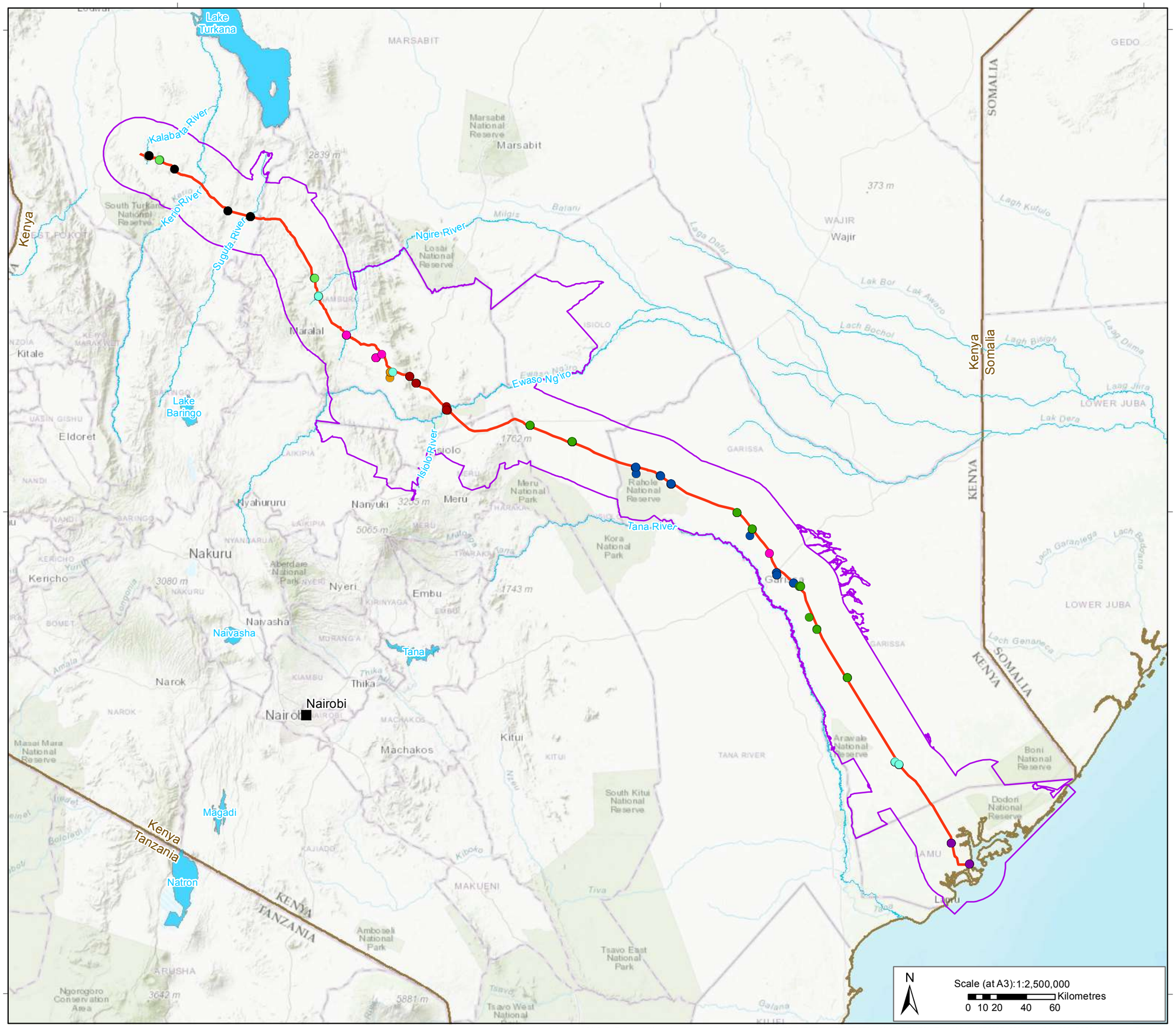
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path: \\vdc1-v-gis-k01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_534_D019_Mammals_sampling_locations.mxd

Drawing 20: Mammals Groupings Identified within the Area of Influence



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Mammal Grouping within Terrestrial Biodiversity Area of Influence (AoI)

- Group I
- Group II
- Group III
- Group IV
- Group IX
- Group V
- Group VI
- Group VII
- Group VIII
- Group X

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

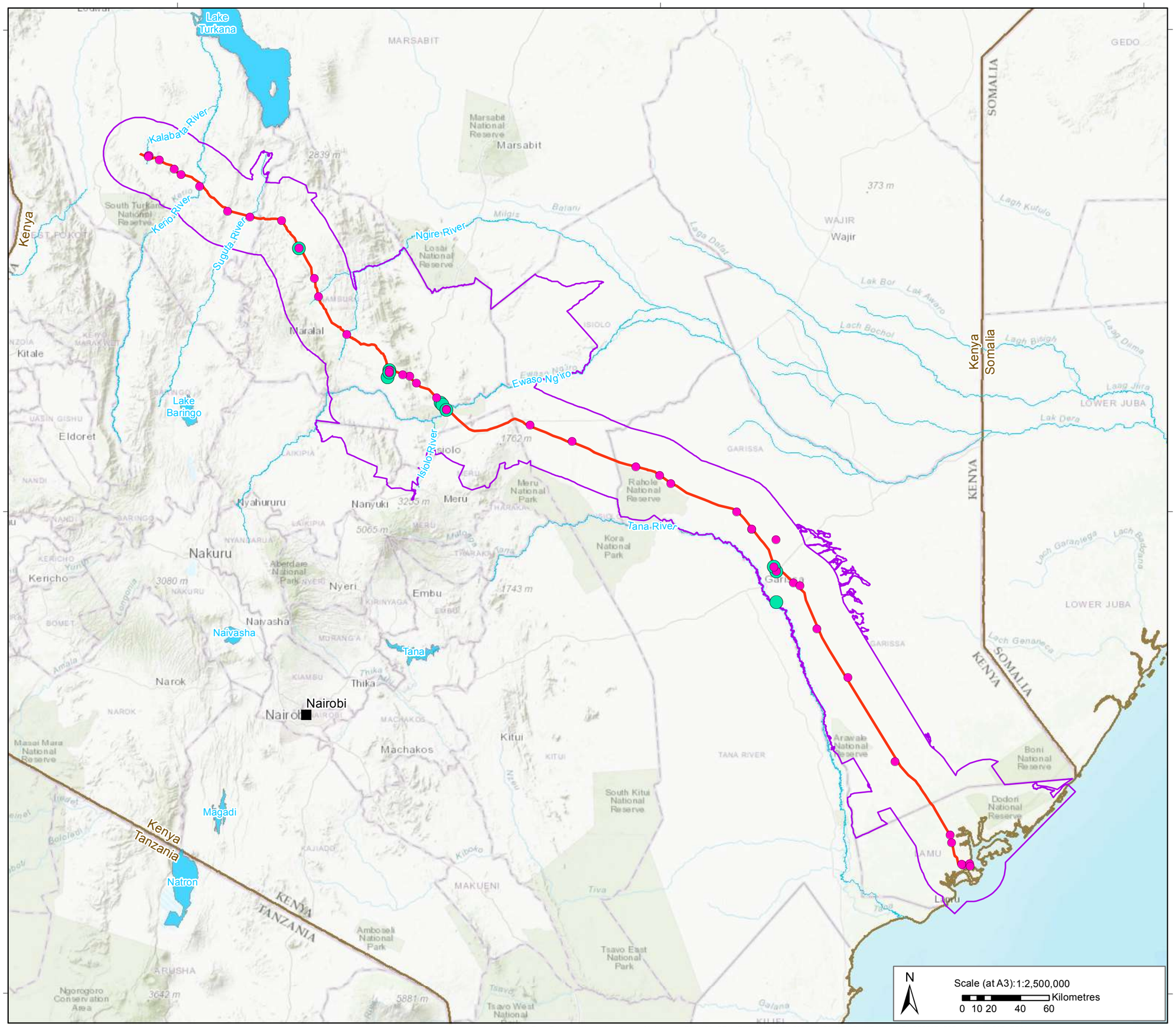
Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Map path:\\de1s-gisuk01\Data\Tullow Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\00_PRODUCTION\MXD\1772867_553_111_OG_563_D020_Mammals_RSA.mxd

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA



Drawing 21: Herpetofauna Sample Locations

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Waterbody
- Watercourse

Herpetofauna Sample Locations

- Advanced Survey
- Full Survey

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 26-02-2019	HR 06-08-2019	TF 06-08-2019

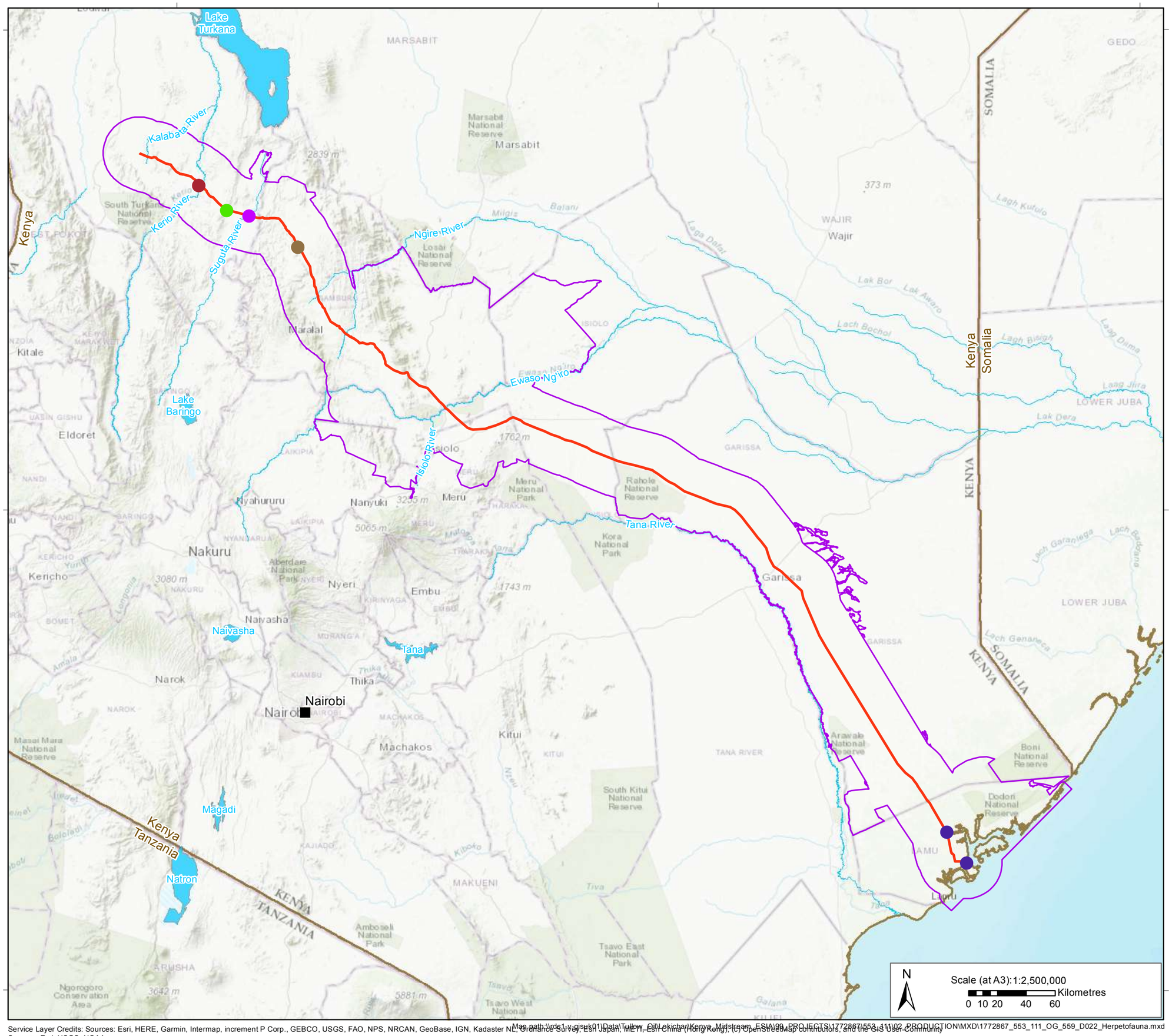
GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_532_D021_Herpetofauna_sampling_Locations.mxd

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Drawing 22: Location of Herpetofauna Species of Conservation Concern



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Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Herpetofauna Locations

- Agama Sp.
- Hemidactylus Spa
- Phrynobatrachus Keniensis
- Sclerophrys Turkanae
- Tomopterna Gallmanni

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 06-08-2019	TF 06-09-2019

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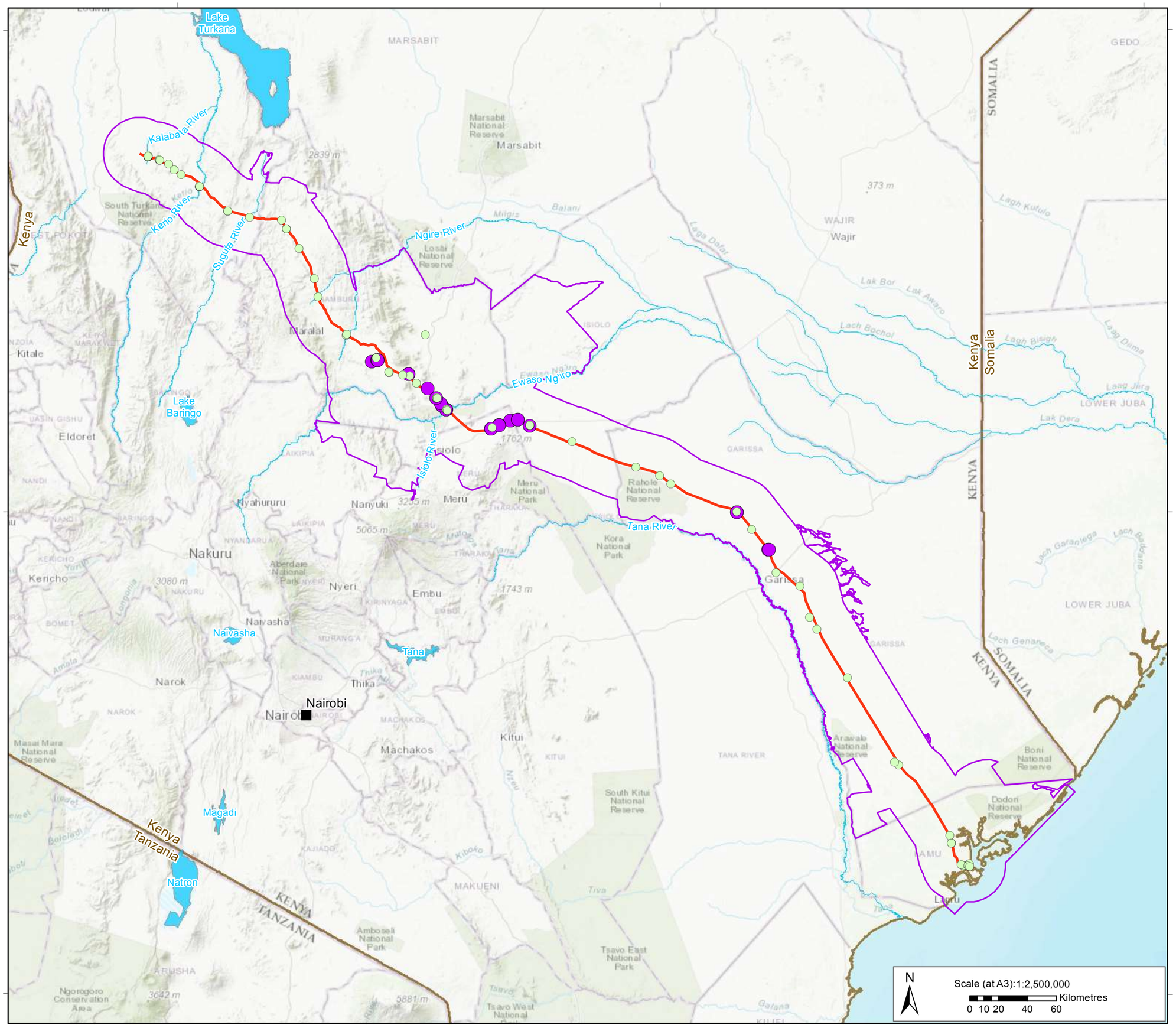
Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Drawing 23: Invertebrate Sample Locations



Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Invertebrate Sample Locations

- Advanced Survey
- Full Survey

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 26-02-2019	LD 06-08-2019	TF 06-08-2019

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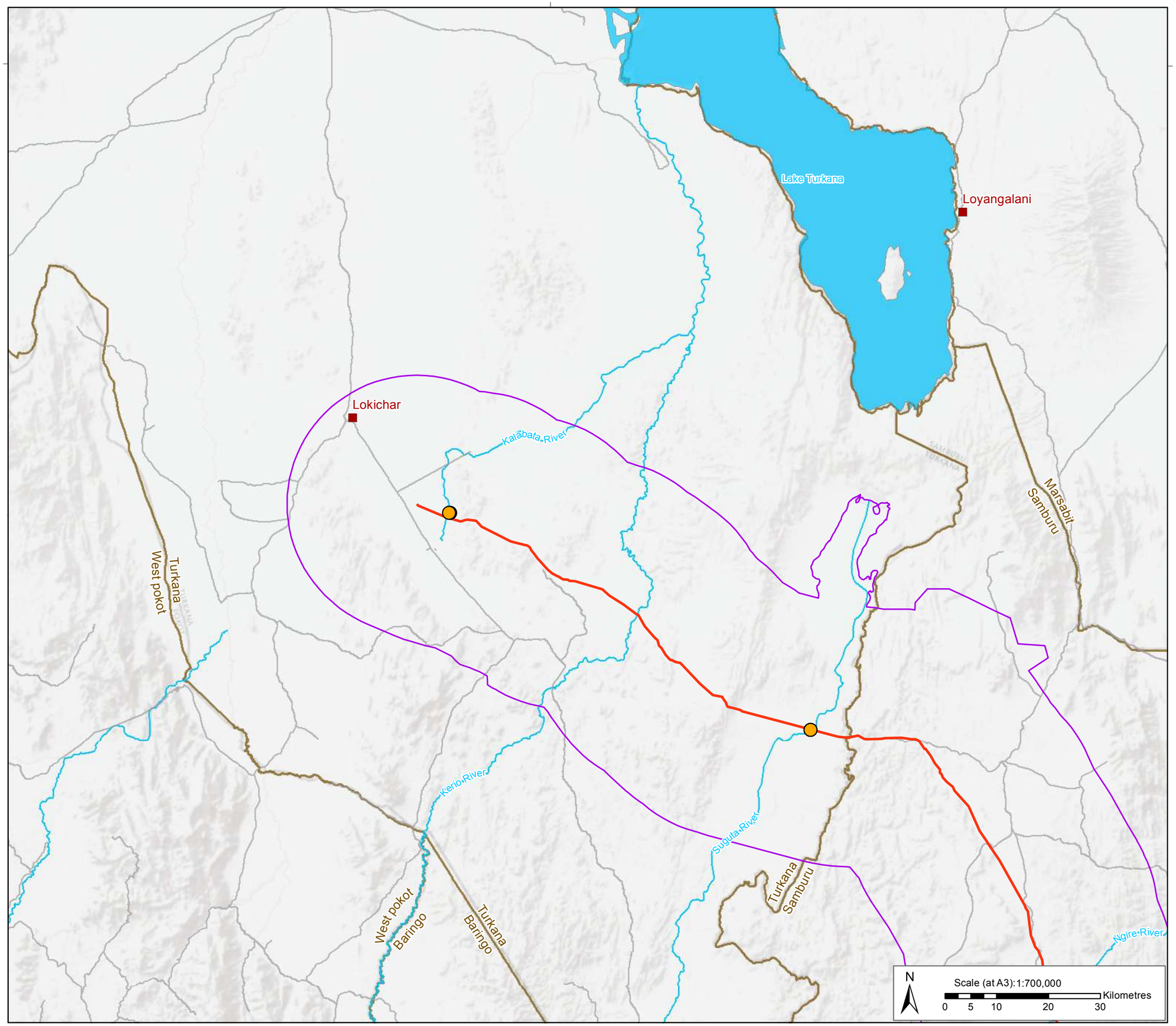
Sources: Esri, USGS, NOAA

Map Attachment: Nairobi Office Data Survey_Dist Japan_WETI_Esri Midstream_HSE_KOG_PRO_DEST_1772867_553_111_OG_533_D023_Invertebrate_sampling_locations.mxd

Drawing 24.1: Mammals Species of Conservation Concern

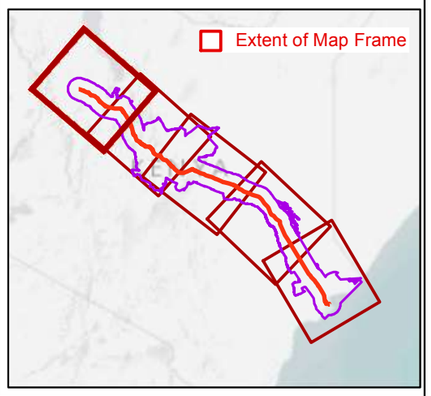


Key

- Town
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- County Boundary
- Road
- Waterbody
- Watercourse

Mammals Species of Conservation Concern

- Crocidura Sp Nov
- Equus Grevyi
- Gerbillus Cosensis
- Hyaena Hyaena



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 07-08-2019	TF 07-08-2019

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Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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Sources: Esri, USGS, NOAA

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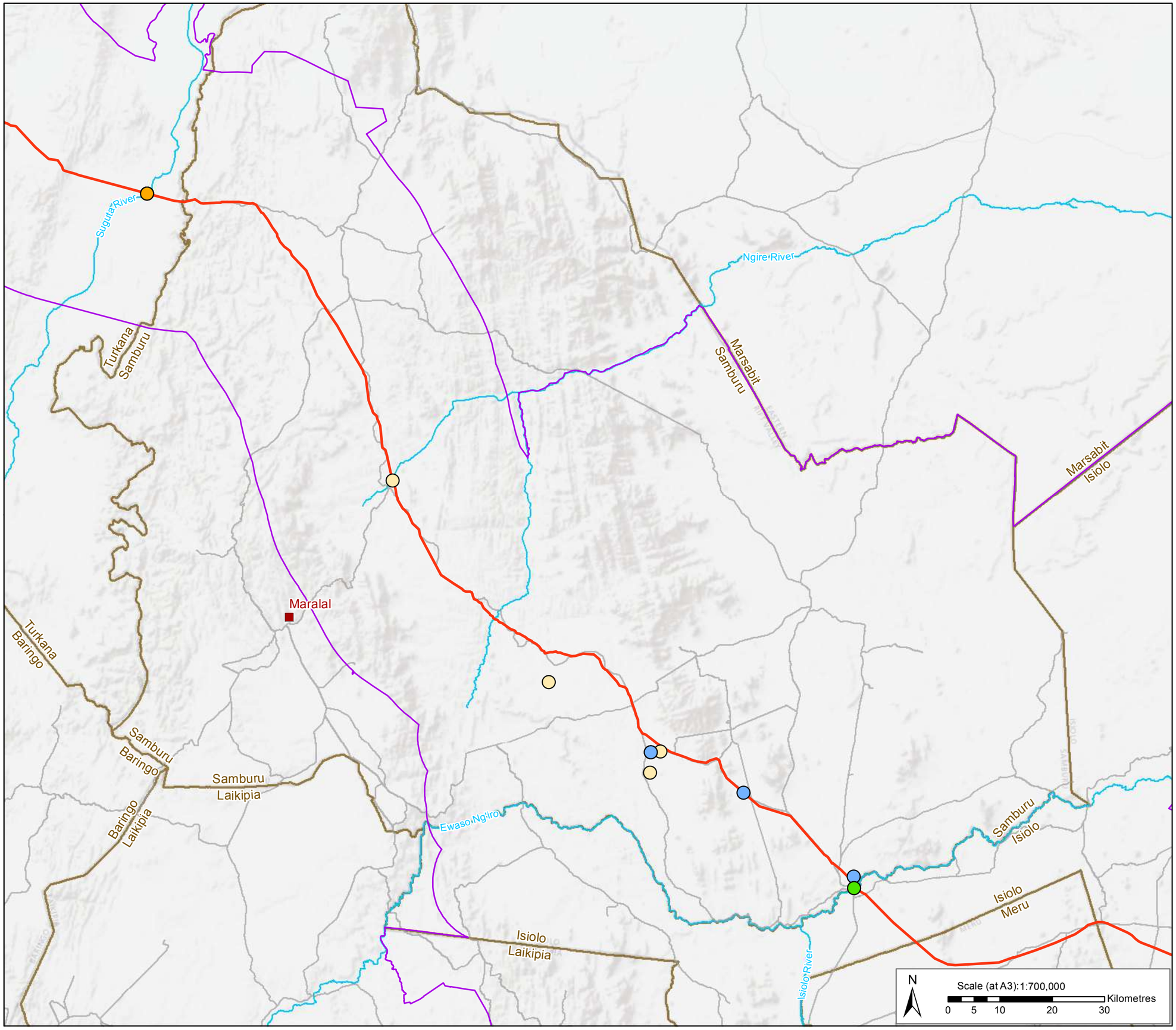
Drawing 24.2: Mammals Species of Conservation Concern

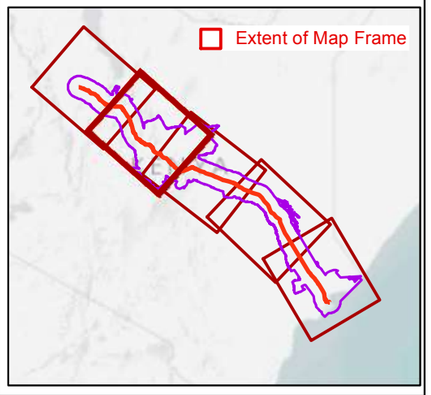


Key

- Town
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- County Boundary
- Road
- Watercourse

Mammals Species of Conservation Concern

- Crocidura Sp Nov
- Equus Grevyi
- Gerbillus Cosensis
- Hyaena Hyaena
- Loxodonta Africana
- Panthera Pardus



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 07-08-2019	TF 07-08-2019

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Sources: Esri, USGS, NOAA

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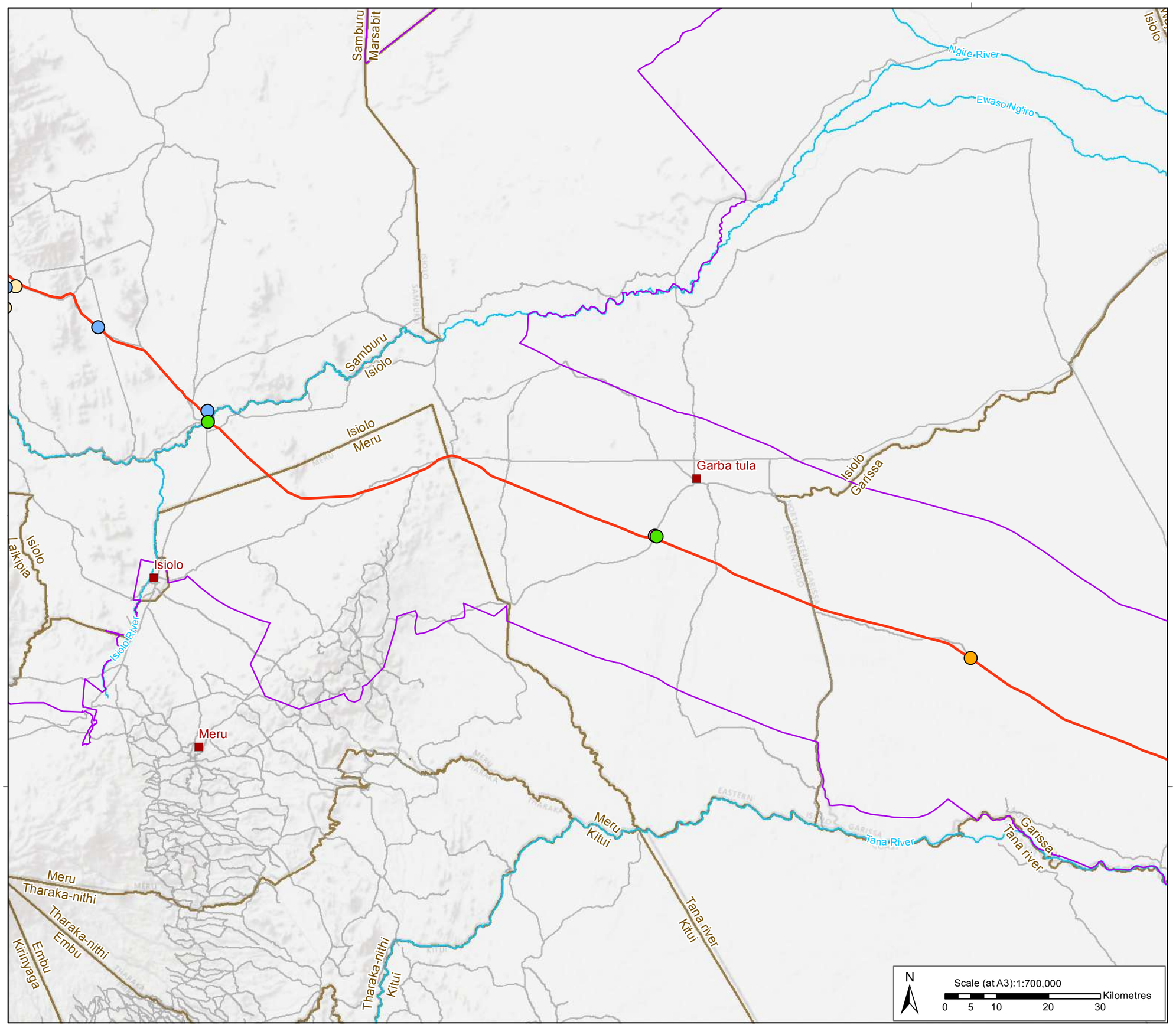
Drawing 24.3: Mammals Species of Conservation Concern

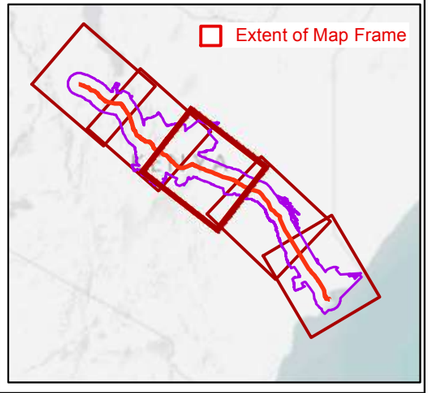


Key

- Town
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- County Boundary
- Road
- Watercourse

Mammals Species of Conservation Concern

- Equus Grevyi
- Hyaena Hyaena
- Loxodonta Africana
- Panthera Leo
- Panthera Pardus



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
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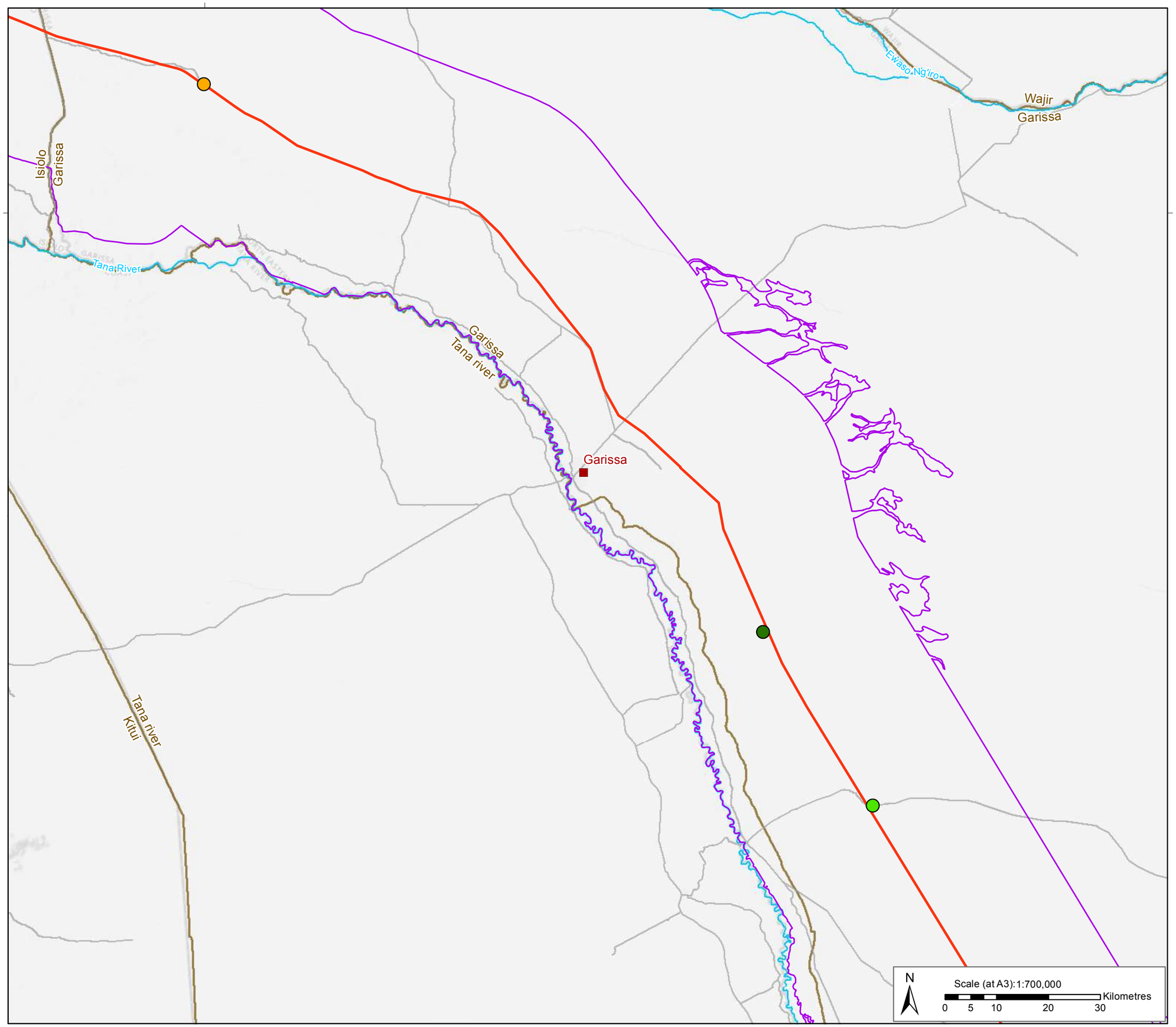
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_562_D024_Mammals1.mxd

Drawing 24.4: Mammals Species of Conservation Concern

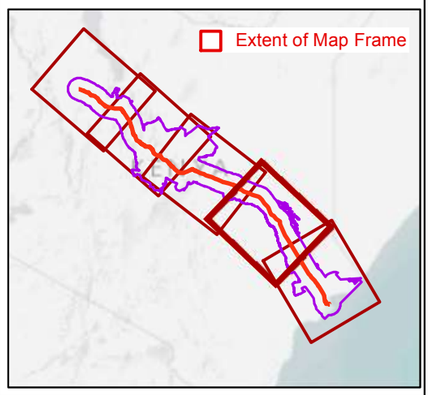


Key

- Town
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- County Boundary
- Road
- Watercourse

Mammals Species of Conservation Concern

- Hyaena Hyaena
- Oryx Beisa
- Panthera Pardus



Data sources:
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Project Ref:	Prepared By:	Reviewed by:	Approved by:
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Sources: Esri, USGS, NOAA

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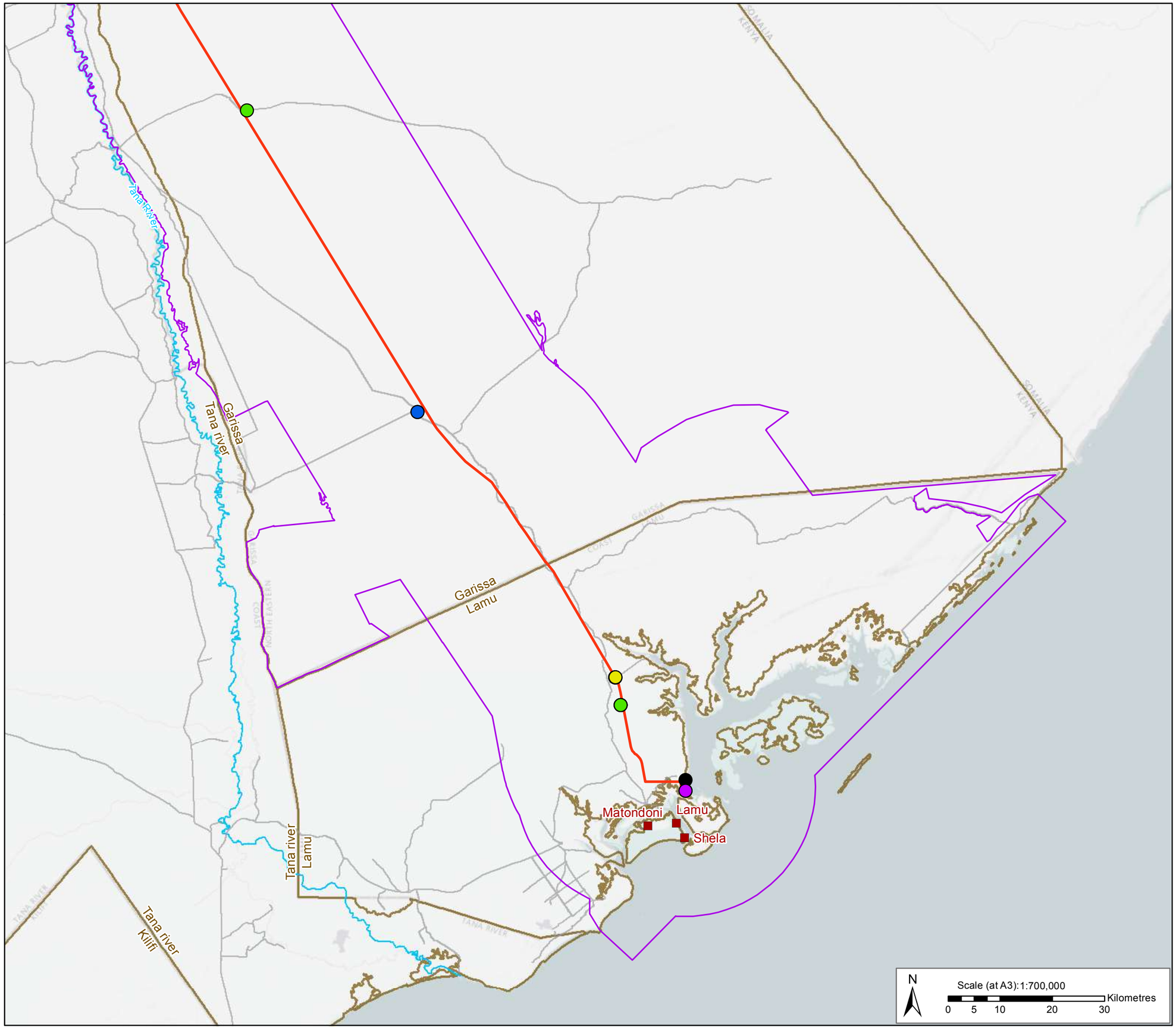
Drawing 24.4: Mammals Species of Conservation Concern

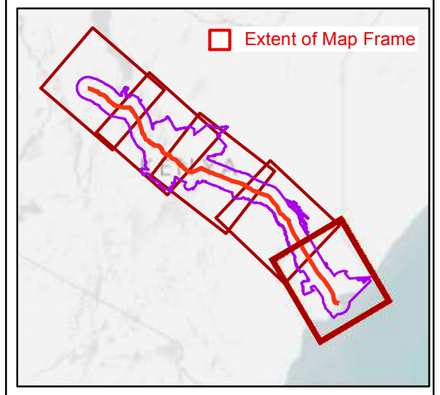


Key

- Town
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- County Boundary
- Road
- Watercourse

Mammals Species of Conservation Concern

- Bdeogale Omnivora
- Beatragus Hunteri
- Cephalophus Adersi
- Galagoides Cocos
- Lycaon Pictus
- Otolemur Garnettii
- Panthera Pardus
- Rhynchocyon Chrysopygus Mandelai



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-03-2019	HR 07-08-2019	TF 07-08-2019

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Sources: Esri, USGS, NOAA

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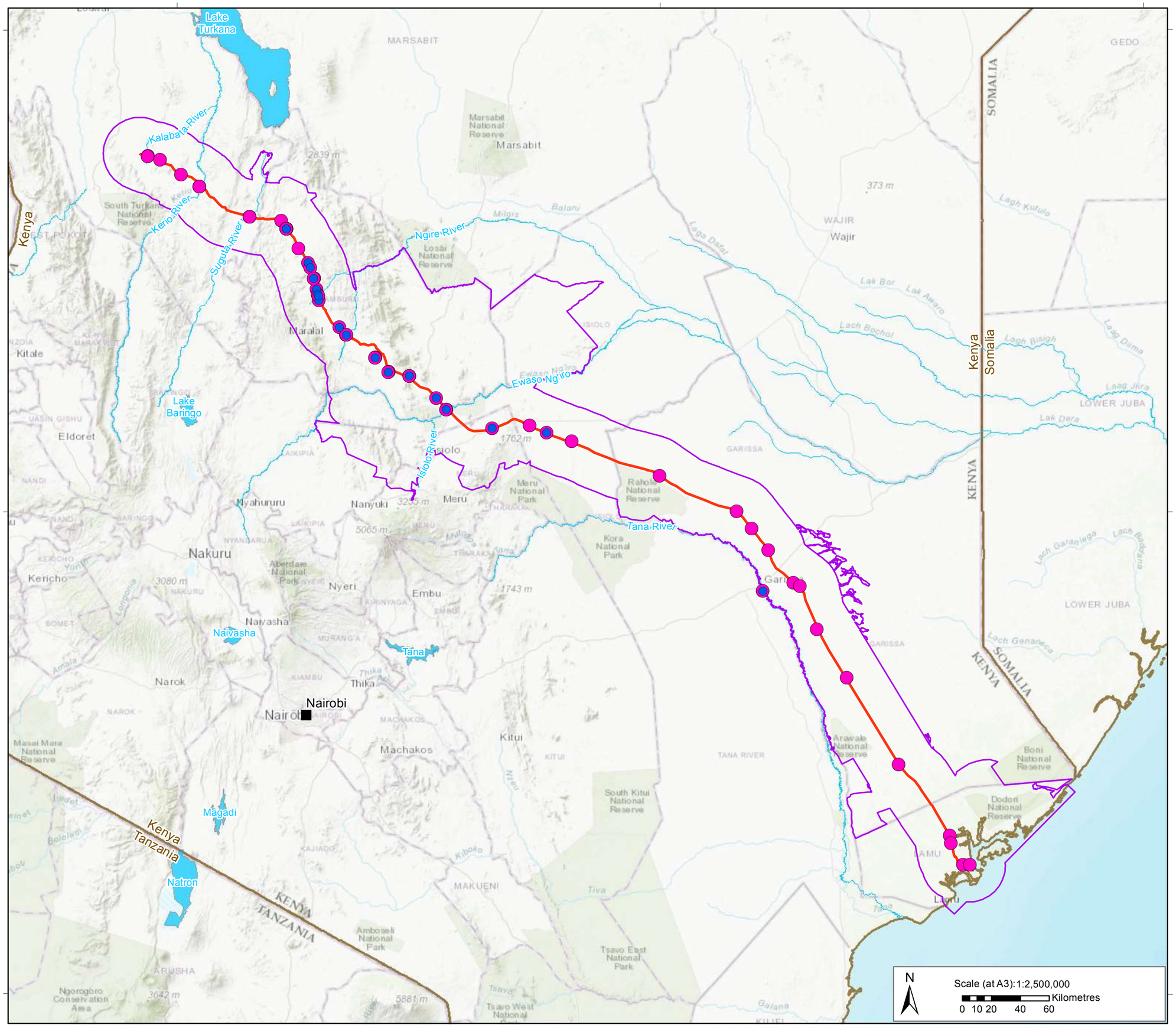

Drawing 25: Aquatic Sample Locations

Key

- City
- Proposed Pipeline Route
- Terrestrial Biodiversity Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Aquatic Sample Locations

- Advanced Survey
- Full Survey

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 03-01-2019	HR 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA

Map path: \\vdn1-ogisuk01\Data\Tullow_Oil\Lakidar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\553_111\02_PRODUCTION\MXD\1772867_553_111_OG_547_D025_Aquatics_Sample_locations.mxd

APPENDIX A

Expected Species Lists

Expected Plant Species within the AoI:

Abrus fruticulosus
Abrus schimperi
Abutilon fruticosum
Abutilon hirtum
Abutilon mauritianum
Acacia colei
Acacia mearnsii
Acalypha ciliata
Acalypha echinus
Acalypha engleri
Acalypha fruticosa
Acalypha neptunica
Acalypha paniculata
Acanthospermum hispidum
Achyranthes aspera
Achyranthes sicula
Achyrospermum carvalhoi
Acmella caulirhiza
Acridocarpus ballyi
Actiniopteris dimorpha
Actiniopteris radiata
Actiniopteris semiflabellata
Actinotrichia fragilis
Adansonia digitata
Adenia aculeata
Adenia keramanthus
Adiantum incisum
Aeollanthus zanzibaricus
Aerangis brachycarpa
Aerva javanica
Aerva lanata
Aeschynomene cristata
Aeschynomene sansibarica
Aeschynomene schimperi
Aeschynomene uniflora
Afrocanthium kilifiense
Afrocanthium pseudoverticillatum
Afrohybanthus enneaspermus
Afrohybanthus pseudodanguyanus
Afzelia quanzensis
Agave americana
Agave angustifolia
Agave attenuata
Agave mitis
Agave sisalana
Agelanthus kayseri
Agelanthus pennatulus
Agelanthus subulatus
Ageratum conyzoides
Ageratum houstonianum
Agrostis kilimandscharica
Albizia lebbeck
Albizia tanganyicensis
Alectra sessiliflora
Aleuritopteris farinosa
Allmaniopsis fruticulosa
Allophylus ferrugineus
Allophylus rubifolius
Aloe amudatensis
Aloe archeri
Aloe chrysostachys
Aloe kilifiensis
Aloe lateritia
Aloe morijensis
Aloe multicolor
Aloe powysiorum
Aloe scabrifolia
Aloe turkanensis
Aloe vituensis
Alsophila humilis
Alysicarpus glumaceus
Alysicarpus rugosus
Amauropelta bergiana
Ammannia capitellata
Ammannia parkeri
Ammannia pedicellata
Ammannia radicans
Ammannia stuhlmannii
Amphiroa anceps
Amphiroa beauvoisii
Amphiroa fragilissima
Amphiroa tribulus
Anadyomene wrightii
Anastrophyllum auritum
Aneilema ephemerum
Aneilema gillettii
Aneilema petersii
Aneilema taylorii
Angylocalyx braunii
Anisocycla blepharosepala
Anoectangium aestivum
Anoectangium eukilimandscharicum
Anogramma leptophylla
Anredera cordifolia
Anthospermum herbaceum
Areca catechu
Argomuellera macrophylla
Argyrolobium friesianum
Aristida adscensionis

Aristida kelleri
Aristolochia albida
Artabotrys modestus
Asparagus aethiopicus
Asparagus falcatus
Asparagus flagellaris
Asparagus racemosus
Asparagus setaceus
Aspilia macrorrhiza
Asplenium aethiopicum
Asplenium gueinzianum
Asplenium rutifolium
Asplenium theciferum
Astripomoea lachnosperma
Asystasia guttata
Atractylocarpus alticaulis
Atriplex farinosa
Aulacomnium turgidum
Austrocylindropuntia subulata
Avena sativa
Avrainvillea erecta
Aytonia fischeriana
Azadirachta indica
Azima tetracantha
Azolla nilotica
Baccharoides lasiopus
Bacopa floribunda
Balanites aegyptiaca
Balanites maughamii
Balanites rotundifolia
Baphia longipedicellata
Barleria acanthoides
Barleria argentea
Barleria eranthemoides
Barleria grandicalyx
Barleria polhillii
Barleria robertsoniae
Basananthe lanceolata
Basananthe zanzibarica
Bauhinia taitensis
Berchemia discolor
Bidens hildebrandtii
Blechnum australe
Blepharis kenyensis
Blepharis linariifolia
Blepharis pratensis
Blepharis tanae
Blepharispermum fruticosum
Blepharispermum minus
Blepharispermum pubescens
Blepharispermum villosum
Blighia unijugata
Blindia acuta
Blotiella stipitata
Bonnaya zanzibarica
Boodlea composita
Boscia angustifolia
Boscia coriacea
Boscia keniensis
Boscia mossambicensis
Bostrychia tenella
Bothriochloa radicans
Bothriocline fusca
Bothriocline glomerata
Bourreria nemoralis
Bourreria petiolaris
Brachiaria brizantha
Brachiaria dictyoneura
Brachiaria leersioides
Brachiaria longiflora
Brachiaria semiundulata
Brachymenium pulchrum
Breutelia stricticaulis
Bridelia taitensis
Bromus leptoclados
Brucea macrocarpa
Bryoerythrophyllum campylocarpum
Bryosedgwickia barlassinae
Bryum amplirete
Bryum planomarginatum
Bryum pseudotriquetrum
Buchnera leptostachya
Bulbostylis hispidula
Bulbostylis lolokweensis
Bulbostylis microelegans
Cadaba farinosa
Cadaba glandulosa
Cadaba mirabilis
Cadaba ruspolii
Caesalpinia decapetala
Caesalpinia volkensii
Callisia repens
Callisia warszewicziana
Calotropis gigantea
Calotropis procera
Calymperes palisotii
Calymperes pallidum
Calymperes tenerum
Calyptrotheca somalensis
Calyptrotheca taitensis
Campanula keniensis
Campylopus nivalis
Canavalia rosea
Canthium oligocarpum
Capparis sepiaria
Cardiospermum corindum
Carduus schimperi
Carduus sylvarum

Carex conferta
Carissa edulis
Caroxylon africanum
Carpolobia goetzei
Cascabela thevetia
Cassia abbreviata
Cassia afrofistula
Cassipourea celastroides
Catharanthus roseus
Catunaregam nilotica
Catunaregam obovata
Caucanthus albidus
Caucanthus auriculatus
Caucanthus edulis
Caulerpa cupressoides
Caulerpa mexicana
Caulerpa racemosa
Caulerpa sertularioides
Caulerpa webbiana
Celosia hastata
Celtis gomphophylla
Cenchrus americanus
Cenchrus ciliaris
Cenchrus mezianus
Cenchrus polystachios
Ceratodictyon spongiosum
Cereus jamacaru
Ceropegia duemmeri
Ceropegia foetida
Ceropegia retrospiciens
Cestrum aurantiacum
Chascanum hildebrandtii
Chascanum marrubiifolium
Cheilanthes multifida
Chenopodium opulifolium
Chloris mossambicensis
Chloris nutans
Chloris virgata
Chlorodesmis caespitosa
Chlorophytum africanum
Chlorophytum andongense
Chlorophytum comosum
Chlorophytum tenerrimum
Chlorophytum tuberosum
Chlorophytum zavattarii
Chrysopogon plumulosus
Chytranthus obliquinervis
Cirsium vulgare
Cissus adeyana
Cissus rotundifolia
Cissus sylvicola
Cladostemon kirkii
Clerodendrum tricholobum
Clitoria ternatea
Cnestis polyphylla
Coccinia grandis
Coccinia megarrhiza
Coccinia samburuensis
Coccinia trilobata
Coffea rhamnifolia
Coffea sessiliflora
Cola porphyrantha
Combretum aculeatum
Combretum butyrosum
Combretum constrictum
Combretum exalatum
Combretum hereroense
Combretum iliairii
Combretum molle
Combretum padoides
Commelina benghalensis
Commelina foliacea
Commelina imberbis
Commelina melanorrhiza
Commicarpus helenae
Commicarpus pedunculosus
Commicarpus plumbagineus
Commiphora africana
Commiphora campestris
Commiphora edulis
Commiphora erlangeriana
Commiphora grandifolia
Commiphora kataf
Commiphora oblongifolia
Commiphora rostrata
Commiphora schimperi
Conostomium longitubum
Convolvulus jefferyi
Coptosperma graveolens
Coptosperma kibuwae
Coptosperma nigrescens
Coptosperma supra-axillare
Corallocarpus ellipticus
Corchorus fascicularis
Corchorus olitorius
Corchorus pseudoolitorius
Corchorus tridens
Corchorus trilocularis
Corchorus urticifolius
Cordia crenata
Cordia guineensis
Cordia longipetiolata
Cordia monoica
Cordia sinensis
Cordyla africana
Cordylostigma obtusilobum
Craibia brevicaudata
Craibia laurentii

Crassula capitella
Crassula volkensii
Cratoneuron filicinum
Crepis carbonaria
Cressa cretica
Crossandra mucronata
Crossandra pungens
Crotalaria barkae
Crotalaria chrysochlora
Crotalaria comanestiana
Crotalaria deflersii
Crotalaria deserticola
Crotalaria emarginata
Crotalaria fascicularis
Crotalaria goodiiformis
Crotalaria hyssopifolia
Crotalaria laburnifolia
Crotalaria leptocarpa
Crotalaria malindiensis
Crotalaria massaiensis
Crotalaria oocarpa
Crotalaria polysperma
Crotalaria pseudospartium
Crotalaria rhynchocarpa
Crotalaria somalensis
Crotalaria uguenensis
Croton dichogamus
Croton megalocarpoides
Croton polytrichus
Croton pseudopulchellus
Croton talaeporos
Cryptolepis calophylla
Cryptolophocolea lilliena
Cryptopleura ramosa
Cryptostegia madagascariensis
Cucumis dipsaceus
Cucumis prophetarum
Curio avasimontanus
Cuscuta hyalina
Cyanotis repens
Cyathula coriacea
Cyathula erinacea
Cyathula orthacantha
Cyathula polycephala
Cylicomorpha parviflora
Cylindropuntia imbricata
Cynanchum hastifolium
Cynanchum somaliense
Cynanchum viminale
Cynodon nlemfuensis
Cynodon plectostachyus
Cynoglossum coeruleum
Cynometra lukei
Cyperus alopecuroides
Cyperus alternifolius
Cyperus amabilis
Cyperus blysmoides
Cyperus cartilagineus
Cyperus chordorrhizus
Cyperus crassipes
Cyperus denudatus
Cyperus flavescens
Cyperus glaucophyllus
Cyperus grandibulbosus
Cyperus impubes
Cyperus isolepis
Cyperus kaessneri
Cyperus kilimandscharicus
Cyperus latifolius
Cyperus longus
Cyperus marginatus
Cyperus mundtii
Cyperus pelophilus
Cyperus persquarrosus
Cyperus pseudohildebrandtii
Cyperus rotundus
Cyperus rubicundus
Cyperus soyauxii
Cyphia glandulifera
Cyphostemma adenocaule
Cyphostemma allophyloides
Cyphostemma dysocarpum
Cyphostemma grahamii
Cyphostemma pseudonjegerre
Cyphostemma thomasii
Dactyloctenium aegyptium
Dalbergia eremicola
Dalechampia scandens
Dasya scoparia
Datura stramonium
Deinbollia kilimandscharica
Delamerea procumbens
Delonix regia
Delosperma nakurense
Delphinium leroyi
Dialium holtzii
Dialium orientale
Dialium reticulatum
Dichrostachys cinerea
Dicliptera inconspicua
Dicoma tomentosa
Dicranella kenyae
Dicranoloma billarderii
Dicranopteris linearis
Dierama pendulum
Digera muricata
Digitaria abyssinica
Digitaria argyrotricha

Digitaria aridicola
Digitaria macroblephara
Digitaria milanjiana
Digitaria rivae
Digitaria velutina
Dignathia hirtella
Diodia aulacosperma
Diospyros abyssinica
Diospyros ferrea
Diospyros greenwayi
Diospyros kabuyeana
Diplocyclos schliebenii
Diplostigma canescens
Dirichletia glaucescens
Disa aconitoides
Disa deckenii
Disa erubescens
Disakisperma yemenicum
Disocactus flagelliformis
Disperis nemorosa
Distimake ampelophyllus
Dodonaea viscosa
Dombeya taylorii
Dorstenia hildebrandtii
Doryopteris concolor
Doryopteris kirkii
Dovyalis abyssinica
Dovyalis caffra
Drosera indica
Dryopteris antarctica
Dryopteris ruwenzoriensis
Drypetes natalensis
Dumortiera hirsuta
Duosperma grandiflorum
Duranta erecta
Duvernoia stachytarphetoides
Dyschoriste hildebrandtii
Dysphania schraderiana
Echinops hispidus
Echinops hoehnelii
Ehretia bakeri
Ekebergia capensis
Elachyptera parvifolia
Elaeodendron aquifolium
Elaeodendron buchananii
Elaeodendron schweinfurthianum
Elaphoglossum lastii
Elaphoglossum welwitschii
Eleocharis acutangula
Eleocharis retroflexa
Eleusine coracana
Emelianthe panganensis
Emilia bellioides
Emilia tricholepis
Emilia ukambensis
Empogona ovalifolia
Encephalartos tegulaneus
Endostemon tereticaulis
Englerina ramulosa
Enneapogon cenchroides
Enneapogon desvauxii
Entandrophragma angolense
Enteropogon macrostachyus
Eragrostis aspera
Eragrostis cilianensis
Eragrostis ciliaris
Eragrostis cylindriflora
Eragrostis exasperata
Eragrostis hispida
Eragrostis papposa
Eragrostis superba
Eragrostis tenuifolia
Eriocaulon elegantulum
Eriochloa meyeriana
Erythrococca pubescens
Erythrodontium lamoruense
Erythroxylum platyclados
Erythroxylum platycladum
Ethulia conyzoides
Ethulia faulknerae
Ethulia scheffleri
Euclea divinorum
Eulophia clitellifera
Eulophia horsfallii
Eulophia petersii
Euphorbia atroflora
Euphorbia breviarticulata
Euphorbia bussei
Euphorbia cuneata
Euphorbia cuprispina
Euphorbia diminuta
Euphorbia engleri
Euphorbia joyae
Euphorbia lophiosperma
Euphorbia neostolonifera
Euphorbia nyikae
Euphorbia pereskiifolia
Euphorbia pervittata
Euphorbia polyacantha
Euphorbia renneyi
Euphorbia ritchiei
Euphorbia samburuensis
Euphorbia saxorum
Euphorbia scheffleri
Euphorbia septentrionalis
Euphorbia tirucalli
Euphorbia turkanensis
Euphorbia uhligiana

Euploca rariflora
Euploca strigosa
Exacum oldenlandioides
Excoecaria bussei
Farsetia stenoptera
Farsetia undulicarpa
Felicia abyssinica
Feretia apodanthera
Ficus sycomorus
Fimbristylis polytrichoides
Fissidens bogosicus
Fissidens submarginatus
Flueggea virosa
Frullania caffraria
Frullania erosolimbata
Fuerstia africana
Fuirena pubescens
Fuirena umbellata
Funaria hygrometrica
Galactia argentifolia
Galaxaura tenera
Gardenia ternifolia
Gardenia volkensii
Gelidiella acerosa
Gerrardanthus lobatus
Gisekia pharnaceoides
Gisekia pharnacioides
Glinus setiflorus
Gmelina arborea
Gnidia latifolia
Gomphrena serrata
Gracilaria crassa
Grandidiera boivinii
Grauanthus linearifolius
Grevillea robusta
Grewia balensis
Grewia bicolor
Grewia densa
Grewia holstii
Grewia kakothamnos
Grewia lilacina
Grewia plagiophylla
Grewia similis
Grewia stuhlmannii
Grewia tembensis
Grewia tenax
Grewia trichocarpa
Grewia villosa
Gutenbergia boranensis
Gymnanthemum coloratum
Gymnosporia gracilis
Gymnosporia keniensis
Gymnosporia putterlickioides
Gymnosporia rubra
Gymnosporia serrata
Gymnostomum keniae
Gynandropsis gynandra
Gynura pseudochina
Habenaria altior
Habenaria armatissima
Habenaria petitiana
Habenaria subarmata
Halimeda renschii
Halimeda stuposa
Halimeda tuna
Halopyrum mucronatum
Haplocoelopsis africana
Haplocoelum foliolosum
Haplocoelum inopleum
Haplopteris volkensii
Hebenstretia dentata
Heinsia crinita
Helichrysum ellipticifolium
Helichrysum glumaceum
Helinus integrifolius
Heliotropium benadirense
Heliotropium longiflorum
Heliotropium pectinatum
Heliotropium scotteae
Heliotropium steudneri
Heliotropium zeylanicum
Helixanthera kirkii
Hermannia exappendiculata
Hibiscus aponeurus
Hibiscus calyphyllus
Hibiscus diversifolius
Hibiscus flavifolius
Hibiscus hildebrandtii
Hibiscus micranthus
Hibiscus pycnostemon
Hibiscus schizopetalus
Hibiscus sparseaculeatus
Hibiscus vitifolius
Holarrhena pubescens
Hovenkampia schimperiana
Hugonia castaneifolia
Hybanthus enneaspermus
Hydnora africana
Hydnora johannis
Hydnora sinandevu
Hydrolea zeylanica
Hymenophyllum sibthorpioides
Hymenophyllum tunbridgense
Hymenostylium crassinervium
Hypericum peplidifolium
Hypericum revolutum
Hyphaene compressa
Hypoestes forskaolii

Hypolepis rugosula
Impatiens pseudoviola
Indigastrum costatum
Indigofera cliffordiana
Indigofera colutea
Indigofera cuneata
Indigofera elwakensis
Indigofera hochstetteri
Indigofera insularis
Indigofera longimucronata
Indigofera malindiensis
Indigofera spinosa
Indigofera strobilifera
Indigofera tanaensis
Indigofera tanganyikensis
Indigofera vohemarensis
Indigofera volkensii
Indigofera wituensis
Indigofera zanzibarica
Ipomoea biflora
Ipomoea coptica
Ipomoea cordofana
Ipomoea garckeana
Ipomoea hildebrandtii
Ipomoea lapidosa
Ipomoea obscura
Ipomoea ochracea
Ipomoea paolii
Ipomoea pileata
Ipomoea spathulata
Ipomoea ticcopa
Isoetes abyssinica
Isoetes welwitschii
Isoglossa membranacea
Ixora scheffleri
Jacaranda mimosifolia
Jasminum fluminense
Jatropha curcas
Jatropha dichtar
Jatropha hildebrandtii
Jatropha oblanceolata
Jatropha rivae
Jatropha stuhlmannii
Jeffreycia zanzibarensis
Josephinia africana
Julbernardia magnistipulata
Juncus oxycarpus
Justicia heterocarpa
Justicia odora
Justicia scandens
Justicia unyorensis
Kalanchoe delagoensis
Kalanchoe fadeniorum
Kalanchoe fedtschenkoi
Kalanchoe lateritia
Kanahia laniflora
Karomia gigas
Kedrostis gijef
Kedrostis pseudogijef
Keetia zanzibarica
Kewa bowkeriana
Kigelia africana
Kirkia tenuifolia
Kleinia polycotoma
Kohautia caespitosa
Kotschya aeschynomenoides
Kraussia kirkii
Lagarosiphon cordofanus
Lagarosiphon hydrilloides
Lamprothamnus zanguebaricus
Lannea cotoneaster
Lannea schweinfurthii
Lantana camara
Lantana trifolia
Laportea lanceolata
Launaea hafunensis
Lawsonia inermis
Lecaniodiscus fraxinifolius
Leersia hexandra
Lepidagathis scariosa
Leptodontiopsis elata
Leptodontium filicaule
Leptothrium senegalense
Leucaena leucocephala
Leucas calostachys
Leucas glabrata
Leucas jamesii
Leucas martinicensis
Leucas mwingensis
Leucas tomentosa
Leucas tsavoensis
Leucas urticifolia
Leucas volkensii
Liagora mauritiana
Limeum viscosum
Linderniella bolusii
Lippia carviodora
Loewia tanaensis
Lomaridium attenuatum
Lomariopsis warneckei
Lonchocarpus kanurii
Lovoa swynnertonii
Ludwigia perennis
Ludwigia stenorraphe
Lycium europaeum
Lycium shawii
Lysimachia barbata
Macromitrium trollii

Macrotyloma uniflorum
Madotheca keniana
Maerua calantha
Maerua crassifolia
Maerua denhardtiorum
Maerua endlichii
Maerua holstii
Maerua kaessneri
Maerua subcordata
Manilkara sulcata
Marchantia polymorpha
Marsdenia rubicunda
Marsdenia stelostigma
Marsilea aethiopica
Marsilea fadeniana
Marsilea megalomanica
Megalochlamys violacea
Megastachya mucronata
Meineckia fruticans
Meineckia ovata
Meineckia phyllanthoides
Melhania ovata
Melhania parviflora
Melhania volleseniana
Melia azedarach
Melia volkensii
Melinis repens
Melpomene flabelliformis
Merremia hemmingiana
Metzgeria leptoneura
Micractis bojeri
Microcharis garissaensis
Microcharis latifolia
Micrococca holstii
Microglossa hildebrandtii
Microlejeunea globosa
Mikania cordifolia
Mildbraedia carpinifolia
Millettia lasiantha
Millettia tanaensis
Millettia vatkei
Mimusops fruticosa
Mirabilis jalapa
Mkilua fragrans
Momordica littorea
Momordica rostrata
Monanthotaxis fornicata
Monodora grandidieri
Monothecium aristatum
Monsonia senegalensis
Mostuea microphylla
Murdannia axillaris
Murrayella periclados
Mussaenda microdonta
Myrothamnus flabellifolius
Mystroxylon aethiopicum
Najas horrida
Nasturtium officinale
Neckera complanata
Neckera remota
Nectaropetalum kaessneri
Neomeris vanbosseae
Neuracanthus pictus
Newtonia erlangeri
Newtonia paucijuga
Nicotiana glauca
Nopalea cochenillifera
Nymphoides forbesiana
Ochna atropurpurea
Ochna insculpta
Ochna thomasiana
Ocimum decumbens
Ocimum filamentosum
Ocimum spectabile
Octoblepharum albidum
Oeosporangium viride
Oldenlandia fastigiata
Oldenlandia richardsonioides
Oliverella hildebrandtii
Oncella ambigua
Oncella curviramea
Oncoba routledgei
Oncocalyx angularis
Oncocalyx cordifolius
Oncocalyx fischeri
Oncocalyx ugogensis
Ophioglossum costatum
Ophioglossum gomezianum
Ophioglossum latifolium
Ophioglossum polyphyllum
Opilia campestris
Opuntia ficus-indica
Opuntia microdasys
Opuntia monacantha
Opuntia stricta
Orbivestus cinerascens
Orbivestus homilanthus
Ormocarpum keniense
Orthosiphon thymiflorus
Orthostichella rigida
Oryza punctata
Oryza sativa
Osmundaria fimbriata
Osteospermum vaillantii
Osyris abyssinica
Oxyanthus goetzei
Oxygonum sinuatum
Oxystelma bornouense

Ozoroa insignis
Paederia pospischilii
Panicum hippothrix
Panicum infestum
Panicum maximum
Panicum pinifolium
Panicum trichoides
Paracephaelis trichantha
Parapentas battiscombei
Parkinsonia aculeata
Parkinsonia anacantha
Parochetus communis
Passiflora edulis
Passiflora subpeltata
Pavetta abyssinica
Pavetta crebrifolia
Pavetta dolichantha
Pavetta hymenophylla
Pavetta linearifolia
Pavetta sepium
Pavetta sphaerobotrys
Pavonia arabica
Pavonia blepharicarpa
Pavonia burchellii
Pavonia calycina
Pavonia leptocalyx
Pavonia propinqua
Pavonia senegalensis
Pellaea calomelanos
Pellaea longipilosa
Pentanisia foetida
Pentanisia ouranogyne
Pentas lanceolata
Pentatropis bentii
Peperomia abyssinica
Peperomia pellucida
Peperomia retusa
Peperomia tetraphylla
Perotis pilosa
Persicaria senegalensis
Phaulopsis imbricata
Philonotis speirophylla
Phlegmariurus saururus
Phyllanthus kaessneri
Phyllanthus welwitschianus
Physalis minuta
Pistia stratiotes
Plagiochila lindblomii
Plagiochila squamulosa
Plagiochila telekii
Plectranthus hadiensis
Plectranthus lasianthus
Plectranthus montanus
Plectranthus prostratus
Pleopeltis macrocarpa
Pleurostylia africana
Plicosepalus sagittifolius
Plumbago zeylanica
Pneumatopteris subpennigera
Pneumatopteris unita
Pogonatum urnigerum
Pohlia flexuosa
Polycarpaea eriantha
Polygala abyssinica
Polygala erioptera
Polygala kilimandjarica
Polygala sphenoptera
Polyscias kikuyuensis
Polysphaeria multiflora
Polystichum sinense
Polystichum volkensii
Polytrichum subpilosum
Populus ilicifolia
Porella abyssinica
Portieria harveyi
Portulaca foliosa
Potamogeton richardii
Potentilla dentata
Pouteria adolfi-friedericii
Premna resinosa
Prionitis obtusa
Pristimera goetzei
Prosopis juliflora
Pseuderanthemum hildebrandtii
Pseudobersama mossambicensis
Pseudosopubia hildebrandtii
Psidium guajava
Psilotrichum cyathuloides
Psilotrichum gnaphalobryum
Psilotrichum sericeum
Psychotria amboniana
Psychotria capensis
Psychotria punctata
Psydrax faulknerae
Psydrax kaessneri
Psydrax schimperiana
Pteris albersii
Pteris catoptera
Pteris dentata
Pterolobium stellatum
Pupalia lappacea
Pygeum africanum
Racomitrium lamprocarpum
Racomitrium nigroviride
Racopilum speluncae
Radula heteroica
Rauvolfia mannii
Renauldia hoehnelii

Rhinacanthus dichotomus
Rhinacanthus pulcher
Rhynchosia holstii
Rhynchosia minima
Rhynchosia pulchra
Rhynchosia sublobata
Rhynchosia velutina
Rhynchostegiella keniae
Ricinus communis
Rinorea convallarioides
Rinorea elliptica
Rinorea squamosa
Rorippa micrantha
Rotheca microphylla
Rotheca myricoides
Rotheca rupicola
Rothia hirsuta
Rothmannia fischeri
Rothmannia ravae
Ruellia bignoniiflora
Ruellia patula
Rytigynia celastroides
Rytigynia eickii
Rytigynia mrimaensis
Rytigynia parvifolia
Salacia leptoclada
Salvadora persica
Salvia leucantha
Salvinia hastata
Sambucus nigra
Sansevieria conspicua
Sansevieria ehrenbergii
Satyrium coriophoroides
Scabiosa columbaria
Sclerocarpus africanus
Sclerocarya gillettii
Scutia myrtina
Searsia natalensis
Searsia pyroides
Secale cereale
Seddera hirsuta
Seddera latifolia
Sehima nervosum
Selaginella eublepharis
Selaginella rupestris
Senegalia ataxacantha
Senegalia brevispica
Senegalia hamulosa
Senegalia mellifera
Senegalia rovumae
Senegalia senegal
Senegalia thomasii
Senna alata
Senna didymobotrya
Senna obtusifolia
Senna occidentalis
Senna ruspolii
Senna siamea
Senna spectabilis
Sericocomopsis hildebrandtii
Sericocomopsis pallida
Sesamothamnus rivae
Sesamum angustifolium
Sesbania bispinosa
Sesbania sesban
Sesbania somalensis
Sesbania speciosa
Setaria acromelaena
Setaria sagittifolia
Setaria verticillata
Sida tanaensis
Sideroxylon inerme
Sieruela hirta
Sieruela parvipetala
Solanum aculeastrum
Solanum aculeatissimum
Solanum agnewiorum
Solanum arundo
Solanum campylacanthum
Solanum coagulans
Solanum dasyphyllum
Solanum forsskalii
Solanum hastifolium
Solanum lanzae
Solanum lycopersicum
Solanum malindiense
Solanum nigriviolaceum
Solanum pampaninii
Solanum somalense
Solanum stipitatostellatum
Solanum taitense
Solanum terminale
Solanum tettense
Sonchus stenophyllus
Sophora inhambanensis
Sopubia eminii
Sorghum arundinaceum
Sorghum bicolor
Spermacoce filituba
Sphaeranthus samburuensis
Sphaeranthus spathulatus
Sphaeranthus suaveolens
Sphaeranthus ukambensis
Sphagnum davidii
Sporobolus geminatus
Sporobolus nervosus
Sporobolus pellucidus
Sporobolus virginicus

Spragueanella rhamnifolia
Sterculia stenocarpa
Stictocardia incomta
Stictocardia macalusoi
Streptocarpus exsertus
Striga forbesii
Striga gesnerioides
Struthiola thomsonii
Strychnos madagascariensis
Strychnos spinosa
Stylidocleome brachycarpa
Stylosanthes fruticosa
Suaeda monoica
Swertia crassiuscula
Swertia lugardae
Synaptolepis kirkii
Synsepalum subverticillatum
Syrrhopodon kenyae
Syzygium cordatum
Tacazzea apiculata
Tagetes minuta
Tarenna pavettoides
Tecoma stans
Tennantia sennii
Tephrosia athiensis
Tephrosia elata
Tephrosia hildebrandtii
Tephrosia polyphylla
Tephrosia pumila
Tephrosia subtriflora
Tephrosia uniflora
Teramnus repens
Terminalia boivinii
Terminalia catappa
Terminalia kilimandscharica
Terminalia tetraptera
Tetradenia riparia
Tetradenia urticifolia
Tetraena simplex
Tetrapogon bidentatus
Tetrapogon cenchriformis
Tetrapogon roxburghiana
Thalictrum rhynchocarpum
Thecacoris spathulifolia
Thecacoris usambarensis
Thilachium thomasii
Thuidium assimile
Thuidium loricalycinum
Thuidium versicolor
Tinnea aethiopica
Tinospora oblongifolia
Tithonia diversifolia
Trachyspermum pimpinelloides
Tradescantia pallida
Tradescantia zebrina
Tragia benthamii
Tragia glabrescens
Tragus berteronianus
Triainolepis africana
Triaspis mozambica
Triaspis niedenzuiana
Tribulus cistoides
Trichocladus ellipticus
Trichodesma marsabiticum
Tristellateia africana
Triticum monococcum
Turnera thomasii
Turraea barbata
Turraea cornucopia
Turraea wakefieldii
Tylosema humifusa
Udotea indica
Umbilicus botryoides
Urochloa panicoides
Urochloa sclerochlaena
Utricularia inflexa
Uvaria denhardtiana
Uvaria kirkii
Uvaria lucida
Vachellia drepanolobium
Vachellia elatior
Vachellia etbaica
Vachellia horrida
Vachellia nilotica
Vachellia oerfota
Vachellia paolii
Vachellia reficiens
Vachellia robusta
Vachellia seyal
Vachellia tortilis
Vachellia turnbulliana
Vachellia zanzibarica
Vahlia dichotoma
Valoniopsis pachynema
Vangueria loranthifolia
Vangueria pallidiflora
Vanvoorstia spectabilis
Vatovaea pseudolablab
Vepris glandulosa
Vepris robertsoniae
Vepris samburuensis
Vepris sansibarensis
Verbena bonariensis
Vernonia galamensis
Vigna frutescens
Vigna membranacea
Vigna oblongifolia
Vigna praecox

Vigna schimperi
Vigna unguiculata
Vigna vexillata
Viscum tuberculatum
Vitex fischeri
Volkameria acerbiana
Volkameria eriophylla
Volkensinia prostrata
Wajira albescens
Warburgia ugandensis
Warneckea mouririfolia
Warnstorfia sarmentosa
Wielandia fadenii
Withania somnifera
Xanthium strumarium
Xenostegia pinnata
Xylocarpus granatum
Xylocarpus moluccensis
Xyris anceps
Xyris capensis
Yamadaella caenomyce
Zaleya pentandra
Zanthoxylum holtzianum
Zea mays
Zornia apiculata
Zornia glochidiata
Zornia pratensis

Expected Fungi Species within the RSA:

Buellia chermesina

Buellia parastata

Canoparmelia texana

Coccocarpia dissecta

Dirinaria aegialita

Dirinaria applanata

Dirinaria coccinea

Dirinaria confluens

Epicoccum heterochroum

Funalia floccosa

Fusarium lolii

Heterodermia albicans

Heterodermia diademata

Hexagonia hydnoides

Hyperphyscia isidiata

Kazachstania africana

Lecidea viridana

Lecidella viridans

Lobaria pulmonaria

Melanopsichium pennsylvanicum

Microbotryum reticulatum

Panus lecomtei

Parmelinella wallichiana

Parmotrema abessinicum

Parmotrema andinum

Parmotrema austrosinense

Parmotrema hababianum

Parmotrema tinctorum

Pertusaria mimosarum

Podaxis pistillaris

Punctelia rudecta

Pyxine cocoes

Pyxine katendei

Pyxine lilacina

Pyxine lyei

Pyxine maculata

Pyxine petricola

Pyxine reticulata

Pyxine vermiformis

Ramalina consanguinea

Ramalina dumeticola

Ramalina fecunda

Ramalina maritima

Rinodina tincta

Torula spongicola

Trametes cingulata

Umbilicaria umbilicarioides

Usnea decipiens

Usnea exasperata

Usnea liechtensteinii

Ustilago hitchcockiana

Xylodon flaviporus

Expected Macro-Invertebrate Species within the RSA:

Arthropoda:

Acraea encedon
Acraea eponina
Acraea quirina
Actihema hemiacta
Aedes albicosta
Aethiopicodynerus schulthessi
Afranthidium sakaniense
Afreumenes aethiopicus
Agrius convolvuli
Allepipona similis
Amblyomma eburneum
Amblyomma exornatum
Amblyomma latum
Anax speratus
Andriasa contraria
Anisodes leonaria
Antanartia abyssinica
Antanartia dimorphica
Antanartia hippomene
Antepipona jocosa
Antepipona mucronata
Antepipona pulchripilosella
Anthia hexasticta
Argyroploce caryothicta
Artema atlanta
Bactrocera cucurbitae
Bactrocera nigrivenata
Beckerella hildebrandtii
Bistrispinaria atlas
Blastobasis glauconotata
Callosphingia circe
Camponotus maculatus
Camponotus somalinus
Cephonodes hylas
Cephonodes trochilus
Ceratitis caetrata
Ceratitis capitata
Ceratitis cosyra
Ceratitis cristata
Ceratitis curvata
Ceratitis fasciventris
Ceratitis lobata
Ceratitis munroanum
Ceratitis pennitibialis
Ceratitis perisae
Ceratitis perseus
Ceratitis pinax
Ceratitis punctata
Ceratitis querita
Ceratitis rosa
Ceratitis rubivora
Ceratophaga vastellus
Cerceris xosa
Chlorochaeta pulchra
Chlorodynerus somalus
Chrysomya polymita
Cirrospilus crowei
Coeliades anchises
Coeliades forestan
Coeliades keithloa
Colletes rothschildi
Colocleora expansa
Colocleora probola
Colotis amata
Colotis chrysonome
Colotis danae
Colotis elgonensis
Colotis eris
Copris harrisi
Coptorhina nitefacta
Cosmetra podocarpivora
Cotinis mutabilis
Crematogaster mimosae
Crocothemis erythraea
Crocothemis sanguinolenta
Crossopriza johncloudsleyi
Cryptophlebia batrachopa
Ctenocephalides felis
Cyrtacanthacris tatarica
Cyrtolabulus striaticlypeus
Cyrtolabulus zethiformis
Dacus adenionis
Dacus annulatus
Dacus armatus
Dacus bivittatus
Dacus ciliatus
Dacus durbanensis
Dacus frontalis
Dacus hyalobasis
Dacus inornatus
Dacus longistylus
Dacus ostiofaciens
Dacus pleuralis
Dacus punctatifrons
Dacus siliqualactis
Dacus telfaireae
Dacus tenebricus
Dacus triater
Dacus umbeluzinus

Dacus umbrilatus
Dacus vertebratus
Danaus chrysippus
Dasysceloctis congensis
Deckenia imitatrix
Delta higletti
Digitonthophagus petilus
Digitonthophagus ulcerosus
Dirhinus gigasetosus
Dirhinus quadrhinus
Dorylus atriceps
Dorylus fimbriatus
Dorylus fulvus
Dovania poecila
Ellenbeckia monospila
Erebus walkeri
Euchloron megaera
Eucratoscelus constrictus
Eumenes lucasius
Eurema desjardinsii
Gametoides sanguinolenta
Garreta lugens
Glossina brevipalpis
Graphium angolanus
Graphium policenes
Gymnopleurus reichei
Gynacantha usambarica
Gynacantha villosa
Hemigymnochaeta bequaerti
Hiallum affinis
Hippotion celerio
Homotoma chlamydodora
Hypolimnas dubius
Hypolimnas misippus
Knemidokoptes pilae
Lamyra greatheadi
Laphyctis argenteofasciata
Leptomenes eumenoides
Leptomenes stenosoma
Leucostrophus alterhirundo
Ligia exotica
Lychas obsti
Macropoliana ferax
Martensia nyiroensis
Mecistocephalus angusticeps
Megachile maxillosa
Messor barbarus
Miantochora polychroaria
Micreumenes crassipunctatus
Micreumenes kenyaensis
Micreumenes marci
Microclanis erlangeri
Neorhagoletis latifrons
Nephele argentifera
Notogomphus kilimandjaricus
Notogomphus maathaiae
Ocymyrmex nitidulus
Odontomachus haematodus
Oides funebris
Onitis alexis
Onitis pinheyi
Onitis thoracicus
Onthophagus falsus
Onthophagus infuscatus
Onthophagus leroyi
Ornithodoros moubata
Ovodynerus sjoestedti
Ovodynerus yngvei
Pachyanthidium semiluteum
Pachycondyla tarsata
Palpopleura lucia
Papilio antimachus
Papilio chrapkowskoides
Papilio dardanus
Papilio demodocus
Papilio echerioides
Papilio ophidicephalus
Papilio phorcas
Papilio rex
Parabuthus liosoma
Parabuthus maximus
Parabuthus pallidus
Paragaleodes pallidus
Paragomphus pumilio
Pheidole indica
Phumosia lutescens
Phyllomacromia pallidnervis
Platythyrea cribrinodis
Poliana micra
Polistes marginalis
Polyptychoides grayii
Polyrhachis gagates
Potamonautes alluaudi
Potamonautes neumanni
Potamonautes odhneri
Potamonautes subukia
Pseudapis anthidioides
Pterochilus bimammillatus
Rhingia caerulescens
Rhynchium marginellum
Rufoclanis numosae
Sarcophaga suffusa
Scelio howardi
Sceliodes laisalis
Scopula natalica
Scopula vitiosaria
Scymnus levaillanti
Smeringopus turkana

Sternocera castanea

Stomoxys taeniatus

Stomoxys varipes

Stroudia laikipia

Strumigenys omalyx

Syllegomydas astrictus

Syllegomydas heothinos

Synagris analis

Taxigramma biseta

Tetramorium altivagans

Tetramorium caldarium

Tetramorium metactum

Thaumatotibia leucotreta

Thaumatovalva limbata

Titoceres jaspideus

Traminda obversata

Tricarinodynerus rufoflavus

Trichospilus boops

Tricyclea bifrons

Trioza erytreae

Trirhithrum coffeae

Trirhithrum meladiscum

Trissolcus mopsus

Tuta absoluta

Typhloscaris aberdarensis

Vanemdenia africana

Wadicosa benadira

Zethus favillaceus

Annelida:

Stuhlmannia variabilis

Mollusca:

Achatina bloyeti

Achatina glutinosa

Anolacia aperta

Bellamya unicolor

Biomphalaria pfeifferi

Bistolida kieneri

Bulinus forskalii

Cleopatra bulimoides

Conasprella coromandelica

Conus arenatus

Conus catus

Conus coronatus

Conus lividus

Conus namocanus

Conus violaceus

Conus zeylanicus

Cypraecassis rufa

Dosinia crocea

Erronea caurica

Lanistes ovatus

Melanoides tuberculata

Naria helvola

Naria marginalis

Oliva bulbosa

Palmadusta diluculum

Staphylaea staphylaea

Terebra laevigata

Terebralia palustris

Vasum rhinoceros

Expected Reptile Species within the RSA:

Acanthocercus atricollis
Acanthocercus cyanogaster
Adolfus jacksoni
Afrotyphlops mucruso
Afrotyphlops punctatus
Agama agama
Agama lionotus
Agama rueppelli
Aparallactus turneri
Atheris desaixi
Atheris hindii
Atheris squamigera
Atractaspis microlepidota
Bitis arietans
Bitis worthingtoni
Boaedon fuliginosus
Broadleysaurus major
Causus resimis
Causus resimus
Causus rhombeatus
Chamaeleo dilepis
Chamaeleo gracilis
Chelonia mydas
Chondrodactylus bibronii
Crocodylus niloticus
Crotaphopeltis braestrupi
Crotaphopeltis hotamboeia
Cryptoblepharus africanus
Dasypeltis medici
Dasypeltis scabra
Dendroaspis angusticeps
Dendroaspis polylepis
Duberria lutrix
Echis carinatus
Echis pyramidum
Elapsoidea sundevallii
Epacrophis boulengeri
Eretmochelys imbricata
Eryx colubrinus
Gonionotophis poensis
Heliobolus spekii
Hemidactylus angulatus
Hemidactylus frenatus
Hemidactylus isolepis
Hemidactylus mabouia
Hemidactylus mercatorius
Hemidactylus platycephalus
Hemidactylus ruspolii
Hemidactylus squamulatus
Hemidactylus turcicus
Hemirhagerrhis kelleri
Hemirhagerrhis nototaenia
Holodactylus africanus
Homopholis fasciata
Kinyongia excubitor
Latastia longicaudata
Leptosiaphos kilimensis
Lycophidion capense
Lygodactylus keniensis
Lygodactylus mombasicus
Lygodactylus picturatus
Lygodactylus somalicus
Lygodactylus wojnowskii
Mochlus afer
Mochlus sundevalli
Naja melanoleuca
Naja nigricollis
Naja pallida
Natriciteres olivacea
Pelomedusa subrufa
Pelusios sinuatus
Philothamnus battersbyi
Philothamnus irregularis
Philothamnus punctatus
Philothamnus semivariegatus
Prosymna stuhlmanni
Psammophis biseriatus
Psammophis phillipsii
Psammophis punctulatus
Psammophis sibilans
Psammophis subtaeniatus
Psammophylax multisquamis
Pseuderemias smithii
Python natalensis
Python sebae
Rhamphiophis oxyrhynchus
Rhamphiophis rostratus
Rhinotyphlops unitaeniatus
Rieppeleon kerstenii
Stigmochelys pardalis
Telescopus dhara
Telescopus obtusus
Thelotornis kirtlandii
Thrasops jacksonii
Trachylepis brevicollis
Trachylepis dichroma
Trachylepis maculilabris
Trachylepis planifrons
Trachylepis quinquetaeniata

Trachylepis striata

Trachylepis varia

Trioceros hoehnelii

Trioceros jacksonii

Varanus albigularis

Varanus exanthematicus

Varanus niloticus

Expected Amphibian Species within the RSA:

Amietia angolensis

Amietophrynus garmani

Amietophrynus gutturalis

Amietophrynus kerinyagae

Amietophrynus regularis

Amietophrynus steindachneri

Amietophrynus xeros

Boulengerula denhardti

Boulengerula spawlsi

Bufo pentoni

Chiromantis petersii

Chiromantis xerampelina

Hemisus marmoratus

Hyperolius argus

Hyperolius cystocandicans

Hyperolius glandicolor

Hyperolius montanus

Hyperolius nasutus

Hyperolius pusillus

Hyperolius tuberilinguis

Hyperolius viridiflavus

Kassina senegalensis

Phrynobatrachus graueri

Phrynobatrachus keniensis

Phrynobatrachus kinangopensis

Poyntonophrynus lughensis

Ptychadena anchietae

Ptychadena mahnerti

Ptychadena mascareniensis

Ptychadena oxyrhynchus

Rana fulleborni

Rana mascareniensis

Rana wittei

Schistometopum gregorii

Sclerophrys turkanae

Tomopterna cryptotis

Tomopterna delalandii

Tomopterna gallmanni

Tomopterna marmorata

Tomopterna wambensis

Xenopus borealis

Xenopus laevis

Expected Bird Species within the RSA:

Accipiter badius
Accipiter melanoleucus
Accipiter minullus
Accipiter nisus
Accipiter tachiro
Acrocephalus arundinaceus
Acrocephalus baeticatus
Acrocephalus griseldis
Acrocephalus schoenobaenus
Acryllium vulturinum
Actitis hypoleucos
Actophilornis africanus
Agapornis fischeri
Agricola pallidus
Alcedo cristata
Alcedo semitorquata
Alopochen aegyptiaca
Amadina fasciata
Amaurornis flavirostra
Amblyospiza albifrons
Anaplectes jubaensis
Anaplectes rubriceps
Anas capensis
Anas clypeata
Anas erythrorhyncha
Anas hottentota
Anas sparsa
Anas undulata
Anastomus lamelligerus
Andropadus importunus
Anhinga rufa
Anthoscopus caroli
Anthoscopus musculus
Anthreptes neglectus
Anthreptes orientalis
Anthreptes reichenowi
Anthreptes rubritorques
Anthus campestris
Anthus cinnamomeus
Anthus leucophrys
Anthus melindae
Anthus similis
Anthus trivialis
Anthus vaalensis
Apalis chariessa
Apalis cinerea
Apalis flavida
Apalis melanocephala
Apalis porphyrolaema
Apaloderma narina
Apus affinis
Apus apus
Apus barbatus
Apus caffer
Apus melba
Apus niansae
Aquila heliaca
Aquila nipalensis
Aquila pomarina
Aquila rapax
Aquila spilogaster
Aquila verreauxii
Ardea alba
Ardea cinerea
Ardea goliath
Ardea melanocephala
Ardea purpurea
Ardeola idae
Ardeola ralloides
Ardeotis kori
Arenaria interpres
Arizelocichla kikuyuensis
Asio capensis
Aviceda cuculoides
Balearica regulorum
Batis minor
Batis molitor
Batis perkeo
Batis soror
Bias musicus
Bostrychia hagedash
Bradornis microrhynchus
Bradornis pallidus
Bradypterus baboecala
Bradypterus cinnamomeus
Bubalornis albirostris
Bubalornis niger
Bubo africanus
Bubo cinerascens
Bubo lacteus
Bubulcus ibis
Bucorvus leadbeateri
Buphagus africanus
Buphagus erythrorhynchus
Burhinus capensis
Burhinus vermiculatus
Butastur rufipennis
Buteo augur
Buteo buteo

Buteo oreophilus
Buteo rufofuscus
Butorides striata
Bycanistes brevis
Bycanistes bucinator
Calamonastes simplex
Calandrella cinerea
Calandrella somalica
Calendulauda africanoides
Calendulauda alopex
Calendulauda poecilosterna
Calidris alba
Calidris ferruginea
Calidris minuta
Camaroptera brachyura
Camaroptera brevicaudata
Campephaga flava
Campephaga phoenicea
Campephaga quiscalina
Campethera abingoni
Campethera cailliautii
Campethera mombassica
Campethera nubica
Campethera tullbergi
Caprimulgus clarus
Caprimulgus climacurus
Caprimulgus donaldsoni
Caprimulgus europaeus
Caprimulgus fossii
Caprimulgus fraenatus
Caprimulgus inornatus
Caprimulgus nubicus
Caprimulgus pectoralis
Caprimulgus poliocephalus
Caprimulgus tristigma
Cecropis abyssinica
Cecropis daurica
Cecropis senegalensis
Centropus superciliosus
Ceryle rudis
Ceyx pictus
Chalcomitra amethystina
Chalcomitra hunteri
Chalcomitra senegalensis
Charadrius alexandrinus
Charadrius asiaticus
Charadrius dubius
Charadrius hiaticula
Charadrius leschenaultii
Charadrius marginatus
Charadrius mongolus
Charadrius pecuarius
Charadrius tricollaris
Chelictinia riocourii
Chlidonias hybrida
Chlidonias leucopterus
Chlorocichla flaviventris
Chlorophoneus nigrifrons
Chlorophoneus sulfureopectus
Chrysococcyx caprius
Chrysococcyx cupreus
Chrysococcyx klaas
Cichladusa guttata
Ciconia abdimii
Ciconia ciconia
Ciconia episcopus
Ciconia nigra
Cinnyricinclus leucogaster
Cinnyris bifasciatus
Cinnyris chalcomelas
Cinnyris habessinicus
Cinnyris mariquensis
Cinnyris mediocris
Cinnyris nectarinioides
Cinnyris pulchellus
Cinnyris reichenowi
Cinnyris superbus
Cinnyris venustus
Circaetus cinerascens
Circaetus cinereus
Circaetus fasciolatus
Circaetus gallicus
Circaetus pectoralis
Circus aeruginosus
Circus macrourus
Circus pygargus
Circus ranivorus
Cisticola aberdare
Cisticola aridulus
Cisticola ayresii
Cisticola bodessa
Cisticola brachypterus
Cisticola brunnescens
Cisticola cantans
Cisticola chiniana
Cisticola cinereolus
Cisticola distinctus
Cisticola galactotes
Cisticola hunteri
Cisticola juncidis
Cisticola marginatus
Cisticola nana
Cisticola natalensis
Cisticola restrictus
Cisticola robustus
Clamator glandarius
Clamator jacobinus
Clamator levaillantii

Coccopygia melanotis
Coccopygia quartinia
Colius leucocephalus
Colius striatus
Columba arquatrix
Columba delegorguei
Columba guinea
Columba larvata
Columba livia
Coracias abyssinicus
Coracias caudatus
Coracias garrulus
Coracias naevius
Coracina caesia
Corvus albicollis
Corvus albus
Corvus capensis
Corvus edithae
Corvus rhipidurus
Corvus splendens
Corythaixoides concolor
Corythaixoides leucogaster
Cossypha caffra
Cossypha heuglini
Cossypha natalensis
Coturnix coturnix
Coturnix delegorguei
Creatophora cinerea
Crex egregia
Crithagra burtoni
Crithagra citrinelloides
Crithagra donaldsoni
Crithagra dorsostriata
Crithagra hyposticta
Crithagra mozambica
Crithagra reichardi
Crithagra reichenowi
Crithagra striolata
Crithagra sulphurata
Crithagra xanthopygia
Cryptospiza salvadorii
Cuculus canorus
Cuculus clamosus
Cuculus gularis
Cuculus solitarius
Cursorius cursor
Cursorius somalensis
Cursorius temminckii
Cyanomitra olivacea
Cyanomitra veroxii
Cyanomitra verticalis
Cypsiurus parvus
Delichon urbicum
Dendrocygna bicolor
Dendrocygna viduata
Dendropicos fuscescens
Dendropicos goertae
Dendropicos namaquus
Dicrurus adsimilis
Dicrurus ludwigii
Dicrurus modestus
Dinemellia dinemelli
Dioptrornis chocolatinus
Dioptrornis fischeri
Drepanorhynchus reichenowi
Dromas ardeola
Dryoscopus cubla
Dryoscopus gambensis
Dryoscopus pringlii
Egretta ardesiaca
Egretta dimorpha
Egretta garzetta
Egretta gularis
Egretta intermedia
Elanus caeruleus
Elminia albonotata
Emberiza flaviventris
Emberiza hortulana
Emberiza poliopleura
Emberiza tahapisi
Eminia lepida
Ephippiorhynchus senegalensis
Eremomela flavicrissalis
Eremomela icteropygialis
Eremopterix leucopareia
Eremopterix leucotis
Eremopterix signatus
Erythrocercus holochlorus
Erythropygia galactotes
Erythropygia leucophrys
Erythropygia quadrivirgata
Estrilda astrild
Estrilda charmosyna
Estrilda erythronotos
Estrilda rhodopyga
Euodice cantans
Euplectes afer
Euplectes albonotatus
Euplectes ardens
Euplectes axillaris
Euplectes diadematus
Euplectes gierowii
Euplectes nigroventris
Euplectes progne
Eupodotis senegalensis
Eurillas curvirostris
Eurillas latirostris
Eurocephalus anguitimens

Eurocephalus ruppelli
Eurystomus glaucurus
Falco alopex
Falco amurensis
Falco biarmicus
Falco cherrug
Falco chicquera
Falco concolor
Falco cuvierii
Falco dickinsoni
Falco fasciinucha
Falco naumanni
Falco peregrinus
Falco rupicoloides
Falco subbuteo
Falco tinnunculus
Francolinus hildebrandti
Francolinus leucoscepus
Francolinus sephaena
Francolinus shelleyi
Francolinus squamatus
Fraseria caerulescens
Fulica cristata
Galerida cristata
Gallinago gallinago
Gallinago nigripennis
Gallinula chloropus
Geokichla guttata
Geokichla piaggiae
Glareola pratincola
Glaucidium capense
Glaucidium perlatum
Granatina ianthinogaster
Guttera pucherani
Gymnoris pyrgita
Gymnoris xanthocollis
Gypohierax angolensis
Gyps africanus
Gyps fulvus
Gyps rueppellii
Haematopus ostralegus
Halcyon albiventris
Halcyon chelicuti
Halcyon leucocephala
Halcyon senegalensis
Halcyon senegaloides
Haliaeetus vocifer
Hedydipna collaris
Hedydipna platura
Heteromyias albispecularis
Hieraaetus ayresii
Hieraaetus pennatus
Hieraaetus wahlbergi
Himantopus himantopus
Hippolais icterina
Hippolais languida
Hippolais olivetorum
Hirundo aethiopica
Hirundo angolensis
Hirundo rustica
Hirundo smithii
Hydroprogne caspia
Hypargos niveoguttatus
Hypergerus lepidus
Ichthyaetus hemprichii
Iduna pallida
Iduna similis
Indicator indicator
Indicator minor
Indicator variegatus
Irania gutturalis
Ixobrychus minutus
Ixobrychus sturmii
Kaupifalco monogrammicus
Lagonosticta nitidula
Lagonosticta rhodopareia
Lagonosticta rubricata
Lagonosticta senegala
Lamprotornis chalybaeus
Lamprotornis chloropterus
Lamprotornis fischeri
Lamprotornis hildebrandti
Lamprotornis purpuroptera
Lamprotornis regius
Lamprotornis shelleyi
Lamprotornis splendidus
Lamprotornis superbus
Laniarius aethiopicus
Laniarius bicolor
Laniarius ferrugineus
Laniarius funebris
Laniarius major
Laniarius sublacteus
Lanius cabanisi
Lanius collaris
Lanius collurio
Lanius cristatus
Lanius dorsalis
Lanius excubitoroides
Lanius humeralis
Lanius isabellinus
Lanius minor
Lanius phoenicuroides
Lanius somalicus
Larus ridibundus
Leptoptilos crumenifer
Leptoptilos crumeniferus
Limosa lapponica

Limosa limosa
Linurgus olivaceus
Lissotis hartlaubii
Lissotis melanogaster
Lonchura bicolor
Lophaetus occipitalis
Lophotis gindiana
Lophotis ruficrista
Luscinia luscinia
Luscinia megarhynchos
Lybius leucocephalus
Lybius melanopterus
Lybius torquatus
Macheiramphus alcinus
Macrodipteryx vexillarius
Macronyx ameliae
Macronyx aurantiigula
Macronyx croceus
Macronyx sharpei
Malaconotus blanchoti
Malimbus rubriceps
Megaceryle maxima
Melaenornis pammelaina
Melaenornis semipartitus
Melierax canorus
Melierax metabates
Melierax poliopterus
Melocichla mentalis
Merops albicollis
Merops apiaster
Merops hirundineus
Merops nubicus
Merops oreobates
Merops orientalis
Merops persicus
Merops pusillus
Merops revoilii
Merops superciliosus
Microcarbo africanus
Micronisus gabar
Milvus aegyptius
Milvus migrans
Mirafra africana
Mirafra albicauda
Mirafra cantillans
Mirafra hypermetra
Mirafra pulpa
Mirafra rufocinnamomea
Mirafra williamsi
Monticola rufocinereus
Monticola saxatilis
Monticola semirufus
Motacilla aguimp
Motacilla alba
Motacilla cinerea
Motacilla clara
Motacilla flava
Muscicapa adusta
Muscicapa caerulescens
Muscicapa gambagae
Mycteria ibis
Myrmecocichla aethiops
Necrosyrtes monachus
Nectarinia johnstoni
Nectarinia kilimensis
Nectarinia tacazze
Neocossyphus rufus
Neophema chrysogaster
Neophron percnopterus
Neotis denhami
Neotis heuglinii
Netta erythrophthalma
Nicator gularis
Nigrita canicapillus
Nilaus afer
Notopholia corrusca
Numenius arquata
Numenius phaeopus
Numida meleagris
Nycticorax nycticorax
Odontospiza caniceps
Odontospiza griseicapilla
Oena capensis
Oenanthe hispanica
Oenanthe isabellina
Oenanthe oenanthe
Oenanthe pileata
Oenanthe pleschanka
Oenanthe scotocerca
Onychognathus morio
Onychognathus salvadorii
Onychognathus walleri
Onychoprion anaethetus
Oriolus auratus
Oriolus larvatus
Oriolus oriolus
Oriolus percivali
Ortygospiza fuscocrissa
Otus scops
Otus senegalensis
Oxyura maccoa
Pandion haliaetus
Parus albiventris
Parus thruppi
Passer castanopterus
Passer domesticus
Passer eminibey
Passer gongonensis

Passer griseus
Passer rufocinctus
Pelecanus onocrotalus
Pelecanus rufescens
Pernis apivorus
Pernis ptilorhynchus
Phalacrocorax carbo
Phalaropus lobatus
Philomachus pugnax
Phoeniconaias minor
Phoeniculus bollei
Phoeniculus damarensis
Phoeniculus purpureus
Phoenicurus phoenicurus
Pholia sharpii
Phyllastrephus cabanisi
Phyllastrephus cerviniventris
Phyllastrephus debilis
Phyllastrephus fischeri
Phyllastrephus placidus
Phyllastrephus strepitans
Phyllastrephus terrestris
Phyllolais pulchella
Phylloscopus sibillatrix
Phylloscopus trochilus
Phylloscopus umbrovirens
Pinarocorys erythropygia
Platalea alba
Platysteira cyanea
Platysteira peltata
Plectropterus gambensis
Plegadis falcinellus
Plocepasser donaldsoni
Plocepasser mahali
Plocepasser rufoscapulatus
Ploceus baglafecht
Ploceus bicolor
Ploceus bojeri
Ploceus capensis
Ploceus cucullatus
Ploceus insignis
Ploceus intermedius
Ploceus jacksoni
Ploceus luteolus
Ploceus melanocephalus
Ploceus melanogaster
Ploceus nigricollis
Ploceus ocularis
Ploceus pelzelni
Ploceus rubiginosus
Ploceus spekei
Ploceus subaureus
Ploceus vitellinus
Ploceus xanthops
Pluvialis apricaria
Pluvialis squatarola
Podica senegalensis
Podiceps cristatus
Poeoptera sharpii
Poeoptera stuhlmanni
Pogoniulus bilineatus
Pogoniulus chrysoconus
Pogoniulus leucomystax
Pogoniulus pusillus
Pogonocichla stellata
Poicephalus gulielmi
Poicephalus meyeri
Poicephalus rufiventris
Polemaetus bellicosus
Polihierax semitorquatus
Polyboroides typus
Porphyrio porphyrio
Prinia rufifrons
Prinia somalica
Prinia subflava
Prionops plumatus
Prionops retzii
Prionops scopifrons
Prodotiscus regulus
Prodotiscus zambesiae
Psalidoprocne albiceps
Psalidoprocne pristoptera
Pseudalaemon fremantlii
Pseudalethe poliocephala
Pseudhirundo griseopyga
Pseudonigrita arnaudi
Pseudonigrita cabanisi
Pterocles decoratus
Pterocles exustus
Pterocles gutturalis
Pterocles lichtensteinii
Ptilopachus petrosus
Ptilopsis leucotis
Ptyonoprogne fuligula
Puffinus bailloni
Pycnonotus barbatus
Pycnonotus dodsoni
Pycnonotus tricolor
Pytilia melba
Quelea cardinalis
Quelea erythrops
Quelea quelea
Rallus caerulescens
Recurvirostra avosetta
Rhinopomastus cyanomelas
Rhinopomastus minor
Rhinoptilus chalcopterus
Rhinoptilus cinctus

Riparia cincta
Riparia paludicola
Riparia riparia
Rostratula benghalensis
Sagittarius serpentarius
Sarkidiornis melanotos
Saxicola rubetra
Saxicola torquatus
Scepomycter winifredae
Schoutedenapus myoptilus
Scopus umbretta
Scotopelia peli
Serinus flavivertex
Setophaga striata
Speculipastor bicolor
Spermestes bicolor
Spermestes cucullata
Spermophaga ruficapilla
Spizocorys personata
Sporopipes frontalis
Stactolaema leucotis
Stelgidillas gracilirostris
Stephanoaetus coronatus
Sterna dougallii
Sterna fuscata
Sterna hirundo
Sterna nilotica
Sterna repressa
Streptopelia capicola
Streptopelia decipiens
Streptopelia lugens
Streptopelia roseogrisea
Streptopelia semitorquata
Streptopelia senegalensis
Strix woodfordii
Struthio camelus
Struthio molybdophanes
Sylvia abyssinica
Sylvia atricapilla
Sylvia boehmi
Sylvia borin
Sylvia communis
Sylvia nisoria
Sylvietta brachyura
Sylvietta isabellina
Sylvietta leucophrys
Sylvietta whytii
Tachybaptus ruficollis
Tachymarptis aequatorialis
Tauraco corythaix
Tauraco fischeri
Tauraco hartlaubi
Tchagra australis
Tchagra jamesi
Tchagra senegalus
Telacanthura ussheri
Telophorus cruentus
Telophorus quadricolor
Terathopius ecaudatus
Terpsiphone viridis
Thalasseus bengalensis
Thalasseus bergii
Thamnolaea cinnamomeiventris
Threskiornis aethiopicus
Tmetothylacus tenellus
Tockus alboterminatus
Tockus deckeni
Tockus erythrorhynchus
Tockus flavirostris
Tockus jacksoni
Tockus nasutus
Torgos tracheliotos
Trachyphonus darnaudii
Trachyphonus erythrocephalus
Treron calvus
Tricholaema diademata
Tricholaema lacrymosa
Tricholaema melanocephala
Trigonoceps occipitalis
Tringa glareola
Tringa nebularia
Tringa ochropus
Tringa stagnatilis
Tringa totanus
Trochocercus cyanomelas
Turdoides aylmeri
Turdoides hindei
Turdoides hypoleuca
Turdoides jardineii
Turdoides plebejus
Turdoides rubiginosa
Turdoides sharpei
Turdoides squamulata
Turdus abyssinicus
Turdus merula
Turdus olivaceus
Turdus tephronotus
Turnix sylvaticus
Turtur chalcospilos
Turtur tympanistria
Tyto alba
Upupa epops
Uraeginthus bengalus
Uraeginthus cyanocephalus
Uraeginthus ianthinogaster
Urocolius macrourus
Urorhipis rufifrons
Vanellus albiceps

Vanellus armatus

Vanellus coronatus

Vanellus lugubris

Vanellus melanopterus

Vanellus spinosus

Vanellus tectus

Vidua chalybeata

Vidua fischeri

Vidua hypocherina

Vidua macroura

Vidua paradisaea

Vidua purpurascens

Xenus cinereus

Zapornia flavirostra

Zosterops abyssinicus

Zosterops kikuyuensis

Zosterops poliogastrus

Zosterops senegalensis

Expected Mammal Species within the RSA:

Acinonyx jubatus
Acomys cahirinus
Acomys ignitus
Acomys kempi
Acomys percivali
Acomys wilsoni
Aepyceros melampus
Aethomys hindei
Alcelaphus buselaphus
Arvicanthis abyssinicus
Arvicanthis neumanni
Arvicanthis niloticus
Arvicanthis somalicus
Atelerix albiventris
Bdeogale omnivora
Beatragus hunteri
Bos taurus
Camelus dromedarius
Canis adustus
Canis aureus
Canis mesomelas
Capra hircus
Cardioderma cor
Cephalophus adersi
Ceratotherium simum
Cercopithecus mitis
Chaerephon ansorgei
Chaerephon pumilus
Chaerephon pusillus
Chlorocebus aethiops
Chlorocebus pygerythrus
Civettictis civetta
Colobus angolensis
Colobus guereza
Cricetomys ansorgei
Crocidura bicolor
Crocidura hildegardeae
Crocidura hirta
Crocidura macarthuri
Crocidura montis
Crocidura olivieri
Crocidura parvipes
Crocidura raineyi
Crocuta crocuta
Damaliscus lunatus
Dasymys incomtus
Dendrohyrax arboreus
Dendromus insignis
Dendromus nyikae
Diceros bicornis
Eidolon helvum
Elephantulus rufescens
Epomophorus labiatus
Epomophorus minimus
Epomophorus minor
Epomophorus wahlbergi
Equus asinus
Equus grevyi
Equus quagga
Erythrocebus patas
Eudorcas thomsonii
Felis silvestris
Galago gallarum
Galago senegalensis
Galagoides cocos
Galerella sanguinea
Genetta genetta
Genetta maculata
Genetta tigrina
Gerbilliscus nigricaudus
Gerbilliscus robustus
Gerbilliscus validus
Gerbillus agag
Gerbillus pulvinatus
Giraffa camelopardalis
Giraffa reticulata
Grammomys caniceps
Grammomys dolichurus
Grammomys ibeanus
Graphiurus murinus
Helogale hirtula
Helogale parvula
Herpestes ichneumon
Heterocephalus glaber
Heterohyrax brucei
Hippopotamus amphibius
Hipposideros caffer
Hipposideros ruber
Hyaena hyaena
Hylochoerus meinertzhageni
Hypsugo ariel
Hystrix cristata
Ichneumia albicauda
Ictonyx striatus
Kerivoula argentata
Kobus ellipsiprymnus
Laephotis wintoni
Lavia frons
Lemniscomys barbarus

Lemniscomys striatus
Leptailurus serval
Lepus capensis
Litocranius walleri
Lophuromys aquilus
Lophuromys zena
Loxodonta africana
Lycaon pictus
Madoqua guentheri
Madoqua kirkii
Mastomys natalensis
Mellivora capensis
Mus setulosus
Mus tenellus
Mus triton
Myomyscus brockmani
Myotis tricolor
Nanger granti
Neoromicia capensis
Neoromicia helios
Neoromicia nana
Neoromicia rendalli
Neoromicia tenuipinnis
Neoromicia zuluensis
Nycteris hispida
Nycteris thebaica
Nycticeinops schlieffenii
Oenomys hypoxanthus
Oreotragus oreotragus
Oryx beisa
Oryx gazella
Otocyon megalotis
Otolemur garnettii
Otomys tropicalis
Ourebia ourebi
Panthera leo
Panthera pardus
Papio anubis
Papio cynocephalus
Paraxerus ochraceus
Phacochoerus aethiopicus
Phacochoerus africanus
Philantomba monticola
Piliocolobus rufomitratus
Pipistrellus aero
Pipistrellus hesperidus
Procavia capensis
Proteles cristata
Raphicerus campestris
Redunca arundinum
Redunca fulvorufula
Rhinolophus clivosus
Rhinolophus fumigatus
Rhinolophus simulator
Rhinopoma hardwickii
Scotoecus albigula
Scotoecus hindei
Scotoecus hirundo
Scotophilus dinganii
Scotophilus nigrita
Scotophilus trujilloi
Surdisorex polulus
Sylvicapra grimmia
Syncerus caffer
Tachyoryctes ibeanus
Tachyoryctes rex
Tachyoryctes spalacinus
Tachyoryctes splendens
Tadarida lobata
Taphozous hildegardeae
Taphozous mauritianus
Taphozous perforatus
Taterillus harringtoni
Taurotragus oryx
Tragelaphus angasii
Tragelaphus imberbis
Tragelaphus oryx
Tragelaphus scriptus
Tragelaphus strepsiceros
Triaenops afer
Xerus rutilus

Expected Fish Species within the RSA:

Aplocheilichthys jeanneli

Bagrus urostigma

Barbus paludinosus

Bodianus macrognathos

Chiloglanis devosi

Chiloglanis sp. nov. 'Kerio'

Chiloglanis sp. nov. 'Northern Ewaso Nyiro'

Coptodon zillii

Cyprinocirrhites polyactis

Diaphus suborbitalis

Echidna nebulosa

Enteromius neumayeri

Epinephelus chlorostigma

Epinephelus macrospilos

Epinephelus rivulatus

Labeo aff. mesops

Labeo sp. nov. 'Baomo'

Labeo victorianus

Marcusenius sp. nov. 'Turkwell'

Mormyrus kannume

Myrichthys colubrinus

Nothobranchius bojiensis

Nothobranchius patrizii

Nothobranchius willerti

Oreochromis leucostictus

Oreochromis niloticus

Oreochromis spilurus

Ostorhinchus apogonoides

Parailia somalensis

Pardiglanis tarabinii

Periophthalmus argentilineatus

Plectranthias longimanus

Plectranthias morgansi

Pristis pristis

Pseudanthias cooperi

Pseudanthias squamipinnis

Pseudochromis leucorhynchus

Synodontis manni

Velifer hypselopterus

APPENDIX B

Recorded Species Lists

Recorded Plant Species within the RSA:

Actiniopteris radiata (Sw.) Link

Abildgaardia triflora (L.) Abeyw.

Abrus precatorius L.

Abrus precatorius L. ssp. africanus Verdc.

Abutilon fruticosum Guill. & Perr.

Abutilon fruticosum Guill. & Perr. var. fruticosum

Abutilon pannosum (G. Forst.) Schltdl.

Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.

Abutilon sp.

Acacia ataxacantha DC.

Acacia bussei Sjøstedt

Acacia elatior

Acacia elatior Brenan

Acacia hamulosa Benth.

Acacia horrida (L.) Willd.

Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan

Acacia mellifera

Acacia mellifera (Vahl) Benth

Acacia mellifera (Vahl) Benth.

Acacia mellifera (Vahl) Benth. ssp. mellifera

Acacia nilotica (L.) Delile ssp. leiocarpa Brenan

Acacia nilotica (L.) Willd. ex Delile

Acacia oerfota (Forssk.) Schweinf.

Acacia paolii

Acacia paolii Chiov.

Acacia reficiens

Acacia reficiens Wawra

Acacia reficiens Wawra ssp. misera (Vatke) Brenan

Acacia Senegal

Acacia senegal (L.) Willd.

Acacia senegal (L.) Willd. var. senegal

Acacia seyal Delile var. seyal

Acacia stuhlmannii Taub.

Acacia thomasii (K.E)

Acacia thomasii Harms

Acacia tortilis

Acacia tortilis (Forssk.) Hayne

Acacia tortilis (Forssk.) Hayne ssp. spirocarpa (A. Rich.) Brenan

Acacia zanzibarica (S. Moore) Taub.

Acacia zanzibarica (S. Moore) Taub. var. zanzibarica

Acalypha indica

Acalypha indica L.

Acalypha lanceolata Willd.

Acanthospermum hispidum

Acanthospermum hispidum DC.

Achyranthes aspera L.

Actiniopteris radiate

Adansonia digitata L.

Adenia venenata

Adenia venenata Forssk.

Adenia volkensii

Adenia volkensii Harms

Adenium obesum (Forssk.) Roem. & Schult.

Aerva lanata

Aerva lanata (L.) Juss. ex Schult.

Aerva lanata (L.) Schult.

Aeschynomene cristata Vatke

Aeschynomene cristata Vatke var. pubescens J. Léonard

Aeschynomene sp.B

Afrocanthium kilifiense (Bridson) Lantz

Agathisanthemum bojeri Klotzsch var. bojeri

Agelanthus sansibarensis (Engl.) Polhill & Wiens ssp. sansibarensis

Agelanthus subulatus (Engl.) Polhill & Wiens

Albizia anthelmintica Brongn.

Albuca abyssinica

Allmaniopsis fruticulosa Suess.

Allmaniopsis fruticulosa Suess.

Allophylus rubifolius (A. Rich.) Engl. var. alnifolius (Baker) Friis & Vollesen

Aloe citrina S. Carter & Brandham

Aloe deserti (IUCN C.C)

Aloe deserti A. Berger

Aloe ruspoliana Baker

Aloe sp.

Aloe vituensis Baker

Alternanthera pungens

Alternanthera pungens Kunth

Alternanthera pungens Kunth

Alysicarpus glumaceus (Vahl) DC. ssp.

Alysicarpus vaginalis (L.) DC.

Alysicarpus vaginalis (L.) DC. var. vaginalis

Amaranthus sparganiocephalus Thell.

Ammania auriculata Willd.

Ampelocissus africana (Lour.) Merr. var. africana

Anacardium occidentale L.

Ancylobotrys petersiana (Klotzsch) Pierre

Andropogon chinensis (Nees) Merr.

Aneilema calceolus Brenan

Aneilema petersii (Hassk.) C.B. Clarke ssp. petersii

Anisotes tanensis Baden

Antidesma venosum Tul

Antidesma venosum Tul.

Aptosimum pumilum (Hochst.) Benth.

Aristida adscensionis L.

Aristida adscensionsis L.

Aristida barbicollis Trin. & Rupr.

Aristida kenyensis

Aristida mutabilis

Aristida mutabilis Trin. & Rupr.

Aristida sp.

Aristida stenostachya Clayton

Aristolochia bracteolata Lam.

Asparagus africanus Lam.

Asparagus buchananii

Asparagus buchananii Baker

Asparagus falcatus L.

Asparagus flagellaris (Kunth) Baker

Asparagus scaberulus A. Rich.?

Asparagus sp.

Aspilia mossambicensis (Oliv.) Wild

Asystasia ansellioides C.B. Clarke

Asystasia gangetica (L.) T. Anderson ssp. micrantha (Nees) Ensermu

Azima tetracantha Lam.

Bacopa floribunda (R. Br.) Wettst.

Balanites aegyptiaca (L.) Delile

Balanites rotundifolia

Balanites rotundifolia (Tiegh.) Blatt.

Balanites rotundifolia (Tiegh.) Blatt. var. rotundifolia

Barleria acanthoides

Barleria acanthoides Vahl

Barleria eranthemoides R. Br. ex C.B. Clarke

Barleria gracilispina (Fiori) I. Darbysh.

Barleria linearifolia Rendle

Barleria sp.

Bauhinia taitensis Taub.

Blepharis edulis

Blepharis edulis (Forssk.) Pers.

Blepharis maderaspatensis (L.) Roth

Blepharis sp.

Blepharis tanae Napper

Blepharis turkanae Vollesen

Blepharispermum minus S. Moore

Blyttia fruticulosum

Boerhavia coccinea Mill.

Boerhavia repens

Boerhavia repens L.

Boerhavia helenae Roem. & Schult.

Boscia angustifolia

Boscia angustifolia A. Rich

Boscia coriacea

Boscia coriacea Pax

Boscia fadeniorum Fici

Boscia keniensis Beentje

Boswellia neglecta (R.E)

Brachiaria chusqueoides (Hack.) Clayton

Brachiaria leersioides

Brachiaria leersioides (Hochst.) Stapf

Brachiaria leucacrantha (K. Schum.) Stapf

Brachiaria longiflora Clayton

Brachiaria reptans (L.) Gardner & C.E. Hubb.

Bridelia cathartica G. Bertol.

Bridelia micrantha (Hochst.) Baill.

Buchnera hispida D. Don

Buckollia volubilis (Schltr.) Venter & R.L. Verh.

Bulbostylis hispidula (Vahl) R.W. Haines ssp. filiformis (C.B. Clarke) R.W. Haines

Bulbostylis hispidula (Vahl) R.W. Haines ssp. hispidula

Burnatia enneandra Micheli

Cadaba barbigera Gilg

Cadaba farinosa Forssk.

Cadaba farinosa Forssk. ssp. farinosa

Cadaba farinose

Cadaba gillettii R.A. Graham

Cadaba gillettii R.A. Graham

Cadaba glandulosa Forssk.

Cadaba heterotricha Stocks

Cadaba rotundifolia

Cadaba ruspolii Gilg

Cadaba sp.

Caesalpinia trothae Harms

Calotropis procera

Calotropis procera (Aiton) W.T. Aiton

Calyptrotheca somalensis Gilg

Capparis cartilaginea Decne.

Capparis fascicularis DC.

Capparis sepiaria L.

Capparis sp.

Caralluma gracilipes K. Schum.

Caralluma priogonium K. Schum.

Carpodiptera africana Mast.

Cassytha filiformis L.

Catunaregam nilotica (Stapf) Tirveng.

Celosia fadenorum C.C. Towns.

Celosia schweinfurthiana Schinz

Cenchrus ciliaris

Cenchrus ciliaris L.

Cenchrus echinatus L.

Cenchrus mitis Andersson

Cenchrus sp.

Centamopsis sordida C.C. Towns.

Cephalopentandra ecirrhosa (Cogn.) C. Jeffrey

Chamaecrista mimosoides (L.) Greene

Chamaecrista telfairiana (Hook.f.) Lock

Chascanum sp.

Chassalia umbraticola Vatke

Chassalia umbraticola Vatke ssp. umbraticola

Chloris mossambicensis K. Schum.

Chloris roxburghiana Schult.

Chloris virgata Sw.

Chlorophytum tuberosum (Roxb.) Baker

Chrysopogon plumulosus Hochst.

Cissampelos pareira L. var. hirsuta (DC.) Forman

Cissus adeyana Masinde & L.E. Newton

Cissus aphylla Chiov.

Cissus aphyllantha Gilg & Brandt

Cissus cactiformis Gilg

Cissus phymatocarpa Masinde & L.E. Newton

Cissus quadrangularis

Cissus quadrangularis L.

Cissus rotundifolia (Forssk.) Vahl

Cissus rotundifolia (Forssk.) Vahl var. rotundifolia

Citrullus colocynthis (L.) Schrad.

Cleome allamani

Cleome allamani Chiov.

Cleome scaposa

Cleome scaposa DC.

Cleome sp.

Cleome tenella

Cleome tenella L. f.

Coccinia grandis

Coccinia grandis (L.) Voigt

Coccinia microphylla Gilg

Cocculus pendulus (J.R. Forst. & G. Forst.) Diels

Coffea rhamnifolia (Chiov.) Bridson

Combretum aculeatum

Combretum aculeatum Vent.

Combretum aculeatum Vent.

Combretum hereroense Schinz

Combretum hereroense Schinz ssp.

Combretum padoides Engl. & Diels

Commelina albescens Hassk.

Commelina benghalensis L.

Commelina erecta L. ssp. erecta

Commelina erecta L. ssp. livingstonii (C.B. Clarke) J.K. Morton

Commelina forskaolii Vahl

Commelina mascarenica C.B. Clarke

Commelina sp.

Commiphora africana (A. Rich.) Engl.

Commiphora baluensis Engl.

Commiphora bruceae Chiov.

Commiphora campestris Engl.

Commiphora campestris Engl

Commiphora campestris Engl.

Commiphora campestris Engl. ssp.

Commiphora confusa Vollesen

Commiphora danduensis J.B. Gillett

Commiphora edulis

Commiphora edulis (Klotzsch) Engl. ssp. boiviniana (Engl.) J.B. Gillett

Commiphora erosa Vollesen

Commiphora holtziana Engl.

Commiphora kataf

Commiphora kataf (Forssk.) Engl.

Commiphora kua

Commiphora kua (R. Br. ex Royle) Vollesen

Commiphora pseudopaolii J.B. Gillett

Commiphora rostrata Engl

Commiphora rostrata Engl. var. rostrate

Commiphora sp.

Commiphora sp.1

Commiphora sp.2

Commiphora sp.3

Coptosperma graveolens (S. Moore) Degreef

Coptosperma wajirensis (Bridson) Degreef

Corbichonia decumbens

Corbichonia decumbens (Forssk.) Exell

Corchorus brevicornatus Vollesen

Corchorus olitorius L.

Corchorus sp.

Corchorus tridens

Corchorus tridens L.

Corchorus trilocularis L.

Cordia faulknerae Verdc.

Cordia monoica

Cordia monoica Roxb.

Cordia quercifolia Klotzsch

Cordia sinensis

Cordia sinensis Lam.

Cordia sp.

Crinum sp.

Crossandra stenostachya (Lindau) C.B. Clarke

Crotalaria comanestiana Volkens & Schweinf.

Crotalaria malindiensis Polhill

Crotalaria massaiensis Taub.

Crotalaria rhynchocarpa Polhill

Crotalaria saltiana Andrews

Crotalaria sp.

Croton dichogamus Pax

Croton dichogamus Pax

Croton menyharthii Pax

Ctenolepis cerasiformis (Stocks) Hook.f.

Cucumis prophetarum L. ssp. dissectus (Naudin) C. Jeffrey

Cucumis sacleuxii Pailleux & Bois

Cymbopogon schoenanthus (L.) Spreng.

Cynanchum gerrardii (Harv.) Liede

Cynanchum hastifolium K. Schum. ssp. longirostrum Goyder

Cynanchum hastifolium K. Schum. ssp. longistyl

Cynodon dactylon (L.) Pers.

Cyperus amauropus Steud.

Cyperus articulatus L.

Cyperus blysmoides C.B. Clarke

Cyperus compressus L.

Cyperus denudatus L.f.

Cyperus diurensis Boeckeler?

Cyperus frerei C.B. Clarke

Cyperus grandibulbosus C.B. Clarke

Cyperus mollipes (C.B. Clarke) K. Schum.

Cyperus neoschimperi Kük.

Cyperus niveus Retz. var. leucocephalus (Kunth) Fosberg

Cyperus pectinatus Vahl

Cyperus prolifer Lam.

Cyperus pseudovestitus

Cyperus rotundus L.

Cyperus rubicundus Vahl

Cyperus sp.

Cyphostemma adenocaule (A. Rich.) Wild & R.B. Drumm. ssp. adenocaule

Cyphostemma duparquetii (Planch.) Desc.

Cyphostemma hildebrandtii (Gilg) Wild & R.B. Drumm.

Cyphostemma sp.?nov.

Dactyloctenium aegyptium

Dactyloctenium aegyptium (L.) Willd.

Dactyloctenium geminatum Hack.

Dactyloctenium scindicum Boiss.

Dalbergia melanoxylon Guill. & Perr.

Dalechampia parvifolia Lam.

Dalechampia trifoliata Peter ex Verdc. & Greenway

Dalechampia trifoliata Peter ex Verdc. & Greenway var. trifoliata

Datura stramonium

Datura stramonium L.

Deinbollia borbonica Scheff. forma glabrata Radlk.

Delonix elata

Delonix elata (L.) Gamble

Desmidorchis acutangula

Desmidorchis foetida (E.A. Bruce) Plowes

Desmidorchis retrospiciens Ehrenb.

Dialium orientale Baker f.

Dichrostachys cinerea (L.) Wight & Arn.

Dichrostachys cinerea (L.) Wight & Arn.

Digera muricata

Digera muricata (L.) Mart.

Digera muricata (L.) Mart. ssp. ?

Digera muricata (L.) Mart. ssp. trinervis C.C. Towns. var. macroptera C.C. Towns.

Digera muricata (L.) Mart. ssp. trinervis C.C. Towns. var. patentipilosa C.C. Towns.

Digitaria argyrotricha (Andersson) Chiov.

Digitaria ciliaris (Retz.) Koel.

Digitaria longiflora (Retz.) Pers.

Digitaria milanjiana (Rendle) Stapf

Digitaria perrottetii (Kunth) Stapf

Digitaria rivae

Digitaria velutina (Forssk.) P. Beauv.

Dignathia hirtella

Diheteropogon amplectens (Nees) Clayton

Diheteropogon amplectens (Nees) Clayton var. amplectens

Dinebra polycarpha S.M. Phillips

Dinebra somalensis (Stapf) P.M. Peterson & N. Snow

Diospyros bussei Gürke

Diospyros scabra (Chiov.) Cufod.

Diospyros squarrosa Klotzsch

Dipcadi viride (L.) Moench

Dobera glabra

Dobera glabra (Forssk.) Poir.

Dobera loranthifolia (Warb.) Harms

Dovyalis abyssinica (A. Rich.) Warb.

Drake-Brockmania somalensis Stapf

Drake-brockmania somalensis Stapf

Duosperma longicalyx

Duosperma longicalyx (Deflers) Vollesen ssp. longicalyx

Duosperma stoloniferum (R.E)

Echinochloa colona (L.) Link

Echinochloa haploclada (Stapf) Stapf

Echinochloa stagnina (Retz.) P. Beauv

Echinochloa stagnina (Retz.) P. Beauv.

Ehretia bakeri Britten

Elaeodendron aquifolium (Fiori) Chiov.

Eleocharis atropurpurea (Retz.) J. Presl

Elytraria acaulis (L.f.) Lindau

Encephalartos hildebrandtii A. Braun & C.D. Bouché

Endostemon gracilis (Benth.) M. Ashby

Endostemon tereticaulis (Poir.) M. Ashby

Enneapogon cenchroides

Enneapogon cenchroides (Roem. & Schult.) C.E. Hubb.

Entada abyssinica A. Rich.

Entada leptostachya Harms

Enteropogon barbatus

Enteropogon barbatus C.E. Hubb.

Enteropogon macrostachyus (A. Rich.) Benth.

Enteropogon sp

Eragrostis aethiopica Chiov.

Eragrostis aethiopica Chiov.

Eragrostis cilianense

Eragrostis cilianensis (All.) Janch.

Eragrostis cilianensis (All.) Vignolo ex Janch.

Eragrostis ciliaris (L.) R. Br.

Eragrostis perbella K. Schum

Eragrostis perbella K. Schum.

Eragrostis sennii Chiov.

Eragrostis sennii Chiov.

Eragrostis superba Peyr.

Erianthemum dregei (Eckl. & Zeyh.) Tiegh.

Eriocaulon elegantulum Engl.

Erythrina burttii

Erythrina burttii Baker f.

Erythrococca kirkii (Müll.Arg.) Prain

Erythrococca pubescens Radcl.-Sm.

Erythroxylum platyclados Bojer

Euclea natalensis A. DC. ssp. obovata F. White

Euphorbia cryptospinosa P.R.O. Bally

Euphorbia cuneata Vahl

Euphorbia cuneata Vahl ssp.

Euphorbia cuneata Vahl ssp. lamproderma S.Carter

Euphorbia fluminis S.Carter

Euphorbia heterochroma Pax

Euphorbia hirta L.

Euphorbia inaequilatera

Euphorbia prostrata

Euphorbia prostrata Aiton

Euphorbia robecchii Pax

Euphorbia tescorum

Euphorbia tescorum S. Carter

Feretia apodanthera Delile ssp. keniensis Bridson

Ficus glumosa Delile

Ficus sur Forssk.

Fimbristylis cymosa R. Br.

Flacourtia indica (Burm.f.) Merr.

Flueggea virosa (Willd.) Voigt ssp. virosa

Fuirena ciliaris (L.) Roxb.

Fuirena ciliaris (L.) Roxb. forma ciliaris

Garcinia livingstonei T. Anderson

Garcinia livingstonei T. Anderson

Gardenia fiorii Chiov

Gardenia fiorii Chiov.

Gardenia volkensii K. Schum.

Geigeria acaulis Benth. & Hook. f. ex Oliv. & Hiern

Geigeria acaulis Oliv. & Hiern

Geigeria alata

Geigeria alata (Hochst. & Steud. ex DC.) Oliv. & Hiern

Givotia gosai Radcl.-Sm.

Glinus lotoides L.

Glinus oppositifolius (L.) A. DC.

Glossonema revoilii Franch.

Gnidia latifolia (Oliv.) Gilg

Gomphrena celosioides Mart.

Gossypioides kirkii (Mast.) J.B.Hutch.

Grewia densa K. Schum

Grewia densa K. Schum.

Grewia forbesii Mast.

Grewia holstii Burret

Grewia plagiophylla K. Schum.

Grewia sp.

Grewia stuhlmannii K. Schum.

Grewia tenax

Grewia tenax (Forssk.) Fiori

Grewia tephrodermis K. Schum.

Grewia triflora (Bojer) Walp.

Grewia villosa

Grewia villosa Willd.

Gymnosporia heterophylla (Eckl. & Zeyh.) Loes.

Gymnosporia putterlickioides Loes.

Gymnosporia senegalensis (Lam.) Loes.

Haplocoelum inoploeum Radlk.

Harrisonia abyssinica Oliv.

Heinsia crinita (Afzel.) G. Taylor ssp. parvifolia (K. Schum. & K. Krause) Verdc.

Helichrysum glumaceum

Heliotropium longiflorum (A. DC.) Jaub. & Spach

Heliotropium longiflorum (A. DC.) Jaub. & Spach ssp.?

Heliotropium pectinatum Vaupel ssp. pectinatum

Heliotropium rariflorum

Heliotropium rariflorum Stocks

Heliotropium rariflorum Stocks ssp. hereroense (Schinz) Verdc.

Heliotropium simile

Heliotropium simile Vatke

Heliotropium sp.

Heliotropium steudneri Vatke

Heliotropium steudneri Vatke ssp. steudneri var. steudneri

Heliotropium strigosum

Heliotropium strigosum Willd.

Heliotropium zeylanicum (Burm.f.) Lam.

Hermannia exappendiculata (Mast.) K. Schum.

Hermannia exappendiculata (Mast.) K. Schum.

Hermannia kirkii

Hermannia kirkii Mast.

Hermannia sp.

Hermannia uhligii Engl.

Hermannia uhligii Engl.?

Heteropogon contortus (L.) Roem. & Schult.

Hewittia malabarica (L.) Suresh

Hibiscus cannabinus L.

Hibiscus ceratophorus Thulin

Hibiscus hildebrandtii Sprague & Hutch.

Hibiscus micranthus

Hibiscus micranthus L.f.

Hibiscus surattensis L.

Hildebrandtia sepalosa Rendle

Hilsenbergia lyciacea (Thulin) J.S. Mill.

Hilsenbergia nemoralis (Gürke) J.S. Mill.

Hilsenbergia petiolaris (Lam.) J.S. Mill.

Hilsenbergia teitensis (Gürke) J.S. Mill.

Hoslundia opposita Vahl

Hunteria zeylanica (Retz.) Thwaites

Hybanthus enneaspermus (L.) F. Muell.

Hybanthus enneaspermus (L.) F. Muell. var.?

Hydrolea sansibarica Gilg

Hygrophila schulli (Buch.-Ham.) M.R. Almeida & S.M. Almeida

Hyparrhenia filipendula (Hochst.) Stapf

Hyperthelia dissoluta (Steud.) Clayton

Hyphaene compressa

Hyphaene compressa H. Wendl.

Hypoestes forskahlii (Vahl) R. Br.

Hypoestes sp.

Indet

Indigofera spinose

Indigofera arrecta

Indigofera arrecta A. Rich.

Indigofera charlierana Schinz

Indigofera cuneata Oliv.

Indigofera hirsuta L.

Indigofera hochstetteri Baker?

Indigofera longiracemosa Baill.

Indigofera schimperi

Indigofera schimperi Jaub. & Spach

Indigofera schimperi Jaub. & Spach var. baukeana (Vatke) J.B. Gillett

Indigofera spinosa Forssk.

Indigofera strobilifera (Hochst.) Baker

Indigofera tanaensis J.B. Gillett

Indigofera tanganyikensis Baker f. var. paucijuga J.B. Gillett

Indigofera tinctoria L. var. tinctoria

Indigofera trita L.f. var. subulata (Poir.) Ali

Indigofera wituensis Baker f.

Ipomoea aquatica Forssk.

Ipomoea cicatricosa Baker

Ipomoea kituensis Vatke

Ipomoea sp.

Jacquemontia tamnifolia (L.) Griseb.

Jasminum fluminense Vell.

Jasminum fluminense Vell. ssp. fluminense

Jasminum meyeri-johannis Engl.

Jasminum sp. Not matched

Jatropha curcas L.

Jatropha dichtar

Jatropha dichtar J.F. Macbr.

Jatropha ellenbeckii (R.E)

Jatropha pelargoniifolia (R.E

Jatropha spicata Pax

Josephinia africana Vatke

Justicia bracteata (Hochst.) Zarb

Justicia brevipila Hedrén

Justicia caerulea

Justicia caerulea Forssk

Justicia calyculata Deflers

Justicia flava (Forssk.) Vahl

Justicia odora (Forssk.) Lam.

Justicia odora (Forssk.) Lam.

Kalanchoe densiflora Rolfe

Kanahia laniflora (Forssk.) R. Br.

Kedrostis abdallai A. Zimm.

Kedrostis foetidissima (Jacq.) Cogn.

Keetia zanzibarica (Klotzsch) Bridson

Keetia zanzibarica (Klotzsch) Bridson ssp. zanzibarica

Kigelia africana (Lam.) Benth.

Kigelia africana (Lam.) Benth. ssp. africana

Kleinia squarrosa Cufod.

Kohautia caespitosa Schnizl.

Kyllinga polyphylla Kunth

Kyllinga polyphylla Kunth var. polyphylla

Lagarosiphon cordofanus Casp.

Lamprothamnus zanguebaricus Hiern

Landolphia kirkii Dyer

Lannea alata

Lannea cotoneaster (Chiov.) Sacleux

Lannea cotoneaster (Chiov.) Sacleux.

Lannea rivae (Chiov.) Sacleux

Lannea schweinfurthii (Engl.) Engl.

Lannea schweinfurthii (Engl.) Engl. var. stuhlmannii (Engl.) Kokwaro

Lannea triphylla (A. Rich.) Engl.

Lantana viburnoides (Forssk.) Vahl ssp. viburnoides var. viburnoides

Launaea cornuta (Hochst. ex Oliv. & Hiern) C. Jeffrey

Lawsonia inermis

Lawsonia inermis L.

Lecaniodiscus fraxinifolius Baker ssp. scassellatii (Chiov.) Friis

Ledebouria sp.

Leptochloa obtusiflora Hochst.

Leptothrium senegalense

Leptothrium senegalense (Kunth) Clayton

Leucas glabrata (Vahl) Sm.

Leucas nubica Benth.

Leucas urticifolia (Vahl) Sm. var. angustifolia Sebald

Limnophila indica (L.) Druce

Limnophyton obtusifolium (L.) Miq.

Lobelia fervens Thunb.

Lobelia fervens Thunb. ssp. recurvata (E.Wimm.) Thulin

Loeseneriella africana (Willd.) N. Hallé var. richardiana (Cambess.) N. Hallé

Ludwigia adscendens (L.) H. Hara ssp. diffusa (Forssk.) P.H. Raven

Lycium europaeum

Lycium shawii Roem. & Schult.

Maclura africana (Bureau) Corner

Maerua calantha Gilg

Maerua crassifolia

Maerua crassifolia Forssk.

Maerua decumbens (Brongn.) DeWolf

Maerua denhardtiorum Gilg

Maerua edulis (Gilg & Gilg-Ben.) DeWolf

Maerua endlichii Gilg & Gilg-Ben.

Maerua glauca Chiov.

Maerua glauca Chiov.?

Maerua kaessneri Gilg & Gilg-Ben.

Maerua mungaii Beentje

Maerua oblongifolia

Maerua oblongifolia (Forssk.) A. Rich

Maerua oblongifolia (Forssk.) A. Rich.

Maerua parvifolia Pax

Maerua sessiliflora Gilg

Maerua subcordata (Gilg) DeWolf

Maerua triphylla A. Rich.

Maerua triphylla A. Rich. var. calophylla (Gilg) DeWolf

Manilkara mochisia (Baker) Dubard

Margaritaria discoidea (Baill.) G.L. Webster

Markhamia zanzibarica (DC.) Engl.

Marsilea sp.

Megalochlamys trinervia (C.B. Clarke) Vollesen

Melhania ovata (Cav.) Spreng.

Melhania rotundata Mast.

Melhania velutina Forssk.

Melia volkensii

Melia volkensii Gürke

Melochia corchorifolia L.

Merremia tridentata (L.) Hallier f.

Meyna tetraphylla (Hiern) Robyns ssp. comorensis (Robyns) Verdc.

Micrargeria filiformis (Schumach. & Thonn.) Hutch. & Dalziel

Microchloa kunthi

Millettia usaramensis Taub. ssp. usaramensis var. usaramensis

Mimusops obtusifolia Lam.

Mollugo cerviana (L.) Ser.

Mollugo cerviana (L.) Ser. var. spathulifolia Fenzl

Momordica boivinii Baill.

Momordica rostrata A.Zimm.

Momordica spinosa Chiov.

Momordica trifoliolata Hook.f.

Monanthotaxis fornicata (Baill.) Verdc.

Monodora grandidieri Baill.

Murdannia axillaris Brenan

Murdannia simplex (Vahl) Brenan

Neptunia oleracea Lour.

Nesaea pedicellata Hiern

Nesaea triflora (L.f.) Kunth ssp. triflora

Neuracanthus keniensis (K.E)

Neuracanthus pictus M.G. Gilbert

Neuracanthus tephropyllus Bidgood & Brummitt

Neuracanthus tephropyllus Bidgood & Brummitt ssp. tephropyllus

Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.

Nymphaea nouchali Burm.f. var. zanzibariensis (Casp.) Verdc.?

Nymphoides forbesiana (Griseb.) Kuntze

Ochna mossambicensis Klotzsch

Ochna ovata F. Hoffm.

Ocimum americanum L.

Ocimum gratissimum L. ssp. gratissimum var. macrophyllum Briq.

Oldenlandia affinis (Roem. & Schult.) DC. ssp. fugax (Vatke) Verdc.

Oldenlandia corymbosa L.

Oncocalyx kelleri (Engl.) M.G. Gilbert

Opilia campestris Engl.

Opilia amentacea

Opilia amentacea Roxb.

Opilia campestris Engl.

Opilia campestris Engl. var. campestris

Opuntia sp.

Opuntia stricta

Opuntia vulgaris Mill.

Orbea sp.

Ormocarpum kirkii S. Moore

Ormocarpum trichocarpum (Taub.) Engl.

Oropetium minimum

Orthosiphon pallidus Benth.

Orthosiphon pallidus Royle ex Benth.

Oryza punctata Steud.

Oxyanthus zanguebaricus (Hiern) Bridson

Oxygonum atriplicifolium (Meisn.) Martel.

Oxygonum sinuatum

Oxygonum sinuatum (Meisn.) Dammer

Ozoroa obovata (Oliv.) R. Fern. & A. Fern.

Panicum deustum Thunb.

Panicum deustum Thunb.?

Panicum genuflexum Stapf

Panicum hippothrix K. Schum.

Panicum infestum Andersson

Panicum maximum Jacq.

Panicum sp.

Parthenium hysterophorus L.

Paspalidium obtusifolium (Delile) N.D. Simpson

Pavetta sp.

Pavonia blepharicarpa N. Brummitt & Vollesen

Pavonia leptocalyx (Sond.) Ulbr.

Pavonia patens

Pavonia sp.

Pedaliodiscus macrocarpus Ihlenf.

Pedalium murex L.

Pentas bussei K. Krause

Pentas parvifolia Hiern

Pentatropis nivalis (J.F. Gmel) D.V. Field & J.R.I. Wood

Pentatropis nivalis (J.F. Gmel.) D.V. Field & J.R.I. Wood

Pentodon pentandrus (Schumach. & Thonn.) Vatke var.

Peponium vogelii (Hook.f.) Engl.

Pergularia daemia

Pergularia daemia (Forssk.) Chiov. ssp. daemia

Perotis patens Gand.

Philenoptera bussei (Harms) Schrire

Phragmanthera sp.

Phyllanthus amarus Schumach. & Thonn.

Phyllanthus harrisii Radcl.-Sm.

Phyllanthus leucocayx Hutch.

Phyllanthus maderaspatensis L. var. maderaspatensis

Phyllanthus reticulatus Poir.

Phyllanthus reticulatus Poir. var. glaber (Thwaites) Müll.Arg.

Pistia stratiotes L.

Plectranthus pseudomarrubioides R.H. Willemse

Plectranthus sp.

Plicosepalus sagittifolius (Engl.) Danser

Polygala conosperma Bojer

Polygala amboniensis Gürke

Polygala conosperma Bojer

Polygala erioptera

Polygala erioptera DC.

Polygala erioptera DC.

Polygala sphenoptera Fresen.

Polysphaeria parvifolia Hiern

Portulaca oleracea

Portulaca oleracea L.

Portulaca quadrifida L.

Portulaca wightiana Wight & Arn.

Premna resinosa

Premna resinosa (Hochst.) Schauer

Premna resinosa (Hochst.) Schauer ssp. holstii (Gürke) Verdc.

Premna velutina Gürke

Prosopis juliflora

Prosopis juliflora (Sw.) DC.

Pseudovigna argentea (Willd.) Verdc.

Psilotrichum scleranthum Thwaites

Psilotrichum sericeum (Roxb.) Dalziel

Psydrax faulknerae Bridson

Pterodiscus coeruleus Chiov.

Pterodiscus ruspolii

Pterodiscus ruspolii Engl.

Pupalia lappacea

Pupalia lappacea (L.) A. Juss

Pupalia lappacea (L.) A. Juss.

Pupalia lappacea (L.) A. Juss. var. velutina (Moq.) Hook.f.

Pycreus hildebrandtii C.B. Clarke

Pycreus polystachyos (Rottb.) P. Beauv. var. polystachyos

Pycreus sp.

Pyrenacantha kaurabassana Baill.

Pyrostria bibracteata (Baker) Cavaco

Rhynchosia velutina Wight & Arn.

Rhynchosia viscosa (Roth) DC.

Rhynchosia viscosa (Roth) DC. ssp. viscosa var. viscosa

Ricinus communis

Ricinus communis L.

Roifia dictyocarpus (Webb) Verdc.

Rotheca makanjana (H. Winkl.) Steane & Mabb.

Rotheca microphylla (Blume) Callm. & Phillipson

Rottboellia cochinchinensis (Lour.) Clayton

Rourea coccinea (Schumach. & Thonn.) Benth. ssp. boiviniana (Baill.) Jongkind

Rourea orientalis Baill.

Ruellia patula

Ruellia patula Jacq.

Rytigynia celastroides (Baill.) Verdc. var. celastroides

Sacciolepis curvata (L.) Chase

Salsola africana (Brenan) Botsch.

Salvadora persica

Salvadora persica L.

Salvadora persica L. var. persica

Sansevieria ??

Sansevieria ehrenbergii Baker

Sansevieria forskaoliana (Schult. f.) Hepper & J.R.I. Wood

Sansevieria pinguicula P.R.O. Bally

Sansevieria powellii N.E. Br.

Sansevieria sp. cf. nitida B.J. Chahinian

Sansevieria sp.2

Schoenefeldia transiens (Pilg.) Chiov.

Schoenoplectiella articulata (L.) Lye

Schoenoplectiella juncea (Willd.) Lye

Schoenoplectiella lateriflora (J.F. Gmel.) Lye ssp. lateriflora

Schoenoplectiella senegalensis (Steud.) Lye

Sclerocarya birrea (A. Rich.) Hochst.

Sclerocarya birrea (A. Rich.) Hochst. ssp. caffra (Sond.) Kokwaro

Scutia myrtina (Burm.f.) Kurz

Searsia natalensis (C. Krauss) F.A. Barkley

Seddera bagshawei Rendle

Seddera bagshawei Rendle?

Seddera hirsuta

Seddera hirsuta Hallier f.

Seddera hirsuta Hallier f. var. gracilis (Chiov.) Verdc.

Senna didymobotrya (Fresen.) H.S. Irwin & Barneby

Senna singueana (Delile) Lock

Sericocomopsis hildebrandtii

Sericocomopsis hildebrandtii Schinz

Sericocomopsis pallida (S. Moore) Schinz

Sesamothamnus busseanus (R.E)

Sesamothamnus busseanus Engl.

Sesamothamnus rivae Engl.

Sesamothamnus sp.

Sesamum alatum

Sesbania bispinosa (Jacq.) W. Wight var. micrantha (Chiov.) J.B. Gillett

Sesbania bispinosa (Jacq.) W. Wight

Setaria incrassata (Hochst.) Hack.

Setaria pumila (Poir.) Roem. & Schult.

Setaria verticillata

Setaria verticillata (L.) P. Beauv.

Sida cordifolia L.

Sida massaica Vollesen

Sida ovata Forssk.

Sideroxylon inerme L. ssp. diospyroides (Baker) J.H. Hemsl.

Solanum arundo

Solanum arundo Mattei

Solanum campylacanthum A. Rich.

Solanum coagulans

Solanum coagulans Forssk.

Solanum hastifolium Dunal

Solanum incanum

Solanum somalense Franch.

Solanum sp.

Solanum taitense Vatke

Solanum usaramense Dammer

Sorghum arundinaceum

Spermacoce filituba (K. Schum.) Verdc.

Sphaeranthus kirkii Oliv. & Hiern var. cyathuloides (O. Hoffm.) Beentje

Sphaeranthus ukambensis Vatke & O. Hoffm.

Sphaeranthus zavattarii Cufod.

Sphaeranthus zavattarii Cufod.

Sporobolus consimilis Fresen.

Sporobolus coromandelianus (Retz.) Kunth

Sporobolus helvolus (Trin.) T. Durand & Schinz

Sporobolus ioclados (Trin.) Nees

Sporobolus iocladus (Trin.) Nees

Sporobolus nervosus

Sporobolus rangei

Sporobolus rangei Pilg.

Sporobolus spicatus

Sporobolus spicatus (Vahl) Kunth

Sporobolus virginicus (L.) Kunth

Sterculia rhynchocarpa K. Schum.

Sterculia stenocarpa

Sterculia stenocarpa H. Winkl.

Stipagrostis hirtigluma (Steud. ex Trin. & Rupr.) De Winter

Stipagrostis uniplumis

Stipagrostis uniplumis (Licht.) De Winter

Striga asiatica (L.) Kuntze

Striga gesnerioides (Willd.) Vatke

Strophanthus mirabilis Gilg

Strychnos madagascariensis Poir.

Strychnos panganensis Gilg

Strychnos spinosa Lam.

Strychnos spinosa Lam. ssp. volkensii (Gilg) E.A. Bruce

Stylosanthes fruticosa (Retz.) Alston

Suaeda monoica

Suaeda monoica J.F. Gmel.

Suregada zanzibariensis Baill.

Synadenium compactum N.E. Br.

Synaptolepis kirkii Oliv.

Tabernaemontana elegans Stapf

Tagetes minuta

Tagetes minuta L.

Talinum portulacifolium (Forssk.) Schweinf.

Tamarindus indica L.

Tamarix nilotica (Ehrenb.) Bunge

Tephrosia linearis (Willd.) Pers.

Tephrosia noctiflora Baker

Tephrosia pumila (Lam.) Pers. var.?

Tephrosia purpurea (L.) Pers. ssp. dunensis Brummitt

Tephrosia sp.

Tephrosia villosa (L.) Pers. ssp. ehrenbergiana (Schweinf.) Brummitt

Terminalia brevipes Pamp.

Terminalia orbicularis Engl. & Diels

Terminalia orbicularis Engl. & Diels

Terminalia parvula Pamp.

Terminalia spinosa

Terminalia spinosa Engl.

Terminilia spinosa Engl.

Tetrapogon bidentatus Pilg.

Tetrapogon cenchriformis

Tetrapogon cenchriformis (A. Rich.) Clayton

Tetrapogon tenellus (Roxb.) Chiov.

Thespesia danis Oliv.

Thespesia danis Oliv.

Thilachium thomasii Gilg

Tiliacora funifera (Miers) Oliv.

Tinnea aethiopica Hook.f.

Tinospora caffra (Miers) Troupin

Tragia hildebrandtii Müll.Arg.

Tragus berteronianus

Tragus berteronianus Schult.

Tragus heptaneuron Clayton

Tribulus terrestris

Tribulus terrestris L.

Trichilia emetica Vahl

Trichodesma trichodesmoides (Bunge) Gürke

Tricholaena teneriffae

Tricholaena teneriffae (L. f.) Link

Tridax procumbens L.

Triumfetta flavescens Hochst. ex A. Rich.

Triumfetta rhomboidea Jacq.

Turraea nilotica Kotschy & Peyr.

Urochloa panicoides P. Beauv.

Urochloa sclerochlaena Chiov.

Urochloa trichopus (Hochst.) Stapf

Utricularia gibba L. ssp. exoleta (R. Br.) P. Taylor

Utricularia inflexa Forssk.

Uvaria acuminata Oliv.

Uvaria kirkii Hook

Uvaria kirkii Hook.f.

Uvaria leptocladon Oliv. ssp. leptocladon?

Uvaria lucida Benth. ssp. lucida

Uvaria scheffleri (S.H)

Uvaria sp.

Vahlia dichotoma (Murray) Kuntze

Vangueria infausta Burch. ssp. rotundata (Robyns) Verdc.

Vatovaea pseudolablab

Vepris glomerata (F. Hoffm.) Engl.

Vepris glomerata (F.Hoffm.) Engl. var. glabra Kokwaro

Vepris nobilis (Delile) Mziray

Vernonia cinerea (L.) Less.

Vernonia cinerea (L.) Less. var. cinerea

Vernonia hildebrandtii Vatke

Vernonia homilantha S. Moore?

Vigna membranacea A. Rich. ssp. hapalantha (Harms) Verdc.

Vigna unguiculata (L.) Walp. ssp. dekindtiana (Harms) Verdc.

Vismia orientalis Engl.

Vitex ferruginea Schumach. & Thonn.

Vitex ferruginea Schumach. & Thonn.

Vitex ferruginea Schumach. & Thonn. ssp. amboniensis (Gürke) Verdc. var. amboniensis

Vitex schliebenii Moldenke

Volkameria glabra E. Mey.) Mabb. & Y.W. Yuan

Volkensinia prostrata (Gilg) Schinz?

Volkensinia prostrata (Volkens ex Gilg) Schinz

Volutaria boranensis (Cufod.) Wagenitz

Wahlenbergia abyssinica (A. Rich.) Thulin ssp. parvipetala Thulin

Waltheria indica L.

Withania somnifera (L.) Dunal

Xanthium strumarium L.

Xerophyta schnizleinia (R.E)

Ximenia americana L.

Ximenia caffra Sond.

Ximenia caffra Sond.

Zaleya pentandra

Zaleya pentandra (L.) C. Jeffrey

Zanthoxylum chalybeum Engl.

Zanthoxylum chalybeum Engl. var. chalybeum

Zehneria anomala C. Jeffrey

Zehneria peneyana (Naudin) Asch. & Schweinf.

Ziziphus mauritiana

Ziziphus mauritiana Lam.

Ziziphus mucronata Willd

Ziziphus mucronata Willd.

Ziziphus mucronata Willd. ssp. mucronata

Zornia apiculata Milne-Redh.

Recorded Macro-Invertebrate Species within the RSA:

Abacetus sp.
Acanthacris ruficornis
Acanthacris sp.
Achatina sp.
Acorypha sp.
Acraea eponina
Acraea quirinalis
Acraea sp.
Acraea uvui
Acrotylus blondeli
Acrotylus sp.
Agrypnus nitidus
Ailopus sp.
Aiolopus longicornis
Amauris formosa
Amegilla sp.
Ammophila sp.
Anax sp.
Anisops sp.
Anthene contrastata
Anthophora sp.
Apis mellifera
Archispirostreptus sp.
Belanogaster sp.
Belenois aurota
Belenois subeida
Belenois thysa
Blatella sp.
Bombylius sp.
Borbo sp.
Brachynus nobilis
Brachythemis impartita
Braunsapis sp.
Buthus sp.
Byblia anvatara
Byblia ilithyia
Cacyreus palemon
Cacyreus sp.
Callida angusticollis
Campalita chlorosticum
Camponotus maculatus
Cantatops sp.
Cataloipus oberthuri
Cathimeris sp.
Catopsilia florella
Cerilocus dohrni
Cerobates sp.
Ceroplesis revoili
Charaxes varanes
Cheilomenes lunata
Chilocorus digitata
Chilocorus sp.
Chlaenius signatus
Chlaenius sp.
Cletus sp.
Coeliades forestan
Colotis amatus
Colotis antevippe
Colotis aurigineus
Colotis celimene
Colotis danae
Colotis eucharis
Colotis euippe
Colotis evagore
Colotis evenina
Colotis protomedia
Colotis regina
Colotis sp.
Crematogaster sp.
Creoleon sp.
Cylistus convexus
Cypholoba tetrastigma
Cytocanthacris sp.
Danaus chrysippus
Deropeltis sp.
Dineutes sp.
Dorylus sp.
Dymentia subvittata
Dysdercus cardinalis
Ectomocoris cruciger
Eumenes campiformis
Eumenes maxillosus
Eumenes sp.
Eupezus brevicollis
Eurema brigitta
Eurema hapale
Eurema hecabe
Eurema senengalensis
Freyeria trochylus
Gegenes hottentota
Gonocephalum sp.
Graphium antheus
Graphium polistratus
Gryllulus sp.
Gryllus bimaculatus
Gryllus sp.
Haematopota sp.
Heteronychus sp.
Heterotarsus tenebriodes
Hister sp.
Hottentonta sp.
Humbe sp.
Hypolimnas misippus
Hypotrigona sp.
Isaniris acuticollis

Junonia hierta
Junonia oenone
Labidura sp.
Lagria sexvitta
Lagria villosa
Lampides boeticus
Lasioglossum sp.
Lepidochrysops polydialecta
Lepisma saccharina
Leptotes pirithous
Liris sp..
Littorina sp.
Lixus sp.
Lophyra neglecta
Lophyridia imperatrix
Macrogalea candida
Macrotermes sp.
Maxentius pinguis
Megachile sp.
Meliponula sp.
Melyris viridicolor
Mesoplatys ochroptera
Metallonotus metallicus
Micraspis sp.
Microcerus sp.
Micromeriella sp.
Microstylum sp.
Monolepta sp.
Monomorium sp.
Musca domestica
Musca sp.
Mylothris rueppeli
Neocleonus mitis
Nephronia thelassina
Neptis sp.
Nezara sp.
Nomia sp.
Ocymyrmex weitzaeckeri
Odontotermes sp.
Orthetrum caffrum
Pachycondyla cribinodis
Pachycondyla tarsata
Paederus sabaeus
Pandinus sp.
Papilio demodocus
Paplopleura deceptor
Parabunthus pallidus
Parabuthus maximus
Parabuthus sp.
Pelopidas mathias
Phalanta phalantha
Pheidole sp.
Pherosophus insiginis
Phrynocolus petrosus
Physcaeneura leda
Pimelia hildebrandti
Pinacopteryx eriphia
Platymeris sp.
Platythyrea cribrinodis
Platythyrea sp.
Plocaederus bennigseni
Polistes marginalis
Polistes smithi
Polyrhachis gagates
Pompilius sp.
Psammodes sp.
Rhabdotis sobrina
Rhytinota gravidula
Rhytinota pinheyi
Rhytinota praeronga
Rhytinota sp.
Rhytinota sulcata
Sarangesa sp.
Sarcophaga sp.
Scarabaeus burchelii
Scarabaeus catenatus
Scarabaeus sp.
Sceliphron quartinae
Schistocerca gregaria
Scolia sp.
Senapsis haemorrhoa
senepsis
Sepidium muscosum
Spialia
Spialia sp.
Sternocera castanea
Tarucus grammicus
termite hill
Tetramorium sp.
Thyreus sp.
Tridactylus medacassus
Trithermis sp.
Vanessa cardui
Vieta senegalensis
Xylocopa caffra
Xylocopa calens
Xylocopa flavorufa
Xylocopa nigrita
Xylocopa sp.
Zizeeria knysna
Zizula hylax
Zophosis puntatafasciata
Zophosis sp.
Zophosis sulcata

Recorded Reptile Species within the RSA:

Agama lionotus

Agama persimilis

Agama rueppelii

Agama sp. (new)

Broadleysaurus major

Chalcides bottegi

Chamaeleo gracilis

Crocodylus niloticus

Echis pyramidum

Heliobolus spekii

Hemidactylus angulatus

Hemidactylus isolepis

Hemidactylus mabouia

Hemidactylus platycephalus

Hemidactylus ruspolii

Hemidactylus sp. (new)

Hemidactylus squamulatus

Hemirhagerrhis hildebrandtii

Homopholis fasciata

Latastia longicaudata

Lygodactylus keniensis

Lygodactylus laterimaculatus

Lygodactylus mombasicus

Lygodactylus scortecci

Lygodactylus wojnowskii

Mochlus sundevalli

Naja pallida

Panaspis wahlbergi

Pelomedusa subrufa

Philochortus rudolfensis

Platyceps florulentus

Psammophis biseriatus

Pseuderemias smithii

Stigmochelys pardalis

Trachylepis brevicollis

Trachylepis dichroma

Trachylepis maculilabris

Trachylepis margaritifer

Trachylepis planifrons

Trachylepis quinquetaeniata

Trachylepis striata

Trachylepis varia

Varanus albigularis

Varanus niloticus

Recorded Amphibian Species within the RSA:

Chiromantis kelleri

Chiromantis petersii

Chiromantis xerampelina

Hemisus marmoratus

Hyperolius argus

Kassina marculifer

Kassina senegalensis

Phrynobatrachus acridoides

Phrynobatrachus keniensis

Ptychadena anchietae

Ptychadena mascareniensis

Sclerophrys maculata

Sclerophrys turkanae

Tomopterna gallmanni

Tomopterna wambensis

Recorded Bird Species within the RSA:

Accipiter minullus
Accipiter tachiro
Acryllium vulturinum
Actitis hypoleucos
Actophilornis africanus
Alopochen aegyptiaca
Amadina fasciata
Anaplectes melanotis
Anthoscopus musculus
Anthreptes orientalis
Anthus cinnamomeus
Apalis cinerea
Apalis flavida
Apalis jacksoni
Apus affinis
Apus caffer
Aquila nipalensis
Aquila rapax
Aquila spilogaster
Aquila verreauxii
Aquila wahlbergi
Ardea alba
Ardea cinerea
Ardea melanocephala
Ardeotis kori
Asio abyssinicus
Batis molitor
Bostrychia hagedash
Bradornis microrhynchus
Bradornis pallidus
Bubalornis albirostris
Bubo africanus
Bubulcus ibis
Calamonastes simplex
Calandrella cinerea
Camaroptera brachyura
Campephaga flava
Campethera nubica
Centropus superciliosus
Cercotrichas leucophrys
Ceryle rudis
Chalcomitra amethystina
Chalcomitra senegalensis
Charadrius dubius
Charadrius tricollaris
Chlorophoneus sulfureopectus
Chrysococcyx cupreus
Chrysococcyx klaas
Cichladusa guttata
Ciconia abdimii
Ciconia episcopus
Cinnyris mariquensis
Cinnyris venustus
Circaetus cinereus
Circus macrourus
Cisticola juncidis
Colius leucocephalus
Colius striatus
Columba guinea
Coracias abyssinicus
Coracias caudatus
Coracias garrulus
Corvus albus
Corvus rhipidurus
Corythaixoides leucogaster
Coturnix coturnix
Creatophora cinerea
Criniferoides leucogaster
Crithagra citrinelloides
Crithagra dorsostriata
Cuculus clamosus
Cuculus solitarius
Curruca nisoria
Cursorius somalensis
Cyanomitra verticalis
Cypsiurus parvus
Dendroperdix sephaena
Dendropicos fuscescens
Dicrurus adsimilis
Dinemellia dinemelli
Dryoscopus cubla
Dryoscopus gambensis
Elanus caeruleus
Emberiza flaviventris
Eremopterix leucopareia
Estrilda astrild
Estrilda charmosyna
Estrilda erythronotus
Estrilda charmosyna
Euodice cantans
Eupodotis senegalensis
Eurocephalus ruppelli
Falco tinnunculus
Ficedula semitorquata
Francolinus sephaena
Fringillaria flaviventris
Granatina ianthinogaster
Gymnoris pyrgita
Gypohierax angolensis

Gyps africanus
Halcyon leucocephala
Halcyon senegalensis
Hedydipna collaris
Hieraaetus ayresii
Hirundo rustica
Hirundo smithii
Indicator indicator
Indicator meliphilus
Lagonosticta rubricata
Lagonosticta senegala
Lamprotornis chalybaeus
Lamprotornis corruscus
Lamprotornis fischeri
Lamprotornis hildebrandti
Lamprotornis purpuroptera
Lamprotornis regius
Lamprotornis superbus
Laniarius aethiopicus major
Laniarius funebris
Lanius collaris
Lanius humeralis
Lanius isabellinus
Lanius somalicus
Leptoptilos crumenifer
Lissotis melanogaster
Melaenornis edolioides
Melierax canorus
Melierax poliopterus
Merops albicollis
Merops bullockoides
Merops lafresnayii
Merops nubicus
Merops oreobates
Merops pusillus
Micronisus gabar
Milvus migrans aegyptius/parasitus
Mirafra africana
Mirafra cantillans
Mirafra hypermetra
Monticola saxatilis
Motacilla aguimp
Muscicapa striata
Necrosyrtes monachus
Nilaus afer
Notopholia corusca
Numida meleagris
Odontospiza griseicapilla
Oena capensis
Oenanthe isabellina
Oenanthe oenanthe
Oenanthe pleschanka
Onychognathus morio
Onychognathus salvadorii
Oriolus larvatus
Parus thruppi
Passer castanopterus
Passer diffusus
Passer griseus
Passer rufocinctus
Petronia pyrgita
Phalacrocorax carbo
Plocepasser mahali
Ploceus baglafecht
Ploceus bicolor
Ploceus nigricollis
Ploceus rubiginosus
Ploceus spekei
Ploceus subaureus
Ploceus taeniopterus
Ploceus vitellinus
Ploceus taeniopterus
Pogoniulus atroflavus
Poicephalus meyeri
Polemaetus bellicosus
Polihierax semitorquatus
Prinia bairdii
Prinia somalica
Prinia subflava
Prionops plumatus
Pseudonigrita cabanisi
Pternistis leucoscepus
Pterocles decoratus
Pycnonotus barbatus
Pycnonotus barbatus tricolor
Pytilia melba
Quelea quelea
Rhinopomastus minor
Rhodophoneus cruentus
Riparia riparia
Scopus umbretta
Speculipastor bicolor
Sporopipes frontalis
Spreo albicapillus
Streptopelia capicola
Streptopelia decipiens
Streptopelia semitorquata
Streptopelia senegalensis
Struthio camelus
Struthio molybdophanes
Sylvietta brachyura
Sylvietta rufescens
Sylvietta whytii
Tachymarptis aequatorialis
Tchagra australis
Tchagra jamesi
Terathopius ecaudatus
Terpsiphone viridis

Threskiornis aethiopicus

Tockus deckeni

Tockus erythrorhynchus

Tockus flavirostris

Tockus hemprichii

Tockus leucomelas

Trachyphonus darnaudii

Trachyphonus erythrocephalus

Tricholaema melanocephala

Tringa glareola

Turdoides plebejus

Turdoides rubiginosa

Turdus tephronotus

Turtur chalcospilos

Upupa epops

Upupa epops africana

Uraeginthus bengalus

Uraeginthus cyanocephalus

Urocolius macrourus

Urorhipis rufifrons

Vanellus armatus

Vanellus coronatus

Vanellus melanopterus

Vanellus spinosus

Vanellus tectus

Vidua fischeri

Vidua paradisaea

Recorded Mammal Species within the RSA:

Acinonyx jubartus

Acomys percivali

Acomys wilsoni

Aepyceros melampus

Arvicanthis neumanii

Arvicanthis niloticus

Atelerix albiventris

Atilax palidunosus

Bdeogale crassicauda

Bdeogale omnivora

Beatragus hunteri

Canis adustus

Canis mesomelas

Caracal caracal

Cephalophus adersi

Cephalophus harveyi

Chlorocebus erythropus

Civettictis civetta

Cricetomys gambianus

Crocidura sp.

Crocidura grandiceps

Crocidura luna

Crocidura sp. (new sp)

Crocuta crocuta

Damaliscus lunatus

Elephantalus rufescens

Epomophrous minimus

Epomophrous wahlbergi

Equus grevyi

Galago galarum

Galago senegalensis

Galagoides cocos

Genetta maculata

Gerbillirus nigricauda

Gerbilliscus leucogaster

Gerbillus cosensis

Giraffa camelopardalis

Helogale parvula

Herpestes ichneomon

Herpestes sanguineus

Hippopotamus amphibius

Hyaena hyaena

Hystrix cristata

Ichneumia albicauda

Ictonyx striatus

Lavia frons

Leptailurus serval

Lepus capensis

Litocranius walleri

Loxodonta africana

Lycaon pictus

Madoqua kirkii cavendishi

Madoqua guentheri

Mesomelas adustus

Neoromicia sp.

Neotragus moschantus

Oreotragus oreotragus

Orycteropus afer

Oryx beisa

Otocyon megalotis

Otolemur garnettii

Ourebia ourebi

Panthera leo

Panthera pardus

Papio anubis

Papio cynocephalus

Paraxerus ochraceous

Petrodromus tetradactylus

Pharcochoerus africanus

Platymops sp.

Procavia johnstoni

Proteles cristata

Rhynchocyon chrysopygus mandelai

Scotoecus hirundo

Suncus sp.

Sylvicapra grimmia

Syncerus caffer

Terterillus cf

Tragelaphus imberbis

Tragelaphus scriptus

Tragelaphus strepsiceros

Xerus rutilus

Recorded Aquatic Species within the RSA:

Fish:

Bagrus sp.

Clarias gariapinus

Clarias gariepinus

Enteromius neumayeri

Enteromius sp.

Labeo cylindricus

Oreochromis niloticus sugutae

Oreochromis sp.

Oreochromis spirulus spirulus

Protopterus affinis amphibius

Synodontis schall

Macroinvertebrates:

Belostomatidae (Family)

Dytiscidae (Family)

Dytiscus marginalis

Euarthropoda (Family)

Lethocerus sp.

Nepidae (Family)

GOLDER

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REPORT

Marine Baseline

Lokichar to Lamu Crude Oil Pipeline

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

Golder Associates (UK) Ltd

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1.0 MARINE ENVIRONMENTAL BASELINE

1.1 Introduction to the Marine Environmental Baseline

The following sections describe the physical and biological baseline conditions of the marine environment that are relevant to the LLCOP Project. The estuarine and marine scope of this baseline assessment, based on primary and secondary data, includes the following components:

- Physical Components:
  - Physical Oceanography;
  - Geomorphology;
  - Underwater acoustics;
  - Illumination; and
  - Water and Sediment Quality;
- Biodiversity Components:
  - Marine Mammals;
  - Sea Turtles;
  - Fishes;
  - Benthic Habitats (including coral reefs and seagrass beds);
  - Mangroves;
  - Plankton; and
- Marine and Coastal Protected Areas and Key Biodiversity Areas.

In addition to the description of the baseline presented in this section for the estuarine and marine areas, a Critical Habitat Screening (CHS) report has also been completed (Golder, 2018). The information contained in this report is incorporated in this section where appropriate.

2.0 AREA OF ANALYSIS

2.1 Determination of the Area of Influence

To inform the spatial area of analysis for baseline data collection, it is important to determine the potential Area of Influence (AoI) from Project activities on the basis that both near-field and far-field impacts could ensue during project activities.

The Project will use an existing berth in Lamu Port; the impacts associated with construction of the berth were analysed in the ESIA for the Construction of the First Three Berths of the Proposed Lamu Port and Associated Infrastructure (Ministry of Transport, 2013). However, there is potential for additional localised effects to occur during construction and operation of the Project, with effects associated with underwater sound generation, accidental discharges and possible vessel collision risks for marine wildlife.

The AoI for this marine biodiversity assessment (Figure 1) within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a 10 km buffer around the berth plus wherever the

buffered route intersected a defined protected area or area of biological importance, that area is incorporated into AoI

There is also potential for synergistic and cumulative impacts to occur with wider activities at the port which are within the AoI, and these may also occur at the seascape level (see Section 2.2) with respect to the movement of some species within and outside the AoI.

Figure 1: AoI for the baseline assessment

2.2 Consideration of Seascape

In addition to the AoI, baseline conditions are considered at a seascape level to determine the regional significance of the Project site and the features within the AoI. This is a precautionary approach that is intended to take direct, indirect and cumulative impacts into account based on broad ecological functions that are usually present in the marine environment. The core requirement of addressing baseline at the seascape level is to ensure that the ESIA does not only consider the Project site or the AoI, but also the wider importance of features that may be affected by the Project. The seascape assessment takes account of, for example, populations, migratory movements, habitat connectivity, habitat continuation and definition of wider eco-regions or biomes where there are similar conditions. Consideration of baseline at the seascape level is particularly important when assessing the presence of critical habitats and legally protected or internationally recognised areas.

For marine biodiversity, the boundary of an appropriate spatial area of analysis will vary by habitats and species, and in some instances, can be large. It is therefore not always appropriate to define single area boundaries for discussion of baseline conditions, and it often requires consideration of highly mobile and transient species with wide ranges across common pelagic habitat. It also requires an understanding within a highly dynamic system with both local and far-field connectivity and ecosystem function linkages. The use of broad seascape areas can help to simplify assessments where there is clear delineation for a wide range of important ecosystem functions.

However, the majority of baseline components for this project are considered at a broad Lamu-Kiunga seascape scale (Figure 2). As discussed below, this area comprises a continuous important habitat of a mainland and island archipelago system with a common habitat complex of mangrove, patchy and marginal reef systems, seagrass beds and exposed sandy beaches. This overall habitat complex provides ecosystem functions for sea turtles (nesting and foraging habitat), reef and pelagic fish (spawning, nursery, foraging) and marine mammals (transient waters and foraging habitat). The area also encompasses legally protected areas, internationally recognised areas and Locally Managed Marine Areas (LMMAs), with potential for connectivity across these sites and other non-protected designated areas. For wide ranging and/or migratory megafauna species that may not have a specific ecosystem function connection with the Lamu-Kiunga seascape a broader spatial area of analysis is required. For such species there is a need to consider areas of aggregation, recruitment, or other specific habitat features of importance to the species at an appropriate scale.

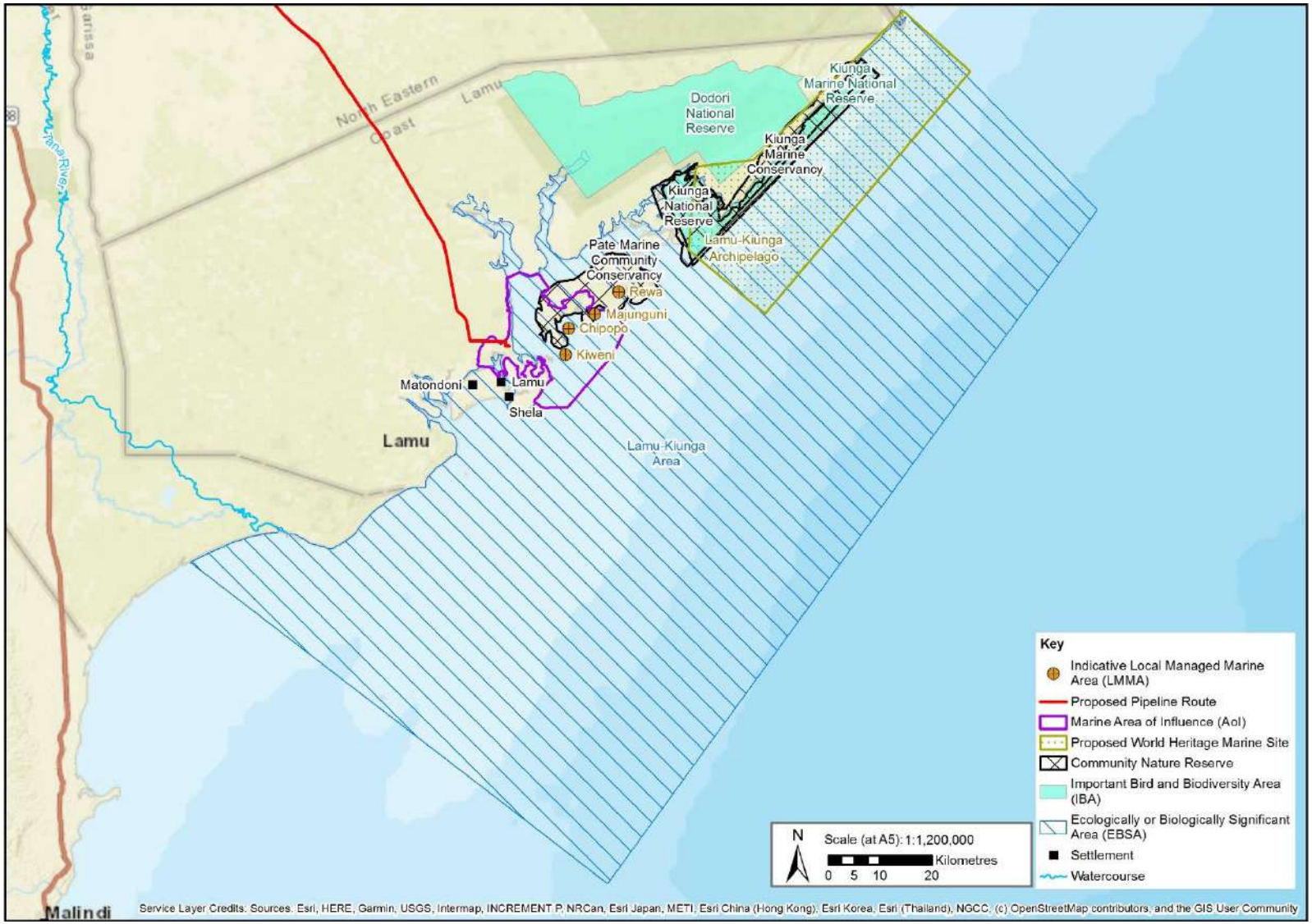

Figure 2: Seascape for the baseline assessment

3.0 APPROACH AND METHODS

3.1 Data Acquisition

Primary and secondary data were used to inform the baseline conditions of the estuarine and marine environments. An ecological characterisation, based on the available secondary data, was completed for all components (ecosystems and ecological features). In addition to the Environmental Impact Assessments (EIAs) produced for other large projects inside the AoI (that is, Lamu Port and the Lamu Coal Power Plant), an extensive literature review was completed. Research institutions and non-governmental organisations (NGOs) that are known to carry out assessment, monitoring and conservation activities in the region were contacted and provided relevant information. These NGOs were:

- Kenya Marine and Fisheries Research Institute (KMNFRI);
- Egerton University (Faculty of Environment and Natural Resources Development);
- World Wide Fund for Nature (WWF);
- Lamu Marine Conservation Trust (LaMCoT); and
- Watamu Marine Association (WMA).

In addition to the secondary data obtained from the literature review, international data banks were assessed, for example:

- Integrated Biodiversity Assessment Tool (IBAT: https://www.ibat-alliance.org/), which consolidates data from:
  - IUCN Red List of Threatened Species;
  - World Database on Protected Areas (WDPA); and
  - World Database on Key Biodiversity Areas;
- UNEP WCMC Ocean Data Viewer (http://data.unep-wcmc.org/);
- The World Resources Institute (WRI) Data Sets (https://www.wri.org/resources);
- The Globcurrent Project (http://www.globcurrent.org);
- Sea Temperature Portal (https://www.seatemperature.org); and
- The Marine Traffic Portal (https://www.marinetraffic.com).

Primary data was collected for mangroves, water and sediment quality. A detailed description of the methods of collection for these components are presented in the associated field reports contained in Volumce III of the ESIA.

Available secondary data should be complemented by primary data for the following biodiversity components: marine mammals; sea turtles; fish; and benthic habitats. These components include species that are sensitive to the potential impacts of the LLCOP project and were identified as contributing to most of the critical habitat triggers in the CHS (Golder, 2018): through this process uncertainties related to the distribution and status of species of conservation concern in the AoI and seascape were minimised as much as possible.

However, the ongoing construction of the Lamu Port is likely changing the baseline conditions in varying degrees, such that the value of collecting additional primary data for specific components should be re-evaluated at a future date, taking into consideration the port construction and operational planning, and the requirement to reduce uncertainties related to key environmental components. Since the Project will utilise existing berth (constrcucted as part of thre Lamu Port development), the main impacts on the marine environment will be associated with operational activities; these will require ongoing adaptive monitoring.

The baseline for the port relates to conditions before construction commenced as reported by the ESIA study already completed (Ministry of Transport, 2013). Where data are absent or there are uncertainties in the baseline understanding, a precautionary approach has been adopted, which recognises the potential presence of high biodiversity values where this is considered possible.

4.0 BASELINE CONDITIONS

4.1 Physical Oceanography

4.1.1 Monsoons

In general, the seasonality of the meteorological-oceanographic conditions in the Western Indian Ocean are driven by the monsoon system. The Lamu-Kiunga area is within the Northern Monsoon Coastal Current eco-region of Kenya (Osuka et al., 2016), with the monsoons arriving on this coast from the north-east and south-east (Government of Kenya, 2009). The North-east Monsoon blows from November to March, with the months of March and April being transition months dominated by east-south-east winds, while the South-east Monsoon occurs from May to July (or August, according to different sources). Between September and November, the North-east Monsoon gradually re-establishes (Tortell, 1998; Government of Kenya, 2010). The South-east Monsoon (especially from July to August) is when the greatest wind speed and largest wave heights occur (ELP, 2012). The maximum wave heights offshore near Lamu are 6 m and 8 m during the North-east and South-east Monsoons respectively, while wave conditions are usually calmer during the inter-monsoon periods (for example, March to April) (ASCLME, 2012).

Kenya is characterised by heavy rains during March to early June, during the transition months, and the start of the South-east Monsoon due to strong incursions of maritime air from the Indian Ocean. Short rain periods occur between October and November, just before the onset of the North-east monsoon (Tortell, 1998; Samoylis et al., 2015). Thereafter, rainfall rapidly decreases, reaching its minimum during the North-east Monsoon (January and February) (Tortell, 1998).

This cycle, both for the winds and for the rains, has become less predictable in recent years, with more erratic rainfall patterns and inconsistent monsoon periods more evident (Samoylis et al., 2015).

4.1.2 Currents

There are four different ocean currents that influence the coastal waters of Kenya (Tortell, 1998; Government of Kenya, 2009; Government of Kenya, 2017a). During the South-east monsoon, the East African Coastal Current (EACC) meets the Somali Current (SC) beyond Malindi, and flows north to the Horn of Africa while, during the North-east Monsoon, the meeting point with the reversed SC is between Malindi and Lamu, creating a convergence zone and a new current, the Equatorial Counter Current (ECC) (Tortell, 1998; ASCLME, 2012; Samoylis et al., 2015). Convergence zones are important for enhancing concentrations of nutrients and primary production, which attracts megafauna. Tortell (1998) and Samoylis et al. (2015) suggest that in the zone near Lamu and Kiunga, the convergent movement of the currents towards the offshore would generate an upwelling process adjacent to the Lamu-Kiunga region. This would enhance nutrient circulation and primary productivity in the marine ecosystem (Osuka et al., 2016).

4.1.3 Tides

The primary source of data and information regarding the physical oceanography of the Lamu-Kiunga Estuarine System is the Lamu Port ESIA (the Port ESIA) (Ministry of Transport, 2013). Sampling for the Port ESIA was completed using current metres located at the mouth of Manda Bay and at the port berth locations. Data were collected for 45 days over the South-east and the North-east Monsoon transition phase (that is, November to December 2010). Another data set was derived from a one-year time series (for 2009) obtained from the Lamu tide gauge, which is installed at a fishery jetty on Lamu Island.

The tide at the estuarine and Lamu tide gauge stations is semi-diurnal, with two unequal peaks during the day. The amplitudes of the neap tides are:

- 0.99 m for the Lamu tide gauge station; and
- 0.92 m for the oceanic station at the mouth of Manda Bay.

The amplitudes of the spring tides are:

- 2.93 m for Lamu tide gauge station; and
- 3.10 m for the oceanic station at the mouth of Manda Bay.

According to the Ministry of Transport (2013), the two main currents at the oceanic station in Manda Bay are the ebb and flood currents created by the tide. They are separated by about 180° (310° for the flood, and 130° for the ebb), and the maximum spring velocity is 0.80 m/s during ebbs and 0.50 m/s during floods. This asymmetry is not pronounced during neap tide. The energy of the two currents and the periods are also different: ebb currents are stronger, with a period of about 5.8 hours, while flood currents are weaker, with periods of about 7 hours. This asymmetry is explained in the port ESIA by the different flow dynamics of ebb and flood currents mainly due to the influence of mangrove areas. The phenomenon of the ebb dominance, with longer ebb periods and faster ebb velocities, is known to occur in other estuarine systems (for example, Shetye and Gouviea, 1992; Mazda et al., 1995; Brown and Davies, 2010).

The information regarding the tidal range, tidal period and current velocity is consistent with the data available for other areas of Kenya. Inshore waters of Kenya experience, in general, semidiurnal tides with tidal range of 3.14 m during spring tides and 1.07 m during neap tides. Moreover, tidal currents rarely exceed 1 m/s of velocity (ASCLME, 2012).

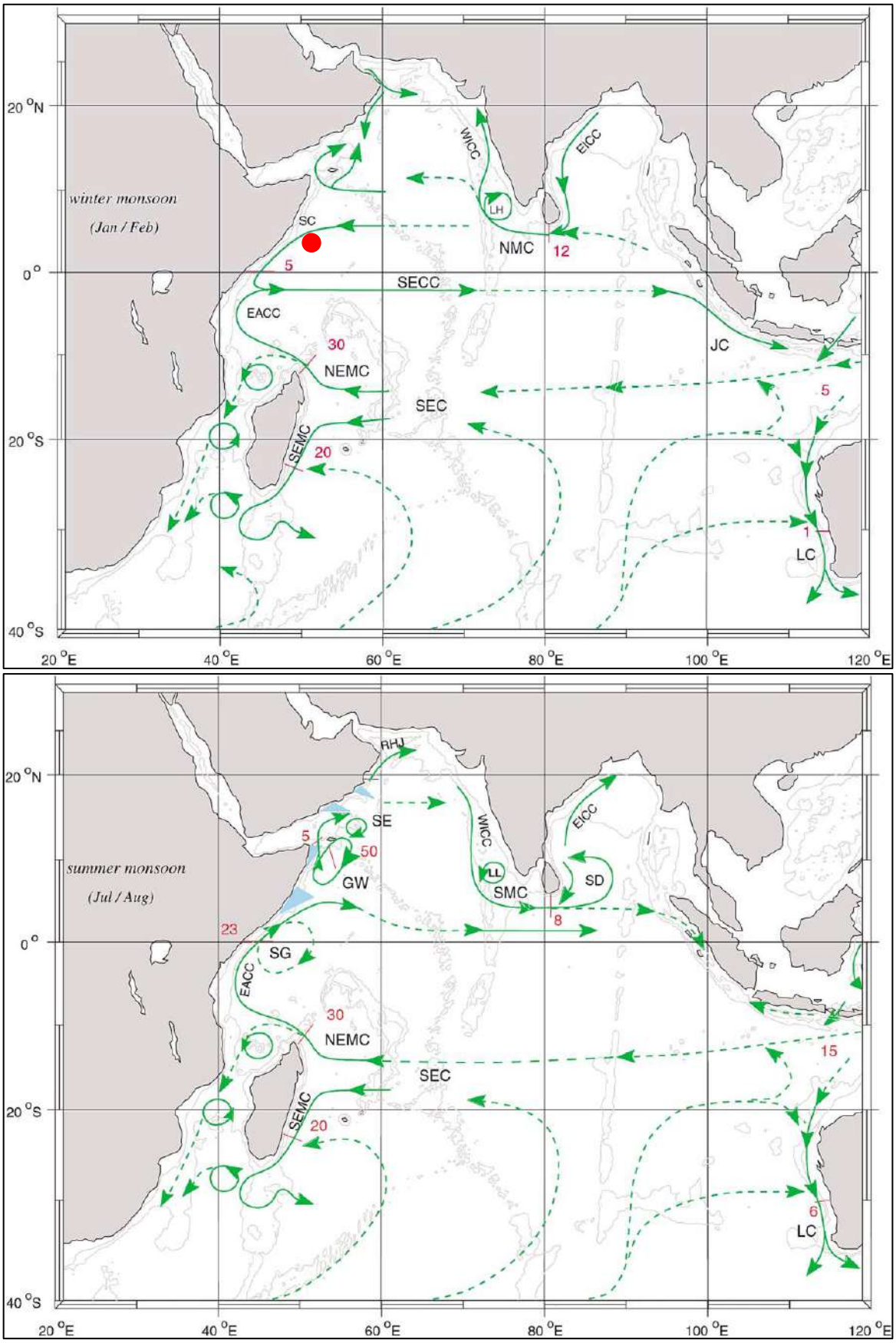

Figure 3: Main currents of the Western Indian Ocean during the (upper) NE-Monsoon – or winter monsoon – and (lower) SE-Monsoon – or summer monsoon.

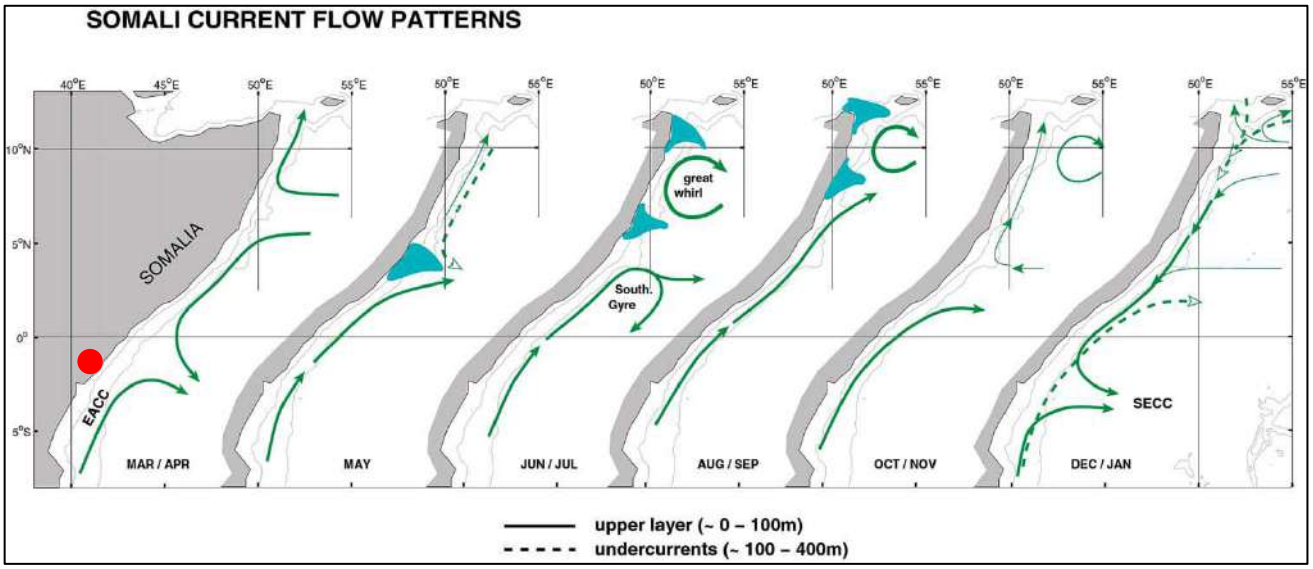

Figure 4: Schematic diagram of the Somali current flow pattern during the course of a year demonstrating the convergent and divergent process that take place in the region and are likely to enhance primary production.
EACC: East Africa Coastal Current, SECC: South Equatorial Countercurrent (called ECC in other sources). The red dot represents the location of Lamu (source: Schott and McCreary, 2001)

4.2 Geomorphology

4.2.1 Geology and Geomorphology

Kenya has about 600 km of low-lying coastline, which is formed as a result of coastal erosion due to the scarce supply of sand from rivers. The coastline is followed by a line of hills up to 300 m high, except in the southern part where hills can reach 1000 m. Just a few metres above the current sea level, extensive fossil reefs are present (Tortell, 1998), which are often used as building material (Government of Kenya, 2009). The seascape north of Malindi has an irregular continental shelf spreading from 4 to 6 km off Kiunga for up to 60 km (Tortell, 1998; Osuka et al., 2016). Otherwise, the continental shelf is typically about 25 km wide. The geology of the islands comprises fossilised sand dunes and beaches of the Pleistocene age. The coastline of Lamu is mostly rocky, consisting of Quaternary sediments that are in contact with Jurassic sediments and the Precambrian basement. It has few indentations and is rimmed by a narrow beach (Osuka et al., 2016) and mangrove sedimentary environments.

4.2.2 Bathymetry

Bathymetric data were collected by EGS (Vietnam) Limited under contract to Japan Port Consultants Limited for the Ministry of Transport in 2010, prior to dredging activities currently being undertaken for the development of Lamu Port,. Therefore the results do not represent an accurate current baseline for areas that have been influenced by port development works. Prior to port construction, at the centre of Manda Bay a channel nearly 60 m deep was present, extending to the mouth of the bay. Outside the bay, in the open sea, the depth steadily increased. Apart from the channel, the water depth within Manda Bay is between 0-30 m, with shallower water in the inner bay.

4.3 Underwater Sound

The marine environment is inundated with sounds generated both by natural sources (for example, breaking waves, rain, wind or marine life), and man-made sources (for example, marine traffic, coastal development, exploration activities or military exercises). Some of these sounds are continuously present almost everywhere in the ocean, this background sound being termed ‘ambient noise’. Little data are available on underwater

ambient noise in the AoI. However, based on the information retrievable in the review literature, an estimation of natural and man-made sources currently occurring in the area is provided in the following sections.

4.3.1 Man-made sources

4.3.1.1 Maritime traffic

The AoI is not currently located on busy maritime routes. Manda Bay was rarely used by ships prior to the start of the construction of Lamu Port in 2015. Since that time, traffic has significantly increased (www.marinetraffic.com) – Figure 5.

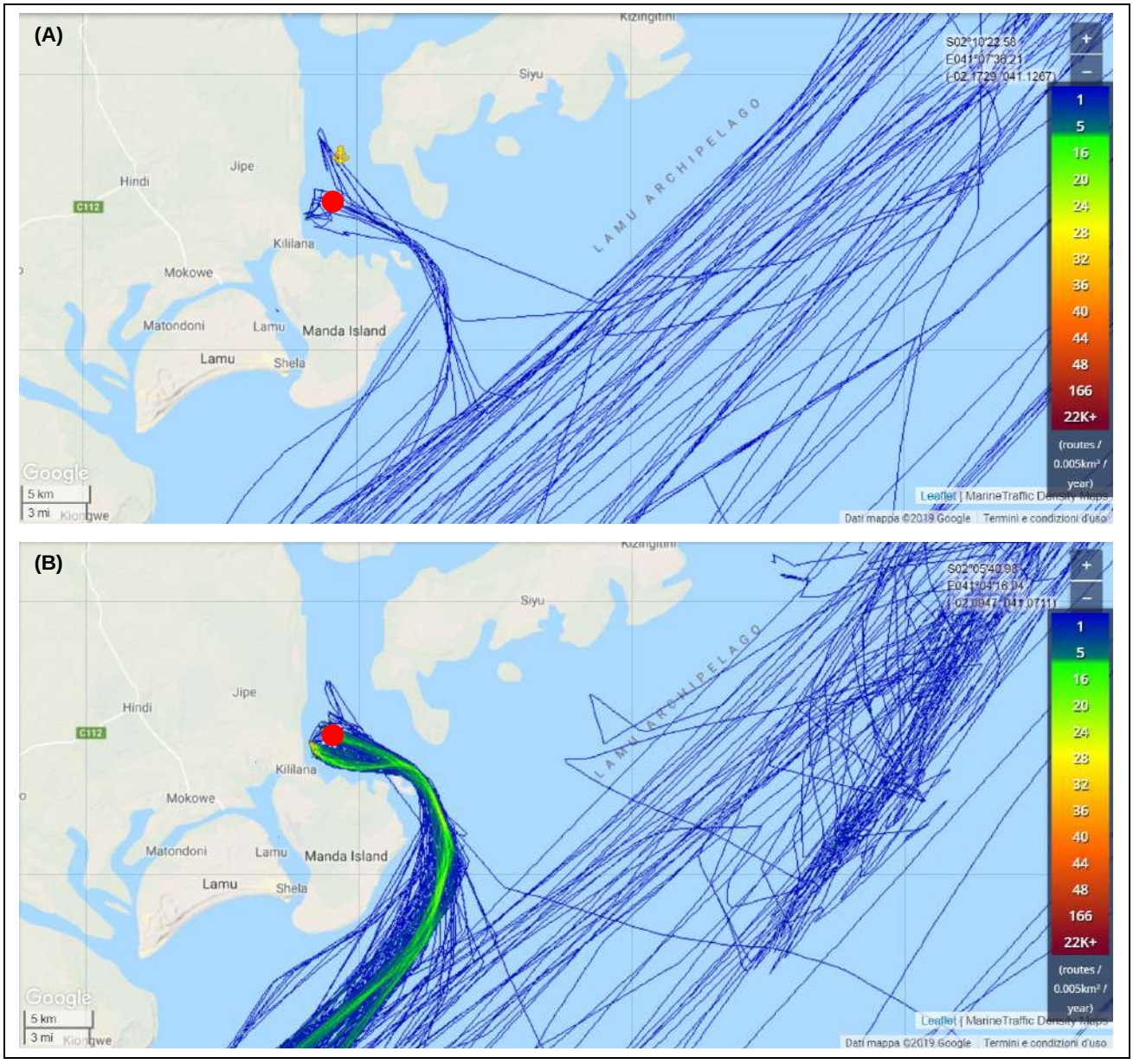

Figure 5: Maritime traffic in the seascape in (A) 2016 and (B) 2017 (Source: www.marinetraffic.com). The red point indicates the approximate location of the LLCOP Project footprint area

The port is currently under construction and, hence, not highly navigated yet. The vessels currently docked (that is, at January 2019) are mainly cargo vessels. A dredger, an edible-oil tanker, and fishing vessel are registered according to the Marine Traffic portal. Except for the fishing vessel, for which no data exist, all the docked vessels exceed 80 m in length.

The AoI is also expected to be frequented by artisanal fisheries. However, these may be considered negligible in terms of underwater noise, since canoes or low-power engines are usually employed.

4.3.1.2 Oil & Gas exploration and exploitation activities

The Project's marine AoI is located inside Oil and Gas Block L4, which is licensed to Zarara Oil and Gas by the Government of Kenya. According to Energy-Pedia (2019), a new exploration well (Pate-2) is being drilled in the vicinity of an abandoned natural gas well (Pate-1), whilst a third one (Pate-3) is expected to be drilled in the future. However, as all three wells are located onshore they are considered to be outside the AoI.

4.3.1.3 Construction/demolition works

The construction of the port includes dredging, pile-driving and installation of other concrete structures. Dredgers are known to emit non-impulsive noise at low frequencies (< 100 Hz), with a Sound Pressure Level (SPL) of 160 dB re 1 µPa at 1 m on average while operating (Boyd et al., 2008). Pile-driving can emit both impulsive (hammering) and/or a non-impulsive (vibrating) sounds, depending on how it is carried out. Usually, both methods are employed together. The SPL of pile-driving works ranges from 190 to 210 dB re 1 µPa at 1 m on average (Leunissen and Dawson, 2018), but the level of sound is dependent upon facrors such as pile size and substrate.

Considering that construction works for the port are expected to last until 2030, those activities are expected to be the most influential on underwater ambient sound levels within the AoI.

4.3.2 Natural sources

Natural factors contributing to underwater noise include wind, rain and waves. Generally, wave noise generated by the wind is dominant. In addition, animals (for example, fish, shrimps and cetaceans) emit sounds in the natural environment, especially for communication. All cetaceans, including the species known to occur, or potentially occur, in the AoI produce sounds for communication, orientation and navigation purposes. Source levels for the tonal sounds are around 170 to 180 dB re 1 µPa at 1 m, while echolocation clicks range from a source level of up to 226 dB re 1 µPa at 1 m for the bottlenose dolphin (*Tursiops truncatus*) (Richards et al., 2007).

4.4 Illumination

The AoI is characterised by an absence of large human settlements. There is a small resort on the north coast of Manda Bay (Manda Bay Lodge) and very little infrastructure along the western coast of the channel. The nearest town is Lamu, which could cause the greatest diffuse illumination. However, the new port development and a proposed coal fired power plant (Amu Power, 2016) will increase localised illumination (although the latter is some distance to the north). There is no available information regarding levels of light emission during the construction and operational phases of Lamu Port (Ministry of Transport, 2013), but for reference Lyttelton Port (2014) reported that light emissions caused illumination of 10 lux (for comparison, the illumination level of moonlight is between 0.5 lux and 1 lux.

The increase in local vessel movements will have already have led to greater transient light emissions. The level of light emission from the artisanal fishery is negligible.

4.5 Water and Sediment Quality

4.5.1 Pre-existing Information

Data sources for the AoI and surrounds are taken from:

- A survey undertaken in August 2012 as part of the ESIA studies for the construction of the Lamu Port in Manda Bay (Ministry for Transport, 2013); and

- A survey undertaken in January 2015 as part of the ESIA studies for the building of a coal fired power plant in in the Kwasasi area of Hindi/Magogoni sub-county (21 km north of Lamu town) (Amu Power, 2016).

In both cases, data collection was carried out before the onset of construction of the coastal facilities.

The analysis of those data available for water and sediment indicates that generally good quality conditions exist, with very few exceedances of national and international toxicity thresholds. Sediment in the surveyed areas was predominantly sandy (> 80%), and TOC levels very low, leading to a low capacity to retain contaminants. Few exceedances were observed in the ESIA of the coal fired power plant for: pH, total nitrogen, TDS, fluoride, *E. coli*, BOD_5 and COD. However, a few considerations must be made regarding those exceedances:

- pH was slightly lower than the international chronic threshold for only a single station;
- The other parameters were present in all or some samples, with concentrations higher than the Kenyan national standards. However, those standards were established for effluent discharge into the environment, not environment water standards for certain types of use and were used only as a reference in the absence of environmental water standards. Hence, reference concentrations may be over- or underestimated for some parameters;
- BOD_5 and COD levels were unusually high indicating possible contamination of samles with anthropogenic organic matter; and
- Regarding sediment quality, only Cd and Cu presented exceedances.

4.5.2 ESIA Survey

Water and sediment samples were collected in ten sampling stations (Figure 6) during two different monsoon seasons: the South-east Monsoon (4 and 5 July 2018) and the North-east Monsoon (13 to 17 November, 2018). The field reports in Volume III of the ESIA provides more detail on the methods and results of the survey. Sampling points were chosen according to a sampling design that included:

- At the surroundings of the potential location of the LLCOP berth and underwater pipeline route: P1 and P3;
- From the berth area to the offshore zone of the AoI, following the prevalent path of the coastal currents[1]: P1 to P8;
- Close to sensitive biodiversity components, such as coral reefs, seagrass beds, mangrove forests and sea turtle breeding sites: P4 to P8;
- At the mouth of tidal channels that may bring effluents from urban settlements to the AoI: P2; and
- At control sites: C1 and C2, positioned so that they would not be directly influenced by the project activities in the future and, at the same time, would not be close to relevant sources of contamination (for example, large villages, urban settlements).

[1] In the ESIA of the Lamu Port (Ministry of the Transport, 2013) the results of the sediment transport modelling indicate that the currents tend to always drive suspended solids from the project site directly to the ocean.

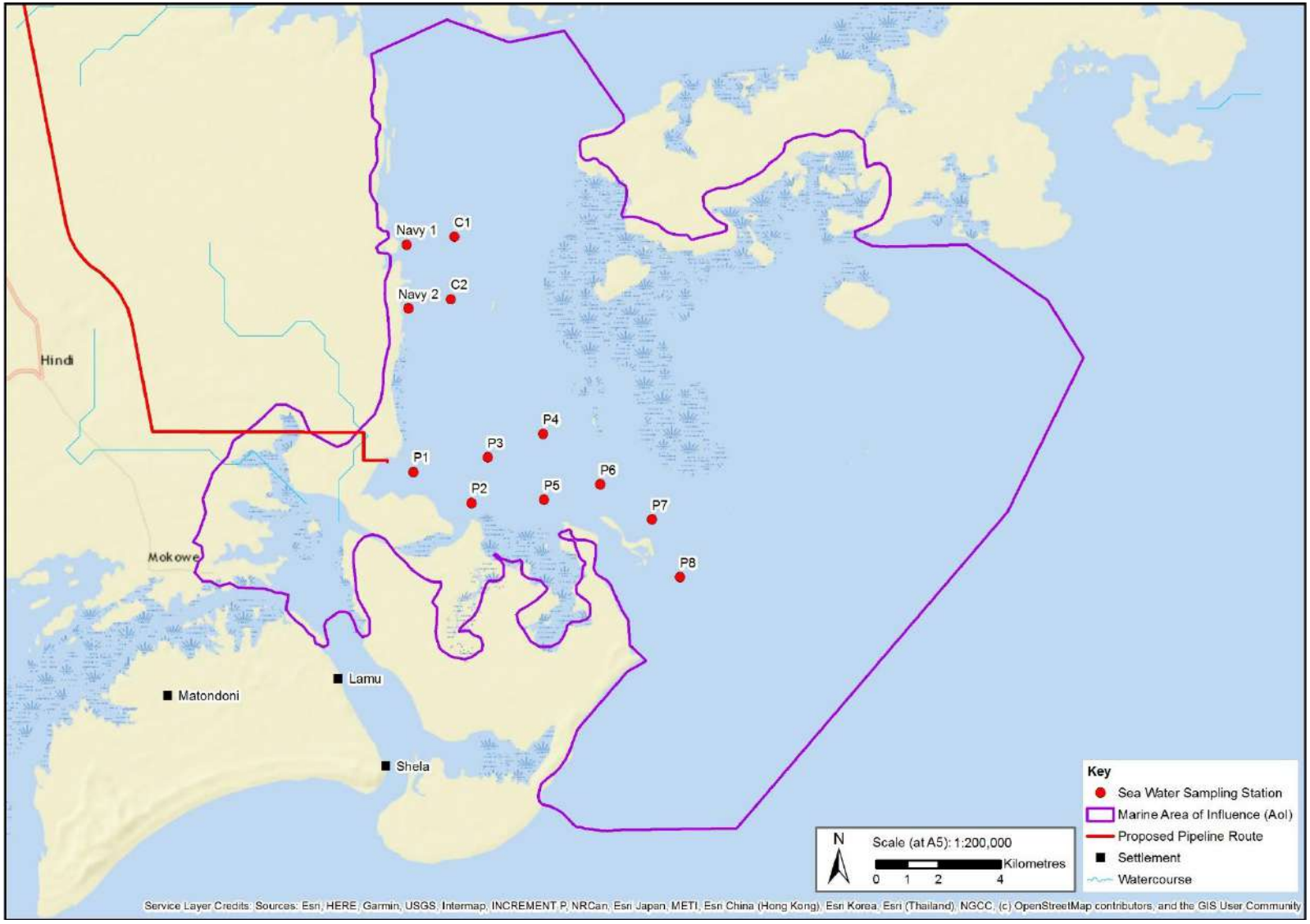

Figure 6: Marine water and sediment sampling locations

Water parameters selected for this study included those listed in the Kenyan national water quality guidelines for discharge into the environment (Legislative supplement No. 36/2006), and additional parameters that could possibly be affected by Project activities. The water quality results were compared with the Kenyan guideline values, and the acute and chronic thresholds for marine surface water listed in the "*Screening Quick Reference Tables*" prepared by National Oceanic and Atmospheric Administration (NOAA) (Buchman, 2008). The latter are derived from the primary entry in the United States of America Ambient Quality Criteria, followed by the lowest of Tier II secondary acute values (SAVs), or other available standards or guidelines.

Lowest observable effect levels (LOELs), previously published by the United States Environmental Protection Agency (USEPA), are also included since these are the main reference for many national standards (Buchman, 2008). As there are no sediment quality standards in Kenya, the parameters selected for this baseline include those that could possibly be affected by Project activities. The results were compared with the TEL and the PEL, as per MacDonald et al. (1996).

No international water quality limits were exceeded. The only parameters that exceeded the Kenyan limits were total phenols, TSS and selenium, for both the sampling events during the North-east and South-east Monsoon season. While selenium and TSS exceed the national thresholds by up to five times, total phenols reached 0.05 mg/l, which is 50 times higher than the guideline threshold (which is 0.001 mg/l). However, as previously mentioned, the Kenyan standards were established for effluent discharge into the environment, not to environment water standards for certain types of use. They were used only as a reference in the absence of environmental water standards. Hence, reference concentrations may be over, or underestimated, for some parameters in contrast to if they referred to environment water quality.

There were no relevant differences in the water quality between the two seasons sampled, the same parameters present exceedances in both periods, although there are fewer exceedances during the South-east Monsoon season. These differences could be due to the heavy rains that fall at the start of this season, which could dilute parameters of interest (Tortell, 1998; Samoylis et al., 2015).

When compared to the data obtained from the previous ESIAs (that is, Ministry of Transport, 2013; Amu Power, 2016), TSS show exceedances that were not recorded previously. Data collected for this ESIA show values of 8 and 79 mg/l, while in the Amu Power survey (2016) they ranged from 2 to 5 mg/l, and in the survey reported by Ministry of Transport (2013) they varied from 0.09 to 0.12 mg/l. The elevated levels observed in this study's baseline were most likely due to port construction activities (that is, dredging, land reclamation works and vessel movements). Such elevated TSS levels are likely to be temporary, occurring cyclically after each maintenance operation of the port following completion of the construction activities; for example, maintenance dredging.

Overall, survey results from the sampling stations around the Project footprint showed good water quality, with very few traces of human impact. It appeared that construction of the port has not had a marked impact water quality. This information should be taken into consideration as standards are set for future assessments during, and after, the Project construction.

Except for station P2, where sediments were silty, the results indicated that sediments in the study area were sandy, corroborating the previous studies regarding sediment grain size. The predominance of sandy bottoms associated with a low percentage of organic matter reduces the potential for retention of contaminants. Exceedances of the threshold levels previously described for sediment parameters were noted for As and Sn compared to TEL. In the case of As, they were limited, with concentrations up to 50% higher than TEL. However, in the case of Sn, concentrations were generally more than two orders of magnitude higher than TEL. Since Sn was not previously quantified it is not possible to make a comparison, while As did not exceed the limits described in either the Lamu Port ESIA (Ministry of Transport, 2013) or the power plant ESIA (Amu Power, 2016). On the other hand, Cd, which was below reference levels in this assessment, was found to be over the TEL in the previous studies. As previously mentioned for the water quality sections, the relatively higher levels

of As recorded during this assessment may have been related the activities associated with the port construction, that is, dredging could have resuspended heavy metals from deeper layers, which then settled in the upper sediment layer.

4.6 Biodiversity

4.6.1 Marine Mammals

Various marine mammal studies have been completed in Kenya at local and national scales, but the coverage across the whole of the country is incomplete and data gaps exist. There is limited information on the presence, or absence, of marine mammal species in the northern Kenya, including within the Lamu-Kiunga seascape. Recent local research is focused on marine parks, such as Watamu. National surveys have included historic aerial sightings undertaken in the mid-1990s (Wamukoya et al., 1997; Kenya Wildlife Service, 1996). The most comprehensive recent survey of marine mammals in Kenya was organised by the Kenya Marine Mammal Network (KMMN), a non-governmental organisation (NGO) that undertakes marine research in Kenya on behalf of local and international partners. However, the area of survey excluded northern Kenya. When there is such data paucity, it is important that precautionary approaches are adopted. Therefore, it has been considered possible that all species recorded in Kenyan waters could be resident or occasionally present in the AoI or wider Lamu-Kiunga seascape, if their behaviour suggests potential for this to be the case.

Based on a literature review and consultation with marine mammal experts in Kenya, the species with confirmed presence in Kenyan waters are presented in Table 1.

Table 1: Marine mammal species confirmed in Kenyan waters

Common Name	Scientific Name	IUCN Red List Status
Indian Ocean humpback dolphin	*Sousa plumbea*	Endangered
blue whale	*Balaenoptera musculus*	Endangered
sperm whale	*Physeter macrocephalus*	Vulnerable
dugong	*Dugong dugon*	Vulnerable
Cuvier's beaked whale	*Ziphius cavirostris*	Least Concern
humpback whale	*Megaptera novaeangliae*	Least Concern
melon-head whale	*Peponocephala electra*	Least Concern
common minke whale	*Balaenoptera acutorostrata*	Least Concern
pantropical spotted dolphin	*Stenella attenuate*	Least Concern
striped dolphin	*Stenella coeruleoalba*	Least Concern
common bottlenose dolphin	*Tursiops truncates*	Least Concern
long-beaked common dolphin	*Delphinus capensis*	Least Concern
Fraser’s dolphin	*Lagenodelhis hosei*	Least Concern
Risso’s dolphin	*Grampus griseus*	Least Concern

Common Name	Scientific Name	IUCN Red List Status
rough-toothed dolphin	*Steno bredanensis*	Least Concern
short-beaked common dolphin	*Delphinus delphis*	Least Concern
Blainville's beaked whale	*Mesoplodon densirostris*	Data Deficient
false killer whale	*Pseudorca crassidens*	Data Deficient
Bryde's whale	*Balaenoptera edeni*	Data Deficient
Indo-pacific beaked whale	*Indopacetus pacificus*	Data Deficient
short-finned pilot whale	*Globicephala macrorhynchus*	Data Deficient
orca	*Orcinus orca*	Data Deficient
Indo-pacific bottlenose dolphin	*Tursiops aduncus*	Data Deficient
spinner dolphin	*Stenella longirostris*	Data Deficient

An understanding of the general habitat preferences of marine mammals is necessary in order to consider the potential value of the seascape and AoI for these species. Of the species listed in Table 1, the following are likely to be present in nearshore waters: humpback whale, Indian Ocean humpback dolphin, bottlenose dolphin (also in deeper waters), long-beaked common dolphin, spinner dolphins (resting during the day), pantropical spotted dolphin (during the day), and dugong. Other species may also occur in coastal water at times, including Bryde's whale, blue whale, minke whale and orca. The marine mammal species that are present in Kenyan waters include migratory and congregatory species. The Lamu-Kiunga seascape, including the AoI, may provide ecological functions for such migratory species, including transit or more localised foraging and nursery habitat.

Blue whales can be found in coastal waters, but they generally prefer deep offshore waters and have only been recorded in Kenya in far offshore waters, in depths of 2,990 m to 4,705 m (Barber et al. 2016). Based on the timing and geographical location, Barber et al. (2016) state that the blue whales recorded may have been either Antarctic blue whales (*Balaenoptera musculus intermedia*, classified as Critically Endangered by IUCN and Endangered in Schedule 6 of the Kenya Wildlife Act (Cap 376)), Madagascar pygmy blue whales (*Balaenoptera musculus brevicauda*) or northern Indian Ocean blue whales (*Balaenoptera musculus musculus*). No blue whales were recorded in shallower waters during transit to the survey area (Barber et al. 2016), and records elsewhere in shallower water have usually been in areas with narrow continental shelves or immediately adjacent to deeper water (Branch et al., 2007). The habitat area of blue whales is large, and their movements in Kenya waters are unknown, which supports the need to act in a precautionary manner while there is uncertainty about the presence and behaviour of such wide-ranging and highly mobile marine mammal species as blue, minke and Bryde's whales, both in Kenyan waters and in the south-west Indian Ocean more generally.

In 1996, 540 dolphins were counted in Ungwana Bay and the Lamu archipelago (Wamukoya et al., 1997). Of these, 40 were observed in Ungwana Bay, and 500 in areas outlying Manda and Pate Islands (Samoilys et al., 2011). A dolphin species of note is the Indian Ocean humpback dolphin, which is classified by the IUCN as Endangered. This species has a restricted distribution, and small populations, where they are present. It prefers shallow nearshore waters, where it is threatened by coastal and nearshore human activities (Braulik et al., 2015; Braulik et al., 2016; Braulik et al., 2017). Information on the extent of occurrence (EOO) and population of this

species is very limited in Kenyan waters and even at regional or global scales. In Kenya, they have been recorded in Shimoni in southern Kenya, and in the Malindi-Watamu area in central Kenya. The population estimate for Shimoni is 104 individuals. Braulik (2015) states the overall estimate for Mozambique, Tanzania and Kenya, at the time of writing, is 455 individuals. However, these data only reflect the abundance of known populations, and may exclude populations that have been recorded by the KMMN in the coastal waters of Malindi and Watamu. There are no absolute abundance estimates from anywhere north or east of Kenya within the known range of this species.

Humpbacks whales have been recorded in the seascape, travelling from feeding grounds in the Southern Ocean to breed off the east African coast. They usually migrate into east African waters between June and December (Richmond, 2012); with a peak in Kenyan waters in August (S. Trott pers. comm. 2018). Consultation with experts in Kenya would suggest that the majority of the whales move south out of Kenyan waters in September, or October at the latest: this pattern is consistent with records in northern Kenya closer to the AoI (S. Trott, pers. comm. 2018). Again, the lack of data for northern Kenya does provide limitations to this understanding.

Between 2011 and 2013, research by the KMMN recorded 198 humpback whale sightings in Kenya, and a catalogue of 61 humpback whale individuals has been compiled. Again, this may not represent the total number of whales present due to the distribution of the survey effort. The whales that are present along the Kenyan coast are most likely from the South-west Indian Ocean sub-population, known as Breeding Stock C, and are historically considered to comprise sub-stock C1 - a genetically distinct group (Cerchio et al., 2013), but satellite tagging undertaken for whales in Madagascar indicates some interchange between sub-stocks C1 and C3. The estimated population of Breeding Sub-stock C1 is approximately 6,000 individuals for the Mozambique nearshore coast, although it is expected to be higher overall for when taking account of whales present in more northern areas (Cerchio et al., 2013).

Cerchio et al. (2013) report on humpback whale movements during the breeding season between Madagascar and northern Kenya and Somalia using satellite tagging of whales to the east of Madagascar between 24 July and 3 August, 2013. The results showed a mother and calf to be located in the Lamu area in late August, and also the movement of a male humpback whale in Somali waters at around the same time. The research also showed that the mother and calf remained within 50 km of Lamu for 5 days before the tag stopped transmitting, potentially demonstrating some localised behaviour in this area. In addition to these satellite data, a mother and calf were sighted in Manda Bay on the 13th October 2011 (KMMN, 2012).

A small number of dugongs have been recorded in the Lamu archipelago feeding on seagrass beds (Samoilys et al., 2011. The Lamu-Kiunga seascape is recognised important dugong habitat (Church and Obura 2006; Government of Kenya, 2009). Areas of potential foraging importance may include the KMNR, Dodori and Mongoni creeks, and the Siyu Channel between Pate Island and the mainland. Aerial surveys in the Lamu Archipelago counted ten individuals in 1994, and six individuals in 1996 (Wamukoya et al. 1997; Samoilys et al., 2011). The sightings in 1996 include animals in the Siyu channel and near Manda Toto Island. During the same period, several clear feeding trails were also observed in areas off Faza, Uvondo and Ndau islands (Wamukoya et al. 1997; Samoilys et al., 2011). In 2002 there were anecdotal reports of between five and eight animals, including two calves, at Siyu Channel and Kiunga Muini (Wamukoya et al. 1997; Samoilys et al., 2011).

Sightings of dugong have become very rare and Osuka et al. (2016) suggest that the infrequency of sightings it is likely to have become extinct in this area. This statement does, however, need to be treated with caution due to the lack of recent research focused on dugong populations. However, available evidence from dugong sightings in Kenya, in addition to their vulnerability to nearshore human impacts, make this a species of conservation concern.

4.6.2 Sea Turtles

Five sea turtle species are reported to occur in Kenyan waters, including the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (*Lepidochelys olivacea*), loggerhead turtle (*Caretta caretta*) and leatherback turtle (*Dermochelys coriacea*). These species have the following IUCN Red List classifications:

- Green turtle: Endangered;
- Hawksbill turtle: Critically Endangered;
- Olive ridley: Vulnerable;
- Loggerhead turtle: Near Threatened (SW Indian Ocean subpopulation); and
- Leatherback turtle: Critically Endangered (SW Indian Ocean subpopulation).

Sea turtles occupy various habitats throughout their life-time, including nesting beaches and coastal, neritic (shallow) and oceanic waters. They are also subject to broad movements for foraging and breeding migrations. Therefore, the baseline understanding of sea turtles needs to be considered broadly, which is reflected in the information provided below.

Between 2008 and 2010, WWF and the KWS collaborated on the tagging of 14 green turtles, and a single hawksbill turtle, with the majority of activity occurring in the KMNR. The data shows that there is connectivity of green turtle nesting beaches in Kenya and Tanzania and Somalia. The data also shows more localised activity in line with that already explained above. There is potentially some connectivity between nearshore waters in the Project area and nesting grounds in the Chagos Archipelago for green turtles. Olendo et al. (2017) also reported upon catch and release tagging programmes in the KMNR, which provided some evidence that green turtles returned to the same beaches to nest over multiple years, but they stated that a low level of recapture limits the understanding of turtle movements in the archipelago. Therefore, impacts in the AoI need to be considered at a local, regional and international level.

Only the green turtle, hawksbill turtle, and olive ridley turtle commonly nest on beaches in Kenya, with the green turtle known to nest in significantly greater numbers than other species (Olendo et al., 2017, Okemwa et al., 2006; Okemwa et al., 2004; Frazier 1975; Wamukoya et al., 1996; Nzuki and Muasa, 2005). Olendo et al. (2017) state that between 1997 and 2013, nesting data from beaches within the Kiunga Marine National Reserve (KMNR) shows that 97.5% of nests were by green turtles, 1.5% by hawksbill turtles, 0.4% were olive ridley turtles, and 0.5% unidentified nests. The leatherback turtle and loggerhead turtle are not thought to normally nest in Kenya (Frazier 1975; Okemwa 2002; Okemwa et al. 2004; Okemwa et al., 2004). However, these species have been recorded in offshore waters, mainly through records of strandings, and are, therefore, expected to be migrating and foraging in Kenyan waters. Loggerhead turtle strandings have been recorded in the Lamu-Kiunga seascape, but at a low level. Sightings of leatherback turtles are rare in Kenyan waters, and although it is expected that they would most probably occur in deep waters between October and March (Hamann et al., 2006), the presence of this species in the Lamu-Kiunga seascape, including the AoI, cannot be discounted.

At the time of writing of their report, Okemwa et al. (2004) stated that monitoring of sea turtle nesting activities covered 31% of the overall coastline. There is therefore a data paucity across the whole Kenyan coast, which limits the full understanding of nesting incidence, and an absence of nesting records where potential nesting habitat exists along the Kenya coastline cannot be assumed to be confirmation of the absence of turtle nesting. The same applies when determining the importance of different areas and overall species population levels, because this is also a function of data availability.

Figure 7 identifies some known nesting sites in Kenya using data compiled in the Environmental Sensitivity Atlas for the Coastal Area of Kenya (KenSea) (Tychsen, 2006). This information is based on historic coarse mapping and should only be considered to provide a very indicative overview of where sea turtle nesting has been recorded. As an example, the data suggest a high priority nesting site to the north-east of Manda Island. However, consultation with Lamu Marine Conservation Trust (LaMCoT), which undertakes sea turtle nesting research on the island, suggests that nesting is focused to the south in the Takwa area (S. Wanjiru, pers. comm., 2018; A. Salim, pers. comm., 2018).

Okemwa et al. (2004) reported upon the status of sea turtles in Kenya, with reference to data collated by the Kenya Sea Turtle Conservation Committee (KESCOM), which was established in 1993 to provide a national integrated approach to sea turtle conservation. They provide a summary of nesting data collated by groups along the Kenya coastline between 1997 and 2000, and state that key nesting sites include: Jumba Ruins; Kijipwa and Nyali along the Mombasa beach stretch; Kiungawini and Mongo Shariff along the Kiunga beach stretch; and the Watamu beach stretch. Green turtles represented 91% of nests reported. It was acknowledged at the time of writing of their report that there were gaps in knowledge for the distribution of key nesting sites especially in sections where accessibility is poor, such as the stretch between Malindi and Lamu. They also report upon turtle strandings, which gives an indication of the turtle species present in Kenyan waters. Fifty-four per cent of the turtle strandings were green turtles, 6% were hawksbill turtle, 2% were loggerhead turtles and 1% were leatherback turtles; the remainder were unidentified.

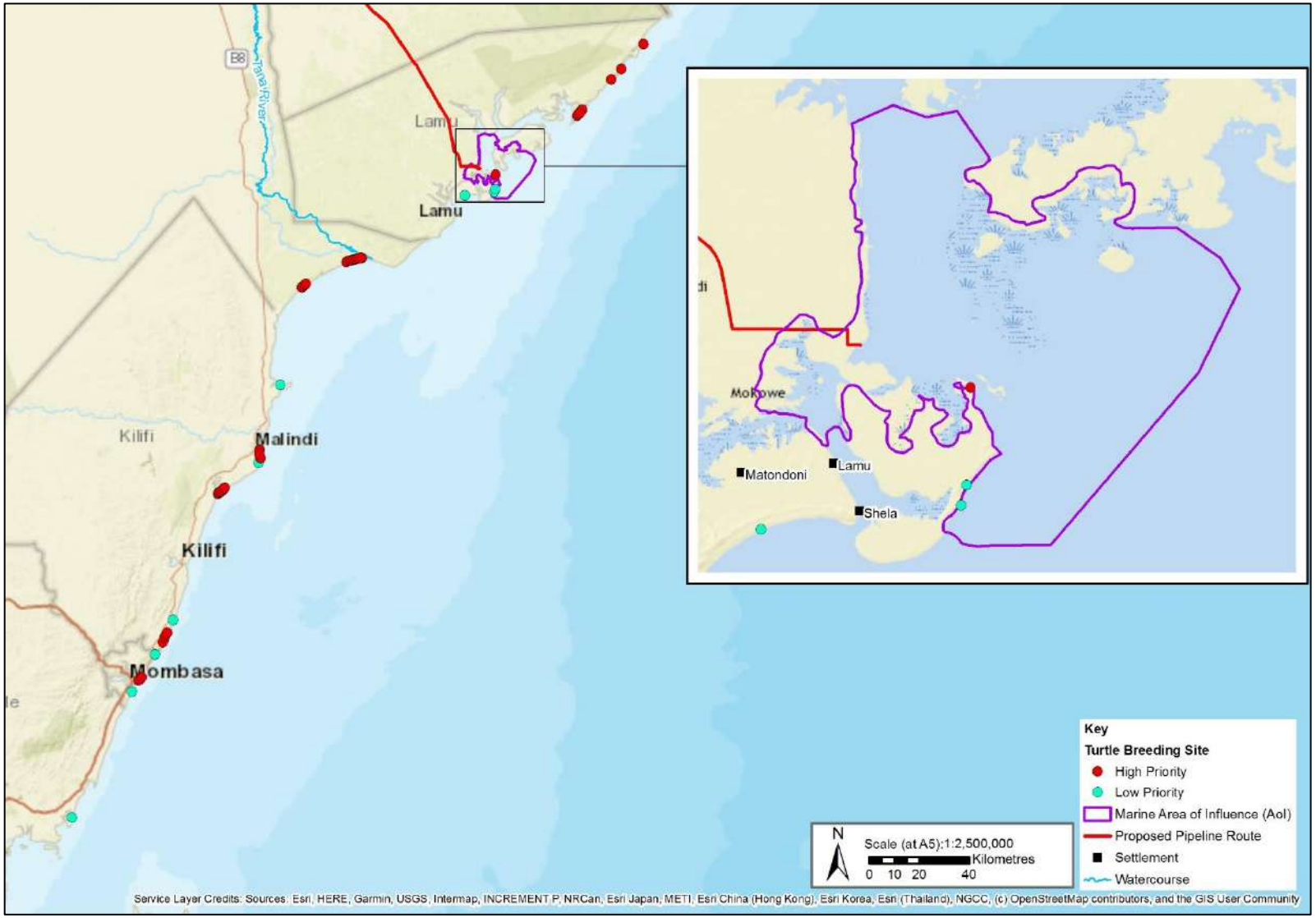

Figure 7: Known sea turtle nesting areas in Kenya - blue denotes low priority nesting sites; red denotes high priority nesting sites. Each point represents 1 km coastline (sourced from the World Resources Institute – origin UNDP et al., 2006)

Within the Lamu-Kiunga seascape, data on nesting events have been collected on beaches over a long period by local conservation groups (e.g. LaMCoT and WWF) with local community support (Olendo et al., 2017; S. Wanjiru, pers. comm. 2018). The Lamu-Kiunga seascape provides the most significant nesting beaches for sea turtles in Kenya and is estimated to support >60% of reported nests (Olendo et al., 2017). Offshore seagrass beds, coral reef areas, and associated algal beds (described later inthis section) provide important foraging habitat for sea turtles. In this regard, the seascape represents a significant foraging resource for sea turtles.

Within the seascape area, the main areas of nesting activity occur on beaches in the KMNR and on Manda Island and Lamu Island (Okemwa et. al. 2004). Within the KMNR, Rubu Island, Kiwayu Island, and Kiunga provide important nesting habitat (Olendo et al., 2017). Long-term monitoring has been completed at Kiunga, Rubu Island, Mvundeni, Mkokoni and Kiwayu. Consultation with LaMCoT confirmed that the main known nesting beach on Manda Island is along the easterly, exposed coast at Takwa (S. Wanjiru, pers. comm., 2018; A. Salim, pers. comm., 2018). This area is located on the boundaries of the AoI, as shown in Figure 8, although as this is where local monitoring effort is focused the possibility of nesting where there is less or no monitoring, either elsewhere on the island or other areas where habitat allows, cannot be discounted. This may include beaches that afford nesting habitat north of the Takwa nesting beach, nearer to the Project site.

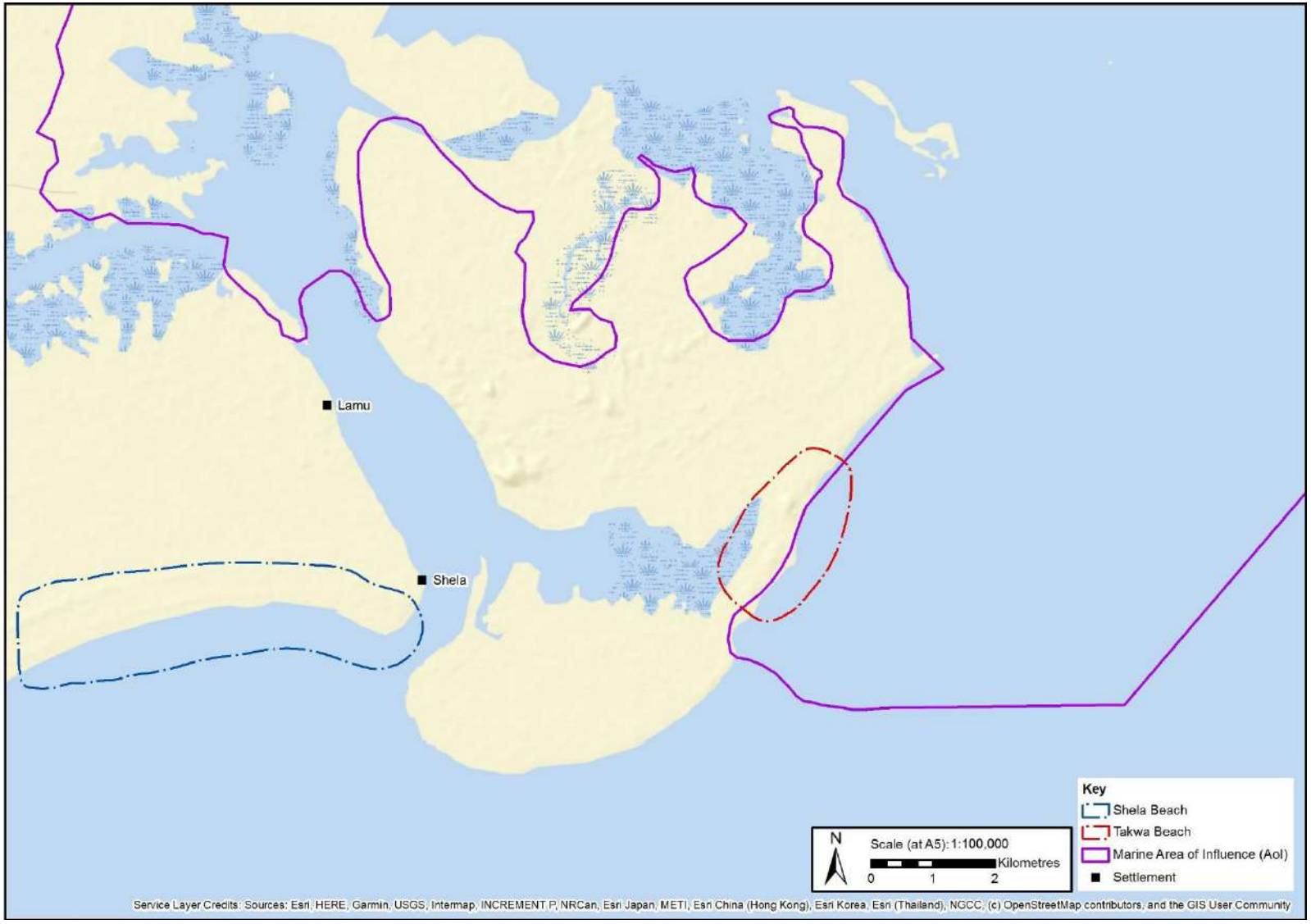

Figure 8: Known nesting beaches on Lamu Island and Manda Island that are monitored by LaMCoT – Shela is in blue and Takwa is in red

Nesting data for Takwa beach show an annual mean of 34 nests per year between 1997 and 2018 (LaMCoT, unpublished data). Olendo et al. (2017) report that the peak nesting period in the KMNR is between March and July, with over 74% of nests recorded during this period, which correlates with the South-east Monsoon and associated rainfall and sea surface temperature. Nesting activity is highest in May, but was confirmed to occur all year round. Olendo et al. (2017) also report that there are higher levels of nesting in the KMNR than at Takwa and Shela beaches, ranging from an annual mean of 141 to 791 nests at Kiwayu, Mkokoni, Mvundeni, Rubu and Kiunga (Rubu had the highest annual mean, at 791 nests).

All of the sea turtles mentioned above are classed as migratory, with species that are breeding and nesting in the area also defined as congregatory. Sea turtles are potentially wide-ranging across their life cycle, and individual species show different patterns of movement, remaining local or travelling long distances to other areas. This understanding is important to determine how activities in the AoI may have a broader impact.

Anthropogenic threats to sea turtles include high levels of poaching (for eggs and meat) by local communities and fisheries by-catch (trawling and artisanal). The Government of Kenya has put in place legislation to protect sea turtles, i.e. the Wildlife Act (Cap 376). There is no legislation protecting key nesting and foraging habitats utilised by sea turtles, except for those falling within legally protected areas. Olendo et al. (2017) reported on that sites monitored in the KMNR showed levels of predation at 16.5% of nests.

4.6.3 Fish

Cartilaginous fish (Chondrichthyes) are known to be present in the AoI (Osuka et al., 2016). Aerial surveys carried out in 1994 along the Kenyan coast, as part of the Marine Resources Inventory of the KWS, showed the presence of sharks and whale sharks, with major concentrations in Ungwana Bay and in the areas around Manda and Pate islands. Furthermore, rays were spotted along all the Kenyan coast (Wamukoya et al., 1996). A black tip reef shark (*Carcharhinus melanopterus*) was observed during the surveys for the Lamu Port (Ministry of Transport, 2013).

Three of the six species of sharks regularly seen and fished for in the Pate Island-Kiunga area (Osuka et al., 2016) are classified as Endangered according to IUCN:

- Whale shark (*Rhincodon typus*) (Pierce and Norman, 2016);
- Scalloped hammerhead (*Sphyrna lewini*) (Baum et al., 2009); and
- Great hammerhead (*Sphyrna mokarran*) (Denham et al., 2007).

The other three (that is, blacktip reef shark (*Carcharhinus melanopterus*), whitetip reef shark (*Triaenodon obesus*) and tiger shark (*Galeocerdo cuvier*) are classified as Near Threatened (Huepel, 2009; Smale, 2009; Simpfendorfer, 2009). Zebra shark (Stegostoma fasciatum), also Endangered, is not frequently sighted or fished but is likely to occur in the area.

Nine species of rays were recorded in the area (Osuka, 2016), four of them are classified as Vulnerable according to the IUCN:

- Giant manta ray (*Manta birostris*) (Marshall et al., 2018);
- Giant guitarfish or whitespotted wedgefish (*Rhynchobatus djiddensis*) (Dudley and Cavanagh, 2006);
- Blotched fantail ray (*Taeniurops meyeni*) (Kyne and White, 2015); and
- Honeycomb stingray (Himantura uarnak) (Manjaji Matsumoto et al., 2016).

The others are classified as Near Threatened (i.e.: spotted eagle ray (*Aetobatus narinari*), Kyne et al, 2006; bluespotted ray (*Taeniura lymma*); Compagno, 2009) or Data Deficient (i.e.: bluespotted sting ray (*Neotrygon kuhlii*), Kyne and Finucci, 2018; blackspotted torpedo (*Torpedo fuscomaculata*), Pheena, 2004; Gulf torpedo (*Torpedo sinuspersici*), Smale, 2006).

The narrow sawfish (*Anoxypristis cuspidata*), which is listed as Endangered by the IUCN (D'Anastasi et al., 2013), and appears in Appendix I of the CITES, is found in Ungwana Bay and the lower reaches of the Tana River where it thrives on shallow muddy habitats. In this area, other important sawfish species are thought to be present including the Critically Endangered *Pristis pectinata* (smalltooth sawfish), *Pristis pristis* (largetooth sawfish), *Pristis zijsron* (green sawfish) (Samoilys et al., 2011), but the presence of these species in the Lamu Archipelago is unknown (Samoilys et al., 2011).

Osuka et al. (2016) recorded 189 species belonging to 19 families of fish associated with coral reefs in the Pate Island and Kiunga Area. These numbers are considered low in comparison with southern reefs, but are expected for these northernmost reefs. The biomass of fish recorded during that 2016 survey was lower than that recorded in 2008 (Osuka et al., 2016). The most abundant species of fish associated with coral reefs in the AoI is the parrotfish (Scaridae), followed by the surgeonfish (Acanthuridae). Other types of fish found were rabbitfishes (Siganidae), sweetlips (Haemulidae), emperors (Pomacanthidae), snappers (Lutjanidae), angelfishes (Pomacanthidae), goatfishes (Mullidae), groupers (Serranidae), butterflyfishes (Chaetodontidae), wrasses (Labridae) and triggerfishes (Balistidae) (Ministry of Transport, 2013; Amu Power 2016). Most of the fish were recorded in the channel between Manda Island and Pate Island.

The main types of fish caught in the Lamu archipelago are reef, seagrass and sand-associated demersal species, such as scarids (parrotfish), scavengers (lethrinids, lutjanids, haemulids) and signanids. In addition, pelagic fish species, such as cavallies, jacks, mackerel, barracuda, kingfish, tuna, sharks and rays are also caught in large quantities (Murage, undated).

Other fish species of conservation concern found in the seascape include the Endangered Napoleon wrasse (or humphead wrasse) (*Cheilinus undulatus*) (Russell, 2004); the endemic angelfish of the Red Sea/Gulf of Aden, (*Apolemichthys xanthotis*); and the brown-marbled grouper (*Epinephelus fuscoguttatus*) (Ministry of Transport, 2013; Samoilys et al., 2011; Osuka et al., 2016). Samoylis et al., (2011) recorded three juvenile females of Napoleon wrasse on the deeper slope at Pazarli reef, which is located south-east of Pate Island. This sighting, supported by the observation of another juvenile during the port ESIA survey (Ministry of Transport, 2013), could be indicative of a spawning aggregation of the Napoleon wrasse in this area, in particular near the Pazarli reef (Samoylis et al., 2011). Benthic Habitats

The AoI is characterised by the presence of three types of benthic habitats:

- Coral reefs: typically, these are fringing coral reefs but also occur as patch reefs (Osuka et al., 2016).
- Seagrasses: which grow mostly on sandy to sandy-muddy sediments from the intertidal zone down to a depth of 20 m or more (Tychsen, 2006); and
- Soft bottom sediment: which occur from the surface to the deepest zones (50 to 60 m at the centre of the channel);

Myriads of algae, invertebrates and fish' including threatened species, inhabit these habitats, and are discussed in this section.

4.6.3.1 Benthic Habitat Map

A habitat map has been developed to define the spatial distribution of the main benthic habitats in the AoI, and is presented in Figure 9. It was created in GIS using the available information on benthic habitat distribution, as described in the following sub-sections and summarised below:

- Coral reefs distribution map for Kenyan coasts produced by: UNDP, KMFRI, and Geological Survey of Denmark and Greenland (GEUS) (2006);
- Global coral reefs distribution map gridded at 500 m resolution compiled by Institute for Marine Remote Sensing, University of South Florida (IMaRS/USF), Institut de Recherche pour le Développement (IRD), UNEP-WCMC, The WorldFish Center, and WRI (2011);
- Map of the distribution of coral reefs and mangroves in the area of Pate and Lamu islands and the Kiunga Marine Reserve as reported in Obura et al. (2012);
- Map of the distribution of coral reefs and mangroves compiled by WWF-East Africa Regional Programme Office as reported by Samoilys and Kanyange (2008); and
- Database of seagrasses distribution available at RCMRD (2015): only the category "*Submerged Vegetation*" was also considered.

In some sections of the map the coral distribution is not precise, as witnessed by the overlapping with some areas of mangroves, recognisable in the satellite orthophoto. This limitation is due to differences in the scale and gridding levels of the available database. Other sections of the AoI do not have enough data regarding the benthic composition, are not categorised,.

4.6.3.2 Coral reefs

In Kenyan coastal waters, coral reef habitats occur from the surface to a depth of 20 – 25 m (Tychsen, 2006), and cover an estimated area of 624.55 km^2 (Osuka et al., 2016). In the AoI and seascape, fringing coral reefs are present to the south-east of Manda Island, south-west of Pate Island, on the peninsula between Mongoni and Dodori creeks, and along the nearshore zone of Kiunga. A small coral reef was located in the footprint of the port, but it is likely that it has already been adversely impacted by construction activities (based on recent satellite imagery, January 2019) as addressed in the port ESIA Report (Ministry for Transport, 2013).

The richness of corals around Pate is low, with 157 species assessed by Obura (2008). These reefs have been described as a mixture of species from the Arabian Sea, Red Sea and southern zones of Africa (for example, the Mozambique Channel) (Obura et al., 2012). This low species richness is suggested to be due to the remoteness of this zone from the known hotspot of coral biodiversity (that is, 10°S), the poorer environmental conditions due to the influence of the Somali current (Obura et al., 2008), and the sediment discharge of rivers, which are particularly abundant along this part of the Kenyan coast (Tychsen, 2006).

In 1998, an El Niño event caused an anomalous increase in water temperature in the Indo-Pacific Ocean, which led to a mass mortality event among corals and other species (Obura et al., 2008). Nearly 90% of the corals on the Kenyan coasts died during this event, and they seem not to have totally recovered. In fact, the remoteness of these coral zones, and the slow growth of those species, make the recovery harder (Tychsen, 2006; Obura et al, 2008; Samoilys et al., 2011; Obura et al., 2012). Coral reefs in the KNMR, north-east to the Lamu archipelago, near the Somali border, suffered nearly a 60% loss of coral cover due to both the 1998 El Niño event and an algal bloom in 2002, which affected these reefs and the associated fish fauna (Church and Obura, 2006).

Coral reefs in this far northern region of Kenya have a unique mix of species from the Red Sea/Arabian Gulf, which are not found further south. They can contain coral genera that are rare in Kenya and endemic to East Africa or northern West Indian Ocean/Arabia region. Species that have been noted by local research in this regard include *Horastrea indica*, *Siderastrea savignyana*, *Caulastrea connata* and *Moseleya* species (Church and Obura, 2006; Samoilys et al., 2011; Osuka et al., 2016). Other unique coral species that are present in the northern reef system include the north-west Indian Ocean, Red Sea and the Gulf of Aden species *Porites nodifera*, *P. columnaris*; and *Coscinaraea columna*; *Pachyseris rugosa*, *Turbinaria reniformis*, *T. mesenterina*, *T. peltata*, *T. stellulata*, *Catalaphyllia jardinei* and *Physogyra lichtensteini*, which although present in this area, have a broader range (Obura, 2008; Osuka et al., 2016).

Samoilys et al. (2011) found large massive *Porites* spp., and a bank of *Goniopora* sp., in a survey in northern Kenya. More recently, Osuka et al. (2016) and the Ministry of Transport (2013) have conducted rapid surveys in the Lamu-Kiunga seascape, including the AoI, which showed a low coverage of corals (25% to 35%), with a dominance of *Porites* spp. and the presence of 15 other genera (mainly *Favites, Goniastera, Coscinaraea* and *Favia*). Osuka et al. (2016) recorded the presence of *Horastrea indica*, *Turbinaria mesenterina*, *T. peltata*, T. stellulata. The Ministry of Transport (2013) identified both *Turbinaria* spp. and *Horastrea* spp.

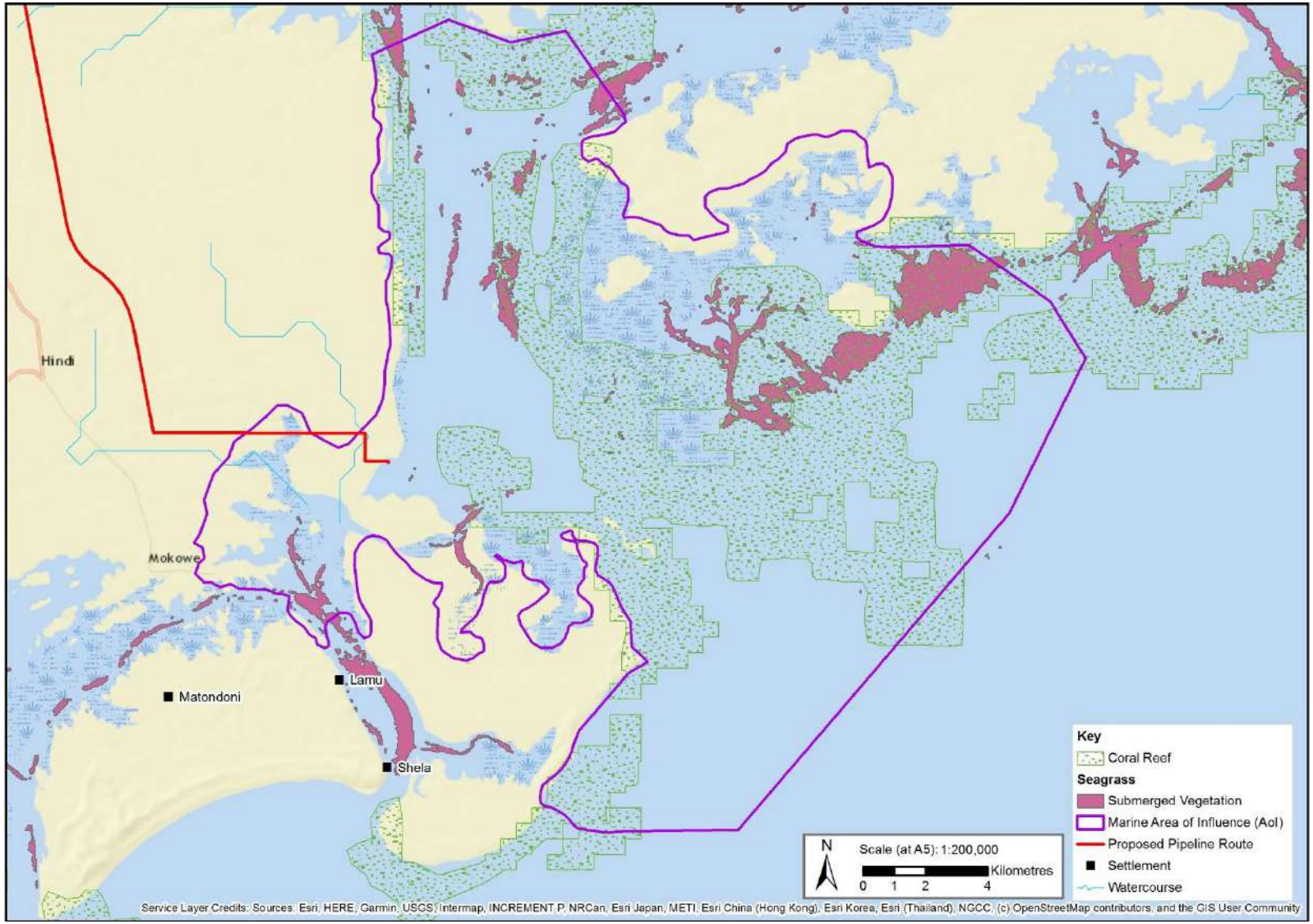

Figure 9: Benthic habitat distribution within and adjacent to the AoI (Elaborated by Golder GIS analyst based on UNDP, 2006; Samoilys and Kanyange, 2008; Institute for Marine Remote Sensing et al., 2011; Obura et al., 2012; RCMRD, 2015)

Amu Power (2016) assessed the habitats in Manda Bay, and reported coral reefs in the deeper sections (20 – 25 m) where the Wange Creek meets the bay. These reefs, which occupied between 10% to 30% of the sea bottom, were of the inner type, fringed in patchy communities in the sheltered sections of the bay. Besides the genera already identified in the previous surveys, Amu Power (2016) recorded *Horastrea indica*, a critical habitat trigger species.

The percentage of cover, and the number of colonies of corals within the AoI, are listed in the port ESIA (Ministry of Transport, 2013). This represents the baseline before port construction activities were started. Hard corals were the second most abundant benthic habitat, both in the zone near Lamu Port and the channel of Manda Bay, with 26% cover in the channel and 35% near the berth area. Within the coral genera, massive *Porites* spp. was most abundant, both in terms of coverage area and the number of colonies, and it was present both in the Manda channel and berth areas. Surveys identified a greater number of colonies and species richness in the channel area in comparison to the port footprint area.

4.6.3.3 Seagrass beds

Seagrass beds are considered to be among the most threatened ecosystems on earth, and they are of high biodiversity value due to the important ecosystem functions they provide for marine animals such as fish, sea turtles and dugong (including spawning, nursery and foraging). The dominant species across the seascape, including the AoI, is *Thallasodendron ciliatum* (Church and Obura, 2006), which is also found near coral reefs (Samoilys et al., 2011). *Syringodium isoetifolium*, *Cymodocea serrulata*, *C. rotundata*, *Halodule wrightii*, *H. uninervis*, *Enhalus acroroides* and *Zostera capansis* are also present (Samoilys et al., 2011; Osuka et al., 2016).

During the port EISA studies (Ministry of Transport, 2013) seagrass sampling was conducted and, in addition to the aforementioned species, *Halophila ovalis* and *H. stipulacea* were recorded. The most abundant species was *Syringodium isoetifolium* (Ministry of Transport, 2013). In addition, Amu Power (2016) recorded *Thalassia hemprichii* (common in shallow water next to mangroves) and *Ruppia maritima*. The most abundant species were *Halodule wrightii* and *Cymodocea rotunda* (on the high intertidal zone), followed by *Thalassia hemprichii* (common in shallow waters, next to mangroves), *Enhalus acoroides*, *Thalasondedron ciliatum*, *Halophila* spp and *Syringondium isoetifolium* (in the shallow to medium-deep waters in coral reef zones).

4.6.3.4 Soft bottoms

Sandy sub-tidal habitats dominate the shoreline from Malindi to Lamu. These areas are supplied with sediment from the Tana and Sabaki Rivers to the south, and extensive creek systems to the north. Kenya's soft-substrate communities are not well known but support significant shrimp and bottom fish populations. There is an active trawling industry exploiting these habitats (Government of Kenya, 2009).

According to Amu Power (2016), in the area where the Wange Creek meets Manda Bay (i.e. the northern limit of the AoI), soft bottoms were found at all depths. In shallow water (0 to 3 m) they were within the mangroves; then from 3 to 9 m they are found within seagrasses and seaweeds; from this depth there is a transition zone consisting of patches of sandy bottom, seagrass and coral reef; finally, at greater depths (up to 20 to 25 m) coral reefs predominate with some patches of sandy-muddy bottoms.

4.6.3.5 Algae

Algae in the AoI and seascape are frequently found in association with coral reefs and seagrasses. Turf algae is dominant in coral areas with coverage of up to 55% (Ministry of Transport, 2013; Osuka et al., 2016). According to available Lamu Port ESIA data, filamentous macroalgal cover in reef areas is relatively low, particularly in comparison to previous surveys (Samoilys et al., 2011; Osuka et al., 2016; Ministry of Transport, 2013). The visual census surveys undertaken within and near to the port area identified 16 species. *Halimeda* sp. was the dominant species (Ministry of Transport, 2013). Coralline algal coverage was also low (Ministry of

Transport, 2013; Osuka et al., 2016). Samoilys et al. (2011) recorded dead corals overgrown by brown algae (*Sargassum* sp., *Turbinaria* sp. and *Hormophysa cuneiformis*).

4.6.4 Benthic macrofauna

The Ministry of Transport (2013) collected sediment samples at four stations within and near to port site for infauna analysis. In addition, an underwater visual census of the seabed was undertaken within and near to the site. Twenty-one taxa comprising 116 benthic species were identified. These included: Amphipoda, Bivalvia, Ciliophora, Cnidaria, Copepoda, Cumacea, Gastropoda, Insecta, Isopoda, Loricifera, Mollusca, Nematoda, Oligochaeta, Opisthobranchia, Ostracoda, Polychaeta, Priapulida, Spincula, Tanaidacea and Thecata, Turbellaria (lower taxonomic levels were not presented in the reference: Ministry of transport, 2013). The taxon Gastropoda, comprising 13 species, was the most abundant, followed by Tanaidacea, Oligochaeta, Nematoda, Ostracoda, Amphipoda and Polychaeta. The least abundant were, in order of increasing occurence, Thecata, Loricifera, Cnidaria, Opisthobranchia and Insecta (Ministry of Transport, 2013).

The dominant species of invertebrates associated with coral reefs recorded by the Ministry of Transport (2013) were sea urchins, belonging to the genus *Diadema*. The high occurrence of sea urchins was often associated with coral degradation. In fact, species of sea urchins of the Kenyan coasts (for example, *Echinothrix diadema*, *Diadema setosum*, *D. savignyi* and *Echinometra mathaei*) have an important role in the carbon cycle and reef development, but overexploitation and removal of finfishes can affect these ecological processes (McClanahan and Shafir, 1990; Carreiro-Silva and McClanahan, 2001).

Four species of Holothurians are likely to be present in the Manda Bay area, typically associated with both soft and hard bottoms. These include the IUCN-classified Endangered species: golden sandfish (*Holothuria lessoni* and *Holothuria scab*ra), Black Teatfish *(Holothuria nobilis*) and prickly redfish (*Thelenota ananas*). All of these are commercially fished (Ministry of Transport, 2013).

Some information is available for crustaceans from the fishery industry. The most common shrimp species fished in the Lamu area are the giant tiger shrimp (*Penaeus monodon*) and Indian banana shrimp (*P. indicus*). They are caught in the zone within the Ndununi and Dodori creeks (Ministry of Transport, 2013). The Ndununi area corresponds to the area where Lamu port is being built; it was previously an important fishing area for shrimps (Ministry of Transport, 2013), but it is likely that it has already been affected by port construction.

Other crustaceans fished in the Manda Bay are crabs, in the mangroves, and spiny lobsters (*Panulirus ornatus*, *P. longipes* and *P. homarus*), which thrive in the crevices of reefs and rocky bottoms (Ministry of Transport, 2013).

4.6.5 Mangroves

4.6.5.1 Pre-existing Information

Mangroves are coastal ecosystems occurring in sheltered intertidal zones of tropical and subtropical regions of the world. They are mainly composed by tree and shrub species possessing adaptations to: living in an unstable soil; coping with frequent submersion and low oxygen levels in the soil; and dealing with high levels of salinity in the water. Associated with the plants are resident fauna (for example, crabs and snails), equally adapted to the niche environmental conditions observed in the mangroves, and non-resident fauna (for example, fishes, birds and mammals) which are also considered part of the ecosystem.

The AoI is located within the East Africa Mangroves Global 200 ecoregion. The Global 200 provides a list of 238 ecoregions that have been selected by WWF as forming the "*world's most unique, irreplaceable and biologically diverse regions.*" This ecoregion is defined by WWF as being critical or endangered (Olson and Dinerstein, 2002) and it encompasses an extensive coastal in Mozambique, Tanzania, Kenya and Somalia. Over 60% of Kenya's mangrove forest is located in the Lamu-Kiunga seascape (Osuka et al., 2016) and these

mangrove habitats are therefore considered to be important at a local, regional, national and ecoregion level. As a result, they could be classed as critical habitat.

Mangrove forests along the Kenyan coast cover approximately 61,271 ha (Government of Kenya, 2017a). The country has lost about 20% of its original mangrove cover (Government of Kenya, 2017b), which represents about 450 ha (0.7%) loss and degradation of mangrove cover per year. This is close to the mean global rate of mangrove deforestation (1%/year) (FAO, 2003).

The AoI is located on a sheltered coastline, with dense mangrove coverage within a continuous mangrove system that forms a key biological component of the coastal and marine Lamu-Kiunga landscape and seascape (Figure 10). Other important mangrove regions in Kenya include Tana, Mida Creek, Kilifi, Mombasa and Gazi-Vanga (Murage, undated). Over 60% of Kenya's mangrove forest coverage is located in this Lamu-Kiunga area, covering an area of 37,350 ha (Osuka et al., 2016; Government of Kenya, 2017a). There is high connectivity between the Lamu-Kiunga mangrove belt and the nearby coral reefs and seagrasses, facilitating the use of mangroves as nursery grounds by fish species.

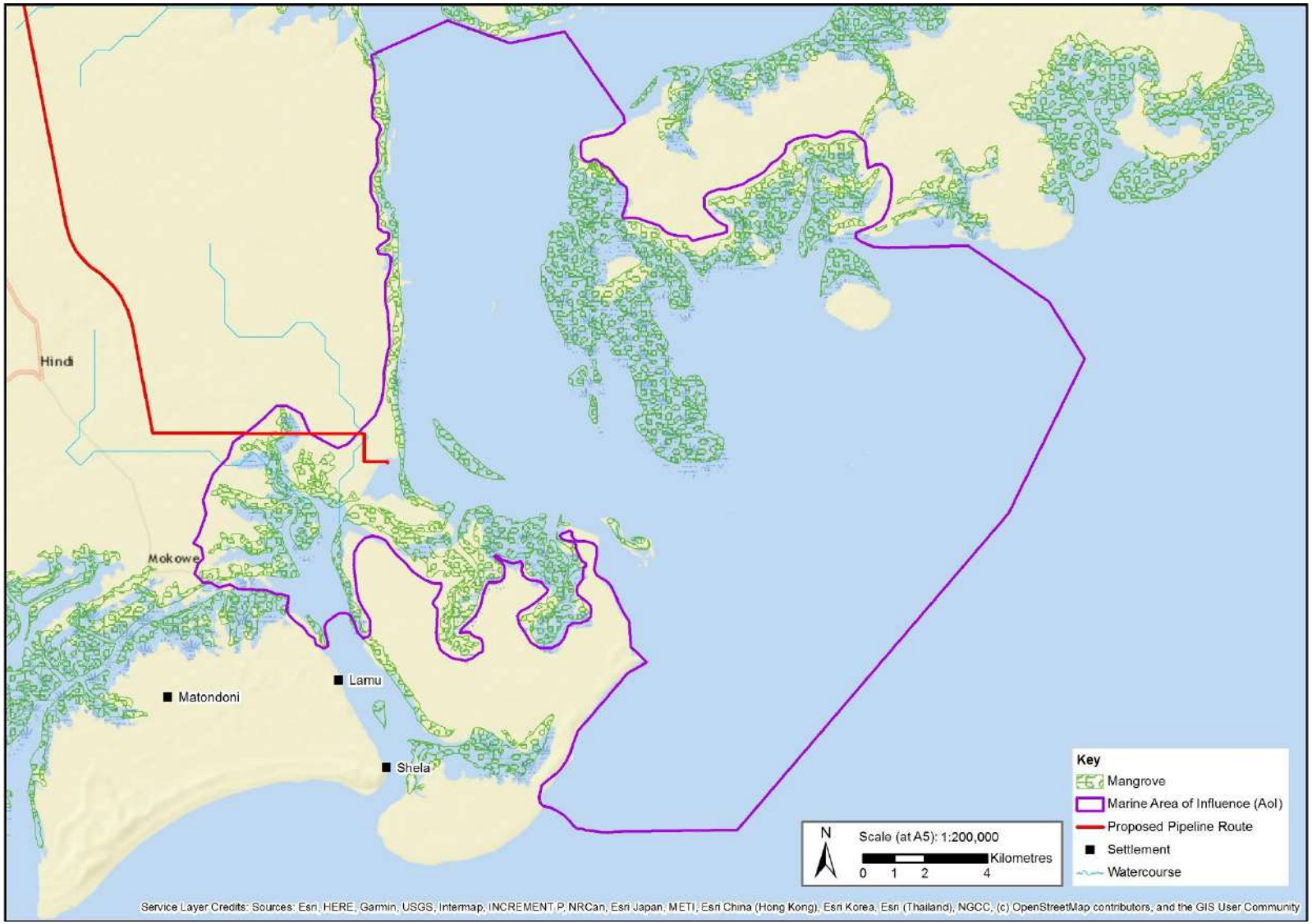

Figure 10: Mangrove cover within and adjacent to the AoI (source: RCMRD, undated)

Mangroves provide important ecosystem function (e.g. nursery, spawning, foraging) for a wide range of marine fauna, including sea turtles, fishes, crustacea and marine mammals, and they are also important for birds. Mangroves also provide ecosystem service functions that are exploited by local communities, including fisheries, other foods, fuelwood, building poles, charcoal, shoreline protection, medicines and cultural services (e.g. sacred sites) (Ministry of Transport, 2013; Murage, undated; Government of Kenya, 2017). They also provide coastal protection from erosion and sea inundation (UNEP-WCMC, 2006).

In the Lamu-Kiunga area, over-exploitation of mangrove of fuel wood for lime making has created open areas with no natural regeneration. The mangroves in some parts of the Lamu-Kiunga area have also been impacted by natural events such as the El Nino rains in 1997-1998, from which some areas still have not recovered.

According to Government of Kenya (2017a) mangroves were declared government reserve forests by Proclamation No. 44 of 30th April 1932, and later by Legal Notice No. 174 of 20th May 1964. Under the "*Gazette Notification for Mangrove Forests in Kenya*", all land between the high- and low-water marks (ordinary spring tides) are described as mangrove areas.

The total area of mangroves inside the AoI is 5,967 ha. This area includes the Pate Island Swamp unit, the largest in the Lamu-Kiunga area. Behind the mangrove forests, in the high intertidal zones, extensive non-vegetated tidal flats which resemble salt flats (or hypersaline flats) occur. These are a natural feature of the mangrove ecosystem formed by very low tidal frequency and long-lasting water deficit conditions (that is, levels of evapotranspiration that are higher than precipitation). Salt flats are considered to be buffer zones for mangrove forest migration in response to climate change and, in some cases, are known to export large amounts of nitrogen sequestered by cyanobacteria to the forest. However, classification of the above-mentioned tidal flats as salt flats (and thus a feature of the ecosystem) is yet to be confirmed in the field.

Eight mangrove tree species occur in the Lamu-Kiunga estuarine complex: grey mangrove (*Avicennia marina*), black mangrove (*Bruguiera gymnorrhiza*), red mangrove (*Rhizophora mucronate*), spurred mangrove (*Ceriops tagal*), *Lumnitzera racemose*, *Soneratia alba*, *Xylocarpus granatum* and *Xylocarpus mollucensis* (Government of Kenya, 2017a). The dominant species in the AoI are *Rhizophora mucronata*, *Ceriops tagal*, *Sonneratia alba* and *Avicennia marina* (Ministry of Transport, 2013; Osuka et al., 2016).

Mangroves of Kenya display a typical zonation of species that is greatly influenced by tidal frequency, geomorphology, and salinity (Government of Kenya, 2017a). A typical zonation of mangrove in Kenya starts with *Sonneratia alba* on the seaward margin, followed by large trees of *Avicennia marina* and *Rhizophora mucronata*. In the creeks, a *Rhizophora-Avicennia* mix is dominant. *Avicennia* is found mostly on the landward side, but can also be found in seaward areas.

4.6.5.2 ESIA Survey

Field surveys of mangrove areas within the AoI were completed between 12 and 16 November 2018. The methods for the survey are presented in Volume III. In summary, mangrove structure was characterised through measurement of plots and visual description along 18 transects marked from the lower to the higher tidal zone of the forests in order to capture the structural variability related to tidal flooding frequency (Figure 11). Forest structure was characterised in the fringe forests of 12 transects. Five were located within the area that may be affected in the footprint (that is, MS1, MS 2A, MS 2B MS3 and MS4), where potential impacts to the mangroves might occur. The other seven transects (MS5A, MS5B, MS7, MS10, and MS11 MS12A, MS12B) were located to gain a general characterisation of the mangroves in the AoI which could be affected by an unplanned event. Soil samples were also collected in transects for particle size analysis.

Across all sampling sites, 336 trees were recorded, which comprised the five typical species: *Ceriops tagal*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, *Avicennia marina* and *Soneratia alba*. In terms of relative species dominance (as a percentage of basal area), *R. mucronata* was dominant in most of the transects. Other species identified in Lamu in previous studies (Government of Kenya, 2017), but not encountered in this study, include *Xylocarpus granatum, Xylocarpusza mollucensis* and *Lumnitzera racemosa*. Mangroves in the area surveyed exhibited a degree of zonation in some locations, with *S. alba* being the most outward (i.e. seaward) species, followed by *C. tagal*, *R. mucronata*, *B. gymnorrhiza* and finally dwarf/shrubby *A. marina* towards the landward side of the mangrove belt. This zonation, however, was not observed in the relatively narrow belts of mangrove where it was contiguous with terrestrial forest. This pattern of species zonation acacords with previous assessments carried out in the region (Ministry of Transport, 2013; GOK, 2017).

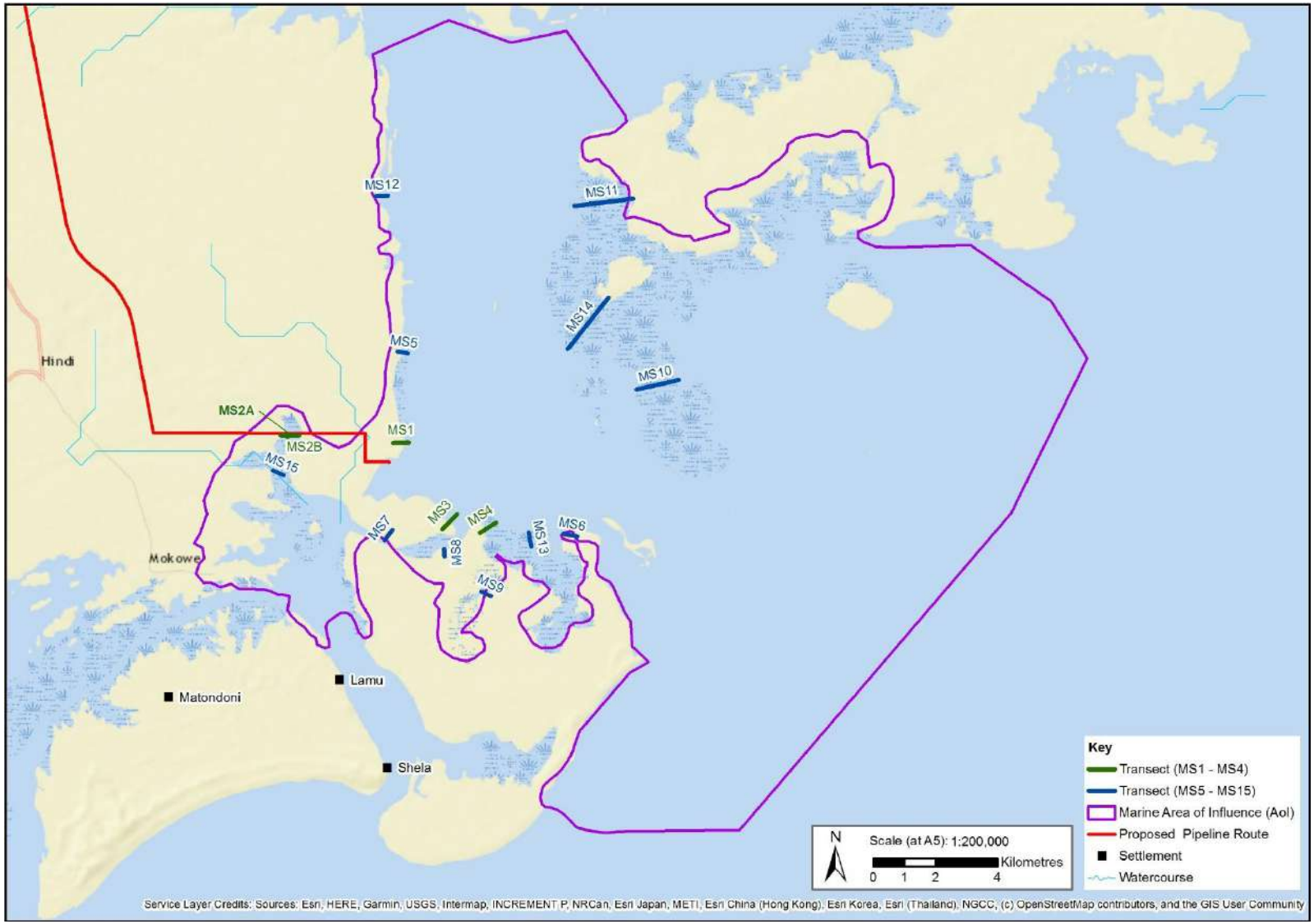

Figure 11: Mangrove transect location

Plots MS2A and MS2B are located in an area that may be affected by the footprint of the Project. Plot MS2A was dominated by shrubby and dwarfed *Avicennia marina*, and plot MS2B was more mixed, comprising *Rizophora mucroanata* and *Ceriops tagal*. Most surveyed areas show relatively low species diversity with plots MS5b and MS7 being most mixed. The total biomass (kg/plot) was lowest at plot MS1 followed by MS4, MS2A, MS2B and MS12A.

Other surveyed areas showed much greater biomass. In general, the species closer to the sea were structurally better developed in terms of stem diameter, tree height and density. The transect showing the highest tree density was MS1; it decreased across plots MS2A, MS2B and MS3, with the lowest density being recorded in plot MS4. Regarding plots outside the Project footprint, high tree density was observed in plots MS5B, MS7 and MS12, with a lower density recorded in plot MS10. *Rhizophora mucronata* and *Avicennia marina* species were found to have a high basal area in transects MS1, MS2A and MS2B and MS4, implying that they are relatively well developed in these areas.

There were few observations of cut stumps at the plots, indicating little or no wood extraction by local communities in the area. The few recordings of cut stumps were in plots MS7 (6 cuts), and MS8, MS13 and MS15 (all 1 cut). Natural die backs were also recorded and observed in plot MS2A (four dead stumps), and in plots MS9 and MS13 (one dead stump).

The non-forested areas were largely comprised of sandy beaches, mudflats, which transformed to sand flats, and, finally rangelands and agricultural fields furthest from the sea. Fauna observed in the mangrove zone consisted mainly of mollusc species: oysters, such as *Brachydontes* spp.; and crabs, such as *Scylla serrata*, *Uca* spp. and *Sesarmidae* species.

Sand dominated the soil composition in all sampling stations, except one where silt composition was comparatively higher. High sand content in the mangrove soils could indicate higher sensitivity to oil spill events, since the oil tends to percolate deeper in sandy soils, leading to more effects over the plants.

4.6.6 Plankton

Plankton data are scarce for the AoI and seascape. The most recent survey was conducted as part of the port ESIA (Ministry of Transport, 2013) in which 41 taxa of phytoplankton and 18 of zooplankton (including 48 sub-taxa) were observed across four sampling sites. Planktonic fish eggs and larvae were also found, with a mean density of 427.5 ± 220.04 m^3. Tintinnida and Brachyura (which comprises planktonic stages of commercially important mangrove crabs) were the most abundant groups of zooplankton, while Copepods were the group with most species. *Coelosphaerium* sp. was the taxon with the highest density in the phytoplankton (454,166 ± 227,083 cells/l).

Surveys done in the North Kenya Banks, which are located near Lamu, showed this area to have aricher plankton component by comparison with the remainder of the Tanzania-Kenya coast (Wickstead, 1961). In other parts of Kenya (for example, Malindi Marine Park and Watamu Marine Park), a study on the larval fish component showed higher densities of larvae during the calm North-east Monsoon season compared to the stormy South-east Monsoon (Mwaluma et al., 2009).

4.7 Protected Areas and Relevant Biodiversity Areas

The AoI overlaps one protected area, the Pate Marine Community Conservancy (Figure 12). This area was declared in 2010 and covers 192 km^2 (according to the World Database on Protected Areas). It includes significant areas of mangroves, coral reefs and seagrass beds that are of importance to local artisanal fishery communities. Community Conservancy areas are, according to Kawaka et al. (2015), Protected Coastal Zones defined by the Kenyan Environmental Management and Coordination Act (1999) as protected areas. They are declared by the Minister of the Environment and Forestry, and co-managed by the community NEMA.

The AoI completely overlaps with a portion of the Ecologically or Biologically Significant Area (EBSA) “Lamu-Kiunga Area”. EBSAs are defined by the Convention on Biological Diversity (CBD) and, although they do not have status of protected areas, they are recognised as areas that serve important purposes, supporting healthy functioning of oceans and the many services they provide (https://www.cbd.int/ebsa/about). the Lamu-Kiunga Area is considered part of six priority landscapes involved in the implementation of climate change adaptation components of World Wide Fund for Nature (WWF) programmes, and these contain mangrove and tidal flat habitats recognised as some of the most extensive and species-rich along the entire coast of East Africa. They provide very important value in terms of biodiversity, climate protection (blue carbon), fishery, nature-based tourism and coastal protection (The Clearing-House Mechanism of the Convention on Biological Diversity, 2015).

Other protected or biologically or ecologically important areas within 20 km of the AoI include:

- Dodori National Reserve (IUCN management category II), also an Important Bird and Biodiversity Area (IBA);
- Kiunga Marine National Reserve (IUCN management category VI), alsoan IBA, which has been designated a UNESCO-Man and the Biosphere Reserve;
- Kiunga Marine Conservancy (Community Nature Reserve; not reported in the IUCN management categories); and
- A proposed UNESCO World Heritage Site: Lamu-Kiunga Archipelago.

In addition to the above, the Kweni Locally Managed Marine (LMMA) is located approximately 6 km from Lamu Port to the south of Pate Island. The site lies adjacent to the channel that forms the navigation approaches to the port. It comprises an area of 57.7 ha and includes coral reef, seagrass beds, fish nursery, and foraging habitat for species such as sea turtles and dugong. Samoilys et al. (2011) noted that the protection of areas such as the Kiweni LMMA has improved localised fish stocks. The area also provides wider ecosystem services, including for locally managed eco-tourism (Murage, undated). The Pate Marine Community Conservancy (PMCC) has been established in 2012 to improve the management of LMMAs around Pate Island, including Kweni.

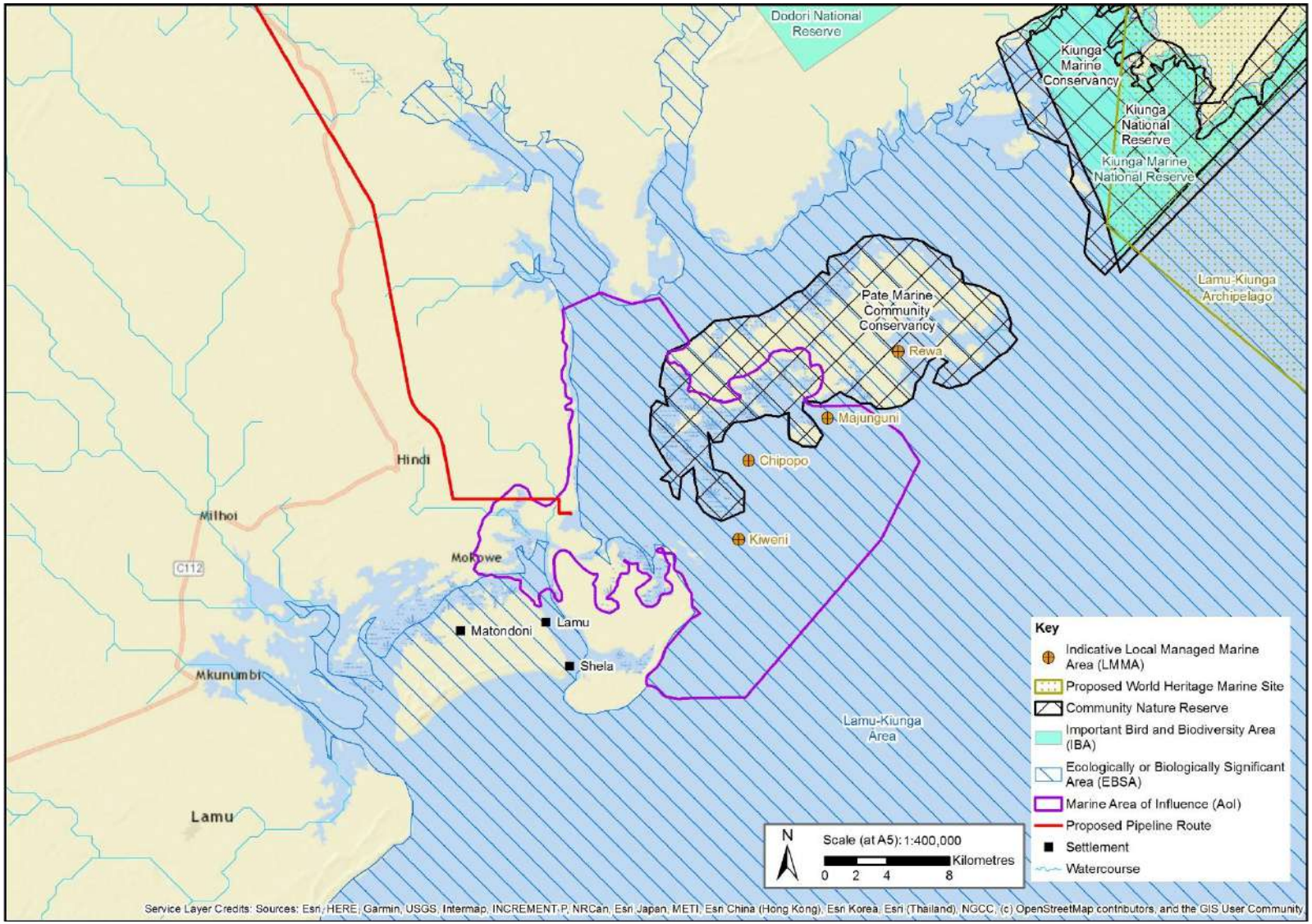

Figure 12: Protected areas, biologically or ecologically significant areas

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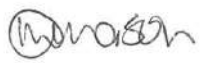

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REPORT

Ecosystem Services Baseline Report

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

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1.0 THE CONCEPT OF ECOSYSTEM SERVICES

Ecosystem services consist of all the natural products and processes that contribute to human well-being, and the personal and social enjoyment derived from nature (Landsberg, *et al*., 2014). They are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems. The benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. The local scale ecosystem services may be the basis for rural livelihoods and subsistence; for example, grasses and shrubland in an otherwise arid landscape are an important grazing resource for livestock, which provides both cash income and food for low-income families. Ecosystem services whose beneficiaries are at the global or regional scale are out of the scope of this assessment.

Ideally, the Project should maintain the value and functionality of priority ecosystem services[1] to those beneficiaries directly dependent upon them, through direct management control.

2.0 ESTABLISHING BASELINE CONDITIONS

2.1 Introduction

Kenyan legislation and policies pertaining to biodiversity conservation and wildlife management do not specifically define what constitutes an ecosystem service; however, ecosystem services are mentioned in the national *Wildlife Policy* in the context of sustainable economic development of the country (Ministry of Forestry and Wildlife, 2012). Ecosystem services are also recognised as features of protected areas that should be conserved (Wildlife Conservation and Management Act, 2013). The *National Biodiversity Strategy and Action Plan* (NBSAP) (Ministry of Environment and Natural Resources, 2000) provides for the conservation and sustainable use of natural resources that provide the basic sources of livelihoods for an estimated 80% of the country's population. These include food, firewood, construction materials, medicines and aesthetics; all of which are ecosystem services.

For the purposes of this assessment, the definitions of ecosystem services are based on those developed by the *Millennium Ecosystem Assessment* (MA, 2005) (Table 1).

Table 1: Ecosystem services categories (MA, 2005)

Broad categories	Definition
Provisioning services	Supporting human needs e.g., traditional hunting grounds, medicinal plants and minerals, water sources, wild foods, firewood, construction materials. These are detailed in.
Cultural services	Aesthetic, spiritual, recreational and other cultural values e.g., sacred sites, traditional meeting areas, traditional knowledge, sense of place. These are detailed in.
Regulating services	Control of the natural environment e.g., maintenance of key ecological processes, groundwater recharge, erosion control, water quality. These are detailed in.
Supporting services	Natural processes essential to resilience and functioning of ecosystems. e.g., primary production, soil formation and conservation, nutrient cycling.

[1] Type I priority ecosystem services are those services upon which the local beneficiaries (including the Project) depend for their livelihoods, health, safety, and/or culture, and which project impacts are most likely to impact; Type II priority ecosystem services are those services upon which the Project is directly dependent or that could prevent the Project from achieving planned operational performance.

The baseline aims to describe the ecosystem services supplied in the Area of Influence (AoI), and the benefits that people get from those services (that is, a qualitative appraisal of demand for the services). It also identifies the services on which the Project will depend for its operational performance. Provisioning and Cultural services are listed County by County whilst supporting and regulating are considered at the Project level.

2.2 Area of Influence

The Lokichar to Lamu Crude Oil Pipeline (LLCOP) spans six counties across Kenya. Communities in the Project's AoI correspond to 49 villages and towns located along the 824 km pipeline route. The Project will primarily affect the people living in these communities and their village and county governments. Information on ecosystem services is presented for the following six counties to add context for the AoI communities: Turkana, Isiolo, Meru, Samburu, Garissa and Lamu.

The communities within the AoI are shown on Figure 1 and are identified as potentially affected by virtue of their proximity to the Project; and their potential to experience direct environmental impacts such as changes to water resources, as well as induced impacts such as disruption to seasonal grazing and pastoral livelihoods.

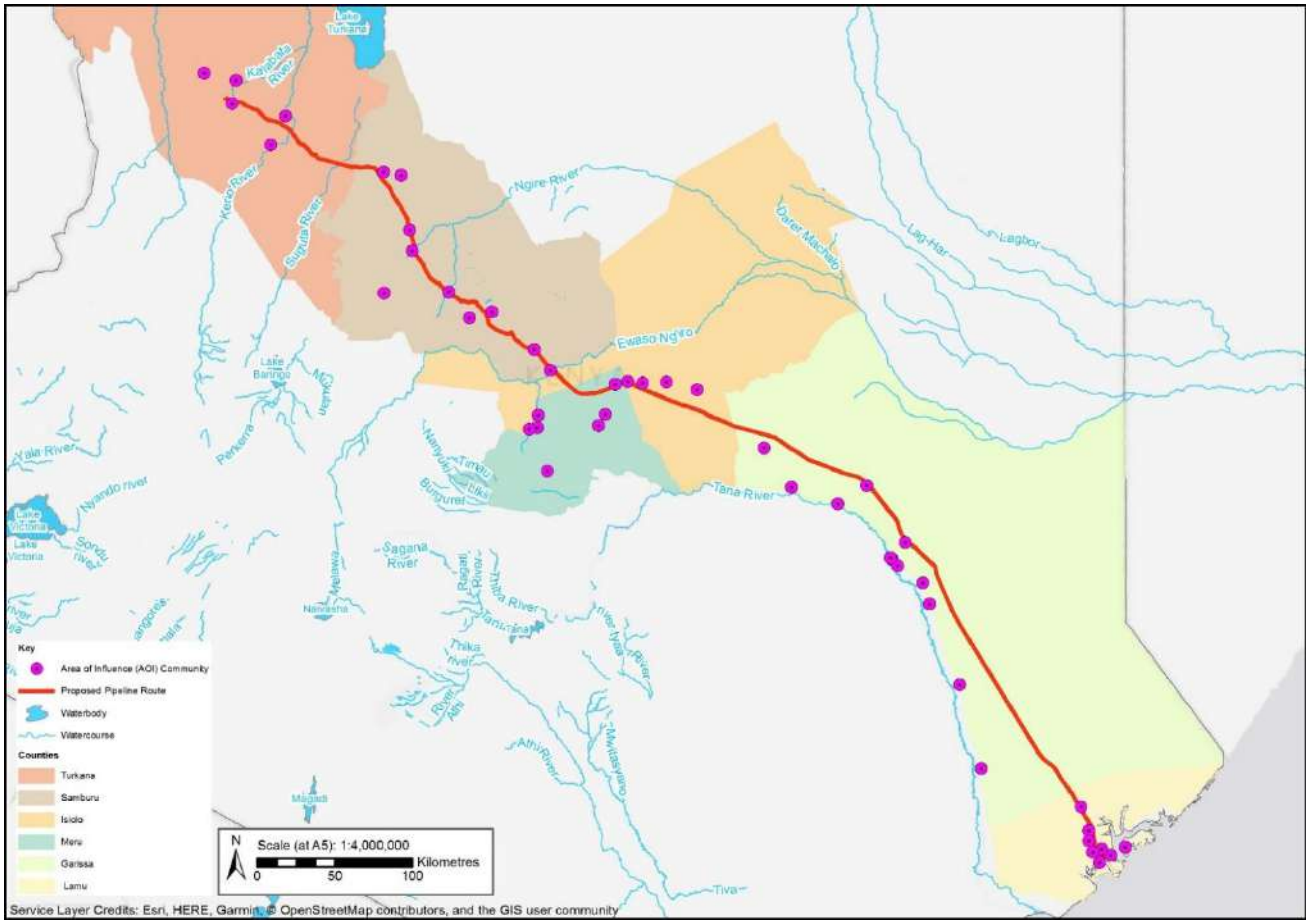

Figure 1: Area of Influence Communities

2.3 Data Collection

Consistent with good practice in ecosystems services assessment, primary data were largely sourced from the social baseline studies presented together with a review of the ecosystem services baseline prepared for the Upstream project (Golder, 2018). Secondary data were gathered from relevant available literature.

Primary data for these baselines were obtained from a variety of biophysical and social surveys and assessments, including Focus Groups and Key Informant Interviews (KIIs).

A summary of focus groups held to inform the social baseline is provided in Table 1. On average groups consisted of seven participants. Participants were given time to comment on the Project and ask questions. Altogether, 1,105 people participated in 161 focus group discussions or interviews. Focus group and interview guides and records can be found in Appendix B of the Social Baseline.

In addition to data gathered as part of the social baseline, one KII held with Elders on 18 May 2017 was specifically focused on identifying ecosystem services in the Upstream project AoI (Turkana). During this KII, the attendees were asked to help populate a detailed inventory of key ecosystem services.

Table 2: Focus Groups and Interviews by Town/Village

County	Town/Village	Focus Groups/Interviews	Total No. of Focus Groups/Interviews	Total No. of Participants
Garissa	Balambala	Local Government, Elders, Youth, Women	4	11
Garissa	Bola Town, Kamuthe	Youth	1	2
Garissa	Bothai	Elders	1	4
Garissa	Bouralgy	Agriculture, Water & Sanitation	2	3
Garissa	Dagoob	Local Government, Elders, Pastoralists, Women	4	11
Garissa	Galbert Township	Local Government	1	1
Garissa	Garissa Town	Education, Water & Sanitation, Women, Youth, Local Government	5	5
Garissa	Kalagosk, Kamuthe	Water & Sanitation	1	1
Garissa	Kamuthe Town	Agriculture, Elders, Pastoralists	3	9
Garissa	Korakora	Elders, Youth, Women, Pastoralists	4	19
Garissa	Mansabubu	Local Government, Education, Elders, Women	4	8
Garissa	Masalani	Bee Keepers, Pastoralists, Women	3	4
Garissa	Masalani, Bulagolol Village	Youth	1	1
Garissa	Modika	Elders, Local Government, Women	3	15
Garissa	Saka	Local Government, Agriculture, Fishers, Pastoralists, Youth	5	26
Garissa	Sankuri	Local Government, Pastoralists, Agriculture	3	6
Garissa	Shimbiri	Women, Youth	2	6

County	Town/Village	Focus Groups/Interviews	Total No. of Focus Groups/Interviews	Total No. of Participants
Isiolo	Boji	Women	1	20
Isiolo	Garba Tula	Elders, Women, Youth	3	36
Isiolo	Isiolo, central	Women, Youth	2	13
Isiolo	Ngara Mara	Elders, Pastoralists, Women, Youth	4	74
Isiolo	Yaq Barsadi	Elders, Women, Youth	3	41
Lamu	Barigoni	Bee Keepers, Elders, Fishers, Women, Youth	5	13
Lamu	Hindi	Business, Elders, Pastoralists, Water & Sanitation, Women	5	8
Lamu	Jipe	Agriculture, Bee Keepers, Education, Elders, Water & Sanitation, Women	6	16
Lamu	Kiliana	Agriculture, Fishers, Women, Youth	4	8
Lamu	Mokowe	Fishers, Pastoralists, Women	3	17
Lamu	Pate	Local Government, Fishers, Women, Disabled, Elders, Youth	6	18
Meru	Kaichuru Village	Agriculture, Elders, Pastoralists, Women, Youth	5	49
Meru	Kandebene	Agriculture & Gender, Elders, Pastoralists, Women	4	57
Meru	Laare Town	Agriculture, Bee Keepers, Elders, Water, Women, Youth	6	72
Meru	Meru Town	Youth	1	1
Meru	Mutuati	Local Government, Elders, Women, Youth	4	49
Samburu	Archers Post	Local Government, Elders Women, Youth	4	35
Samburu	Baragoi	Local Government, Elders, Pastoralists, Women, Youth	5	48
Samburu	Barsaloi	Local Government, Pastoralists, Women, Youth	4	42

County	Town/Village	Focus Groups/Interviews	Total No. of Focus Groups/Interviews	Total No. of Participants
Samburu	Lerata	Local Government, Elders, Women, Youth	4	38
Samburu	Maralal	Education, Youth, Agriculture	3	8
Samburu	Nachola	Local Government, Pastoralists, Women, Youth	4	41
Samburu	Nkaroni	Local Government, Elders, Women, Youth	4	24
Samburu	Suyian	Local Government, Pastoralists, Women, Youth	4	34
Samburu	Swari	Local Government, Elders, Pastoralists, Women, Youth	5	38
Samburu	Wamba	Elders, Women, Youth	3	30
Turkana	Kapalata	Local Government, Elders, Pastoralists	3	42
Turkana	Katilia	Local Government, Elders, Pastoralists	3	25
Turkana	Lokichar	Local Government, Elders, Pastoralists	3	52
Turkana	Lokori	Local Government, Elders, Pastoralists	3	24
TOTAL			**161**	**1,105**

Spatial data were derived from assisted land use mapping, where people identified the spatial distribution of resource use, village infrastructure, travel routes and other valued village attributes relative to the Project alignment. Using base maps developed from satellite imagery, village representatives worked together to map land uses in the area of the Project.

3.0 BASELINE DATA RESULTS

3.1 Turkana County

3.1.1 Background and Economic Base

Turkana County lies within the arid and semi-arid lands region of Kenya, bordered by four counties: Marsabit to the northeast, Samburu to the southeast, and West Pokot and Baringo to the south, as shown in Figure 2. The county also shares international borders with South Sudan to the northwest, Ethiopia to the northeast and Uganda to the west.

The permanent and semi-permanent areas in Turkana County are located along the Turkwel and Kerio rivers where irrigation farming is practiced. Water is accessible in this area and the settlements are close to Lodwar town (Muchoki 2015).

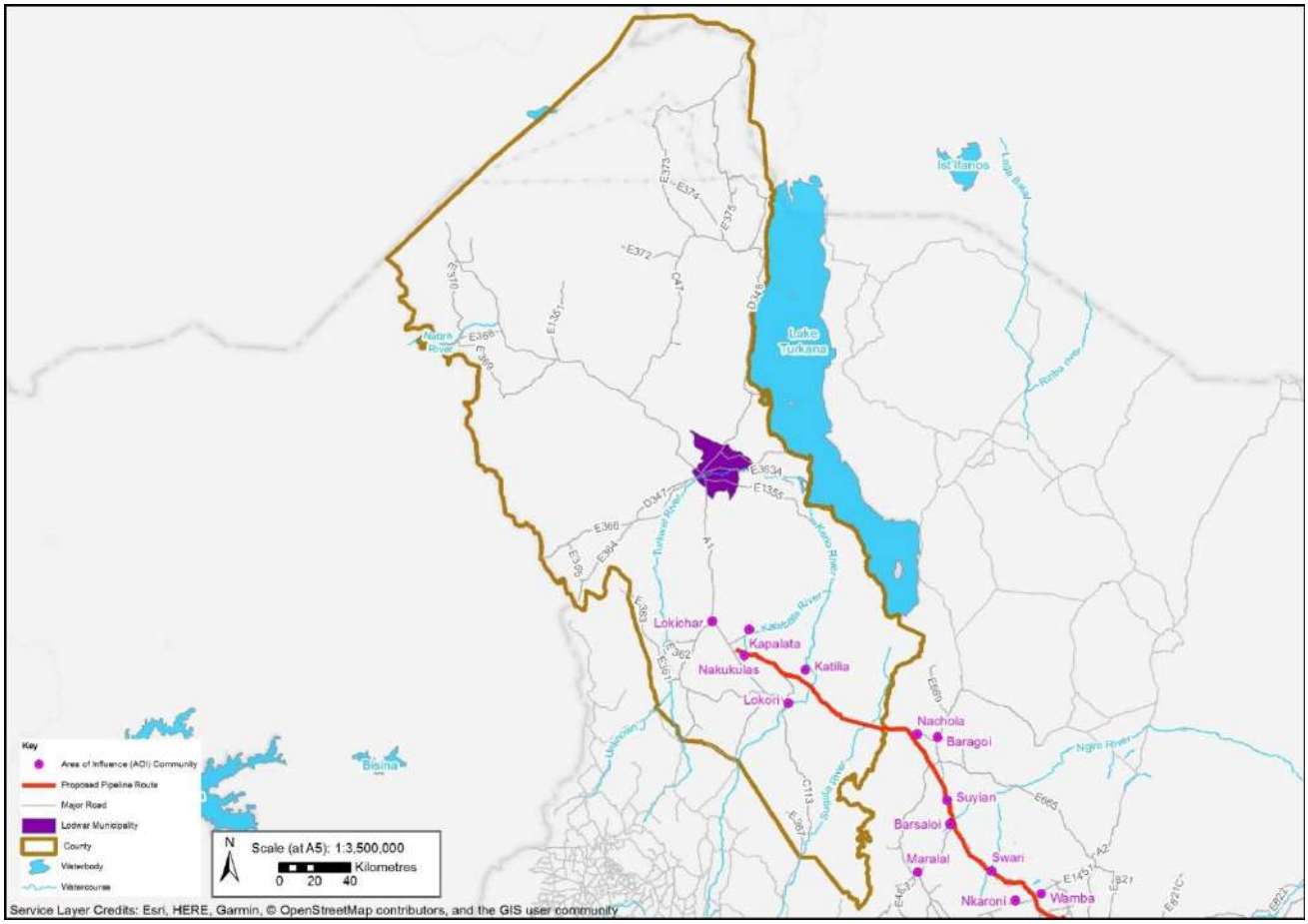

Figure 2: Turkana County

According to the National Drought Management Authority (NDMA), the county has four main livelihood zones. Pastoralism is the main subsistence and economic activity in the county with nearly 60% of the population deriving their livelihood from livestock-based activities (TCH, 2018). The remainder of the county's livelihoods are categorised as 20% agro-pastoral, 12% fisherfolk and 8% in the urban/peri-urban formal and informal employment (TCH, 2018).

Table 3 presents the results of SMART Surveys from 2015-2017 on households' main source of livelihoods. In recent years, livestock herding has remained the primary livelihood at the county level with around a third of all household livelihoods.

Table 3: Main Source of Livelihoods for Households in Turkana County

Main Occupation of Household Head	Turkana South and Turkana East Sub-Counties (%)			Turkana County (%)		
	2015	2016	2017	2015	2016	2017
Livestock herding	22.3	21.8	24.4	27.2	36.1	35.3
Own farm labour	12.4	11.6	12.1	4.6	3.6	4.5

Main Occupation of Household Head	Turkana South and Turkana East Sub-Counties (%)			Turkana County (%)		
	2015	2016	2017	2015	2016	2017
Employed (salaried)	6.1	4.0	2.5	5.1	2.6	1.9
Waged labour (casual)	19.4	16.2	9.5	14.8	10.5	8.7
Petty trade	19.5	17.8	26.5	22.3	14.0	20.2
Merchant/trader	2.4	1.9	3.3	2.7	1.4	1.6
Firewood/charcoal	16.2	23.8	18.3	18.2	21.4	24.1
Fishing	0.0	0.2	0.2	1.5	3.1	1.3
Others	4.5	2.8	3.2	3.7	7.1	2.4

Source: TCH, 2018

The county contains pockets of high potential rangelands which are vital to land use patterns. While the ecosystem is diverse, the marginal environment creates vulnerability in communities' livelihoods strategies. Land users cope by exploiting multiple resources, engaging in multi-species pastoralism, fishing, farming and gathering of wild foods (Muchoki, 2015). Pastoralism is the dominant land use in the county. Other significant land-based livelihoods include small-scale agriculture along the Turkwel and Kerio Rivers and fishing along the western shores of Lake Turkana (Muchoki, 2015).

3.1.2 Provisioning Ecosystem Services

3.1.2.1 Pastoralism

Pastoralism occurs in most parts of the northern and central regions of the County. Livestock sales, self-employment (e.g., bush products, handicrafts, charcoal) and safety nets in the form of cash transfers are the primary income sources in the pastoral livelihood zone.

Most Turkana people practice nomadic transhumance, characterised by flexible social mechanisms such as mobility, communal land ownership, large and diverse herd sizes, and herd separation and splitting (Schilling *et al*., 2012). Livestock, especially cattle, form the core of Turkana culture (Kenya Information Guide, 2015). In the Project area, herds include large numbers of drought-resistant livestock species such as camels and goats, with relatively few cattle (Dyson-Hudson and McCabe, 1983). Average livestock herd size in the Project AoI communities varies and this influences water consumptions requirements. Table 4 presents livestock data in the Project area communities in Turkana County.

Table 4: Livestock Data in Project Area Communities in Turkana County

Community	Animal	Average Household Herd Size	Amount of Water Consumed per Animal	Frequency of Water Consumption
Lokichar	Goats	100-400	10-15 litres	Two Days
	Cows	20-220	100 litres	Two Days
	Donkeys	10-80	100-150 litres	One day

Community	Animal	Average Household Herd Size	Amount of Water Consumed per Animal	Frequency of Water Consumption
	Camels	10-70	10-15 litres	Two Days
Lokori	Goats and Sheep	100-200	7 litres (more during wet season)	Two days
	Donkeys	2-10	40-60 litres	Daily
	Cows	5-10	50-70 litres	Three days
	Camels	10-50	80-100 litres	Seven Days
Kalapata	Shoats (Goats and Sheep)	50-100	20 litres (dry season)	Two days
	Donkeys	5-20	90 litres	Three Days
	Cows	15-40	70 litres	Two days
	Camels	30-100	160 litres (dry season) 60 litres (wet season)	Six Days
Katilia	Shoats (Goats and Sheep)	100-200 goats 50-100 or 200-500 sheep	10-13 litres (dry season)	Not available (n/a)
	Donkeys	20-50	60 litres	Two Days
	Cows	50-150	140 litres	Two days
	Camels	40-100, 70-80, 500-700	100 litres, consuming less during wet season	10 days

Source: Focus Groups, Pastoralists: Lokori, Kalapata, Katilia, January 2019.

Pasture and water resources in the county are characterised by changes in availability from year to year in response to the uncertain rainfall timing and distribution, and so patchy vegetation productivity. As a result, the extent of pastoralists' movement between areas of pastures varies.

Livestock ownership has multiple functions in the lives of the Turkana people, serving as a form of pastoral capital while also functioning as a means of production, storage, transport, and transfer of food and wealth (Schilling *et al*. 2012).

Table 5 presents the herding calendar for pastoralists in Turkana County. The herding calendar experiences seasonal changes due to the irregularity of rainfall. The wet, mid-wet and dry seasons have changed over time. Pastoral movements have become irregular, making grazing patterns difficult to determine.

Table 5: Herding Calendar for Turkana Pasturalists

Month	Turkana Term	Season[(a)]	Activities
January	Lokwang	Dry (*nakamu)*	Long distance herding, water access along the river
February	Lodunge	Dry (*nakamu)*	
March	Lomaruk	Dry (*nakamu)*	
April	Titima	Mid-wet	Migration to pasture areas
May	Elel	Mid-wet	
June	Lochoto	Wet	Migration back to permanent homesteads
July	Losuban	Wet	
August	Lotiak	Mid-wet	Herding, watering, traditional rites, weddings
September	Lolong'u	Mid-Dry	
October	Lopoo	Mid-Dry	n/a
November	Lorara	Dry (*ngirerea*)	Breeding for livestock
December	Lomuk	Dry (*ngirerea*)	

Source: Focus Group, Pastoralists: Lokori, 15 January 2019; Kalapata, 18 January 2019; Katilia, 17 January 2019;

[(a)] *Approximate determination of the type of season varies by Project area community.*

3.1.2.2 Agro-Pastoralism

Agro-pastoralists keep livestock as well as practising small-scale crop farming. The agro-pastoral zone is located along the Turkwel and Kerio Rivers where irrigation schemes allow cultivation of a mix of subsistence crops and small quantities of cash crops (e.g., sorghum, maize, green gram, cowpeas, and vegetables) (FEG, 2016).

3.1.2.3 Fishing

The fishing livelihood zone, along the western shores of Lake Turkana, is where fishing is the main economic activity. Sale of fish, fishing-related casual labour, handicraft sales, petty trading and livestock trading are the main sources of income in this zone (TCH, 2018).

Pastoralists indicated that fishing of tir, loruk, tilapia (Epokot), and catfish (Kopito) occurs along the Kerio River (Focus Group, Pastoralists: Lokori, 15 January 2019; Katilia, 17 January 2019). Fishing also occurs along the Suguta River with fishing of akiragiragiot (no common name), koopito (Nile perch), etiir (Tilapia), naliba (Ningu), loruk (King Fish) and losali (Carp).

3.1.2.4 Water

Turkana County is a water-scarce county that has experienced a general decline in the quantity and quality of water for domestic and productive use. There are two rainy seasons: the long rains occur between March and May and short rains between October and December. Rainfall ranges from 120 to 500 mm per year and is highest at higher altitude in South Turkana. They are, however, erratic and rain sparsely distributed throughout the county, which results in droughts and floods (TCG, 2017).

With the exception of Lake Turkana, few naturally occurring surface water bodies are found in the county due to high evaporation rates during the dry season (TCG, 2017). The main rivers in the county are the Kalapata, Kerio, Malimalite, Tarach, and Turkwel rivers, of which only the Turkwel and Kerio are semi-permanent (UNICEF 2017; Schilling et al. 2012). A network of ephemeral rivers (*luggas* or *laghas)* occurs, and springs are also found across the county, especially in parts of the lake zones and Turkana East.

Without sufficient naturally occurring surface water bodies, the county Government has constructed man-made water bodies across the county such as dams, water pans[2], and sub surface dams (TCG, 2017). The man-made structures are mainly used for domestic and livestock and are especially important during the dry season for livestock.

Excessive grazing pressure in the county can have a deleterious effect on soils, stripping them of the capacity to hold any water as well as increasing rates of erosion and sedimentation (TCG, 2017).

Table 6: Livestock Water Supply for Pastoralists in by Project-Area Communities in Turkana County

Community	Water Supply	Season
Lokichar	■ Water points at Kalapata, Lokichada, Kamanu-Kwee, Kaimegur, and Elelea-Nabolei	Dry
	■ Traditional wells for livestock Kaakali, Kamarese (until it rains) ■ Natural water pans, *Ngataparin,* (Lokulubech, Apa-lolemu and Askim) can hold water for about six months	Wet
	■ Water points Karipun, Kanging'olemogin, Riami-riame, Lokuno	n/a
Lokori	■ Kerio River; ■ Water points at Lohurerei and Lokwamosing ■ Oases at Kaachola, Napeitom, Naskeny, Kanapot, Kangiesei, Kalomesek Sil, and Agolet	Wet and Dry for Oases
Kalapata	■ Kareko, Elelea, Nabolei are the major wells	Mid-Wet
	■ Borehole (Nakiling'a at Loperot) shared by school, community and pastoralists	Dry
	■ Water points at Loturerei, Lokwamosing, Nabolei water well, Kaimegur, and Kaidima ■ Kerio River	n/a
	■ Wells at Lokichada are a central source of water for pastoralists in the different regions of Loperot, Nakukulas, Lokiroe-liwo, Kaching'angar, and Ikalale Akeraan.	n/a
Katilia	■ Wells, springs, boreholes ■ Water catchment (*ngiburin)* and oasis (*ngichwae)* ■ Water (*Eriong'a)* is used on the farms	n/a

Source: Focus Group, Pastoralists: Lokori, 15 January 2019; Kalapata, 18 January 2019; Katilia, 17 January 2019; Lokichar, 19 January 2019;

[2] A water pan is a small reservoir created by excavating open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands

Pastoralists at Lokichar noted that there was insufficient water for livestock and a lack of water points in Kaemomug due to urbanization i.e. development of plots along livestock routes (encroachment) (Focus Group, Pastoralists: Lokichar, 19 January 2019).

3.1.2.5 Other

Other land and resource use focus on forest products, including charcoal, wood carvings, fencing posts, firewood, aloe vera and herbal medicines[3] (TCG, 2013). Although charcoal production is illegal in Turkana County, it offers small returns to those that produce it and is practised along the Turkwel and Kerio Rivers. Wild fruits are sold throughout the county, including Doum Palm, and other fruits known locally as Ngakalalio, Edong, Edapal, and Ebei (Muchoki, 2015). Trade in Prosopis pods around Lodwar and Kakuma is also emerging as an importance source of income.

Honey production is a commercially viable enterprise especially along the Turkwel and Kerio Rivers. Honey production is primarily found in the following areas: Turkwel Division (Turkwel, Kalemunyang and Toyarabon); Katilu Division (Lokapel and Kanaodon); Kainuk Division (Kainuk, Loyapat); and Lokwar, Ekwar, Kaptir, Nakwamuru, Kapelibok and Oropio (Muchoki 2015). Beehives are made from logs cut from special types of trees such as the 'Echoke' (locally known as a sycamore) and the 'Edurukoit' (a type of Acacia).

3.1.3 Cultural Ecosystem Services

Cultural heritage sites are found in the Turkana region in different environments such as open woodland plains, small dry water channels/laggas, river flood plains and rocky and hilly areas. The Lokichar area is especially notable for the dense distribution of sites/occurrences of sites and features.

Sacred or important cultural sites for Project Area communities are presented in Table 7.

Table 7: Sacred or Important Cultural Sites for Project Area Communities

Community	Site Name or Type	Notes
Lokichar	*Ekalale Loa Lotimaan*	■ Sacred trees where people conduct their rites of passage
Katilia	Edoket Angide Akwangorom	■ Trees around here should not be cut
	Akalale	■ Should not be visited by anyone other than authorised person ■ Trees around here should not be cut
	Natural wells at Kanapeot	■ n/a
	Longaada	■ Red ochre found here is harvested for cultural events

Source: Focus Group, Elders: Kalapata, 18 January 2019; Lokichar, 19 January 2019; Katilia, 17 January 2019.

3.2 Samburu County

3.2.1 Background and Economic base

Samburu County lies within the arid and semi-arid lands region of Kenya, shown in Figure 3 (SCG, 2018). It is situated in the northern part of the Great Rift Valley, and bordered by Turkana to the Northwest, Baringo to the south-west, Marsabit to the north-east, Isiolo to the East and Laikipia to the south. The main administrative centres of Samburu are Maralal, Baragoi and Wamba (Insight Guides, 2016).

3 Some of the local herbs used for medicinal purposes include Kutikuti, Ekabonyo, Eogong, and Siir (Focus Group, Lokori Elders, 15 January, 2019). Herbs are mostly found in the forested and hilly areas. Some of the herbs used for medicinal purposes by traditional healers in Lokichar are Echuchuka (Aloe Vera), Emus (traditional herb), Eogong (medicinal herb), Emoronyit (medicinal herb), Esekon (Salrodora Persica), and Eregis (medicinal herb) (Focus Group, Lokichar Elders, 19 January 2019).

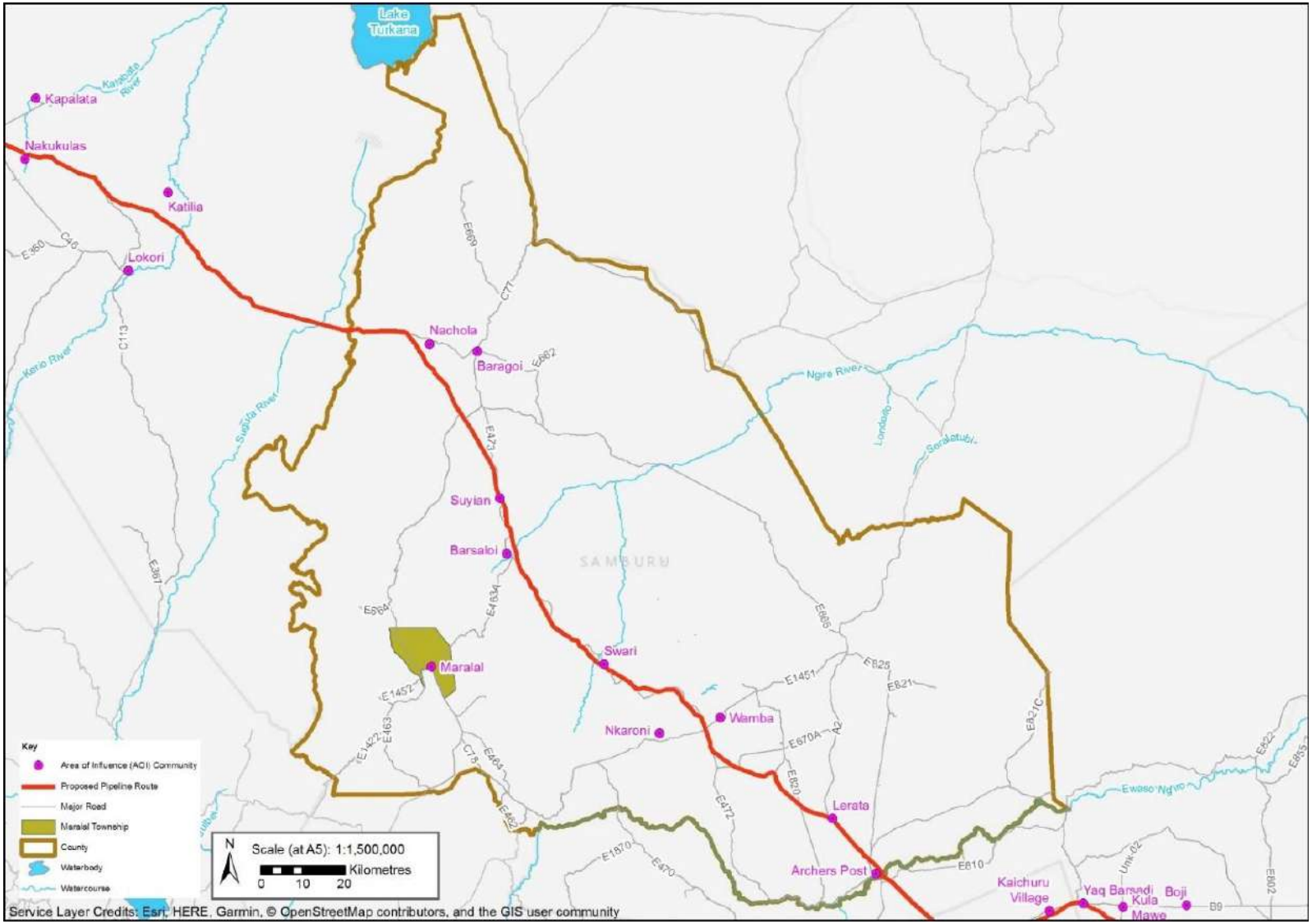

Figure 3: Samburu County

Samburu County includes five ecological zones, including the tropical alpine zone, the upper highlands, the lower highlands, the lower midlands and the lowlands (SCG and WFP 2015). The lowlands cover up to 80% of the county and the land is mainly used as grazing fields for wildlife and livestock by pastoralist communities (SCG and WFP 2015).

The dominant land uses include nomadic pastoralism, wildlife conservation areas such as West Gate, Namunyak, Kalama and Samburu National Reserve, urban development and crop farming (SCG, 2018).

The main economic activities in the AoI communities are livestock rearing, conservancy management, small-scale farming and irrigation, quarry activities and sand harvesting (Focus Groups, Local Government: Archers Post, 19 October 2018; Baragoi, 23 October 2018; Barsaloi, 25 October 2018; Lerata, 29 October 2018; Nachola 22 October 2018; Nkaroni, 27 October 2018; Suyian, 24 October 2018; Swari, 26 October 2018; Appendix B, Social baseline). The communities are also involved in small business initiatives which generate income, such as greenhouses, bee keeping, beading and tree planting, poultry farming and aloe vera harvesting. Other small businesses can include selling firewood, charcoal, manure, milk or liquor, and quarry activities.

3.2.2 Provisioning Ecosystem Services

3.2.2.1 Pastoralism

In 2015, the population of Samburu County was estimated to be 290,000, and the main livelihoods for the population were pastoralistm (56.5%) and agro-pastoralistm (37%) (SCG and WFP 2015). Ninety-two percent of the County land is rangeland suitable for livestock production and supports 202,700 cattle; 622,000 sheep; 714,000 goats; 36,100 camels and 10,000 donkeys (SCG, 2018). The Elders manage the harvesting of *Acacia tortalis* pods and leaves which are used as animal feed.

Herders follow specific grazing routes in search of pasture and water. The average herd size varies based on climate, but in most communities, herd size averages 30 to 40 animals per herder, and up to 100 or more animals for the wealthy. Table 8 shows the average number of animals per herder for Barsaloi, Swari, Suyian, and Baragoi peoples.

Table 8: Average Herd Size

Community	Average Number of Animals per Herder*			
	Goats and sheep	Cows	Camels	Donkeys
Barsaloi	100	50	40	5
Swari	100-200	30-40	30-40	n/a
Suyian	n/a	30	n/a	n/a
Baragoi	n/a	30	n/a	n/a

Source: Focus Groups, Livestock Herders: Barsaloi, 25 October 2018; Swari, 26 October, 2018; Suyian, 24 October 2018; Baragoi, 23 October 2018

**Data were not available for the other communities*

The pastoralists migrate in groups moving with their livestock in search of pasture or water depending on the seasons, and due to security concerns in the area. Table 9 shows a summary of seasonal pastoralist grazing areas, and water sources.

Table 9: Pastoralist Grazing Areas, Homesteads and Travel Routes

Community	Season	Grazing Area	Water Sources
Baragoi	Winter *(Lorikine)*	Sikira	n/a
	Other months	Siap	
	Autumn	Sinkwa	
Barsaloi	short rainy season (October and November)	Barsaloi area	The main source of water is from the Barsaloi River.
	long rainy season (March and April)		
	dry season (January and February)	Marti area (west) Wamba (east) Parts of Marsabit and Isiolo	
	long dry season (May and September)		
Nachola	n/a	Generally located adjacent to the main road, in: ■ Suguta Valley ■ Naturkan ■ Lomirok/Natur	Water for livestock is only available in the Nachola river which is seasonal. There are also dams but there is no water during the dry season.
Suyian	Long rains-*Ltumuren* (October to December)	Graze far from the community due to security concerns. Sunya	The Suyian River is the only source of water.
	Rains-*Lorikine* (June to August)	Sikira Marti	
Swari	Rainy season	Swari area	The only source of water is the Seyia River, and water is available throughout the year.
	Dry season		

Source: Focus Group, Livestock Herders: Baragoi, 23 October 2018; Barsaloi, 25 October 2018; Nachola, 22 October 2018, Suyian, 24 October 2018; Swari, 26 October, 2018.

The livelihoods of pastoralists are under increasing pressure in Samburu County, due to institutional change regulating access to land and a shrinking resource base (Lesorogol, 2017; Pas, 2018). As a result, livestock movements occur over longer periods and greater distances. The rapid growth in the formation of community-based wildlife conservancies that limit livestock access to large areas of pasture and institute new grazing rules has been a major factor in the increased pressure on pastoralist livelihoods. Human population growth, increasing sedenterisation and the consequent growth of towns and other settlements have influenced the landscape for herding. Several grazing areas are no longer used due to the security situation and violent conflict with neighbouring communities; many Samburu herders have moved to neighbouring Laikipia County.

3.2.2.2 Agriculture

Approximately 139,000 ha (8%) of the County is classified as arable land with adequate moisture to support crop farming, of which 28,500 ha is recorded as being under cultivation. Most commercial and subsistence crops in the County are grown in the highland areas of Poro in Kirisia Division due to the fertile soils and adequate rainfall (SCG, 2018; Office of the Controller of Budget, 2018).

The farming seasonal calendar in Samburu County is shown in Table 10.

Table 10: Farming Seasonal Calendar for the AoI communities in Samburu County

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Clearing		-	-	-	-	-	-	-	-	-	-	-
Planting and Weeding	-	-	-		-	-	-	-	-	-		-
Harvesting	-	-	-	-	-	-	-		-	-	-	-

Source: Focus Group, Agriculture: Maralal, 18 October 2018

Rotational planting is practiced allowing manure to accumulate and for soils to become more fertile in between planting. Fertilizers are used for wheat and manure is applied to maize and bean crops.

Farming is challenging in lowland areas where soil quality is poor, there is low rainfall and a shortage of land for farming. The average crop yields and marketing for the Maralal area is presented in Table 11.

Table 11: Average Crop Yields and Marketing for Samburu County

Crop	Yield	Land area (acres)	% sold	Months of sale	Price at harvest (Kenyan Shilling (KSh) per bag)	Price not at harvest (KSh)
Beans	18,000 bags/ 90 kgs	6,000	10	July	5,500	99,000,000
Maize	210,000 bags/ 90 kgs	210	20	August-September	2,400	483,000,000
Wheat	38,500	3,500	95	September	-	-

Source: Focus Group, Agriculture: Maralal, 18 October 2018.

Agricultural activities are constrained by wildlife predation on crops, security concerns, shortages of water, and a lack of agricultural materials (i.e. tanks and troughs).

3.2.2.3 Other

More than half of households use fuel wood as the main source of lighting (61%), and use is even higher in Samburu East (74.2%) and Samburu North (76.8%) compared to Samburu West (43.6%). The majority of households also use firewood for cooking (81%), followed by charcoal (17%) (KNBS, 2009). Wood is sourced from red cider and *acacia tortalis* and typically gathered by women from nearby woodlots where they have free access. Charcoal is produced by burning red cedar or acacia trees; production is permitted. Over-reliance on wood for fuel is considered a health and environmental concern, and the government intends to make efforts to promote sustainable and modern charcoal production technologies, including the use of charcoal kilns and adoption of renewal energy (SCG, 2018).

Beekeeping is being practiced in the county as an alternative production livelihood to livestock production (SCG, 2018). The famers keep bees mainly for crude honey production for use as food and a source of household income.

Fish farming is an emerging livelihood production system that the County Government is promoting through the Directorate of Livestock Production.

Sand harvesting is an economic activity in the lowlands of Samburu East and North. The sand is deposited in dry river valleys and considered high quality; however, there are no structures currently in place to regulate sand harvesting, and the county government had begun training communities in sustainable harvesting practices.

Plants or other materials that are gathered near Baragoi include Sagaram (seed pods from the umbrella thorn tree), Sukuroi (aloe), Nkuuk (for charcoal) and herbs used as medicine. Other traditional herbs that are gathered from elders include *Lekeel siet* and *Sagaram* and *Sitet used* for healing. *Acacia tortalis* (umbrella thorn) is gathered in the Swari area and is highly valued for its pods and herbal properties, and is also used for fencing, shades, ropes and timber.

Other economic activities reported in Suyian include harvesting of aloe vera which is sold in markets in Barsaloi, and harvesting of *acacia tortalis* pods, which is sold at market for 400 ksh per 50 kg bag. Salt is collected from salt licks which are found naturally along riverbanks and sold for cash.

The county is often affected by cyclical droughts, which occur every 1 to 3 years. The frequency is reported to have increased recently because of increasingly erratic weather patterns.

3.2.3 Cultural Ecosystem Services

Cultural sites near the Project alignment were reported by informants close to Baragoi, including Sikinte (circumcision for mud spearing) and Loonyeyok (gum from the Acacia Senegal tree). Informants did not report any sacred sites near Nachola, Suyian, Barsaloi, Lerata, or between Archer's Post and Wamba, although just to the east of Wamba there is a sacred site called Kurdop, situated in a river at the foot of a mountain, as well as a site where warriors celebrate *Lmuget,* a traditional ceremony for boys' coming of age: this was reported to be surrounded by trees that should not be cut down.

Elders who were interviewed emphasised that sacred trees along the Project alignment should not be destroyed, and if they were compensation would be required. Ltepes trees, or *Acacia tortalis* are considered sacred, as the "*father*" tree in the area; they should not be cut. Table 12 shows the sacred and important cultural sites for the AoI communities in the Project area.

Table 12: Sacred or Important Cultural Sites for AoI Communities

Community	Site Name or Type	Notes
Archer's Post	Ltepes (*Acacia tortalis*) (umbrella thorn tree)	A holy/sacred tree in the area that should not be cut
Baragoi	Loonyeyok (gum) site	A cultural site where gum is collected from the Acacia Senegal tree and mixed with honey and hay. This is fed to dairy cows to enhance milk production
	Ltepes (umbrella thorn)	Sacred trees in the area that are specially taken care of; the cutting of Ltepes is illegal as order by council leadership
Lerata	*Ltepes* (umbrella thorn)	Sacred trees in the area
Wamba	Kurdop	A sacred site situated in the river at the foot of the mountain, east of the town
	Lmuget celebration site	A site where warriors celebrate Lmuget, a traditional ceremony for boys transitioning to Morans, which is surrounded by trees that should not be cut down

Source: Focus Group Discussions

3.3 Isiolo County

3.3.1 Background and Economic Base

Isiolo County covers an area of approximately 25,700 km^2, bordering Marsabit County to the north, Samburu and Laikipia Counties to the west, Garissa County to the south east, Wajir County to the north east, Tana River and Kitui Counties to the south and Meru and Tharaka Nithi Counties to the south west, as shown in Figure 4 (GOK 2018).

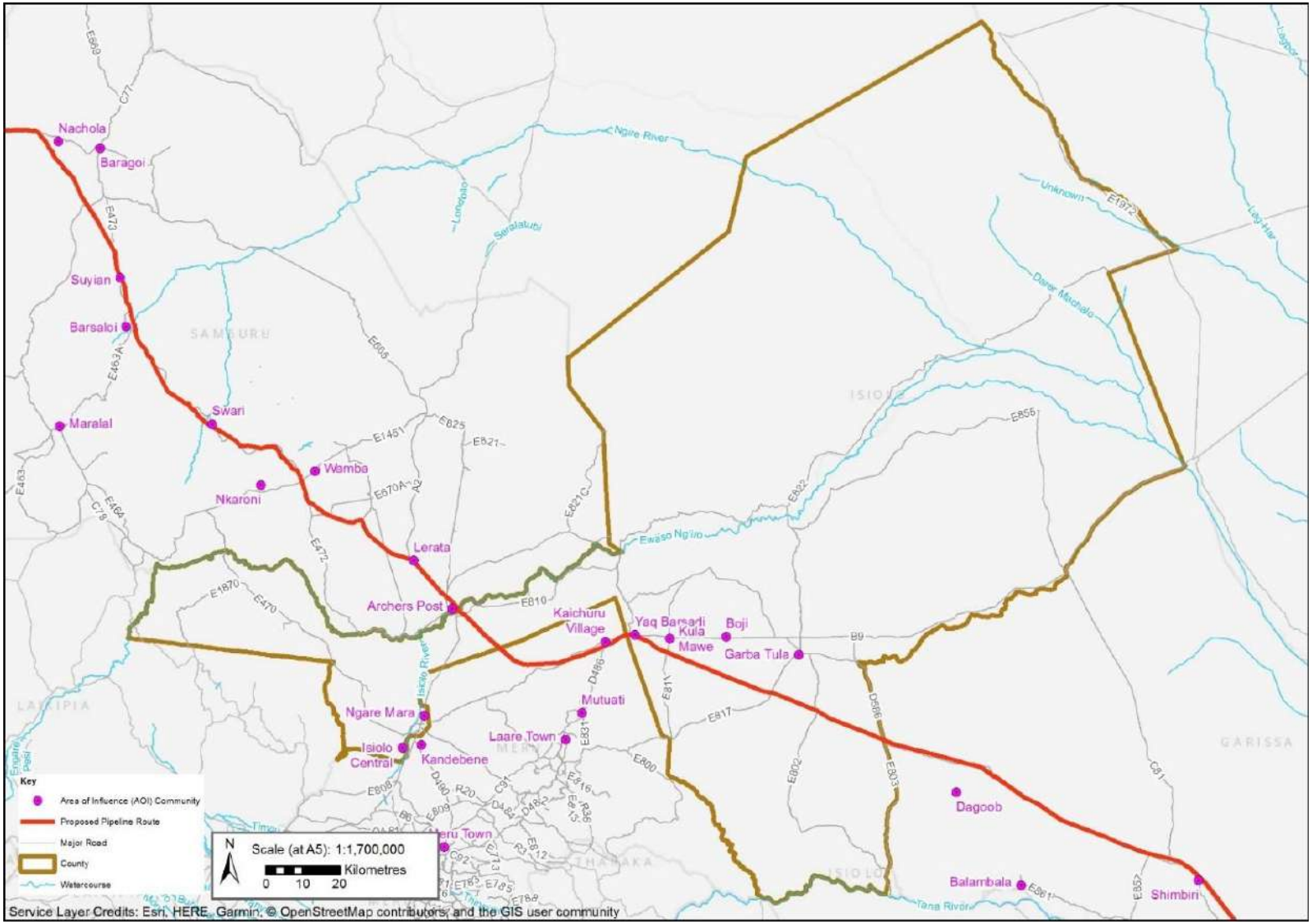

Figure 4: Isiolo County

Agriculture represents the backbone of the County's economy, and is an important source of income, savings, and social status for the population (MoALF, 2018a). Over 80% of inhabitants rely on livestock for their livelihoods, with less than a third (26%) practising agro-pastoralism.

In a study of income sources from households in Garbatula, Kinna and Kulamawe, livestock herding was the most important income-earning activity for the majority of households (45%) (Achiba, 2018). Other sources of income were trading in livestock (7.7%), gathering and sale of wild products (e.g. charcoal, water) (6.5%), and trade in livestock products (4.6%).

The most common source of protein consumed in households in the AoI communities is goat, which is consumed up to 3 times per week in some communities. The frequency of beef and chicken consumption varies by community. Fish is only consumed in Isiolo Central, but rarely. Milk and yogurt are consumed daily in most communities, except in Isiolo Central, but rice is consumed daily in all communities. Wild plants are also consumed in some of the communities when they are in season. In Yaq Barsadi, food is stored in granaries and water is stored in drums and tanks.

Isiolo County falls under the pastoral north-east livelihood cluster, and the current drivers of food insecurity in this area are variability in the amounts and timing of rainfall, conflict and security, and other hazards such as flooding and disease outbreaks (GOK, 2018).

3.3.2 Provisioning Ecosystem Services

3.3.2.1 Pastoralism

The livestock trade makes a large contribution to the income and livelihoods of employers, employees and their dependents (Iruata *et al*., 2015). In a study of the economic contribution of the pastoral meat trade in Isiolo County (Iruata et al., 2015) 66% of respondents from Oldonyiro and Garba Tula towns were employed in the live animal trade, and 17% were employed in eateries or food kiosks. The livestock traders directly support 470 members of their immediate family, and a further 30% of the population are extended family members who also depend on the traders. Isiolo County Council receives revenue from pastoral meat businesses, including livestock transport permits, charges levied on livestock sellers and buyers, slaughter fees, meat inspection fees and medical certificate fees (Iruata *et al*., 2015).

Over 80% of the land in Isiolo County is non-arable, accounting for 22,000 km^2, and is used for grazing by pastoralists (GOK, 2014). Pastoralists from Ngare Mara herd cows, goats and sheep. Livestock numbers have reduced recently because of drought and the reoccurrence of dry seasons. Prior to the drought in 2017, an individual had on average, 100 to 150 cows or more, but now the average is around 30 to 50 cows per individual.

During the months of January and February animals are herded close to home since there is plenty of water and pasture. From March to April there is a decrease in pasture, but in May and June, following the late April rains, pasture is abundant. From July to December there is a decrease in pasture again and herders migrate to other areas, including Kaichuru, Chumbi yare and Magado. There is shortage of water during the dry season from July to December. A cow requires an average of 30 to 40 litres of water per day, while goats need approximately 10 to 15 litres a day.

Inadequate rainfall and drought in the surrounding counties have resulted in decreased pasture and the subsequent movement of livestock from the counties of Wajir, Marsabit, Tana River, Samburu, and Garissa into Isiolo County, where they compete with local livestock for grazing resources (Saferworld, 2015). Adaptation to climate change in Isiolo County has included pasture establishment and conservation, disease control and surveillance, construction and maintenance of boreholes and watering points for livestock, mass vaccination, destocking, and rearing of drought-tolerant livestock types (MoALF, 2018).

Rangeland management remains one of the greatest challenges in conservancies where there is high levels of range degradation and soil erosion, especially due to large-scale livestock movements and during the 2016-2017 drought (NRT, 2018).

3.3.2.2 Agriculture

Agriculture production has varied over the years because of erratic and unreliable rainfall (GOK, 2014). Rain-fed crops are grown in Bulla Pesa, Wabera and Kinna wards where the soil retains moisture (GOK, 2014). The majority of Isiolo County is arid and cannot support rain fed crop farming, so agricultural activities largely depend on irrigation, with the Bisan Adhi, Kinna and Ewaso Ngiro rivers supporting irrigation. There are currently 20 irrigation schemes in the county (GOK, 2018). Only 1,497 hectares are under food crops production, but this is expected to increase to 3,000 hectares because of Rapsu and Makadaka irrigations schemes (GOK, 2018). The average farm size is 1 ha since most of the area is reserved for communal grazing (GOK, 2018). Crops that are produced in these areas include maize, sorghum, beans, green grams, cassava, sweet potatoes, nerica rice, cowpeas, dolicos, kales, tomatoes, onions and watermelons (GOK, 2014; GOK, 2018). Fruit trees are grown with the crops for subsistence and commercial purposes, and they also act as wind breaks and improve soil quality. Fruit trees that are grown include pawpaw, avocadoes, citrus, mangoes and guavas (GOK, 2018).

The farming seasonal calendar in Isiolo Central is shown in Table 13.

Table 13: Farming Seasonal Calendar for Isiolo Central

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Preparing land and planting				-	-	-	-			-	-	-
Weeding	-	-	-			-	-	-	-			-
Harvesting	-	-	-	-	-			-	-	-	-	

Source: Focus Group, Women, Isiolo Central, 9 November 2018

The agricultural sector faces several challenges, and production has declined over the years due to erratic and unreliable rainfall, increasing temperatures, poor soil fertility, poor production practices, low investments in efficient technologies, dependency on relief food, among other factors (MoALF, 2018). There has been low productivity of land because of prolonged drought and poor land management practices including overgrazing and charcoal burning (GOK, 2014).

3.3.2.3 Water

Isiolo County is located in the Pastoral North-East livelihood cluster, and is it characterised by recurrent droughts, hot and dry climate with low and erratic rainfall patterns (MOH, 2018).

Isiolo County is hot and dry in most months of the year and it has two rainy seasons. The long rainy season is from March to May, and the short rains from October to December (MOH, 2018). The short dry season is from January to March, and the long dry season is from June to October. The rainfall in the county averages 580 mm annually, and November and April are the wettest months receiving 149 and 143 mm, respectively (MoALF 2018a). The erratic and unreliable rainfall cannot support crop farming which partly explains the high food insecurity and poverty levels in the county (GOK, 2014).

In general, access to water in Isiolo County comes from four major sources, including direct use of natural water sources such as rivers, streams and springs; developed surface water sources, such as earth dams, sand/subsurface dams, tanks and pans; developed groundwater such as wells, waterholes and boreholes; and emergency water supply by the government using tankers (Mati et al., 2005).

Isiolo County has three main rivers, including Ewaso Nyiro, Isiolo and Bisanadhi (GOK, 2018). Most of the irrigation shemes are found along these rivers (GOK, 2018). The Ewaso Ng'iro River is the most important source of water in Isiolo District, especially for livestock watering, and herders and their livestock often come to the river from the north during dry periods. Surface water availability in Isiolo County varies with seasons of the year, and sources include rivers, streams, springs and runoff from the Isiolo sub-catchment of the Middle Ewaso Ng'iro catchment (GOK, 2018). Surface water abstraction points are mainly along rivers and streams of the three sub catchments. All the rivers from each sub-catchment drain into the Ewaso Ng'iro North River which is the main drainage system in the area. Most of the springs are situated within game reserves and are not accessible to local people. Many springs that were previously located along the major rivers are no longer available because of environmental degradation (Mati et al., 2005).

The main aquifers in Isiolo County are the Isiolo-Nyambeni-Mount Kenya aquifer that has high ground water potential, Merti aquifer, Garbatula-Modagashe aquifer that has very low ground water potential and Kachuru-Kulamawe-Boji aquifer which has fairly low ground water recharge in the aquifer (GOK, 2018).

Developed water sources are poorly distributed, consisting of 123 water sources/points of which 59% are operational during the rainy season and only 36% are operational during the dry season (Mati et al., 2005). There is no piped/tap water in the rural areas and the district relies mostly on boreholes, accounting for 58% of all developed water sources. There is an over reliance on groundwater, yet only 20% of the county has good groundwater potential. Merti, Garbatula and Sericho Divisions are especially lacking water sources, particularly during the dry season. The reliance on shallow wells for water is 17% in the county, most being traditional hand-scooped holes.

Under suitable conditions, floodwater harvesting is practiced through the excavation of shallow pans or ponds, both of which rely on surface runoff, but ponds also rely on some groundwater (Mati et al., 2005). Water harvesting in Isiolo County is limited to one subsurface dam and five operational pans during the rainy season, and one operational pan during the dry season. Isiolo County is overlapped by several sand rivers whose potential for floodwater harvesting and storage has not been fully tapped (Mati et al., 2005).

During the dry seasons, most people rely on piped water (39%) followed by bore hole (34%) and river (10%) (GOK, 2018). During the rainy season, 37% of people rely on piped water, followed by boreholes (25%) and river (11%). The reliance on rain water harvesting increases during the rainy season to 10%.

Table 14: Water Sources in Isiolo County

Water Sources	Dry season	Rainy Season
River	10%	11%
Water pans[4]	4%	7%
Piped water	39%	37%
Boreholes	34%	25%
Rainwater harvesting	2%	10%
Other	11%	10%

Source: GOK, 2018

4 A water pan is a small reservoir created by excavating open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands

Following the rains in the high elevation areas, water flows down through the catchment along riverbeds and aquifers into the Ewaso Ng'iro North river that runs through the centre of Isiolo County (Jarso *et al*., 2017). People and livestock from surrounding counties and other countries migrate towards the Ewaso Ng'iro riverbed in search of water and pasture, particularly during the dry season or droughts. The increased population during these times has placed pressure on the water service infrastructure and what it is able to support. Further, the natural flows through the catchment that used to transfer water from upstream are continuing to decrease due to increasing upstream extractions for irrigation and other uses (Jarso et al., 2017). As a result, according to the NDMA, vulnerable households in Isiolo County have been surviving on as little as 8 litres per person per day (GOK, 2016).

3.3.2.4 Other

Wood is used in households for cooking with the majority (65.2%) of households relying on firewood for cooking, while approximately 30% rely on charcoal.

Another source of income is harvested honey, which is bought and sold at market honey is also used to treat ailments, including malaria, along with medicinal roots and leaves.

3.3.3 Cultural Ecosystem Services

Community members reported several sacred sites along the Project alignment, including cleansing sites and traditional initiation sites. Again, and in congruence with other Counties, some species of acacia trees were reported as sacred and used during ceremonies and community members indicated that they should not be destroyed.

3.4 Meru County

3.4.1 Background and Economic Base

Meru county has a total area of 6,936 km^2 of which 972 km^2 is gazetted forest. The county borders five counties; to the north it borders Isiolo County, to the east Tharaka/Nithi County, to the south-west Nyeri County and to the west Laikipia County (Figure 5).

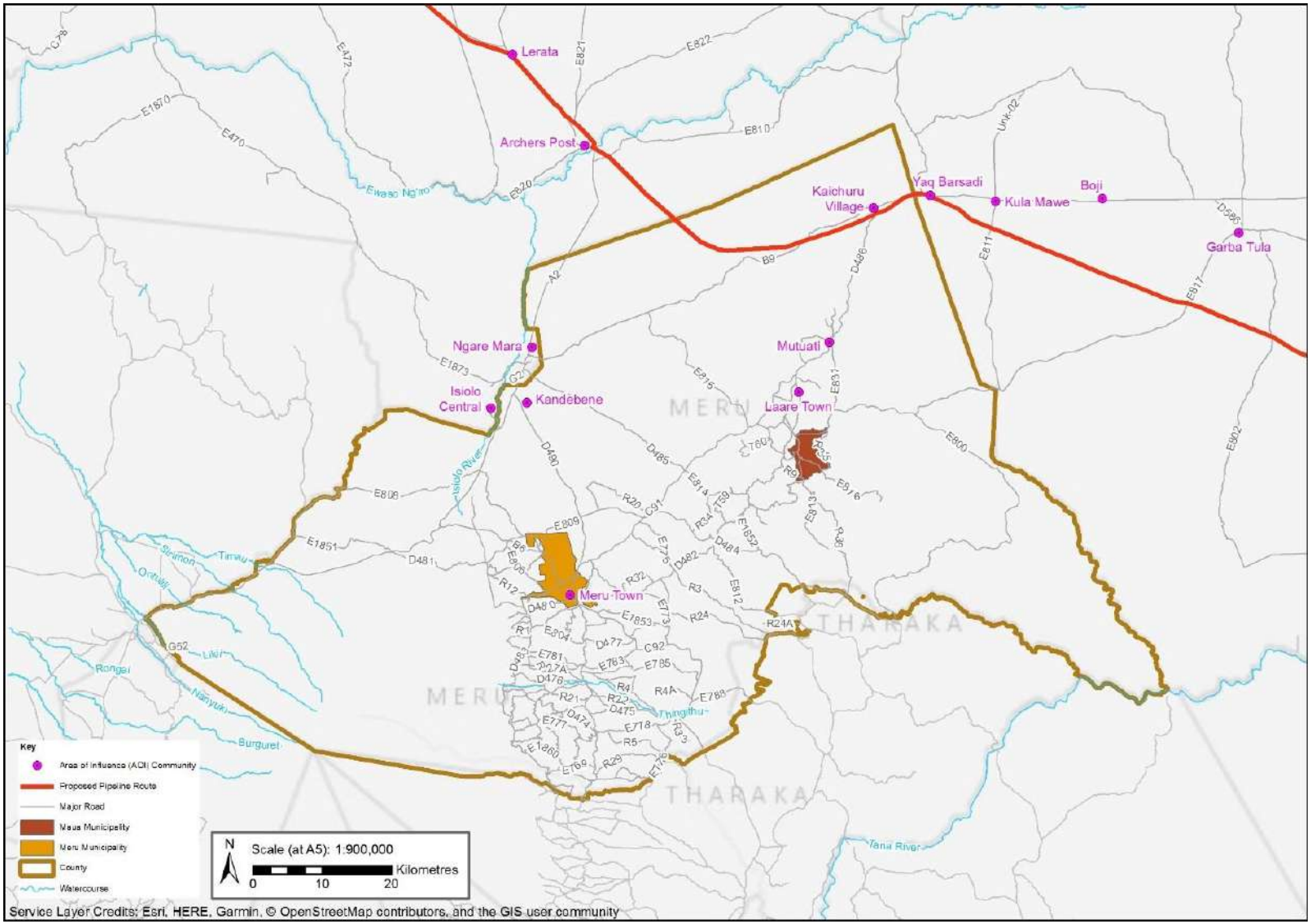

Figure 5: Meru County

Agriculture is the main economic activity of the Ameru people. The land is used for crop and livestock farming. The major income-generating activities in Meru County are farming of potatoes, timber harvesting and charcoal burning. Additionally, the trading sector is important in the county as it generates income and creates employment. Charcoal production is common in the project-affected area and firewood is still used by majority of the households for cooking and lighting. Table 15 below illustrate the economic ecosystem services activities of the women in the communities near the proposed Project.

Table 15: Economic Ecosystem Services Activities of Women from the AoI Communities

Community	Economic Activity
Kaichuru Village	Buying and selling *miraa*[5] Selling firewood and charcoal Running small scale shops and hotels Selling perfumed branches from the Dakar tree
Laare Town	Farming Running small businesses Teaching
Mutuati	Selling firewood Selling animal feed Agricultural farming Dairy farming Running small businesses e.g farming
Kandebene	Agriculture Businesses

Source: Focus Groups, Women: Kaichuru Village, 31 October 2018; Laarre Town 2 November 2018; Mutuati, 1 November 2018; Kandebene, 3 November 2018.

Land in Meru County is utilised in diverse ways, but the predominant use is agricultural activities; crop farming and livestock-keeping. Agricultural land use is common in all the sub-counties and is particularly intense in the Imenti and Buuri Sub-Counties, while livestock are common in Tigania and North Igembe Sub-Counties.

3.4.2 Provisioning Ecosystem Services

3.4.2.1 Pastoralism

In Kaichuru Village, the land use near the proposed Project area is predominantly free grazing. The rangelands are communally grazed. Grazing areas include Galdima, Topesi, Mataba, Dakari, Dakarika, Njaro, Dera, Kabumini and Lakuriko (Focus group, herders: Kandebene, 3 November 2018). The main determinant of animal movements is the availability of water and security concerns from occasional livestock raiders. The main sources of water in the grazing areas near Kaichuru Village are the Barajadi and Gachuru boreholes and Magado, Waso and Chapa springs.

5 Miraa, also known as khat, is a flowering plant native to the Horn of Africa and the Arabian Peninsula. The addictive herb is chewed for its stimulative effect.

The herders in Kandebene do not settle in one area, but move throughout the year, and travel in groups of 50 families for security reasons. The Lanyiru stream, Rikindu River and Wasonara River are commonly used by herders. The Lobua and Chokaa swamps, which are no longer protected areas, are used to feed livestock.

The Meru County farmers keep livestock both for subsistence and commercial purposes. These include dairy and beef cattle, goats, sheep and poultry. The information obtained from the focus group discussions and key informant consultations revealed that the county's main livestock facility, the Kinoru Livestock Resource Centre (KLRC) (a diagnostic facility as well as the county's artificial insemination programme centre) is near the proposed Project area.

3.4.2.2 Agriculture

Agriculture is the main economic activity in the proposed Project area. However, the size of land for farming has been decreasing in size over time increasing the pressure on land. Farmers practice mixed farming where they grow many types of crops and keep livestock on the same piece of land. The average household income in the area is estimated at KSh 2,000 to KSh 20,000 per month. The economy of Meru is primarily agrarian. The growing of a variety of crops and keeping livestock in some parts of the county form a critical chunk of the economic activities of the people of Meru. *Miraa* is a highly lucrative cash crop grown in the project area. Table 16 shows crops grown near the proposed Project.

Table 16: Main Crops Grown in the Project Area

Area	Types of crops
Kaichuru Village	Beans, peas and maize
Mutuati	*Miraa* and bananas
Laare Town	Black beans, maize, sorghum, peas, potatoes, millet, cow peas, and *miraa*
Kandebene	Beans, sorghum, green, tomatoes, onions, maize, cow peas and sunflower

Source: Focus Groups, Women, Kaichuru, 31 October 2018

Planting and harvesting is carried out twice per year. Land preparation and planting typically begins in March and April, and in June and July harvesting for the first part of the year takes place. The land is prepared and planted again starting in August through October and harvesting usually takes place in January and February. Following harvesting, the products are sold or exchanged for children's school fees at the local schools, and there are no processing facilities near Kaichuru Village to process agricultural products. T he farming seasonal calendar for the communities near the proposed Project is shown in Table 17.

Table 17: Farming Seasonal Calendar for the Communities located near the Project

Activity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harvesting beans and potatoes			-	-	-	-	-	-	-	-	-	-
Harvesting millet, maize and sorghum	-			-	-	-	-	-	-	-	-	-
Land Preparation and planting	-	-			-	-	-				-	-
Weeding	-	-	-			-	-	-	-			
Harvesting	-	-	-	-	-				-	-	-	

Source: Focus Groups, Women: Mutuati, 1 November 2018; Laare, 2 November 2018; Kandebene, 3 November 2018.

Rotation is done seasonally between crops (Focus Groups, Agriculture: Kaichuru Village, 31 October 2018; Kandebene, 3 November 2018; Laare Town, 2 November 2018; Appendix B, Social Baseline Chapter). Manure from livestock is used as a fertiliser for beans, maize and peas, and tractors are hired to till the land.

3.4.2.3 Water

There are two long rains seasons occurring from mid-March to May, and a short rains season from October to December. However, climate change has resulted in unpredictable rainfall patterns, which now start earlier or later than previously. The county has eleven (11) permanent rivers. The main river is the Kathita which is a tributary to the Tana River.

The main water sources for both households and livestock are boreholes, rivers, water pans, water vendors and piped water from community-based projects. Boreholes account for the highest number of users at 53.8 % compared to 25 % during the dry season. Rivers and water pans are used equally. The majority of water pans in the grazing areas of the agro-pastoral livelihood zone such as Kachiuru, Ithata, and Njaruine have completely dried up. Boreholes in Kandebene, Inono, Ndumuru, and Mariara are currently the main water sources for both livestock and households.

The main sources of water for livestock herders in Kaichuru Village are the Barajadi and Gachuru boreholes and Magado, Waso and Chapa springs. Households in Kandebene depend on the Kandebene borehole, and in the rainy seasons they also draw water from the Matabithi borehole and the Batalo, Kungu, Karuya and Kandebene dams. The Lanyiru stream flows throughout the year, and the Rikindu River and Wasonara River are seasonal. The Rikindu River flows through the Kandebene community, while the Wasonara River is nearby.

The main water supply in Laare Town is from the diocese of Meru, springs at Laare, Kitawaa, Atununu and Kithingangu, and boreholes in Laare, Ntunene and Kiridora. Spring water is free, and residents pay between KSh 5 to KSh 10 for water from the boreholes. Diocese water is paid for monthly and estimated to be KSh 800. Public water kiosks provide free water, but water supply is limited in May, June, July and August, when the community depend solely on water truckers.

3.4.2.4 Other

In Laare Town, beekeeping is a livelihood and economic activity near the proposed Project area. The beekeepers use their Indigenous Knowledge and locally available materials to keep honeybees in Ndumuru or their homesteads. The beehives are owned individually or as a group, and generally between two and ten hives are owned. The honey production is based on an occupation rate and an average yield is 10 kg per hive. The honey is used domestically and can be used to brew alcohol and is also sold. One kg of honey costs KSh 1000.

The majority of people are dependent on traditional fuels (wood-charcoal, crop residue maize stalks and cobs). Firewood is the major household fuel in the county with over 86.1% of the total population relying on it for their daily energy needs (KNBS, 2009; MCG, 2018).

3.4.3 Cultural Ecosystem Services

Near Kaichuru Village, Igembe is a sacred site surrounded by trees and large stones where natural minerals are found, and it is located near the Project.

Sacred sites near Mutuati that are located near the proposed Project include Buru shrines and Ndumuru sacred sites. The elders meet there to offer rituals on behalf of the community and the area is also used for prayers. The sites are surrounded by natural salts (monyo) and herbs and are used by pregnant women and animals to feed on.

Sacred places near Laare Town include the Igombe salt lick and Kimeru where white ash is found and used for rituals. Other sacred places reported include those where traditional healers go to collect herbs, such as Migombe, Luma and Mea hills.

Natural resources that are considered sacred or of spiritual importance near Kandebene include the Lobua swamp and Chokaa, where particular plants grow that are used to feed livestock (Focus Groups, Elders: Kaichuru, 31 October 2018; Kandebene, 3 November 2018; Laare Town, 2 November 2018; Mutuati, 1 November 2018). The animals also drink myonwo from the swamps, which is from natural saltwater springs and full of nutritional supplements.

3.5 Garissa County

3.5.1 Background and Economic Base

Garissa County is one of the three counties in the north-eastern region of Kenya, as shown in Figure 6 (GCG, 2018). The county borders the Republic of Somalia to the east, Lamu County to the south, Tana River County to the west, Isiolo County to the north-west and Wajir County to the north. The main economic activities in Garissa are crop farming, livestock and fish production.

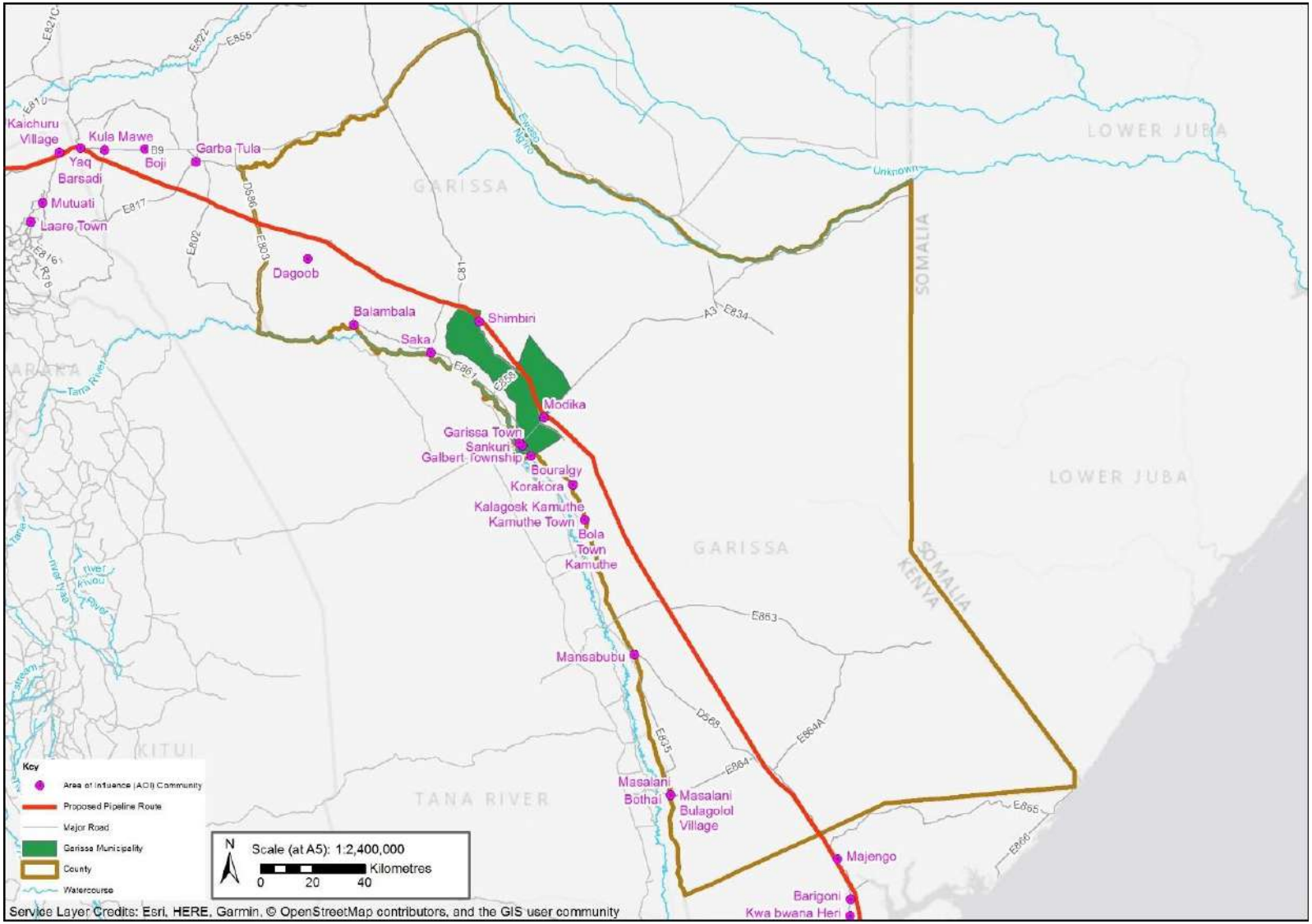

Figure 6: Garissa County

3.5.2 Provisioning Ecosystem Services

3.5.2.1 Pastoralism

The main livestock bred are cattle (Boran), goats (Galla), sheep (black headed Persian) and camel (dromedary one-humped) and livestock products include meat, milk, hides and skins (Focus Groups, Women: Modika, 13 October 2018; Shimbiri, 15 October 2018; Mansabubu, 16 October 2018; Balambala, 17 October 2018; Masalani, 17 October 2018; Appendix B, Social Baseline).

Livestock herd sizes vary greatly among livestock herders (Table 20). Camel herds range from 80 to 100 head, while cows are typically kept in groups of 20 to 100. Goat herds range in size dramatically, from 20 to 700 (Focus Groups, Pastoralists: Korakora, 14 October 2018; Masalani, 17 October 2018; Appendix B, Social Baseline). Cow's milk is sold for 50 KSh per litre. Camels are sold for approximately 35,000 KSh, while cattle and goats fetch comparatively lower prices (16,000 and 7,000 KSh, respectively).

Table 18: Average Herd Size in Garissa County

Community	Average Number of Animals per Herder*			
	Goats	Sheep	Cows	Camels
Korakora	20-700	n/a	30-60	80-100
Kamuthe	100	100	100	100
Masalani	100	100	100	n/a

Source: Focus Groups, Livestock Herders: Korara, 14 October 2018; Kamuthe 15 October 2018; Masalani 17 October 2018.

**Data were not available for the other communities*

There are several challenges associated with the herding of livestock. Drought is a problem during the dry season, particularly given the high water requirements of livestock. Water is required in large quantities for livestock, with Camels requiring up to 100 litres every ten days, and cows requiring 50 litres every three days. However, water for pastoral use is scarce, and is often sourced from water pans and boreholes (Focus Group, Pastoralists: Korakora, 14 October 2018; Appendix B, Social Baseline). Where water is purchased for livestock, it costs approximately 10 KSh per day per animal (Focus Group, Pastoralists, Sankuri 14 October 2018; Appendix B, Social Baseline).

3.5.2.2 Agriculture

Garissa County is principally a semi-arid area and receives an average rainfall of 275 mm per year (GCG, 2018). There are two rainy seasons, the short rains from October to December and the long rains from March to May. Balambala and Fafi Sub-counties practice rain-fed agriculture on a small scale.

It is estimated that Garissa has 44,100 acres of land along the Tana River Basin which can be used for irrigation. Currently, only 5,121 acres of land (12%) along the basin is under irrigation. The main crops grown in the county are watermelons and sweet melon, mangoes, vegetables, tomatoes, paw paws, bananas, cowpeas, simsim, rice, sorghum, lentils, peas, chiles maize and green grams (Focus Group, Agriculture: Saka, 16 October 2018; Bouralgy, 13 October 2018; Sankuri, 14 October 2018; Kamuthe, 15 October 2018; Appendix B, Social Baseline). These are usually produced on a small scale under irrigation along the River Tana. *Miraa* is also sold, a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect (Focus Groups, Women: Modika 13 October 2018; Shimbiri, 15 October 2018; Mansabubu 16 October 2018; Balambala 17 October 2018; Masalani 17 October 2018.

Table 21 shows the crops grown in Kamuthe and Bouralgy.

Table 19: Average Crop Yields and Marketing in Bouralgy and Kamuthe

Community	Crop	Yield (kg)	On how much land (acre)	% sold	Months of sale	Price at harvest (KSh)
Bouralgy	Maize	20 (50 kg sacks)	1 acre	100	August	50 per kg
	Tomato – 20 kg per day	1 acre	95%	January - August	80 to 20 kg	2 at 20 KSh
Kamuthe	Beans	3 sacks	1 acre	100	June	1 sack 3,500 KSh
	Maize	High amount	5 acres	80	March	1 sack 2,000 KSh
	Leafy greens	High amount	5 acres	90	March	-

Source: Focus Groups, Agriculture: Bouralgy, 13 October 2018; Kamuthe 15 October 2018.

Apart from the planting of food and cash crops, farmers also rear livestock such as cows, goats and camels.

There are a number of challenges faced by those practicing agriculture. Floods during the rainy season can wash away crops, particularly vegetables. Temporary burst floods from the release of water by the Kenya Electricity Generating Company also poses a risk of washing away crops adjacent to rivers. There is limited access to farming inputs from the county or national government, and little to no training or workshops to teach people how to farm or use the land effectively, which can result in lower yields than otherwise possible (Focus Groups, Agriculture: Bouralgy 13 October 2018; Kamuthe 15 October 2018; Saka 16 October 2018.

3.5.2.3 Fishing

Fish farming in Garissa County is done on a small scale along the Tana River and in fish ponds. There are five fish ponds with a total area of 1,200m^2 and mud fish, cat fish, bone fish, tilapia and eel are the types typically caught. There are six landing beaches along the Tana River in Garissa, Fafi, Balambala and Masalani.

There is limited artisanal fishing in Garissa County, and it was reported that community members prefer goat, cow or camel meat to fish. However, oil from fish is used for medicinal purposes

3.5.2.4 Water

Garissa County has one permanent river (Tana River), 25 shallow wells, 109 boreholes, 195 water pans and one dam (GCG, 2018). The county is generally water-scarce with acute water shortages experienced during the dry season. In Bouralgy, water is brought from the Tana River, and households pay a rate of 20 KSh per litre (Focus Group, Water and Sanitation: Bouralgy, 13 October 2018).

Approximately 24% of the population in Garissa County have access to safe water (GCG, 2018). Access to piped water is limited to the sub-county headquarters where approximately 27,725 households have a connection to piped water. The remaining population make use of unsafe water directly from the river, luggas, boreholes, shallow wells and pans. Table 22 shows the main sources of water for the AoI communities.

Table 20: Water Supply in the AoI Garissa

Community	Water Supply
Bouralgy	■ Water pans at Bukurey ■ Water trucks bring water from Tana River
Garissa Town	■ Traditional wells and piped water
Korakora	■ Water pans and boreholes
Sankuri	■ Piped water ■ Local River
Kamuthe	■ Water pans (e.g. Daad Seinab, Adnaan, Kalagose and Eey Dure) ■ Boreholes (e.g. Daad Buuce) ■ Piped water from Tana River
Saka	■ Tana River ■ Taps (paid) ■ Borehole
Masalani	■ Water pans
Dagoob	■ Earth dam and seasonal dams ■ River (seasonal)

Source: Focus Groups, Pastoralists: Korakora 14 October 2018; Sankuri, 14 October 2018; Kamuthe, 15 October 2018, Saka 16 October 2018; Masalani, 17 October 2018; Dagoob 18 October 2018; and Focus Groups, Water and Sanitation: Kamuthe 15 Octoebr 2018; Bouralgy 13 October 2018.

3.5.2.5 Other

Firewood is used as a source of energy for cooking by approximately 84% of the county's population, and 25% use wood for lighting (GCG, 2018). Charcoal is used for cooking by 40% of the population (GCG, 2018).

Beekeeping is practiced by some residents of Garissa Town, Balambala, and Masalani (Focus Group, Women: Garissa Town, 12 October 2018; Local Government: Balambala, 17 October 2018; Bee Keeper: Masalani, 17 October 2018). The Gares tree is used to construct beehives traditionally, though beekeepers are increasingly using timber to construct hives. One beehive can produce approximately 24 litres of honey. The harvested honey is used for household food, and traditional medicine, and is sold at a cost of about 3,000 KSh per three litres (Focus Group, Beekeepers: Masalani 17 October 2018.

3.5.3 Cultural Ecosystem Services

There is a sacred tree in Kamuthe which is used by the villagers for traditional ceremonies. Sacred trees also exist in Masalani, some of which also provide fruit.

3.6 Lamu County

3.6.1 Background and Economic Base

Lamu County is located on the northern coast of Kenya and is one of the six counties in the coastal region of Kenya, as shown in Figure 7. It borders the Tana River County to the southwest, Garissa County to the north, the Republic of Somalia to the north-east and the Indian Ocean to the south.

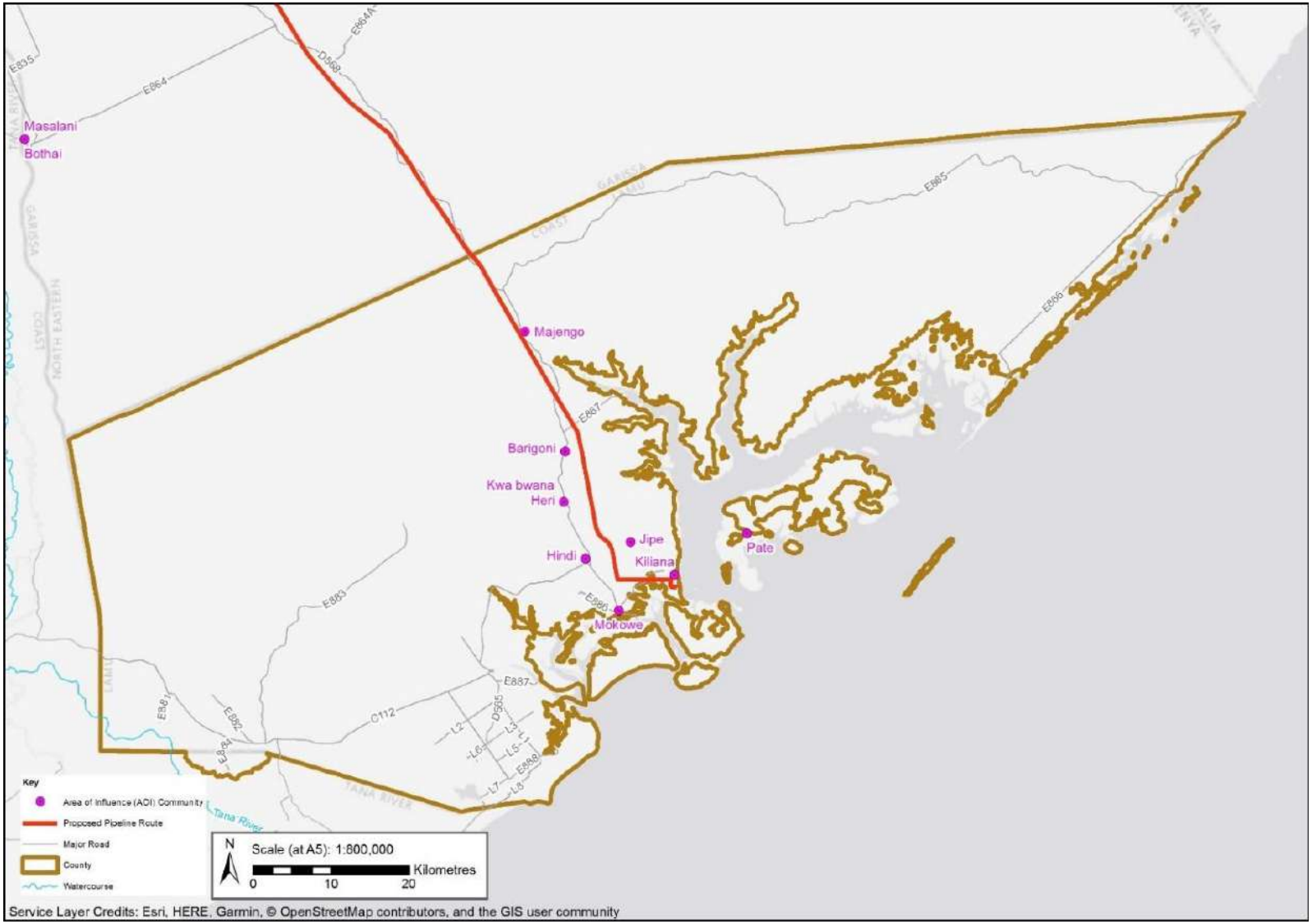

Figure 7: Lamu County

Economic activities in Lamu County include crop agriculture, livestock, fisheries, forestry, mining and tourism (MoALF, 2018b). Fishing is an important economic activity, providing food and employment, and there are 3,500 artisanal fishermen (MoALF, 2018b). The County produces over 1,500 metric tons of fish annually valued at KSh.111.8 million, of which 85% is from marine and 15% from fresh water fishing (LCG, 2016).

The gazetted forest area in Lamu is about 50,093.4 ha, of which 85% is mangrove forests. Some communities in Lamu, such as the Bajuni, depend on mangrove harvesting as their main source of income (GoK, 2017). The Aweer people also depend on the forest as a source of food, as well as selling honey and other wood products (MoALF, 2018b). The main forest products include mangrove poles used in construction of houses and boats; other products include fuelwood, seedlings, charcoal and casuarina poles (LCG, 2016).

3.6.2 Provisioning Ecosystem Services

3.6.2.1 Pastoralism

Livestock production is also an important livelihood for approximately 30% of the population (MoALF, 2018b). The main livestock reared are cattle, sheep, goat, donkeys and poultry.

There are 20 ranches in the county that act as grazing reserves and are used by pastoral farmers from Lamu County as well as from the neighbouring Garissa County (MoALF, 2018b). Most of the farming in Lamu County is rain-fed, and only 1% of households practice irrigation farming (MoALF, 2018b).

Herd size is influenced by the seasons and availability of pasture and water. Scarcity of land and water is a major challenge for herders in Lamu County. During the dry season, the herders travel from one area to another in search of pasture and water. Livestock herders from Hindi obtain their water from seasonal dams which only impound water during the rainy season. Herders from Mokowe obtain water for their animals from boreholes, seasonal dams and ponds.

3.6.2.2 Agriculture

Agriculture is the main sector of the county, engaging 73% of the population and contributing 90% of total household incomes. Of the arable land, 56,923 ha is being utilised; 37.4% is under food crops, 39.5% is under cash crops and 23.1% is under forestry use.

The primary crops grown in the county are maize, cowpeas, dolichos, cassava, pigeon peas and green grams (LCG, 2016). The county also produces mangoes, coconut, cotton, bixa and simsim as cash crops. Cotton production remains the highest source of income for households, contributing 42% to household incomes, followed by banana (14%), maize (8%), cassava (7%), bixa (6%) and mangrove (5%). Those living in the Lamu peri-urban areas practice subsistence farming (LCG, 2016).

Decreasing and unpredictable rainfall has resulted in reduced production, crop failure, scarcity of pasture and loss of livestock. Irrigation practice is limited in the county because of the prevalence of saline groundwater, relatively flat topography, and drying of lakes and rivers.

Unlike Counties inland, In Lamu there is only one rainy season and one dry season per year. During the rainy season cashew nut and mango crops are grown in Kiliana, and other seasonal crops include maize, sunflowers, cowpeas, and simsim (sesame seeds). In Jipe, the main cash crops are *Bixa orellana* ('annatto') and cotton, and the main food crops are maize, cowpeas and green grams. The crop yields and marketing for major crops in Kiliana and Jipe are presented in Table 23.

Table 21: Crop Yields and Marketing for Lamu County

Community	Crop	Yield	On how much land (ha)	Percentage sold (%)	Months of sale	Price at harvest (KSh)	Price at harvest (KSh)
Kiliana	Maize	20 kg,90 bags	0.4 ha	80	August and September	2,500	3,500 per bag
	Simsim (sesame seeds)	6-12 bags; 50 kg	0.4 ha	90	September	6,000	8,000 per bag
Jipe	Maize	8-10 kg	0.4 ha	80	August and September	1,800	3,500 per kg
	Cotton	350 kg	0.4 ha	100	November and December	60 per kg	100 per kg

Source: Focus Group, Agriculture: Kiliana 25 October 2018; Jipe, 26 October 2018.

The farming seasonal calendar for Kiliana is presented in Table 24. The seasonal crops are rotated consecutively with one season left fallow to allow the land to generate nutrients.

Table 22: Farming Seasonal Calendar for Kiliana

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Clearing land	-			-	-	-	-	-	-	-	-	-
Planting	-	-	-		-	-	-	-	-	-	-	-
Harvesting	-	-	-	-	-	-			-	-	-	-

Source: Focus Group, Agriculture: Kiliana, 25 October 2018; Jipe, 26 October 2018.

3.6.2.3 Fishing

The fishing industry is the economic backbone of Lamu County, with 75% of communities depending on fishing for their livelihoods either directly or indirectly (LCG, 2019). Fishing is practiced for subsistence and commercial purposes. The annual fish production for the county is estimated as 2,500 metric tonnes valued at KSh 180 million.

Fishing in the county consists of marine in-shore and fresh water fishing (LCG, 2016). Marine in-shore fishing is carried out in 3,100 km^2 of territorial marine water and extending 144 km from Dar-es-salaam in Kiunga to Ras Teweni. Freshwater fishing is concentrated in channels, ox-bow lakes of Tana River and other inland water bodies.

Fish landing sites are important infrastructure that supports the fishermen and other fisher community operations at the beach (MoALF, 2014). In 2014, there were 28 landing sites recorded in Lamu County, 15 of which were located on islands. The main fish landing sites in Lamu County are presented in Table 25, excluding sites at Mpeketoni and Witu.

Table 23: Fish Landing Sites in Lamu County

Division	Landing Site
Faza	Dodori, Shanga Ishakani, Shanga Rubu, Tchundwa, Rasini, Pate
Kiunga	Kiunga Kiunga, Mkokoni
Kizingitini	Kiwayu, Ndau, Mbwajumwali, Kizingitini
Amu	Langoni (Amu), Shella, Mkomani (Amu), Matondoni, Kipungani
Hindi	Ndununi, Mokowe

Source: Fisheries Department Frame Survey 2006

Fishing is the main livelihood activity in the AoI communities of Mokowe, Kiliana, Barigoni and Pate and fish and crabs are staple foods in these areas.

There are approximately 40 fishing grounds in Lamu County with a diversity of fish species (LCG, 2016). Figure 8 shows the major fishing grounds in Lamu County.

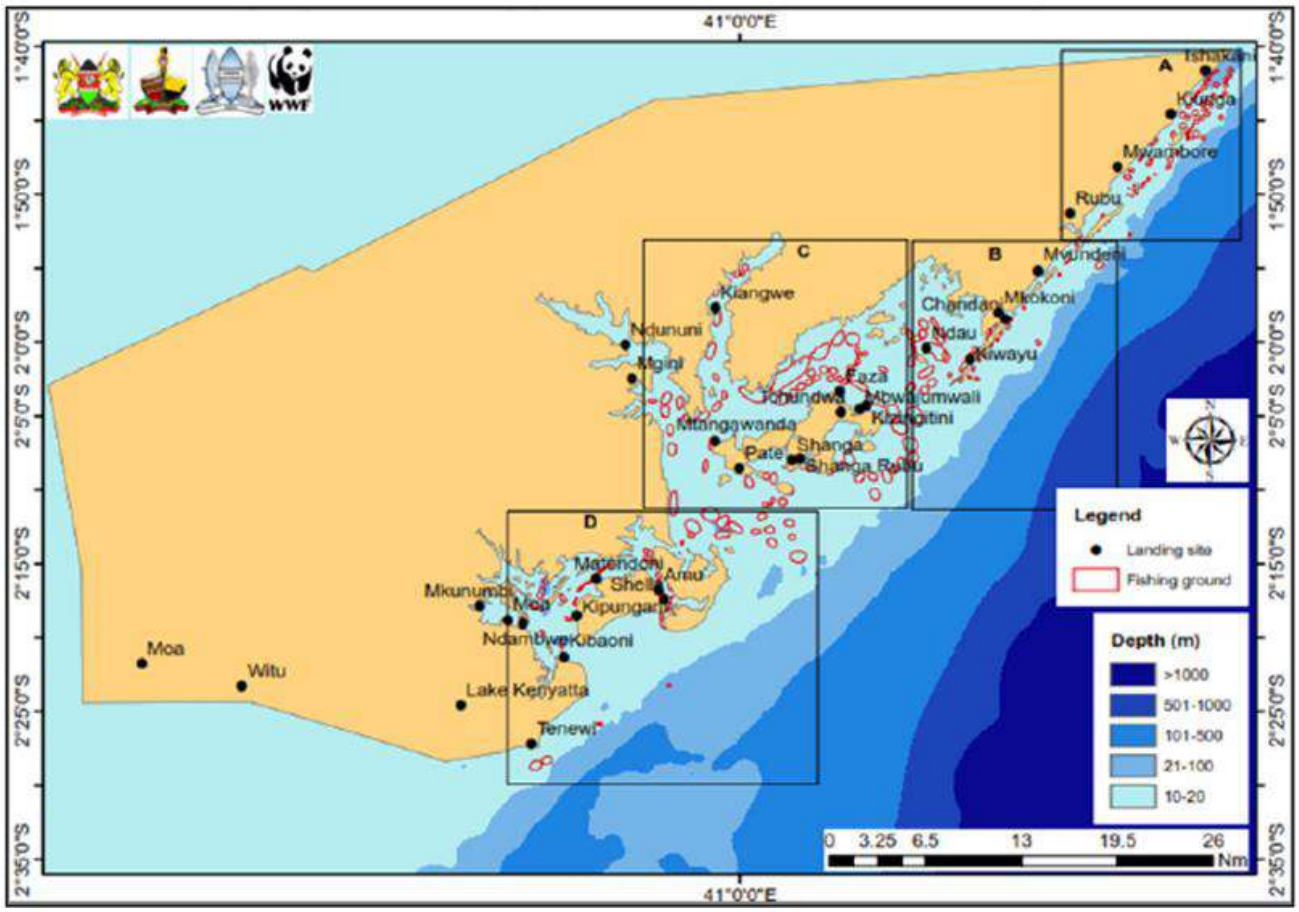

Figure 8: Fishing grounds in Lamu County (Kurrent Technologies, 2016)

The main fishing grounds used by fishers from the AoI communities are listed in Table 24.

Table 24: Fishing Grounds for the AoI Communities in Lamu County

Community	Name of group	Fishing grounds	Types of seafood
Makowe	Bandari Salam Fisheries group	■ Ndununi ■ Kiunga ■ Kipungani ■ Kiliana ■ Manda ■ Bruno	■ Crab ■ Lobster ■ Tuku ■ Tafi (rabbit fish) ■ Mbawa ■ Mkizi (bluespot mullet) ■ Tewa (redmouth grouper)
Kiliana	Zipporah's fisheries	n/a	■ Changu (snapper) ■ Tewa ■ Tazanda ■ Tafi ■ Mkizi
Barigoni	Crab and lobster fishers Snail fish fishers	■ Ndununi ■ Kibaoni ■ Mngiini	■ Tamamba ■ Red snapper ■ Mkizi ■ Tewa ■ Kaa (crab) ■ Lobster/crabs ■ Prawns
Pate	No formal group, individual fishing	■ Bruno ■ Dudune ■ Wange ■ Kiunga ■ Dodori	■ Tasi ■ Jodari (tuna) ■ Tewa ■ Tamamba ■ Fumi (lemur) ■ Lobster and crabs ■ Prawns ■ Tachawa

Source: Focus Groups, Fishers: Mokowe, 24 October 2018; Kiliana, 25 October 2018; Barigoni, 28 October 2018; Pate, 30 October 2018.

According to fishers from Mokowe and Pate, tourism in the area has opened markets for fishers to sell their produce. The fishers also benefit tourists who hire boats for deep sea touring and fishing. However, the tourism industry is monopolised by foreign investors who do not contribute to the local community in any significant way. Nevertheless, fishers from Mokowe and Pate reported that they sell their produce to hotels on Lamu Island in addition to the residents. Fishers from Mokowe also sell their catch to the towns of Malindi and Mombasa. Fish prices fluctuate significantly during the year depending upon supply, beign highest during the dry season. Fishers from Barigoni stated there is no tourism in their area because of security issues

Collectively, the Bandari Salam Fisheries group can catch up to 3 tonnes of fish per day, and each individual can make up to KSh 2000 per day (Focus Group, Fishers: Mokowe, 24 October 2018). Table 25 shows the average price that fish and other marine resources are sold for.

Table 25: Marine Resources Sold for the AoI Communities in Lamu County

Community	Type	Volume/ quantity (kg)	Price (KSh/kg
Mokowe	Crab/Lobster	2-5	1,000 KSh/kg
	Tuku, Tafi, Mbawa, Mkizi, Tewa	Up to 200 kg	200 KSh/kg
Kiliana	Changu	500	120-150
	Tewa	400	120-130
	Tazanda	300	120-130
	Tafi	400	120-140
	Mkizi	300	120-130
Barigoni	Tamamba	10	170
	Red snapper	9	170
	Mkizi	7	150
	Tewa	6	150
	Kaa	6	450
	Lobster and crab	6	400
	Prawns	6	400
Pate	Tasi	n/a	n/a
	Jodari (tuna)	n/a	n/a
	Tewa (redmouth grouper)	n/a	n/a
	Tamamba	n/a	n/a
	Fumi (lemur)	n/a	n/a
	Lobster and crabs	5	4000
	Prawns	n/a	n/a
	Tachawa	n/a	n/a

Source: Focus Groups, Fishers: Mokowe, 24 October 2018; Kiliana, 25 October 2018, Barigoni; 28 October 2018; Pate, 30 October 2018

Destructive over-fishing and fishing techniques have resulted in dwindling inshore fish stocks (MoALF, 2018b; LCG, 2019). The pressure on the fisheries industry is in part due to lack of alternative livelihoods for the fishing communities and an inability to develop offshore fisheries (LCG, 2017). Kenya's offshore coastal marine resources have been vastly untapped and the fishing industry extremely underdeveloped.

3.6.2.4 Water

The county has four major catchment areas, including Dodori, Coastal zone, Duldul, the Lamu Bay drainage and Tana River catchments (LCG, 2016). There are no permanent rivers in the county, but only a few seasonal streams which flow from the west towards the south eastern part of the county. The only permanent open water site in the county is Lake Kenyatta in Mpeketoni which at times dries up during exceptionally dry years. The county also has several swamp areas which are supplied by rain water.

The county is experiencing rising demand for water because of rapid population growth and urbanisation. People rely on shallow wells that have high salinity levels, which poses a major problem for residents since they have access to little fresh potable water. There are several lakes where clean water can be collected from but even those are under threat, including Lake Amu (LCG, 2017). The numerous water catchment areas and wetlands in Hindi ward are also under threat because of the encroachment by people, which leads to decreasing water quantity. The main sources of water in the county are groundwater, surface water, rainfall and desalination of sea water (LCG, 2016). Ground water is used for most water supplies in Lamu County, but most areas have saline groundwater. Surface water sources include the sea, lakes, pans, dams and seasonal rivers.

Other public water sources such as djabias[6] and dams are managed by community committees. Rainwater harvesting structures are used to collect water for domestic use; desalination is mainly the preserve of wealthier private individuals and hotels, because of the cost.

Livestock herders from Mokowe source water from boreholes, seasonal dams and ponds for their cattle. Livestock herders from Hindi obtain water from seasonal dams during the rainy season and buy water from HIMWA during the dry season. Table 26 shows the main sources of water for the AoI communities of Mokowe, Hindi and Jipe. Data for the other communities was unavailable.

Table 26: Water Supply in the Project Area.

Community	Water Supply*	Season
Mokowe	■ Boreholes (pastoralists and community) ■ Seasonal dams (pastoralists) ■ Ponds (pastoralists) ■ NGO (community) ■ Piped water (community)	n/a
Hindi	■ Seasonal dams (pastoralists) ■ Hindi Magogoni Water Association (HIMWA) ■ Piped water (community) ■ Kiosks ■ Water tanks	Rainy season Dry season
Jipe	■ Hindi Magogoni Water Association (HIMWA) (pastoralists) ■ Boreholes (community) ■ Piped water (community)	Rainy season (seasonal dams) Dry season (HIMWA)

Source: Focus Group Discussions

[6] An underground concrete well.

3.6.2.5 Other

Currently Lamu County has a variety of energy sources both for domestic, commercial and industrial use. Firewood (70.9%) and charcoal (22.8%) remain the main source of energy used for cooking purposes (KNBS, 2009).

Beekeeping in carried out in Jipe and Barigoni by individuals or on group farms. In Jipe, there are 15 beehives on the group farm, and an average of five or six on individual farms. In Barigoni, each beekeeper has an average of 10 hives.

Both man-made hives and natural hives consisting of holes in trees are used. Inputs required for the hives in Jipe include wood and nylon ropes, and in Barigoni axes (to cut branches), buckets and matchsticks are required. If constructed well, the hives used in Jipe typically last more than 10 years, and the traditional hives used in Barigoni last approximately two years.

The harvested honey is used for food, herbal medicine, and to brew alcohol. Honey is harvested twice per year, with generally more honey harvested during the rainy season because of increased availability of water and production of flowers. During the rainy season between 10 and 20 litres of honey is harvested per beehive, by comparison with only six litres during the dry season. It is sold in the market for KSh 450 per litre. The revenue from smaller beehives is commonly used to pay for school fees and other basic needs, although in Barigoni beekeepers sell 100% of their harvest since it is their only economic activity.

3.6.3 Cultural Ecosystem Services

Sacred sites in Barigoni includes Kwa Mwalimu, Jadha, Gela, Komuri and Araseli (Focus Group, Elders, Barigoni 2018; Appendix B). Community ancestors are buried at some of these sites, and visitors are not permitted to visit them.

3.7 Regulating Ecosystem Services

Regulating ecosystem services are provided on a landscape scale, and unlike provisioning and cultural ecosystem services, are not specifically linked to a particular vegetation community or habitat type. Regulating ecosystem services provided in the AoI include regulation of local climate via surface reflectance and evaporation; regulation of soil stability and erosion control; maintenance of the natural hydrological regime through regulation of water timing and flows, and groundwater recharge; and evaporation rates (Havstad *et al*., 2007; Safriel *et al.,* 2005).

Pollination is recognised as a Type I priority ecosystem service for local beneficiaries because of the Turkana people's reliance on wild fruits and seed pods as a source of food for themselves and livestock; whilst regulation of water flows and timing, and soil stability and erosion control are considered Type II priority ecosystem services for the Project, playing an important role in maintaining operational performance (e.g. prevention of floods and erosion reduces the amount of maintenance required for infrastructure like roads).

3.8 Supporting Ecosystem Services

Supporting services are the natural processes, such as nutrient cycling and primary production that maintain the other services. Some of the primary ecological functions of the AoI include the provision of habitat for climax vegetation communities and maintenance of fauna species populations; nutrient cycling and support of primary production and plant growth, thereby forming the base of the food chain; and water cycling. The support of primary production, such as fruits used as food by people, is considered to represent a Type I priority ecosystem service within the AoI. Furthermore, sustainable water cycling is considered to be a Type II priority ecosystem service upon which the Project is dependent. These ecosystem services are not tied to specific habitat types or vegetation communities but are supplied at an ecosystem/landscape scale.

As supporting ecosystem services have no specific/direct beneficiaries, and impacts to these are captured within the Provisioning, Cultural and Regulating categories, they are not included as a separate category in the impact assessment.

3.9 Summary of Priority and Non-Priority Ecosystem Services

A summary of the Ecosystem services provided in the AoI are presented in Table 28. The ecosystem services have been colour coded as per the following definitions (Landsberg *et al.,* 2014):

- Priority ecosystem services on which project impacts may affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries (Type I; highlighted in red text);
- Priority ecosystem services that could prevent the project from achieving planned operational performance e.g. water supply, regulation of flow and erosion control (Type II; highlighted in italicised *green* text); and
- Non-priority services (black text).

Table 27: Summary of Ecosystem Services Within the AoI

Provisioning	
Food from: ■ Livestock ■ Apiculture (bee keeping) ■ Arable, fruit and vegetable production ■ Fishing ■ Wild foods	■ Animals are raised for meat and milk; ■ Honey is produced for a food source, and in small-scale sales/trade; ■ Local communities grow crops, vegetables and fruit; ■ Fish are captured and used as a source of food and income; and ■ Edible plant species are gathered in the wild.
Trees	■ Trees are a source of shade for livestock; and ■ Bark and sap may be used for medicinal purposes.
Biomass fuel and timber	■ Firewood is gathered for personal and commercial benefit; and ■ Timber may be harvested for building and furniture making.
Freshwater	■ Water is required for human and animal consumption, together with irrigation, washing, and recreational uses.
Freshwater	■ Freshwater is obtained from local rivers (including Turkwel, Kerio, Barsaloi, Tana, Suyian, Seyia, and Nachola). Other water sources include streams, luggas, traditional wells, natural water pans, bore holes, and rainwater collection.
Natural medicines, perfumes and pharmaceuticals	■ Loonyeyok (gum from the Acacia Senegal tree) and honey is used as herbal medicine, and to enhance milk production in dairy cows; ■ A number of species of medicinal herb are available within the AoI, including aloe which is used to treat disease; and ■ Miraa, chewed for its stimulative effect.

Regulating	
Regulating water flows and timing	The AoI sits within a number of river catchments. These hydrological systems will regulate water run-off, influence ground water recharge and maintain the water storage potential of the landscape. The natural landscape is also likely to regulate flooding during intense rainfall events.
Controlling erosion	Current vegetative cover plays an important part in soil retention on steep slopes and managing scour and soil erosion throughout the year.
Regulating the water cycle	Water systems provide drinking and irrigation water to local villages. Current vegetative establishment controls suspended sediments and regulates the water cycle.
The role of ecosystems in pollination	There are abundant wildflowers growing within the AoI which are used by local bee colonies and which are likely to support crop pollination, for example pollination of fruit trees.
Cultural	
Recreational pleasure people derive from natural or cultivated ecosystems	Habitat within the AoI includes arable, standing/running water, forestry and grasslands. All of these ecosystem features have provided intrinsic recreational pleasure for users over a number of generations.
Educational and inspirational values	Generations of people will learn how to hunt, fish and forage within the AoI.
Ethical and Spiritual Values	Sacred sites and intangible cultural heritage, evident within the AoI, are intrinsically linked with natural ecosystems such as wetlands, rivers, lakes and forests. Some species of acacia trees are regarded as sacred and used during ceremonies and community members indicated that they should not be destroyed.
Supporting	
Supplying habitat	The AoI plays an important part in providing habitat for a large number of species, including some which are nationally protected or endangered at the e.g. Grevy's Zebra.
Primary production	Timber production is supported by the climate and appropriate growing conditions.
Water cycling	The AoI plays a part in sustainable water cycling.

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ANNEX II

D

Biodiversity Baseline Field Reports

D1 Mammals (Advanced Baseline)

D2 Aquatic Ecosystems (Advanced Baseline)

D3 Botany and Habitats (Advanced Baseline)

D4 Invertebrates (Advanced Baseline)

D5 Ornithology (Advanced Baseline)

D6 Herpetology (Advanced Baseline)

D7 Mammals

D8 Aquatic Ecosystems

D9 Botany and Habitats

D10 Mangroves

D11 Invertebrates (Terrestrial and Aquatic)

D12 Ornithology

D13 Marine Waters and Sediments

TECHNICAL MEMORANDUM

DATE 26 July 2018 **Project No.** 1772867

TO PPMT

CC Freddy Brookes

FROM Simon Aldrich, Gary Morris Iveson **EMAIL** saldrich@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – SITE VISIT REPORT: MAMMALS

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867.509.B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the long wet season, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening (Ecountability, 2017);
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted during the dry season and short wet seasons;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

For Mammals study, both direct observations and indirect methods were employed for sampling at each sampling location: AGI and those habitats identified before-hand.

In this advanced study, priority species were identified based on proximity to the LLCOP, access, habitat use,

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and potential for critical habitat. Such species include the threatened and migratory species including African Bush Elephants (ABE), Grevy's Zebra (GZ), Hirola, African Hunting dog, Tomb bat, Elephant shrew, Cheetah, Consen's gerbil rat, among others. Field observations were supplemented by the following techniques:

- Timed transect walks, which involve direct visual observation for any species occurring within the area for a specific period. The techniques include walking along 1 km long transect and observing 100 m either side of the transect line, use of binoculars, and instant identification of observed mammals and activities and using field guide in case of difficulty in identification. To standardize this per site, equal effort (time and tool) is deployed.
- Timed transect walks, which will involve in-direct observation for any species occurring within the area for a specific period. In this, signs of mammal tracks, droppings, wallowing site, foot prints are used to assign animal presence and activity at particular time and space.
- Bat acoustic and visual encounter surveys for bats in roosts were also conducted at suspected localities along LLCOP. The technique deployed involves use of hand-held heterodyne bat detector.
- Meetings and interviews with key informants such as game conservancies, Kenya wildlife officials and local inhabitants to find out the presence of priority mammal species in the targeted sites and their habitat use. To facilitate such discussions a field guide with pictures are used to show the officials and locals being interviewed.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Bernard Agwanda (BA).

2.2 Tasks completed

A brief summary of the field programme during the Mammal study is provided in Table 1.

Table 1: Mammal advanced baseline survey field programme

Date	Task	Location	Initials of team member attending
14/06/18	Travel	Nairobi-Nanyuki-Nairobi	BA
	Meeting with Save the Elephant officials and population data access	Nanyuki	BA
15/06/18	Meeting with Ben of Castor Vali discussing field logistics for Bio-team	Nairobi (my office)	BA
18/06/18	Travel	Within Nairobi	BA
	Meeting & data mining at ecological monitoring office	KWS	BA
21/06/18	Travel	South Nairobi city	BA

Date	Task	Location	Initials of team member attending
	Meeting on data access at Marwell Wildlife	Off Magadi road	BA
24/06/18	Travel	Nairobi-Isiolo	BA
25/06/18	Travel	Archer's, Post	BA
	Conduct mammal study on LLCOP	AGI15, 16	BA
	Habitat searches and data collection	At Eastern section of Sera conservancy	BA
26/06/18	Bat Acoustic survey along LLCOP	South of Shaba & at AGI17	BA
	Travel (afternoon) for a meeting with ZSL & Grevy's Zebra trust	Isiolo-Nairobi	BA
27/06/18	Meeting to receive data from Marwell Foundation, Grevy's zebra trust and ZSL	At IUCN centre, off Magadi rd, Nairobi	BA
	Travel in afternoon	Nairobi-Isiolo	BA
28/06/18	Assessed elephant & wild dog habitat on LLCOP	At AGI-14, 13	BA
	Assessed elephant dispersal corridor on LLCOP	At Namunyak, Kalama	BA
	Travel	Wamba-Archer's post	BA
29/06/18	Assessed Grevy's dispersal habitat in Swari-Barsaloi (Seyan R, cut off road)	Swari (NW of Wamba)	BA
	Interview with Grevy's field scouts & identified Weaning areas	Seyan River	BA
30/06/18	Identification of key feeding and watering points for Grevy's, elephant and hunting dog	Westgate, Namunyak	BA
	Meeting with snr Chief, Koitang Location & Game scout	Westgate	BA
	Study and Travel	Wamba-Isiolo	BA
01/07/18	Travel	Isiolo-Garissa	BA
02/07/18	Meeting with Garissa County AP commandant and Deputy Mr Ibrahim security planning (morning)	Garissa	BA

Date	Task	Location	Initials of team member attending
	Field survey for Giraffe's feeding habitats & bat roosting sites	10Km south of Garissa town	BA
	Meeting with AP Commandant-Garissa to pay for security and plan future security escorts for Dickens (evening)	Garissa	BA
03/07/18	Travel	Garissa Nairobi	BA

2.3 Deviation from Planned Scope of Work

- An invitation to a meeting with Managers of Marwell Widlife Foundation, Grevy's zebra trust in Nairobi, on 27 June morning in Nairobi to obtain data on Grevy's zebra data forced me to return to Nairobi from Isiolo. This went fine and I got valuable data on population, dispersal areas and sensitive areas.
- On the 29 June 2018 the high waters in R. Seyan stopped our plan along LLCOP north wards towards Barsaloi to assess dispersal and migratory route for Elephant and Grevy's zebra breeding sites between Seyan and Suiyan Rivers near Barsaloi. Because of limited time provided for mammal work, I could not re-route even the following day. The study on this section of LLCOP is important to understand fine detail on migratory routes by these two threatened species as in KWS data, Grevy's Zebra trust reports when the rivers are down or detour from Maralal.
- Due to insecurity at Rahole/Bisanadi area (as advised by the security advisor), we could NOT assess breeding activity of gerenuk north of Meru. Rohole is historically known breeding site for Gerenuk and lesser kudu during wet season. Confirmation of this would greatly help timing of construction of on the LLCOP.
- Sections on the LLCOP between Garissa and Lamu despite being potential critical habitat based on presence for threatened and endemic mammal species (e.g Cheetah, Hunting dog, Hirola, Elephant shrew, elephants, Sokoke Mongoose), could not be studied due to insecurity.
- Planned mammal study along LLCOP around R. Kerio intersection and Suguta valley has been cancelled and thus we were unable to assess presence of endangered bat and rodent. Habitat use by Leopard, stripped hyena and primates could not be assessed too.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Swari/*R.* Seyan area *(North West of Wamba)*

Site aim: The aim here was to ascertain whether the habitat along LLCOP is used by African bush Elephant (ABE), Grevy's Zebra (GZ) for migration, dispersal and breeding and thus can trigger critical habitat status.

Observation: records were limited by the flooded Seyan river and thus the team could not go beyond it, GZ and elephant populations are relatively small SE of Seyan River but more between these rivers. Suiyan and Seyan rivers is not key watering site along LLCOP (of course) during wet season such as now but is key other

times, as the rivers water exists in pools and not continuous flow. **These pools need to be identified and verified using records provided by Marwell Wildlife and Grevy's zebra trust.**

Other mammals observed within this stretch include, plain zebra, Gunther's dikdik, Olive baboon among others.

Because of livestock keeping occupation of locals and as the only land use, vegetation along the LLCOP in between Wamba and Swari area is extensively hedged showing considerable modification even at this time of extended rains. This has had extensive habitat modification effect to the extent only pockets useful for these endangered species: Gz and ABE. Visual appreciation of this is provided in pictures below. In light of this and possibility of vegetation clearance during pipeline construction, Habitat condition assessment of Natural/modified habitat is necessary, especially areas that will host pipeline pump stations.

Figure 1:Observed modified GZ habitat with invasive plants on LLCOP; more trees, less grass even in wet season & no GZ currently	Observed fairly natural GZ habitat NW of Wamba along LLCOP; more grass, less trees, no invasive species

West Gate

Notable observation at the point where the LLCOP enters Westgate conservancy is weaning, feeding and watering sites. The proposed line lies exactly on the route between feeding and permanent watering site at Kule River near the entrance of West Gate entrance on Wamba-Archers road.

GZ feeding/weaning habitat on LLCOP, **(**foal and mothers in background)	>1month old dug of ABE at Kule permanent watering point	Kule watering point for GZ, ABE & other wildlife right on LLCOP in Westgate

The watering site is permanent, according to the Local Chief and is also a watering site for many other wildlife including elephant, hunting dog among others during dry season. We observed evidence for this for only

ABE, GZ but not for hunting dog (specific site GPs provided in datasheet). That being the case, **a camera trap session needs to be conducted around this point** to ascertain with certainty the use by all these threatened species: ABE, GZ, hunting dog and other species. Additionally, **water quality** of this site be monitored before during and monitored after LLCOP construction. More importantly, it would be prudent to establish if the site is also **mating and calving** ground for GZ.

Namunyak

On sections of LLCOP through Namunyak especially AGI-14, elephants were observed at the foot of the hills with fresh elephant dung (< 2days) in each of the 3 days spent in this section. ABE are known to prefer to stay in open bush on the plains or hillside during wet season. This helps to keep them warm away from dripping water from the tree canopy. In dry season (often hot too), they shift to thick bush or forest up the mountains and valley bottoms where there are plenty of food and shade from hot sun. It is reasonable to conclude that they use frequently the plains between hills during wet season. This should be taken into account in timing construction of LLCOP at this section especially.

It was noted that Wild dogs (threatened species) frequently disperse Southwards to Samburu park in wet season across the LLCOP during wet season and revert to Wargess range in the north in dry period. They do so through a fairly sheltered dry lugga between the hills. This route reported by Namunyak game rangers should be **verified using camera trap** at the point where it crosses the LLCOP near AGI-13, & 14. A clearance for LLCOP construction may influence hunting and dispersal behaviour of these endangered species.

Fresh<1day old dung indicating active use of habitat between hills(GPS: 37N 0331001; 0089052)	Grassy plains between hills preferred by ABE during wet seasons	Reported Hunting dog connectivity habitat on LLCOP near AGI-14 between dry and wet season feeding areas

Kalama and Sera Conservancy (north of Archer's Post)

Notable observation on LLCOP around these conservancies was a watering and salting point for many animals including ABE. Though the point is only within buffer of LLCOP, elephants cross from Kalama on the SW to this point-Lasoro river in NE within Sera Conservancy (GPS: 37N 0345295; 0078504). The exact point of crossing the LLCOP was not clear in this rapid survey and timing was also not easy to establish though a local guide, Mr. Albert Seroi & Lellan Wani reported evening and night journeys from Kalama to the Larsoro.

LLCOP is observed to pass through a section which is at the time of this advanced survey, is intensively used by a large herd of elephants for watering and foraging. The water point is a man-made water pan by Wamba-Archer's road. The daily use of this water pan by large herd was evident during the study, as piles of fresh dung around the pan.

Elephant daily watering point (GPS: 37N0331595; 0088680), many fresh & old dungs litters around the water	{Close-up photo of the dung} By counting fresh (the night-before study) dung, an estimate of at least 15 individual elephants visited here hours before we arrived on 30/6/2018

Archers post (between Shaba and Buffalo springs)

An active dispersal and habitat use by wild dogs, striped hyaena Rahole, baboons and bush/tree dependent Senegal galago at AGI-15 & 16. The latter is a nocturnal primate, also placed in appendix 1 of the Convention on international Trade on Endangered Species (CITES), just like other primates. Wild dogs uses this corridor to move between Buffalow springs/Samburu in SE and Shaba National Park in NE to minimize chances of conflict with pastoralists. This area (AGI 16) especially needs to further monitoring (for wildlife movement) as it is the shortest distance also the elephant need to move between these two protected aras.

Foot print of striped Hyaena at AGI-16, Ewaso Nyiro river bank	<1 week old elephant dung indicating habitat use around AGI-16	<1day fresh foot print of a baboon at AGI-16(btwn Shaba & Buffalo springs) Ewaso Nyiro river bank

Kula Mawe (AGI-17)

As was predicted during planning this advanced baseline study, Genenuk with kids were observed in hilly plains between Isiolo and Bisanadi around AGI-17. Generenuk perhaps prefers this habitat due to its semi open bushed grassland, low density of livestock and tall grass where they can hide their young in case of predators attack. Clearance of clustered thorny bushes especially during weaning period may thus affect breeding success of this species.

A mother Gerenuk watching us, with a sub adult behind the bush near LLCOP, AGI-17	Typical Gerenuk calving habitat structure in wet season around LLCOP, AGI-17

Garissa

Notable observation on LLCOP around Garissa presence of Giraffe with semi adult hear next their family. Yearlings were not observed as was expected. Due insecurity limitations we could survey far south where reticulated Giraffe is expected to be calving young ones born this year or late last year. Those observed 10 km North of Garissa town were all adult and sub adults. Similar group structure was observed towards R. Tana

Sub-adult giraffe on buffer of LLCOP near Garissa	Adult giraffe feeding on buffer of LLCOP near Garissa

3.2 Key Observations for ESIA

- Calving habitat for the endangered Grevy's zebra between Seyan and Suiyan River and around west gate appears fragile, modified already. Any further ecological disturbance must be screened for direct and indirect impacts on the endangered zebra.
- The watering point during dry season for threatened mammals (GZ, ABE, and hunting dog) is a potential critical habitat (awaiting for confirmation through a site based study) located on the LLCOP north east of AGI14.
- The preliminary data in this study also suggest that proposed AGI-16 is a dispersal area for a number of mammal species between Shaba and Buffalo springs. Development activities in this area must take into account the wildlife component.

- The daily traffic of large herds of elephants to a water pan near AGI-14 may influence timing of construction works at LLCOP at such times of the year or season.

3.3 Meetings and Discussions

The following meetings and discussions took place during the study:

- Meeting between Bernard Agwanda (BA) and Dr Ben Okita of Save the elephant on elephant data along LLCOP on 14 June 2018;
- Meeting between BA and Ben of Castor Vali on 15 Jun 2018 in BA's office, to discuss logistical dynamics of field work by Bio-team;
- Meeting between BA and Dr Shaddrack Ngene of KWS on biodiversity data along the LLCOP on 18 Jun(face-to-face) and on 21 June 2018(telephone);
- Meeting between BA and Sandy Oduor, former Save the elephant field officer on elephant data and migration patterns in Samburu on 14 June 2018;
- On 21 Jun 2018, a discussion between BA and Dr Zeke and Clarine of Merwell Wildlife trust on availability of Grevy's zebra's data for Samburu area;
- A meeting between BA and officials from Grevy's Zebra Trust & ZSL on 27 June 2018 in Nairobi was held in Nairobi;
- Meeting between BA and Grevy's zebra trust scouts In Swari to identify calving grounds along LLCOP;
- Meeting between BA and the Senior Chief Koitang Location & Game scout to explain the purpose of study and to help study team identify GZ, ABE and hunting strong holds; and
- A meeting was held on 2 July 2018 at 8am between BA and Garissa County AP commandant to discuss security planning for Bio-Team.

Note: Those meetings guided sites for observations made, acquisition of data especially on GZ, community acceptance of our study and more importantly potential avoidance of hostility by locals.

3.4 Health and Safety learnings

Based on field-team coordination and personal field study experiences, BA identified and communicated the following health and safety learnings:

- Due to safety reasons, field personnel should work as teams as far as practicable especially in remote areas where tyre puncture, vehicle brake down can be a challenge.
- Areas around North of Baragoi on the LLCOP and north of Isiolo have sporadic cattle rustling that have potential to degrade into banditry that can pose serious security risks. Careful examination of security situations with local administrations is essential on daily basis before working in such areas.
- Case-by-case security escort to Bio-team worked fairly well in the advanced study, but posed efficiency challenges. This might not be good for full field survey. A special security team (unit) dedicated to Bio-team can be arranged complete with vehicles so that each morning they know who and where to work. Additionally, the security officers can be inducted to align them to the Bio-work.
- Sharp bends and steep slopes on some roads especially between Meru and Mwingi through Embu was identified as areas requiring careful driving. Drivers need to be appraised before driving in these roads and warned to be careful and not to over speed.

- Outbreak of Rift valley fever virus in Isiolo, Wajir, Garissa, Tana river was identified as health risk to Bio-team. Personal discipline to avoid meet products, personal hygiene to wash hands after interacting with locals environment including people were reasonable mitigation measures. Carrying sanitizers, water and soap in the car to manage personal hygiene is recommended.
- Because personal minor accidents such as a cut by rock, thorn prick cannot be entirely avoided, it is important that all vehicles be carrying fully loaded First Aid Kit to manage such accidents in the field.
- Communication is important t for both safety and health, use of satellite phones by field team is essential in case GSM based phones lose signals.

3.5 Gaps and Recommendations for full baseline data gathering

This advanced field study aimed identifying mammal-based ecological sensitivities that emerged during the long wet season along the proposed LLCOP and which could guide planning full field study.

True to this objective a number of ecological issues regarding mammals were identified in the study especially those touching on threatened species that can trigger critical habitat status as in IFC 2012; PS6.

However, a number of information and data gaps remain to the extent that impact assessment is not possible yet essential.

- We identified weaning area for a sub population of the endangered Grevy's zebra in Mweibai/ Westgate conservancies on the LLCOP but breeding site (mating and giving birth) is not clear from data received from Merwell or Grevy's Zebra trust, either. This missing information is critical in assigning critical habitat associated with the species in all its range including Barsaloi/Baragoi sections of the LLCOP.
- Besides, report from local chief and observed traces of old dung, there is no firm verifiable data on the reported permanent watering and salting site for Grevy's Zebra and elephant identified in Kule river in Samburu on the LLCOP. Certainly, this is a potential critical habitat on the LLCOP that needs to be verified through a focussed camera and direct observations.
- Similar critical watering points for the endangered Grevy's zebra north of Wamba need to be identified.
- A stretch of section on the LLCOP around AGI-14 have evidence of recent and frequent elephant grazing and watering at the time of this advanced study. It is not clear whether this happens all year around or it is seasonal.
- While it known that wildlife species disperse between Shaba and Buffalo Springs/Samburu National Reserves, little data elaborate which species and what time. In this study traces of evidence of elephant, hunting dog and possibly striped hyena. This information gap need to be addressed to guide constriction at AGI-16.
- Advanced study on sections of LLCOP between Garissa and Lamu was cancelled due to security reasons. This has left a wide knowledge gap regarding how the LLCOP may affect the habitat of threatened species with potential to trigger critical habitat status including:
    - Hirola, *Beatragus hunteri* (Critically Endangered, IUCN 2018);
    - Aders duiker, *Cephalophus adersi* (vulnerable, IUCN 2018, Nationally endangered, KWS 2013);
    - Golden-rumped elephant shrew, *Rhynchocyon chrysopygus* (Endangered, IUCN 2018 & endemic);
    - Tomb bat, *Taphozous hildegarddeae* (vulnerable & near endemic IUCN 2018);

- Sokoke dog mongoose, *Bdeogale omnivore* (endangered & endemic IUCN 2018);
- Hunting dog, *Lycaon pictus* (endangered, IUCN 2018);
- Cheetah, *Acinonyx jubatus* (vulnerable, IUCN 2018, Nationally endangered, KWS, 2013); and
- African Bush Elephant, *Loxodonta Africana*, (vulnerable, IUCN2018, Nationally endangered, KWS2013).

- The stretch of the proposed pipeline corridor between Turkana upstream and Suguta valley was also not studied yet expected to host threatened species of mammals including leopard, Cosen's gerbil rat and vulnerable Tomb Bat.

Recommendations

- A survey to identify dependable watering holes, dispersal routes/time and breeding habitats for Grevy's zebra along the LLCOP between Namunyak Conservancy and Baragoi. Camera trapping and ground trothing can augment existing data from stakeholders.
- A verification survey on sections of the LLCOP observed to be extensively used by large herds of elephants around AGI-14 and identify timings to guide LLCOP construction timings.
- Inventory survey to identify species, timing and exact spot used by dispersing mammals between Shaba and Buffalo Springs National Reserves around LLCOP, AGI-16.
- 2 individual Gerenuk were observed feeding with young kids, a survey to identify how critical the LLCOP section is to the population at such time of the year or season would important for subsequent impact assessment.
- Sections on the LLCOP not covered in the advanced study are certainly key to biodiversity of Kenya as pointed in the eCountability 2017. They need to be covered to understand their presence, habitat use along the proposed LLCOP.

Freddy Brookes
Senior Ecologist

Simon Aldrich
Project Manager

SA/FB/gg

TECHNICAL MEMORANDUM

DATE 25 July 2018 **Project No.** 1772867.527/B.0

TO Alex Mayhook-Walker, PPMT

CC Freddy Brookes

FROM Simon Aldrich, Gary Morris Iveson **EMAIL** saldrich@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – SITE VISIT REPORT: AQUATIC ECOSYSTEMS

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867 509.B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

2.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867 509.B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted during the dry season and short wet seasons;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

The methods listed below were employed at those locations where obvious surface water habitat is present during the survey. The key objective was to map and understand potential connectivity within the pipeline AOI, which could potentially be impacted by pipeline construction during the wet seasons and also check the likelihood (or otherwise) or potential critical species, some of which are considered data deficient (eg the Turkana Toad in the northern area of the route) but may feasibly be present in the study area.

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- Watercourses
  - Measurement of in-situ water quality parameters at each sampling location (pH, dissolved oxygen (DO), electrical conductivity (EC) and water temperature).
  - Sediment sampling.
  - Habitat integrity and suitability assessments.
  - Sampling of fish using netting as appropriate.
  - Sampling of diatoms: these were scraped from underwater stones/plant detritus and preserved for analysis.
  - Sampling of aquatic macroinvertebrates from stream/river microhabitats using fine-meshed nets and kick-sampling method. Selected groups of aquatic invertebrates for focus include: Coleoptera (beetles); Odonata (dragonflies and damselflies); Trichoptera (caddisflies); Hemiptera (true bugs); Ephemeroptera (mayflies).
- Wetlands
  - Ground truthing the extent of wetland boundaries in the context of the pipeline appropriate area of influence (AOI) as exhibited in the wet season context.
  - Mapping the extent of hydrophilic vegetation in the selected areas.
  - Taking soil cores to confirm wetland boundaries through assessing soil wetness characteristics.
  - Recording of the wetland position within the landscape.
  - Mapping of features impacting wetland integrity (for example, overgrazing by cattle, human-use impacts, such as reed harvest).
- The Team included the main pipeline river crossing at Arthurs Post during this advanced baseline survey, taking account of river conditions and crocodile presence. This is at a point impacted by existing human activities, although other potential aquatic areas will not be so subject to disturbance.
- The Aquatic connectivity of the seasonal river systems related to the Tana river will not be included in this advanced baseline field programme, due to the security implications to the south of Garissa.

3.0 FIELD PROGRAMME SUMMARY

3.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Dickens Odeny (DO).

3.2 Tasks completed

A brief summary of the field programme during the aquatic ecosystem visit is provided in Table 1.

Table 1: Programme during the aquatic ecosystem visit

Date	Task	Location
11 June 2018	■ **9.08 am** Departed for Isiolo from Nairobi.	Nairobi
	■ **4.13 pm** Arrived in Isiolo and checked in Bomen Hotel.	Isiolo
12 June 2018	■ **8.28 am** Left Isiolo for Baragoi through Maralal Town.	Isiolo
	■ **8.10 pm** Arrived at Baragoi and checked in at Bonsela Garden.	Baragoi
13 June 2018	■ **8.04 am** departed hotel for sampling point in Lugga located in Nachola Location at Latitude 1.764047, Longitude 36.680533. ▪ Water quality on pools TSS, Temperature, Conductivity. ▪ Sediment coring and collections. ▪ Infauna assessment in sediment cores. ▪ Aquatic microbenthic invertebrate observation. ▪ Riverine tree species observation. ▪ Lugga use by terrestrial fauna and livestock (ecosystem services). ▪ Lugga topography (cross-section) assessment.	Baragoi lugga, Nachola Location
	■ **9.30 am** Coincidental meeting with Kalomdang conservancy Rangers in charge. They presented their concern over crossing of the crude oil pipeline corridor through their conservancy. Security of the area is still not guaranteed as attacks of different form can take place anytime. They offered to provide security and show us track roads leading to the sampling point. ■ **1500 Hr;** Departed from lugga urgently to take the conservancy warden back to the conservancy after receiving an emergency call over the radio. ■ **1544 Hr:** Arrived at Baragoi at Bonsela Garden.	
14/06/2018	■ **0759 Hr:** Departed for Suiyan from Baragoi. ■ **0920 Hr:** Arrived at Suiyan lugga at point of interest and started with measuring water quality, followed by sampling macrobenthic invertebrates, aquatic infauna, fish species and taking sediment cores. Making observations on riverine vegetation, other taxa	Suiyan lugga

Date	Task	Location
	interacting with the lugga such as birds, mammals, amphibians and reptiles. Visited suiyan village located approximately 2 km away from lugga. I interviewed one of the elderly local resident Mr. James Lekarapiti (0706363283) who mentioned the area is within Kusyambu ranges conservancy. The lugga was indicated as a lifeline to both local resident's domestic use and livestock water. Also, it's a place where wild animals drink water importantly during dry season from the shallow dugout wells on lugga bed. The lugga banks provide salt licking points for both livestock and wild herbivores. ■ **1450 Hr:** Left lugga for Baragoi. ■ **1613 Hr:** Arrived at Baragoi at Bonsela Garden.	
15/06/2018	■ **0813 Hr:** Departed for Barsaloi from Baragoi. ■ **1005 Hr:** Arrived at Barsaloi lugga at point of interest and started with measuring water quality, followed by sampling macrobenthic invertebrates, aquatic infauna, fish species and taking sediment cores. Making observations on riverine vegetation, other taxa interacting with the lugga such as birds, mammals, amphibians and reptiles. I interviewed local residents met on lugga; Mr John Losike (0710802209) and Mr. Simon Leaburwa (0708857176). I interviewed them and discussed the importance of the lugga to the local community and wildlife, seasonality of the lugga. They mentioned that elephant movement (migration) along the lugga is associated with the seasonality of the lugga. Besides domestic use of water and for livestock, locals harvest sand from lugga for selling. One tonne of sand is sold at KES 8,000 and the proceeds are used on disadvantaged people like the old group and orphans. A borehore is dug near the bank of the lugga and pumped to near local school and center. The water is sold at 20 litres at KES 5 and money is used for buying fuel for generator and maintaining the pump. ■ **1528 Hr:** Left Barsaloi lugga for Baragoi. ■ **1740 Hr:** Arrived at Baragoi.	Barsaloi lugga
16/06/2018	■ **0836 Hr:** Departed from Baragoi center for North West of Nachola location where AGI 07 is located. ■ **0921 Hr:** Met administrative chief of Nachola location at Nachola village. He joined us together with the village elder of the area we	Nachola lugga (near AGI 07)

Date	Task	Location
	were visiting to the field for security reasons. Chief's name Christopher Lokarach (0703 379188). ■ **1004 Hr:** Arrived at an outlet lugga of basin where AGI is located and crude oil corridor crosses over. The lugga is dry and only has very few pools with water some are left with mud layers. The following activities were carried out in the lugga: ▪ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ▪ Sampling macrobenthic invertebrates and aquatic infauna; ▪ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ▪ Making observations on riverine vegetation; ▪ Observing how other taxa interact with the lugga (e.g. birds, mammals, amphibians and reptiles); and ▪ Assessing ecosystem services of the lugga. ■ **1626 Hr:** arrived at Baragoi center.	
17/06/2018	■ **0938 Hr:** Departed from Baragoi center for Seiya River (lugga) in Serrim Sublocation. ■ **1134 Hr:** Arrived at Seiya lugga. The lugga is full on a normal flooding regime. The following activities were carried out in the lugga: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ measuring water quality; ✓ Sampling macrobenthic invertebrates and fish; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain; ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the lugga (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the lugga and had discussion with Mr. Lekaaso Lmasion (0713097374) and Mr. Sotinai Letoisoni. ■ **1700 Hr:** Left Lugga for Baragoi. ■ **1905 Hr:** arrived at Baragoi center.	Seiya lugga

Date	Task	Location
	■ **1930 Hr:** Refueling the vehicle for tomorrow's early departure at 0600 Hr for Silanga-Nanyukie sampling point in Wamba.	
18/06/2018	■ **0600 Hr:** Departed from Baragoi center for Silanga-Nanyukie River (lugga) in Wamba through Maralal town. ■ **1134 Hr:** Arrived at lugga in Silanga-Nanyukie area. The lugga is full on a normal flooding regime. The following activities were carried out in the lugga: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ measuring water quality of pool waters; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the lugga (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the lugga through observation and discussions with some local residents. Had a discussion with Mr. Philemon Lakortot (0710 762656), Leshimbre Sian and Elisi Lengopia (Namunyak Conservancy Ranger – 0712 502195). ■ **1600 Hr:** Left Lugga for Archers Post. ■ **1705 Hr:** arrived at Archers Post but left shortly for Isiolo to refuel and buy some field consumables center. ■ **1830 Hr:** Arrived at Archers Post and checked in at the Great County Lodge. ■ **Note:** Tomorrow's surveying site is Ngaroni Location in Wamba	Silanga-Nanyukie lugga
19/06/2018	■ **0900Hr:** Left Archers Post for Baa lugga (Ngaroni) together with Linda Ware ■ **1000 Hr:** arrived at the lugga**:** ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ measuring water quality of pool waters; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain);	Baa lugga (Ngaroni)

Date	Task	Location
	✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the lugga (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the lugga through observation. ■ **1530 Hr:** Left Lugga for Archers Post. ■ **1640 Hr:** Arrived at Archers Post and checked in at the Great County Lodge.	
20/06/2018	■ **0800 Hr:** Left the Great County Lodge for sampling in Ewaso Nyiro River together with Linda Were. ■ **0820 Hr:** arrived at the river worked on the upstream and center of the corridor: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ measuring water quality; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the lugga through observation. Had a discussion with the owner of Umoja Camp Restaurant on benefit the facility gets from frontier to the river. ■ **1500 Hr:** Left Lugga for Archers Post. ■ **1515 Hr:** Arrived at Archers Post and checked in at the Great County Lodge.	Archers Post
21/06/2018	■ **0815 Hr:** Left the Great County Lodge for sampling in downstream of project corridor in Ewaso Nyiro River. Accompanied by Linda Were ■ **0835 Hr:** arrived at the river worked on the downstream of the corridor: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ measuring water quality; ✓ Sampling macrobenthic invertebrates;	Archers Post

Date	Task	Location
	✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. Had a discussion with the owner of Lion's Cave Restaurant on benefit the facility gets from frontier to the river. ■ **1200 Hr:** Left for Loibor-Ngare water pan in Archers Post. ■ **1230 Hr:** Arrived at Loibor-Ngare water pan: ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1530 Hr:** Left the water pan for the Great County Lodge. ■ **1600 Hr:** Arrived at the Great County Lodge.	
22/06/2018	■ **0900 Hr:** Took Linda Were to Samburu Oryx Airstrip. ■ **1100 Hr:** Arrived back at the hotel. Sorting out sample for the rest of the day.	Archers Post
23/06/2018	■ **0750 Hr:** Left for lugga in Koiting (near AGI 14). ■ **0840 Hr:** Arrived on site and started working: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain; ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1130 Hr:** Finish making observation and departed for Baragoi. ■ **1800 Hr:** Arrived in Baragoi Center.	On transit to Baragoi
24/06/2018	■ **0800 Hr:** Left Baragoi for Ngwasi lugga. ■ **1000 Hr:** arrived at the lugga:	Ngwasi lugga

Date	Task	Location
	✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1600 Hr:** Left the water pan for Baragoi center. ■ **1800 Hr:** Arrived at Bonsela Hotel.	
25/06/2018	■ **0800 Hr:** Left Baragoi Bonsela hotel for Rareiti water pan. ■ **0930 Hr:** arrived at the water pan: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Measuring water quality; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1300 Hr:** Left Bonyeke lugga (New 03). ■ **1400 Hr: Arrived at Bonyeke lugga:** ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling for macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation.	

Date	Task	Location
	■ **1630 Hr:** Left Bonyeke for Baragoi center. ■ **1730 Hr:** Arrived at Bonsela Hotel.	
26/06/2018	■ **0800 Hr:** Left Baragoi Bonsela hotel for Siteti lugga (New 04). ■ **0900 Hr:** arrived at the lugga: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1100 Hr:** Left Siteti lugga (New 04) for Kaolet lugga (New 05). ■ **1130 Hr:** Arrived at Kaolet lugga: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling for macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1400 Hr:** Left Kaolet lugga (New 05) for lugga in Marti (New 06). ■ **1430 Hr:** Arrived at lugga in Marti (New 06): ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling for macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and	Siteti, Kaolet and Marti

Date	Task	Location
	✓ Assessing ecosystem services of the river through observation. ■ **1630 Hr:** Left lugga in Marti (New 06) for Baragoi center. ■ **1710 Hr:** Arrived at Bonsela Hotel	
27/06/2018	■ **0800 Hr:** Left Baragoi Bonsela hotel for lugga in north of Marti (New 07) ■ **0910 Hr:** Arrived at the lugga in north of Marti (New 07): ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1200 Hr:** Left lugga in north of Marti (New 07) for a water pan in North of Marti (New 08). ■ **1230 Hr:** Arrived at the water pan lugga: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga;; ✓ Measuring water quality parameters ✓ Sampling for macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1600 Hr:** Left the water pan lugga for Baragoi. ■ **1700 Hr:** Arrived at Bonsela Hotel.	Marti Sublocation
28/06/2018	■ **0900 Hr:** Departed Baragoi for Archers Post. ■ **1500 Hr:** Arrived at Archers Post and stayed at Great County Lodge.	Travelling only

Date	Task	Location
29/06/2018	■ **0830 Hr:** Left Great County Lodge for lugga in Naathu (near AGI 17). ■ **1010 Hr:** Arrived at the lugga in Naathu (Near AGI 17): ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1500 Hr:** Left lugga in Naathu for Isiolo. ■ **1700 Hr:** Arrived at Boman Hotel, Isiolo.	Naathu
30/06/2018	■ **0810 Hr:** Left Boman Hotel for lugga in Kula Mawe. ■ **1010 Hr:** Arrived at lugga in Kula Mawe: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1500 Hr:** Left lugga in Naathu for Isiolo. ■ **1700 Hr:** Arrived at Boman Hotel, Isiolo.	Kula Mawe
01/07/2018	■ **0850 Hr:** Left Boman Hotel for lugga at North west of Archers Post (Point 1). ■ **0930 Hr:** Arrived at lugga in North west of Archers Post (Point 1): ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates;	North west of Archers Post and Maua

Date	Task	Location
	✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1200 Hr:** Left lugga in North west of Archers Post (Point 1) for Maua. ■ **1720 Hr:** Arrived at Ikweta Country Inn, Maua.	
02/07/2018	■ **0820 Hr:** Left Ikweta Country Inn for water pan in Garbatula. ■ **1030 Hr:** Arrived at water pan in Garbatula: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Measuring water quality parameters; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1510 Hr:** Left water pan in Garbatula for Maua. ■ **1640 Hr:** Arrived at Ikweta Country Inn, Maua.	Garbatula
03/07/2018	■ **0900 Hr:** Departed Maua for Garissa Town. ■ **1700 Hr:** Arrived in Garissa Town and stayed at Nomad Hotel.	Travelling only
04/07/2018	■ **0800 Hr:** Left Nomad Hotel to meet the Assistant Administrative Police Commandant, Isiolo Mr. Ibrahim. ■ **1030 Hr:** Left with two Police for Tana River stretch near Garissa town: ✓ Sampling macrobenthic invertebrates; ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and	Tana River, Garissa

Date	Task	Location
	✓ Assessing ecosystem services of the river through observation. ■ **1430 Hr:** Returned to Nomad Hot.	
05/07/2018	■ **0800 Hr:** Left Nomad Hotel to meet the Assistant Administrative Police Commandant, Isiolo Mr. Ibrahim. ■ **1000 Hr:** Left with two Police for lugga Bour-Algi near Garissa town: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Sampling macrobenthic invertebrates; ✓ Taking sediment cores for sampling aquatic infauna and laboratory analysis (PAHs and sediment grain); ✓ Making observations on riverine vegetation; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1310 Hr:** Left lugga for Ziwa, an oxbow lake near Tana River: ✓ Taking measurement of river physical characteristics of river/lugga such as: width and height of normal and extreme flooding of lugga; ✓ Measuring water quality parameters; ✓ Sampling macrobenthic invertebrates; ✓ Observing how other taxa interact with the river (e.g. birds, mammals, amphibians and reptiles); and ✓ Assessing ecosystem services of the river through observation. ■ **1530 Hr:** Returned back to Nomad Hot.	Bour-Algi, Garissa
06/07/2018	■ Stayed in the hotel sorting out samples, ensuring labels are intact, making data inputs in spreadsheet.	Nomad Hotel, Garissa Town
07/07/2018	■ **0800 Hr:** Departed Garissa for Nairobi. ■ **1300 Hr:** Arrived in Nairobi.	Travelling only

3.3 Deviation from Planned Scope of Work

Sampling at Nachola was proposed to be on 12 June but the day was spent on travelling. Therefore, it was sampled on 13 June. Thus, visiting of sampling point scheduled on 13 June was done on 14 June. This pushed

subsequent activities to the next day. The Journey management plan (JMP) was revised to address the changes already on the sampling schedule.

4.0 OBSERVATIONS FROM FIELD WORK

4.1 General observations made during fieldwork

Descriptions of physical morphology of the hydrological features such as depth of river or lugga and pool of water, cross-section width of the low surface water flow which was used for calculating potential lugga or river discharge rate. Lugga bed substrates and banks were characterised based on the dominant material formations. Estimation of lugga or river slope (%) was conducted within the project area of hydrological influence. The potential lugga flow velocity (dry lugga) was inferred from the relationship of flow height (depth) with velocity of measured lugga.

4.2 Water quality Parameter

Water quality parameters that were measured were pH, temperature, total dissolved substance, and electrical conductivity. An average measurement of three points was used; one at the centre of the proposed oil pipeline corridor, another one in upstream and the third one located downstream of the corridor.

4.3 Aquatic Macrobenthic Invertebrate survey

A pond net was used for sampling the aquatic macro-invertebrates by dragging the net at the bottom of the river and water pools in lugga. The collected litters and sediment at the bottom were transferred into a basin where the organisms were searched by washing the litter and sediments to reveal their presence. Additional physical observations were conducted for invertebrates that swim on the surface or at the benthic habitat.

4.4 Aquatic Infauna survey

Sediment was cored on the river or lugga (as appropriate) bed between 0 to 40 cm deep to observe presence of live or dead parts of aquatic infauna. This group of invertebrate consist of organisms that burrow into the river or lugga bed as part of their ecological behaviour. Sediments cored at intervals of 0-20cm and 20-40cm were raised and transferred to a sorting tray for identification.

4.5 Fish sampling survey

Sampling of fish was carried out on permanent rivers and lugga's with pools of water during rainy season. Non-selective gill nets were used for sampling fish communities. This has an advantage of its flexibility to sample in small and large water bodies, deep and shallow waters. The net was set near the banks of river/streams and at the middle part of the river channel. It was also deployed on large pools in lugga habitats.

4.6 Other taxa survey

Wetland fauna were also recorded by physical observations, footprints, calls and local residents anecdotal accounts. This group included reptiles and amphibian, bird species, mammals and terrestrial invertebrates.

4.7 Riverine vegetation survey

Riverine vegetation was considered to be plants or tree species with a distribution that is largely associated with proximity to river or lugga systems (riparian). Vegetation on the banks of a river or lugga were recorded by walking approximately 1 km along the feature within a likely zone if influence defined by the project. Physical observation was used for identification of species. Photographs were taken for unique tree species or vegetation formations occurring in the riparian system.

4.8 Ecosystem services survey

The ecosystem services of drainage systems (river, lugga and wetlands) were assessed based on four types of services. Physical observation and discussion with the local communities played important role in highlighting these services.

4.9 Specimen Preservation

Preservation of specimens was only conducted for fish species where there was little or no recorded occurrence in the region. Other species were captured and released or physical observations made and information recorded. Formalin was used diluted with water at a ratio of 1:10, in order, to provide optimum condition for preservation of fish specimens where required.

Table 2: Photographic Records of Field Observations

No.	Photo	Comments
		Physical characteristic of rivers or lugga
		■ Measuring width of low and high surface flow of lugga ■ Measuring water quality parameters at Seiya River

No.	Photo	Comments
		■ Aquatic Macrobenthic Invertebrate sampling by dragging pond net behind surveyor ■ Underwater camera set to capture moving aquatic macroinvertebrates in clear pool of waters
		■ Aquatic infauna sampling by coring river bed 0-20 & 20-40cm deep ■ Turning cores onto open lid to search for species collected
		■ Sediment collection for laboratory analysis ■ Feeling sediment texture by rubbing against fingers

No.	Photo	Comments
		Fish sampling using gill net Fish sampling using pond net
		Turning stones upside down in dry lugga looking for invertebrate and herpetofauna species hiding in moist and cool environments

4.10 Data collected

4.10.1 Luggas

Luggas surveyed derive their waters from areas near and adjacent to Maralal forest, Baragoi and Wamba area (Table 2). Lugga's with headwaters in sub-locations near Maralal forest have surface water flow much longer than other luggas and these include Suiyan, Seiya, and Barsaloi luggas. Ewaso Nyiro (shaded grey in Table 2) have a wider catchment area hence they are characterized by permanent surface flow though highly fluctuating.

Most of the lugga's join together and drain into Lorian swamp which extends much further into Somalia. However, Baragoi lugga drains into Lake Logipi (Table 2).

The average length of the luggas within the proposed crude oil corridor is 2 km with the minimum of 1.09 km for Siteti lugga to a maximum of 6.5 km for Kula Mawe lugga (Table 2).

The lugga's exhibit an average slope of 1.8 %; Baa lugga has a minimum average slope of 0.9% while Naathu has the highest average slope of 3.6 % (Table 2).

About 78% of the lugga's have sandy substrates on the bed; others consist of 6 % mixture of gravels, and pebbles, 6 % mixture of sand and pebbles, and 6 % clay sand, gravels and pebbles (Table 2).

The banks of the lugga consist of 50 % sand loam soil, 11 % are mostly rocky with few stones and thin layers of sand loam, and and others are mixture of rocky and stones, sand loam and few gravels, stony and clay sand, stony and sand loam (Table 2).

4.10.2 Water pan

Some water pans exist within the corridor of the proposed crude oil pipeline. These water pans include the Marti area, Loibor-Ngare, Rareiti and Garbatula. Water pans are found along seasonal drainages that collect runoffs from flowing into main river or lugga channels. It is understood that Marti water lasts more than 10 months and sometimes extends to the next rainy season with water. Loibor-Ngare water pan can last for about 7-10 months with water, while Rareiti and Garbatula hold water for about 5-8 months in a year.

Sometimes the duration of water in the water pan depends on prolonged rainy seasons that recharge the reservoirs with water. Loibor-Ngare pan has a twin pan; shallow and deeper one which makes it larger in surface area with 3.18 ha, Garbatula pan 0.73 ha, Marti 0.67 ha, and Rareiti pan 0.18 ha,

Table 3 –: Physical characteristics of luggas within the proposed oil corridor. Characteristics described are length of drainage, slope angle, substrate and bank characteristics, headwater location and outlets of the luggas.

Sampling Site	Coordinate	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Nachola (Lugga near AGI 07)	1.764047˚ N, 36.680533˚ E	2,650	1.6	Gravels, Pebbles and stones	Rocky, stony	Terter in Nachola	Downstream of Baragoi Lugga
Baragoi River/lugga	1.764040°N, 36.680533°E	1,500	1.3	Sandy	Sand loam and few gravels	Nachola, Lesirikan, Lkotikal area	Lake Logipi
Marti Lugga 1 (New 07)	1.552448°N, 36.815607°E	1,330	1.7	Mostly sandy	Rocky and sand loam soil	Marti area	Suiyan Lugga, Downstream of sampling point
Marti Lugga 2 (New 06)	1.522629°N, 36.830387°E	3,390	1.8	Mostly sandy	Mostly Sand loam soil	Marti area	Marti Lugga 1 (New 07)
Ngwasi Lugga (New 01)	1.151778°N, 37.009369°E	1,630	1.4	Mostly sandy	Mostly Sand loam soil	Mabati area	Seiya Lugga, Downstream of sampling point
Kaolet Lugga (New05)	1.386880°N, 36.867898°E	1,150	1.8	Mostly sandy	Mostly Sand loam soil	Barsaloi	Barsaloi Lugga, Downstream of sampling point
Siteti Lugga (New04)	1.356635°N, 36.875363°E	1,090	2.0	Mostly sandy	Mostly Sand loam soil	Soit Naibor	Downstream of sampling point for Barsaloi Lugga
Bonyeke Lugga (New03)	1.317944°N, 36.882321°	2,950	2.9	Mostly sandy	Mostly Sand loam soil	Raraiti	Barsaloi Lugga, Upstream of sampling point

Sampling Site	Coordinate	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Koiting (Lugga near AGI 14)	0.846726°N, 37.444505°E	4,450	3.3	Mostly sandy	Mostly Sand loam soil	Koiting	Archers Post Lugga, Downstream of sampling point
Suiyan Lugga	1.453957°N, 36.849481°E	1,130	1.3	Sandy and pebbles	Mostly rocky with few stones and thin layers of sand loam	Soit Naibor, Morijo and Marti	Barsaloi Lugga, Downstream of sampling point
Barsaloi Lugga	1.345287°N, 36.879264°E	1,250	1.3	Mostly sandy	Mostly rocky with few stones and thin layers of sand loam	Soit Naibor, Morijo and Marti, Raraiti, Mabati, Lulu	Joins with Seiyan and drain into Lorian swamp
Seiya Lugga	1.103464°N, 37.053257°E	1,300	1.8	Mostly sandy	Mostly rocky, Sand deposits	Moru, Mabati, Mugur, Nonkeek, Ressim	Joins with Seiyan and drain into Lorian swamp
Baa lugga (Ngaroni)	0.960277°N, 37.233044°E	1,100	0.9	Mostly sandy	Mostly Sand loam soil	Ngolngotim (Ngilai), Wamba Town	Drains into Ewaso Nyiro Downstream of sampling point
Silanga-Nanyukie Lugga	0.870509°N, 37.314768°E	1,420	2.1	Mostly sandy	Mostly Sand loam soil	Wamba Town	Drains into Ewaso Nyiro Downstream of sampling point
Archers Post Lugga	0.708867°N, 37.610556°E	1,120	1.3	Mostly sandy	Mostly Sand loam soil	Archers Post	Drains into Ewaso Nyiro Downstream of sampling point
Ewaso Nyiro River	0.637959°N, 37.673754°E	1,450	1.2	Mostly sandy	Rocky and Sand loam	Kipsing, Mumonyot, Oldonyiro, Lodongokwe,	Drains into Lorian Swamp, which disappear into Somali

Sampling Site	Coordinate	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
						Ngaroni, Archers Post, Wamba Town, Ngolngotim	
Naathu (Lugga near AGI 17)	0.521596°N, 37.958556°E	1,030	3.6	Mostly gravel with few sand and stones	Stony and Sand loam	Kabachi and Naathu	Drains into Ewaso Nyiro Downstream of sampling point
Kula Mawe Lugga	0.493462°N, 38.295817°E	6,500	1.0	Mixed clay sand, gravels and pebbles	Stony and Clay sand	Amwathi (Kabachi)	Drains into downstream of Lorian Swamp

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Table 4: Photographic Record Examples of Luggas

No.	(a)	(b)	Comments
Baragoi Lugga			■ Longitudinal observation of Baragoi lugga at the oil pipeline crossing point
Suiyan Lugga			■ Substrate dominated by pebbles on the lower side of the oil pipeline crossing point
Barsaloi Lugga			■ Rocky banks of Barsaloi lugga
Ewaso Nyiro River			■ Sand loam bank of Ewaso Nyiro River ■ Rocky banks of Ewaso Nyiro downstream
Nachola lugga			■ Gravels and pebbles substrate of lugga in Nachola near AGI07 ■ Banks: sand loam and rocky

No.	(a)	(b)	Comments
Water pans			■ Loibor Ngare water pan (a) ■ Rareiti water pan (b) ■ Garbatula water pan (c) ■ Marti water pan (d)

4.11 Water Quality

Water quality parameters were measured on surface water which flows or was stagnant on lugga, water pans and lakes. The hydrology features of the surface waters consisted of flowing lugga, water pool in lugga, stagnant water in water pan and lake (ox-bow lake).

Water Temperature: Water pools in lugga's have the highest average measured temperature of 26 °C among the water features. The flowing water and water pans have apparently relatively similar average water temperature of 24.7 °C. Measurement of water temperature from an ox-bow lake along the Tana River indicated an average water temperature of 25.6 °C (Figure. 1). Minimum average water temperature of 24.5 was recorded in Ewaso Nyiro and Garbatula water pan while, a maximum water of 27 °C was recorded in water pool in lugga in Ngaroni area (Table. 3).

pH levels: the surface water features had closely averaged pH along the crude oil pipeline corridor. The highest pH of 8.01 was measured in a water pan while the lowest pH of 7.98 was measured in water pools in luggas (Figure. 1). Site measurements of pH indicate that the highest pH of 8.01 was recorded in Seiya lugga, Ewaso Nyiro River and water pan in Garbatula; while the lowest pH of 7.96 was recorded in water pool in Baa lugga in Ngaroni (Table. 3).

Water Conductivity and Total Dissolved Substance (TDS): Correlation between water conductivity and TDS from the sampled sites is 100%. Highest conductivity of 711 (µs) and TDS of 469 (ppm) was observed in water pools in luggas. This is followed by the ox-bow lake that has a conductivity of 644 (µs) and TDS of 439 (ppm). Apparently, water pans have a low average conductivity of 183 (µs) and TDS of 116 (ppm) (Figure. 1). The Site with the highest conductivity and TDS are the water pools in Baa lugga in Ngaroni area which averaged at 933 (µs) and 644 (ppm), respectively (Table 3).

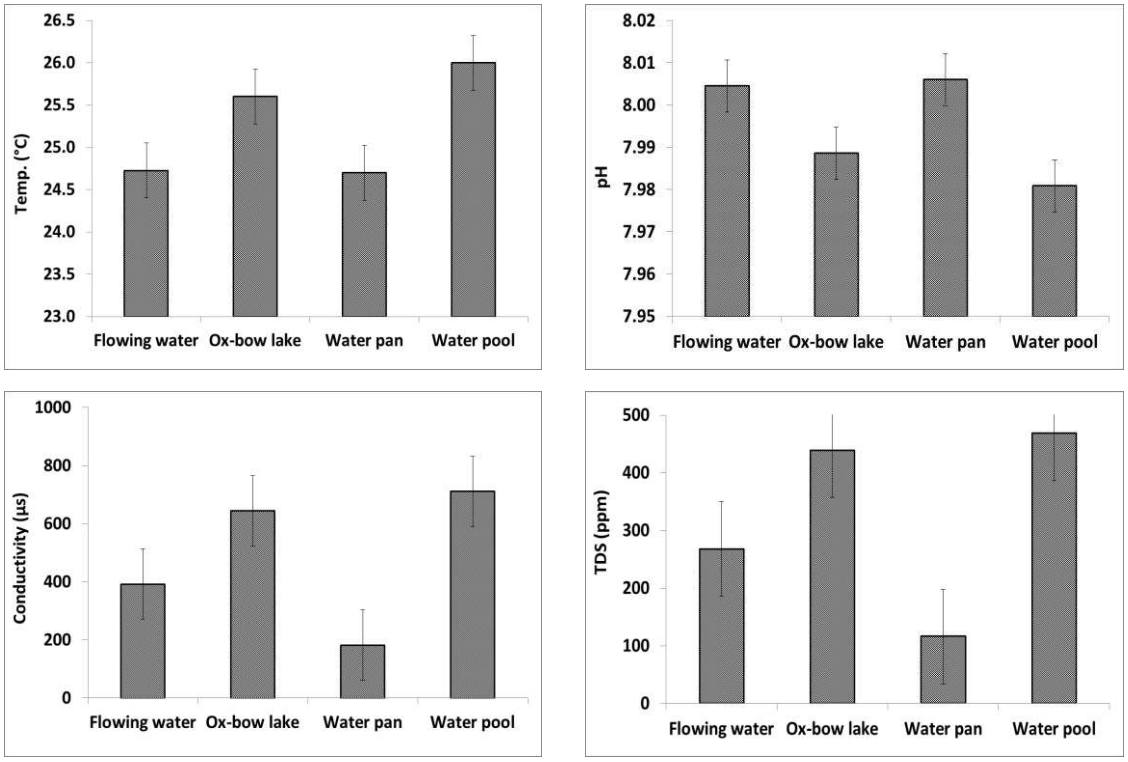

Figure 1: Measured water quality; average water temperature (°C), pH, conductivity (µs), total dissolved substances (ppm) on lugga, water pools, water pans and lake along the proposed pipeline corridor

Table 5: Physical characteristics of luggas within the proposed oil corridor. Characteristics described are length of drainage, slope angle, substrate and bank characteristics, headwater location and outlets of the luggas

Location Name	Date	Time	Water Feature Type	Temp. (°C)	Conductivity (µs)	TDS (ppm)	pH
Suiyan	14/6/2018	10 - 12 am	Flowing water	24.8	543	352	8.00
Barsaloi	15/6/2018	10 - 12 am	Flowing water	25	574	403	8.00
Seiya	17/6/2018	10 - 12 am	Flowing water	24.6	278	195	8.01
Ewaso Nyiro	20/06/2018	10 - 12 am	Flowing water	24.5	174	121.5	8.01
Silanga-Nanyukie Lugga	18/06/2018	10 - 12 am	Water pool	25	489	293	8.00
Ngaroni (Baa lugga)	19/06/2018	10 - 12 am	Water pool	27	933	644	7.96

Location Name	Date	Time	Water Feature Type	Temp. (°C)	Conductivity (µs)	TDS (ppm)	pH
Dam Point 8 (North Marti)	27/06/2018	10 - 12 am	Water pan	24.9	247	171	8.00
Water Pan (Garbatula)	2/7/2018	10 - 12 am	Water pan	24.5	118	60.5	8.01
Ziwa (Tana River)	5/7/2018	10 - 12 am	Ox-bow lake	25.6	644	439	7.99

Parameter interaction: Water parameters measured indicated high relationship with each other. Increase in water temperature affects 85% (R^2=0.85, p=0.003) increase in electrical conductivity (µs) of water and TDS (ppm), and 99% decrease in pH conditions of the water features (Figure. 2). Water conductivity and TDS negatively correlates and significantly associates with pH (R=-0.96, p=0.001) (Figure. 3). This implies most of the dissolved substances (96%) have the potential to release hydroxide ions (OH^-) in water.

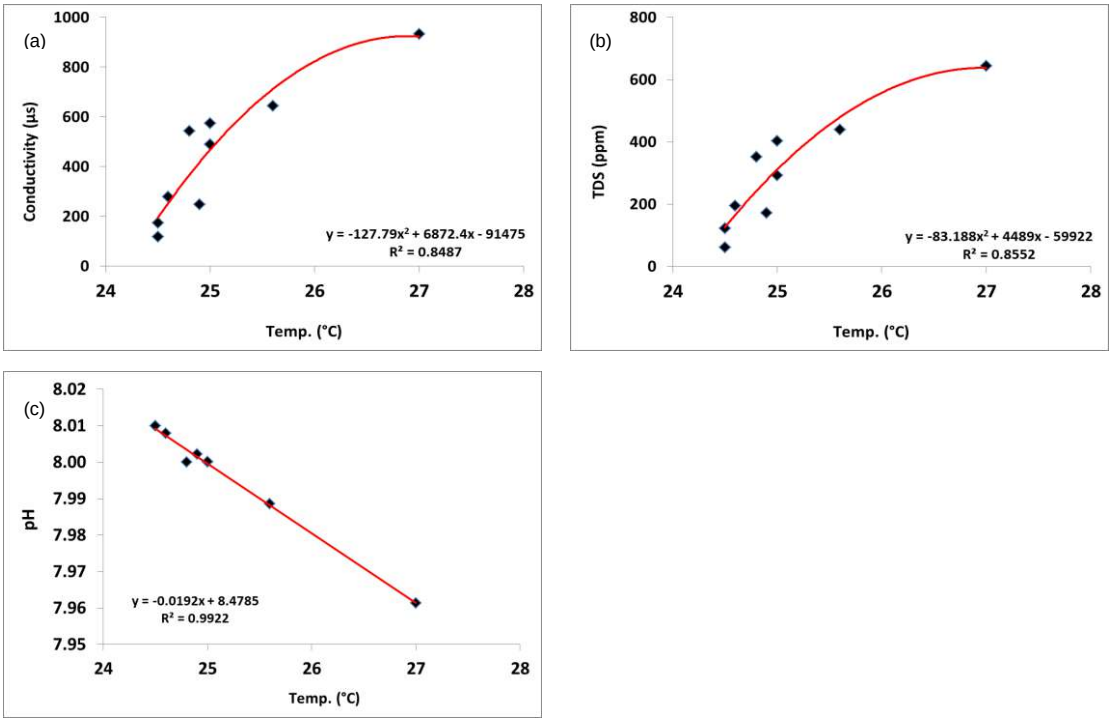

Figure 2. Relationship of pH, electrical conductivity and TDS with temperature in surface water features on sites along the proposed crude oil pipeline corridor. 2(a) - Conductivity increases with the increase in temperature. 2(b) – TDS increases with the increase in temperature. 2 (c) – pH decreases with the increase in temperature.

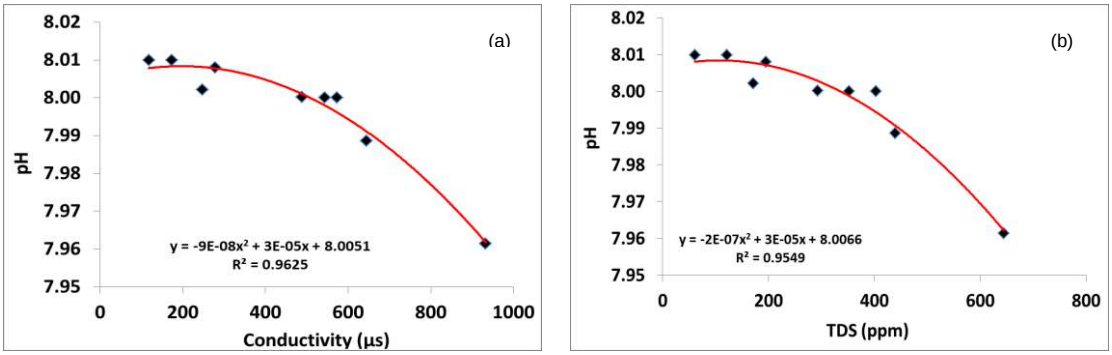

Figure 3. Correlation of pH with electrical conductivity and TDS temperature in surface water features on sites along the proposed crude oil pipeline corridor. 3(a) – pH decreases with increase in conductivity. 3(b) – pH decreases with the increase in TDS

4.12 Surface water flow characteristics

Lugga surface flow is characterised by width, height or depth from which discharges are estimated. The surface flow in lugga's leaves marks that can be used for determining the width and height or depth of the flow. The relationship of flow height and velocity potentially provide estimation for luggas that do not have surface flow during observation but have marks on height level and width. However, it is important to note that these observations provide an estimation for low and high flows during rainy seasons but not the mean surface flow.

Seiya lugga had the widest averaged low surface flow width of 95 m and depth of 0.3 m during the observation, followed by the Ewaso Nyiro River that had an averaged width of 50 m and average depth of 0.4 m. Based on the relationship of flow height and velocity, Ewaso Nyiro is calculated to discharge more water of about 42 m^3s^{-1} during low surface water flows, followed by Baa lugga that was estimated to potentially discharge about 38 m^3s^{-1}. Low surface water discharge for Seiya lugga was calculated at 26 m^3s^{-1} and for lugga in Nachola (near AGI07) potential discharge was estimated at 19 m^3s^{-1} (Table 4).

During high surface water flow Ewaso Nyiro gains an averaged maximum width of 110 m, Seiya 100 m, Baragoi lugga 64 m and Baa lugga 56 m. Ewaso Nyiro can attain highest estimated discharge of 3,457 m^3s^{-1}, Baragoi and Baa lugga attains potential discharge of 1,300 m^3s^{-1} (Table 4). The latter drains into Ewaso Nyiro river.

Table 6: Flow characteristics of luggas based on surface water flow width (m), depth or height (m), velocity (m/s) and discharge m3s-1

River/Lugga	Low surface flow					High surface flow				
	Width	Height	Time (s) per 20m	Velo city	Dischar ge	Width	Height	Time (s) per 20m	Velocity	Discharge
Nachola (Lugga near AGI 07)	7.5	0.7	4.4	3.6	19.1	13.5	0.9	3.4	5.8	71.0
Baragoi River/lugga	24	0.25	12.3	1.3	7.8	64	1.8	1.7	11.7	1346.5
Marti Lugga 1 (New 07)	11.5	0.2	15.4	1.0	2.4	18	0.6	5.1	3.9	42.1

River/Lugga	Low surface flow					High surface flow				
	Width	Height	Time (s) per 20m	Velo city	Dischar ge	Width	Height	Time (s) per 20m	Velocity	Discharge
Marti Lugga 2 (New 06)	6	0.1	30.8	0.5	0.3	10	0.35	8.8	2.3	8.0
Ngwasi Lugga (New 01)	13	0.2	15.4	1.0	2.7	15	2.1	1.5	13.6	429.5
Kaolet Lugga (New05)	11	0.09	34.2	0.5	0.5	16	1.4	2.2	9.1	203.6
Siteti Lugga (New04)	4.5	0.06	51.3	0.3	0.1	15	1.2	2.6	7.8	140.3
Bonyeke Lugga (New03)	22	0.1	30.8	0.5	1.1	50	1	3.1	6.5	324.7
Archers Post Lugga	22	0.1	30.8	0.5	1.1	50	1	3.1	6.5	324.7
Koiting (AGI 14)	0.85	0.25	12.3	1.3	0.3	2.35	2	1.5	13.0	61.0
Suyan	30	0.08	22.0*	0.4	0.9	45	1	3.1	6.5	292.2
Barsaloi	27	0.05	21.0*	0.4	0.5	75	1.2	2.6	7.8	701.3
Seiya Lugga	95	0.3	8.8*	0.9	25.9	100	0.5	6.2	3.2	162.3
Baa lugga (Ngaroni)	19	0.62	5.0	3.2	37.9	56	1.9	1.6	12.3	1312.7
Silanga-Nanyukie	30	0.2	15.4	1.0	6.2	40	0.6	5.1	3.9	93.5
Ewaso Nyiro	50	0.4	7.7*	2.1	41.6	110	2.2	1.4	14.3	3457.1
Naathu (AGI 17)	5	0.07	44.0	0.4	0.1	8	0.25	12.3	1.6	3.2
Kula Mawe	10	0.08	38.5	0.4	0.3	30	1.2	2.6	7.8	280.5

*Observed data

4.13 Aquatic Macroinvertebrates

The aquatic macroinvertebrate species were observed on slow flowing luggas and stagnant waters and water pans. A total of 16 species of invertebrates were observed in the survey luggas and water pans. The highest number of species was observed in Baragoi lugga (7), Marti water pan (7) and Suiyan (7). The most common species in the area are the diving beetles (*Dytiscus marginalis*) (17%) which are common in pools of water in lugga with vegetation litter/detritus. This species is observed coming to the surface of water and diving back to the bottom. Another species is the dragonfly *Trithemis arteriosa* (17%) which were observed patching on wet substrates and sticks. This is followed by damselfly *Africallagma glaucum* constituting 14% of occurrences.

Lethocerus species was observed in only three places in Marti water pan, banks of Suiyan lugga where flow is limited and in Garbatula water pan.

The presence of mollusc species was determined by presence of shells that were observed from the sand cores and on the surface. These species have not been identified and are currently provided as interim names (Mollusc Indet.).

Table 7: Aquatic Macroinvertebrates

	Site																							
	AGI 07 (Nachola)	Baragoi	Marti water	New07	New06	Nowasi	New05	New04	New03	Newpoint	AGI 14	Suiyan	Barsaloi	Bareiti pan	Seiya	Baa lugga	Silanga-	Loibor-	Ewaso Nyiro	Naathu (AGI	Garbatula	Kula Mawe	Garbatula-Lugga1	Ziwa
Dragonflies																								
Brachythemis leucosticta		√										√	√	√	√			√			√			√
Trithemis arteriosa	√	√	√										√	√	√	√		√			√			√
Orthetrum chrysostigma																								
Pantala flavens			√															√						√
Trithemis donaldsoni												√						√						
Bradinopyga strachani												√												
Ictinogomphus ferox			√									√												

						Site																	
Aethiothemis solitaria (young)	√																						
Orthetrum chrystigma			√																				√
Damselflies																							
Africallagma glaucum	√	√	√									√	√		√		√		√				
Leech																		√					
Lethocerus (Indet.)			√									√									√		
Dytiscus marginalis		√	√									√	√		√		√		√		√		
Mollusc																							
Mollusc (Indet. 1)		√																					
Mollusc (Indet. 2)		√											√			√	√					√	
Mollusc (Indet. 3)		√																					

Table 8: Photographic record

No.	(a)	(b)	Comments
01			■ Diving beetle swimming in water pool in Baragoi lugga ■ Diving caught in a pondnet in Nachola lugga (AGI 07)

No.	(a)	(b)	Comments
02			■ Mollusc shells collected from Baragoi lugga bed
03			■ Water scorpion Nepidae species observed in Suiyan lugga ■ Giant water bug *Lethocerus sp.* species observed in Water pan in Marti
04			■ Dragonfly *Brachythemis leucosticta* in Garbatula water pan ■ Unidentified larvae in Loibor-Ngare water pan
05			■ Larvae of dragonfly collected from Loibor-Ngare water pan ■ Leech exposed under stone in Marti water pan

4.14 Fish species

Assessing fish species during the wet season was challenging as the river water flows were high and in flood in many cases. This prevented using the seine net that was carried for sampling. Only gillnets were used by throwing into slow flowing parts of the river water. The exercise was carried out in areas which are known to have fish species such as Ewaso Nyiro and Tana Rivers. Sampling in Tana River ox-bow lake (Ziwa) realized two fish species *Clarias gariapinus* and *Tilapia* species.

Table 9: Fish species

No.	Photo	Comments
		■ Tilapia species sampled in Ziwa (Tana River) ■ *Clarias gariapinus* sampled in Ziwa (Tana River)

4.15 Other taxa observed

Observations were made on lugga and water pans concerning other aquatic animals and terrestrial animal visitors to the water resources. Presence and activities were recorded from physical observations, foot prints signs, droppings (spurs, pellets and scatters) and accounts from local residents.

Bird Species: About 17 birds were common in the lugga and water pans within the proposed pipeline corridor. Three species are common in the landscape; the Common drongo, Superb starling and Ring-necked dove. Bird species rarely observed were Steel-blue Whydah and Greater sand plover which were only observed in Silanga-Nanyukie lugga.

Wetland birds (marked with * in Table 9 below) that were observed are the Black-headed lapwing and Hadada ibis in Loibor-Ngare and Garbatula water pans, the Greater sand plover in Silange-Nanyukie lugga while the Great White Egret (*Ardea alba*) was observed along Ewaso Nyiro River. The Great White Egret is covered by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) due to its partial migration.

Birds were observed feeding on drying pool areas within lugga's and on the edge of lugga banks and shores of water pans. These are areas where seeds are deposited during low surface water flow in lugga's and when water pan water recedes. The distribution of bird nests along the lugga is supported by the large trees that are distributed along the lugga. Other than foraging, water pools in lugga and water pan are used by birds for bathing to lower their body temperature.

Butterfly Species: Over 16 species of butterfly were recorded but the most common were *Junonia hierta*, *Catopsilla florella*, *Belanois aurata* and *Azanus ubaldus* within the proposed pipeline route. Butterflies were observed moving across the lugga from one bank to the other. They use the riverine vegetation as their foraging grounds, especially riparian trees. The species *Belanois aurata* was commonly observed foraging on flowers on the banks of the lugga.

Water pool areas also provide butterflies with a place for feeding on decaying plant parts such as fruits and leaves. During the hot periods of the day, most butterflies concentrate near water pools. The lugga systems also attract wild fauna and livestock that drop their pellets, spurs or scatters that butterflies feed on. The system sustains most of butterflies throughout the year even when very little vegetation is evsident on the landscape. Groups of butterfly species were observed on drying water pools commonly with *Azanus ubaldus* and *Eurema floricola*.

Mammal Species: Few mammal species was observed visiting lugga and water pans. Species that actively utilise the lugga's are the Olive Baboons. Presence of footprints discovered some wild animal visitors of the lugga and water pans such as Hyena, Leopard, Olive Baboons and the Jackal. Velvet monkeys are common in lugga's within large riverine trees in Baragoi, and Ngwasi Lugga.

Local residents account that animals such as lions and giraffe are seen drinking water in the Ewaso Nyiro River, waterbucks and hippopotamus are often passing going downstream of the Ewaso Nyrio river. Elephants are observed by local residents moving along Barsaloi Lugga from Latakweny upstream to Lulu area during dry season by end of December. Downstream movement from Lulu to Latakweny begins in April following the onset of the rainy season.

Reptiles and Amphibians: The Nile crocodile was observed in the Ewaso Nyiro River and Tana River lying on the banks of the river. These species occur mainly in permanent rivers that support its population with food and safe habitat. Water pans are mostly inhabited by Turtle (Terrapins) and frogs (and tadpoles). Other observed species in this group are visitors from terrestrial system that visit for water and foraging along the banks and water pans. Water pans and water pool areas with mud deposits of clay loam or clay sand provide a suitable hiding place for frogs, turtles and other aquatic species during dry periods.

Table 10: Riparian Fauna

			Site																		
	AGI 07	Baragoi Lugga	Marti Pan	Marti Lugga1	Marti Lugga2	Ngwasi Lugga	New05 (Kaolet)	New04 (Siteti)	New03	Archers Post	AGI 14	Suiyan	Barsaloi	Seiya	Baa lugga	Silanga-	Loibor-Ngare	Ewaso Nyiro	Naathu (AGI	Kula Mawe	Garbatula-
Butterflies																					
Colotis celimene																					
Hypolimnas misippus																					
Byblia ilithyia	√	√										√	√		√						
Dixeia pigea																					
Eurema floricola																					
Azanus ubaldus																					
Actizera stellata																					
Belenois aurota		√	√									√	√	√						√	

			Site																		
Belenois solilucis																					
Junonia oenone			√									√									√
Junonia hierta	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Colotis evagore									√			√	√								
Colotis antevippe									√			√	√								
Catopsilia florella	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Vanessa abyssinica																					
Eurema hecabe							√														
Papilio demodocus																					√
Dung Beetle	√																				
Cricket	√										√										
Ground nesting bees																					
Black Wasp		√	√														√				√
Halictid bee																					
Honey Bee			√														√				√
Birds																					
*Black-headed lapwing			√														√				√
*Greater sand plover																√					
*Hadada ibis																√					√

			Site																		
* Great White Egret																		√			
Mourning collared dove			√																		√
Namaqua dove			√														√				√
Ring neck dove	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Common Bulbul								√								√		√			
Northern Shrike												√									
Tropical boubou												√	√								
Common Drongo	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Ground Hornbill	√	√	√																		
Steel-blue whydah																√					
African pied wagtail																√					
White-browed sparrow-weaver		√										√	√			√		√			√
Barn swallow												√	√			√		√			
Common Ostrich		√										√									
Mammals																					
Vevet monkey		√				√						√									

			Site																		
Olive baboon		√	√															√			√
Waterbuck																		√			
Hippopotamus																		√			
Giraffe																		√			
Rock Hyrax													√					√			
Elephant													√					√			√
Warthog		√																			
Leopard												√	√					√			
Lion																		√			
Hyena			√									√	√					√			√
Jackal			√									√	√					√			√
Grevy Zebra		√										√	√	√							
Baboon		√	√									√	√	√				√			
Reptiles and Amphibians																					
Rock Python												√	√					√			
Frog (Tadpoles)			√										√					√			√
Nile crocodile																		√			
Striped back snake																		√			
Speckled sand snake																		√			
Lugh toad																		√			

			Site																		
Serrated Hinged Terrapin														√			√				
Nile monitor																		√			
Red-headed Rock Agama	√											√	√					√			
Rainbow Skink												√	√					√			
Yellow-headed Dwarf Gecko																		√			

Table 11: Photographic record

No.	Photo	Comments
01		■ Serrated Hinged Terrapin ■ Tadpole in the last stage of development to a frog
02		■ *Junonia hierta* in Nachola (AGI07) ■ Butterflies feeding on animal dropping (*Actizera stellata* and *Azanus ubaldus*) ■ Group of *Azanus ubaldus* feeding on detritus on the shore of Marti water pan ■ Group of *Eurema hecabes* and *Belanois aurata* feeding and cooling body on a drying water pool in Kaolet lugga

No.	Photo	Comments
03		■ Dung Beetle in Nachola (AGI07) ■ Scorpion exposed under stone in lugga
04		■ Rock Hyrax in rocky banks of Ewaso Nyiro River ■ Nile crocodile resting on the bank of Ewaso Nyiro River at Sarova Shaba area

4.16 Riverine vegetation

Riverine habitat provides water for trees that are sustained by root water throughout the year. A species of plant that has adapted to this condition is the Acacia species that tap water on the banks of the lugga with their deep roots. Due to the dynamics of the lugga geomorphology affected by water erosion, the plant has to adapt to the ever deepening lugga in order to survive.

Species that are dominant on lugga banks are *Acacia tortilis* owing to its effective dispersal along the lugga and ability to endure long periods of drought. With the dynamics of the lugga, the population of the trees are potentially threatened by horizontal erosion of lugga banks that destroy most trees leaving them fallen along the lugga banks. Secondly, the vertical erosion increases depth for plant roots to access water; this ultimately deprives some trees with water and the plant eventually dries up naturally. Other tree species observed are the *Ficus sycomorus* and *Acacia senegalensis*.

The riverine vegetation provide feeds to livestock and wild herbivore during dry season. Part of the Acacia tortilis such as pods and leaves that drop on lugga bed provides livestock feeds.

Table 12: Photographic record Contd.

No.	Photo	Comments
		■ *Acacia tortilis* on the bank of Silanga-Nanyukie Lugga ■ *Ficus sycomorus* established on the bank of Suiyan lugga
		■ Erosion of lugga bank in Baragoi lugga due to increased discharge of water from the catchment ■ Erosion of lugga bank casing riverine trees fall down in Suiyan lugga

4.17 Ecosystem Services

Domestic and Livestock water: Major luggas such as Baragoi, Suiyan, Barsaloi, Seiya and Silanga-Nanyukie are important for their capacity to store water and permeate subsurface flow of waters from catchments. This water is extracted by digging by hand to reach the waters in the lugga bed. In other places, boreholes sunken adjacent to the lugga provide water throughout the year that are used for domestic purposes and watering of livestock. Due to this, most villages or manyattas are located close to the lugga.

Salt licking for livestock: Most of the lugga banks in Baragoi and Wamba areas have salt deposits which are licked by livestock and wild herbivores for addition of minerals in the body. Locals says livestock that licks the salt deposit are not prone to diseases. The erosion of the lugga banks continuously exposes salt deposits for seasonal use.

Livestock feed provision: the riverine Acacia trees support livestock with leaves and pods for foraging. These trees are distributed along the influence of lugga drainage systems throughout the year. Livestock, therefore get feed during drought period in the region.

Sand harvesting: Sand harvesting is common on luggas that have a substrate of the bed sandy deposits. Luggas which were observed with sand harvesting activity are Barsaloi, upstream of Baragoi lugga, Ewaso Nyiro River, and lugga in Garissa. Most of the local youths are engaged in sand harvesting as a means of earning an income.

Fishing: Only Ewaso Nyiro and Tana River support fishing for subsistence; a few are sold in the local market. Dominant fish species caught are *Clarias gariepinus* and few Tilapia species.

Decorations materials for houses: Exposed banks of lugga in Nachola (near AGI07) has red and white stones which are mined and crushed for decorating houses in Nachola area.

Minerals and mining: Exposed rocky lugga banks reveals traces of rocks that are associated with mineral such as gold. Gold mining takes place in Nachola area along upstream luggas. Hence the lugga in Nachola would be a potential mining location for gold in future.

Recreation and Leisure: some hotels and restaurants are constructed adjacent to Ewaso Nyiro River due to attractive setting. Owners of business appreciate the frontier to the river as they get more profit than restaurants away from the river.

Table 13: Ecosystem Services Photographic record

No.	(a)	(b)	Comments
			■ Salt licking point at the bank of Baragoi lugga ■ Borehole sunken adjacent to Barsaloi lugga for effective recharge by lugga
			■ Filtering of lugga water by digging on the banks of Seiya lugga for drinking ■ Shallow dugout wells for fetching water by local residents in Silanga Nanyukie

No.	(a)	(b)	Comments
			■ Local chief of Nachola Location showing red soft stones used for decorating mud wall houses ■ Local chief of Nachola Location showing Stones associated with occurrence of gold
			■ A man demonstrating how fishing is done using fish hooks in Ewaso Nyiro River. ■ Sand harvesting in lugga in Garissa
			■ Lion's Cave restaurant situated on the bank of Ewaso Nyiro bank

4.18 Key Observations for ESIA

The findings represent the advanced baseline survey carried out along the parts of the proposed pipeline alignment from luggas in Samburu, Isiolo, Meru and part of Garissa County:

- The distribution of water in the entire courses of the luggas from catchment is intermittent on the surface but continuous below sand beds throughout the year. The phenomenon flow of water makes the wetlands (rivers/lugga) constitute a lifeline for the wild fauna and livestock on the landscape through:

- Provision of water during dry (drought) season through the dugout wells on the lugga;
- The riverine trees, especially *Acacia tortilis*, provide forage through dropping of pods that livestock relies on during the entire dry (drought) season;
- Provision of cool hiding places for frogs under layers of muds in mud pools and layered litters in the lugga;
- Drying water pools that provide butterflies with mud puddling grounds; and
- Synchronization of water availability with the migration of elephants from upper catchment to the lower course of the lugga/river (Barsaloi) for breeding downstream;

- Most drainage (lugga) around the pipeline crossing areas are poor in aquatic species richness due to high seasonality. Among the drainages, Ewaso Nyiro has crocodiles and fish species due to its permanence flow of water;
- In seasonal rivers (lugga), Whirling beetles, diving beetles (diving beetles) and toadpoles are found in water pools and in areas where water flows slowly. Three species of dragonflies are common on the lugga and water pans in the area; *Trithemis arteriosa*, *Orthetrum Chrysostigma* and *Brachythermis impatita*;
- The rainy season is characterised by low and high surface flows of lugga. Among the lugga, Baa lugga has potentially high low, and high high surface flow. Baragoi and Baa luggas are the only seasonal drainage system with very high surface flow during rainy seasons. Ewaso Nyiro River is permanent drainage but however dynamic during rainy season. It has substantively higher flows than the lugga; some of the luggas outlet into the river system;
- Water quality is not variable in lugga (seasonal) but considerably different with Ewaso Nyiro River. For instance, water temperature, conductivity and total dissolved substances in Ewaso Nyiro is considerably lower than observation in all lugga;
- Fish and crocodile species distribution only occur in permanent rivers of Ewaso Nyiro and Tana River;
- Wetland birds such as Black-headed lapwing, and Hadada ibis are common on permanent and water pan areas but very limited observation were made on lugga (seasonal drainage);
- Lugga's provide ecosystem services mainly on domestic and livestock watering during dry season, salt licking area and livestock forage through Acacia pods;
- Current threat on riverine trees is erosion that affects the trees in two ways:
  - Horizontal erosion of the banks affecting anchorage stability of large trees; and
  - Vertical erosion of the lugga channel increasing depth for plant root accessing water in lugga; and
- The ecosystem services of lugga's and rivers and the roles of lugga's in maintaining species population, habitats and ecosystem relies on the flow of water in the lugga at the surface and in sub-terrain. Interference of the water flow in terms of reduction of quantity and distribution of flow in a year would adversely affect ecosystem services (mainly provisioning and regulating). Hence, the pipeline project should avoid affecting water flows in lugga in any way as mentioned above.

4.19 Meetings and Discussions

The following account was provided by Dickens Odeny:

'On June 13th, 2018 at 9.10 am I had an impromptu meeting with Kalomdam Conservancy warden Mr. James Naperit (0727303567/0704983871) and Chief of Nachola Location Mr. Christopher Lokarach. Mr. Naperit was very interested in knowing the alignment of the proposed Lokichar-Lamu crude oil pipeline with the position of the conservancy. He was keen in knowing how the alignment will affect the conservancy operation and wild distribution. Together with the local chief, they informed me on difficulty in tracing tracks leading to the point of interest as they are currently covered by vegetation. Also, the area has experienced sporadic attacks by cattle raiders or bandits. It is not safe for visitors to understand how to navigate around when such incidences take place. We went to the Conservancy office and signed visitors book and we were informed that the place has accommodation of tents charged at KES 1,000. Being that Mr. Naperit was interested in knowing the alignment of the proposed crude oil pipeline he offered to assist as with an extra conservancy ranger Mr. Aparadwa Elim. The two were armed with AK47 rifle (loaded) and together with the chief who knows the terrain, we led to the point of interest for sampling

- *On June 15th, 2018 by 10.000 am, interviewed one of the elderly local resident Mr. James Lekarapiti (0706363283) on how livestock and wild animals interact with Barsaloi lugga. I was informed that the area lies within Kusyambu ranges conservancy that has many wild animals visiting the lugga. The lugga was indicated as a lifeline to both local residents domestic use and livestock water. Also, it's a place where wild animals drink water importantly during dry season from the shallow dugout wells on lugga bed. The lugga banks provide salt licking points for both livestock and wild herbivores.*
- *On June 16th, 2018 by at 9.21 am met with the administrative chief of Nachola Mr. Christopher Lokarach (0703 379188) at Nachola village. He provided company as a security and introduces us to local community as he guides us to site AGI 07.*
- *On June 17th, 2018 by 1.30 pm met with two local residents Mr. Lekaaso Lmasion (0713097374) and Mr. Sotinai Letoisoni at Seiya River (lugga) and interviewed on provision services of the lugga to the local community.*
- *On July 4th, 2018 at 8.10 am met the Assistant Administrative Police Commandant, Garissa Mr. Ibrahim. The commandant briefed me on the security incidences in the county. This include incidence of explosion of land mine that injured scores of police officer near Ijara area. Also, the heightened security within Garissa town and its environ after the incidence of explosion. I was warned by the officer not to go beyond 5-7 km radius of Garissa Town. I was provided with two Police officer who accompanied me to Tana River stretch near Garissa town '*

4.20 Health and Safety learnings

Dickens Odeny provided the following comments: '*Efforts could be carried have carried out concerning the mobilization of the local administrators for gathering real time security and safety issues on administrative locations and sub location. Such contacts would be used by experts for consulting on situation on ground for tactical avoidance of an emergency. Alternatively, one should always ask for advice from local administrators on security and safety incidences. These include robbery and ethnic/clan violence, and even wild animal attacks. For instance, rangers at Kalomdam conservancy informed me that lions occur in or near the conservancy when grass vegetation is distributed all over the landscape during wet season. In a situation where an expert does not get clear track roads that lead to proposed sampling point, he or she might use roads that end up in potentially dangerous places.'*

4.21 Gaps and Recommendations for full baseline data gathering

- **Gap 1:** The aquatic biodiversity information in drainage channels in Turkana, and Lamu were not covered and Garissa was insufficiently covered for sampling during the wet season scoping survey due to security reasons.
  - **Recommendation:** These areas would only be surveyed when security is conducive and safe for operation. Alternatively, species distribution modelling of species of conservation importance can be considered to assess potential distribution. These will rely on species distribution data in the database.
- **Gap 2:** The surveys focused on drainage channels but not wetlands (lakes) which are potentially main receptors of impacts of development projects. Wetlands should be surveyed if surface water interaction is realised and residual effects are possible.
  - **Recommendation:** Some wetlands should be considered for survey as these are the main habitats that replenish rivers or lugga systems with species and population. However, security will determine access to wetland to visit
- **Gap 3:** Ecosystem services of wetland (lugga/river) have been conducted mostly by observations on the lugga. These has limited information that could be acquired for appreciation of the lugga or river for ecosystem services.
  - **Recommendation:** There is a need to have a detailed study through discussion or administration of structured questions on the residents located near the wetland, in order, to understand how the lugga affect the dynamics and different structures of the community. This activity needs sufficient period for completion
- **Gap 4:** During wet season when water is widely distributed in the river courses (channel), most of aquatic and terrestrial animal visitors are widely dispersed on the landscape hence effective observation of the diverse species and population is limited.
  - **Recommendation:** Dry season observation is inevitable, in order, to make effective observation where the species concentrate in areas such as slow surface water flows, drying water pools, dugout wells, and water pans

Freddy Brookes
Biodiversity Lead

Simon Aldrich
Project Manager

FB/SA/es

TECHNICAL MEMORANDUM

DATE 24 July 2018 **Project No.** 1772867.526/B.0

TO Alex Mayhook-Walker, PPMT

CC Freddy Brookes

FROM Simon Aldrich, Gary Morris Iveson **EMAIL** saldrich@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – SITE VISIT REPORT: BOTANY AND HABITATS

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867 509.B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the long wet season, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening (Ecountability, 2017);
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted during the dry season and short wet seasons;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

The field programme was conducted to support the baseline flora and habitat inventory, condition and quality assessment, and ground-truth the preliminary vegetation, land cover, and potential critical habitat. Our programme included a focus on the key 'gap' area through the mountains north of Samburu National Park, and

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pipeline route characteristics for main biotypes in the wet season (e.g. Acacia landscapes in the Grevy Zebra breeding zone to the west of Wambu, and to the east of Isiolo)

The security area south of Garissa is not included within this advanced field study, and access and understanding of this area will be developed during the main baseline programme. The section near Lamu, where the pipeline crosses a corner of the Bono Forest, is likewise excluded.

- Sampling was stratified across vegetation community types, which have been preliminarily mapped at the desktop level.
- Plotless landscape sampling frames were used to compile an inventory of plant species (that is, trees, shrubs, forbs, and graminoids) present at each sampling location, and to characterise the vegetation communities along the pipeline route.
- Searches for plant species of conservation concern and invasive plant species were conducted.
- The advanced field programme was led by John Kimeu. Golder will also correlate activities and findings with the scoping advice for flora to be undertaken by Quentin Luke of the National Museums Service.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- John Kimeu (JK).

2.2 Tasks completed

A brief summary of the field programme during the site work is provided in Table 1.

Table 1: Flora baseline survey field programme

Date	Task	Location	Initials of team member attending
11/06/2018	Travel to Isiolo, from Nairobi, and preparation for 9 days survey	Nairobi	JMK
11/06/2018	Arrival to Isiolo, prepared for day one of the survey.	Isiolo	JMK
12/06/2018 13/06/2018	Conducted a road transect survey at Wamba, following Archer's Post-Baragoi road (AGI-14 to AGI-13 & 12, c. a stretch of c. 27km), and sampled 6 points.	Wamba	JMK
	Conducted a road transect survey, still at Wamba and following Archer's Post-Baragoi road (from AGI-13 to 2km past Sware, near AGI-11), and sampled 4 points.	Wamba/Sware	JMK
14/06/2018	Surveyed Archer's Post/Wamba areas (between AGI-16 & 14) for 3 points, following Forest and Archer's Post-Baragoi roads	Archer's Post/Wamba	JMK

Date	Task	Location	Initials of team member attending
15/06/2018	Conducted surveys at Shaba national reserve (2 points) and c. 32 km from Isiolo-on Isiolo-Mandera road (1 point).	Shaba & Nyambene NR	JMK
16 & 17/06/2018	Surveyed Nyambene national reserve (on Isiolo-Mandera road to Kachiuru area, and covering AGI-17), and sampled 7 points.	Nyambene NR	JMK
18/06/2018	Travelled to Garissa from Isiolo (c.11 hrs by road)	Isiolo & Garissa	JMK
19/06/2018	Conducted surveys at Mondika-Garissa (covering AGI 19, 20 & 21), sampling points	c.14km eastward of Garissa town	JMK
20/06/2018	Did surveys to South East of Garissa town, following the old Garissa-Bura road (covered environs of AGI-22), and sampled 2 points.	c.14km South East of Garissa town	JMK
21/06/2018	Travel Back to Nairobi from Garissa	Garissa & Nairobi	JMK

2.3 Deviation from Planned Scope of Work

The proposed sampling plan was honoured with only a few changes (i.e. added two points- Sware, which is north of Wamba town, on Archer's Post-Baragoi road and Kachiuru area, on Isiolo-Mandera road).

Sampling at the Lamu area, which was to run from dates 22 - 27 June, 2018 (this period including two days of travelling), was cancelled due to security concerns, hence results of that region are not included in this report.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Three general vegetation types, including Acacia and Acacia-commiphora bushlands, and grassland, were identified in the study sites (see figure 1a-c). Notable critical/specialised microhabitats within these three general vegetation types, and which greatly enriched records of annual plant species for this study, were; numerous ephemeral streams and a few small wetlands/water pans (figure 1d &e).

The study recorded 132 vascular plant species, which include: one of conservation concern; two Kenyan endemics; and eight regionally endemics (see listing in the appendix and in section 3.2). Of the 132 species, Acacia bushland vegetation recorded 123, and Acacia-commiphora bushland and grassland had 72 and 64 records, respectively (See in the appendix).

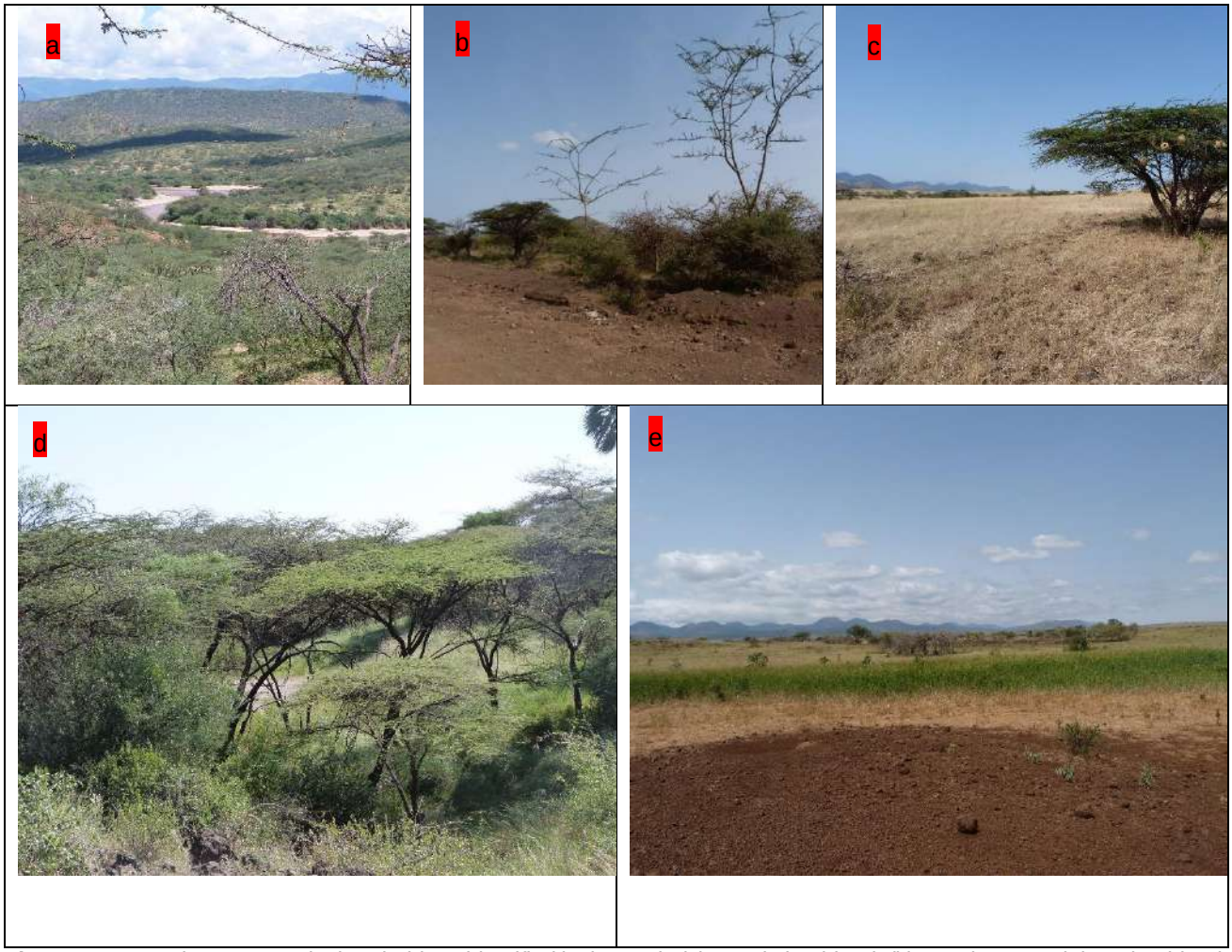

Figure 1: Vegetation types and micro-habitats identified in the study (a) Acacia bushland, (b) Acacia-Commiphora bushland, (c) Grassland, (d) ephemeral stream and (e) seasonal water pan

General areas of Wamba, Archer's post and Garissa (mainly owned by pastoralist communities and hence enjoy minimal protection status) were mostly of highly modified Acacia bushlands and small sections of Acacia-commiphora bushlands. Generally, these sites were overgrazed/browsed, and as a result, had high rates of soil erosion. Shaba points (established in a protected area i.e. Shaba National Reserve) were mostly of minimally disturbed Acacia-commiphora vegetation type. On the other hand, Nyambene points, on Isiolo-Mandera road, were of minimally to moderately disturbed grassland and Acacia-Commiphora vegetation types.

Six species namely: *Acanthospermum hispidum*; *Alternanthera pungens*; *Datura stramonium*; *Oxygonum sinuatum*; *Ricinus communis*; and *Tagetes minuta*, were recorded by this study (see some in figure 2a-c). Wamba, Archer's Post and Garissa sites, compared to Shaba and Nyambene, had the highest percentage of these weed species. The study recorded two invasive species, including: *Opuntia sp*; and *Prosopis juliflora* (see figure 3a-c). *Opuntia sp*., which is from Southern USA, Mexico and Venezuela, was only recorded at Archer's Post, where it had only a few individuals. This species is though known to be hardy and to spread quickly, hence if the few seen individuals will be left unmanaged, they have a high chance of spreading and out-competing native plant species of the area, and this will result into decline in biodiversity and pastureland. *Prosopis juliflora*, locally called Mathenge, and of Mexico origin, was brought to Kenya for restoration of arid lands. It is an aggressive habitat invader and highly impacts negatively on the local biodiversity/habitats. In this study, few individuals of *Prosopis juliflora* were recorded at Wamba plots, and in abundance at plots of Archer's Post and Garissa.

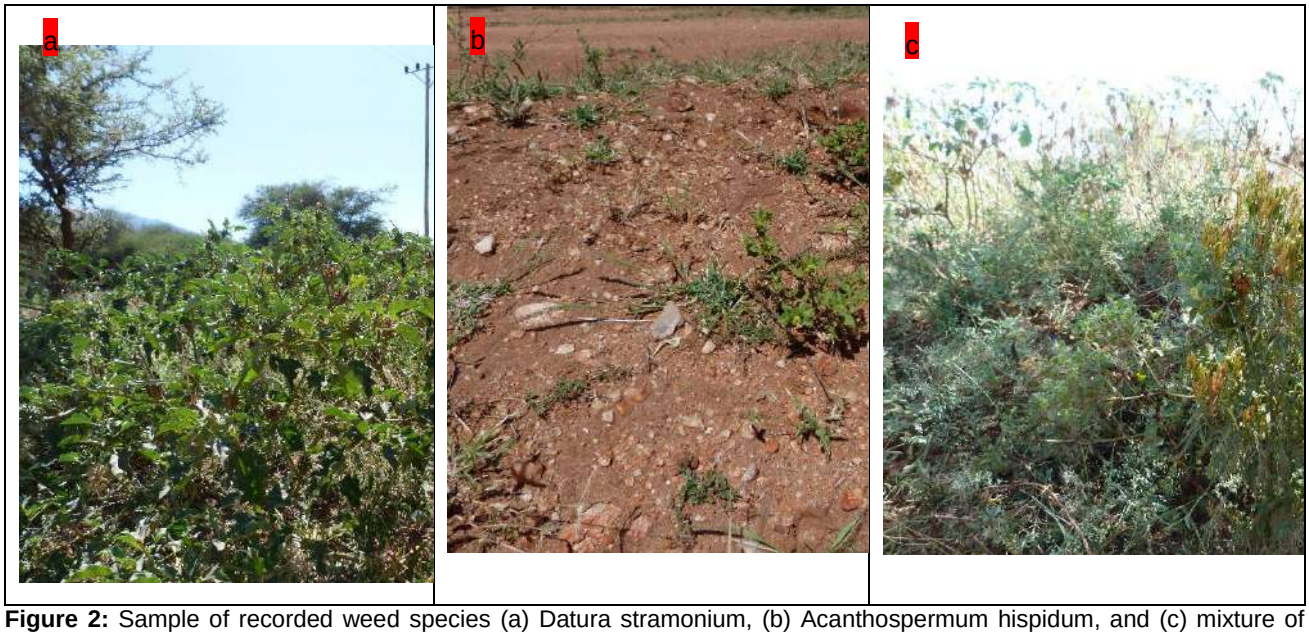

Figure 2: Sample of recorded weed species (a) Datura stramonium, (b) Acanthospermum hispidum, and (c) mixture of Tagetes minuta and Datura stramonium

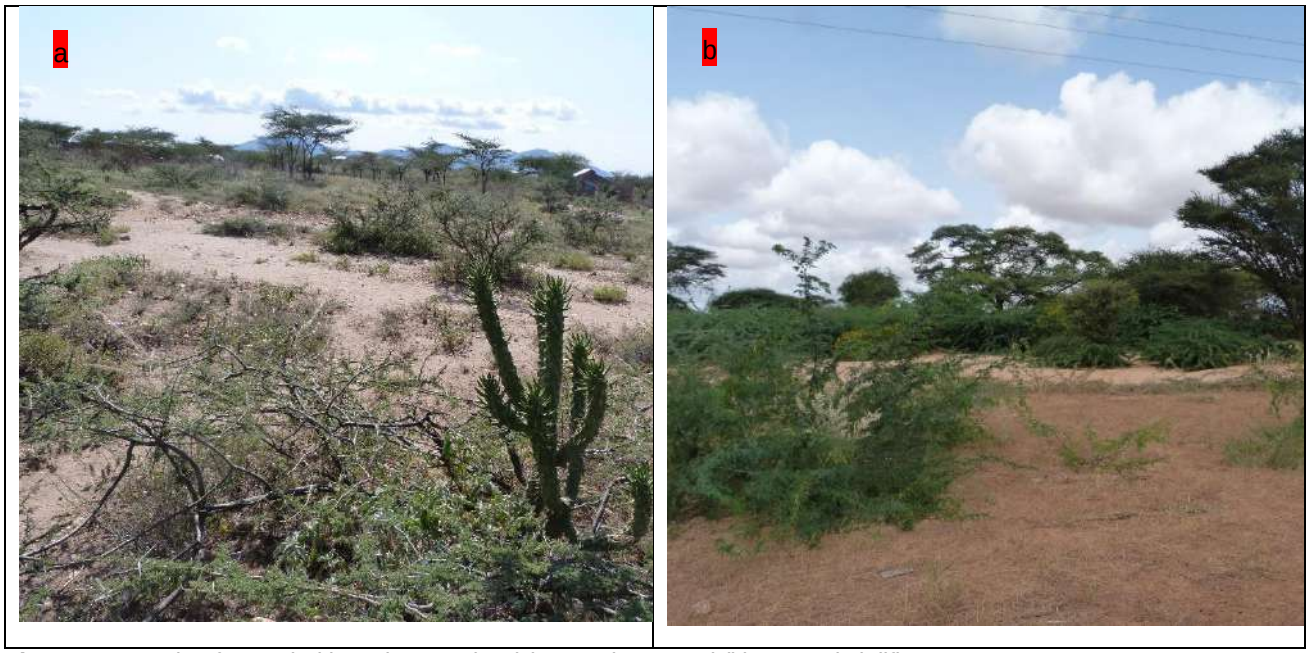

Figure 3: Sample of recorded invasive species (a) Opuntia sp. and (b) Prosopis juliflora

The following sites: (1) area around AGI-14 in Wamba; (2) Shaba National Reserve in Isiolo_N00037'29.4"; E37041'07.9"; and (3) point N00034'27.5"; E38005'26.9" in Isiolo, on Isiolo-Mandera road, in the study area, were flagged for unique flora. Selection of the three sites was based on the high number of species of conservation concern/endemics that were recorded at these sites.

3.2 Key Observations (species of conservation concern and endemics) for the LLCOP ESIA

The following key observations are provided in accordance with the advanced baseline surveys undertaken:

- *Aloe deserti* - ranked near threatened (NT), with several fragmented populations under the IUCN list. One individual recorded at Sware, north of Wamba town;
- *Neuracanthus keniensis* - Kenyan endemic that is restricted to North and north eastern Kenya and listed under the IUCN list as of least conservational concern (Shaba National Reserve in Isiolo_N00^{0}37'29.4"; E37^{0}41'07.9");
- *Acacia thomasii*_Endemic to Kenya/uncommon plant occurring in small groups on Acacia/commiphora woodlands (Seen in several groupings around point N00^{0}34'27.5"; E38^{0}05'26.9", on Isiolo-Mandera road);
- *Duosperma stoloniferum*_Restricted to Kenya and Somalia Acacia commiphora bushlands (Shaba National Reserve in Isiolo_N00^{0}37'29.4"; E37^{0}41'07.9");
- *Euphorbia tescorum*_Regionally endemic (Several populations at Sware, north of Wamba town);
- Xerophyta schnizleinia (of Northern Frontier in Kenya, Karamoja in Uganda, Ethiopia, Somali republic and Nigeria (Smith & Ayensu 1975) (a small population at area around AGI-14, Wamba);
- *Uvaria scheffleri*_Though of wide coverage in the country, it occupies sensitive environments (several individuals at area around AGI-14, Wamba);
- *Sesamothamnus busseanus* ._ Regionally endemic (Kenya, Tanzania, Somalia & Ethiopia) (dotted individuals at Shaba NR);
- *Jatropha ellenbeckii* _ Regionally endemic (few individuals at area around AGI-14, Wamba);
- *Jatropha pelargoniifolia* _ Regionally endemic (Few individuals at Sware, north of Wamba town);
- *Adenia venenata* _ Regionally endemic (North Uganda and Tanzania, Kenya, and Somalia (One individual around point N00^{0}34'27.5"; E38^{0}05'26.9", on Isiolo-Mandera road);
- *Melia volkensii* _Regionally endemic (Several individuals at point N00^{0}34'27.5"; E38^{0}05'26.9", on Isiolo-Mandera road); and
- *Boswellia neglecta*_Regionaly endemic(in Kenya, Ethiopia, Uganda, NE Tanzania & somalia) (Several individuals at point N00^{0}34'27.5"; E38^{0}05'26.9", on Isiolo-Mandera road).

3.3 Meetings and Discussions

A meeting was held on 19 June 2018 (8.00 – 10.00am) with Garissa County Commissioner Mr JK Chepchieng and other County Officials for team security planning. Being the first team to arrive in Garissa, the contacts and arrangements made at this meeting facilitated work by teams arriving afterwards. (Victor Wasonga and John Kimeu)

3.4 Health and Safety learnings

The following health and safety learnings were communicated by John Kimeu: *'Field cars need to be fitted with walkie-talkie radio for communication especially in areas where phone network coverage is poor as safety measure.'*

3.5 Gaps and Recommendations for full baseline data gathering

Based on the completed rapid assessment, this study has characterized flora (including species of conservation concern and endemics; see details in section 3.2), vegetation types and existing environmental threats, and identified sites of unique flora in the study area. These results are of wet season, hence, for comparison and completeness of study, a dry season sample is highly recommended. The identified sites with unique flora in

the study area are recommended for detailed sampling. The Coastal section, which had been proposed for sampling and due to security reasons was not, has unique flora. For example, it holds many coastal plant endemics, which are worthy capturing in the final report of this study. Based on this reasoning, a survey or literature review of the flora of that section is highly recommended. Lastly, after completion of the project, habitat assessment study is highly recommended.

Freddy Brookes
Biodiversity Lead

Simon Aldrich
Project Manager

FB/SA/es

APPENDIX

Yellow, red, pink and green highlighted in the list represent categories of Kenya endemics (K.E), conservation concern (C.C), regional endemics (R.E) and of sensitive habitats (S.H), * = not present

Species	Acacia Bushland	Acacia-Commiphora Bushlands	Grassland
Acacia elatior	1	*	*
Acacia mellifera	1	1	1
Acacia paolii	1	*	1
Acacia reficiens	1	1	*
Acacia Senegal	1	*	*
Acacia thomasii (K.E)	1	1	*
Acacia tortilis	1	*	1
Acalypha indica	1	*	1
Acanthospermum hispidum	1	*	*
Actiniopteris radiate	1	1	*
Adenia venenata	1	*	*
Adenia volkensii	1	1	1
Aerva lanata	1	1	1
Albuca abyssinica	1	*	*
Aloe deserti (IUCN C.C)	1	*	*
Aloe sp.	1	*	1
Alternanthera pungens	1	*	1
Aristida kenyensis	1	1	1
Aristida mutabilis	1	*	*
Asparagus buchananii	1	1	*
Balanites rotundifolia	1	1	1
Barleria acanthoides	1	1	1
Blepharis edulis	1	1	1
Blyttia fruticulosum	1	*	*

Species	Acacia Bushland	Acacia-Commiphora Bushlands	Grassland
Boerhavia repens	1	1	1
Boscia angustifolia	1	1	*
Boscia coriacea	1	1	1
Boswellia neglecta (R.E)	*	1	*
Brachiaria leersioides	1	1	1
Cadaba farinose	1	1	*
Cadaba rotundifolia	1	1	*
Calotropis procera	1	1	1
Cenchrus ciliaris	1	1	1
Cissus quadrangularis	1	*	*
Cleome allamani	1	1	1
Cleome scaposa	1	1	1
Cleome tenella	1	1	1
Coccinia grandis	1	*	*
Combretum aculeatum	1	1	*
Commiphora edulis	*	1	*
Commiphora kataf	*	1	*
Commiphora kua	*	1	*
Corbichonia decumbens	1	*	1
Corchorus tridens	1	1	1
Cordia monoica	1	1	*
Cordia sinensis	1	1	*
Dactyloctenium aegyptium	1	*	1
Datura stramonium	1	*	1
Delonix elata	1	1	*
Desmidorchis acutangula	1	*	*

Species	Acacia Bushland	Acacia-Commiphora Bushlands	Grassland
Digera muricata	1	1	1
Digitaria rivae	1	*	*
Dobera glabra	1	*	*
Duosperma longicalyx	1	*	1
Duosperma stoloniferum (R.E)	1	*	1
Enneapogon cenchroides	1	1	1
Enteropogon barbatus	1	1	*
Erythrina burttii	1	1	*
Euphorbia inaequilatera	1	*	1
Euphorbia prostrata	1	*	1
Euphorbia tescorum	1	1	*
Geigeria alata	1	1	*
Grewia tenax	1	1	1
Grewia villosa	1	1	1
Lawsonia inermis	1	*	*
Helichrysum glumaceum	*	*	1
Heliotropium rariflorum	1	1	1
Heliotropium simile	1	1	1
Heliotropium strigosum	1	*	1
Hermannia kirkii	1	1	1
Hibiscus micranthus	1	1	1
Hyphaene compressa	1	1	*
Hypoestes sp.	1	*	1
Indigofera spinose	1	1	1
Indigofera arrecta	1	*	1
Indigofera schimperi	1	1	1

Species	Acacia Bushland	Acacia-Commiphora Bushlands	Grassland
Jatropha dichtar	1	*	*
Jatropha ellenbeckii (R.E)	1	*	*
Jatropha pelargoniifolia (R.E	1	*	*
Justicia caerulea	1	1	1
Leptothrium senegalense	1	1	1
Lycium europaeum	1	1	1
Maerua crassifolia	1	1	*
Maerua oblongifolia	1	1	*
Melia volkensii	1	*	*
Neuracanthus keniensis (K.E)	1	*	*
Opuntia stricta	1	*	*
Oropetium minimum	1	*	1
Oxygonum sinuatum	1	*	1
Pavonia patens	1	*	1
Pergularia daemia	1	*	*
Polygala erioptera	1	*	1
Portulaca oleracea	1	*	*
Premna resinosa	1	1	*
Prosopis juliflora	1	1	1
Pterodiscus ruspolii	1	1	1
Pupalia lappacea	1	1	1
Ricinus communis	1	*	*
Ruellia patula	1	*	*
Salvadora persica	1	1	*
Seddera hirsuta	1	1	*
Sericocomopsis hildebrandtii	1	1	1

Species	Acacia Bushland	Acacia-Commiphora Bushlands	Grassland
Sesamothamnus busseanus (R.E)	1	1	*
Sesamum alatum	1	*	1
Setaria verticillata	*	*	1
Solanum arundo	*	1	1
Solanum coagulans	1	1	1
Solanum incanum	1	1	1
Sorghum arundinaceum	*	*	*
Sporobolus consimilis Fresen.	1	1	*
Sporobolus rangei	1	*	*
Sporobolus spicatus	1	1	*
Sterculia stenocarpa	*	1	*
Stipagrostis uniplumis	1	1	*
Suaeda monoica	1	1	*
Tagetes minuta	1	*	1
Terminalia spinosa	1	1	*
Tetrapogon cenchriformis	1	*	1
Tragus berteronianus	1	1	1
Tribulus terrestris	1	1	1
Tricholaena teneriffae	1	*	*
Vatovaea pseudolablab	1	*	*
Xerophyta schnizleinia (R.E)	1	*	*
Zaleya pentandra	1	*	*
Ziziphus mauritiana	1	1	*
Lannea alata	1	*	*
Opilia amentacea	1	*	*
Eragrostis cilianense	1	*	1

Species	Acacia Bushland	Acacia-Commiphora Bushlands	Grassland
Microchloa kunthi	1	1	*
Sporobolus nervosus	1	*	*
Dignathia hirtella	1	*	1
Uvaria scheffleri (S.H)	1	*	*
Totals	**123**	**72**	**64**

TECHNICAL MEMORANDUM

DATE 25 July 2018 **Project No.** 1772867.528/B.0

TO Alex Mayhook-Walker, PPMT

CC Freddy Brookes

FROM Simon Aldrich, Gary Morris Iveson **EMAIL** saldrich@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – SITE VISIT REPORT: INVERTEBRATES

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867.509/B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the long wet season, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening (Ecountability, 2017);
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted during the dry season and short wet seasons;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

Terrestrial invertebrate activity that is evident and particularly active in the wet season was the key focus for the advanced baseline programme. The team also addressed the potential presence of the range-restricted Geophilomorph Centipede (*Mecistocephalus angusticeps*), and the Fungus Beetle (*Coptorhina nitefacta*), both identified in the in the Critical Habitat Screening in locations in the Samburu and Matthews Range areas.

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The primary method for sampling was via sweep netting and direct searches at each sampling location and pit fall traps where possible.

Targeted terrestrial invertebrate groups included: Coleoptera (beetles); Hymenoptera (bees, wasps, ants); Lepidoptera (moths, butterflies); Orthoptera (grasshoppers, crickets, locusts, katydids); Diptera (flies):

- Sweep-netting entailed trapping invertebrates (mostly insects) using a sweep net for fixed periods along selected sampling sites. The collected specimens were euthanized and carefully kept in labelled butterfly envelopes and specimen vials containing 70% ethanol. Some of the specimens were identified in the field, while the rest were retained for later processing and identification at the National Museums of Kenya invertebrate laboratory;
- Timed direct searches involved walking along a transect within a time limit, collecting invertebrates under tree logs, rocks, on vegetation etc., invertebrates targeted included: longhorn beetles, butterflies, scolytid beetles, etc.; and
- Pitfall traps were mainly used to collect ground crawling invertebrates. Typically, the traps were left in place for 24 hours. The trapped invertebrates were collected and kept in labelled specimen jars containing 70% ethanol (preservative) for later processing and identification at the National Museums of Kenya (NMK) invertebrate laboratory.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Morris Mutua (MM).

2.2 Tasks completed

A brief summary of the field programme during visit is provided in Table 1.

Table 1: (Terrestrial Invertebrates baseline survey field programme

Date	Task	Location	Initials of team member attending
11/06/2018	Travel to Isiolo from Nairobi and preparation for 13 days survey	Isiolo	MM
11/06/2018	Arrival at Isiolo, prepared a draft survey programme for the duration of visit to guide in the surveys.	Isiolo	MM
12/06/2018	Conducted invertebrates survey at Wamba, Samburu county	Samburu	MM
13/06/2018	Conducted aquatic macro-invertebrates survey at Nagor-oworu river and other surveys at Namunyak community conservancy near Matthews range	Samburu county	MM

Date	Task	Location	Initials of team member attending
14/06/2018	Harvested traps and conducted other surveys in Wamba and Namunyak CC. Finished sampling in Samburu county	Samburu county	MM
15/06/2018	Conducted surveys at Ewaso Nyiro river and other points along Isiolo – Wajir road	Isiolo county	MM
16/06/2018	Conducted repeat survey at points along Isiolo-Wajir road	Isiolo county	MM
17/06/2018	Harvested traps and did more surveys in points along Isiolo-Wajir road	Isiolo county	MM
18/06/2018	Conducted surveys in dry seasonal rivers within Kalama community conservancy	Isiolo county	MM
19/06/2018	Travelled to Meru county Maua and did laid traps in the study points	Meru county	MM
20/06/2018	Harvested traps and conducted other surveys in the points within Kula mawe and Garba tula road	Meru county	MM
21/06/2018	Travelled to Garissa county from Meru	Garissa county	MM
22/06/2018	Laid traps and conducted other surveys in points along Garissa-Modagashe road including AGI 20	Garissa county	MM
23/06/2018	Harvested traps and conducted other surveys in the points alog Garissa-Modagashe road	Garissa county	MM
24/06/2018	Travelled back to Nairobi from Garissa	Nairobi	MM

2.3 Deviation from Planned Scope of Work

The following statement was provided by Morris Matua. *'All the points as reflected in my scope of work were covered despite meeting armed pastoralists at some points who were less concerned with my activities. There were some insecurity alerts in Garissa points but I managed to accomplish my survey after requesting for police escort.*

My proposal to further my survey in Turkana and Lamu counties might be affected if the current community stand off and insecurity alerts persists'.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Different methods were employed to observe, record and document invertebrates both in the riparian and terrestrial ecosystems as mentioned in Table 1 above.

Invertebrate species cumulative curve

Invertebrates were recorded on a daily basis. The cumulative number of species was plotted against the sampling effort which was based on daily species count. This linear regression approach, also called species incidence, helps to provide a species list for an area with an approximate assessment of completeness of sampling (Sutherland 1996, Pomeroy and Tengecho, 1986). The graph showing species accumulation indicates that with additional effort, more species are likely to be detected, since the graph almost, but did not, reach asymptote (flattening toward a direction where new species are not likely) (Figure 1). Another sampling based on seasonality (dry/wet season) is likely to discover additional species which could lead to levelling of the curve which almost levelled in the current survey.

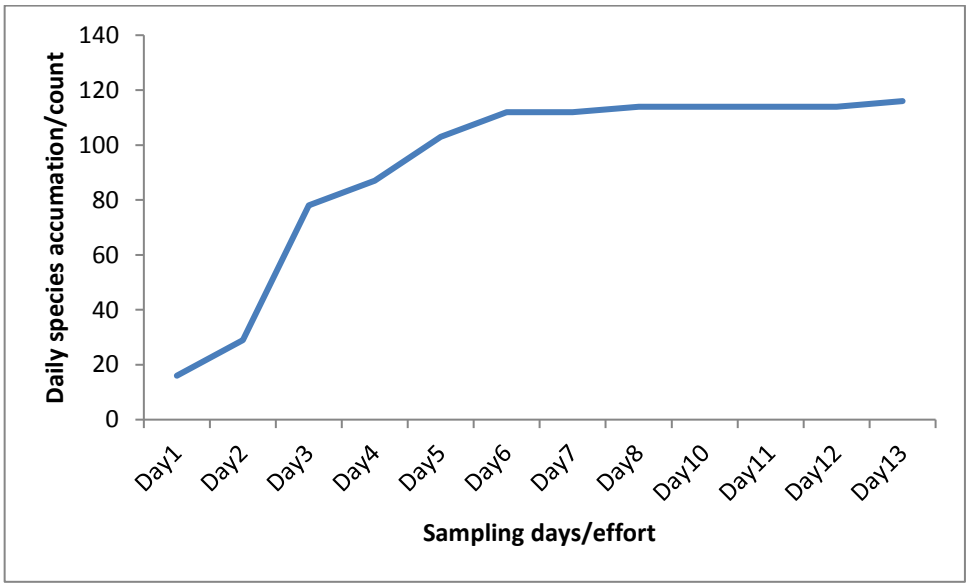

Figure 1: Species cumulative curve

The species richness and abundance differed amongst the different areas which were sampled during the June 2018 survey (Figure 2). The low species richness and abundance in some of the sites was attributed to the sampling effort employed. Traps were not set in some of the sites due to security concerns in these areas.

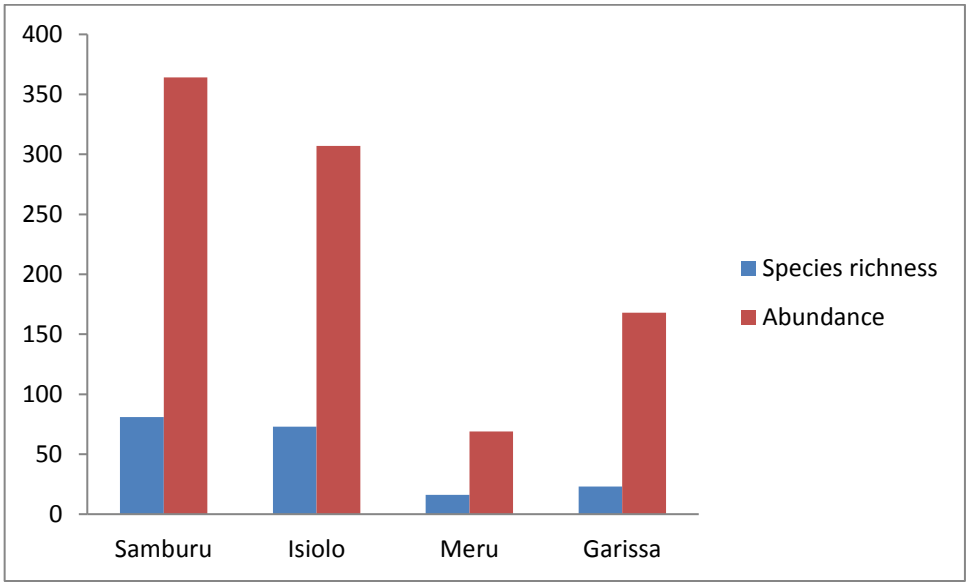

Figure 2: Mean species richness and abundance

Samburu

The pipeline route passes through community conservancies which are often species rich. The local community are pastoralists and are highly depended on the ecosystem for their livelihood and wellbeing.

A total of 81 species and 364 individual invertebrates' individuals belonging to 2 classes and 8 orders were recorded in different points covering the pipeline route within Samburu County. This included; 26 species of Order Lepidoptera (butterflies & Moths), 19 species of Order Hymenoptera (Bees, Wasps & Ants), 13 species of the Order Coleoptera (beetles), 8 species of Order Diptera (flies), 7 species of Order Orthoptera (Grasshoppers, Crickets and Locusts), 5 species of the Order Hemiptera (true bugs), 2 species of Order Odonata (Dragonflies) and 1 species of Order Solifugae.

Although the documented species play different ecological role in supporting ecosystem services, none of the species is listed under the *IUCN* Red data book or *CITES.*

Isiolo

The pipeline proposes to dissect across major rivers both permanent and seasonal. A major part of this route is covered by volcanic rocks which have created micro-habitats for some invertebrates' species.

A total of 73 species and 307 individual invertebrates' individuals those belonging to 3 classes and 11 orders were recorded in different points covering the pipeline route within Isiolo County. This included; 18 species of Order Lepidoptera (butterflies & Moths), 20 species of Order Hymenoptera (Bees, Wasps & Ants), 12 species of the Order Coleoptera (beetles), 5 species of Order Diptera (flies), 9 species of Order Orthoptera (Grasshoppers, Crickets &Locusts), 2 species of the Order Hemiptera (true bugs), 2 species of Order Odonata (Dragonflies), 2 species Order Isoptera (Termites), 1 species of Order Neuroptera (lacewings), 1 species of Order Spirostreptida (Millepedes) and Aranaea (Spiders).

Although the documented species play different ecological role in supporting ecosystem services, none of the species is listed under the *IUCN* Red data book or *CITES.*

Meru

This part of the route is mainly rocky hence the name Kula mawe "Eating rocks". The recording of few species and individuals was attributed to the conditions resulting from the presence of the volcanic rocks which has either modified or hindered occurrence of some species while creating conducive refuges for others.

A total of 16 species and 69 invertebrate individuals belonging to 1 class and 5 orders were recorded in different points covering the pipeline route within Meru County. This included; 5 species Order Hymenoptera, 5 species Order Lepidoptera, 4 species Order Orthoptera, 1 species each Order Coleoptera and Isoptera.

Although the documented species play different ecological role in supporting ecosystem services, none of the species is listed under the *IUCN* Red data book or *CITES.*

Garissa

The area is dominated by by Somali Acacia and Commiphora bushes and thickets. The soils are sandy with abundant grasses providing suitable habitats for some beetle and grasshoppers. Locals are generally nomadic camel herders.

A total of 23 species and 168 invertebrate individuals belonging to 1 class and 6 orders were recorded in different points covering the pipeline route within Garissa County. This included; 7 species of Order Orthoptera, 7 species of Order Lepidoptera, 5 species of Order Hymenoptera, 2 species of Order Diptera, 1 species each of Order Coleoptera and Isoptera.

Although the documented species play different ecological role in supporting ecosystem services, none of the species is listed under the *IUCN* Red data book or *CITES.*

3.2 Data collected

The invertebrate data is attached in a separate excel spread sheet (Attached as Table 2).

3.3 Key Observations for ESIA

- Geophilomorph Centipede (*Mecistocephalus angusticeps)* is an endemic species to Seychelles and Kenya. This species is recorded from coastal habitat in Seychelles where it lives in leaf litter and under stones, and in lowland areas in Kenya where it has been recorded from caves. The species was not documented in the current survey and further effort to discover and detect its presence/occurrence is required.
- Several migratory butterflies belonging to the Family Pieridae, *Catopsilia florella* and *Belenois spp.* were observed flying along the pipeline route within Samburu locations. This was a vivid indication of a migratory route and/or dispersal area but further information is needed to affirm the discovery.
- Huge locust swarms were observed in Garissa points. The species are of agricultural importance and the government bodies should be alerted to avert any form of outbreak/heavy infestation.
- The pipeline route dissects through seasonal river channels at some points. Although sampling was done during the current visit, a detailed survey in neighboring and related permanent rivers will help towards understanding and documenting of candidate species.

3.4 Meetings and Discussions

The following was communicated by Morris Matua: *'I held an informal meeting with the accountant (Richard Lolosolu +254 722 138 680) of Kalama community conservancy (Gigiri group ranch) on 18th June 2018. He*

needed clarification on our activity within their area of jurisdiction. I managed to respond to him in guidance of the Pipeline key messages and FAQs document and he was satisfied.'

3.5 Health and Safety learnings

The following health and safety learnings were communicated by Morris Matua: '*Some areas (e.g. Archers post) had numerous mosquitoes some of which are malaria carrier species, care should be taken to avoid infections. Most of the locals along the pipeline route are nomads and pastoralists; deployment of public liaison officer and administering of questionnaires is paramount prior to undertaking of any activity, in order, to create awareness and reduce the suspicion of cattle rustling'.*

3.6 Gaps and Recommendations for full baseline data gathering

Areas near the coastal line are known to host endemic and rare species; hence an assessment to document such species will be required. Invertebrates differ in biology and behaviour, and additional survey is required to document the dry season species and also enhance the completeness of the checklist which did not level even after the inclusion of the last samples (Figure 1). Further observations will be necessary to formulate recovery and restoration mitigation measures during and after the pipeline construction.

Proposed areas for further survey include:

- Samburu near Mathews range, Namunyak conservancy. This will enhance surveys to detect or record the *Coptorhina nitefacta* beetle which is known from two dissimilar localities. The species was described from Bura 1,050m a.s.l in the Teita hills, with further specimen recorded from the surroundings of Garissa (Flolov *et al* 2008). As this species is known by only two specimens and localities, it is not possible to assess whether it faces any possible threats;
- Low coastal land, Lamu, Boni or Witu forest. The coastal remnant forests are home to species which have not been able to penetrate inland and documenting them is highly recommended. *Chlorocnemis abbotti* is a species of damselfly in the family Protoneuridae which is threatened by habitat loss. This species is found in Kenya, Malawi and Tanzania (Clausnitzer, 2005). Its natural habitats are subtropical or tropical moist lowland forests, rivers, intermittent rivers and fresh water springs. There is need to survey the lowland moist forests and determine its presence; and
- Turkana has been avoided in several expeditions due to high levels of insecurity and poor road network. Carrying out another survey will enhance the checklists of the few collections at hand. *Omophron sp*. is a ground beetle species in the Family: Carabidae, and Sub-family:Omophrininae which is new to Kenyan records was documented in Loperot river, South Lokichar (Mutua, 2016). *Omophron*, Latreille 1802 is a genus of ground beetle and the only extant genus in the subfamily Omophrininae. It is mostly distributed in the Northern hemisphere with southern border running through Gutemale and Hispaniola in Americas, South Africa & Madagascar in Africa, Malaysia & Philippines in Asia (Uldis 2010). Only one specimen was collected and documented during the June 2016 survey and more expeditions are required to enhance onto its collection. The species is not listed under IUCN Red data book.

Freddy Brookes
Biodiversity Lead

Simon Aldrich
Project Manager

FB/SA/es

APPENDIX

Overall checklist for recorded Invertebrates in Samburu, Isiolo, Meru and Garissa counties

No.	Class	Order	Common Name	Family	Genus/species
1	Arachnida	Aranaea	Spiders	Lycosidae	*sp1*
2	Insecta	Coleoptera	Beetles	Dytiscidae	*Copelatus sp*
3	Insecta	Coleoptera	Beetles	Hydrophilidae	*Helochares sp*
4	Insecta	Coleoptera	Beetles	Hydrophilidae	*Cercyon sp*
5	Insecta	Coleoptera	Beetles	Staphylinidae	*Aleochara sp*
6	Insecta	Coleoptera	Beetles	Carabidae	*Abacetus sp*
7	Insecta	Coleoptera	Beetles	Carabidae	*Ooidius ephippium*
8	Insecta	Coleoptera	Beetles	Tenebrionidae	*Zophosis puntatafasciata*
9	Insecta	Coleoptera	Beetles	Coccinelidae	*Cheilomenes lunata*
10	Insecta	Coleoptera	Beetles	Meloidae	*Coryna apicicornis*
11	Insecta	Coleoptera	Beetles	Meloidae	*Coryna arussina*
12	Insecta	Coleoptera	Beetles	Melyridae	*Melyris viridicolor*
13	Insecta	Coleoptera	Beetles	Meloidae	*Coryna parenthesis*
14	Insecta	Coleoptera	Beetles	Cicindelidae	*Lophyra neglecta*
15	Insecta	Coleoptera	Beetles	Gyrinidae	*Dineutes sp*
16	Insecta	Coleoptera	Beetles	Gyrinidae	*Dineutes africana*
17	Insecta	Coleoptera	Beetles	Tenebrionidae	*Zophosis sulcata*
18	Insecta	Coleoptera	Beetles	Buprestidae	*sp1*
19	Insecta	Coleoptera	Beetles	Tenebrionidae	*Adesmia sp*
20	Insecta	Coleoptera	Beetles	Tenebrionidae	*Sepidium muscosum*
21	Insecta	Coleoptera	Beetles	Scarabaeidae	*Rhabdotis sobrina*
22	Insecta	Coleoptera	Beetles	Bostrychidae	*sp1*
23	Diplopoda	Spirostreptida	Millepedes	Spirostreptidae	*Archispirostreptus sp*
24	Insecta	Diptera	Flies	Asilidae	*Microstylum sp*
25	Insecta	Diptera	Flies	Chironomidae	*Chironomus sp*

No.	Class	Order	Common Name	Family	Genus/species
26	Insecta	Diptera	Flies	Bombyliidae	*Bombylius sp*
27	Insecta	Diptera	Flies	Muscidae	*Musca xanthomelas*
28	Insecta	Diptera	Flies	Asilidae	*Ancylorhynchus sp*
29	Insecta	Diptera	Flies	Muscidae	*Musca domestica*
30	Insecta	Diptera	Flies	Calliphoridae	*Chrysomya sp*
31	Insecta	Diptera	Flies	Calliphoridae	*Bengalia sp*
32	Insecta	Diptera	Flies	Calliphoridae	*Calliphora sp*
33	Insecta	Diptera	Flies	Tachinidae	*sp1*
34	Insecta	Diptera	Flies	Sarcophagidae	*Sarcophaga sp*
35	Insecta	Hemiptera	True bugs	Pentatomidae	*Cletus sp*
36	Insecta	Hemiptera	True bugs	Corixiidae	*Micronecta sp*
37	Insecta	Hemiptera	True bugs	Nepidae	*Ranatra sp*
38	Insecta	Hemiptera	True bugs	Pentatomidae	*Cletus sp*
39	Insecta	Hemiptera	True bugs	Lygaeidae	*Lethaeus sp*
40	Insecta	Hemiptera	True bugs	Pyrrhocoridae	*Dysdercus cardinalis*
41	Insecta	Hemiptera	True bugs	Lygaeidae	*Dieuches sp*
42	Insecta	Hymenoptera	Ants	Formicidae	*Dorylus sp*
43	Insecta	Hymenoptera	Bees	Halictidae	*Lasiogossum sp*
44	Insecta	Hymenoptera	Bees	Apidae	*Thyreus sp*
45	Insecta	Hymenoptera	Wasps	Sphecidae	*Ammophila sp*
46	Insecta	Hymenoptera	Wasps	Sphecidae	*Tachysphex sp*
47	Insecta	Hymenoptera	Ants	Formicidae	*Crematogaster sp*
48	Insecta	Hymenoptera	Wasps	Scoliidae	*sp1*
49	Insecta	Hymenoptera	Ants	Formicidae	*Camponotus maculatus*
50	Insecta	Hymenoptera	Ants	Formicidae	*Polyrhachis gagates*
51	Insecta	Hymenoptera	Ants	Formicidae	*Pheidole sp*

No.	Class	Order	Common Name	Family	Genus/species
52	Insecta	Hymenoptera	Ants	Formicidae	*Ocymyrmex weitzaeckeri*
53	Insecta	Hymenoptera	Ants	Formicidae	*Pachycondyla tarsata*
54	Insecta	Hymenoptera	Bees	Apidae	*Macrogalea candida*
55	Insecta	Hymenoptera	Ants	Formicidae	*Tetramorium sp*
56	Insecta	Hymenoptera	Bees	Apidae	*Apis mellifera*
57	Insecta	Hymenoptera	Bees	Halictidae	*Pseudapis sp*
58	Insecta	Hymenoptera	Bees	Megachilidae	*Megachile sp*
59	Insecta	Hymenoptera	Bees	Apidae	*Melliponula sp*
60	Insecta	Hymenoptera	Wasps	Eumenidae	*Eumenes sp*
61	Insecta	Hymenoptera	Bees	Apidae	*Amegilla sp*
62	Insecta	Hymenoptera	Bees	Apidae	*Braunsapis sp*
63	Insecta	Hymenoptera	Wasps	Ichneumonidae	*sp1*
64	Insecta	Hymenoptera	Wasps	Scoliidae	*Mierromeriella sp*
65	Insecta	Hymenoptera	Bees	Apidae	*Xylocopa calens*
66	Insecta	Hymenoptera	Wasps	Scoliidae	*Scolia sp*
67	Insecta	Isoptera	Termites	Termitidae	*termite hill 1*
68	Insecta	Isoptera	Termites	Termitidae	*termite hill*
69	Insecta	Isoptera	Termites	Termitidae	*Odontotermes sp*
70	Insecta	Lepidoptera	Butterflies	Pieridae	*Catopsilia florella*
71	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Junonia oenone*
72	Insecta	Lepidoptera	Butterflies	Pieridae	*Eurema brigitta*
73	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Vanessa cardui*
74	Insecta	Lepidoptera	Butterflies	Lycaenidae	*Zizula hylax*
75	Insecta	Lepidoptera	Butterflies	Pieridae	*Belenois aurota*
76	Insecta	Lepidoptera	Butterflies	Pieridae	*Colotis evanina*
77	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Phalanta phalantha*

No.	Class	Order	Common Name	Family	Genus/species
78	Insecta	Lepidoptera	Butterflies	Pieridae	*Pinacopteryx eriphia*
79	Insecta	Lepidoptera	Butterflies	Hesperiidae	*Aspilia sp*
80	Insecta	Lepidoptera	Butterflies	Papilionidae	*Papilio demodocus*
81	Insecta	Lepidoptera	Butterflies	Lycaenidae	*Freyeria trochylus*
82	Insecta	Lepidoptera	Butterflies	Pieridae	*Colotis evagore*
83	Insecta	Lepidoptera	Butterflies	Pieridae	*Colotis celimene*
84	Insecta	Lepidoptera	Butterflies	Hesperiidae	*Borbo sp.*
85	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Danaus chrysippus*
86	Insecta	Lepidoptera	Butterflies	Lycaenidae	*Lampides boeticus*
87	Insecta	Lepidoptera	Butterflies	Pieridae	*Colotis sp*
88	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Junonia hierta*
89	Insecta	Lepidoptera	Butterflies	Pieridae	*Colotis euippe*
90	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Amauris formosa*
91	Insecta	Lepidoptera	Butterflies	Lycaenidae	*Anthene contrastata*
92	Insecta	Lepidoptera	Butterflies	Lycaenidae	*Lepidochrysops polydialecta*
93	Insecta	Lepidoptera	Butterflies	Pieridae	*Belenois creaona*
94	Insecta	Lepidoptera	Moths	Noctuidae	*Sphingimorpha sp*
95	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Acraea sp*
96	Insecta	Lepidoptera	Butterflies	Hesperiidae	*Borbo borbonica*
97	Insecta	Lepidoptera	Butterflies	Nymphalidae	*Byblia ilithyia*
98	Insecta	Lepidoptera	Butterflies	Hesperiidae	*Coeliades forestan*
99	Insecta	Lepidoptera	Butterflies	Pieridae	*Colotis aurigeneous*
100	Insecta	Neuroptera	Lacewings	Myrmeleontidae	*Creoleon sp*
101	Insecta	Odonata	Dragonfly	Libellulidae	*Orthetrum sp*
102	Insecta	Odonata	Dragonfly	Aeshinidae	*Anax sp*
103	Insecta	Orthoptera	Grasshoppers	Acrididae	*Acanthacris ruficornis*

No.	Class	Order	Common Name	Family	Genus/species
104	Insecta	Orthoptera	Grasshoppers	Acrididae	*Aiolopus longicornis*
105	Insecta	Orthoptera	Grasshoppers	Acrididae	*Acorypha sp*
106	Insecta	Orthoptera	Crickets	Gryllidae	*Gryllulus sp*
107	Insecta	Orthoptera	Grasshoppers	Acrididae	*Cataloipus oberthuri*
108	Insecta	Orthoptera	Locusts	Acrididae	*Schistocerca gregaria*
109	Insecta	Orthoptera	Grasshoppers	Acrididae	*Humbe sp*
110	Insecta	Orthoptera	Grasshoppers	Acrididae	*Acanthacris sp*
111	Insecta	Orthoptera	Grasshoppers	Acrididae	*Acrotylus blondeli*
112	Insecta	Orthoptera	Crickets	Gryllidae	*Gryllus sp*
113	Insecta	Orthoptera	Crickets	Gryllidae	*Henicus sp*
114	Insecta	Orthoptera	Grasshoppers	Acrididae	*Acrotylus sp*
115	Insecta	Orthoptera	Crickets	Gryllidae	*Phaeophilacris sp*
116	Arachnida	Solifugae	Camel spider		*sp1*

TECHNICAL MEMORANDUM

DATE 25 July 2018 **Project No.** 1772867.524/B.0

TO Alex Mayhook-Walker, PPMT

CC Freddy Brookes

FROM Simon Aldrich, Gary Morris Iveson **EMAIL** saldrich@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – SITE VISIT REPORT: ORNITHOLOGY

1.0 INTRODUCTION

The following field report relates to the execution of field activities defined in plan of study 1772867 509.B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the long wet season, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening (Ecountability, 2017);
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted during the dry season and short wet seasons;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

This element of the advanced baseline was focused on the potentially critically endangered species identified in the Critical Habitat Screening, such as Saker Falcon (*Falco cherug*), White-backed Vulture (*Gyps africanus*), and Ruepell's Vulture (G. ruepellii). A key area is the rocks and crags in the 'gap' section north of the Samburu

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National Park and other areas of potential migratory importance during the wet season. Any important bird

- Distance sampling and absolute census – was used to survey colonially roosting water birds and water fowl at wetlands or waterbodies, as they were identified.
- Timed species counts (of birds seen and heard) across fixed time periods and routes, which were conducted to sample bird species associated with each broad habitat type/vegetation community.
- Point counts and rapid assessment (of birds seen and heard) were used in areas of rugged terrain, densely vegetated habitats and habitats that are heterogeneous or highly fragmented, where universal sampling designs are unlikely to work.

habitat areas which could be impacted during pipeline construction (seasonal or permanent) were included.

Opportunistic encounters were recorded while travelling along the route.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Philista Malaki (PM).

2.2 Tasks completed

A brief summary of the field programme during [Philista Malaki] visit is provided in Table 1.

Table 1: [Ornithological] baseline survey field programme

Date	Task	Location	Initials of team member attending
11/06/2018	Travel to Isiolo by Road, departed Nairobi 1030hrs	Nairobi-Isiolo	PM
11/06/2018	Checked in Bowen Hotel, 1730hrs Had team meeting in the evening before dinner to strategize on next day assignment Preparation for Bird Survey, re-confirming sample points in GPS	Isiolo	PM
12/06/2018	Depart Isiolo 0900hrs for Maralal	Isiolo-Maralal	PM
12/06/2018	General species assessment - list of observed species along Isiolo-Maralal highway captured on birdmap General habitat assessment - documented different habitat types (woodland, grassland, wetland, shrubland)to help make inference on species distribution and occurrences Took photo of habitats considered important for birds, wetlands, riverine and temporary pools Arrival @Maralal 1700hrs	Maralal	PM

Date	Task	Location	Initials of team member attending
	Discussed next day work strategy with VW		
13/06/2018	Depart Hotel @0700hrs heading NNE towards Marti where pipeline crosses Maralal-Baragoi Road	Maralal-Marti	PM
13/06/2018	Documented Bird Species between Maralal and Marti and detailed sampling at Marti Dam Interesting Observations Martial Eagle, African Hawk Eagle feeding on Silver-backed Jackal fresh carcass along the road, Common Kestrel and Chanting Goshawk also observed, Checked in Hotel, @1800hrs Discussed strategy for next day work over dinner >30 species documented and habitat assessed	Maralal-Marti-Maralal	PM
14/06/2018	Depart Samburu Guest Hotel @0900HRS	Maralal	PM
14/06/2018	Working enroute to Wamba from Maralal Documented Birds at Kisima Dam Documented Birds along the road to Wamba	Maralal-Wamba	PM
15/06/2018	Depart Hotel 0715hrs to Wamba	Archers-Wamba	PM
15/06/2018	Surveys in Namnyiak and West gate conservancy Interesting records Brown Snake Eagle and Verreaux's Eagle at westgate, Egyptian Vulture between Archers and Wamba Junction, Verreaux's Eagle Owl on way back to Archers, Arrived Archers @2230hrs, Discussed Plan for next day	Archers-Wamba Junction	PM
16/06/2018	Depart Hotel 0900hrs to Wamba	Archers-Wamba	
	Surveys in Namnyiak and West gate conservancy Interesting records Bateleur, Black-chested Snake Eagle , Gabar Goshawk, Chanting Goshawk Arrived Archers @1700hrs, Discussed Plan for next day	Archers-Wamba Junction	PM
17/06/2018	Depart Hotel @0815hrs to Uaso River	Archers	PM
17/06/2018	Bird surveys within Archers Area Sighted Hooded Vulture along the River Hotel @1700hrs	Archers	PM

Date	Task	Location	Initials of team member attending
18/06/2018	Bird Surveys within Uaso River	Archers-Uaso	PM
19/06/2018	Travel to Garissa	Archers-Garissa	PM
20/06/2018	Sampled sites in Garissa	Garissa	PM
21/06/2018	Depart for Nairobi	Garissa-Nairobi	PM

2.3 Deviation from Scope

The survey was fully conducted within the scope of the project objectives. The findings will be able to inform future surveys as intended. The only limitation was inability to access those areas within our Plan of study that had reported insecurity incidences at the time of the surveys such as Garissa and Lamu.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Scope of survey

All points selected in Maralal, Samburu, Wamba, Archers post, were surveyed successfully. However, due to security issues in Garissa we were not able to get to the pre-selected sites hence other accessible and safe sites were selected.

Bird Habitat description

Habitats ranging from Acacia woodlands, Wooded grasslands, Open grasslands, Bushlands, characterised the survey site. Aquatic habitats also represented by temporary pools of water and constructed dams for domestic and livestock use were scattered across the proposed pipeline routing. These varied habitats are a good representation of the rich diversity of birds observed and expected along the pipeline routing. Cliffs and hilly landscapes characterized the general area especially between Archers to Wamba. These features provided suitable habitats for raptors and vultures.

Bird observation

More than 100 species of birds were observed during the rapid assessment representing birds from different families. This included passerines, raptors, vultures and wetland birds. The list of species observed is and supporting status assessments are attached in Appendix A.

Species of conservation concern observed included, African White-backed Vulture *Gyps africanus*, and the Hooded vulture *Necrosyrtes monachus,* which were observed in the Ewaso ng'iro river at the field work area. Both of these vulture species are listed as Critically Endangered on the IUCN list. The Palm nut Vulture *Gypohierax angolensis* a species categorised as IUCN Least Concern was also recorded in the same area (Ewaso ng'iro river) crossing.

Other notable species of conservation concern due to their behaviour and habitat dependency include plovers that nest on the ground near pools and in wetlands; sandgrouse that move in flocks and that are sometimes observed flocking at any available water pools; species of bustards that nest on the ground, mainly on wooded grasslands, and species of gamebirds including vulturine guineafowls.

Different species may have varying sensitivities to the proposed project activities depending on their behaviour (e.g. habitat preferences/dependency, feeding patterns, diurnal and seasonal movements etc.). It is therefore important to understand species reliance on habitats through their lifecycle or migratory patterns in order to minimize residual effects.

Data collected

See attached excel file in Appendix 1.

3.2 Key observations for ESIA

The key species listed under IUCN were the African White-backed Vulture, *Gyps africanus* CR (Critically endangered) and the Hooded Vulture *Necrosyrtes monachus* CR. However; more surveys targeting vulture species, likely to be present and triggering critical habitat, would reveal more, especially North of Samburu National Park and in Wamba area, where habitats are suitable for the species. Others species were also recorded though under the NT (near threatened) or Vu (vulnerable) category.

3.3 Meetings and Discussions

Philista Maleki indicated that: *'Several contacts with locals some who were aware, others not aware of the project. A Notable encounter was with a local owning a camp i.e. Lengusaka Camp in Wamba, who was very knowledgeable and was of great help to us while working in Wamba and Westgate. Also, interacted with the local assistant chief in Wamba who even though was welcoming, did not seem to be impressed with our presence since there was no prior formal communication to his office of our work within his jurisdiction. He requested that in future we should provide prior notice courtesy call to his office so that through his office the community would be aware of the on-going work as the community may sometimes turn hostile to people they consider strangers.'*

3.4 Health and Safety learning

The following learnings were provided by Philista Maleki:

'The drivers and vehicles allocated need to strictly have radio on all the time for communication especially in areas where phone network coverage is poor as a safety measure. Having a local guide accompany the surveyors is very crucial onsite as well as prior communication with the local administration. This saves the team a lot of time to make courtesy calls or undertake introduction time that eats into survey time.

Working in teams is important, so that work does not stop especially when once vehicle has a problem, then one team can join another as the issue of vehicle is sorted. My vehicle was switched off in the middle of the bush for close to an hour, moving as a team provided a quick mitigation as the issue was sorted quickly and effectively.'

3.5 Gaps and Recommendations for additional data gathering

- Additional surveying and monitoring for migratory and nesting birds considered of conservation concern is required for the ESIA Baseline. Breeding and nesting periods are generally early April to late August for most birds. However, certain birds do not have a defined breeding or nesting season. While the bird migration peaks in October-November and March-April.
- This survey coincided with breeding and nesting season for most birds though time was limited to undertake intensive observation to map out key breeding and nesting sites.

- The next stage of the ESIA survey needs to be timed to fall within the bird migration season to establish specific migratory routes for critically endangered and endangered song birds and raptors because the pipeline crosses within the known migratory corridor. Further extended surveys during peak migration (October / November period) to be extended to two weeks mainly targeting diurnal migrating raptors at specific vantage points. Vantage point survey requires more time to provide comprehensive picture of bird movements within the target sites.
- Specialised raptor survey to monitor movements and use of habitat especially use of wetlands along the entire proposed oil pipeline (where access allows). Specific surveys targeted at raptors, vultures, game birds are required to monitor their population and movements within the area of influence.
- The Lamu sites are considered important or the ESIA baseline, especially for marine birds that are endemic, critically endangered or endangered and access considering security conditions will need to be considered if gaps remain from desk top searches.

Freddy Brookes

Biodiversity Lead

Simon Aldrich

Project Manger

FB/SA/es

Date	Time	SITE	Habitat	Species common name	*Species Scientific name*	Seen/Heard	Latitude	Longitude	IUCN Status	Endemic (s	Strategy (e.g. forest dependent, grassla
13/06/2018	11:19	Maralal_Baragoi	Forestland, Wooded grassla	Namaqua Dove	*Oena capensis*	Seen	1.3124148	36.6233773	LC	Local	Grassland dependent
13/06/2018	11:20	Maralal_Baragoi	Forestland, Wooded grassla	Black-bellied Bustard	*Lissotis melanogaster*	Seen	1.3124148	36.6233773	LC	Local	Grassland dependent
13/06/2018	11:20	Maralal_Baragoi	Forestland, Wooded grassla	Ring-necked Dove	*Streptopelia capicola*	Seen	1.3124148	36.6233773	LC	Local	Generalist
13/06/2018	11:21	Maralal_Baragoi	Forestland, Wooded grassla	Fischer's Sparrow Lark	*Eremopterix leucopareia*	Seen	1.3124148	36.6233773	LC	Local	Grassland dependent
13/06/2018	11:37	Maralal_Baragoi	Forestland, Wooded grassla	Common Kestrel	*Falco tinnunculus*	Seen	1.3124148	36.6233773	LC	Local	Generalist
13/06/2018	12:01	Maralal_Baragoi	Forestland, Wooded grassla	Superb Starling	*Lamprotornis superbus*	Seen	1.638793333	36.75281667	LC	Local	Generalist
13/06/2018	12:01	Maralal_Baragoi	Forestland, Wooded grassla	Common Fiscal	*Lanius collaris*	Seen	1.638793333	36.75281667	LC	Local	Generalist
13/06/2018	12:01	Maralal_Baragoi	Forestland, Wooded grassla	Red-winged Starling	*Onychognathus morio*	Seen	1.638793333	36.75281667	LC	Local	Generalist
13/06/2018	12:32	Maralal_Baragoi	Forestland, Wooded grassla	Bateleur	*Terathopius ecaudatus*	Seen	1.635856667	36.77160167	NT	Local	Grassland dependent
13/06/2018	12:38	Maralal_Baragoi	Forestland, Wooded grassla	Abyssinian Scimitarbill	*Rhinopomastus minor*	Seen	1.642085	36.757165	LC	Local	Generalist
13/06/2018	12:39	Maralal_Baragoi	Forestland, Wooded grassla	Namaqua Dove	*Oena capensis*	Seen	1.642085	36.757165	LC	Local	Grassland dependent
13/06/2018	12:39	Maralal_Baragoi	Forestland, Wooded grassla	Ring-necked Dove	*Streptopelia capicola*	Seen	1.642085	36.757165	LC	Local	Generalist
13/06/2018	12:39	Maralal_Baragoi	Forestland, Wooded grassla	Common Drongo	*Dicrurus adsimilis*	Seen	1.642085	36.757165	LC	Local	Generalist
13/06/2018	12:48	Maralal_Baragoi	Forestland, Wooded grassla	Slate-coloured Boubou	*Laniarius funebris*	Seen	1.643361667	36.75655833	LC	Local	Generalist
13/06/2018	12:50	Maralal_Baragoi	Forestland, Wooded grassla	Black-faced Waxbill	*Estrilda erythronotus*	Seen	1.643238333	36.75661833	LC	Local	Generalist
13/06/2018	12:53	Maralal_Baragoi	Forestland, Wooded grassla	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	1.64319	36.75661167	LC	Local	Forest dependent
13/06/2018	12:55	Maralal_Baragoi	Forestland, Wooded grassla	Superb Starling	*Lamprotornis superbus*	Seen	1.64319	36.75661167	LC	Local	Generalist
13/06/2018	12:57	Maralal_Baragoi	Forestland, Wooded grassla	Cinnamon-chested Bee-eater	*Merops oreobates*	Seen	1.64319	36.75661167	LC	Local	Forest dependent
13/06/2018	12:59	Maralal_Baragoi	Forestland, Wooded grassla	Laughing Dove	*Streptopelia senegalensis*	Seen	1.64319	36.75661167	LC	Local	Generalist
13/06/2018	13:05	Maralal_Baragoi	Forestland, Wooded grassla	Crested Francolin	*Francolinus sephaena*	Seen	1.644563333	36.75751667	LC	Local	Grassland dependent
13/06/2018	13:08	Maralal_Baragoi	Forestland, Wooded grassla	Common Waxbill	*Estrilda astrild*	Seen	1.644145	36.75765333	LC	Local	Generalist
13/06/2018	13:10	Maralal_Baragoi	Forestland, Wooded grassla	Klaas's Cuckoo	*Chrysococcyx klaas*	Seen	1.644218333	36.75775667	LC	Local	Forest dependent
13/06/2018	13:10	Maralal_Baragoi	Forestland, Wooded grassla	Brubru	*Nilaus afer*	Seen	1.644215	36.75775833	LC	Local	Forest dependent
13/06/2018	13:13	Maralal_Baragoi	Forestland, Wooded grassla	Vitelline Masked Weaver	*Ploceus vitellinus*	Seen	1.643516667	36.757945	LC	Local	Forest dependent
13/06/2018	13:15	Maralal_Baragoi	Forestland, Wooded grassla	Grey-headed Sparrow	*Passer griseus*	Seen	1.643303333	36.75769833	LC	Local	Generalist
13/06/2018	13:18	Maralal_Baragoi	Forestland, Wooded grassla	Red-billed Quelea	*Quelea quelea*	Seen	1.6432	36.75750167	LC	Local	Grassland dependent
13/06/2018	13:21	Maralal_Baragoi	Forestland, Wooded grassla	Three-banded Plover	*Charadrius tricollaris*	Seen	1.643086667	36.75753	LC	Local	Wetland Dependent
13/06/2018	13:38	Maralal_Baragoi	Forestland, Wooded grassla	Sand Martin	*Riparia riparia*	Seen	1.643153333	36.75749333	LC	Local	Generalist
13/06/2018	13:51	Maralal_Baragoi	Forestland, Wooded grassla	Cardinal Woodpecker	*Dendropicos fuscescens*	Seen	1.641821667	36.75659167	LC	Local	Forest dependent
13/06/2018	13:57	Maralal_Baragoi	Forestland, Wooded grassla	Yellow-spotted Petronia	*Petronia pyrgita*	Seen	1.641346667	36.75652167	LC	Local	Forest dependent
13/06/2018	14:01	Maralal_Baragoi	Forestland, Wooded grassla	Variable Sunbird	*Cinnyris venustus*	Seen	1.641275	36.75653333	LC	Local	Generalist
13/06/2018	14:17	Maralal_Baragoi	Forestland, Wooded grassla	Pale Flycatcher	*Bradornis pallidus*	Seen	1.64158	36.756455	LC	Local	Forest dependent
13/06/2018	12:44	Maralal_Baragoi	Forestland, Wooded grassla	Egyptian Goose	*Alopochen aegyptiaca*	Seen	1.643203333	36.75691	LC	Local	Wetland Dependent
12/06/2018	13:25	TLP	Woodland	Common Drongo	*Dicrurus adsimilis*	Seen	0.9758803	37.3177985	LC	Local	Generalist
12/06/2018	14:00	TLP	Woodland	Namaqua Dove	*Oena capensis*	Seen	0.9758803	37.3177985	LC	Local	Grassland dependent
12/06/2018	14:00	TLP	Woodland	White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	0.9758803	37.3177985	LC	Local	Forest dependent
12/06/2018	14:08	TLP	Woodland	Red-winged Starling	*Onychognathus morio*	Seen	0.9758803	37.3177985	LC	Local	Generalist
12/06/2018	14:26	TLP	Woodland	Golden-breasted Starling	*Lamprotornis regius*	Seen	0.9758803	37.3177985	LC	Local	Forest dependent
12/06/2018	14:40	TLP	Woodland	Red-rumped Tinkerbird	*Pogoniulus atroflavus*	Seen	0.7864482	36.8998472	LC	Local	Forest dependent
12/06/2018	14:43	TLP	Woodland	Common Bulbul	*Pycnonotus barbatus*	Seen	0.7692704	36.8978306	LC	Local	Generalist
12/06/2018	14:58	TLP	Woodland	Grassland Pipit	*Anthus cinnamomeus*	Seen	0.8167732	36.8581592	LC	Local	Grassland dependent
12/06/2018	14:51	TLP	Woodland	Speckled Pigeon	*Columba guinea*	Seen	-1.1842622	36.8373064	LC	Local	Generalist
12/06/2018	15:13	TLP	Woodland	Crowned Plover	*Vanellus coronatus*	Seen	0.9419496	36.7770691	LC	Local	Grassland dependent
12/06/2018	15:22	TLP	Woodland	Fischer's Sparrow Lark	*Eremopterix leucopareia*	Seen	0.9419496	36.7770691	LC	Local	Grassland dependent
12/06/2018	15:22	TLP	Woodland	Pied Crow	*Corvus albus*	Seen	0.9419496	36.7770691	LC	Local	Generalist
12/06/2018	15:23	TLP	Woodland	Hildebrandt's Starling	*Lamprotornis hildebrandti*	Seen	0.9419496	36.7770691	LC	Local	Generalist
12/06/2018	15:49	TLP	Woodland	Black-headed Heron	*Ardea melanocephala*	Seen	1.0767032	36.7026302	LC	Local	Wetland Dependent
12/06/2018	15:49	TLP	Woodland	Speckled Mousebird	*Colius striatus*	Seen	1.0767032	36.7026302	LC	Local	Generalist
14/06/2018	09:21	Maralal_Archers	Open grassland, ephemeral	Lilac-breasted Roller	*Coracias caudatus*	Seen	1.0917276	36.6968308	LC	Local	Forest dependent
14/06/2018	09:22	Maralal_Archers	Open grassland, ephemeral	Kenya Rufous Sparrow	*Passer rufocinctus*	Seen	1.0917276	36.6968308	LC	Local	Generalist
14/06/2018	09:42	Maralal_Archers	Open grassland, ephemeral	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	1.0917276	36.6968308	LC	Local	Forest dependent
14/06/2018	10:08	Maralal_Archers	Open grassland, ephemeral	White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	1.0917276	36.6968308	LC	Local	Forest dependent

14/06/2018	10:11	Maralal_Archers	Open grassland, ephemeral	Ring-necked Dove	*Streptopelia capicola*	Seen	1.0917276	36.6968308	LC	Local	Generalist
14/06/2018	10:12	Maralal_Archers	Open grassland, ephemeral	Slate-coloured Boubou	*Laniarius funebris*	Seen	1.0917276	36.6968308	LC	Local	Generalist
14/06/2018	10:15	Maralal_Archers	Open grassland, ephemeral	Red-capped Lark	*Calandrella cinerea*	Seen	1.0917276	36.6968308	LC	Local	Grassland dependent
14/06/2018	10:20	Maralal_Archers	Open grassland, ephemeral	Blacksmith Plover	*Vanellus armatus*	Seen	1.0917276	36.6968308	LC	Local	Wetland Dependent
14/06/2018	10:25	Maralal_Archers	Open grassland, ephemeral	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	1.0915612	36.6984442	LC	Local	Forest dependent
14/06/2018	10:28	Maralal_Archers	Open grassland, ephemeral	Greater Blue-eared Starling	*Lamprotornis chalybaeus*	Seen	1.0915612	36.6984442	LC	Local	Generalist
14/06/2018	10:29	Maralal_Archers	Open grassland, ephemeral	Speckled Pigeon	*Columba guinea*	Seen	1.0915612	36.6984442	LC	Local	Generalist
14/06/2018	10:35	Maralal_Archers	Open grassland, ephemeral	Superb Starling	*Lamprotornis superbus*	Seen	1.0915612	36.6984442	LC	Local	Generalist
14/06/2018	10:40	Maralal_Archers	Open grassland, ephemeral	Tawny-flanked Prinia	*Prinia subflava*	Seen	1.0915612	36.6984442	LC	Local	Forest dependent
14/06/2018	10:44	Maralal_Archers	Open grassland, ephemeral	Red-winged Lark	*Mirafra hypermetra*	Seen	1.0915612	36.6984442	LC	Local	Grassland dependent
14/06/2018	10:22	Maralal_Archers	Open grassland, ephemeral	Egyptian Goose	*Alopochen aegyptiaca*	Seen	0.8569065	36.8271418	LC	Local	Wetland Dependent
14/06/2018	10:54	Maralal_Archers	Open grassland, ephemeral	Black-bellied Bustard	*Lissotis melanogaster*	Seen	0.9179458	36.7553951	LC	Local	Grassland dependent
14/06/2018	11:32	Maralal_Archers	Open grassland, ephemeral	Grassland Pipit	*Anthus cinnamomeus*	Seen	0.804935	36.872245	LC	Local	Grassland dependent
14/06/2018	11:32	Maralal_Archers	Open grassland, ephemeral	Rufous-naped Lark	*Mirafra africana*	Seen	0.804935	36.872245	LC	Local	Grassland dependent
14/06/2018	11:37	Maralal_Archers	Open grassland, ephemeral	Speckled Pigeon	*Columba guinea*	Seen	0.804935	36.872245	LC	Local	Generalist
14/06/2018	11:40	Maralal_Archers	Open grassland, ephemeral	Laughing Dove	*Streptopelia senegalensis*	Seen	0.804885	36.87273667	LC	Local	Generalist
14/06/2018	11:50	Maralal_Archers	Open grassland, ephemeral	Greater Blue-eared Starling	*Lamprotornis chalybaeus*	Seen	0.80486	36.87282167	LC	Local	Generalist
14/06/2018	11:50	Maralal_Archers	Open grassland, ephemeral	Superb Starling	*Lamprotornis superbus*	Seen	0.80486	36.87282167	LC	Local	Generalist
14/06/2018	12:52	Maralal_Archers	Open grassland, ephemeral	Red-headed Weaver	*Anaplectes melanotis*	Seen	0.9765625	37.320291	LC	Local	Forest dependent
15/06/2018	08:39	Namnyak	Wooded grassland, Open gr	African Mourning Dove	*Streptopelia decipiens*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:39	Namnyak	Wooded grassland, Open gr	Brubru	*Nilaus afer*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	08:39	Namnyak	Wooded grassland, Open gr	Laughing Dove	*Streptopelia senegalensis*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:40	Namnyak	Wooded grassland, Open gr	African Pied Wagtail	*Motacilla aguimp*	Seen	0.8735333	37.3162367	LC	Local	Grassland dependent
15/06/2018	08:41	Namnyak	Wooded grassland, Open gr	White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	08:41	Namnyak	Wooded grassland, Open gr	Superb Starling	*Lamprotornis superbus*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:49	Namnyak	Wooded grassland, Open gr	Grey-headed Sparrow	*Passer griseus*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:50	Namnyak	Wooded grassland, Open gr	Slate-coloured Boubou	*Laniarius funebris*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:50	Namnyak	Wooded grassland, Open gr	Common Drongo	*Dicrurus adsimilis*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:52	Namnyak	Wooded grassland, Open gr	Spotted Palm Thrush	*Cichladusa guttata*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	08:53	Namnyak	Wooded grassland, Open gr	Namaqua Dove	*Oena capensis*	Seen	0.8735333	37.3162367	LC	Local	Grassland dependent
15/06/2018	08:56	Namnyak	Wooded grassland, Open gr	Baglafecht Weaver	*Ploceus baglafecht*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	08:57	Namnyak	Wooded grassland, Open gr	Rufous Chatterer	*Turdoides rubiginosa*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	09:00	Namnyak	Wooded grassland, Open gr	Cardinal Woodpecker	*Dendropicos fuscescens*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	10:09	Namnyak	Wooded grassland, Open gr	Red-billed Firefinch	*Lagonosticta senegala*	Seen	0.881343333	37.31859667	LC	Local	Grassland dependent
15/06/2018	10:09	Namnyak	Wooded grassland, Open gr	African Citril	*Crithagra citrinelloides*	Seen	0.881343333	37.31859667	LC	Local	Forest dependent
15/06/2018	10:12	Namnyak	Wooded grassland, Open gr	Grey-headed Sparrow	*Passer griseus*	Seen	0.88153	37.31870333	LC	Local	Generalist
15/06/2018	10:22	Namnyak	Wooded grassland, Open gr	Superb Starling	*Lamprotornis superbus*	Seen	0.88165	37.31919833	LC	Local	Generalist
15/06/2018	09:08	Namnyak	Wooded grassland, Open gr	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
15/06/2018	09:09	Namnyak	Wooded grassland, Open gr	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
15/06/2018	09:10	Namnyak	Wooded grassland, Open gr	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
15/06/2018	13:13	Namnyak	Wooded grassland, Open gr	Hoopoe	*Upupa epops*	Seen	0.6225071	36.9872102	LC	Local	Forest dependent
15/06/2018	07:25	Archer_Wamba	Woodland	Egyptian Goose	*Alopochen aegyptiaca*	Seen	0.6421375	37.6634989	LC	Local	Wetland Dependent
15/06/2018	07:33	Archer_Wamba	Woodland	Red-winged Starling	*Onychognathus morio*	Seen	0.772163333	37.55671167	LC	Local	Forest dependent
15/06/2018	07:33	Archer_Wamba	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.772163333	37.55671167	LC	Local	Forest dependent
15/06/2018	07:37	Archer_Wamba	Woodland	White-fronted Bee-eater	*Merops bullockoides*	Seen	0.7721633	37.5567117	LC	Local	Forest dependent
15/06/2018	07:42	Archer_Wamba	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.7600485	37.5675133	LC	Local	Generalist
15/06/2018	07:52	Archer_Wamba	Woodland	Common Drongo	*Dicrurus adsimilis*	Seen	0.7600485	37.5675133	LC	Local	Generalist
15/06/2018	08:14	Archer_Wamba	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.853831667	37.40866333	LC	Local	Forest dependent
15/06/2018	08:22	Archer_Wamba	Woodland	Crowned Plover	*Vanellus coronatus*	Seen	0.8538317	37.4086633	LC	Local	Grassland dependent
15/06/2018	13:41	Naibelibeli	Woodland	Fan-tailed Raven	*Corvus rhipidurus*	Seen	0.8766481	37.3378044	LC	Local	Generalist
15/06/2018	13:41	Naibelibeli	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.8766481	37.3378044	LC	Local	Generalist
15/06/2018	13:41	Naibelibeli	Woodland	African Mourning Dove	*Streptopelia decipiens*	Seen	0.8766481	37.3378044	LC	Local	Generalist
15/06/2018	13:42	Naibelibeli	Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.8766481	37.3378044	LC	Local	Forest dependent

15/06/2018	13:45	Naibelibeli	Woodland	Namaqua Dove	*Oena capensis*	Seen	0.79657	37.21578833	LC	Local	Grassland dependent
15/06/2018	14:24	Naibelibeli	Woodland	Brubru	*Nilaus afer*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
15/06/2018	16:01	Westgate	Woodland	Brown Snake Eagle	*Circaetus cinereus*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:01	Westgate	Woodland	Verreaux's Eagle	*Aquila verreauxii*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:01	Westgate	Woodland	Klaas's Cuckoo	*Chrysococcyx klaas*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:01	Westgate	Woodland	Northern Black Flycatcher	*Melaenornis edolioides*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:02	Westgate	Woodland	Abyssinian Scimitarbill	*Rhinopomastus minor*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:02	Westgate	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.7818096	36.9065093	LC	Local	Generalist
15/06/2018	16:02	Westgate	Woodland	Hildebrandt's Starling	*Lamprotornis hildebrandti*	Seen	0.7818096	36.9065093	LC	Local	Generalist
15/06/2018	16:03	Westgate	Woodland	African Grey Flycatcher	*Bradornis microrhynchus*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:03	Westgate	Woodland	Brubru	*Nilaus afer*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:03	Westgate	Woodland	Sand Martin	*Riparia riparia*	Seen	0.7818096	36.9065093	LC	Local	Generalist
15/06/2018	16:03	Westgate	Woodland	White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:04	Westgate	Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
15/06/2018	16:04	Westgate	Woodland	Laughing Dove	*Streptopelia senegalensis*	Seen	0.7818096	36.9065093	LC	Local	Generalist
15/06/2018	16:04	Westgate	Woodland	Ring-necked Dove	*Streptopelia capicola*	Seen	0.7818096	36.9065093	LC	Local	Generalist
15/06/2018	16:17	Westgate	Woodland	Fan-tailed Raven	*Corvus rhipidurus*	Seen	0.9752106	37.3165658	LC	Local	Generalist
15/06/2018	16:20	Westgate	Woodland	Nubian Woodpecker	*Campethera nubica*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
15/06/2018	08:37	Namnyak1	Woodland	African Mourning Dove	*Streptopelia decipiens*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:37	Namnyak1	Woodland	Brubru	*Nilaus afer*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
15/06/2018	08:37	Namnyak1	Woodland	Laughing Dove	*Streptopelia senegalensis*	Seen	0.8735333	37.3162367	LC	Local	Generalist
15/06/2018	08:37	Namnyak1	Woodland	Ring-necked Dove	*Streptopelia capicola*	Seen	0.8735333	37.3162367	LC	Local	Generalist
17/06/2018	11:55	Archer1	Woodland	Brubru	*Nilaus afer*	Seen	0.6450707	37.669236	LC	Local	Forest dependent
17/06/2018	11:58	Archer1	Woodland	White-headed Mousebird	*Colius leucocephalus*	Seen	0.6450707	37.669236	LC	Local	Forest dependent
17/06/2018	12:01	Archer1	Woodland	Hoopoe	*Upupa epops*	Seen	0.6450707	37.669236	LC	Local	Forest dependent
17/06/2018	12:31	Archer1	Woodland	Northern White-crowned Shrike	*Eurocephalus rueppelli*	Seen	0.6441185	37.6681336	LC	Local	Forest dependent
17/06/2018	08:30	Archer2	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.6540111	37.6572996	LC	Local	Forest dependent
17/06/2018	09:17	Archer2	Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.6391915	37.6652576	LC	Local	Forest dependent
17/06/2018	09:20	Archer2	Woodland	Hoopoe	*Upupa epops*	Seen	0.6633089	37.6500358	LC	Local	Forest dependent
17/06/2018	09:20	Archer2	Woodland	Brubru	*Nilaus afer*	Seen	0.6633089	37.6500358	LC	Local	Forest dependent
17/06/2018	09:20	Archer2	Woodland	Semi-collared Flycatcher	*Ficedula semitorquata*	Seen	$0.66	$37.65	LC	Local	Forest dependent
17/06/2018	09:58	Archer2	Woodland	White-crowned Starling	*Spreo albicapillus*	Seen	0.6391915	37.6652576	LC	Local	Forest dependent
17/06/2018	10:52	Archer2	Woodland	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	Seen	0.6391915	37.6652576	LC	Local	Generalist
17/06/2018	10:57	Archer2	Woodland	Golden-breasted Bunting	*Emberiza flaviventris*	Seen	0.6391915	37.6652576	LC	Local	Generalist
17/06/2018	08:33	Archer2	Woodland	Ring-necked Dove	*Streptopelia capicola*	Seen	0.678985	37.63642	LC	Local	Generalist
17/06/2018	08:34	Archer2	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.678985	37.63642	LC	Local	Forest dependent
17/06/2018	08:48	Archer2	Woodland	Yellow-breasted Apalis	*Apalis flavida*	Seen	0.6775	37.6358283	LC	Local	Forest dependent
17/06/2018	08:48	Archer2	Woodland	Nubian Woodpecker	*Campethera nubica*	Seen	0.6775	37.6358283	LC	Local	Forest dependent
17/06/2018	08:51	Archer2	Woodland	Yellow-spotted Petronia	*Petronia pyrgita*	Seen	0.7028597	37.6203592	LC	Local	Forest dependent
17/06/2018	08:51	Archer2	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.6775	37.6358283	LC	Local	Forest dependent
17/06/2018	08:56	Archer2	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.6826867	37.6530444	LC	Local	Generalist
17/06/2018	09:03	Archer2	Woodland	Brown-crowned Tchagra	*Tchagra australis*	Seen	0.6895375	37.6346822	LC	Local	Forest dependent
17/06/2018	10:03	Archer2	Woodland	Northern White-crowned Shrike	*Eurocephalus rueppelli*	Seen	0.7015099	37.6230967	LC	Local	Forest dependent
17/06/2018	10:07	Archer2	Woodland	Grey Wren-Warbler	*Calamonastes simplex*	Seen	0.7017348	37.6226405	LC	Local	Forest dependent
17/06/2018	10:40	Archer2	Woodland	White-throated Bee-eater	*Merops albicollis*	Seen	0.7028597	37.6203592	LC	Local	Forest dependent
17/06/2018	10:41	Archer2	Woodland	Pale Flycatcher	*Bradornis pallidus*	Seen	0.7028597	37.6203592	LC	Local	Forest dependent
17/06/2018	10:42	Archer2	Woodland	Chin-spot Batis	*Batis molitor*	Seen	0.6710256	37.6428084	LC	Local	Forest dependent
17/06/2018	11:14	Archer2	Woodland	Emerald-spotted Wood-Dove	*Turtur chalcospilos*	Seen	0.6829276	37.6530435	LC	Local	Generalist
16/06/2018	13:02	Westgate1	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
16/06/2018	13:05	Westgate1	Woodland	Red-winged Starling	*Onychognathus morio*	Seen	0.9752106	37.3165658	LC	Local	Generalist
16/06/2018	13:14	Westgate1	Woodland	Bateleur	*Terathopius ecaudatus*	Seen	0.9752106	37.3165658	LC	Local	Forest dependent
16/06/2018	13:21	Westgate1	Woodland	Bristle-crowned Starling	*Onychognathus salvadorii*	Seen	0.975	37.317	LC	Local	Forest dependent
16/06/2018	15:11	Westgate1	Woodland	Yellow-breasted Apalis	*Apalis flavida*	Seen	0.90457	37.3693067	LC	Local	Forest dependent

17/06/2018	08:51	Westgate1	Woodland	Meyer's Parrot	*Poicephalus meyeri*	Seen	0.6775	37.6358283	LC	Local	Forest dependent
16/06/2018	11:33	Lengusaka	Woodland	Common Bulbul	*Pycnonotus barbatus*	Seen	0.801015	37.150332	LC	Local	Generalist
16/06/2018	11:48	Lengusaka	Woodland	Red-eyed Dove	*Streptopelia semitorquata*	Seen	0.880053333	37.31992333	LC	Local	Generalist
17/06/2018	12:14	Lengusaka	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.6450707	37.669236	LC	Local	Forest dependent
16/06/2018	14:10	Sirrata	Woodland	Meyer's Parrot	*Poicephalus meyeri*	Seen	0.899573333	37.3682	LC	Local	Forest dependent
16/06/2018	14:22	Sirrata	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.901958333	37.36802333	LC	Local	Forest dependent
16/06/2018	14:23	Sirrata	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.901958333	37.36802333	LC	Local	Forest dependent
16/06/2018	14:34	Sirrata	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.903291667	37.36848833	LC	Local	Forest dependent
16/06/2018	14:35	Sirrata	Woodland	Common Drongo	*Dicrurus adsimilis*	Seen	0.903291667	37.36848833	LC	Local	Generalist
16/06/2018	14:56	Sirrata	Woodland	Golden-breasted Starling	*Lamprotornis regius*	Seen	0.90457	37.36930667	LC	Local	Forest dependent
16/06/2018	14:59	Sirrata	Woodland	Red-eyed Dove	*Streptopelia semitorquata*	Seen	0.90457	37.36930667	LC	Local	Generalist
16/06/2018	15:01	Sirrata	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.90457	37.36930667	LC	Local	Generalist
16/06/2018	15:05	Sirrata	Woodland	D'Arnaud's Barbet	*Trachyphonus darnaudii*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:08	Sirrata	Woodland	Speckle-fronted Weaver	*Sporopipes frontalis*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:10	Sirrata	Woodland	Northern White-crowned Shrike	*Eurocephalus rueppelli*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:10	Sirrata	Woodland	White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:19	Sirrata	Woodland	Grey-headed Sparrow	*Passer griseus*	Seen	0.90457	37.3693067	LC	Local	Generalist
16/06/2018	15:19	Sirrata	Woodland	Brubru	*Nilaus afer*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:22	Sirrata	Woodland	White-headed Mousebird	*Colius leucocephalus*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:23	Sirrata	Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:25	Sirrata	Woodland	African Pied Wagtail	*Motacilla aguimp*	Seen	0.90457	37.3693067	LC	Local	Grassland dependent
16/06/2018	14:10	TLPDATA	Woodland	Meyer's Parrot	*Poicephalus meyeri*	Seen	0.899573333	37.3682	LC	Local	Forest dependent
16/06/2018	14:22	TLPDATA	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.901958333	37.36802333	LC	Local	Forest dependent
16/06/2018	14:23	TLPDATA	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.901958333	37.36802333	LC	Local	Forest dependent
16/06/2018	14:34	TLPDATA	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.903291667	37.36848833	LC	Local	Forest dependent
16/06/2018	14:35	TLPDATA	Woodland	Common Drongo	*Dicrurus adsimilis*	Seen	0.903291667	37.36848833	LC	Local	Generalist
16/06/2018	14:56	TLPDATA	Woodland	Golden-breasted Starling	*Lamprotornis regius*	Seen	0.90457	37.36930667	LC	Local	Forest dependent
16/06/2018	14:59	TLPDATA	Woodland	Red-eyed Dove	*Streptopelia semitorquata*	Seen	0.90457	37.36930667	LC	Local	Generalist
16/06/2018	15:01	TLPDATA	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.90457	37.36930667	LC	Local	Generalist
16/06/2018	15:05	TLPDATA	Woodland	D'Arnaud's Barbet	*Trachyphonus darnaudii*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:08	TLPDATA	Woodland	Speckle-fronted Weaver	*Sporopipes frontalis*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:10	TLPDATA	Woodland	Northern White-crowned Shrike	*Eurocephalus rueppelli*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:10	TLPDATA	Woodland	White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:19	TLPDATA	Woodland	Grey-headed Sparrow	*Passer griseus*	Seen	0.90457	37.3693067	LC	Local	Generalist
16/06/2018	15:19	TLPDATA	Woodland	Brubru	*Nilaus afer*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:22	TLPDATA	Woodland	White-headed Mousebird	*Colius leucocephalus*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:23	TLPDATA	Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
16/06/2018	15:25	TLPDATA	Woodland	African Pied Wagtail	*Motacilla aguimp*	Seen	0.90457	37.3693067	LC	Local	Grassland dependent
18/06/2018	07:37	uaso1	Riverine, Woodland	Mottled Swift	*Tachymarptis aequatorialis*	Seen	0.636055	37.673435	LC	Local	Generalist
18/06/2018	07:37	uaso1	Riverine, Woodland	Speckled Pigeon	*Columba guinea*	Seen	0.636055	37.673435	LC	Local	Generalist
18/06/2018	07:37	uaso1	Riverine, Woodland	African Pied Wagtail	*Motacilla aguimp*	Seen	0.636081667	37.67332	LC	Local	Grassland dependent
18/06/2018	07:38	uaso1	Riverine, Woodland	Black-winged Plover	*Vanellus melanopterus*	Seen	0.636093333	37.67333667	LC	Local	Wetland Dependent
18/06/2018	07:41	uaso1	Riverine, Woodland	Vitelline Masked Weaver	*Ploceus vitellinus*	Seen	0.636618333	37.67368167	LC	Local	Forest dependent
18/06/2018	07:42	uaso1	Riverine, Woodland	White-throated Bee-eater	*Merops albicollis*	Seen	0.6366183	37.6736817	LC	Local	Grassland dependent
18/06/2018	07:44	uaso1	Riverine, Woodland	Red-billed Firefinch	*Lagonosticta senegala*	Seen	0.637035	37.67411167	LC	Local	Generalist
18/06/2018	07:46	uaso1	Riverine, Woodland	Wire-tailed Swallow	*Hirundo smithii*	Seen	0.637528333	37.67425833	LC	Local	Generalist
18/06/2018	07:46	uaso1	Riverine, Woodland	Hadada Ibis	*Bostrychia hagedash*	Seen	0.637611667	37.67434833	LC	Local	Wetland Dependent
18/06/2018	07:46	uaso1	Riverine, Woodland	Hooded Vulture	*Necrosyrtes monachus*	Seen	0.637611667	37.67434833	LC	Local	Forest dependent
18/06/2018	08:02	uaso1	Riverine, Woodland	Black-faced Sandgrouse	*Pterocles decoratus*	Seen	0.638213333	37.675965	LC	Local	Grassland dependent
18/06/2018	08:05	uaso1	Riverine, Woodland	Three-banded Plover	*Charadrius tricollaris*	Seen	0.637926667	37.67585333	LC	Local	Wetland Dependent
18/06/2018	08:08	uaso1	Riverine, Woodland	Cinnamon-chested Bee-eater	*Merops oreobates*	Seen	0.638273333	37.67545	LC	Local	Forest dependent
18/06/2018	08:16	uaso1	Riverine, Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.637256667	37.67424	LC	Local	Forest dependent
18/06/2018	08:17	uaso1	Riverine, Woodland	Laughing Dove	*Streptopelia senegalensis*	Seen	0.637333333	37.67448167	LC	Local	Generalist

18/06/2018	08:24	uaso1	Riverine, Woodland	Spotted Palm Thrush	*Cichladusa guttata*	Seen	0.636946667	37.67443833	LC	Local	Forest dependent
18/06/2018	08:30	uaso1	Riverine, Woodland	Brubru	*Nilaus afer*	Seen	0.63646	37.67493333	LC	Local	Forest dependent
18/06/2018	08:32	uaso1	Riverine, Woodland	Sulphur-breasted Bushshrike	*Chlorophoneus sulfureopectus*	Seen	0.636468333	37.67503667	LC	Local	Forest dependent
18/06/2018	08:35	uaso1	Riverine, Woodland	Meyer's Parrot	*Poicephalus meyeri*	Seen	0.63696	37.67534167	LC	Local	Forest dependent
18/06/2018	08:38	uaso1	Riverine, Woodland	Egyptian Goose	*Alopochen aegyptiaca*	Seen	0.637321667	37.67642167	LC	Local	Wetland Dependent
18/06/2018	08:48	uaso1	Riverine, Woodland	Black-faced Waxbill	*Estrilda erythronotus*	Seen	0.636003333	37.675925	LC	Local	Grassland dependent
18/06/2018	08:49	uaso1	Riverine, Woodland	Pale Flycatcher	*Bradornis pallidus*	Seen	0.636003333	37.675925	LC	Local	Forest dependent
18/06/2018	08:56	uaso1	Riverine, Woodland	Woodland Kingfisher	*Halcyon senegalensis*	Seen	0.635941667	37.67462667	LC	Local	Wetland Dependent
18/06/2018	09:13	uaso1	Riverine, Woodland	Martial Eagle	*Polemaetus bellicosus*	Seen	0.635708333	37.67251333	VU	Local	Forest dependent
18/06/2018	09:13	uaso1	Riverine, Woodland	Abyssinian Scimitarbill	*Rhinopomastus minor*	Seen	0.635745	37.67252	LC	Local	Forest dependent
18/06/2018	09:13	uaso1	Riverine, Woodland	Egyptian Goose	*Alopochen aegyptiaca*	Seen	0.635743333	37.67252167	LC	Local	Wetland Dependent
18/06/2018	09:24	uaso1	Riverine, Woodland	Pied Crow	*Corvus albus*	Seen	0.638588333	37.66745167	LC	Local	Generalist
20/06/2018	10:46	uaso1	Riverine, Woodland	Golden-breasted Starling	*Lamprotornis regius*	Seen	-0.561478333	39.71976167	LC	Local	Forest dependent
20/06/2018	10:55	uaso1	Riverine, Woodland	Superb Starling	*Lamprotornis superbus*	Seen	-0.560593333	39.71995167	LC	Local	Generalist
18/06/2018	14:49	WambaJunction	Woodland	Bateleur	*Terathopius ecaudatus*	Seen	0.6417069	37.6560781	NT	Local	Forest dependent
18/06/2018	14:58	WambaJunction	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.6417069	37.6560781	LC	Local	Forest dependent
18/06/2018	15:05	WambaJunction	Woodland	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	Seen	0.6417069	37.6560781	LC	Local	Forest dependent
18/06/2018	15:07	WambaJunction	Woodland	Eastern Chanting Goshawk	*Melierax poliopterus*	Seen	0.6417069	37.6560781	LC	Local	Forest dependent
18/06/2018	15:07	WambaJunction	Woodland	Palm nut Vulture	*Gypohierax angolensis*	Seen	0.6417069	37.6560781	LC		Forest dependent
18/06/2018	15:13	WambaJunction	Woodland	D'Arnaud's Barbet	*Trachyphonus darnaudii*	Seen	0.6417069	37.6560781	LC	Local	Forest dependent
18/06/2018	15:23	WambaJunction	Woodland	Fan-tailed Raven	*Corvus rhipidurus*	Seen	0.6417069	37.6560781	LC	Local	Generalist
18/06/2018	15:39	WambaJunction	Woodland	Egyptian Goose	*Alopochen aegyptiaca*	Seen	0.7600485	37.5675133	LC	Local	Wetland Dependent
18/06/2018	15:39	WambaJunction	Woodland	Hooded Vulture	*Necrosyrtes monachus*	Seen	0.7600485	37.5675133	CR	Local	Forest dependent
18/06/2018	15:39	WambaJunction	Woodland	Black-winged Plover	*Vanellus melanopterus*	Seen	0.7600485	37.5675133	LC	Local	Wetland Dependent
18/06/2018	15:39	WambaJunction	Woodland	Black-bellied Starling	*Lamprotornis corruscus*	Seen	0.7600485	37.5675133	LC	Local	Forest dependent
18/06/2018	15:40	WambaJunction	Woodland	Speckled Pigeon	*Columba guinea*	Seen	0.7600485	37.5675133	LC	Local	Generalist
18/06/2018	15:41	WambaJunction	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.7600485	37.5675133	LC	Local	Generalist
18/06/2018	15:44	WambaJunction	Woodland	Little Ringed Plover	*Charadrius dubius*	Seen	0.7600485	37.5675133	LC	Local	Wetland Dependent
18/06/2018	15:45	WambaJunction	Woodland	Wattled Starling	*Creatophora cinerea*	Seen	0.7600485	37.5675133	LC	Local	Forest dependent
18/06/2018	15:49	WambaJunction	Woodland	African Pied Wagtail	*Motacilla aguimp*	Seen	0.7600485	37.5675133	LC	Local	Grassland dependent
18/06/2018	15:47	WambaJunction	Woodland	Common Sandpiper	*Actitis hypoleucos*	Seen	0.3543666	37.9477104	LC	Local	Wetland Dependent
20/06/2018	11:08	WambaJunction	Woodland	Marabou Stork	*Leptoptilos crumeniferus*	Seen	-0.563156667	39.719675	LC	Local	Generalist
20/06/2018	11:09	WambaJunction	Woodland	Brown Babbler	*Turdoides plebejus*	Seen	-0.563156667	39.719675	LC	Local	Forest dependent
20/06/2018	11:12	WambaJunction	Woodland	Eastern Yellow-billed Hornbill	*Tockus flavirostris*	Seen	-0.563156667	39.719675	LC	Local	Forest dependent
20/06/2018	11:14	WambaJunction	Woodland	Wood Sandpiper	*Tringa glareola*	Seen	-0.563156667	39.719675	LC	Local	Wetland Dependent
18/06/2018	16:11	Kalama1	Woodland	African White-backed Vulture	*Gyps africanus*	Seen	0.7600485	37.5675133	CR	Local	Forest dependent
18/06/2018	16:11	Kalama1	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.7600485	37.5675133	LC	Local	Forest dependent
18/06/2018	16:11	Kalama1	Woodland	Slate-coloured Boubou	*Laniarius funebris*	Seen	0.7600485	37.5675133	LC	Local	Forest dependent
18/06/2018	16:34	Kalama1	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.729521667	37.590455	LC	Local	Forest dependent
18/06/2018	16:41	Kalama1	Woodland	Common Bulbul	*Pycnonotus barbatus*	Seen	0.7297367	37.5910967	LC	Local	Generalist
18/06/2018	09:43	Kalama	Woodland	Common Drongo	*Dicrurus adsimilis*	Seen	0.7600485	37.5675133	LC	Local	Generalist
18/06/2018	09:43	Kalama	Woodland	Superb Starling	*Lamprotornis superbus*	Seen	0.7457513	37.5807248	LC	Local	Generalist
18/06/2018	09:43	Kalama	Woodland	Ring-necked Dove	*Streptopelia capicola*	Seen	0.7457513	37.5807248	LC	Local	Generalist
18/06/2018	09:44	Kalama	Woodland	Wattled Starling	*Creatophora cinerea*	Seen	0.7457513	37.5807248	LC	Local	Forest dependent
18/06/2018	09:46	Kalama	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.6779883	37.6343933	LC	Local	Forest dependent
18/06/2018	09:48	Kalama	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	0.6779883	37.6343933	LC	Local	Forest dependent
18/06/2018	09:57	Kalama	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	0.706643333	37.60917667	LC	Local	Forest dependent
18/06/2018	10:00	Kalama	Woodland	Meyer's Parrot	*Poicephalus meyeri*	Seen	0.706131667	37.60855667	LC	Local	Forest dependent
18/06/2018	10:16	Kalama	Woodland	Speckled Pigeon	*Columba guinea*	Seen	0.709171667	37.61071167	LC	Local	Generalist
18/06/2018	10:22	Kalama	Woodland	Nubian Woodpecker	*Campethera nubica*	Seen	0.710228333	37.61111167	LC	Local	Forest dependent
18/06/2018	10:23	Kalama	Woodland	Laughing Dove	*Streptopelia senegalensis*	Seen	0.710228333	37.61111167	LC	Local	Generalist
18/06/2018	10:26	Kalama		Abyssinian Scimitarbill	*Rhinopomastus minor*	Seen	0.71091	37.61174167	LC	Local	Forest dependent
18/06/2018	10:26	Kalama	Woodland	Wattled Starling	*Creatophora cinerea*	Seen	0.710926667	37.61174667	LC	Local	Forest dependent

18/06/2018	10:33	Kalama	Woodland	White-crested Helmetshrike	*Prionops plumatus*	Seen	0.710935	37.61362333	LC	Local	Forest dependent
18/06/2018	10:55	Kalama	Woodland	Variable Sunbird	*Cinnyris venustus*	Seen	0.711426667	37.61425333	LC	Local	Generalist
18/06/2018	10:56	Kalama	Woodland	Namaqua Dove	*Oena capensis*	Seen	0.711426667	37.61425333	LC	Local	Grassland dependent
18/06/2018	11:02	Kalama	Woodland	White-headed Mousebird	*Colius leucocephalus*	Seen	0.7114267	37.6142533	LC	Local	Forest dependent
18/06/2018	11:04	Kalama	Woodland	Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.7114267	37.6142533	LC	Local	Forest dependent
18/06/2018	11:13	Kalama	Woodland	Pale Flycatcher	*Bradornis pallidus*	Seen	0.7171569	37.6071477	LC	Local	Forest dependent
18/06/2018	11:13	Kalama	Woodland	Black-capped Social Weaver	*Pseudonigrita cabanisi*	Seen	0.7171569	37.6071477	LC	Local	Forest dependent
18/06/2018	11:13	Kalama	Woodland	Speckle-fronted Weaver	*Sporopipes frontalis*	Seen	0.7171569	37.6071477	LC	Local	Forest dependent
18/06/2018	11:16	Kalama	Woodland	African Bare-eyed Thrush	*Turdus tephronotus*	Seen	0.737173	37.5886517	LC	Local	Forest dependent
18/06/2018	11:17	Kalama	Woodland	Kenya (Eastern) Violet-backed Sunbird	*Anthreptes orientalis*	Seen	0.737173	37.5886517	LC	Local	Generalist
18/06/2018	11:19	Kalama	Woodland	Yellow-spotted Petronia	*Petronia pyrgita*	Seen	0.7028597	37.6203592	LC	Local	Forest dependent
20/06/2018	10:20	Garissa1	Woodland	Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	-0.4637537	39.6448442	LC	Local	Forest dependent
21/06/2018	07:32	Garissa1	Woodland	Woodland Kingfisher	*Halcyon senegalensis*	Seen	-0.4608053	39.640306	LC	Local	Wetland Dependent
20/06/2018	10:21	Garissa1	Woodland	White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	-0.564716667	39.72028833	LC	Local	Forest dependent
20/06/2018	10:22	Garissa1	Woodland	Laughing Dove	*Streptopelia senegalensis*	Seen	-0.564716667	39.72028833	LC	Local	Generalist
20/06/2018	10:26	Garissa1	Woodland	Common Drongo	*Dicrurus adsimilis*	Seen	-0.564576667	39.71993667	LC	Local	Generalist
20/06/2018	10:26	Garissa1	Woodland	Ring-necked Dove	*Streptopelia capicola*	Seen	-0.564576667	39.71993667	LC	Local	Generalist
20/06/2018	10:30	Garissa1	Woodland	White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	-0.563756667	39.71958833	LC	Local	Forest dependent
20/06/2018	10:40	Garissa1	Woodland	Black-winged Plover	*Vanellus melanopterus*	Seen	-0.56246	39.71971667	LC	Local	Wetland Dependent
20/06/2018	12:50	Garissa2	Woodland	Sacred Ibis	*Threskiornis aethiopicus*	Seen	-0.4605406	39.6429453	LC	Local	Wetland Dependent
20/06/2018	12:50	Garissa2	Woodland	Marabou Stork	*Leptoptilos crumeniferus*	Seen	-0.4605406	39.6429453	LC	Local	Generalist
20/06/2018	12:59	Garissa2	Woodland	Wattled Starling	*Creatophora cinerea*	Heard	-0.437338333	39.63343667	LC	Local	Forest dependent
20/06/2018	12:59	Garissa2	Woodland	Southern Greyheaded Sparrow (split)	*Passer diffusus*	Seen	-0.437168333	39.63354167	LC	Local	Generalist
20/06/2018	13:00	Garissa2	Woodland	Kenya Rufous Sparrow	*Passer rufocinctus*	Seen	-0.437168333	39.63354167	LC	Local	Generalist
20/06/2018	13:01	Garissa2	Woodland	White-rumped Swift	*Apus caffer*	Seen	-0.437293333	39.63362833	LC	Local	Generalist
20/06/2018	13:02	Garissa2	Woodland	Cattle Egret	*Bubulcus ibis*	Seen	-0.437293333	39.63362833	LC	Local	Generalist
20/06/2018	13:04	Garissa2	Woodland	Cinnamon-chested Bee-eater	*Merops oreobates*	Seen	-0.437138333	39.634085	LC	Local	Forest dependent

Species common name	*Species Scientific name*	Seen/Heard	Latitude	Longitude	IUCN Status	Endemic (s	Strategy (e.g. forest dependent, grassla
Semi-collared Flycatcher	*Ficedula semitorquata*	Seen	$0.66	$37.65	LC	Local	Forest dependent
Abyssinian Scimitarbill	*Rhinopomastus minor*	Seen	1.642085	36.757165	LC	Local	Generalist
African Bare-eyed Thrush	*Turdus tephronotus*	Seen	0.737173	37.5886517	LC	Local	Forest dependent
African Citril	*Crithagra citrinelloides*	Seen	0.881343333	37.31859667	LC	Local	Forest dependent
African Grey Flycatcher	*Bradornis microrhynchus*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
African Mourning Dove	*Streptopelia decipiens*	Seen	0.8735333	37.3162367	LC	Local	Generalist
African Pied Wagtail	*Motacilla aguimp*	Seen	0.7600485	37.5675133	LC	Local	Grassland dependent
African White-backed Vulture	*Gyps africanus*	Seen	0.7600485	37.5675133	CR	Local	Forest dependent
Baglafecht Weaver	*Ploceus baglafecht*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
Bateleur	*Terathopius ecaudatus*	Seen	1.635856667	36.77160167	NT	Local	Grassland dependent
Black-bellied Bustard	*Lissotis melanogaster*	Seen	0.9179458	36.7553951	LC	Local	Grassland dependent
Black-bellied Starling	*Lamprotornis corruscus*	Seen	0.7600485	37.5675133	LC	Local	Forest dependent
Black-capped Social Weaver	*Pseudonigrita cabanisi*	Seen	0.7171569	37.6071477	LC	Local	Forest dependent
Black-faced Sandgrouse	*Pterocles decoratus*	Seen	0.638213333	37.675965	LC	Local	Grassland dependent
Black-faced Waxbill	*Estrilda erythronotus*	Seen	1.643238333	36.75661833	LC	Local	Generalist
Black-headed Heron	*Ardea melanocephala*	Seen	1.0767032	36.7026302	LC	Local	Wetland Dependent
Blacksmith Plover	*Vanellus armatus*	Seen	1.0917276	36.6968308	LC	Local	Wetland Dependent
Black-throated Barbet	*Tricholaema melanocephala*	Seen	0.6775	37.6358283	LC	Local	Forest dependent
Black-winged Plover	*Vanellus melanopterus*	Seen	-0.56246	39.71971667	LC	Local	Wetland Dependent
Bristle-crowned Starling	*Onychognathus salvadorii*	Seen	0.975	37.317	LC	Local	Forest dependent
Brown Babbler	*Turdoides plebejus*	Seen	-0.563156667	39.719675	LC	Local	Forest dependent
Brown Snake Eagle	*Circaetus cinereus*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
Brown-crowned Tchagra	*Tchagra australis*	Seen	0.6895375	37.6346822	LC	Local	Forest dependent
Brubru	*Nilaus afer*	Seen	1.644215	36.75775833	LC	Local	Forest dependent
Cardinal Woodpecker	*Dendropicos fuscescens*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
Cattle Egret	*Bubulcus ibis*	Seen	-0.437293333	39.63362833	LC	Local	Generalist
Chin-spot Batis	*Batis molitor*	Seen	0.6710256	37.6428084	LC	Local	Forest dependent
Cinnamon-chested Bee-eater	*Merops oreobates*	Seen	1.64319	36.75661167	LC	Local	Forest dependent
Common Bulbul	*Pycnonotus barbatus*	Seen	0.7297367	37.5910967	LC	Local	Generalist
Common Drongo	*Dicrurus adsimilis*	Seen	1.642085	36.757165	LC	Local	Generalist
Common Fiscal	*Lanius collaris*	Seen	1.638793333	36.75281667	LC	Local	Generalist
Common Kestrel	*Falco tinnunculus*	Seen	1.3124148	36.6233773	LC	Local	Generalist
Common Sandpiper	*Actitis hypoleucos*	Seen	0.3543666	37.9477104	LC	Local	Wetland Dependent
Common Waxbill	*Estrilda astrild*	Seen	1.644145	36.75765333	LC	Local	Generalist
Crested Francolin	*Francolinus sephaena*	Seen	1.644563333	36.75751667	LC	Local	Grassland dependent
Crowned Plover	*Vanellus coronatus*	Seen	0.8538317	37.4086633	LC	Local	Grassland dependent
D'Arnaud's Barbet	*Trachyphonus darnaudii*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
Eastern Chanting Goshawk	*Melierax poliopterus*	Seen	0.6417069	37.6560781	LC	Local	Forest dependent

Eastern Yellow-billed Hornbill	*Tockus flavirostris*	Seen	-0.563156667	39.719675	LC	Local	Forest dependent
Egyptian Goose	*Alopochen aegyptiaca*	Seen	1.643203333	36.75691	LC	Local	Wetland Dependent
Emerald-spotted Wood-Dove	*Turtur chalcospilos*	Seen	0.6829276	37.6530435	LC	Local	Generalist
Fan-tailed Raven	*Corvus rhipidurus*	Seen	0.8766481	37.3378044	LC	Local	Generalist
Fischer's Sparrow Lark	*Eremopterix leucopareia*	Seen	0.9419496	36.7770691	LC	Local	Grassland dependent
Golden-breasted Bunting	*Emberiza flaviventris*	Seen	0.6391915	37.6652576	LC	Local	Generalist
Golden-breasted Starling	*Lamprotornis regius*	Seen	-0.561478333	39.71976167	LC	Local	Forest dependent
Grassland Pipit	*Anthus cinnamomeus*	Seen	0.8167732	36.8581592	LC	Local	Grassland dependent
Greater Blue-eared Starling	*Lamprotornis chalybaeus*	Seen	0.80486	36.87282167	LC	Local	Generalist
Grey Wren-Warbler	*Calamonastes simplex*	Seen	0.7017348	37.6226405	LC	Local	Forest dependent
Grey-headed Sparrow	*Passer griseus*	Seen	1.643303333	36.75769833	LC	Local	Generalist
Hadada Ibis	*Bostrychia hagedash*	Seen	0.637611667	37.67434833	LC	Local	Wetland Dependent
Hildebrandt's Starling	*Lamprotornis hildebrandti*	Seen	0.9419496	36.7770691	LC	Local	Generalist
Hooded Vulture	*Necrosyrtes monachus*	Seen	0.7600485	37.5675133	CR	Local	Forest dependent
Hoopoe	*Upupa epops*	Seen	0.6633089	37.6500358	LC	Local	Forest dependent
Kenya (Eastern) Violet-backed Sunbird	*Anthreptes orientalis*	Seen	0.737173	37.5886517	LC	Local	Generalist
Kenya Rufous Sparrow	*Passer rufocinctus*	Seen	1.0917276	36.6968308	LC	Local	Generalist
Klaas's Cuckoo	*Chrysococcyx klaas*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
Laughing Dove	*Streptopelia senegalensis*	Seen	1.64319	36.75661167	LC	Local	Generalist
Laughing Dove	*Streptopelia senegalensis*	Seen	-0.564716667	39.72028833	LC	Local	Generalist
Lilac-breasted Roller	*Coracias caudatus*	Seen	1.0917276	36.6968308	LC	Local	Forest dependent
Little Ringed Plover	*Charadrius dubius*	Seen	0.7600485	37.5675133	LC	Local	Wetland Dependent
Marabou Stork	*Leptoptilos crumeniferus*	Seen	-0.563156667	39.719675	LC	Local	Generalist
Martial Eagle	*Polemaetus bellicosus*	Seen	0.635708333	37.67251333	VU	Local	Forest dependent
Meyer's Parrot	*Poicephalus meyeri*	Seen	0.6775	37.6358283	LC	Local	Forest dependent
Mottled Swift	*Tachymarptis aequatorialis*	Seen	0.636055	37.673435	LC	Local	Generalist
Namaqua Dove	*Oena capensis*	Seen	1.3124148	36.6233773	LC	Local	Grassland dependent
Northern Black Flycatcher	*Melaenornis edolioides*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
Northern White-crowned Shrike	*Eurocephalus rueppelli*	Seen	0.6441185	37.6681336	LC	Local	Forest dependent
Nubian Woodpecker	*Campethera nubica*	Seen	0.710228333	37.61111167	LC	Local	Forest dependent
Pale Flycatcher	*Bradornis pallidus*	Seen	1.64158	36.756455	LC	Local	Forest dependent
Palm nut Vulture	*Gypohierax angolensis*	Seen	0.6417069	37.6560781	LC		Forest dependent
Pied Crow	*Corvus albus*	Seen	0.9419496	36.7770691	LC	Local	Generalist
Red-billed Firefinch	*Lagonosticta senegala*	Seen	0.637035	37.67411167	LC	Local	Generalist
Red-billed Hornbill	*Tockus erythrorhynchus*	Seen	1.0915612	36.6984442	LC	Local	Forest dependent
Red-billed Quelea	*Quelea quelea*	Seen	1.6432	36.75750167	LC	Local	Grassland dependent
Red-capped Lark	*Calandrella cinerea*	Seen	1.0917276	36.6968308	LC	Local	Grassland dependent
Red-eyed Dove	*Streptopelia semitorquata*	Seen	0.880053333	37.31992333	LC	Local	Generalist
Red-headed Weaver	*Anaplectes melanotis*	Seen	0.9765625	37.320291	LC	Local	Forest dependent

Red-rumped Tinkerbird	*Pogoniulus atroflavus*	Seen	0.7864482	36.8998472	LC	Local	Forest dependent
Red-winged Lark	*Mirafra hypermetra*	Seen	1.0915612	36.6984442	LC	Local	Grassland dependent
Red-winged Starling	*Onychognathus morio*	Seen	1.638793333	36.75281667	LC	Local	Generalist
Ring-necked Dove	*Streptopelia capicola*	Seen	0.7457513	37.5807248	LC	Local	Generalist
Rufous Chatterer	*Turdoides rubiginosa*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
Rufous-naped Lark	*Mirafra africana*	Seen	0.804935	36.872245	LC	Local	Grassland dependent
Sacred Ibis	*Threskiornis aethiopicus*	Seen	-0.4605406	39.6429453	LC	Local	Wetland Dependent
Sand Martin	*Riparia riparia*	Seen	0.7818096	36.9065093	LC	Local	Generalist
Scarlet-chested Sunbird	*Chalcomitra senegalensis*	Seen	0.6391915	37.6652576	LC	Local	Generalist
Slate-coloured Boubou	*Laniarius funebris*	Seen	0.7600485	37.5675133	LC	Local	Forest dependent
Southern Greyheaded Sparrow (split)	*Passer diffusus*	Seen	-0.437168333	39.63354167	LC	Local	Generalist
Speckled Mousebird	*Colius striatus*	Seen	1.0767032	36.7026302	LC	Local	Generalist
Speckled Pigeon	*Columba guinea*	Seen	-1.1842622	36.8373064	LC	Local	Generalist
Speckle-fronted Weaver	*Sporopipes frontalis*	Seen	0.7171569	37.6071477	LC	Local	Forest dependent
Spotted Palm Thrush	*Cichladusa guttata*	Seen	0.8735333	37.3162367	LC	Local	Forest dependent
Sulphur-breasted Bushshrike	*Chlorophoneus sulfureopectus*	Seen	0.636468333	37.67503667	LC	Local	Forest dependent
Superb Starling	*Lamprotornis superbus*	Seen	1.638793333	36.75281667	LC	Local	Generalist
Tawny-flanked Prinia	*Prinia subflava*	Seen	1.0915612	36.6984442	LC	Local	Forest dependent
Three-banded Plover	*Charadrius tricollaris*	Seen	1.643086667	36.75753	LC	Local	Wetland Dependent
Variable Sunbird	*Cinnyris venustus*	Seen	0.711426667	37.61425333	LC	Local	Generalist
Verreaux's Eagle	*Aquila verreauxii*	Seen	0.7818096	36.9065093	LC	Local	Forest dependent
Vitelline Masked Weaver	*Ploceus vitellinus*	Seen	1.643516667	36.757945	LC	Local	Forest dependent
Wattled Starling	*Creatophora cinerea*	Heard	-0.437338333	39.63343667	LC	Local	Forest dependent
White-bellied Go-away-bird	*Corythaixoides leucogaster*	Seen	1.64319	36.75661167	LC	Local	Forest dependent
White-browed Sparrow Weaver	*Plocepasser mahali*	Seen	0.6391915	37.6652576	LC	Local	Forest dependent
White-crested Helmetshrike	*Prionops plumatus*	Seen	0.710935	37.61362333	LC	Local	Forest dependent
White-crowned Starling	*Spreo albicapillus*	Seen	0.6391915	37.6652576	LC	Local	Forest dependent
White-fronted Bee-eater	*Merops bullockoides*	Seen	0.7721633	37.5567117	LC	Local	Forest dependent
White-headed Buffalo Weaver	*Dinemellia dinemelli*	Seen	0.9758803	37.3177985	LC	Local	Forest dependent
White-headed Mousebird	*Colius leucocephalus*	Seen	0.7114267	37.6142533	LC	Local	Forest dependent
White-rumped Swift	*Apus caffer*	Seen	-0.437293333	39.63362833	LC	Local	Generalist
White-throated Bee-eater	*Merops albicollis*	Seen	0.7028597	37.6203592	LC	Local	Forest dependent
Wire-tailed Swallow	*Hirundo smithii*	Seen	0.637528333	37.67425833	LC	Local	Generalist
Wood Sandpiper	*Tringa glareola*	Seen	-0.563156667	39.719675	LC	Local	Wetland Dependent
Woodland Kingfisher	*Halcyon senegalensis*	Seen	0.635941667	37.67462667	LC	Local	Wetland Dependent
Yellow-breasted Apalis	*Apalis flavida*	Seen	0.90457	37.3693067	LC	Local	Forest dependent
Yellow-spotted Petronia	*Petronia pyrgita*	Seen	1.641346667	36.75652167	LC	Local	Forest dependent

TECHNICAL MEMORANDUM

DATE 23 July 2018 **Project No.** 1772867.525/B.0

TO Alex Mayhook-Walker, PPMT

CC Freddy Brookes

FROM Simon Aldrich, Gary Morris Iveson **EMAIL** saldrich@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – SITE VISIT REPORT: HERPETOLOGY

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867 509.B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This advanced element focusses on biological data gathering that may be influenced by the long-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the long wet season, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening (Ecountability, 2017);
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted during the dry season and short wet seasons;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

For herpetology, the primary method for sampling was via direct searches at each sampling location. The viability of installing short-term traps, such as pitfalls, was established during the planning phase and when on-site.

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Focus species will depend on location, access, and potential for critical habitat. Such species include the range restricted species like chameleons, caecilians, and amphibians, for example.

- Time-limited active searching sites will involve searches for any species occurring within the area for a specific period. Techniques include identification of active animals, searching through leaf and bark litter, overturning logs and stones, searching beneath the bark of trees, investigating burrows and fallen timber, and recording tracks, diggings, scats and other signs. An equal amount of time was spent at each site.
- Acoustic and visual encounter surveys for amphibians and reptiles, where appropriate. Voucher specimens of tadpoles were collected for identification by NMK.
- Interviews with local inhabitants to ascertain what reptile and amphibian species they have encountered in the area, when they encounter them, and how frequently. This exercise was aided using published, pictorial field guides, which the local people were shown to assist in identifying species.
- Retention of voucher specimens where necessary, for taxonomic analysis of cryptic species.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Victor Wasonga (VW).

2.2 Tasks completed

A brief summary of the field programme during herpetology visit is provided in Table 1.

Table 1: Herpetology advanced baseline survey field programme

Date	Task	Location	Initials of team member attending
11/06/18	Travel	Nairobi-Isiolo	VW
12/06/18	Travel	Isiolo-Maralal	VW
13/06/18	Habitat searches and data collection	Merti-Nachola Game Ranch	VW
	Preparation of collected samples	Maralal	VW
14/06/18	Habitat searches and data collection	Kisima	VW
	Travel	Maralal-Archer's Post	VW
	Preparation of collected samples	Archer's Post	VW
15/06/18	Setting up pitfall with drift fence and Funnel traps (2 stations)	Namunyak Conservancy	VW
	Setting up pitfall with drift fence and Funnel traps (2 stations)	Westgate Conservancy	VW

Date	Task	Location	Initials of team member attending
	Habitat searches and data collection (Day)	Namunyak/Westgate	VW
	Meeting with local administration (Asst Chief. Wamba) for introductions and project overview	Namunyak	VW
	Habitat searches and data collection	Namunyak/Westgate	VW
	Preparation of collected samples	Archer's Post	VW
16/06/18	Checking traps, data collection and removal of traps	Namunyak/Westgate	VW
	Habitat Searches and data collection (Day)	Namunyak/Westgate	VW
	Habitat Searches and data collection (Day)	Namunyak/Westgate	VW
	Preparation of collected samples	Archer's Post	VW
17/06/18	Habitat searches and data collection	Sera Community Conservancy	VW
	Preparation of collected samples	Archer's Post	VW
18/06/18	Travel	Archer's Post-Garissa	VW
19/06/18	Meeting with Garissa County Commissioner Mr JK Chepchieng & other County Officials for team security planning	Garissa	VW
	Habitat searches and data collection	Modika	VW
	Preparation of collected samples	Garissa	VW
20/06/18	Habitat searches and data collection	Jariroti	VW
	Preparation of collected samples	Garissa	VW
21/06/18	Travel	Gairissa-Nairobi	VW

2.3 Deviation from Planned Scope of Work

Sampling at Mabati location north of Maralal scheduled for 13 June 2018 was cancelled due to inaccessibility but instead re-routed to Merti-Nachola Community Conservancy further north along the Maralal-Baragoi road.

Rahole National Reserve scheduled for a two-day site visit was cancelled based on unfavourable security assessment by the PPMT, instead sampling was undertaken near Modika adjacent areas within 15 km of Garissa town. In addition:

- Studies meant to address the Kerio River valley from 17 - 19 June 2018 were cancelled as a consequence of local community unrest leading to staff evacuation by the client; and
- The original plan to visit lowland coastal forests of Lamu was also excluded in the present study due to insecurity.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Merti-Nachola Game Ranch (North of Maralal)

A total of nine (9) species including two amphibians and seven reptiles were documented (refer to the attached herpetology data sheet for the rest of the discussion). The main land use in this wooded grassland is pastoralism and community-based wildlife conservation. In general, Samburu County has a network of game reserves and conservancies, either within or adjacent to the proposed pipeline corridor.

A more detailed current landuse planning for the County is available in the County Integrated Development Plan (CIDP). During the present wet season visit, a high density of juvenile amphibians and egg-nests were recorded from Charda Dam (the only water point sampled here) confirming recent and ongoing amphibian breeding. Given that sampling in this (as well as other water points in other locations discussed below) were restricted to day searches, it is expected that more amphibian species occur here than currently reported.

Similarly, there are potentially other dams in this conservation area which can also be categorized as amphibian breeding sites. It would be important to map such sites relative to the proposed pipeline corridor during the main phase of baseline survey. No snakes were seen, but a more terrestrially focused sampling might reveal some species. Both the Slender Chameleon and Savannah monitor lizard are listed in CITES Appendix II, but none of the species currently documented are in the IUCN Red Data list of Threatened species. Charda Dam (N01.64377^{o}, E036.75769^{o}) is mid-way between AGI 07 & AGI 08.

Kisima

Opportunistic sampling was carried out along the road from Maralal to Wamba. There are various swamps and rivers around Kisima. One snake, East African shovel-snout, three amphibians, and two lizards were recorded in this location. None of these species is listed as threatened.

Namunyak & Westgate Community Conservancies (Wamba) including Mathews Range

Namunyak Community wildlife conservancy covers the lowland woodlands around Wamba including Mathews Range while the adjacent Westgate lies in the lowlands to the south. A total of 10 species were documented during the present visit while additional five (5) species from the Mathews Range are from National Museums of Kenya database. Mt Kulal stump-nosed chameleon occurring in the Mathews Range is listed as Near Threatened; the 14 remaining species are either not evaluated or least concern.

Five species of amphibians recorded were all in breeding season. The Mathews range is an important ecological feature in this ecosystem characterised by permanent water springs which are common breeding sites for amphibians. Numerous earth dams and other additional breeding locations e.g. Naibelibeli

(N00.83886°, E037.30791°) are found in the surrounding lowlands. Such satellite water points are also primarily useful as seasonal water reservoirs for wildlife and livestock for the surrounding communities. Both sampling locations are closer to AGI 14.

Sera Conservancy (Archer's Post)

This is the rangeland to the East of Archer's Post-Laisamis highway, slightly crossing Ewaso Nyiro River to the south. This sampling area covers AGI 15 & AGI 16. Link-marked sand snake and five lizard species were recorded during the current visit. Large populations of Nile Crocodiles (Kenya's largest reptile) are also known within the Ewaso Nyiro River ecosystem.

Modika (North of Garissa)

Rahole National Reserve in Garissa (marked as an Area of interest (AOI) due to wildlife conservation utilization in the habitat screening report (eCountability, 2017) was not visited as scheduled due to prevailing security situation in the area. Instead, the present sampling was restricted to within 15 km around Garissa town along the luggas and other water points. A cattle watering point near Modika (S00.34383°, E039.70225°) revealed presence and breeding of three amphibian species including Peter's form nest frog, Mascarene ridged frog and Ancheta's ridged frog. In addition, three lizards were observed in this location. While the Kenya dwarf gecko is associated with trees and other vegetation, the other two lizards are ground dwellers. More sampling is expected in the next baseline survey not just in Rahole NR and the intervening extent along the pipeline corridor. This sampling location is closer to AGI 20

Jariroti (East of Garissa)

A large dry river bed passing through Jariroti village draining into Tana River. A tree-line of relatively high canopy are well established along the river bed, consequently offering important microhabitats for various reptile and amphibian species. Three reptiles were documented in the current field visit, none of which are listed as threatened. This sampling location is closer to AGI 21.

3.2 Data collected

The Herpetology data is attached in a separate spread sheet (Attached as Table 1).

3.3 Key Observations for ESIA

- Mt Kulal stump-nosed chameleon (*Trioceros narraioca*) is Near Threatened according to the IUCN list of Threatened species. This species occurs in Mathews Range (Namunyak Community Conservancy) near Wamba.
- The snake Kenya sand boa (*Gongylophis colubrinus*) is endemic to lowland dry savannas of Kenya. Discussions with locals in Namunyak confirmed that the species is frequently encountered in the area.

3.4 Meetings and Discussions

The following meetings and discussions took place during the study:

- Assistant Chief in Wamba requested a meeting on 15 June 2018 with Victor Wasonga at around 7.00 – 7.30 pm seeking clarification on team identity and the project overview. Another team member, Philista Malaki (ornithology) was also sampling in the same area at the time. Having explained the rationale for biodiversity assessment to inform the pipeline construction, he was satisfied but advised that the local leadership needed to be informed prior to the team visit in future for security purposes; and

- A meeting was held on 19 June 2018 (8.00 – 10.00am) with Garissa County Commissioner Mr JK Chepchieng and other County Officials for team security planning. Being the first team to arrive in Garissa, the contacts and arrangements made at this meeting facilitated work by teams arriving afterwards.

3.5 Health and Safety learnings

The following health and safety learnings were communicated by Victor Wasonga:

- Working in thorn bush environments when setting up traps and routine habitat searches;
- Staying out late (beyond dark) for nocturnal habitat searches is not possible in accordance with Golder protocol;
- Careful driving advised to avoid traffic accidents with heavy motor vehicle trucks along narrow and hilly pathways;
- Awareness of bandits associated with cattle rustlers among the pastoralist communities; and
- Convoy management for personnel movement should be centralized to avoid communication barriers which might lead to unprecedented and unsafe journey interruptions.

3.6 Gaps and Recommendations for full baseline data gathering

The current field work during the rainy season was aimed at quick assessment of amphibians in addition to gathering technical and logistical considerations necessary for a full assessment. The following gaps and recommendations would be critical in the next phase for further determination of possible occurrence of ecologically sensitive reptile and amphibian species and/or habitats within the proposed corridor:

- Locations that were scheduled but not sampled due to the current prevailing security assessment will be given priority during the full baseline survey. These include:
  - Kerio Valley (Turkana);
  - Rahole National Reserve (Garissa); and
  - Coastal lowland forests (Lamu);
- The stretch of the proposed pipeline corridor between Wamba and Baragoi is also yet to be sampled for amphibian and reptile species;
- The area covering Isiolo-Garba Tula road will also be sampled;
- A dry season spell will be most suitable to capture data on reptiles; and
- Further surveys are recommended in order to:- a) develop a more comprehensive species checklist for the project area and b) allow for standardization of sampling effort e.g. trapping protocols to be applied in sites where only habitat searches were carried out during the present survey.

The crepuscular and mostly secretive life history strategies of most amphibians and reptiles dictates repeat surveys to get the most accurate species assemblages of the targeted sites.

Freddy Brookes
Biodiversity Lead

Simon Aldrich
Project Manager

FB/SA/es

Region	Sampling Location	Lat. N	Long. E	Photo Ref.	Taxa	Common Name	*Genus*	*Species*	Conservation status	Observation Notes
Samburu	Merti-Nachola Conse	01.64377°	036.75769°	DSC04813	Reptile	Slender chameleon	*Chamaeleo*	*gracilis*	IUCN: LC; CITES: Appendix II	Female (gravid), breeding season
Samburu	Merti-Nachola Conse	01.64377°	036.75769°	DSC04800	Reptile	Helmetted terrapin	*Pelomedusa*	*subrufa*	IUCN: LC	Adults and juveniles, recent breeding
Samburu	Merti-Nachola Conse	01.64377°	036.75769°	DSC04851	Amphibian	Gallmann's Sand Frog	*Tomopterna*	*gallmanni*	IUCN: LC	Hundreds of juveniles seen at Charda Dam
Samburu	Merti-Nachola Conse	01.64377°	036.75769°		Reptile	Striped skink	*Trachylepis*	*striata*	Not evaluated	Observed on isolated Acacia trees
Samburu	Merti-Nachola Conse	01.64377°	036.75769°	DSC04906	Reptile	Tropical house gecko	*Hemidactylus*	*mabouia*	Not evaluated	Abundant on isolated trees
Samburu	Merti-Nachola Conse	01.64377°	036.75769°	DSC04964	Reptile	Smith's sand lizard	*Pseudoremias*	*smithii*	Not evaluated	Ground dwelling lizard
Samburu	Merti-Nachola Conse	01.64377°	036.75769°		Reptile	Speke's sand lizard	*Heliobolus*	*spekii*	Not evaluated	Ground dwelling lizard
Samburu	Merti-Nachola Conse	01.64377°	036.75769°	DSC04797	Amphibian	Perter's foam-nest frog	*Chiromantis*	*pertersii*	IUCN: LC	Breeding season; Several foam nests seen at Charda Dam
Samburu	Merti-Nachola Conse	01.64377°	036.75769°		Reptile	Savanna monitor lizard	*Varanus*	*albigularis*	Not evaluated: CITES: Appendix II	Burrower, can climb trees
Maralal	Kisima	00.92999°	036.77242°	DSC04842	Reptile	East African shovel-snout	*Prosymna*	*stuhlmanni*	Not evaluated	Burrowing species
Maralal	Kisima	00.84486°	036.87231°		Reptile	Elementeita rock agama	*Agama*	*caudospina*	Not evaluated	In rock out-crops
Maralal	Kisima	00.84486°	036.87231°	DSC04910	Amphibian	Anchieta's ridged frog	*Ptychadena*	*anchietae*	IUCN: LC	in most water points sampled
Maralal	Kisima	00.84486°	036.87231°	DSC05000	Amphibian	Mascarene rodged frog	*Ptychadena*	*mascareniensis*	IUCN: LC	in most water points sampled
Wamba	Namunyak	00.88142°	037.32022°	DSC04900	Reptile	East African house gecko	*Hemidactylus*	*angulatus*	not evaluated	Associated with large trees
Wamba	Namunyak	00.88142°	037.32022°	DSC04906	Reptile	Tropical house gecko	*Hemidactylus*	*mabouia*	Not evaluated	Associated with large trees
Wamba	Namunyak	00.88142°	037.32022°	DSC04910	Amphibian	Anchieta's ridged frog	*Ptychadena*	*anchietae*	IUCN: LC	in most water points sampled
Wamba	Westgate	00.83886°	037.30791°	DSC04910	Amphibian	Anchieta's ridged frog	*Ptychadena*	*anchietae*	IUCN: LC	in most water points sampled
Wamba	Westgate	00.83886°	037.30791°	DSC04797	Amphibian	Peter's foam-nest frog	*Chiromantis*	*pertersii*	IUCN: LC	Recent breeding; juveniles seen
Wamba	Westgate	00.83886°	037.30791°		Amphibian	Senegal kassina	*Kassina*	*senegalensis*	IUCN: LC	Recent breeding; juveniles seen
Wamba	Westgate	00.83886°	037.30791°		Amphibian	Wamba sand frog	*Tomopterna*	*wambensis*	IUCN: LC	Recent breeding; juveniles seen
Wamba	Namunyak	00.88142°	037.32022°		Reptile	Striped skink	*Trachylepis*	*striata*	not evaluated	In rocky out-crops
Wamba	Westgate	00.86740°	037.31825°	DSC04980	Reptile	Sundevall's writhing skink	*Mochlus*	*sundevalli*	not evaluated	Burrowing species
Wamba	Westgate	00.86740°	037.31825°		Reptile	Wahlberg's snake-eyed skink	*Panaspis*	*wahlbergi*	not evaluated	Burrowing species
Wamba	Westgate	00.86740°	037.31825°		Reptile	Rainbow skink	*Trachylepis*	*margaritifer*	not evaluated	Rock-dwelling species
Archer's Pos	Sera	00.67916°	037.63655°	DSC04964	Reptile	Smith's sand lizard	*Pseudoremias*	*smithii*	not evaluated	Ground dwelling lizard
Archer's Pos	Sera	00.67916°	037.63655°	DSC04964	Reptile	Smith's sand lizard	*Pseudoremias*	*smithii*	not evaluated	Ground dwelling lizard
Archer's Pos	Sera	00.67916°	037.63655°	DSC04970	Reptile	Long-tailed sand lizard	*Latastia*	*longicaudata*	not evaluated	Ground dwelling lizard
Archer's Pos	Sera	00.66524°	037.64885°	DSC04980	Reptile	Sundevall's writhing skink	*Mochlus*	*sundevalli*	not evaluated	Burrower
Archer's Pos	Sera	00.66524°	037.64885°		Reptile	Zebra skink	*Trachylepis*	*dichroma*	not evaluated	Burrower
Archer's Pos	Sera	00.66524°	037.64885°		Reptile	Tropical house gecko	*Hemidactylus*	*mabouia*	not evaluated	
Archer's Pos	Sera	00.63513°	037.67253°	DSC04989	Reptile	Link-marked sand snake	*Psammophis*	*biseriatus*	not evaluated	
Garissa	Modika	S00.37236°	039.71833°		Reptile	Kenya dwarf gecko	*Lygodctylus*	*keniensis*	Not evaluated	Common on large trees
Garissa	Modika	S00.34383°	039.70225°	DSC04910	Amphibian	Anchieta's ridged frog	*Ptychadena*	*anchietae*	IUCN: LC	in man-made water point
Garissa	Modika	S00.34383°	039.70225°	DSC05000	Amphibian	Mascarene rodged frog	*Ptychadena*	*mascareniensis*	IUCN: LC	in man-made water point
Garissa	Modika	S00.34383°	039.70225°	DSC04797	Amphibian	Peter's foam-nest frog	*Chiromantis*	*pertersii*	IUCN: LC	in man-made water point
Garissa	Jariroti	S00.56451°	039.71985°		Reptile	Red-headed rock agama	*Agama*	*lionotus*	Not evaluated	
Garissa	Jariroti	S00.56451°	039.71985°		Reptile	Kenya dwarf gecko	*Lygodctylus*	*keniensis*	Not evaluated	
Garissa	Jariroti	S00.56451°	039.71985°	DSC04964	Reptile	Smith's sand lizard	*Pseudoremias*	*smithii*	Not evaluated	Ground dwelling lizard
Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Jackson's forest lizard	*Adolfus*	*jackksoni*		
Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Archer's Post gecko	*Hemidactylus*	*funaiolii*	not evaluated; endemic to the Horn o	terrestrial, mostly found under rocks
Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Mt Kulal stump-nosed chameleon	*Trioceros*	*narraioca*	IUCN: Near Threatened	
Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Battersbyi's green snake	*Philothamnus*	*battersbyi*		
Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Leopard tortoise	*Stigmochelys*	*pardalis*	not evaluated; CITES Appendix II	

Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Tropical house gecko	*Hemidactylus*	*mabouia*		
Samburu	Mathews Range	01.12658°	037.31612°		Reptile	Nyika gecko	*Hemidactylus*	*squamulatus*		terrestrial
Samburu	Mathews Range	01.12658°	037.31612°		Amphibian	Common reed frog	*Hyperolius*	*viridiflavus*	IUCN: LC	
Samburu	Mathews Range	01.12658°	037.31612°	DSC04964	Reptile	Smith's sand lizard	*Pseudoremias*	*smithii*	Not evaluated	Ground dwelling lizard

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.106.B0

TO Paul Mowatt, PPMT

CC Gary Morris Iveson

FROM Tim Flower, Freddy Brookes **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES – SITE VISIT REPORT: MAMMALS

Preface: The following field report has been provided by mammal expert Bernard Agwanda. Golder has provided minimal editing to maintain the sentiment and expert opinion of Bernard Agwanda.

1.0 INTRODUCTION AND SCOPE

This field report relates to the implementation of field studies defined in the plan of study (PoS) Turkana 1772867.533 and PoS full baseline 1772867.536. This suite of baseline fieldwork is designed to support the ESIA for the LLPCOP Project to characterise biodiversity features of conservation concern (including critical habitat). It focusses on target mammal species identified in the Critical Habitat Screening (CHS) Report, Advance baseline recommendations, gap analysis study, desktop review study, recommendations from our Kenyan experts, government and non-government research agencies, and addresses information and data gaps from all the above.

The purpose of this baseline survey is to:

- Investigate occurrence of mammal species and populations of conservation concern within the pipeline corridor;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening (Ecountability, 2017), Golder (2018), and reports from agencies such as the Grevy Zebra Trust;
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Provide input to project routing and design mitigation; and
- Inform the overall baseline biodiversity study for the ESIA.

For this study, both direct observations and indirect methods were employed for sampling at each sample location (see Table 1 below) and those habitats identified before-hand.

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Table 1: Geographic coordinates of sampling locations, and proximity to nearest proposed Station (where applicable)

Sample Location Reference	Latitude	Longitude	Nearest Station (where applicable)	Distance and direction to nearest Station (where applicable)
L03	2.02913	36.14053	-	-
L04	2.02636	36.14408	-	-
L05	1.87710	36.31841	Station 2	2.03km NW
L06	1.82591	36.51360	-	-
L07	1.81782	36.64504	Station 3	0.82km NW
L08	1.53371	36.82555	Station 4 (PS2)	0.27km N
L09	1.34634	36.87762	-	-
L10	1.34372	36.88004	-	-
L12	0.96238	37.23134	-	-
L13	0.95976	37.23381	-	-
L14	0.84672	37.44450	Station 6	1.06km SE
L15	0.63842	37.67263	Station 7	0.71km N
L16	0.63691	37.67468	Station 7	0.87km N
L17	0.52066	37.97111	Station 8	2.24km W
L18	0.37324	38.58746	Station 9 (PRS)	1.3km SE
L19	0.10262	39.19789	Station 10	0.13km NE
L20	-0.24036	39.67218	Station 11	1.52km S
L21	-0.44278	39.82497	Station 12 (PS3)	0.35km SE
L22	-0.73089	39.97120	Station 13	1.57km N
L23	-1.32932	40.33394	Station 14	3.04km NW
L24	-1.68480	40.58685	Station 15	0.03km SW
L25	-1.91898	40.74360	Station 16	0.60km SW

In this baseline survey, priority species were identified based on likelihood of occurring within close proximity to the LLCOP, access, habitat use, and potential for critical habitat (CH). Such species include threatened and migratory species including African Bush Elephants (ABE), Grevy's Zebra (GZ), Hirola, African Hunting dog, Tomb bat, Elephant shrew, Cheetah, Cosen's gerbil rat, among others. Field observations were supplemented by the following techniques:

- Timed transect walks, which involved direct visual observation for any species occurring within the area for a specific period. The techniques include walking 1-km long transects and observing 100 m either side of the transect line, use of binoculars, and instant identification of observed mammals and activities and using published field guides in case of difficulty in identification. To standardise this per site, equal effort was applied;
- Timed transect walks, which involved non-direct observation for any species occurring within the area for a specific period. Signs of mammal tracks, droppings, wallowing sites, and foot prints were used to assign animal presence and activity at a location;
- Bat acoustic and visual encounter surveys for bats and roost sites were also conducted at likely habitat. The technique employed that involved use of hand-held heterodyne bat detectors; and
- Meetings and interviews with key informants, such as game conservancies, Kenya wildlife officials and local inhabitants, to find out the presence of priority mammal species in the targeted sites and their habitat use. To facilitate such discussions, a published field guide with pictures was used to show the officials and locals being interviewed.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The mammal fieldwork was completed by the following member(s) of the Golder team:

- Bernard Agwanda (BA).

2.2 Tasks completed

A summary of the field programme is provided in Table 2.

Table 2: Mammal baseline survey field programme

Date	Task	Location	Initials of team member attending
1/10/18	Travel	Nairobi-Kapese	BA
	Induction at KAPESE	Kapese, Lokichar	BA
2/10/18	Mammal survey at Kalapata at KP10-16	Kalapata, Nakukulas,	BA
3/10/18	Mammal survey at Kalapata and KP17-24	Maruongpei, Nakukulas	BA
4/10/18	Mammal survey setting traps at KP25-40	Lotubae	BA
05/10/18	Mammal survey-checking traps at Lotubae	Lotubae	BA
6/10/18	Meeting with local Chief Mr. Lukas Lokolonyoi	Kerio river	BA

Date	Task	Location	Initials of team member attending
	Mammal survey setting traps at River Kerio KP41-50(L03)	Kerio river	BA
7/10/18	Mammal survey-checking traps at R Kerio	Kerio L03	BA
8/10/18	Travel from Kapese to Wilson Nairobi	Kapese/Nairobi	BA
9/10/18	Specimen curation and data backup at NMK	Nairobi	BA
	Meet at Castor vali to receive equipment	Nairobi	BA
10/10/18	Travel by road from Nairobi to Isiolo	Nairobi/Isiolo	BA
11/10/18	Mammal survey at Archers Post (L15)	Archer's post	BA
12/10/18	Mammal survey setting trap on Ewaso Nyiro, L16	Ewaso Nyiro	BA
13/10/18	Mammal survey checking traps on Ewaso Nyiro, L16	Ewaso Nyiro	BA
14/10/18	Mammal survey East of Kula Mawe(L17)	Kula Mawe	BA
15/10/18	Mammal survey at Kula Mawe	Kula Mawe, isiolo	BA
16/10/18	Mammal survey east of Garbatulla	Maua	BA
17/10/18	Travel by road to Ol Maro,Laikipia	Maua/Laikipia	BA
18/10/18	Mammal survey and setting trap at L05 in Suguta valley	Suguta Valley	BA
19/10/18	Mammal survey and checking traps at L05	Suguta valley	BA
20/10/18	Travel from Olmaro to Baragoi	Olmaro/Baragoi	BA
21/10/18	Mammal survey at LLCOP in Suiyan location	Suiyan	BA
22/10/18	Mammal survey at LLCOP at Nachola- L07	Nachola	BA
23/10/18	Mammal survey at LLCOP at Nachola at lugga	Nachola	BA
24/10/18	Mammal survey at LLCOP in Barsaloi	Barsaloi	BA
25/10/18	Mammal survey at LLCOP in Namunyak	Samburu-wamba	BA
26/10/18	Mammal survey at LLCOP in Swari	Samburu-Wamba	BA
27/10/18	Mammal survey at LLCOP in L12	Mwibai and surrounding	BA
28/10/18	Mammal survey at L13	Samburu-Wamba	BA

Date	Task	Location	Initials of team member attending
29/10/18	Mammal survey at Westgate/Mwibai Conservancies	Samburu Wamba	BA
	Meeting with Andrew (Grevy's Zebra trust officer) in Westgate regarding data and observations.	Westgate Conservancy	BA
30/10/18	Grevy's zebra strong hold confirmation survey at Leposiwo, Silango and Lesteti (Samburu-Wamba)	Wamba	BA
31/10/18	Travelled from Shaba to Nairobi	Shaba/Nairobi	BA
01/11/18	Preserved sampled specimens and preserved them in the Laboratory at National Museum of Kenya (NMK). Also backed up data	Nairobi	BA
02/11/18	Travelled from Nairobi to Garissa	Nairobi/Garissa	BA
03/11/18	Mammal survey on LLCOP-setting traps at L20 near Modicca	Garissa	BA
04/11/18	Mammal survey-check traps at L20	Garissa	BA
05/11/18	Mammal survey at L19 and in Rahole N.R	Rahole	BA
06/11/18	Mammal survey at LLCOP Easy of Modicca	Modicca	BA
07/11/18	Mammal survey at LLCOP East of Kenya Defence Force (KDF) camp	Modicca	BA
08/11/18	Mammal survey at Sankuri (L21)	Sankuri	BA
09/11/18	Mammal survey at LLCOP in Ijara	Ijara	BA
10/11/18	Mammal survey at LLCOP in Bura East (Fafi)	Bura	BA
11/11/18	Travel from Hola to Nairobi	Hola/Nairobi	BA
12/11/18	Travel from Nairobi to Lamu	Nairobi/Lamu	BA
13/11/18	Mammal survey at LLCOP in Lamu new port area	Lamu	BA
	Held a meeting with County commissioner, County Admin police Commandant, and Kililana rep-Mohammed (cell: 0726888542)	Lamu	BA
14/11/18	Mammal survey on LLCOP at Baragoni	Baragoni	BA
	Meeting with Police commandant and Inspector at Hindi. Provided escort of 10 armed police	Hindi	BA

Date	Task	Location	Initials of team member attending
	Held a joint meeting with Bagagoni KDF operation camp commander- Mjr Kemboi and Insp Ndungu of Adm police	Bargoni	BA
15/11/18	Debriefing meeting with police at Hindi	Hindi AP camp	BA
	Mammal survey on LLCOP in Mrandeni	Mrandeni	BA
16/11/18	Mammal survey at LLCOP near Shoreline		BA
17/11/18	Mammal survey at LLCOP mangrove/land intertidal habitat	New port, Lamu	BA
18/11/18	Data curation / backup and preparation for demobilisation	Peponi-Lamu	BA
19/11/18	Travel from Lamu to Nairobi	Lamu/Nairobi	BA
20/11/18	Laboratory work to identify specimens and data backup.	Nairobi	BA

2.3 Deviation from Planned Scope of Work

- Worked in Suguta valley on 18 and 19 October 2018, while operating from Ol Maro in Laikipia instead of the original plan of between 8 and 15 October while operating from Turkana. This change was due to security reasons, and it worked well. No incidence of security breach or safety issues.
- Due to security advice, sought accommodation in Shaba Sarova instead of Isiolo, after security advice that Isiolo was unsafe at that time (31/10/18).
- In view of the data provided by GZT, and insights provided to Bernard Agwanda by Andrew Letura of GZT, Grevy's zebra-focused search was conducted on 28 and 29 October to confirm the data and strong-holds at this time of the year.
- Sections on the LLCOP between Ijara and Baragoni were not visited by the Golder team due to increased insecurity in that area, as confirmed by Police and Masalani and Mj Kemboi of KDF in Baragoni.
- Planned mammal study along LLCOP around Lamu was not completed due to late delivery of equipment. Essential equipment including camera traps, binoculars, bat detector, and small mammal traps were not delivered by courier agent until 16 November when the team was winding up.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Turakana: Nakukulas, Maruangpei lotubae & Kerio river

Site aim: The aim here was to ascertain presence of mammal species that could trigger IFC Critical habitat status: Hamilton's tomb bat (HTB), Cosen's gerbil (CG) and African bush Elephant (ABE).

Observation: Only the Cosen's gerbil was found at Nakukulas and Lotubae. Presence of HTB (classified as data deficient by IUCN) could not be established using roost searches and Bat detectors. Night survey for this bat was not possible either due to security protocols. Overnight deployment of bat detector at Nakukulas was also not possible, due to risks of theft.

There were no elephants observed on either banks of the river. Apparently, this area where LLCOP passes is not used by the elephants as migratory corridor. This contrasts with the Southern banks of this river which is frequently used by elephants as migratory and dispersal habitat. The ABE seems not to use this section of the river (L03 and L04). Many other mammal species were however observed but they do not meet IFC criteria for critical habitat.

Extensive modified habitat outlined by invasion of *Prosopis juliflora* was observed at the Kerio bank.

Yellow winged bat (Lavia frons) on a tree at Nakukulas	Foot print of olive baboon (*Papio anubis*), on LLCOP east of Nakukulas	Cosen's gerbil, captured in pitfall trap on LLCOP in Maruangpei	Scat of bat-eared fox observed on LLCOP at Lotubae

Figure 1: Turakana observations

Suguta valley (LLCOP L05 & L06)

Aim: The main objective for prioritising mammal study at this site is due to current information gaps. Based on literature search and review of NMK specimen database, there is no information about mammals in this hard-to-access landscape.

Observation: This hot, dry and dramatic landscape constitutes a natural habitat, largely unmodified by humans. Main observations include a Cheetah (IUCN vulnerable), Striped Hyaena (IUCN Near Threatened), Greater kudu (IUCN Least Concern), a likely new species of White-toothed shrew (*Crocidura sp nov*. and a gerbil rat all captured on the LLCOP between L05 and L06. Other mammal species in the Least Concern category of IUCN were also observed.

Cheetah observed on LLCOP in Suguta valley (L05/L06)	Striped hyaena captured in camera trap in Suguta valley	Crocidura species (likely new), trapped in Suguta valley on LLCOP.

Figure 2: Suguta observations

Nachola, Baragoi, Barsaloi (L07 - L10)

Aim: The objective of the study here was to establish presence of, and habitat use, of IUCN endangered Grevy's Zebra and other mammals along the LLCOP corridor.

Observations: Kalumdang Conservancy in Nachola location is a conservation area, a haven for large mammals that are intensively hunted elsewhere. All the mammal species observed are common and non-threatened species. No Grevy's zebra were observed along this stretch, though locals mentioned occasional sightings.

Two Thomson's gazelle and an ostrich in the protected area (Kalamdum conservancy)	Scat (diarrhoea) of hyena in Nachola on LLCOP, L07	Feeding area of fruit bats on LLCOP, L07	Scat of \ a jackal and Dikdik's pellets at Barsaloi

Figure 3: Nachola, Baragoi, Barsaloi observations

Wamba-Samburu: Westgate, Mwibai Namunyak and surroundings (L12 - L14)

Aim: The objective focused on here in Samburu East is to establish presence of and habitat use by three threatened species:

1) Grevy's zebra(GZ), an endangered and Migratory species;

2) Elephant (ABE) vulnerable-IUCN, and Nationally protected in Schedule one of Wildlife Act 2013; and

3) African Wild dog (AHD) endangered-IUCN.

Observations: Grevy were observed in various sections of the LLCOP in this stretch. Specific sites used by these animals were also identified. Nursery habitat identified in June 2018 (the wet season), reaffirmed this area as a stronghold for breeding, and in Westgate, near Kule spring, both on the LLCOP corridor. Unlike the observations made in June 2018, just after the long rains when about 15 female, 7 foals, and about 5 colts holding territories were observed in this location. During the currect survey, only two males were seen (N 00.83013 deg; E 37.32425 deg & N 00.83660 deg; E 37.322209 deg).

The presence of these males suggests that the habitat is both breeding and nursery habitat for the GZ. When asked where the females had gone, the game rangers at Westgate indicated that they moved south to Ewaso Nyiro river and Samburu National Reserve.

Notably, this GZ stronghold is already affected by powerline construction (see the picture below taken during this study on 29 October 2018).

Figure 4: A male Grevy's zebra standing in his over-grazed territory. Only two males were observed in October compared to over twenty in June.

A single male GZ was observed at Lesteti at the centre of a dried up water pan (N 00.99369deg; E 37.14780deg). This is one of the sites indicated by (GZT) as a stronghold. The local herdsmen believe the females had migrated to water sources in the northwest at the foot of Mathews range forest. Inspection of the habitat surrounding the dam to the south also shows signs of good GZ habitat: open grassland, though currently bare without grass.

Figure 5: Male Grevy in a dry water pan at Lestesi, Samburu

Figure 6: Denuded Grevy habitat surrounding Lesteti dry waterpan

Search for GZ at other sites, indicated in the GZT map (desk data), was not successful. No GZ were observed near Wamba junction, Lopesiwo, orin the vicinity. I conducted an examination of habitat type at these sites and concluded very little grass exist to sustain the GZ, even in a good rainy season. The observations made by the GZT is likely to be based on dispersal or historic data before woody plants invaded these sites. Only Lesteti has significant patches of grass suitable for GZ when rainfall is significant (which was not the case at the time of this study).

Signs of AHD were observed and local herdsmen whom confirmed frequent use of the corridor between Matthews range and Samburu Game reserve in the dry season and back in wet season along Lembaras lugga (GPS: N 00.85529 deg; E 37.40188 deg.).

African Bush elephant (ABE) were observed in four locations on the LLCOP in this area, unlike in June 2018, which had seventeen fresh observations in the same area. Notably, the ABE use the section around L14 stretching eastwards towards L15 as a dispersal area between the Wargess forest and the drier southern hills. They also use it for migration according to desk study data. Seasonal use at a water dam identified in June 2018 (GPS N 00.80266 deg; E 37.48633 deg) clearly shows the cyclic presence of ABE along the LLCOP.

At this dry waterpan site, a lot of ABE dung left behind shows intensive use by many herds 2 to 3 months ago, and nearly none in recent times. It appears (as expected) that the ABE have moved up to Wargess forest in the north where there is water and browse forage available.

2-3 month old signs of ABE on LLCOP near L14	About 1-month old dung in Lopesiwo near L13	Over 2 month old dung at dry water pan near L14
Barnes and Barnes (1995) formula was used to estimate dung decay rate and therefore time of defecation of the dung		

Figure 7: Dung samples

Ewaso Nyiro River, Archer's post (L15/16)

Aim: The aim here was to determine if the habitat where L15 and L16 on the LLCOP is used by Mammals as dispersal or migratory corridor between Shaba and Buffalo Springs Reserves.

Observations: A diversity of species use the southern bank of the Ewaso Nyiro river as feeding and dispersal habitats. Standing out among this, is the ABE. Examination of the ABE dung (density and clustered age) suggests the site is used more frequently used in June/August (semi-wet) and occasionally in the dry season.

Figure 8: A large herd with calves were observed trying to cross from Buffallo to Shaba in the evening

The corridor where the LLCOP passes is a recognised haven for these animals, because most carnivores, such as lions are disturbed or actively chased by local herdsmen. Only Hyena and jackal tracks were frequently observed.

Survey Location L16 is situated on a roosting site for baboons, *Papio anubis.* This was observed on a cluster of duam palm by the river bank (N 00.63783 deg; E 37.67765 deg)-see picture below.

Figure 9: Night roost for the baboon on LLCOP at L16 (GPS: N 00.63783 deg; E 37.67765 deg),

Figure 10: Piles of dropping under the palm, in different age classes as evidence of roosting

Other mammals such as Leopard, Striped Hyena, black backed jackal were also observed through tracks and foot prints. Non-definite foot prints of AHD were also detected. This requires confirmation as this may be expected between the two wildlife protected area with Wild dogs. The dogs may disperse here as the only safe point and where other wildlife also pass.

Kula Mawe (L17)

Aim: The aim here was to assess the roosting habitat of Hamilton's free-tailed bat and breeding activities of Gerenuk along the LLCOP here between Isiolo and Bisanadi around L17.

Observation: Up to 7 Gerenuk families observed with sub-adult in company. This confirms synchronous breeding during wet season we observed in June.

No Tomb bats weredetected on the hills East of L17 on the LLCOP. Common species such as Heart-nosed bat, Yellow-winged bat, Free-tailed bats were observed though.

Figure 11: A male Gerenuk watching us, as mother and a sub-adult escapes the camera around the bush near LLCOP, L17

Figure 12: A sub adult Gerenuk sported East of L17 of the LLCOP

Figure 13: Heart-nosed bat, captured from rock shelter on LLCOP west of L17

Garbatula (LLCOP: L18)

Aim: The aim here was to assess presence of fossorial (ground dwelling) mammal species, Naked mole rat, *Heterocephalus glaber*, which is also very social and may be affected by ground construction work of the LLCOP.

Observations: Presence of the *H*. *glaber* was detected from east of Kula Mawe stretching through to the east of Garbatula. This species is not endangered. It is not migratory either. It is however, the only strictly fossorial mammal on the entire stretch of the LLCOP and caution is needed while operating in its habitat. A population

lives in tightly related social groups that utilise a network of underground nests linked with tunnels. When the tunnels are cut off then families are cut off many times forever in such as a case as a permanent pipeline.

Two termite-dependent mammal species were also noted to live in high density along this red soil stretch of the LLCOP around Garbatula. Aadwolf, *Proteles cristata* a relative of hyaena but specialised in termite eating and Aardvark (an African ant-bear), *Orycteropus afer*, were observed more frequently on this section than elsewhere. Both spend time in the underground burrows in the day but venture out to feed at night. Though both are not in the threatened category of IUCN, recent review by Jonathan Kingdon (2013) noted that they are threatened by shrinking habitat associated with expansion in agricultural, urban and livestock overgrazing that exterminate termites in tropical Africa.

Figure 14: Soil heaps by H glaber indicating underground nests and feeding activities along LLCOP in Garbattula area (GPS: 00.43600 deg; 38.45145)

Figure 15: An underground aardvark hole, shared by Aardwolf along LLCOP in Garbatula (GPS: 00.43760 deg; 38.45217 deg)

The Garbatula area of the LLCOP was also observed to have elevated presence of breeding families of the nocturnal primate, Senegal lesser Bushbaby, *Galago senegalensis*. Up to three pairs were observed in about 2 km square (GPS: N 00.43846 deg; E 38.45032). They live strictly on top of trees, preferring the thickest and thorniest Acacia trees. Although this species is listed as least concern under the IUCN Redlist, they are in appendix 1 of the Convention on International Trade in Endangered Species (CITES).

Other mammal species observed include, Leopard, Spotted Hyaena, many species of mongoose, Serval cat and many species of antelopes including Lesser kudu, and Oryx. All of these are non-threatened except the Leopard which is in the vulnerable category of the IUCN Red list. Occasional appearance of Lions from Meru was also noted from local herdsmen who confessed to chasing or killing them due to livestock predation.

Figure 16: A mother Senegal lesser bushbaby hides and cuddles her young away from camera up high and thorniest part of Acacia tree canopy along LLCOP in Garbatula.

Rahole (LLCOP L19)

Aim: Rahole National Reserve was created by the Government of Kenya (GoK) as a wildlife dispersal area from Meru and Kora to absorb anthropogenic disturbances from the north to Meru National Park. The aim of this survey was to establish presence (at any time of the year) of mammal of conservation concern from Meru to this area where the LLCOP is proposed to pass.

Observation: This section mirrors what is in the adjacent Garbatula. Many large, medium and small carnivores, Aardvark and aardwolf. Primates, including baboons, Vervet monkey and nocturnal Senegal Bush baby and a wide variety of antelopes including Lesser kudu. Leopard was the only threatened species noted (vulnerable under the IUCN Red list).

Notable absence of lion was also noted here.

Leopard foot print observed along LLCOP in Rahole	Aardwolf scat along LLCOP in Rahole	Fresh and old Striped Hyaena scat at Rahole	Fresh and old Baboon scat under roost

Figure 17: Rahole observations

Garissa: Modicca and Sakuri (LLCOP L20, L21)

Aim: The aim of the survey here was to determine presence and habitat use of Giraffe, *Camelapardalis reticulata*, while also on the look-out for any mammal species of conservation concern.

Observation: This section had a higher density of Giraffe compared to elsewhere on the LLCOP (about 5 individuals in nearly every 10 km stretch). In each herd, one or two sub-adults were observed that were likely to have been born in early part of the year (April-May). The wide-spread dikdik, *Madoqua guetheri*, was also frequently encountered during this survey. Common Warthogs, *Pharcomochoerus africanus* were also observed.

The frequency of encountering scats of spotted hyaena was quite high, with an observed density of one scat every 100 m. This is likely due to the fact the local communities here do not dispose or eat dead animals and hyaena take advantage of this.

Figure 18: Sub-adult giraffe herded away from us by her mother on LLCOP near Modicca, Garissa (GPS: N 00.10629 deg; E 39.56932 deg)

Figure 19: A young Senegal bushbaby (RHS) in the thorniest hide out with the mother (LHS) at LLCOP L20. (GPS: N 00.10693 deg; E 39.56954deg)

Figure 20: Toilet of dikdik at Sankuri, on LLCOP-L21

Figure 21: A spotted Hyaena killed by vehicle on a tarmac road around LLCOP- L20 near Modicca, Garissa

Fafi/Bura east (LLCOP L22 and L23)

Aim: No data on mammals were found during the previously undertaken literature search. Few and very old mammal specimen collections from Fafi / Bura East. The aim here, therefore, was to assess the diversity of mammals along the proposed LLCOP in this region particularly paying attention to species of mammals of conservation concern.

Observation: The mammals observed here include, Common warthog, Gunther's dikdik, Gerenuk, Lesser kudu and Reticulated giraffe, among the herbivores. Carnivores detected here include the commonest of all, Spotted hyaena and a number of mongoose and civets. Aadvark was also observed on this stretch.

This section of the LLCOP reassembles Garissa (Modicca and Sankuri) in terms of mammal diversity and abundance.

Ijara (LLCOP L24 and surrounding)

Aim: The aim was to detect habitat use by critically endangered Hirola, *Baetrugus hunteri* and endangered African Wild dog (AWD), *Lyncaon pictus.* These species have been documented to occur in this range. For example, sightings of a pack of AHD in Ijara (unpublished report at National Museums of Kenya by Agwanda 2011), and Hirola's shrinking range report to Conservation Committee and IUCN SSC and Ruffords Small grant (Ali 20170. Also see: https://www.rufford.org/files/11188-2%20Progress%20Report.doc.

Observations: Both AWD and Hirola were detected near Ruqa in Ijara, about 3 km south of the LLCOP in Ruqa. Hirolas presence was inferred from local herdsmen who previously worked on Ali's research on Hirola in the area. One of the local herdsmen, Suleiman Ahmed, who previously worked in Ishaqbin Conservancy, and is conversant with this antelope, knows where a herd grazes some 2-5 km from the LLCOP. Due to security restriction we could not go there. Previous (2009-2012) personal experience in this area, coupled with Ali's records provided me with enough knowledge and data for this task. Non-definite pellets were recovered (see below) near a dry waterhole, Mr Suleiman mentioned.

Figure 22: Pellets allegedly of B. hunter observed at a dry waterhole near Ruqa, Ijara. Effort to search for the herd with Suleiman was restricted due to security concern in the area.

Similarly, AHD are occasional visitors from the south-eat of Ijara, especially during the rainy season when they come for common and abundant warthogs among the villages. A recent report of the AHD in the neighbouring Boni-Dodori forest reserves reinforces this observation.

Overall, the entire stretch from Ijara to Lamu has been studied by Agwanda (NMK), Amin (Zoological Society if London), Andanje and Oguoka (KWS) using camera traps from 2008 to 2013 and there is a significant amount of data on the endangered species: Hirola, AHD, elephants, and more importantly the endangered, endemic and least known giant sengi (elephant shrew) and Aders duiker. The reports from their study are available at NMK, KWS and also published in over 5 journals.

Budhei: No work was done here due to heightened risks of terrorist attacks between Ijara and Bargani.

The aim however was to assess presence of endangered mammal species including endangered Golden rumped sengi (elephant shrew), AHD and a number of vulnerable species (Ader's duiker, Lion, Leopard and Elephant).

The conclusions and recommendations for this section of the LLCOP is thus based on literature review and data owned by B Agwanda and colleagues at KWS and Zoological Society of London.

Baragoni

Aim: The focus of mammal survey here was to determine presence of endangered and endemic mammals on the LLCOP in this region. The expected mammals include: Ader's duiker (Vu), giant sengi (elephant shrew), endemic and endangered, AHD, endangered, elephant (migratory species) and lions, vulnerable.

Observations: The survey team was advised by Kenya Defence Force commandant at Baragoni not to go North West of the camp so the observations were made from Baragoni KDF camp towards the south east.

The endangered and endemic Giant Sengi, *Rynchocyon chrysopygus* (new subspecies) was observed. Our local guide, given to us by The KDF commandant, Mr Twahiru Mohamed confirmed seeing and hunting for this sengi and Ader's duiker in the adjacent bush behind the barracks.

Figure 23: Characteristic nest of the Golden-rumped sengi (GRES) observation LLCOP in Baragoni(GPS: S 02.01661deg; E 40.79624 deg)

Figure 24: Runway constructed by 4-toed sengi but used by GRES as well. Observed in Baragoni

The vulnerable and near endemic Ader's duiker, *Cephalophus adersi* was also observed to occur in this region. This observation is also consistent with camera trap data gathered by Agwanda and Amin between 2008 and 2013. The locals hunt for this antelope and Mr Twahimu confirmed and called it Dhirdhir in his Awer language.

Figure 25: Droppings of Ader's duiker in Baragoni (GPS: S 02.01649deg; E40.79608deg)

Figure 26: Footprint of Ader's duiker in Baragoni GPS: S 02.01649deg; E40.79608deg)

Other conservation concern species were not detected in the very brief survey (owing to security concerns).

Lamu (L25)

Aim: The aim was to detect presence of the endemic and endangered mammal species along the LLCOP in Lamu (similar to the ones in Baragoni).

Observation: Limited survey was conducted here due to lack of essential equipment. Visual sighting of the GRES (elephant shrew) was however made and picture of the runway similar to the one above was made at GPS point S 02.01661deg; E 40.79624). In addition, nest of Diani bush baby, a near endemic primate restricted to coastal forest and bushes was also made at GPS (02.19497 deg; E 40.91728 deg).

Other mammals of conservation expected here were not observed perhaps due to lack of necessary survey equipment.

Non-threatened mammals detected in this stretch were: Needle-clawed bush bay, *Otolemur garnetti*, Yellow baboon, *Papio cynocephalus*, Harvey's duiker, *Cepahalophus harveyi*, Sokoke mongoose, *Bdeogale omnivora*, Large spotted genet, *Genetta maculata* among others.

3.2 Key Observations for ESIA

- The presence of Cosens's Gerbil, *Gerbillus cosensis*, a data deficient species (IUCN 2018), which lives a semi-fossorial life is the main highlight in Turkana. It burrows underground under vegetation where it stays in the day and only venture out foraging at night.
- Cheetah, Acinonyx jubatus, listed as vulnerable by IUCN 2018 is nationally prioritized as indicated in schedule one of the Wildlife Act 2013, GoK. Its presence in Suguta valey requires a careful assessment of potential impact.
- A potentially new species of *Crocidura* sp (shrew) found in the Suguta valley near L05 can reasonably be considered data deficient.
- The presence of Grevy's zebra (GZ) on the LLCOP is dynamic in time and space in ways that no current data seems to satisfactorily pinpoint; not even the elaborate dataset from GZT, nor those from KWS. For instance, the hotspots in the GZT dataset were nearly empty at the time of this current survey but were full of the GZ in June 2018. Relative to the LLCOP, only two of the five hotspots had GZ during this study. The two had one and two zebras respectively. The knowledge gap and question is, which time and sites do get completely empty.
- The watering point, Kule spring, during the dry season for threatened mammals (GZ, ABE, and AHD), previously referred to as a potential critical habitat, was found to have been developed by "SANDDAMING" by local authorities, this has reduced access to water by wildlife.
- Elephant presence along the LLCOP around L14 is seasonal, with abundance ranging from very high in April to June, medium in November and very low in the rest of the months. This timing can be used to plan construction activities of the pipeline. The same applies for the AHD dispersal on river Lembaras.
- The LLCOP corridor across Ewaso Nyiro was observed to be used by elephants for dispersal between Buffalo Springs and Shaba National Reserves. Construction activities in this area will therefore need to be aligned to the elephant dispersal pattern;
- Ground dwelling Naked mole rat. *H. glaber* recorded in Garbatula and Rahole is the only significantly species susceptible to the LLCOP construction.

- Ijara area has one critically endangered and one endangered species of mammal: Hirola and African Wild dog. While the latter is far ranging, Hirola is range-restricted and requires habitat rehabilitation in Ijara, Ishaqbini and Arawale National Reserves. In fact the greatest threat to this antelope is loss of habitat.
- There is a threatened antelope, Ader's duiker classified as vulnerable (IUCN 2018), in the area between Budhei and Lamu. Though it doesn't meet IFC CH criteria, the species may be affected by vegetation clearance. According to camera trap data, the area has other species of mammals in similar status-vulnerable: Lion, *Panthera leo*, Leopard, *Panthera pardus*, and African elephant, *Loxodonta Africana.*
- Data collected through camera trap and sightings between 2008 to 2014 shows presence of Topi, *Damaliscus lunatus ssp topi (*antelope*)* which is endemic and endangered subspecies (IUCN 2017). The coastal population mainly ranges between Budhei and Baragoni where dense bushes breaks into open grass fields. By virtue of its IUCN status, it meets IFC criteria for Critical habitat.
- In Baragoni and Lamu the key observation is presence of Golden-rumped shrew, *Rhynchocyon chrysopygus*, an endangered species (IUCN 2018). The species is forest/bush dependent and so sensitive to vegetation clearance.

3.3 Meetings and Discussions

The following meetings and discussions took place during the study:

- 26 September 2018: Bernard Agwanda (BA) met Bio-Team (Dickens, Victor, Kimeu, Mutua & Philista) to plan survey strategy at NMK;
- 27 September 2018: BA met Dr Ben Hussein of CVA to plan field work logistics at CVA offices;
- 01 August 2018 BA met Kapese Tullow team to plan security during field work at Kapese;
- 01 August 2018: BA met CVA FSA and CVA medic to plan field work and to inspect the field vehicles;
- 03 August 2018: BA together with CVA-FSA met Kapese Tullow security advisor at Kapese camp, to review security for Kerio area;
- 05 August 2018: BA met Gary Morris at Lokichar to brief him and get updates on new plans for Suguta valley;
- 17 October 2018: BA met Andrew the pilot to plan flight route and destination to Suguta;
- 21 October 2018: BA met Chief, Evans Nitira of Nachola location, Baragoi to discuss access to the LLCOP;
- 22 October 2018: BA met Chief of Suyan location, Mr Karoli Lalaur and AP Inspector Tanui to introduce Bio-Team and brief them on our work;
- 25 October 2018: BA met member of Parliament for Samburu East and Chief to introduce Bio-Team and explain our presence;
- 27 October 2018 BA met Andrew Letura of Grevy Zebra Trust at his office in Westgate to get insights into Grevy's Zebra breeding and foaling habitats;
- 28 October 2018 BA met Ward Admin (Wamba), Chief, subchief and wildlife scout members to explain to them the difference between our work, LAPPSET, KENTRACO and other NGOs in the area;
- 8 November 2018: BA met OCPD-Masalani to plan for security escort in Ijara;
- 9 November 2018: BA met Dep OCPD-Masalani to plan security and payments at masalani police station;

- 10 November 2018: BA met OCPD Bura East to plan for security escort to the LLCOP in Fafi on 2 July 2018 at 8 am between BA and Garissa County AP commandant to discuss security planning for Bio-Team;
- 13 November 2018: BA met County Commissioner Lamu and his deputy in his office to discuss our mission, access, and security escort. Later met County AP commandant, to finalize plans for security escort;
- 13 November 2018: BA met Kililana Village Association member, Mr Husein who mistook Bio-Team for LAPPSET, to explain to him the difference and indeed our work;
- 14 November 2018: BA met AP commandant and Inspector to finalize payment and police escort plans; and
- 15 November 2018: BA met KDF Bargoni Commandant, Mjr. Kemboi to explain our mission and seek security advice for the area.

Note: Those meetings guided sites for observations made, acquisition of data, especially on Grevy's Zebra, community acceptance of our study and more importantly potential avoidance of hostility by locals.

3.4 Health and Safety learnings

Based on field-team coordination and personal field study experiences, Bernard Agwanda identified and communicated the following health and safety learnings:

- Due to safety reasons, field personnel should work as teams as far as practicable, especially in remote areas where tyre puncture, and vehicle brake down can be a challenge;
- Areas around the north of Baragoi on the LLCOP, and north of Isiolo have sporadic cattle rustling that have potential to degrade into banditry that can pose serious security risks. Careful examination of security situations with local administrations is essential on daily basis before working in such areas;
- Sharp bends and steep slopes on some roads. especially between Meru and Mwingi through Embu was identified as areas requiring careful driving. Drivers need to be appraised before driving in these roads and warned to be careful and not to over speed;
- Outbreak of Rift Valley fever virus in Isiolo, Wajir, Garissa, Tana river was identified as health risk to the team. Personal discipline to avoid meat products, personal hygiene to wash hands after interacting with the local environment, including people, were reasonable mitigation measures. Carrying sanitizers, water and soap in the car to manage personal hygiene is recommended;
- Because personal minor accidents such as a cuts, thorn prick cannot be entirely avoided, it is important that all vehicles be carrying fully loaded First Aid Kit to manage such accidents in the field; and
- Communication is important for both safety and health, use of satellite phones by field team is essential in case GSM based phones lose signals.

3.5 Gaps and Recommendations for Impact Assessment

Gaps

- Months that GZ move away from areas targeted is not always clear. This information is needed to guide next steps in ESIA and ESMP on this endangered species;
- Already an existing Power line construction activity has dissected the GZ strong hold in Mweibae and Westgate. It would useful to assess if LLCOP may exacerbate the impact or not;

- Hirola is a critically endangered antelope, the only one in Africa, yet we do not know for certain plant diet composition of the surviving population in Ijara. This is information is important if options of offsetting through habitat restoration or rehabilitation will be considered;
- Old literature (Yakub & Aman 2002) and recent one (by Ali et al 2017) shows that Hirola is distributed in Ijara community area, Ishaqbini Conservancy and Arawale N. Reserve. Unfortunately, core habitat of Hirola in Ijara (outside Ishaqbini and Arawale) with respect to LLCOP route, is not well known;
- Little is known about the dispersal and breeding patterns of Hirola in Ijara yet this information is key in planning construction time;
- Little is known on current breeding patterns of the endangered GRES (elephant shrew) and critically endangered subspecies of Topi (antelope) in Budhei-Lamu area. Security and late arrival of Camera trap and other equipment limited efforts to obtain this data. It is prudent to have a quick survey with complete equipment to get these insights.

Recommendations

Additional Grevy's zebra and Hirola studies may be required to:

- Further defining birthing and mating sites and foaling habitats;
- Identifying core habitats of Hirola in Ijara that are proximal to the LLCOP (a visit to Ijara, Ishaqbini, Hirola conservation office at Ishaqbini and Arawale NR office;
- Synthesize Hirola and Grevy's zebra data, literature and more importantly Conservation Action Plans approved by KWS to identify key actions LLCOP can contribute to, as a way of helping to conserve these endangered species;
- Verification survey on sections of the LLCOP observed to be extensively used by large herds of elephants around L14 and identify timings to guide LLCOP construction timings; and
- Lamu area was not surveyed using standard equipment. A study to identify core habitat for the threatened species would be beneficial before construction.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.108.B0

TO Paul Mowatt, PPMT

CC Freddy Brookes

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES – SITE VISIT REPORT: AQUATIC ECOSYSTEMS

Preface: The following field report has been provided by Aquatic Ecosystem expert Dickens Odeny. Golder has provided minimal editing to maintain the sentiment and expert opinion of Dickens Odeny.

1.0 INTRODUCTION AND SCOPE

This field report relates to the implementation of field studies defined in the plan of study (PoS) Turkana 1772867.533 and PoS full baseline 1772867.536. This suite of baseline fieldwork is designed to support the ESIA for the LLCOP Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This element focusses on biological data gathering for key species and habitats identified from the Critical Habitat Screening (CHS) Report (Golder and Ecountability) and recommendations from other Kenyan experts.

The results will be used to:

- Inform the overall baseline biodiversity study for the ESIA; and
- Provide species, habitat and population spatial data to assist with future impact assessments.

The methods listed below were employed at those locations where obvious surface water habitat is present during the survey. The key objective was to map and understand potential connectivity within the pipeline area of influence (AOI), which could potentially be impacted by pipeline construction during the wet and dry seasons and also check the likelihood (or otherwise) or potential critical species, some of which are considered data deficient (eg the Turkana Toad in the northern area of the route) but may feasibly be present in the study area.

- Watercourses;
  - Measurement of in-situ water quality parameters at each sampling location (pH, dissolved oxygen (DO), electrical conductivity (EC) and water temperature);
  - Sediment sampling;
  - Habitat integrity and suitability assessments;
  - Sampling of fish using netting as appropriate;
  - Sampling of diatoms: these were scraped from underwater stones/plant detritus and preserved for analysis; and

- Sampling of aquatic macroinvertebrates from stream/river microhabitats using fine-meshed nets and kick-sampling method. Selected groups of aquatic invertebrates for focus include: Coleoptera (beetles); Odonata (dragonflies and damselflies); Trichoptera (caddisflies); Hemiptera (true bugs); Ephemeroptera (mayflies).

- Wetlands:
  - Ground truthing the extent of wetland boundaries in the context of the pipeline appropriate area of influence (AOI) as exhibited in the dry season context;
  - Recording of the wetland position within the landscape; and
  - Mapping of features impacting wetland integrity (for example, overgrazing by cattle, human-use impacts, such as reed harvest).

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Dickens Odeny (DO).

2.2 Tasks completed

A brief summary of the field programme during the aquatic ecosystem visit is provided in Table 1.

Survey activities

- Measured water quality parameters: Electrical Conductivity (µS), Temperature (˚C), Total Dissolved Substance (ppm) and pH on cattle water trough;
- Observed uses of lugga by the local people;
- Surveyed plants within and in the riverine areas of the lugga;
- Surveyed present birds, invertebrates, reptiles and amphibians in the riverine woodland (and bushes) along the lugga with the corridor of the proposed crude oil pipeline;
- Collected sediments by hand augering to depths of 15cm and 45cm by soil auger;
- Searched for infauna in sediment samples;
- Observed and recorded (qualitatively) wetness of subterranean sediment cores from lugga in categories; dry soil, moderately wet and very wet;
- Recorded types of lugga bed substrate quality;
- Recording environmental threats on the lugga, rivers and wetland; and
- Conducted interviews with locals on common birds, amphibians and reptiles, invertebrates (including butterflies) in the lugga, river and wetlands by guiding them using guide books.

Table 1: Programme during the aquatic ecosystem survey. See Figure 1 and Table 2 for detail of location visited.

Date	Task	Location
01 October 2018	■ Travelled to Lokichar by air; and ■ Attended induction meeting on HSE with Tullow personnel.	Nairobi & Lokichar
02 October 2018	■ Conducted survey in Nakukulas lugga (S01)	Lokichar
03 October 2018	■ Continued with survey in Nakukulas lugga (S01)	Lokichar
	■ Relocated to Kang'thethein lugga for survey (S02)	Lokichar
04 October 2018	■ Continued with survey in Kang'thethein lugga (S02)	Lokichar
05 October 2018	■ Conducted survey in Karuko on an oasis (spring) (S03)	Lokichar
06 October 2018	■ Conducted survey in Kerio River (S04)	Kerio/Lokichar
07 October 2018	■ Continued with survey in Kerio River (S04)	Kerio/Lokichar
08 October 2018	■ Travelled back to Nairobi by flight	Lokichar/Nairobi
09 October 2018	■ Storing samples and specimen and preparing for the subsequent survey/sampling	Nairobi
10 October 2018	■ Travelling to Isiolo by Road	Nairobi/Isiolo
11 October 2018	■ Conducted a repeat survey (dry season) in Ewaso Nyiro River (S05)	Samburu/Isiolo
12 October 2018	■ Continued with a repeat survey (dry season) in Ewaso Nyiro River (S05)	Samburu/Isiolo
13 October 2018	■ Continued with a repeat survey (dry season) in Ewaso Nyiro River (S05)	Samburu/Isiolo
14 October 2018	■ Conducted survey in Naathu Lugga (S06)	Meru/Isiolo
14 October 2018	■ Relocated to Kula Mawe to conducted survey in a lugga (S07)	Isiolo
15 October 2018	■ Continued with a repeat survey (dry season) survey in Naathu Lugga (S06)	Meru/Isiolo
	■ Travelled to Maua by road through Kula Mawe-Kiina-Maua route	Maua/Meru
16 October 2018	■ Conducted survey in Garbatula (earthpan) (S08)	Isiolo
17 October 2018	■ Travelled from Maua to Ol Malo through Nanyuki by road	Maralal, Samburu
18 October 2018	■ Airlifted to Suguta valley and conducted a survey on Suguta river (S09)	Maralal, Samburu
19 October 2018	■ Airlifted to Suguta valley to continue with the survey on Suguta river (S09)	Maralal, Samburu
20 October 2018	■ Travelled from Ol Malo to Baragoi through Maralal	Baragoi, Samburu

Date	Task	Location
21 October 2018	■ Conducted survey at Suiyan Lugga (S10)	Baragoi, Samburu
22 October 2018	■ Conducted survey in west of Nachola near Station 3 (S11)	Baragoi, Samburu
22 October 2018	■ Conducted survey in Baragoi Lugga (Nachola area) (S12)	Baragoi, Samburu
23 October 2018	■ Continued with the survey in Baragoi Lugga (Nachola area) (S12)	Baragoi, Samburu
	■ Relocated to conduct survey in earthpan in Marti area (S13)	Baragoi, Samburu
24 October 2018	■ Conducted survey at Barsaloi lugga (S14)	Baragoi, Samburu
25 October 2018	■ Conducted survey on earthpan in Kalama/Namunyak area (S15) ■ Relocated to conduct survey on lugga in koiting (S16) ■ After finishing day's work, team travelled to Wamba Town for accommodation	Wamba, Samburu
26 October 2018	■ Conducted survey at Seiya lugga (S17)	Wamba/Baragoi, Samburu
27 October 2018	■ Continued with the survey at Seiya lugga (S17)	Wamba/Baragoi, Samburu
28 October 2018	■ Conducted survey at lugga in Ngaroni (S18)	Wamba, Samburu
29 October 2018	■ Conducted survey at lugga in Silanga-Nanyukie (S19) ■ After the field survey, the team travelled to Sarova Shaba for accommodation	Wamba, Samburu
30 October 2018	■ Continued with the survey at lugga in Silanga-Nanyukie (S19)	Wamba, Samburu
31 October 2018	■ Travelled from Sarova Shaba (Isiolo) to Nairobi	Isiolo/Nairobi
01 November 2018	■ Storing samples and specimen and preparing for the subsequent survey/sampling	Nairobi
02 November 2018	■ Travelled from Nairobi to Garissa	Nairobi/Garissa
03 November 2018	■ Conducted survey at a seasonal wetland in Shimbir (S20)	Sankuri, Garissa
04 November 2018	■ Conducted survey at a seasonal wetland in Sankuri (S21)	Sankuri, Garissa
05 November 2018	■ Conducted survey at a lugga near Rahole (S22)	Balambala, Garissa
06 November 2018	■ Conducted survey at a seasonal wetland in Bour-Algi (S23)	Central Garissa, Garissa

Date	Task	Location
07 November 2018	■ Conducted survey in Kora-Kora (S24)	Central Garissa, Garissa
08 November 2018	■ Conducted survey in Nanighi, Bura (S25)	Bura, Garissa
09 November 2018	■ Travelled to Hola from Garissa by road ■ Conducted survey Gerille (S28)	Garissa/Hola Gerille, Ijara
10 November 2018	■ Conducted survey in Bura East (S28)	Bura, Garissa
11 November 2018	■ Travelled from Hola to Nairobi by road	Hola/Nairobi
12 November 2018	■ Travelled from Nairobi (Wilson Airport) to Lamu (Manda Airport) by flight ■ Travelled from Manda Island to Lamu Island by boat	Nairobi/Lamu
13 November 2018	■ Conducted survey in Mangrove at Mokowe-Hindi (S29)	Mokowe, Lamu
14 November 2018	■ Conducted survey near Army Barack in Hindi-Magogoni (S30)	Hindi-Magogoni, Lamu
15 November 2018	■ Conducted survey in wetland in Mradeni (Dipu dam) (S31)	Bargoni, Lamu
16 November 2018	■ Continued with the survey in Mangrove at Mokowe-Hindi (S29)	Hindi-Magogoni, Lamu
17 November 2018	■ Continued with the survey in Mangrove at Mokowe-Hindi (S29)	Hindi-Magogoni, Lamu
18 November 2018	■ Organising data	Peponi Hotel, Lamu Island
19 November 2018	■ Travelled from Lamu to Manda Island by boat ■ Travelled from Manda Island Airport to Nairobi by flight	Lamu/Nairobi

2.3 Deviation from Planned Scope of Work

The scheduled work in Ijara area was interrupted due to security warning. However, the Journey management Plan (JMP) was generally followed as previously scheduled.

3.0 SURVEY APPROACHES

3.1 Sampling Locations

Sampling sites along the proposed Lokichar – Lamu Crude Oil Pipeline for the aquatic and wetland system were characterised by lugga, earthpan, oasis (springs), rivers (permanent and seasonal), and wetlands (swamps – permanent and seasonal).

- Rivers are a natural flowing watercourse flowing towards an ocean, sea, lake or another river. The flow can be permanent or seasonal;
- Lugga are types of drainage system similar to rivers but are characterized by surface water seasonality, intermittent flow and subterranean flows of water during dry season;
- Wetland are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres;
- Earthpans are excavated depressions that collect surface runoffs and stores water for longer period in dry areas livestock watering and domestic use; and
- Oasis's are springing surface water in dry areas such as arid and desert that do not have an outlet

Table 2. List of sites with sampling codes and drainage feature (or resource)

Site Code	LOCATION	Feature	Latitude	Longitude
S01	Nakukulas	Lugga	2.2185	35.8231
S01x	Nakukulas	Earthpan	2.2147	35.8189
S02	Kan'gthethein	Lugga	2.1932	35.8983
S03	Karuko	Oasis	2.1017	36.0267
S04	Kerio River	River	2.0287	36.141
S05	Ewaso Nyiro River	River	0.6373	37.674
S07	Kula Mawe	Lugga	0.5407	38.192
S08	Garbatula	Earthpan	0.4381	38.4521
S09	Suguta River	River	1.8385	36.4527
S10	Suiyan	Lugga	1.4561	36.8544
S11	West of Nachola (c.1.4km SE of Station 3)	Lugga	1.8152	36.6492
S12	Baragoi	Lugga	1.765	36.6826
S16	Koiting	Lugga	0.8464	37.4445
S17	Seiya	Lugga	1.1025	37.0515

Site Code	LOCATION	Feature	Latitude	Longitude
S18	Ngaroni	Lugga	0.9621	37.2349
S19	Silanga-Nanyukie	Lugga	0.8731	37.3164
S20	Sankuri	Seasonal Wetland	-0.1072	39.5674
S21	Sankuri	Seasonal Wetland	-0.2403	39.6707
S22	Rahole	Lugga	0.2243	38.9973
S23	Bour-Algi	Seasonal Wetland	-0.444	39.8262
S24	Kora Kora	Seasonal Wetland	-0.4641	39.8662
S25	Nanighi	-	-0.732	39.9711
S26	Shimbir	-	0.0014	39.4731
S27	Gerille	Seasonal Wetland	-1.575	40.4799
S28	Bura	-	-1.0351	40.1571
S29	Mokowe	Mangrove intertidal	-2.2005	40.879
S30	Bargoni	-	-2.0164	40.7963
S31	Mradeni	Wetland (Dipu dam)	-2.0636	40.8048
S32	Port area	Marine Water	-2.1981	40.922

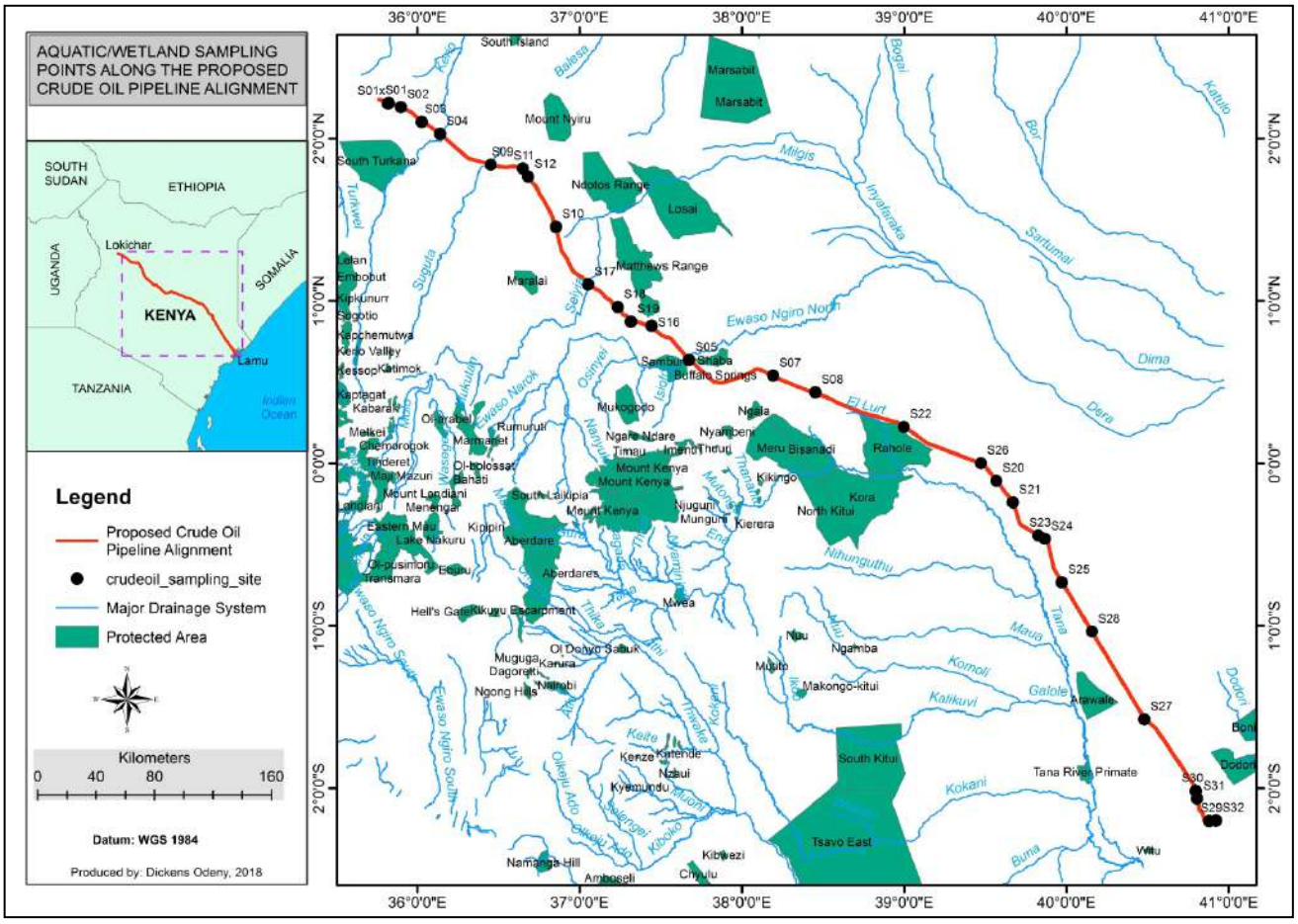


Figure 1. distribution of sampling sites for aquatic/wetland survey along the proposed Lokichar-Lamu crude oil pipeline (LLCOP) alignment

Code	Photo of selected sites surveyed	Comments
S01 **S03**		S01 – Nakukulas Lugga S03 – Karuko Oasis
S04 **S05**		S04 – Kerio River S05 – Ewaso Ngiro River
S09 **S20**		S09 - Suguta River S20 – Seasonal wetland in Sankuri
S29 **S31**		S29 – Mangrove area in Mokowe Lamu S31 – Dipu dam in Mradeni Lamu

3.2 Water quality Parameter

Water quality parameters measured were pH, Temperature, Total Dissolved Substance (TDS), Electrical Conductivity (EC) and Total Suspended Solid (TSS). An average measurement of three points was used; one at the centre of the proposed oil pipeline corridor, another one in upstream and the third one located downstream of the corridor.

Filtering river water using 1 lt filter accelerated by vacuum pump to obtain filtrate from river water

Weighing dried filter papers with filtrates to obtain weight of TSS

Figure 2: Measuring water quality

3.3 Aquatic Macrobenthic Invertebrate survey

3.3.1 Sampling Macro-Invertebrates in River System

Sampling of aquatic macro-invertebrate species targeted vegetated habitats and open water areas. Pond nets were used for sampling the aquatic macro-invertebrates by dragging the net at the bottom and banks of the river or lugga. The collected litters and sediment at the bottom were transferred into a basin where the organisms were searched by washing the litter and sediments to reveal their presence. Additional physical observations were conducted for invertebrates that swim on the surface or at the benthic habitat.

Sampling aquatic macro-invertebrates in vegetated areas

Sampling aquatic macro-invertebrates in open river areas.

Figure 3: Water sampling techniques

3.3.2 Sampling Macro-Invertebrates in Marine Environment

These groups comprised of the marine crustaceans and molluscs that occur within the mangroves, mudflats and beach sand within the survey area. Since crabs are the most common taxa among crustaceans, quantitative survey was conducted to estimate their population. An indirect approach, of using crab burrows, was adopted for estimating the population. Three replicas of a 1x1 m sample quadrats was randomly designed within each 10x10 m quadrat for the mangrove survey and in the open mudflats. Mollusc were recorded within the 10x10 m quadrats of mangroves, and; in the open mudflats, observation was made 4 m radius of the 1x1 m quadrat for sampling crab burrows. In addition, search on mollusc species on mangrove stems and leaves were made.

Setting of 1x1 m quadrat for sampling crab burrow holes

Measuring of crab burrow hole size (diameter)

Figure 4: Measuring crab burrows

3.4 Aquatic Infauna survey

Sediment was cored on the river or lugga (as appropriate) bed between 0 to 60 cm deep (where the soil was penetrable) to observe presence of live or dead parts of aquatic infauna. This group of invertebrate consist of organisms that burrow into the river or lugga bed as part of their ecological behaviour. Sediments cored at intervals of 0-30 (15cm) and 30-60 (45cm) were raised and transferred to a sorting tray for identification.

Preliminary search of infauna from the dry sediment cores

Figure 5: Searching for aquatic infauna

3.5 Fish sampling survey

Sampling of fish was carried out on permanent rivers where electrofisher used for sampling fish communities. Where necessary, non-selective gill nets were used for sampling in deep slow-moving waters. The non-selective gillnet has an advantage of its flexibility to sample in small and large water bodies, deep and shallow waters. The net was set near the banks of river/streams and at the middle part of the river channel. It was also deployed on large pools in lugga habitats.

Electrofisher component (powered by battery)

Demonstration of non-selective gillnet for effective fish sampling

Figure 6: Fish sampling equipment

3.6 Mangrove Survey

The survey of mangrove focused on the species and stock density distribution within the intertidal zone. Mangrove species diversity was recorded from the observation made along through the shoreline area. The shoreline was traversed throughout during the survey and the diversity was noted. Mangrove stock density was assessed using 3 replica 10x10 m sample quadrats that were distributed from the shore towards the sea front with at least spacing of 100m from each other. Sites were selected for the exercise based on discontinuity of mangroves from mangrove mosaics, ability to penetrate muddy areas for locating 2 most interior replica, width of the mangrove mosaic and scantiness of the mangroves.

3.7 Other taxa survey

Wetland fauna were also recorded by physical observations, footprints, calls and local residents anecdotal accounts. This group included reptiles and amphibian, bird species, mammals and terrestrial invertebrates.

3.8 Riverine vegetation survey

Plant species were recorded within the riverine of the lugga and river system. Vegetation was recorded walking along the river; where possible observation was made across the proposed crude oil corridor along the drainage feature. Physical observation was used for identification of species and in addition, photographs were taken for unique tree species or vegetation formations occurring in the riverine area.

3.9 Species highlighted from local resident accounts

Study design involved field surveys to sample the different biodiversity groups in the different sites along the proposed crude oil pipeline. Due time limitation in the field, more species data was collected from interview

with the local people with experience on species within the lugga and its riverine system. Species that were well identified by local residents from field guides were birds, butterflies, dragonflies (damselflies), amphibians and reptiles, and other terrestrial macro-invertebrates. This information was then verified by comparing it with the literature distribution of the concerned species. The identification was done using the relevant guide books for each taxon.

Going through the birds guide book for Kenya with a local resident at Silanga-Nanyukie to identify common bird species in the lugga and riverine system

Local resident identifying common snakes within the lugga riverine system

Figure 7: Bird and snake identification

3.10 Ecosystem services survey

The ecosystem services of drainage systems (river, lugga and wetlands) were assessed based on four types of services which include provisioning, regulating, cultural and supporting services. Out of these, provisioning and regulating services were identified during the survey.

- Provisioning Services: Services considered in the identification to be products people obtain from ecosystem.
- Regulating services: These were considered to be the benefits people obtain from regulation of ecosystem processes and include surface water purification, carbon storage and sequestration, climate regulation, protection from natural hazards.

3.11 Specimen Preservation

Preservation of specimens was conducted for fish species and benthic macro-invertebrate species. Fish were preserved in formalin which was diluted with water at a ratio of 1:10, in order, to provide optimum condition for preservation of fish specimens. The benthic aquatic macro-invertebrates were preserved in an alcohol (95%) which was changed twice to reduce effect of water dilution.

4.0 BIODIVERSITY INFORMATION

4.1.1 River/Lugga Physical Characteristics

Luggas surveyed derive their waters from areas near and adjacent to Maralal forest, Baragoi and Wamba area (Table 3). Lugga's with headwaters in sub-locations near Maralal forest have surface water flow much longer than other luggas and these include Suiyan, Seiya, and Barsaloi luggas. Ewaso Nyiro (shaded grey in Table 3) has a wider catchment area hence they are characterised by permanent surface flow though highly fluctuating. Most of the lugga's join together and drain into Lorian swamp which extends much further into Somalia. However, Baragoi lugga drains into Lake Logipi (Table 3).

The average length of the luggas within the proposed crude oil pipeline corridor is 2 km with the minimum of 1.09 km for Siteti lugga to a maximum of 6.5 km for Kula Mawe lugga (Table 3).

The lugga's exhibit an average slope of 1.8 %; Baa lugga has a minimum average slope of 0.9% while Naathu has the highest average slope of 3.6 % (Table 3).

About 78% of the lugga's have sandy substrates on the bed; others consist of 6 % mixture of gravels, and pebbles, 6 % mixture of sand and pebbles, and 6 % clay sand, gravels and pebbles (Table 3).

The banks of the lugga consist of 50 % sand loam soil, 11 % are mostly rocky with few stones and thin layers of sand loam, and and others are mixture of rocky and stones, sand loam and few gravels, stony and clay sand, stony and sand loam (Table 3).

Table 3: Physical characteristics of luggas within the proposed oil corridor. Characteristics described are length of drainage, slope angle, substrate and bank characteristics, headwater location and outlets of the luggas.

Sampling Site	Coordinate	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Nachola (Lugga c.7.9km SE of Station 3)	1.764047˚ N, 36.680533˚ E	2,650	1.6	Gravels, Pebbles and stones	Rocky, stony	Terter in Nachola	Downstream of Baragoi Lugga
Baragoi River/lugga	1.764040°N, 36.680533°E	1,500	1.3	Sandy	Sand loam and few gravels	Nachola, Lesirikan, Lkotikal area	Lake Logipi
Marti Lugga 1 (New 07)	1.552448°N, 36.815607°E	1,330	1.7	Mostly sandy	Rocky and sand loam soil	Marti area	Suiyan Lugga, Downstream of sampling point
Marti Lugga 2 (New 06)	1.522629°N, 36.830387°E	3,390	1.8	Mostly sandy	Mostly Sand loam soil	Marti area	Marti Lugga 1 (New 07)
Ngwasi Lugga (New 01)	1.151778°N, 37.009369°E	1,630	1.4	Mostly sandy	Mostly Sand loam soil	Mabati area	Seiya Lugga, Downstream of sampling point
Kaolet Lugga (New05)	1.386880°N, 36.867898°E	1,150	1.8	Mostly sandy	Mostly Sand loam soil	Barsaloi	Barsaloi Lugga, Downstream of sampling point
Siteti Lugga (New04)	1.356635°N, 36.875363°E	1,090	2.0	Mostly sandy	Mostly Sand loam soil	Soit Naibor	Downstream of sampling point for Barsaloi Lugga

Sampling Site	Coordinate	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Bonyeke Lugga (New03)	1.317944°N, 36.882321°	2,950	2.9	Mostly sandy	Mostly sand loam soil	Raraiti	Barsaloi Lugga, Upstream of sampling point
Koiting (Lugga c.1km NW of Station 6)	0.846726°N, 37.444505°E	4,450	3.3	Mostly sandy	Mostly sand loam soil	Koiting	Archers Post Lugga, Downstream of sampling point
Suiyan Lugga	1.453957°N, 36.849481°E	1,130	1.3	Sandy and pebbles	Mostly rocky with few stones and thin layers of sand loam	Soit Naibor, Morijo and Marti	Barsaloi Lugga, Downstream of sampling point
Barsaloi Lugga	1.345287°N, 36.879264°E	1,250	1.3	Mostly sandy	Mostly rocky with few stones and thin layers of sand loam	Soit Naibor, Morijo and Marti, Raraiti, Mabati, Lulu	Joins with Seiyan and drain into Lorian swamp
Seiya Lugga	1.103464°N, 37.053257°E	1,300	1.8	Mostly sandy	Mostly rocky, Sand deposits	Moru, Mabati, Mugur, Nonkeek, Ressim	Joins with Seiyan and drain into Lorian swamp
Baa lugga (Ngaroni)	0.960277°N, 37.233044°E	1,100	0.9	Mostly sandy	Mostly sand loam soil	Ngolngotim (Ngilai), Wamba Town	Drains into Ewaso Nyiro Downstream of sampling point
Silanga-Nanyukie Lugga	0.870509°N, 37.314768°E	1,420	2.1	Mostly sandy	Mostly sand loam soil	Wamba Town	Drains into Ewaso Nyiro Downstream of sampling point

Sampling Site	Coordinate	Length (m)	Average Slope (%)	Substrate characteristics	Bank soil characteristics	Headwater Location	Outlet Location
Archers Post Lugga	0.708867°N, 37.610556°E	1,120	1.3	Mostly sandy	Mostly Sand loam soil	Archers Post	Drains into Ewaso Nyiro Downstream of sampling point
Ewaso Nyiro River	0.637959°N, 37.673754°E	1,450	1.2	Mostly sandy	Rocky and sand loam	Kipsing, Mumonyot, Oldonyiro, Lodongokwe, Ngaroni, Archers Post, Wamba Town, Ngolngotim	Drains into Lorian Swamp, which disappear into Somali
Naathu (Lugga near Station 8)	0.521596°N, 37.958556°E	1,030	3.6	Mostly gravel with few sand and stones	Stony and sand loam	Kabachi and Naathu	Drains into Ewaso Nyiro Downstream of sampling point
Kula Mawe Lugga	0.493462°N, 38.295817°E	6,500	1.0	Mixed clay sand, gravels and pebbles	Stony and Clay sand	Amwathi (Kabachi)	Drains into downstream of Lorian Swamp
Kerio River	2.0287˚N 36.141˚E	1210	1.9	Sand	Mostly sand loam soil	Arror River, and Embobut River	Drains into Lake Turkana
Suguta River	1.8385˚N 36.4527˚E	1220	2.1	Sand	Mostly clay sand soil	Baragoi area	Drains into Lake Logipi

4.1.2 Water pan water storage capacity

Several earthpans/waterpans are distributed along the corridor of the proposed oil pipeline. During the survey, most of earthpans in the Lokichar and Samburu area were visited except for areas such as Garissa and Lamu due to security constraints.

The duration of the pans water storage in the area is not well understood but discussion with the local users provide relative duration of water availability. The earthpans in the project corridor have a full capacity of water storage ranging from 680 to 1656 m^3 during the rainy season. The earthpan in Garbatula has an average surface area of 0.73 ha with a full capacity of water during rainy season at 680 m^3. The earthpan in Kalama/Namunyak attains a maximum full capacity at 1469 m^3, and Marti (Chardi) 1656 m^3 which apparently is replenished during rainy season.

The water reduces to a low capacity levels that are maintained by the long rains. This leaves the earthpan to remain at a low level for quite some time after the long rains. For example, the Marti (Chardi) earthpan can maintain a volume of about 500 m^3 before it is depleted by livestock and evaporation. Kalama and Garbatula have relatively low capacity storage during the long-rains.

Sometimes the duration of water in the water pan depends on prolonged rainy seasons that recharge the reservoirs with water. The lifespan of some earthpans were accounted for by the local community based on experience on daily uses for water livestock. The features fill up in April and dry up in October unless the short rains is reliable. Thus, the earthpans normally store water for an average period of 6-7 months; however, some can last for 10 months when adequately replenished by the short rains.

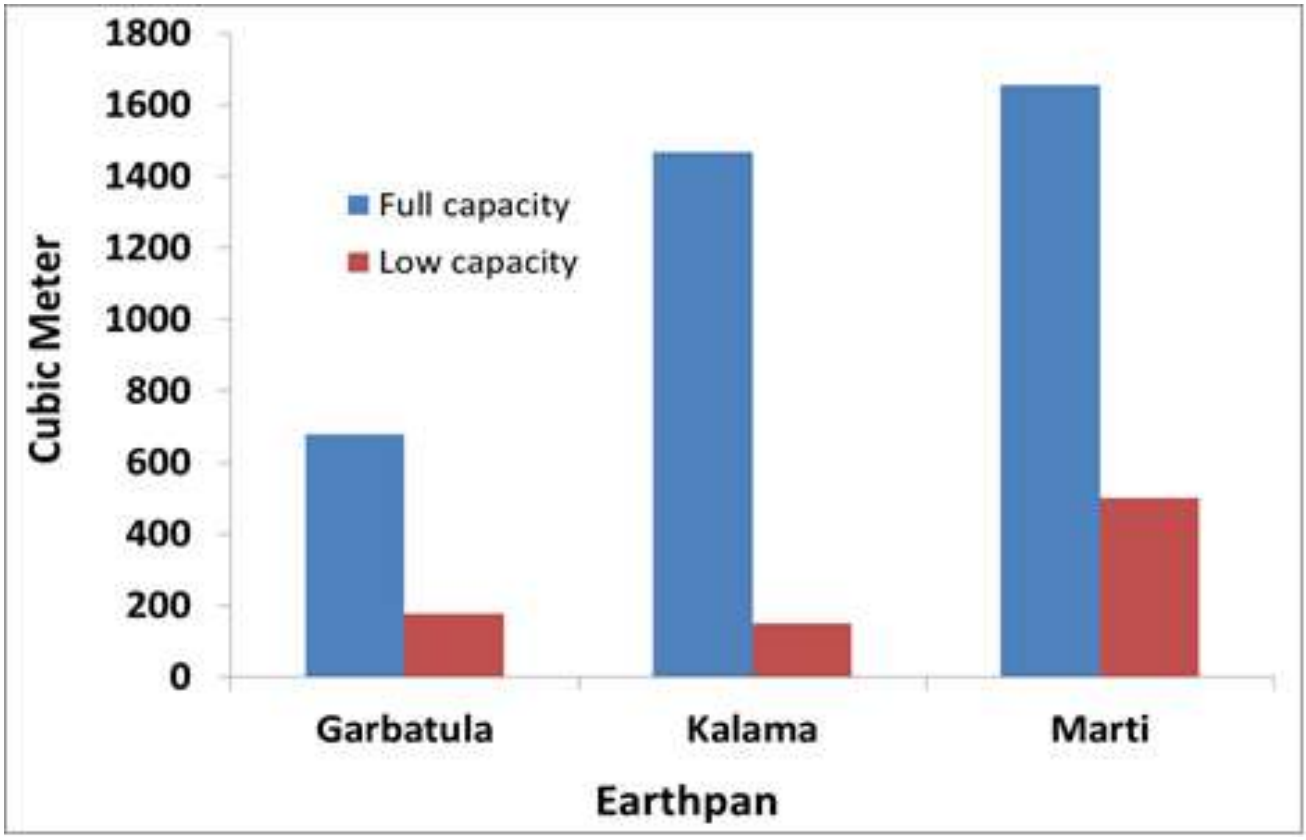


Figure 8. Estimated water storage capacity of selected earthpans (waterpans) along the proposed crude oil pipeline.

Water Quality

Measurements of water quality parameters were recorded on rivers, water pools in lugga and dugout wells on lugga, earthpans/waterpans. The result is presented for the dry and wet season for the drainage features above.

Water Temperature: water temperature is higher during the dry season than wet season. During the dry season, oasis in Karuko (Lokichar) recorded the highest temperature of 32.7˚C followed by the earthpans and rivers (Table 4). While in wet season, the water pool in lugga has highest average high temperature of 26°C among the water features (Table 4). An average water temperature of the drainage features between the dry and wet seasons shows for instance, Barsaloi lugga has highest average water temperature difference of 9˚C, Silanga-Nanyukie lugga (5.3˚C), Ewaso Nyiro River (3.6˚C), Seiya lugga (3.1˚C) and Ngaroni (Baa lugga) (2˚C). Lugga system had no surface water flow but the subterranean waters tapped by dugout wells on the lugga.

pH levels: Karuko oasis recorded highest average pH among the water features in dry season on the proposed oil pipeline corridor followed by the river systems (Table 4). Suguta River has the highest pH among the river features in the dry season and the lowest pH was observed in Ewaso Nyiro (Table 4). During the wet season, the surface water features had relatively similar averaged pH level. The highest pH was measured in a water pan in the wet season while the lowest pH was measured in water pools in luggas (Table 4). The highest pH in the wet season was recorded in Seiya lugga, Ewaso Nyiro River and water pan in Garbatula; while the lowest pH was recorded in water pool in Baa lugga (Ngaroni) (Table 4).

Water Conductivity and Total Dissolved Solids (TDS): the highest EC and TDS in dry season were observed in borehole water, surface streams in lugga and marine water (Table 4). During wet season, the highest EC and TDS were observed in water pools in luggas. By comparison, dry season measurements of EC and TDS are high in dry season than in the wet season (Table 4). The highest difference in EC and TDS was observed on lugga in Silanga-Nanyukie where dry season recorded over 4000 µS from the surface streaming waters; while water pools measured about 434 µS (Table 4) during wet season. See table 4 for more details.

Total Suspended Solids (TSS): Measurements of TSS were conducted on three river systems; Ewaso Ngiro, Kerio and Suguta Rivers. Ewaso Ngiro River discharges high amount of TSS, four times more than discharge in Kerio River and eight times more than discharge in Suguta River (Table 4).

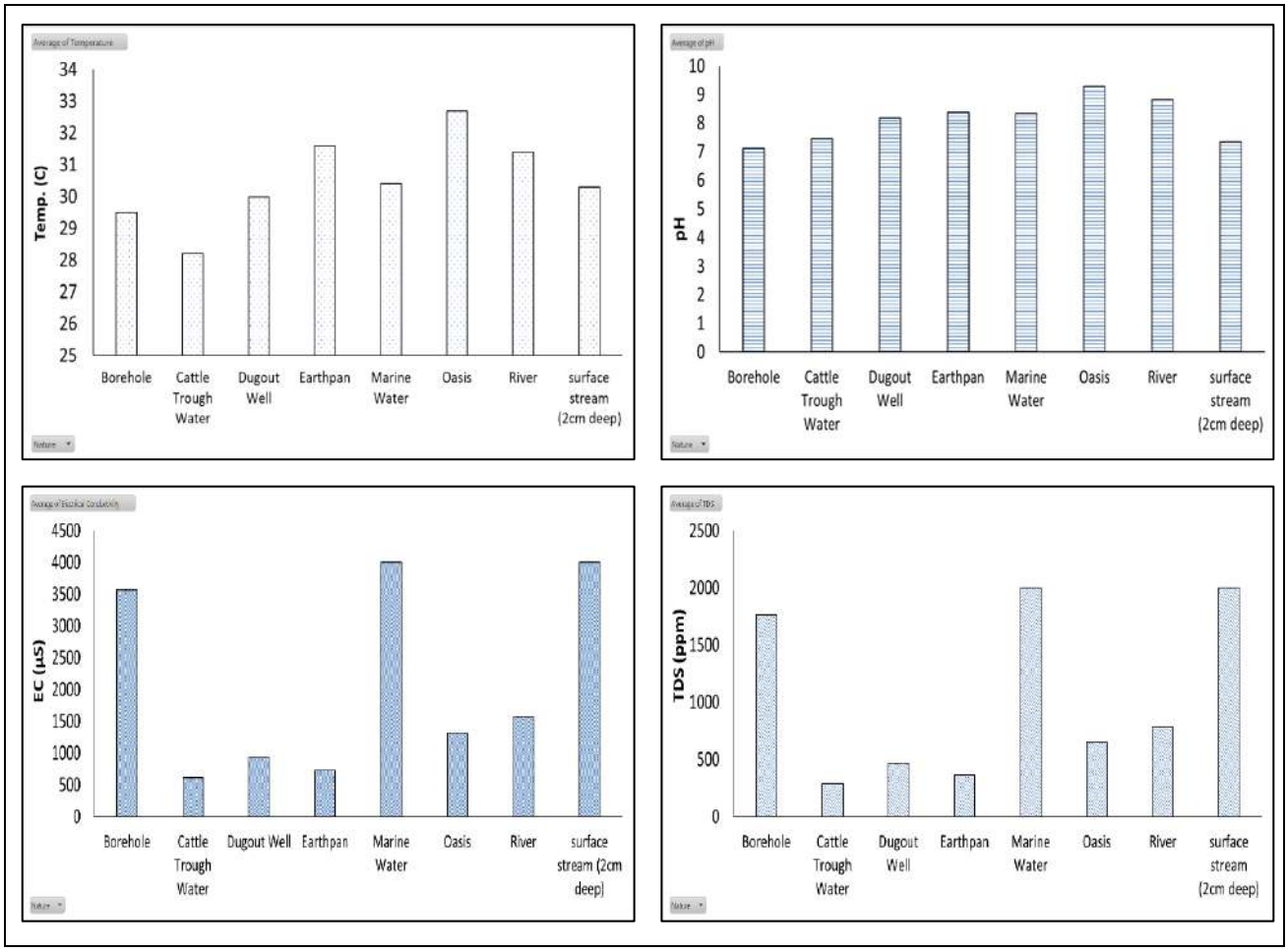


Figure 9. Measured water quality during dry season; average water temperature (°C), pH, conductivity (µs), total dissolved substances (ppm) on lugga/river, water pools, oasis, dugout wells, and waterpans along the proposed pipeline corridor

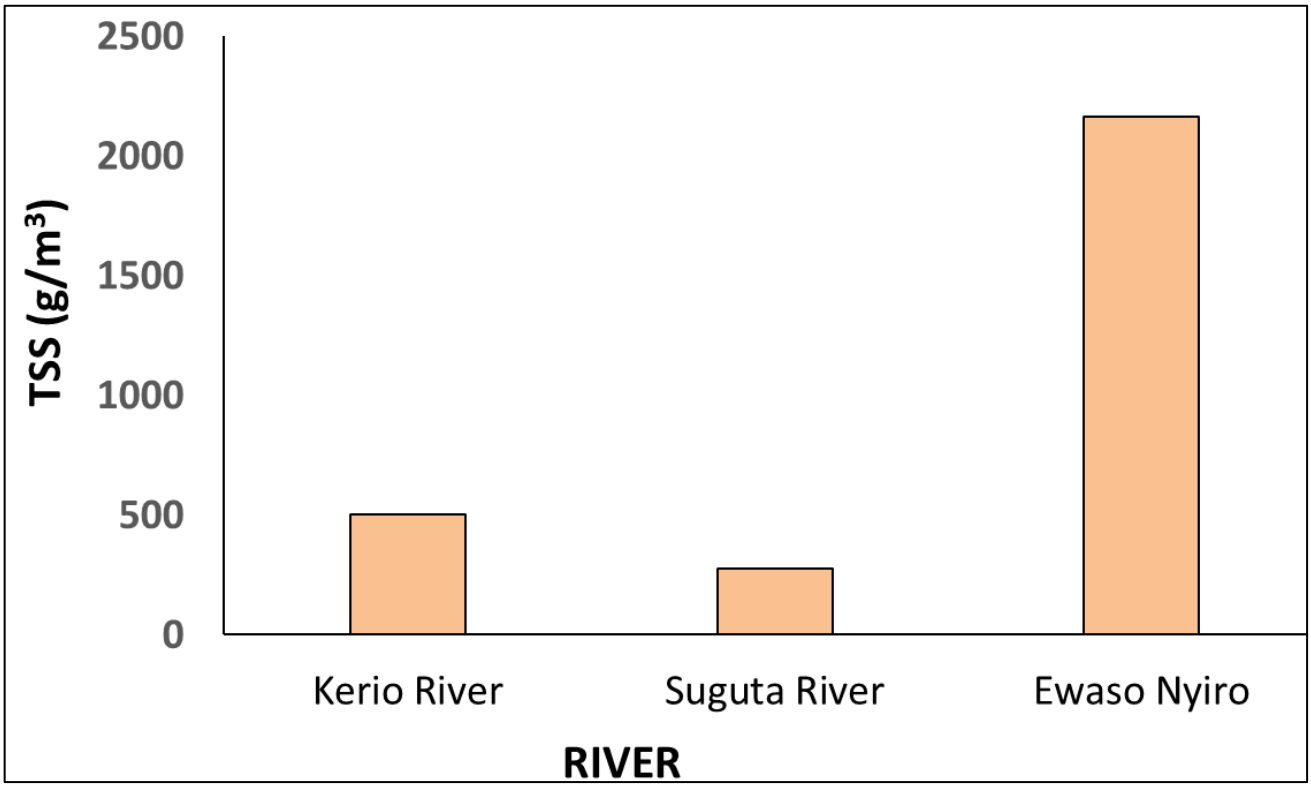


Figure 10. Discharges of Total Suspended Solids in the river systems along the proposed Lokichar-Lamu crude oil pipeline

Table 4: Water quality parameters of drainage systems (luggas and rivers) for wet and dry season within the proposed oil corridor.

Location Name	Season	Date	Water Feature Type	Temp. (°C)	Conductivity (µs)	TDS (ppm)	pH	TSS
Suiyan lugga	Wet	14/6/2018	Flowing water	24.8	543	352	8.00	
	Dry	21/10/2018	No water	No data	No data	No data	No data	-
Barsaloi lugga	Wet	15/6/2018	Flowing water	25	574	403	8.00	-
	Dry	24/10/2018	Dugout Well	34	610	308	8.73	-
Seiya lugga	Wet	17/6/2018	Flowing water	24.6	278	195	8.01	
	Dry	26/10/2018	Dugout Well	27.7	486	243	7.85	
Ewaso Nyiro River	Wet	20/06/2018	Flowing water	24.5	174	121.5	8.01	
	Dry	11/10/2018	Flowing water	28.1	434	217	8.52	2163
Silanga-Nanyukie Lugga	Wet	18/06/2018	Water pool	25	489	293	8.00	-
	Dry	29/10/2018	surface stream (2cm deep)	30.3	4000	2000	7.36	-
			Borehole	29.5	3562	1764	7.13	-
Ngaroni (Baa lugga)	Wet	19/06/2018	Water pool	27	933	644	7.96	-
	Dry	28/10/21018	Dugout Well	25.0	1472	734	7.78	-
	Wet	27/06/2018	Earthpan	24.9	247	171	8.00	-

Location Name	Season	Date	Water Feature Type	Temp. (°C)	Conductivity (µs)	TDS (ppm)	pH	TSS
Dam Point 8 (North Marti)	Dry	23/10/2018	Earthpan	No water	No water	No water	No water	-
Water Pan (Garbatula)	Wet	2/7/2018	Earthpan	24.5	118	60.5	8.01	-
	Dry	16/10/2018	Earthpan	No water	No water	No water	No water	-
Ziwa (Tana River)	Wet	5/7/2018	Ox-bow lake	25.6	644	439	7.99	
	Dry	Not visited	Ox-bow lake	-	-	-	-	-
Nakukulas Lugga	Wet	Not visited	-	-	-	-	-	-
	Dry	02/10/2018	Dugout well in lugga	28.5	373	186	7.9	-
	Dry	02/10/2018	Cattle Trough Water	28.2	614	291	7.46	
Kangthethein Lugga	Wet	Not visited	-	-	-	-	-	-
	Dry	03/10/2018	Dugout Well	33.3	1160	582	8.39	-
Karuko	Wet	Not visited	-	-	-	-	-	-
	Dry	05/10/2018	Oasis	32.7	1323	653	9.29	
Kerio River	Wet	Not visited	-	-	-	-	-	-
	Dry	06/10/2018	Flowing water	30.5	271	135	8.42	500

Location Name	Season	Date	Water Feature Type	Temp. (°C)	Conductivity (µs)	TDS (ppm)	pH	TSS
Suguta River	Wet	Not visited	-	-	-	-	-	-
	Dry	18/10/2018	Flowing water	35.6	4000	2000	9.51	275
Gerille (Ijara)	Wet	Not visited	-	-	-	-	-	-
	Dry	09/11/2018	Earthpan	31.6	1670	828	9.52	-
Dipu Dam (Lamu)	Wet	Not visited	-	-	-	-	-	-
	Dry	15/11/2018	Earthpan	34.7	158	76	7.71	
Lamu Port Area	Wet	Not visited	-	-	-	-	-	-
	Dry	16/11/2018	Marine Water	30.4	4000	2000	8.34	-

4.2 Water flow characteristics

4.2.1 Surface flow characteristics (Short Rains)

Surface flow of rivers during the dry season was only observed on permanent rivers Ewaso Ngiro, Suguta and Kerio Rivers; Luggas had no surface water flows. Ewaso Ngiro River has the highest water discharge of about 16 m^3s^{-1}, Suguta and Kerio Rivers had relatively low amounts of water discharged during the period of assessment. Most luggas and rivers has an established dynamic surface flow during the long rainy season. Information on discharges of drainage systems during long rainy season are compiled in Table 5.

4.2.2 Subterranean flow of water during dry season

The subterranean water flow in lugga's was observed using wetness of sub-soil which was cored between 30 – 60 cm deep from the surface of the lugga bed. Two lugga had 100% of their subterranean soil very wet along the luggas during the dry season (short rains); Barsaloi and Seiya lugga has their subterranean soil 100% very wet. These luggas are followed by Nachola (Baragoi) lugga which has about 67% of the lugga very wet and 33% moderately wet; Suiyan lugga 89% moderately wet and 11% very wet subterranean soils. Lugga in Koiting and Rahole are very dry and no moist soil was observed in their subterranean soils.

The observations made on the subterranean flow of water indicate Seiya and Barsaloi are very important lugga for provision of water in the dry lands. This implies more water is available in the two lugga and they can be relied upon for water provision for the livestock and domestic uses.

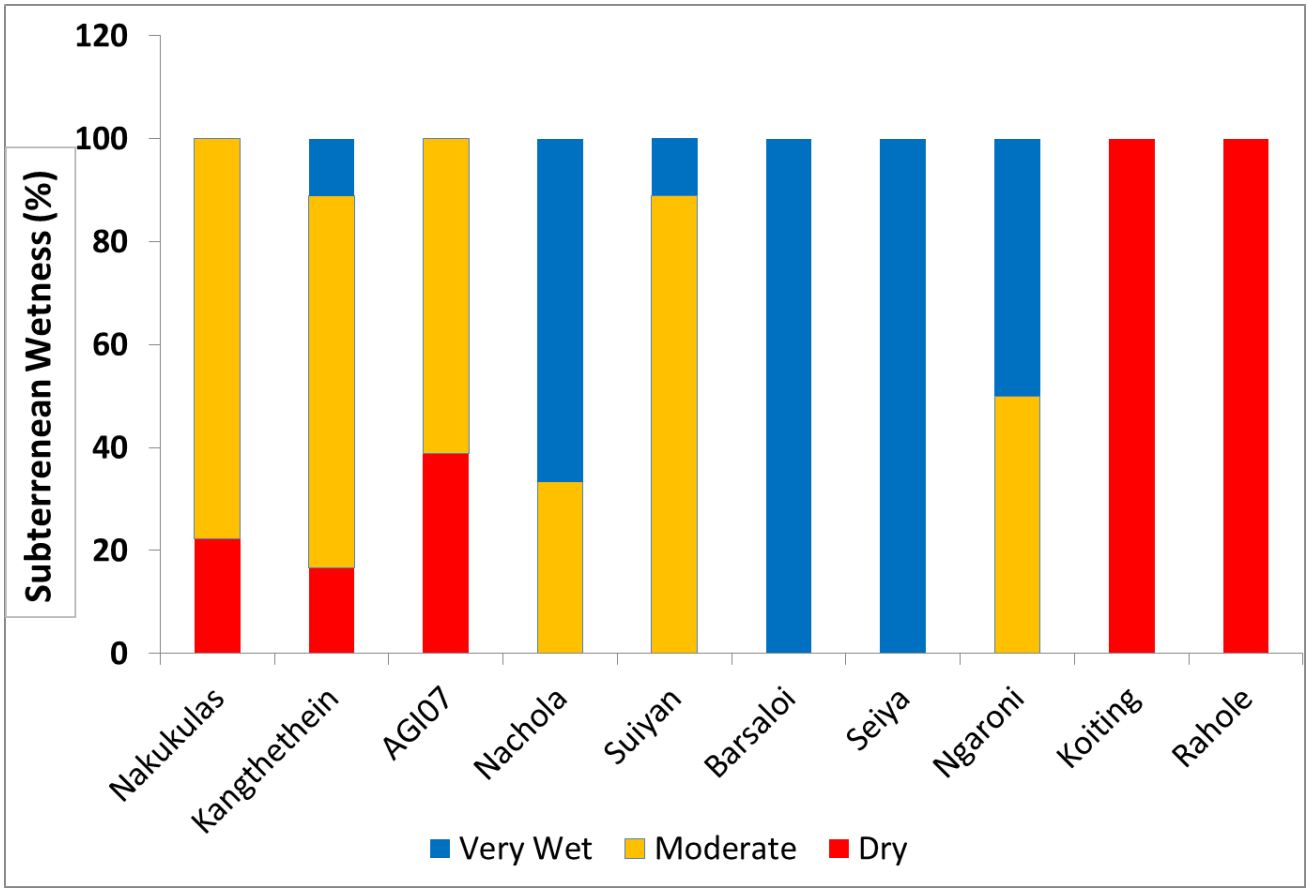


Figure 11. The distribution of subterranean water in lugga based on wetness of lugga bed soil between 30-60 cm deep.

Table 5: Flow characteristics of luggas based on surface water flow width (m), depth or height (m), velocity (m/s) and discharge m^3s^{-1} during wet season of long rains.

River/Lugga		Low surface flow					High surface flow				
	Season	Width	Height	Time (s) per 20m	Velocity	Discharge	Width	Height	Time (s) per 20m	Velocity	Discharge
Nachola (Lugga near S11)	Wet season	7.5	0.7	4.4	3.6	19.1	13.5	0.9	3.4	5.8	71.0
	Dry season	-	-	-	-	No Flow					
Baragoi River/lugga	Wet season	24	0.25	12.3	1.3	7.8	64	1.8	1.7	11.7	1346.5
	Dry season	-	-	-	-	No Flow					
Koiting (near Station 6)	Wet season	0.85	0.25	12.3	1.3	0.3	2.35	2	1.5	13.0	61.0
	Dry season	-	-	-	-	No Flow					
Suyan	Wet season	30	0.08	22.0*	0.4	0.9	45	1	3.1	6.5	292.2
	Dry season	-	-	-	-	No Flow					
Barsaloi	Wet season	27	0.05	21.0*	0.4	0.5	75	1.2	2.6	7.8	701.3
	Dry season	-	-	-	-	No Flow					
Seiya Lugga	Wet season	95	0.3	8.8*	0.9	25.9	100	0.5	6.2	3.2	162.3
	Dry season	-	-	-	-	No Flow					
Baa lugga (Ngaroni)	Wet season	19	0.62	5.0	3.2	37.9	56	1.9	1.6	12.3	1312.7
	Dry season	-	-	-	-	No Flow					

River/Lugga		Low surface flow					High surface flow				
	Season	Width	Height	Time (s) per 20m	Velocity	Discharge	Width	Height	Time (s) per 20m	Velocity	Discharge
Silanga-Nanyukie	Wet season	30	0.2	15.4	1.0	6.2	40	0.6	5.1	3.9	93.5
	Dry season	-	-	-	-	No Flow					
Ewaso Ngiro	Wet season	50	0.40	7.7*	2.1	41.6	110	2.2	1.4	14.3	3457.1
	Dry season	22	0.35	7.5	2.08	16.0					
Naathu (near Station 8)	Wet season	5	0.07	44.0	0.4	0.1	8	0.25	12.3	1.6	3.2
	Dry season	-	-	-	-	No Flow					
Kula Mawe	Wet season	10	0.08	38.5	0.4	0.3	30	1.2	2.6	7.8	280.5
	Dry season	-	-	-	-	No Flow					
Kerio River	Wet season	-	-	-	-	No Data	112	1.6	2		1862
	Dry season	62	0.11	15	0.53	3.64					
Suguta River	Wet season	-	-	-		No Data	21	1.2	20	7.79	196
	Dry season	15	0.19	20	1.00	2.85					

**Observed data*

4.3 Freshwater aquatic macroinvertebrates

The aquatic macro-invertebrates assessed include the benthic and floating species and; aquatic species that spend early part of life as larvae in water but when adult they live outside the water (Figures 12 and 13). However, their survival still depends on the wetland habitat.

The survey was carried out during the dry season and most of the luggas were dried of the surface waters that potentially support aquatic macro-invertebrates. During the survey, a dragonfly species *Pantala flavascens* were frequently observed along the proposed oil pipeline alignment. This constituted 95% of the sites visited had the species observed on flight throughout across the lugga, rivers and wetlands. This species seems not to be deterred by the dry conditions of some areas. *Trithemis kirbyi* was only observed frequently in rivers and dry luggas that has hand dugout wells with water and lugga areas with intermittent flow of surface streams. Due to complete dependence of some of the macro-invertebrate species on water, they were only observed in areas with water which were few in the project area thence were rare by distribution (Table 6).

The oasis at Karuko has about 41% of the aquatic macro-invertebrate species recorded along the project area. The oasis is apparently a hotspot of aquatic macro-invertebrate species in the dry area of Lokichar and across the landscape assessment was conducted. Kerio river and Baragoi lugga represent about 33 and 30 % of the species recorded across the landscape of the proposed project. Garissa County apparently has very low distribution of aquatic macro-invertebrate and wetland dependent species (Table 6).

Table 6: Aquatic Macroinvertebrates

	Nakukulas	Kan'gthethein	Karuko	Kerio River	Ewaso Nyiro River	Kula Mawe	Garbatula	Suguta River	Suiyan	S11	Baragoi	Barsaloi	Seiya	Ngaroni	Silanga	Sankuri	Rahole	Bour-Algi	Mradeni	Frequency of occurrence
Anax imperator													x		x					11
Brachythemis leucosticta	x													x						11
Trithemis arteriosa		x	x																	11
Trithemis kirbyi	x		x	x	x			x	x		x	x	x	x	x					58
Trithemis annulata				x																5
Crocothemis sanguinolenta			x		x									x						16
Crocothemis erythraea					x			x			x	x	x		x				x	37
Palpopleura portia											x									5
Orthetrum chrysostigma													x						x	11
Pantala flavenscens	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	95
Trithemis donaldsoni			x	x	x			x	x			x	x							37
Trithemis pruinata				x																5
Tramea limbata						x	x													11
Phyllomacromia sp.												x								5
Aethiothemis solitaria														x						5
Africallagma glaucum												x								5
Aciagrion steelae															x					5
Diving Beetle	x		x																	11
Whirligig Beetle			x								x									11
Water Scorpion											x									5
Giant Water Bug											x									5
Small Whirligig Beetles											x									5
Aeshnidae larvae (Indet. 1)			x	x																5
Libellulidae larvae (Indet. 1)			x	x	x			x												5
Libellulidae larvae (Indet. 2)			x	x	x			x												5
Coenagrionidae larvae (Indet.)				x																5
Curculionidae larvae (Indet.)			x																	5
Frequency of occurrence (%)	15	7	41	33	26	7	7	19	11	4	30	22	22	19	19	4	4	4	11	

Aeshnidae larvae (Indet. 1)

Libellulidae larvae (Indet. 1)

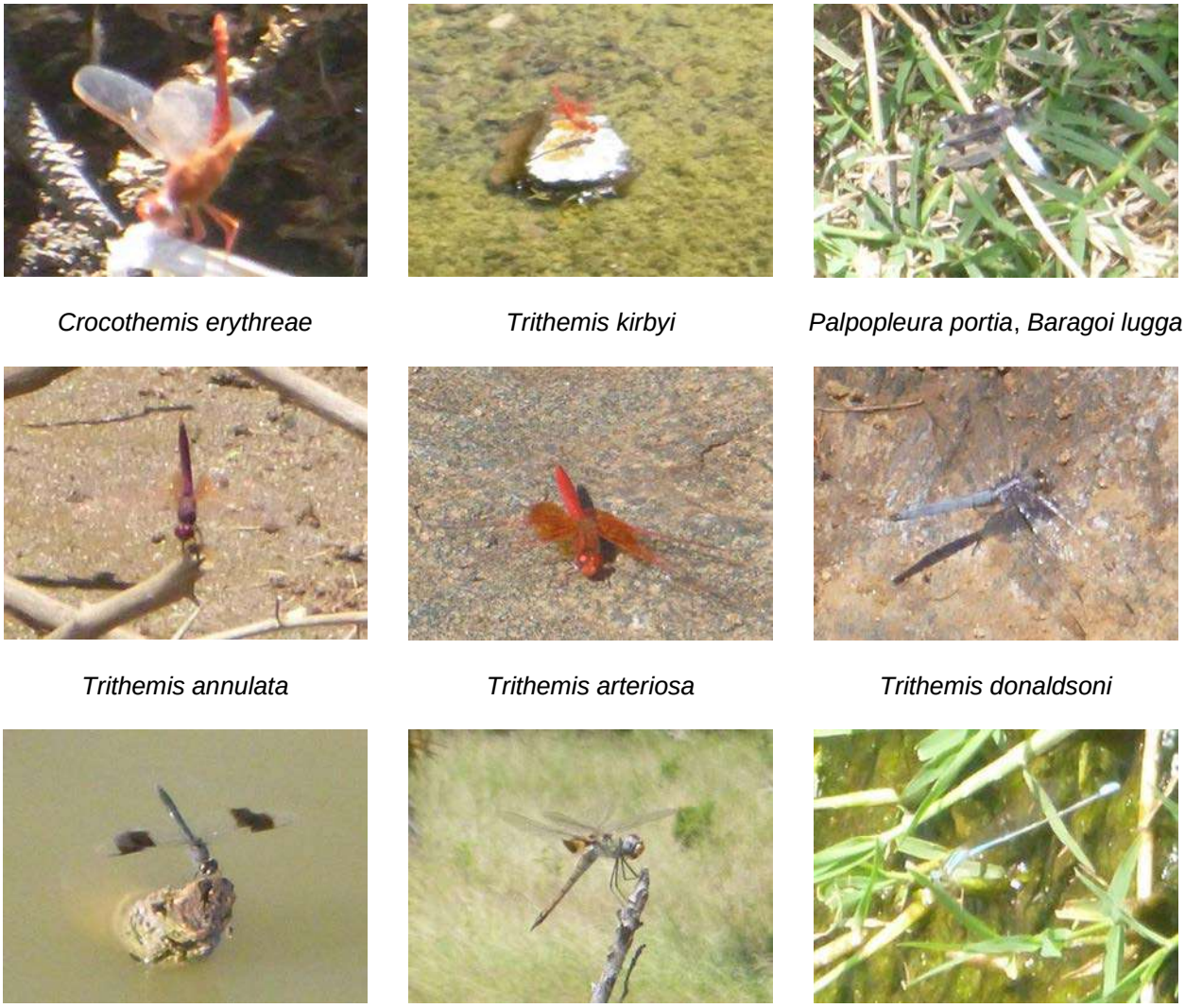
Libellulidae larvae (Indet. 2)

Water Scorpion

Coenagrionidae larvae (Indet.)

Curculionidae larvae (Indet.)

Figure 12. The aquatic benthic macro-invertebrate species sampled from rivers and oasis along the proposed oil pipeline



Crocothemis erythreae | *Trithemis kirbyi* | *Palpopleura portia*, *Baragoi lugga*

Trithemis annulata | *Trithemis arteriosa* | *Trithemis donaldsoni*

Brachythemis impartita | *Trithemis monardi,* near mangroves | *Aciagrion africanum*

Figure 13. Dragonfly species recorded within the lugga and river systems along the proposed oil pipeline

4.4 Fish species

The survey of fish species during dry season was conducted on three permanent rivers along the proposed oil pipeline. These included the Ewaso Nyiro, Suguta and Kerio Rivers. Five fish species were sampled on Kerio River and Ewaso Ngiro. Of these; two species were caught in both river system *Clarias gariepinus* and an *Oreochromis sp.* (Figure 14). Ewaso Ngiro is unique with *Labeo cylindricus* and *Bagrus sp.*, which were caught during the assessment. While, *Synodontis schall*, *Enteromius neumayeri*, and *Enteromius sp. (Indet.)* were unique for Kerio River (Figure 14). The Suguta River has an endemic fish species *Oreochromis niloticus sugutae* which only occurs in the system. In the coastal wetland, *Protopterus affinis amphibius* and *Oreochromis spilurus* were observed in Dipu Dam (Figure 14).

Clarias gariepinus in Kerio, Ewaso Nyiro and Suguta Rivers

Synodontis schall in Kerio River

Enteromius neumayeri in Kerio River

Bagrus sp. Ewaso Ngiro

Labeo cylindricus, Ewaso Nyiro

Enteromius sp. in Kerio River

Oreochromis sp. Ewaso Ngiro, Kerio and Suguta River

Oreochromis niloticus sugutae, Suguta River (Endemic species to Suguta River Basin)

Protopterus affinis amphibius in Dipu Dam

Figure 14. Fish species sampled in the permanent river system of Ewaso Ngiro, Kerio and Suguta Rivers

4.5 Wetland Birds Species

About 13 species of birds recorded within the rivers and lugga, and wetlands were wetland dependent birds. These birds include the Black-Headed Plover which occurred mostly in seasonal wetlands in Garissa area; Spur-Winged Plover common in Ewaso Ngiro, Kerio River, and Karuko Oasis. Great Egret, Giant Kingfisher and Egyptian Goose were conspicuous in Dipu dam at the coast and Ewaso Ngiro. Grey-Headed Kingfisher was observed in the riverines of Barsaloi and Ngaroni lugga. The three-Banded Plover was common in Nachola (Baragoi) and Barsaloi lugga. While, most of the wetland bird records was high in Ewaso Ngiro River and these included the Buff-Breasted Sandpiper, Pied Kingfisher, Green Sandpiper, Yellow-Billed Stork, African Crake, Sacred Ibis. Presence of African Fish Eagle in Kerio River indicates the river has considerable population of fish.

Most of these birds are covered by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) due to their partial migration.

Spur-Winged Plover

Egyptian Goose, Ewaso Ngiro and Dipu Dam

Sacred Ibis

Green Sandpiper

Grey-Headed Kingfisher

Three-Banded Plover

Greater Egret

Black-headed Heron

Figure 15: Wetland bird species.

4.6 Wetland Plant Species

Dipu dam wetland has a high wetland plant species compared to the drainage and wetland system visited. About 13 species of wetland plants were observed in Dipu dam wetland out of 16 plant species recorded on the entire pipeline alignment. In Barsaloi and Ewaso Ngiro the most common plant species is *Kanahia* species which withstand long dry seasons; while in Dipu dam wetland species of *Cyperus* was dominant. The banks of Suguta River are dominated by *Sporobolus* species; *S. africanus* and *S. spicatus*. Other lugga and wetlands do not have wetland dependent plants but terrestrial vegetation that is influenced by the dynamics of water in the landscape.

Sporobolus africanus

Sporobolus spicatus

Cyperus denudatus

Cyperus cylindrica

Kanahia sp. In Ewaso Ngiro

Nympaea lotus (flowering) and Pistia stratiotes (Water lettuce)

Hyphaene compressa

Epilobium hirsutum

Hygrophila auriculata

Figure 16: Wetland plant species

4.7 Other wetland species observed

4.7.1 Aquatic/wetland mammal species

Wetland dependent mammals are distributed in few watercourses on the proposed crude oil pipeline project corridor. Two species were identified on few sites along the proposed crude oil pipeline; these include Hippopotamus and Waterbucks. Hippopotamus population is completely depend on water habitat and wetland vegetation for survival. However, Waterbucks are mostly found on grassland but stay near water areas such as rivers, and lakes in order to avoid dehydration. A population of Hippos was observed at Dipu dam in Mradeni (Bargoni area). Its distribution has also been recorded in Ewaso Ngiro River. Presence of waterbucks has been noted by their footprints and local account in Dipu dam.

Figure 17. Hippopotamus observed in Dipu Dam in Mradeni, Lamu.

4.7.2 Aquatic/wetland reptiles and amphibians during dry season

The aquatic or wetland dependent reptiles and amphibians included Crocodiles, frogs and turtles. Presence of the Nile crocodile is dominant in the downstream of the corridor of the proposed crude oil pipeline in Ewaso Ngiro River. Local account informed of presence of crocodiles in the upstream of the corridor of the proposed pipeline in Kerio River. Observations on the earthpan / waterpan recorded the Turtles and frogs in the water body. Only one earthpan, at Nakukulas that had water during the dry season survey from which Turtle (Terrapins) and frogs (and tadpoles) were recorded. The dry areas in Garissa recorded the Foam-Nest frog that spend most of the day on the tree in the seasonal wetlands.

Nile Crocodile Ewaso Ngiro and Suguta

Ptychadena anchietae

Terrapin

Foam-Nest Frog

Ptychadena sp.

Figure 18: Aquatic reptiles and amphibians

4.8 Common terrestrial animals in lugga/river in dry season

4.8.1 Invertebrate Species

Observation made in the lugga/river banks and seasonal wetland indicated low diversity of terrestrial macro-invertebrate species. Only conspicuous invertebrate species were recorded during the dry season survey. About 18 species were very common within the lugga/river and on vegetation on their banks, and the seasonal wetlands. The Red Desert Locust was observed on vegetations on the banks of lugga in Nakukulas and Kang'thethein foraging on leaves (Table 7). Absence or low cover of grass in Lokichar attributed to the infestation of the locust on the riverine vegetation. Thus, the locust poses competition on vegetation forage with livestock along the lugga. The Yellow Pansy (*Junonia hierta*) has a wider distribution across the landscape; observed from Lokichar to Mradeni in Lamu (Table 7).

The highest number of invertebrate species was recorded in Kang'thethein (39%) followed by Nakukulas and Suiyan Lugga which each represented 33% of the species observed. Areas with low terrestrial invertebrate species observed in the lugga/river banks, and shores of wetlands were; Karuko, Suguta, Seiya, Bour-Algi and Mradeni (Table 7).

Table 7. The distribution ofcommon terrestrial invertebrates on sites along the proposed crude oil pipeline alignment.

	Nakukulas	Kan'gthethein	Karuko	Kerio River	Ewaso Nyiro River	Kula Mawe	Garbatula	Suguta River	Suiyan	S11	Baragoi	Barsaloi	Seiya	Ngaroni	Silanga	Sankuri	Rahole	Bour-Algi	Mradeni	Frequency of occurrence (%)
Red Desert Locust	1	1																		11
Antlion Nymph	1																			5
Tsetse fly	1																			5
Black Wasp	1								1											11
Armoured Ground Cricket	1																			5
African migrant				1					1	1		1		1	1					32
Yellow Pansy	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Arabian Sailor		1																		5
Joker		1																		5
Yellow splendor		1																		5
Papilio demodocus												1								5
Belenois aurota						1	1		1	1		1								26
Blue sailor														1						5
Acrea neobule											1								1	11
Carpenter bee				1															1	11
Honey Bee		1			1	1			1											21
Spider (Indet.)									1											5
Spotted ground beetles		1																		5
	33	39	6	17	11	17	11	6	33	17	11	22	6	17	11	6	6	6	17	

4.8.2 Terrestrial mammals

The most common mammal species observed on the riverines of lugga and river is the Vevet Monkey that occurs in luggas in Lokichar and Samburu area. The Olive Baboon and Lesser Kudu are mostly distributed in lugga in Samburu and their presence was indirectly observed around earthpan in Garbatula in Isiolo. The downstream of lugga in Silanga-Nanyukie consist of rocky banks where Rock Hyrax inhabit. Recent visitation of elephant was observed in lugga in Koiting and Suiyan lugga by the presence of their dung and destruction of trees. Local people in Barsaloi normally observe elephants moving along Barsaloi Lugga from Latakweny located in downstream to Lulu area in upstream during dry season by end of December. Downstream movement from Lulu to Latakweny begins in April following the onset of the rainy season.

Other species were recorded from accounts by the local people; for instance presence of hyena and leopard are accounted in Baragoi lugga, Barsaloi, Seiya, Ewaso Ngiro and Kerio River. Also, Buffaloes are accounted for in Dipu dam wetland grazing and drinking water. Gerenuk population is widely distributed in sites in Garissa area such as Sankuri, Balambala and Gerille.

Figure 19. Rock Hyrax observed on rocky banks of lugga in Silange-Nanyukie, Wamba area. Vervet monkey on *Acacia tortilis* in Barsaloi

4.8.3 Terrestrial Reptiles and amphibians on the sides of lugga / river

The immediate banks of luggas had very few terrestrial reptiles and amphibian distributions. Nakukulas and Kang'thethein lugga was dominated by the Speke's Sand Lizard. Kang'thethein, in particular, had a unique observation of the White-Throated Savanna monitor within the lugga on Dum palms. These species were not recorded in other places near the river or lugga and wetlands. Areas vegetated by Sporobolus species in Kerio River banks host the Nile Monitor Lizard; a species that was recorded by account in Ewaso Nyiro and Dipu dam in Mradeni (Lamu). Lugga with rocky banks in parts of the lugga course such as in Barsaloi, Seiya, Silanga-Nanyukie luggas and Ewaso Nyiro River has the Red-Headed Rock Agama. While, parts of luggas or wetlands with tree barks were observed the Blue-Headed Tree Agama.

Blue-Headed Tree Agama, Female (Kang'thethein lugga)

Rainbow Skink (Ewaso Nyiro)

Speke's Sand Lizard (Suiyan lugga)

Southern Long-Tailed Lizard (Sankuri area)

Red-Headed Rock Agama, Female (Rahole area)

Figure 20: Terrestrial repiles and amphibians

4.8.4 Terrestrial birds observed on the sides of lugga/river

A total of 41 terrestrial bird species were common along the proposed oil pipeline within lugga, river banks and wetlands. Most of the birds were observed foraging on the banks of lugga / rivers, flying across the lugga / river and bathing in pools of water in the lugga. The rapid survey reveals terrestrial birds are diverse in Nakukulas (27%), Silanga-Nanyukie (27%) and Kangthethein (24%) luggas (Table 8). Lower counts of terrestrial bird species were recorded Suguta River near Station 3 (West of Nachola) and Baragoi lugga (in Nachola). Namaqua Dove are widely spread on the landscape of the proposed project area (Table 8). Other terrestrial bird species that has relatively high counts are the White-Headed Buffalo Weaver, Common Drongo and Ring Necked Dove. About 21 bird species were rarely observed during the survey and some of them include Houglin's Courser, Spotted-Eagle owl, and Green Wood-Hoopoe among others (see Table 8).

Red-Billed Hornbill (Silanga Nanyukie

Black Kite (Ewaso Nyiro)

Spotted-Eagle Owl (Kula Mawe)

Hoopoe (Garbatula)

Emerald Spotted Dove (Suiyan lugga)

Golden-Breasted Starling (Seiya lugga)

Figure 21: Terrestrial birds

Table 8. Distribution of the common terrestrial bird species along the proposed Lokichar-Lamu oil pipeline with lugga, river and wetlands

	Nakukulas	Kan'gthethein	Karuko	Kerio River	Ewaso Nyiro River	Naathu	Kula Mawe	Garbatula	Suguta River	Suiyan	S11	Baragoi	Barsaloi	Seiya	Ngaroni	Silanga	Sankuri	Rahole	Bour-Algi	Mradeni	Frequency of occurrence (%)
Abyssinian Roller	x																				5
African Cukoo															x						5
African Fish Eagle				x																	5
African Green Pigeon															x			x			10
African Pied Wagtail					x																5
African White-Winged Dove		x																			5
Barn Swallow							x														5
Black Raven	x														x						10
Black-Bellied Bustard		x																			5
Black-Headed Batis																	x				5
Blue-Steel Whydah																x					5
Cisticola											x										5
Common Bulbul	x			x				x		x				x						x	30
Common Drongo	x	x	x	x		x	x		x		x		x		x						50
Emerald Spotted Dove										x						x					10
Fischer's Starling																	x				5
Golden-Breasted Starling														x							5
Green Wood-Hoopoe																				x	5
Hilderbrandt's Starling																			x		5
Hoopoe							x	x								x					15
Houglin's Courser																			x		5
Long-Tailed Fiscal																	x				5

	Nakukulas	Kan'gthethein	Karuko	Kerio River	Ewaso Nyiro River	Naathu	Kula Mawe	Garbatula	Suguta River	Suiyan	S11	Baragoi	Barsaloi	Seiya	Ngaroni	Silanga	Sankuri	Rahole	Bour-Algi	Mradeni	Frequency of occurrence (%)
Mourning Dove							x						x	x							15
Namaqua dove	x	x	x	x	x	x		x	x	x		x	x	x	x	x					70
Red Eyed Dove	x	x												x						x	20
Red-Billed Hornbill						x		x								x		x			20
Red-Fronted Warbler		x	x																		10
Ring Necked Dove	x				x								x	x	x	x	x		x	x	45
Slit Collared Boubou														x							5
Speckled Mouse Bird						x				x					x						15
Speckled Pigeon					x									x		x					15
Spotted-Eagle owl							x														5
Superb Sterling	x		x	x				x								x			x		30
Von Der Dekens Hornbill														x							5
Vulturine Guineafowl																	x	x			10
Wax Bill																x					5
White Bellie Go-Away Bird	x			x				x							x	x					25
White-Browed Sparrow-Weaver	x	x		x	x	x	x														30
White-Headed Buffalo Weaver	x	x					x	x		x		x	x	x	x	x					50
Yellow-Billed Hornbill																		x			5
Yellow-Necked Spurfowl		x				x															10
Grey Kestrel												x	x								10
Black Kite					x																5
Species Distribution (%)	27	22	10	17	15	15	17	17	5	12	5	7	15	24	22	27	12	10	10	10	

4.9 Riverine vegetation

The riverine vegetation is predominantly observed along the rivers and Luggas. The vegetation formations and majorly comprising of the *Acacia tortilis* and *Salvadora persica* population. The distributions of these species are sustained along the watercourse by dispersal of their propagules by river or lugga water current. Doum palm are concentrated in Karuko oasis due to the availability of the water throughout the year. Parts of the river or lugga that interact with the adjacent lands through the surface and subterranean waters has a major influence on the distribution of the riverine vegetation. As such, changes on the lugga or river water levels affect the tree species available, population and the size of the trees. Luggas that apparently are wet in the subterranean normally support more Acacia trees in large population and sizes. For instance, there is relatively higher riverine tree covers in Seiya and Barsaloi due to their ability to store more water throughout the year that support plant growths.

Acacia tortilis in the background. *Calotropis procera* in the foreground in Nakukulas

Ziziphus Mauritania in Kang'thethein

Doum palms in Karuko Oasis

Balanites aegyptiaca (Naathu)

Delonix elata (Kula Mawe)

Duam palm in the riverine of Suguta River

Figure 22: Riverine vegetation

4.10 Mangrove Survey

The common mangrove species in the area are *Rhizophora mucronata*, *Ceriops tagal*, *Sonneratia alba*, and *Avicenia marina*. *Sonneratia alba* forms its own stand at the sea front that does not overlap with other mangrove species in the area. Three more mangrove species were observed; however, they do not form conspicuous stand that would be notable as other. These species are *Bruguiera gymnorrhiza, Lumnitzera racemosa* and *Xylocarpus granatum*. Generally, lateral distribution of mangrove species from the shore towards the sea is comprised of *Avicenia marina*, followed by *Ceriops tagal* and *Rhizophora mucronata* and where there is no mud, *Sonneratia alba* occur at the sea front.

An average mangrove stock density in the area is 2280 per ha. Distribution of mangrove stock density from shoreline towards the sea shows high density at the middle 2,682 mangrove trees (per ha.); towards sea

follows with about 2,400 stock per ha., and as low as 1758 stock per ha near the open shoreline. *R. mucronata* has higher stock density in the area by 3,715 per ha, *C. tagal* 1,801 per ha and A. marina 1,324 per ha (Figure 27).

Most areas in the near open shore and mangrove area are muddy generated from loose eroded soil from the adjacent landscapes. These therefore provide *R. mucronata* opportunity to survive and displace other species. With future increase in sedimentation of silt and clay deposits, the level of mud will increase which will affect severely the distribution of C. tagal. R. mucronata are more tolerant to inundation than other mangrove species due to its large number of aerial stilt roots buttressing the trunk.

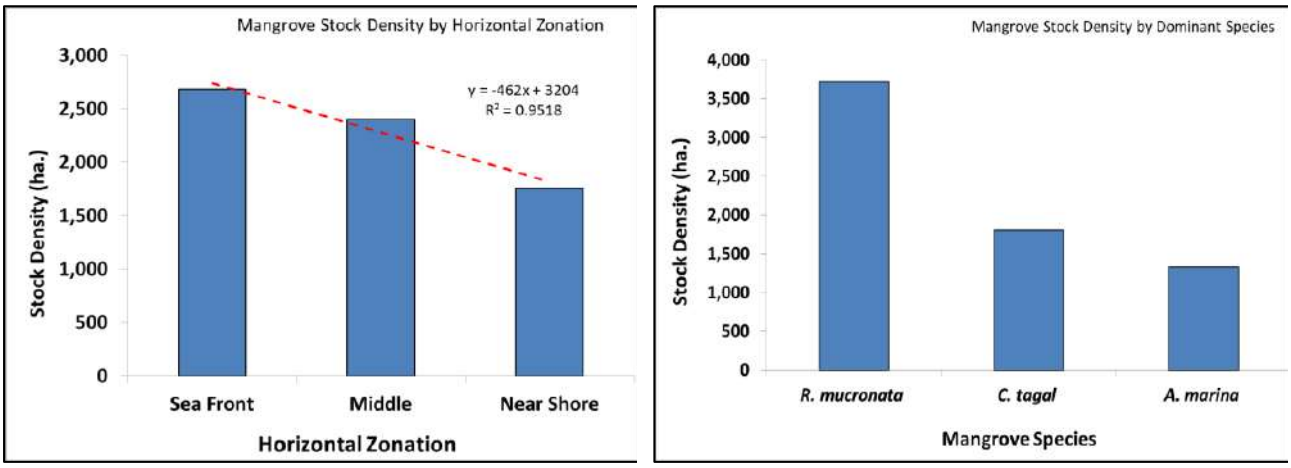


Figure 23. Stock density of mangroves by horizontal zonation and by species

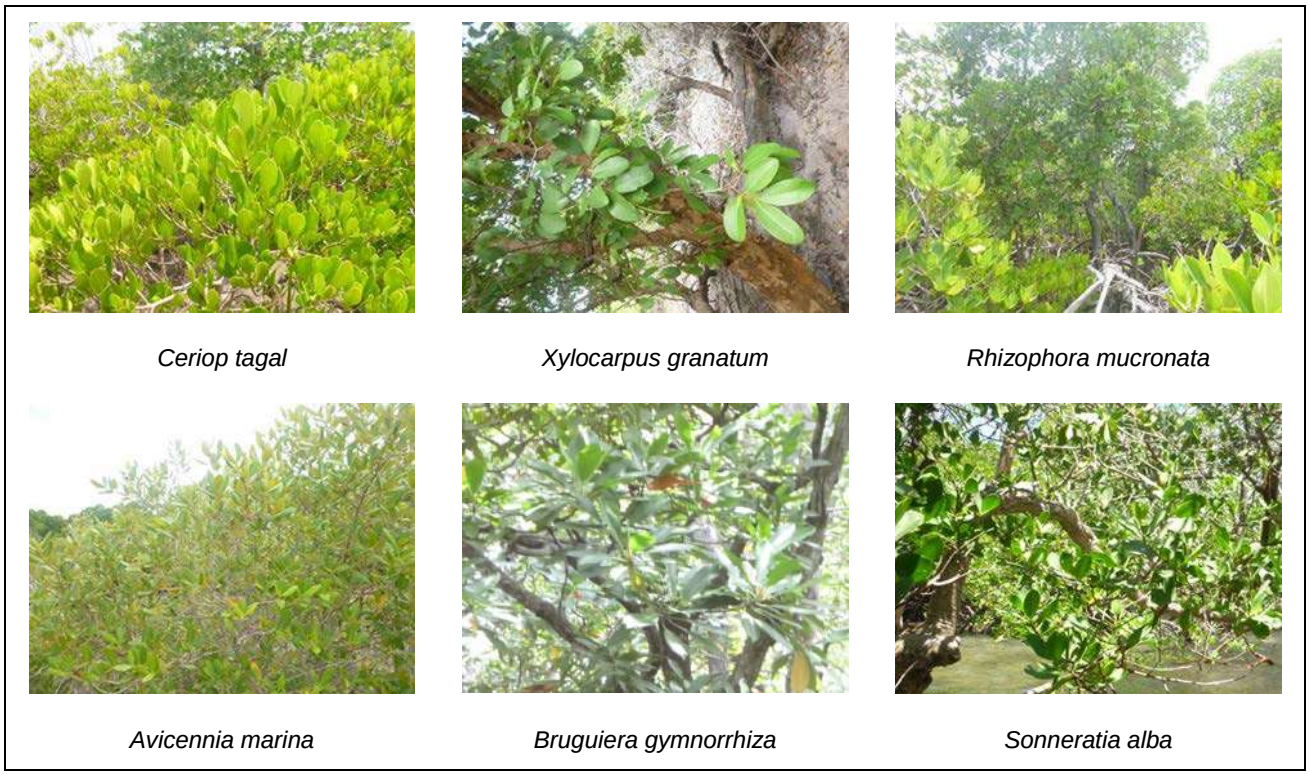


Figure 24: Examples of mangrove species

4.11 Marine macro-benthic Invertebrates

4.11.1 Crustaceans: Crab Survey

Crabs are dominant species in Mokowe among the crustaceans in the open intertidal and in mangrove habitats. Some species are notably common in the area and these include *Uca tetragonon*, *Uca urvillei, Uca inversa, U. chlorophthalmus, Dardanus deformis*, and *Cardisoma carninfex*. *Scylla serrata* (mangrove or mud crab) was observed foraging on mangrove litters. Generally, large adult species inhabit dense mangrove areas where they get cover from predators. It is most sought crab species for commercial fisheries and mariculture along the coast.

Uca chlorophthalmus

Uca sp.

Neosarmatium

Defensive y*oung Scylla serrata* grazing near shore mangrove area

Calappa hepatica burrowing in sand

Cardisoma carnifex

Uca sp.

Figure 25: Crustaceans

4.11.1.1 Crab Burrow Density

Crab burrow density were assessed in open intertidal area and inside mangrove stands in Mokowe. Burrow sizes were clustered four categories of sizes; <1.5 cm, 1.51-2.5, 2.51-4.0, and >4.01 cm. The total estimated crab density in the area is 57,500 per hectare. The mangrove area has six time the crab population in the open areas with the burrow diameter size <1.5 being the dominant size in the system. The small size burrow

diameter are relatively high in *R. mucronatum* dominant areas. However, the large burrow holes are relatively high in *C. tagal* dominant areas.

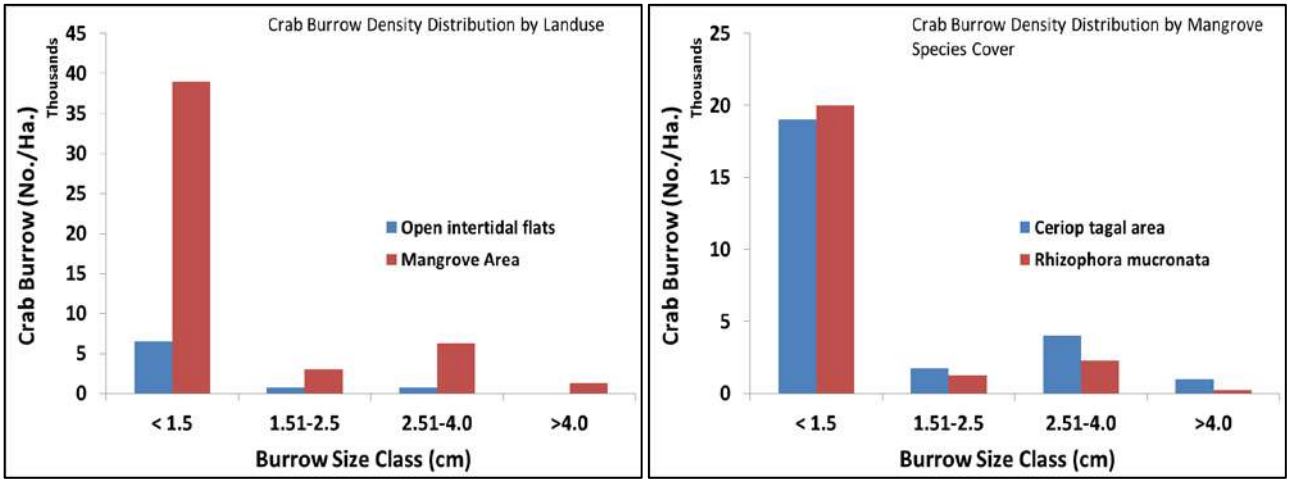


Figure 26: Crustacean density

4.12 Ecosystem Services

4.12.1 Domestic and Livestock water

Barsaloi and Seiya are located in an area experiencing low and unequally distributed rainfall. However, the drainage system store a lot of subterranean waters that support livestock and domestic use to the local people. Major luggas such as Baragoi, Suiyan, and Silanga-Nanyukie are important for their capacity to store water and permeate subsurface flow of waters from catchments. This water is extracted by digging by hand to reach the water tables in the lugga. In other places, boreholes are sunken adjacent to the lugga in order to access water table in lugga throughout the year.

4.12.2 Livestock feed provision

The riverine Acacia trees support livestock with leaves and pods for foraging. These trees are distributed along the influence of lugga drainage systems throughout the year. Livestock, therefore get feed during drought period in the region.

4.12.3 Sand harvesting

Sand is harvested from some of the watercourses for building and construction activities. Local people and especially youths earn an income from sand harvesting. The replenishment of sand in lugga is enhanced by the deposits from the adjacent land and from catchment areas. Sand harvested from Ewaso Ngiro supports building and construction in Archers Post, Isiolo and the neigbouring towns. The growth of small urban centres utilises sands from the lugga. Building in Barsalo Center relies on sand from Barsaloi lugga and Sware relies on sand from Seiya lugga. The Ewaso Ngiro Sand harvesting is common on luggas that have a substrate of the bed sandy deposits.

4.12.4 Fishery activities

Few water systems support fishery activities along the project pipeline. These include Ewaso Nyiro River and Dipu Dam in Lamu; locals account subsistence fisheries in Kerio River however this has not been confirmed. In Ewaso Nyiro, fishery activities takes place effectively during dry season when river waters are low making it easy to use simple gears for fishing. Dominant fish species caught are *Clarias gariepinus, Protopterus* and some Tilapia species.

Water harvesting for urban use in Ewaso Ngiro

Sand harvesting in Ewaso Ngiro

Livestock watering in Suiyan lugga

Fishing at Dipu dam, Mradeni for subsistence economy

Figure 27. Ecosystem Services: water collected by lorries in tanks for urban use; sand harvested for construction in Isiolo Town, Goats served water from hand dugout wells, and fish caught in Dipu dam (Lamu) for subsistence economy

4.13 Key Observations for ESIA

The findings represent the baseline survey carried out along the parts of the proposed pipeline alignment from luggas in Samburu, Isiolo, Meru, Garissa and Lamu County:

- Water volumes in earth pans and the discharge of rivers/luggas during dry season is important for meeting water demand in the area;
- The levels and dynamics of water quality parameters in Kerio and Ewaso Ngiro Rivers should not be affected due to the aquatic organisms that depend on them. This also includes Seiya and Barsaloi lugga that support riverine vegetation, and are used for livestock and domestic consumption;
- The aquatic macro-invertebrate species with low frequency of distribution in study sites has very low population that can easily be affected on sites when the water they depend on is affected. Other species are only common in dry season; thus, the project activities would likely to affect their lifecycle. The flow of waters and vegetation sustain their population on the landscape;

- Movements of fish species and population in the river system can be affected by development projects. For instance, *Synodontis schall* is a species from Lake Turkana but normally migrate to Kerio River and River Turkwell for breeding during the long and the short rains. Its movement together with others can temporarily be interfered;
- Population of birds in confined wetlands such as the oasis in Karuko can easily be adversely affected when the habitat is modified;
- Wetlands are habitat of mammal species (Hippopotamus and Waterbucks) and reptiles and amphibians; interference with the wetland would likely affect these populations. Hippos inhabit Dipu dam while aquatic reptiles are distributed in the wetlands and rivers (Ewaso Nyiro and Suguta) and turtle in earthpans;
- Species distribution and population of mangroves: There would be potential increase in sedimentation and mobilisation of muddy substrates along the shoreline that would affect species that do not withstand muddy substrates; and
- Crustacean distribution and population would also be affected by sedimentation and remobilization of muddy substrates

4.14 Health and Safety learnings

- Always have drinking water in dry and hot areas. Sip it constantly for rehydration of the body;
- When working in a team, it is important to stay together and each person accountable of where others are; and
- Collecting security information is important for planning daily field activities.

Gaps and Recommendations for full baseline data gathering

- **Gap 1:** The aquatic biodiversity information in drainage channels in Turkana, and Lamu were not covered in wet season.
  - **Recommendation:** These areas should be considered for survey during the wet season of long rains in advance or parallel with construction;
- **Gap 2:** Fish population structure assessment has not been covered during the field sampling due to little time provided. Only species richness was carried out.
  - **Recommendation:** Three permanent rivers Ewaso Ngiro, Kerio and Suguta Rivers requires an advance fish population assessment in dry season (not dry short rainy season) which normally occur in January and February. In advance or parallel with construction.
- **Gap 3:** Complete dry season aquatic/wetland biodiversity information. Surveys have been carried out during the offing of long rains and in the mid of short rains. The influence of the short rains in the luggas was observed during the survey.
  - **Recommendation:** A possible repeat of survey for dry season in January and February on prioritized sites should be considered in advance or parallel with construction.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

FB/TGF/kc

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.109.B0

TO Paul Mowatt, PPMT

CC Freddy Brookes

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU OIL PIPELINE ESIA PROJECT BASELINE STUDIES – SITE VISIT REPORT: BOTANY AND HABITATS

Preface: The following field report has been provided by botany expert John Kimeu. Golder has provided minimal editing to maintain the sentiment and expert opinion of John Kimeu.

1.0 INTRODUCTION AND SCOPE

This field report relates to the implementation of field studies defined in the plan of study (PoS) Turkana 1772867.533 and PoS full baseline 1772867.536. This suite of stage 2 baseline fieldwork is designed to support the ESIA for the LLCOP Project to characterise biodiversity features of conservation concern (including critical habitat). This element focusses on biological data gathering for botany and habitats along the LLCOP route.

The purpose of the baseline studies is to:

- Visit selected locations along the LLCOP route including coverage of all Counties, habitat typologies and key potential biodiversity 'hot spot' areas identified along the route for investigation;
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species, habitats and ecosystems that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Provide input to project routing and design mitigation;
- Inform the overall baseline biodiversity study for the ESIA; and
- Inform the Impact Assessment for identification of potential short and long-term impacts of the LLCOP on the expected species within each Biotype area and develop recommended mitigation measures as appropriate.

The field programme was conducted to support the baseline flora and habitat inventory, condition and quality assessment, and ground-truth the preliminary vegetation, land cover, and potential critical habitat. Our programme covered a number of sample locations (see Table 1 below) and included a focus on the key 'gap' area through the mountains north of Samburu National Park, and pipeline route characteristics for main biotypes in the dry season (e.g. Acacia landscapes in the Grevy Zebra breeding zone to the west of Wamba, and to the east of Isiolo, Garissa and Lamu).

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Table 1: Geographic coordinates of sampling locations, and proximity to nearest proposed Station (where applicable).

Sampling Location Reference	Latitude	Longitude	Nearest Station (where applicable)	Distance and direction to nearest Station (where applicable)
L01	2.24227	35.76223	Lokichar Export Facility	1.30 km SE
L02	2.08869	36.05581	Station 1	1.14 km NE
L03	2.02913	36.14053	-	-
L04	2.02636	36.14408	-	-
L05	1.87710	36.31841	Station 2	2.03 km NW
L06	1.82591	36.51360	-	-
L07	1.81782	36.64504	Station 3	0.82 km NW
L08	1.53371	36.82555	Station 4 (PS2)	0.27 km N
L09	1.34634	36.87762	-	-
L10	1.34372	36.88004	-	-
L11	1.22175	36.93930	Station 5	1.81 km NW
L12	0.96238	37.23134	-	-
L13	0.95976	37.23381	-	-
L14	0.84672	37.44450	Station 6	1.06 km SE
L15	0.63842	37.67263	Station 7	0.71 km N
L16	0.63691	37.67468	Station 7	0.87 km N
L17	0.52066	37.97111	Station 8	2.24 km W
L18	0.37324	38.58746	Station 9 (PRS)	1.3 km SE
L19	0.10262	39.19789	Station 10	0.13 km NE
L20	-0.24036	39.67218	Station 11	1.52 km S
L21	-0.44278	39.82497	Station 12 (PS3)	0.35 km SE
L22	-0.73089	39.97120	Station 13	1.57 km N
L23	-1.32932	40.33394	Station 14	3.04 km NW
L24	-1.68480	40.58685	Station 15	0.03 km SW
L25	-1.91898	40.74360	Station 16	0.60 km SW
L26	-2.20407	40.90856	Lamu Marine Terminal	0.84 km E

- Sampling was stratified across vegetation community types, which have been preliminarily mapped at the desktop level;
- Plotless landscape sampling frames were used to compile an inventory of plant species (that is, trees, shrubs, forbs, and graminoids) present at each sampling location, and to characterise the vegetation communities along the pipeline route;
- Searches for plant species of conservation concern and invasive plant species were conducted; and
- The field programme was led by John Kimeu (JK). Strategic technical advice, baseline data collection and identification of flora was undertaken by Quentin Luke of the National Museums of Kenya (NMK) Service.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member of the Golder team:

- John Kimeu (JK).

2.2 Tasks completed

A brief summary of the field programme during the site work is provided in Table 2.

Table 2: Flora baseline survey field programme

Date	Task	Location	Initials of team member attending
1/10/2018	Travel to Lokichar from Nairobi (by air), arrived and thereafter prepared for day one of the survey.	Nairobi/ Lokichar	JMK
2/10/2018	Survey to E. Nakukulas (KP–10)	Lokichar	JMK
3/10/2018	Survey to E. Nakukulas (KP–10)	Lokichar	JMK
4/10/2018	Survey to North of Lotubae (KP–23)	Lokichar	JMK
5/10/2018	Survey to North of Lotubae (KP–23)	Lokichar	JMK
6/10/2018	Survey to KP–47	Lokichar	JMK
7 & 8/10/2018	Survey to West bank of Kerio river (L03)	Kerio	JKM
9/10/2018	Travel Back to Nairobi from Lokichar	Lokichar & Nairobi	JMK
10/10/2018	Travel to Isiolo (by road) from Nairobi, arrived and prepared for day one of the survey	Nairobi & Isiolo	JKM
11/10/2018	Survey to L15 (West bank of Ewaso nyiro–at Acher's post)	Samburu	JKM

Date	Task	Location	Initials of team member attending
12/10/2018	Survey to L16 (East bank of Ewaso nyiro–at Acher's post)	Isiolo	JKM
13/10/2018	Survey to L16 and its eastward environs	Isiolo	JKM
14/10/2018	Survey to L17 (c. 17 km past Gachuri market) and a point at SW of Kula Mawe market	Meru/Isiolo	JKM
16/10/2018	Survey to L18, west of Galbatula, and stayed at Maua town	Isiolo	JKM
17/10/2018	Travel to Ol Maro (Samburu) from Maua, arrived and prepared for Suguta sampling	Maua/Samburu	JKM
18 & 19 /10/2018	Survey L05 & L06 (Suguta valley), and operating from Ol Maro	Ol Maro/Suguta valley	JKM
20/10/2018	Travel to Baragoi from Ol Maro (Saburu)	Saburu	JKM
21/10/2018	Survey Suyan laga (L08)	Samburu	JKM
22/10/2018	Survey L07 (Nachola area)	Turkana	JKM
23/10/2018	Survey L09 & L10 (Basaloi)	Samburu	JKM
24/10/2018	Survey L11 (Sware)	Samburu	JKM
25/10/2018	Survey L14 (Kalama ranch)	Wamba	JKM
26/10/2018	Survey L12 and L13 (West of Wamba town)	Wamba	JKM
27/10/2018	Resurvey to L11	Wamba	JKM
28/10/2018	Resurvey to L14	Wamba	JKM
29/10/2018	Survey Hell's Gate Conservancy, east of Wamba town, between L13 & –14	Wamba	JKM
30/10/2018	Survey NW of L14, at Lembarus area which is at Nemnyaka conservancy environs	Wamba	JKM
1/11/2018	Travel to Nairobi from Shaba (Isiolo)	Shaba/Nairobi	JKM
2 & 3/11/2018	Archiving sample and data at the National Museums of Kenya	Nairobi	JKM
4/11/2018	Travel to Garissa from Nairobi, arrived and prepared for day one of sampling	Nairobi/Garissa	JKM

Date	Task	Location	Initials of team member attending
5/11/2018	Survey L20 (N of Garissa town)	Garissa	JKM
6/11/2018	Survey L19 (N of Garissa town, at Rahole game reserve)	Rahole	JKM
7/11/2018	Survey environs of L19 (N of Garissa town)	Rahole	JKM
8/11/2018	Survey L21 and its environs	Garissa	JKM
9/11/2018	Travelled from Garissa to Hola and surveyed L23, approached it from Hola	Garissa	JKM
10/11/2018	Survey L22(S of Garissa town), approached it from Bura	Garissa	JKM
11/11/2018	Travel to Nairobi from Hola	Hola/Nairobi	JKM
12/11/2018	Travel to Lamu from Nairobi	Nairobi/Lamu	JKM
13/11/2018	Survey around L26 (at the new port)	Lamu	JKM
14/11/2018	Survey between L24 & –25 (Baragoni near the Army barracks)	Lamu	JKM
15/11/2018	Survey L25 (between Baragoni and the new port)	Lamu	JKM
16/11/2018	Survey L26 (at the new port)	Lamu	JKM
17/11/2018	Data & specimen sorting	Lamu	JKM
18/11/2018	Data & specimen sorting	Lamu	JKM
19/11/2018	Travel to Nairobi from Lamu	Lamu/Nairobi	JKM

2.3 Deviation from Planned Scope of Work

The proposed sampling plan was honoured except at two points; L04, situated at the eastern bank of Kerio river, in Turkana County; and L24, at Boni forest, in Lamu County. Sample site L04 was excluded due to security concerns and also, due to its inaccessibility. L24, on the other hand, was left purely on security concerns. Results of these two points are therefore not included in this report.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Two major distinct vegetation affinities (including inland and coastal~ see in figure 1) were realised for the study sites. Sample sites L01 through L22 were of inland vegetation affinity, mostly of dry Acacia and Acacia-Commiphora bushlands, a few grassland patches, and notable specialised microhabitats (including numerous ephemeral streams and occasional wetlands/water pans).

Vegetation at the inland sample sites (except at Shaba and Rahole National Reserve) was of highly modified status, largely due to overstocked animal herds of the pastoralist communities, who occupy the general area of these sample points. L23 was at a transitional zone, with a mixture of inland dry Acacia and Acacia-Commiphora bushlands, and woodlands of coastal vegetation affinity. Its vegetation, compared with of the aforementioned L01 through L22 points of pure inland affinity, was wetter and less modified, and the general area was inhabited by pastoralist communities.

Subsequent sample points after L23 (L25 and L26) were purely of the coastal flora. General area for sample points L25 and L26 were inhabited by both pastoralist and sedentary agricultural communities. Vegetation at sample point L25 (a woodland/bushland), apart from traces of old bushland fire, showed no noticeable modification. L26, located near the new port, on the other hand, was of modified bushland and its area was demarcated for development.

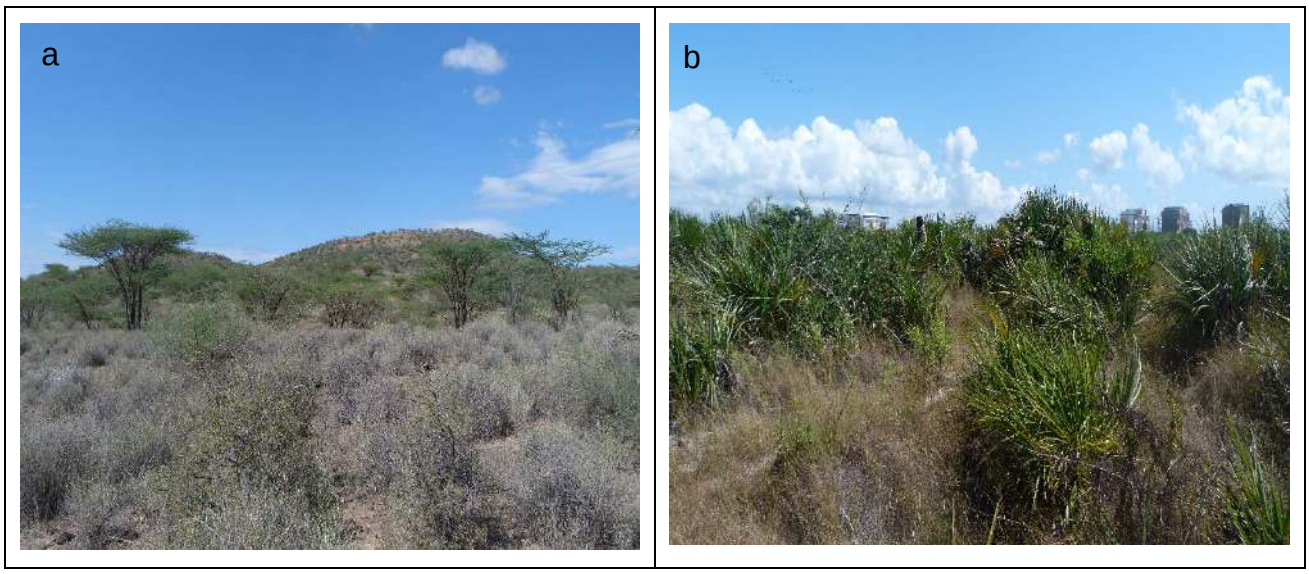

Figure 1: Samples for the two vegetation affinities identified in the study (a) inland and b) Coastal bushlands

3.2 Key Observations (species of conservation concern and endemics) for the LLCOP ESIA

The following key observations are provided in accordance with the baseline surveys undertaken during the dry sampling season, and are in addition to the earlier observations reported for the wet sampling season study:

- *Blepharis turkanae* – A Kenyan endemic restricted to the Turkana region, in Northern Kenya. This species is ranked vulnerable (VU) in the IUCN list (reported to be threatened by livestock farming/ranching, and oil and gas drilling operations). Highly browsed patches/individuals of the species were recorded at KP–23 and also at L05;
- *Aloe deserti* – ranked near threatened (NT), with several fragmented populations in the IUCN list. Two clumps were recorded at the east bank of Ewaso Nyiro, at Archers post (L16);

- *Acacia thomasii* – Endemic to Kenya/uncommon plant occurring in small groups on Acacia-Commiphora woodlands. In this sampling, occasional Individuals were recorded at Kula Mawe (N00^{0}32'21.7"; E38^{0}11'30.1");
- *Melia volkensii* – Regionally endemic. A few individuals were recorded at the Kalama conservancy (N00^{0}30'46.0"; E37^{0}26'39.1"), at Wamba, SE of L14;
- *Elaeodendron aquifolium*–ranked endangered (EN) in the IUCN list. Study only recorded one individual at Rahole NR (between L18 & 19 at N00^{0}13'26.8"; E38^{0}59'47.0");
- *Allmaniopsis fruticulosa* – endemic to Southern north Kenya. Was occasional at sample points (1) S00.65650^0; E39.92523^0 & (2) S00.46084^0; E39.86596^0), which are south of L21, in Garissa county;
- *Dialium orientale* –Listed near threatened (NT) in the IUCN. Recorded abundantly at AL25 & L26. However, the individuals at L26 were all saplings/regenerations from old tree individuals which had been cleared for paving way to development;
- *Crotalaria malindiensis*– Listed as Near Threatened (NT) by the IUCN. Occasional at L25; and
- *Dalbergia melanoxylon*–Listed as NT by the IUCN, with threats of residential and commercial development, agriculture, and logging and wood harvesting. Recorded a few mature individuals at L25 and its samplings saplings at L26.

3.3 Meetings and Discussions

All meetings with the local leadership concerning for the bio-team were conducted by Mr. Bernard Agwanda

3.4 Health and Safety learnings

The following health and safety learnings were communicated by John Kimeu: 'Safety and health was well covered i.e. had a medic and a security advisor for the whole of the sampling trip'.

3.5 Monitoring and Mitigation

This study has characterised flora of the study area (including species of conservation concern and endemics, vegetation types and affinities, existing environmental threats, and sites of unique flora). These results are additional to the ones of the wet season (advanced baseline). However, for the wet season, flora all the Coastal section and of lower Garissa was not captured due to security reasons. Monitoring and mitigation will be required for comparative flora study of wet and dry seasons, a rapid assessment survey for these sections is recommended in parallel with project development.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

FB/TGF/kc

APPENDIX A

Botany Report

Final Botany Report

TULLOW OIL PIPELINE Project:

Floral Biodiversity Report for proposed pipeline Lochichar to Lamu Port Kenya

Authors:

Quentin Luke

Mwadime Nyange

Prepared by: **WRQ LUKE**

Reference:

Date: February 2019

1 INTRODUCTION

1.1 Project description and background

Messrs Golder Associates were contracted by Tullow Oil to carry out baseline biodiversity studies for their planned oil pipeline from Lochichar, Turkana County to Lamu Port, Lamu County. This line development of over 800km could have significant effects on the biological environment. For this reason, baseline desktop and field studies were commissioned to assess the characteristics and magnitude of the impacts of the project. These studies conform to the Performance Standards of the International Finance Corporation (IFC 2012a,b). More specifically, the Baseline studies focused on determining the presence of Species of Conservation Concern (SCC).

1 . As a second step, the Habitats in the study area have been mapped and classified as Natural, Modified and Critical according to the IFC Performance Standard 6 (IFC 2012a)

2 . The present document assembles and synthesises the current knowledge on the botany of the LLCOP Project area, focusing on SSCs and Critical Habitats. It then performs an initial analysis of the envisaged impacts of the project on the biological environment. It must be stressed that this document is preliminary in its nature, because field work in the Baseline Studies has not been completed at the present date.

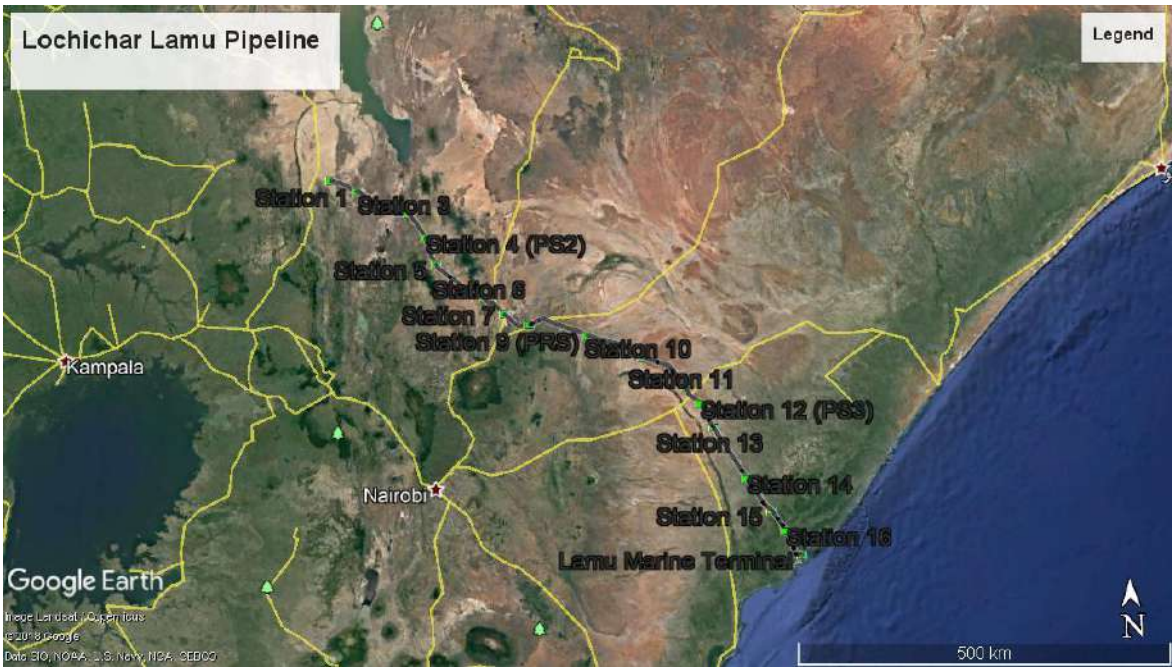

Figure 1. Study area (from Golder Associates, 2019).

1.1.1 *International standards and policies*

1.1.1.1 Equator Principles III

The Equator Principles III (2013) are a set of guidelines used for managing environmental issues specifically relating to financing a project. Principle 1 sets out to categorise projects based on the magnitude of potential impacts and risks to the environment. Given the nature and magnitude of the LLCOP , it is most likely to be classified as a "Category A" project, i.e. "Projects with potential significant adverse social and environmental impacts that are diverse, irreversible and unprecedented."

Based on Principle 2 ("Social and Environmental Assessment"), the Project, classed under "Category A", requires an assessment of the environmental impacts, addressed to the satisfaction of the Equator Principles Financial Institutions (EPFIs), and noting the probable risks of the proposed Project. The assessment process should also recommend mitigation and management measures that are properly suited to the project. Accordingly, any environmental assessment requires the establishment of baseline conditions (i.e. biodiversity assets). In doing so, the issue regarding protection and conservation of biodiversity (including endangered species and sensitive ecosystems) also needs to be addressed as well as the identification of any legally protected areas.

Principle 9 ("Independent Monitoring and Reporting") is considered an important procedure that should be followed, particularly for "Category A" projects, to ensure the Project continues to have limited impacts and that appropriate management structures are in place to ensure well managed and minimised environmental impacts.

1.1.1.2 International Finance Corporation Performance Standards (2012)

The International Finance Corporation (IFC) Performance Standards define the role of clients in terms of managing large projects with the primary objective of minimising impacts on the environment by projects. With specific reference to this project and this report, Performance Standard 1 and 6 provide the necessary environmental guidelines.

Performance Standard 1 emphasises the importance of environmental performance throughout the duration of a project through identifying and assessing environmental impacts within the Project's study area with the objective of minimising or, wherever possible, avoiding impacts. This highlights the importance of incorporating specific monitoring as part of the assessment of risks and impacts and to identify performance indicators that can be used to quantify the extent of various impacts.

Performance Standard 6 recognises the importance of protecting and conserving biodiversity as a fundamental component to sustainable development, through the management and use of natural resources. It is therefore a requirement to assess the relevant impacts of the Project which may affect different levels of biodiversity. Part of this assessment is to determine (in association with relevant stakeholders) the value of ecological goods and services impacted upon by a project, and the repercussions brought about by project impacts. A principle component to Performance Standard 6 is that environmental assessments take in to account the threats to biodiversity caused by habitat destruction and loss, especially from the perspective of important species, and addresses ways to avoid or mitigate threats. Distinction is made between natural and modified habitats whilst recognising that habitat destruction is a major impact to the maintenance of biodiversity.

In the case of natural habitat, a project may not significantly convert or degrade the habitat, unless there are no technically and financially feasible alternatives; the project benefits' outweigh the costs (including environmental), and appropriate mitigation is implemented. Where areas are classed as modified habitat, the project is to ensure that further degradation and conversion is minimised and where possible attempt to enhance habitat and protection of biodiversity. However, in certain situations both natural and modified habitats may be regarded as critical habitats based on having a high biodiversity value. In such instances, projects may not implement any activities unless the following requirements are met:

- There are no measurable adverse impacts on the habitats' ability to support those species that determine the habitat as being critical or the functions of the critical habitat;
- No reduction in numbers of endangered species occur; and
- Lesser impacts are mitigated accordingly.

Where a project is located within a legally protected area, the aforementioned criteria required for critical habitats needs to be accounted for as well as the following:

- Actions need to conform with those defined for protected area management plans;
- Consultations with various stakeholders associated with the protected area regarding the proposed project; and
- Implement additional programmes that promote the conservation aims of the protected area.
- Under any given situation no alien species may be introduced, particularly those that are highly invasive, and correct action by the project is needed to prevent accidental introductions.

An additional requirement by Performance Standard 6 is the management and use of renewable natural resources. Projects are therefore required to manage these resources sustainably, particularly forests (natural and plantations) and aquatic ecosystems, which are regarded as principle providers of natural resources.

2 METHODOLOGY

2.1 Study area

The study area was provided as a kmz GoogleEarth file showing the planned route for the pipeline (see above).

The area considered in this report is only part of the whole pipeline. John Kimeu Mbaluka was employed at an earlier date than QL and MN and thus studied various points from Lochichar (Stn 1) to Rahole (Stn 9). Thus this report covers Rahole through to the Lamu Marine Terminal.

2.2 Desktop study

A botanical study was prepared by QL in Jan 2018 in a separate contract to Messrs eCountability to produce a list of restricted range, endemic and threatened plant species for the project area (at that time a much less defined band from Turkana County to Lamu Port). This list was produced by filtering QL's database over the FTEA botanical regions K1, K2, K4 and K7 (see Annex 1)

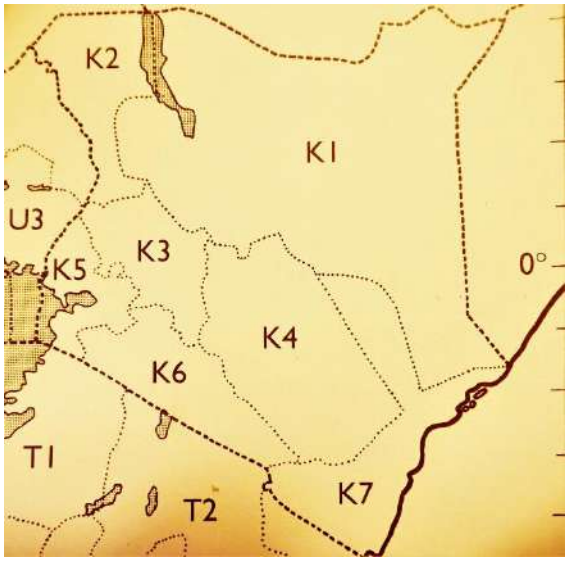

Fig.2 FTEA Botanical Regions

2.2.1 *Mapping and classification of landcover*

A key component of the biodiversity study is the mapping and classification of primary habitats/vegetation communities and dominant land uses. This process is particularly important when assessing the direct footprint area and allows for the quantification of present habitat availability as well as the potential habitat losses that may occur because of the pipeline development.

In the absence of high-resolution satellite imagery, Google-Earth was used to analyse as well as to spatially define the landcover that occurs within the area in conjunction with the Potential Natural Vegetation Map (ref…). The assumption is made that the Area of Impact (AOI) is not more than 1 km wide for the entire length of the pipeline.

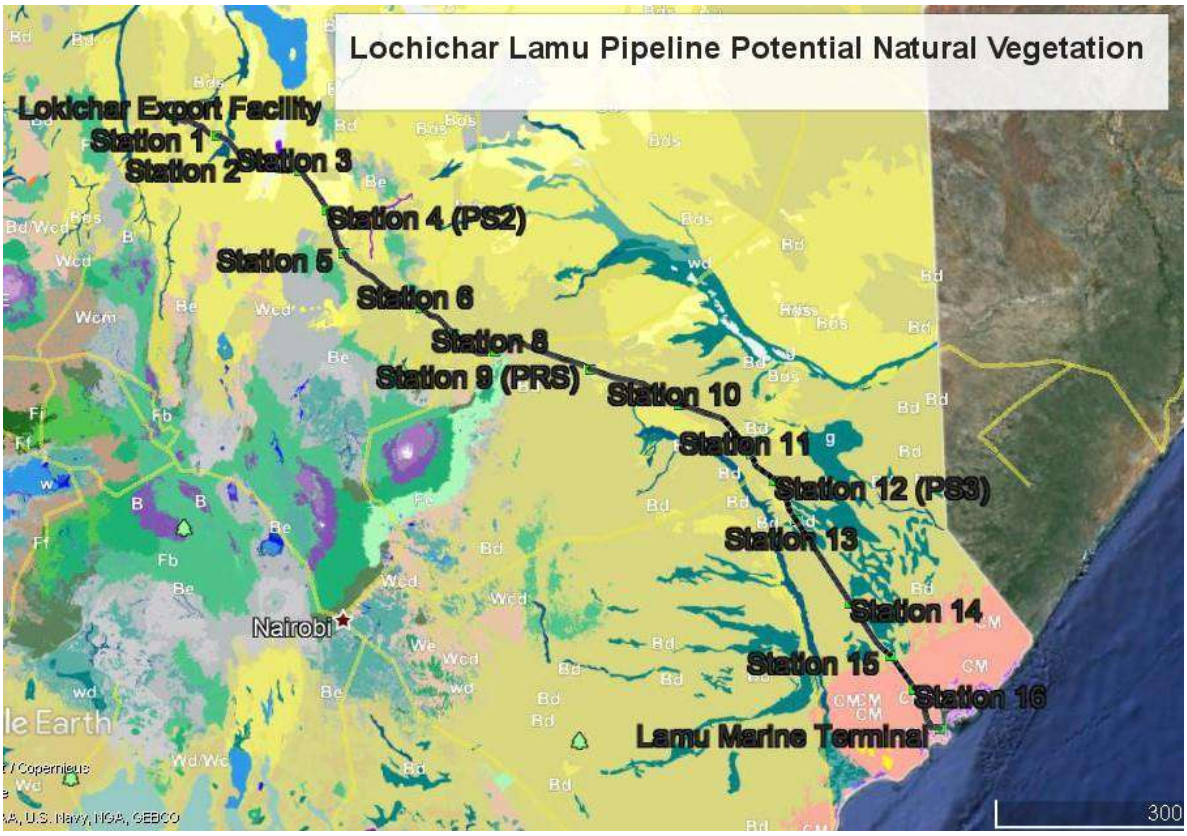

Fig. 3: Potential Natural Vegetation of LLCOP

Name	White (1983)	WAC (2017)	Elevation range (m)	Size (km^2)	IFC Classification
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket	Somali Masai	Bd		494.4	Natural
Acacia-Commiphora stunted bushland	Somali Masai	Bds		156.7	Natural

Coastal mosaic	Zanzibar Inhambane Regional Mosaic	CM		64.0	Natural
Edaphic grassland on drainage-impeded or seasonally flooded soils	Somali Masai	g		28.4	Natural
Mangrove	Zanzibar Inhambane Regional Mosaic	M		0.74	Natural
Riverine wooded vegetation	Somali Masai	R		6.2	Natural
Desert	Somali Masai	S		6.4	Natural
Dry combretum wooded grassland	Somali Masai	Wcd		9.5	Natural
Total				766.3	

Table 1

Fig.4 Acacia Commiphora Bushland & Thicket

Fig.5 Coastal Mosaic

2.2.2 *Species of Conservation Concern (SCC)*

Information of species importance of flora recorded within the study area, as well as the species expected to occur in the region as determined by the desktop assessment, was obtained through searching relevant databases. Databases included both the International Union for Conservation of Nature (IUCN) and the Convention on International Trade in Endangered Species (CITES).

2.2.2.1 International Union for Conservation of Nature (IUCN)

The conservation status of species for all plant taxa was determined using the International Union for Conservation of Nature (IUCN) categories[1] (IUCN, 2013). This system is designed to determine the relative risk of extinction, with

the main purpose of the IUCN Red List to catalogue and highlight those taxa that are facing a higher risk of global extinction with those listed as Critically Endangered, Endangered and Vulnerable collectively considered as Threatened. The IUCN Red List also includes information on taxa that cannot be evaluated because of insufficient information (i.e. Data Deficient) as well as taxa that are close to meeting the threatened thresholds (i.e. Near Threatened).

1.1.1.2 Convention on International Trade in Endangered Species (CITES)

In addition to Red Data and other notable species, all species that occur, or are likely to occur, within the project area which are CITES-listed, were identified based on known distributions and the official CITES website (www.cites.org). The main purpose of CITES is to subject the international trade in specimens of selected species to certain controls whereby all imports, exports, and re-exports covered by the Convention have to be authorised through a licensing system. All species relevant to the study area fall within CITES categories I and II. These categories are defined as follows:

- ***Category I –*** species are those that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research.
- ***Category II –*** species are not necessarily now threatened with extinction but may become so unless trade is closely controlled. International trade in specimens of Appendix-II species may be authorised by the granting of an export permit or re-export certificate.

2.3 Flora assessments

The purpose of the flora surveys was principally to establish the baseline for the study area through compiling species lists (inventories), as opposed to employing actual quantitative and statistically rigorous methods that are typically used for assessing species composition. This approach is considered to be particularly important when assessing areas that are poorly researched from a botanical perspective. Further, quantitative surveys would then make use of the baseline species lists.

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[1] **IUCN Categories:**

Extinct – there is no reasonable doubt that the last individual of the species has died.

Extinct in the Wild – the species no longer occurs in the wild, and is only found in cultivation or in captivity.

Critically Endangered – the species is considered to be facing an extremely high risk of extinction in the wild, based on IUCN criteria.

Endangered – the species is considered to be facing a very high risk of extinction in the wild, based on IUCN criteria.

Vulnerable – the species is considered to be facing a high risk of extinction in the wild, based on IUCN criteria.

Near Threatened – when evaluated against IUCN criteria, does not qualify for a Threatened category but is close to qualifying for or is likely to qualify in one of those categories in the near future.

Least Concern – when evaluated against IUCN criteria, does not qualify for any category as Threatened or Near Threatened. Widespread and abundant species fall in this category.

Data Deficient – there is inadequate information regarding the species' population size, distribution or threats for an assessment to be made.

Surveys at designated points on the pipeline route, particularly at the marked "Stations" were carried out (see Fig.6 & 7). Plant species were recorded and added to a continuous list. Common and easily identified plant species were merely recorded as sight records - (SR). Plants with less certain identities were collected as voucher specimens, which were then pressed, dried and placed in a specimen sheet based on standard flora collecting protocols. In general, collections consisted of duplicate sheets for each plant sampled so that the second sheet could be sent to another herbarium (i.e. herbarium specimens – HS) for inspection by other flora specialists. However, in some cases only a single specimen sheet was produced as such plant species were found to be particularly scarce during the surveys. Where better (e.g. fertile) material was encountered, such samples were added to previous collection specimens to enhance the quality of collected samples. A rough area of 1 km^2 was covered until the rate of recording of additional species dropped off and it was reasonable to conclude that most species in the area had been recorded.

Fig. 6 GPS Pt 399

Fig. 7 Station 12

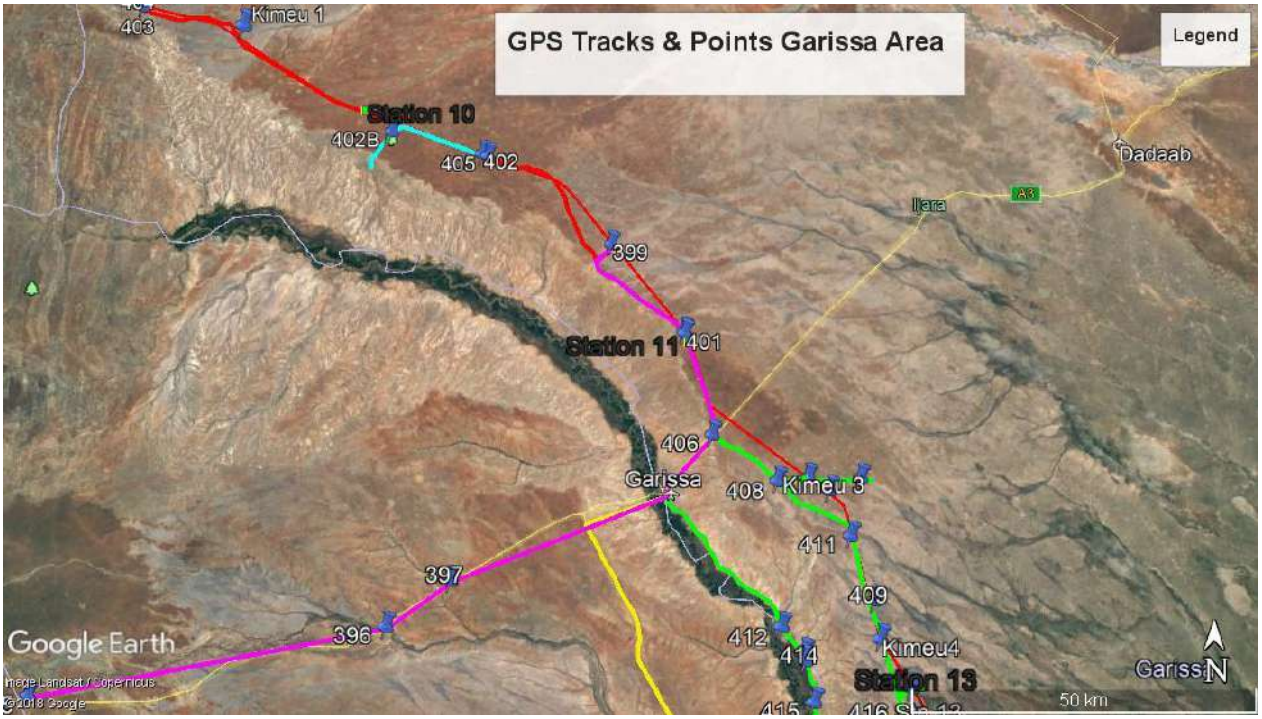

Fig. 8

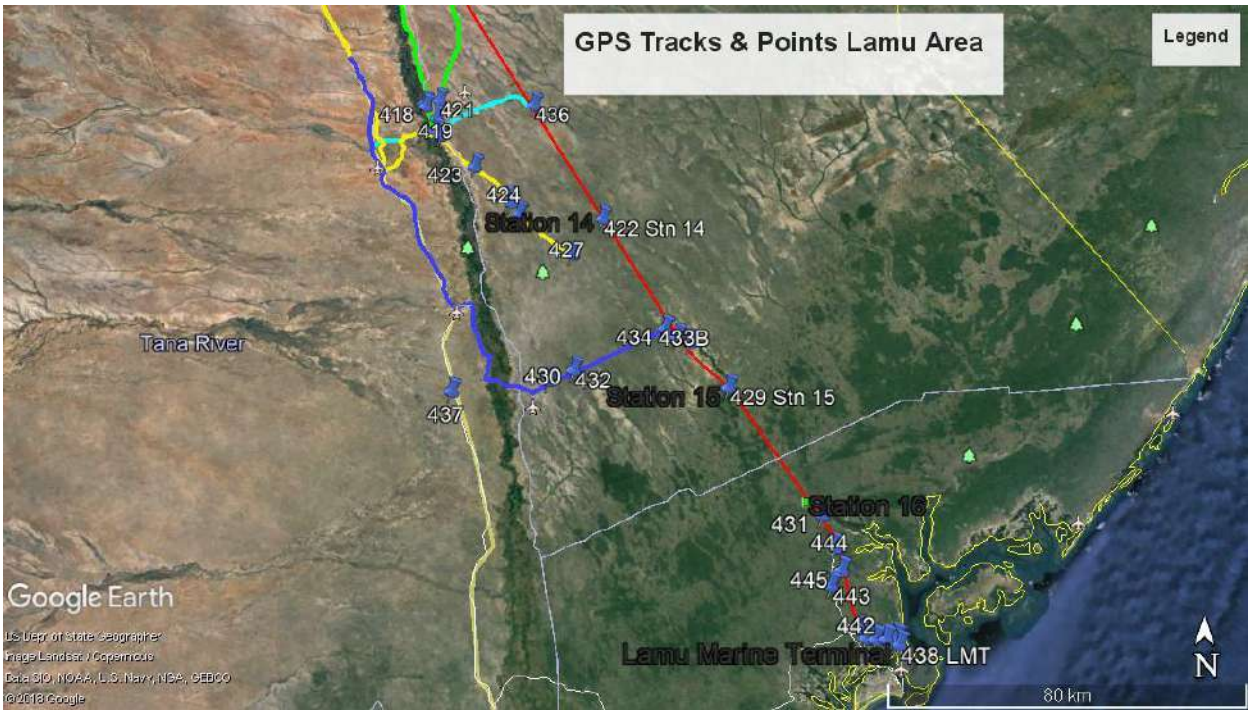

Fig. 9

The objective of the flora surveys was essentially to build up a 'checklist' of plants for the area as quickly as possible so as to inform the vegetation classification and to provide a reference for later quantitative plot surveys. Any cultivated, naturalised or 'escaped' plant species were recorded when and where encountered. The location of recorded species was also captured through reference to sample locations.

Collected specimen sheets will be deposited at the East African Herbarium (Nairobi, Kenya) (EA), and the Royal Botanic Gardens (Kew, England) (K) where a duplicate specimen was collected.

2.4 Curation of biodiversity samples

Flora

Plant specimens collected during the flora survey were arranged, in old newspaper sheets between absorbent cardboard corrugates. The daily collections were then pressed using a plant press sandwich arranged to encourage air movement between samples. A kerosene burner was use to improve the pressing and drying process.

Unidentified and unique samples will then be sent to various herbaria.

3 REVIEW OF REGIONAL BIODIVERSITY FEATURES

3.1 Ecological regions

Ecological regions (ecoregions) are large areas that exhibit relative homogeneity of ecosystems through the integration of ecological and geographical mapping and are thus important units of analysis particularly in terms of environmental assessment and management (Loveland & Merchant, 2004). The biodiversity of flora, fauna and ecosystems that characterise an ecoregion therefore tend to be distinct from other ecoregions. Ecoregions are classified for both terrestrial and freshwater systems.

3.1.1 *Terrestrial ecoregions*

There are 867 land-based ecoregions that have been defined at a worldwide scale by the World Wildlife Fund (WWF) (Olson et al., 2001). These ecoregions are characterised according to ecological features, and are derived from White, 1983. The project runs through regions 104 (Masai Xeric Grasslands & Shrublands), 45 (Northern *Acacia-Commiphora* Bushlands & Thickets), 44 (Somali *Acacia-Commiphora* Bushlands & Thickets) and 20 (Northern Zanzibar-Inhambane Coastal Forest Mosaic).

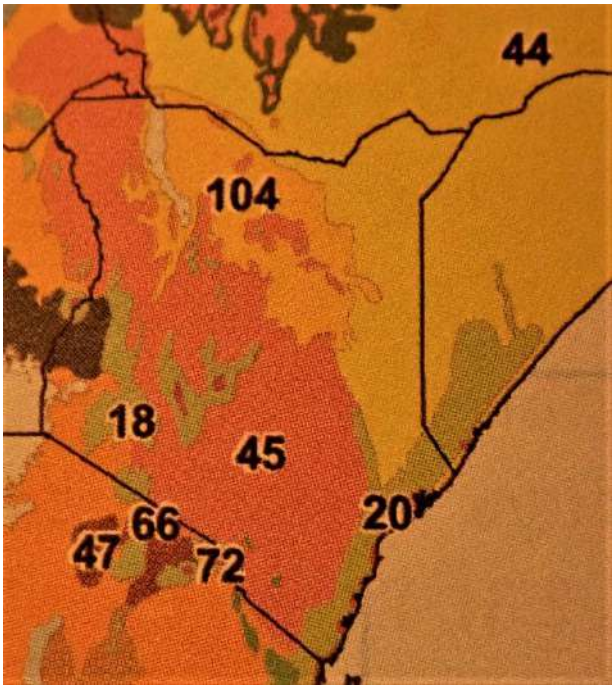

Fig 10: Terrestrial Ecoregions (Olson et al., 2001)

3.2 Protected Areas

The present route skirts various protected areas (PA's) and reserves. From the north it passes between the Conservancies of Namunyak, Mebei, West Gate and Kalama and then passes between Samburu and Shaba. After leaving Isiolo, it runs through the Nyambene NR and then follows the boundary of the Rahole NR. After Garissa it runs to the east of the Arawale Reserve and reaches Lamu Marine Terminal without further involvement with PA's.

3.3 Botanical Region

The Flora of Tropical East Africa (FTEA) was a project started in 1952 during the colonial administration and ran for some 60 years. The flora was published family by family and, in each volume, the phytogeography for each plant taxon was recorded using some fairly arbitrary regions based on old administrative boundaries. Thus the project area falls within the FTEA geographical regions of K2, K1, K4 and K7.

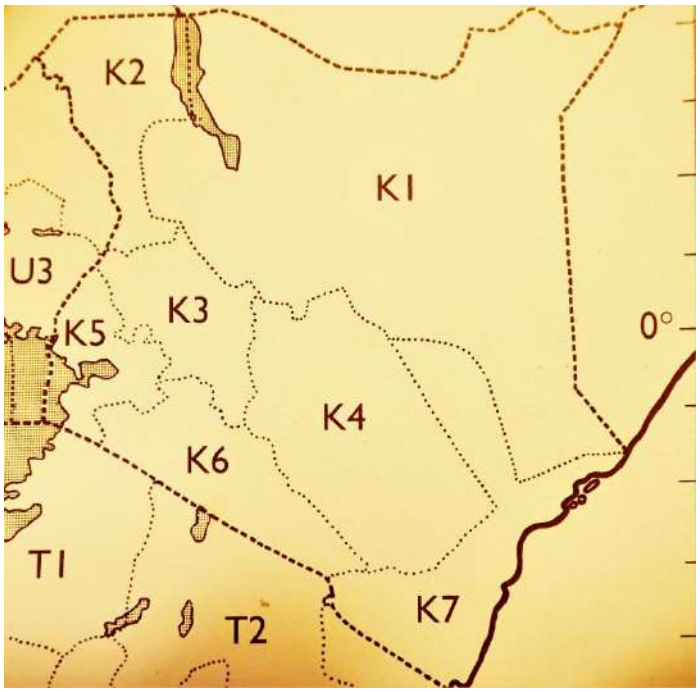

Fig.11

4 DESCRIPTION OF THE FLORA BASELINE

4.1 Classification of vegetation and land use

Table 1, above, gives the estimated areas for each vegetation type/land use with eight categories assuming a corridor 1 km wide. The largest component is the Somali Masai *Acacia-Commiphora* Bushland & Thicket followed by the *Acacia-Commiphora* Stunted Bushland. The Coastal Mosaic with its higher plant diversity is next. All other areas are just over a quarter of the whole with the Edaphic Grassland being the next largest area at nearly 3,000 Ha.

4.2 Mapping and delineation of vegetation and land use

Table 2 Landcover/vegetation types and their respective areas occurring within the study area

Landcover class	mapping area (ha)	Percent of total area (%)
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket	49,440	64.5
Acacia-Commiphora stunted bushland	15,670	20.4
Coastal mosaic	6,400	8.4
Edaphic grassland on drainage-impeded or seasonally flooded soils	2,840	3.75
Mangrove	74	0.1
Riverine wooded vegetation	620	0.81

Desert	640	0.84
Dry combretum wooded grassland	950	1.2
Total	**76,634**	

4.3 Description of present state of flora

The following list summarises the floral habit diversity

Trees (T)	134
Shrubs (S)	78
Climbers or Lianes (C)	65
Ferns (F)	1
Herbs (H)	287
Parasites (P)	7
Aquatic (A)	2
TOTAL	**574**

Composition of the flora in terms of the most common plant families and the most common genera is as follows:

	Family	**Taxa**
1.	Poaceae	69
2.	Papilionaceae (Leguminosae)	41
3.	Malvaceae	39
4.	Cyperaceae	31
5.	Capparaceae	27

.

	Genus	**Taxa**
1.	Cyperus	16
2.	Maerua	15
3.	Indigofera	13
4.	Acacia	11

4.3.1 Red Data and Species of Conservation Concern (SCC)

Family	Species	Hab.	IUCN	Locality	GPS
Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	H	en B1ab(iii) + B2ab(iii)	1.8km N of Stn 11	Pt 398
Euphorbiaceae	Euphorbia fluminis S.Carter	S	en B1ab(iii) + B2ab(iii)	44 km NW Stn10 - Stn9	Pt 403
Celastraceae	Elaeodendron aquifolium (Fiori) Chiov.	T	en B2ab(iii)	44 km NW Stn10 - Stn9	Pt 404
Amaranthaceae	Celosia fadenorum C.C. Towns.	H	EN B2ab(iii)	Stn12	Pt 407
Euphorbiaceae	Euphorbia fluminis S.Carter	S	en B1ab(iii) + B2ab(iii)	21km S of Stn 12	Pt 409
Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	H	en B1ab(iii) + B2ab(iii)	21km S of Stn 12	Pt 409
Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	H	en B1ab(iii) + B2ab(iii)	7.8km E of Stn 12	Pt 410
Capparaceae	Maerua mungaii Beentje	C	vu B1ab(iii) + B2ab(iii)	Tana R. E Bank Rd Bura S	Pt 419

Asteraceae	Blepharispermum minus S. Moore	S	vu B1ab(iii) +2ab(iii)	27km S of Bura E to Masalani	Pt 424
Capparaceae	Maerua mungaii Beentje	C	vu B1ab(iii) + B2ab(iii)	12km SW of Stn 14	Pt 427
Euphorbiaceae	Euphorbia fluminis S.Carter	S	en B1ab(iii) + B2ab(iii)	12km SW of Stn 14	Pt 427
Asteraceae	Blepharispermum minus S. Moore	S	vu B1ab(iii)+2ab(iii)	16km E of Masalani	Pt 433
Capparaceae	Maerua mungaii Beentje	C	vu B1ab(iii) + B2ab(iii)	14km NW of Stn 15	Pt 436
Asteraceae	Blepharispermum minus S. Moore	S	vu B1ab(iii) +2ab(iii)	14km NW of Stn 15	Pt 436
Rubiaceae	Coffea rhamnifolia (Chiov.) Bridson	T	en B2ab(iii)	Hola – Garsen	Pt 437
Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	Lamu Maritime Term	Pt 438
Papilionaceae (Leguminosae)	Crotalaria rhynchocarpa Polhill	H	en B1ab(iii) + B2ab(iii)	Lamu Maritime Term	Pt 438
Lythraceae	Nesaea triflora (L.f.) Kunth ssp. trifloral	H	EN B2ab(iii)	5km W of Lamu Maritime Term	Pt 439
Hydroleaceae	Hydrolea sansibarica Gilg	H	VU B2ab(iii)	5km W of Lamu Maritime Term	Pt 439
Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	3km W of Lamu Maritime Term	Pt 440
Papilionaceae (Leguminosae)	Crotalaria malindiensis Polhill	H	vu B1ab(iii) +B2ab(iii)	3km W of Lamu Maritime Term	Pt 440
Papilionaceae (Leguminosae)	Crotalaria rhynchocarpa Polhill	H	en B1ab(iii) + B2ab(iii)	3km W of Lamu Maritime Term	Pt 440
Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	7.5km W of Lamu Maritime Term	Pt 441
Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	12km SE of Stn 16	Pt 444
Papilionaceae (Leguminosae)	Crotalaria malindiensis Polhill	H	vu B1ab(iii) +B2ab(iii)	12km SE of Stn 16	Pt 444
Papilionaceae (Leguminosae)	Indigofera tanganyikensis Baker f. var. paucijuga J.B. Gillett	H	vu B2ab(iii)	12km SE of Stn 16	Pt 444
Lythraceae	Nesaea pedicellata Hiern	H	VU B2ab(iii)	17.3km SE of Stn 16	Pt 445
Euphorbiaceae	Erythrococca pubescens Radcl.-Sm.	S	vu B1ab(iii) + B2ab(iii)	17.3km SE of Stn 16	Pt 445
Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	17.3km SE of Stn 16	Pt 445
Rubiaceae	Afrocanthium kilifiense (Bridson) Lantz	T	VU B1+2c	17.3km SE of Stn 16	Pt 445
Hydroleaceae	Hydrolea sansibarica Gilg	H	VU B2ab(iii)	17.3km SE of Stn 16	Pt 445

NB. IUCN Threat Status in lower case if assessed but not yet on Red List website, in caps if already uploaded

Fig. 12 Elaeodenron aquifolium

Fig. 13 Indigofera tanaensis

Fig. 14 Crotalaria rhynchocarpa

Fig. 15 Celosia fadenorum

CITES

Plant species that fall under CITES regulations are as follows:

Appendix I: None

Appendix II: All species of Orchidaceae; All succulent species of the genus Euphorbia; All species of the genus Aloe not listed on Appendix I; plus a few named species such as *Prunus africana*. This translates into the following taxa recorded from Garissa-Lamu Area:

Species	Hab.	Comment	Locality	GPS
Euphorbia fluminis S .Carter	S	in hort died CITES II	44 km NW Stn10 - Stn9	Pt 403
Euphorbia fluminis S. Carter	S	CITES II	21km S of Stn 12	Pt 409
Euphorbia fluminis S. Carter	S	CITES II		Pt 427
Euphorbia kalisana S. Carter	H	CITES II	Kimeu 4 10km N of Stn13	
Euphorbia kalisana S. Carter?	H	CITES II	Kimeu 4 10km N of Stn13	
Euphorbia robecchii Pax	T	CITES II	Stn 12 (AGI 21)	
Aloe citrina S. Carter & Brandham	H	in hort MN; CITES II	Tana R. E Bank Rd to Bura	Pt 417
Aloe ruspoliana Baker	H	in hort tag 135; CITES II	14km S of Bura E to Masalani	Pt 423
Aloe sp.	H	in hort tag 133; CITES II	Tana River E Bank Rd to Bura	Pt 413
Aloe vituensis Baker	H	in hort tag 131; CITES II	Upper Rd Bura to Garissa	Pt 420

4.3.2 Endemics, Limited Range, New Regional Records and other Notable Species

Family	Species	Hab.	IUCN	Comment	Locality	GPS
Capparaceae	Boscia fadeniorum Fici	T			Stn12	Pt 407
Capparaceae	Boscia fadeniorum Fici	T			7.8km E of Stn 12	Pt 410
Capparaceae	Boscia fadeniorum Fici	T		2nd collection	Upper Rd Bura to Garissa	Pt 421
Capparaceae	Boscia fadeniorum Fici	T				Pt 436
Capparaceae	Boscia keniensis Beentje	T			Tana River E Bank Rd to Bura	Pt 414
Amaranthaceae	Allmaniopsis fruticulosa Suess.	H			21km S of Stn 12	Pt 409
Amaranthaceae	Allmaniopsis fruticulosa Suess.	H			Kimeu 4 (Stn 12 to 13)	
Amaranthaceae	Centamopsis sordida C.C. Towns.	H			21km S of Stn 12	Pt 409
Malvaceae	Corchorus brevicornatus Vollesen	H		1st for Kenya, 2nd for East Africa	20km N Stn 11 to 10	Pt 399
Malvaceae	Hibiscus ceratophorus Thulin	H				Pt 440

Malvaceae	Hibiscus ceratophorus Thulin	H			Lamu Maritime Term	Pt 438
Papilionaceae (Leguminosae)	Aeschynomene sp.B	H				Pt 445
Vitaceae	Cyphostemma sp.?nov.	H				Pt 427
Burseraceae	Commiphora pseudopaolii J.B. Gillett	T	LR/nt		Stn12	Pt 407
Oleaceae	Jasminum sp. Not matched	H			27km S of Bura E to Masalani	Pt 424
Rubiaceae	Coptosperma wajirensis (Bridson) Degreef	S				Pt 426
Rubiaceae	Pavetta sp.	T		not matched	Stn12	Pt 407
Rubiaceae	Psydrax faulknerae Bridson	T				Pt 444
Asteraceae	Sphaeranthus zavattarii Cufod.	H	DD		20km N Stn 11 to 10	Pt 399
Asteraceae	Sphaeranthus zavattarii Cufod.	H	DD		21km S of Stn 12	Pt 409
Peddaliaceae	Pterodiscus coeruleus Chiov.	H		no mat. In EA		Pt 435
Acanthaceae	Neuracanthus pictus M.G. Gilbert	H			44 km NW Stn10 - Stn9	Pt 403
Verbenaceae	Chascanum sp.	H				Pt 436
Dracaenaceae	Sansevieria sp.1	H		in hort tag 134	Tana R. E Bank Rd Bura S	Pt 419
Dracaenaceae	Sansevieria sp.2	H		in hort tag 136	12km SW of Stn 14	Pt 427
Commelinaceae	Murdannia axillaris Brenan	H				Pt 439
Commelinaceae	Murdannia axillaris Brenan	H				Pt 445
Cyperaceae	Cyperus frerei C.B. Clarke	H		does not equal C.crassipes (FTEA)	Lamu Maritime Term	Pt 438

Fig. 16 Boscia fadeniorum

Fig. 17 Neuracanthus pictus

4.4 Invasive/Alien plant species

No invasive species were recorded during this survey. The only alien species noted was the Cashew Tree, *Anacardium orientale,* a cultivated/naturalised species noted at Pt 438 and 441 and *Jatropha curcas*, a cultivate exotic introduced for a failed biofuel project.

5 DISCUSSION

5.1 Assumptions, limitations and gaps in knowledge

Sampling: Due to the extent of the project area, the difficulty of access and security concerns the biodiversity survey for the ESIA has been planned for limited sampling rather than a continuous transect. Prior to the work carried out by MN and QL, John Kimeu sampled some 15 sites from Lochichar to Rahole. A further 16 points were surveyed giving a total of 39 sites (see **Appendix III**) for the entire pipeline. If one assumes that each sample site covered 1km^2 (which is extremely generous) then the sample rate for the 766 km (as measured on GE) is 5%.

Botanists must ensure that an adequate area has been surveyed to enable assessment of all impacts to flora and vegetation. The size of the survey area will vary depending on the availability of existing survey information and scale of potential impacts. It may be necessary to survey beyond the proposal area to provide a local and regional context, particularly in an area or region that has been subject to minimal survey effort **(EPA, 2016).**

This rate of sampling would possibly be adequate if the sample sites had been chosen by the vegetation specialist based on examination of aerial photos (or satellite imagery) and not based on the convenience for a multidisciplinary survey team with security concerns. Information presented by JM suggests that the northern section of the survey was hindered by extreme aridity. The principle of survey during both wet and dry conditions should be adhered to even if the unpredictability of rainfall in these areas makes this difficult to plan and implement. Most of the earlier points should be resurveyed under better conditions and additional points should be added based on examination of aerial video footage.

5.2 Impacts affecting and defining the present environment

Although no engineering design plan has been shared, it is understood that the pipeline route as given on a GE kmz file is a reliable indication of the centre line for the project and this will entail digging a 2m deep trench (less where rocky) for a 30cm diameter pipe. It is also understood that the “stations” numbered 1 to 16 represent areas of contruction of pumping facilities. Thus total removal of vegetation can be envisaged on a 4m corridor with 16 x 1 Ha plots being distributed along the line. Further disturbance can be predicted for access roads, storage and construction camps.

5.3 Identification of key potential impacts associated with the pipeline

Three different impacts on the vegetation can be considered:

i) total but temporary as in trench digging
ii) total and permanent as in pump or above ground infrastructure
iii) temporary as in line clearance and access

The first two can be considered direct impacts with permanent effects on vegetation and species of conservation concern. The third impact if managed correctly can be of little concern.

5.4 Management measures and recommendations

No information has been provided on environmental management of the project at this stage. Idealy some trained supervision should be employed during implementation that can identify SCCs and take appropriate action. This can

range from simple avoidance to conservation action in the form of translocation (not recommended) to propagation and offset.

It is assumed that as 'best practice' dictates, the project will operate under the principle of "***no net loss***".

5.5 Monitoring requirements

It is assumed that an environmental management plan will be designed and implemented. This will include both short term monitoring during the project construction phase and longer term monitoring to check on unforeseen or under valued impacts. This is of major importance as regards the unintended introduction of invasive, alien species.

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Appendix 1 **Habit Key: T- Tree; S – Shrub; C – Climber; H – Herb; P – Parasite; TF – Terrestrial Fern; A – Aquatic**

***Collected this survey**

Family	**Species**	**Comment**	**Iucn**	**Syn**	**habit**
Marsileaceae	Marsilea botryocarpa Ballard	K7 ENDEMIC. Tsavo, Taru, TRPR	EN B2 ab (i,ii,iii,iv)		TF
Marsileaceae	Marsilea megalomanica Launert	Kenyan ENDEMIC. Isiolo, Tsavo E	Ne		TF
Turneraceae	Turnera thomasii (Urb.) Story	Witu, 70km S of Madogashi, nr Garissa		Loewia thomasii (Urb.)J. Lewis	S
Capparaceae	Boscia fadeniorum Fici	TYPE. 12km Garissa-Garsen 0.605S 39.586E			T
Capparaceae	Boscia keniensis Beentje	Madogashi, Garissa 40km S, Dzombo		B.sp. A of FTEA	T
Capparaceae	Cadaba parvula Polhill	Type only. Isiolo			S
Brassicaceae	Farsetia stenoptera Hochst. ssp. speciosa Jonsell	El Barta, Mathews, Archer's Post 40km NW, Rojeweru			H
Molluginaceae	Limeum praetermissum C. Jeffrey	Wajir, S.Horr, Laga Dera, Kora			H
Portulacaceae	Portulaca greenwayi M.G. Gilbert	Bura-Ijara, Bura East, Hola			H
Amaranthaceae	Allmaniopsis fruticulosa Suess.	Ijara, Hola 48km W, Wajir 80km SW			H
Amaranthaceae	Celosia fadenorum C.C. Towns.	Dadaab-Wajir, Garsen-Thika	en B2ab(iii)		H
Amaranthaceae	Lagenantha gillettii (Botsch.)M.G. Gilbert & Friis	Mado Gashi , Habaswein		Gyroptera gillettii Botsch.	S
Lythraceae	Nesaea parkeri Verdc. var. longifolia Verdc.	Msa to Lama & Witu, nr Mangai	VU D2		H
Lythraceae	Nesaea parkeri Verdc. var. parkeri	Lali Hills, Tsavo E, TRNPR, Lunghi FR	EN B2ab(iii)		H
Passifloraceae	Basananthe spinosa W.J.de Wilde	Marsabit, Ewaso Nyiro, Lagadema Hill			S
Cucurbitaceae	Coccinia samburuensis Holstein	Maralal to Baragoi, Mt Nyiru, Mathews		Coccinia sp. A of FTEA	C
Cucurbitaceae	Cucumis sp. 'kuikora'	Kui Is., Kora		Oreosyce sp. A of FTEA	C
Melastomataceae	Warneckea maritima (A. Fern. & R. Fern.) R.D. Stone & Q. Luke ined.	Witu, Lunghi FR	EN B1 ab (iii) + B2 ab (iii)	Warneckea sansibarica (Taub.) Jacq.-Fél. var. maritima R.D. Stone & Q. Luke ined.	T
Melastomataceae	Warneckea mouririifolia (Brenan) Borhidi	Usambaras, Kwale to Boni	VU B1ab(iii) + B2ab(iii)		T
Tiliaceae	Corchorus gillettii Bari	Wajir, Mado Gashi, Hola, Garsen			H
Tiliaceae	Grewia praecox K. Schum. ssp. latiovata C.Whitehouse	K7 Endemic. Kurawa, Taru-MacRd 10km, TRNPR			S
Sterculiaceae	Hermannia pseudathiensis Cheek	Wajir 80km SW, Habaswain 26km NE, Mado Gashi 13Km S			S
Sterculiaceae	Melhania denhardtii K. Schum.	K7 endemic. Ngao, Mida, Dakawachu			H
Malvaceae	Abutilon pilosicalyx Verdc.	Wajir, Garissa-Mado Gashi (3km N of Garissa-Dadaab Rd), Garissa -Dadaab 18km			H

Euphorbiaceae	Erythrococca pubescens Radcl.-Sm.	Kwale, Kilifi, Kurawa, TRNPR, Boni	vu B1ab(iii) + B2ab(iii)		S
Euphorbiaceae	Euphorbia fluminis S. Carter	Wenje T/0 - Garsen 8km, Malindi-Garsen 73km, Hola, TRNPR	en B1ab(iii) + B2ab(iii)		S
Euphorbiaceae	Euphorbia kassneri Pax	Kwale - Gadu, Mrima Rd, Garsen-Ngao 20km	en B2ab(iii)		S
Euphorbiaceae	Euphorbia pervittata S. Carter	Laisamis 11km S, Archers, Merti, Kora, Garissa 9.5km W, Illim Mt	vu B1ab(iii) + B2ab(iii)		H
Euphorbiaceae	Euphorbia samburuensis P.R.O. Bally & S.Carter	Baragoi 20km S, Baragoi NE (base of Bartagwet), Maralal 43km N			S
Euphorbiaceae	Euphorbia subscandens P.R.O. Bally & S.Carter	Ngoronit 10km E, Hill below Poi Mtn			H
Euphorbiaceae	Euphorbia turkanensis S.Carter	Lokori (1.93N 36.0167E, Kokidodoka			S
Euphorbiaceae	Jatropha oblanceolata Radcl.-Sm.	Mado Gashi 31km S, Meru NP			S
Euphorbiaceae	Monadenium renneyi S.Carter	Tana-Rojweru 1-2km W, Kora-Meru Bridge			H
Euphorbiaceae	Monadenium ritchiei P.R.O. Bally ssp. nyambense S.Carter	Lagadema Hill, Nyambenis			H
Euphorbiaceae	Monadenium ritchiei P.R.O. Bally ssp. ritchiei	Isiolo 12 km SW & 2 km SW			H
Euphorbiaceae	Monadenium virgatum P.R.O. Bally	Lango-ya-Simba, Galana Ranch, Msa-Voi 53.5km	vu D2		H
Phyllanthaceae	Phyllanthus maderaspatensis L. var. exasperata Radcl.-Sm.	TRNPR, Nairobi Ranch	vu D2		H
Phyllanthaceae	Phyllanthus tanaensis J.F. Brunel	Kurawa, Kau, Kwale	en B1ab(ii,iii,iv) +2ab(ii,iii,iv)		H
Caesalpiniaceae (Leguminosae)	Parkinsonia anacantha Brenan	Kenyan Endemic. Lorian (end of Golana Gof) 0.65N 39.0 E , Isiolo 22km N, Tula 0.65S 39.283E	T		
Mimosaceae (Leguminosae)	Acacia turnbilliana Brenan	Garissa NE, Wajir, Wajir 88km N & 23km NE		?=A.edgeworthii T. Anders.	S
Mimosaceae (Leguminosae)	Albizia tanganyicensis Baker f. ssp. adamsoniorum Brenan	Meru NP, Kindaruma Dam W slope,			T
Mimosaceae (Leguminosae)	Dichrostachys cinerea (L.) Wight & Arn. ssp. keniensis Brenan & Brummitt	Coastal Kenya			T
Papilionaceae (Leguminosae)	Aeschynomene sp. B of FTEA	Witu, Mkunumbi, Nairobi Ranch			H
Papilionaceae (Leguminosae)	Crotalaria grata Polhill	Mwachi, A-S, Kurawa	EN B1ab(i,ii,iii,iv,v) +2ab(i,ii,iii,iv,v)		H
Papilionaceae (Leguminosae)	Crotalaria jerokoensis Baker f.	Nr Mandera Jeroko 3.4N 41.3E, Bura T/O 1.18S 39.83E		?=C.massaiensis	H
Papilionaceae (Leguminosae)	Crotalaria malindiensis Polhill	Malindi (Sabaki), Kiunga, Kiwayu, Kurawa Rd, Mokowe-Bodhei	vu B1ab(iii) +B2ab(iii)		H
Papilionaceae (Leguminosae)	Crotalaria rhynchocarpa Polhill	Sabaki, Mvundeni, Ras Tenewi, Nairobi Ranch, Lamu Is	en B1ab(iii) + B2ab(iii)		H
Papilionaceae (Leguminosae)	Indigofera elwakensis J.B. Gillett	Wajir, El Wak 13km S, Mado Gashi 70km S to Garissa 1.163N 39.433E			H

Papilionaceae (Leguminosae)	Indigofera platyspira J.B. Gillett ex Thulin & M.G. Gilbert	Habaswein 26km NE 1.158N 39.679E, Kora			H
Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	Korokora 16km E (0.607S 39.92E), Garissa	en B1ab(iii) + B2ab(iii)		S
Papilionaceae (Leguminosae)	Indigofera tanganyikensis Baker f. var. paucijuga J.B. Gillett	Bura Hills - Taita, Lamu, Samburu-MacRd, Shimoni, Tana Delta	vu B2ab(iii)		H
Papilionaceae (Leguminosae)	Microcharis garissaensis (J.B. Gillett) Schrire	Garissa 16km SE, Ngomeni-Kitui, Voi, Tana R-Bil Bil, Kora, Boni		Indigofera garissaensis J.B. Gillett	H
Urticaceae	Pouzolzia fadenii Friis & Jellis	Lamu: Kitwa Pembe, Nairobi Ranch, Cha Simba, Marenji, Mrima			H
Salvadoraceae	Salvadora persica L. var. angustifolia Verdc.	Kulal, Mathews			S
Rhamnaceae	Lasiodiscus pervillei Baill. ssp. ferrugineus (Verdc.) E. Figueredo	Witu, Kwale, Kilifi, Kimboza, Zaraninge	VU B1+2c; vu B1ab(iii) + B2ab(iii)	Lasiodiscus mildbraedii Engl. ssp. ferrugineus, L.ferrugineus Verdc.	T
Vitaceae	Cyphostemma dysocarpum (Gilg & Brandt) Desc. ssp. pwani Verdc.	K7 Endemic. Kui Is, Kiunga Is, Malindi, Kipini, Lamu Is, Nairobi Ranch, Taru			C
Vitaceae	Cyphostemma sp. G of FTEA	Murka/Dalu			C
Vitaceae	Cyphostemma sp. S of FTEA	Isiolo			C?
Vitaceae	Cyphostemma sp. T of FTEA	Mado Gashi 63km S (0.217N 39.416E)			C
Rutaceae	Vepris samburuensis Kokwaro	Mathews, Mt Nyiru, Nr Baragoi, Lolokwe N (0.86N 37.546E)	VU B1+2c		T
Balanitaceae	Balanites rotundifolia (Tiegh.) Blatt. var. setulifera Sands	Tsavo E, Hola & Hola 72km WSW (1.78S 39.45E), Kilibasi?, Kaya Singwaya?			T
Burseraceae	Commiphora oblongifolia J.B. Gillett	Isiolo 24km E (Shabele 0.458N 37.836E), Ishiara 5km W, Hunter's Lodge 6km NW, Meru NP, Katumba Hill, Mzinga Hill			
Burseraceae	Commiphora sp. A of FTEA	Hola 30km N, TRPNR			T
Anacardiaceae	Sclerocarya gillettii Kokwaro	Dadaab-Wajir, Mado Gashi 63km S, Hatama Corner T/O 7km W (0.514S 39.472E)	VU B1+2c		T
Ebenaceae	Diospyros wajirensis F. White	Wajir, Dadaab-Wajir 3km N UasoNyiro bend (0.233N 40.331E), Mado Gashi 63km S (0.218N 39.412E) & Mado-Garissa (0.233N 39.75E)	LR/nt		T
Sapotaceae	Synsepalum subverticillatum (E.A. Bruce) T.D. Penn.	Witu FR, Kwale, Kilifi	EN B1+2c		T
Oleaceae	Jasminum punctulatum Chiov.	Bachuma, MacRd, Kiwayu, Som		Jasminum grahamii Turrill	C
Apocynaceae	Ceropegia laikipiensis Masinde	Barsalinga Drift (0.785N 37.102E), Longopito			C
Apocynaceae	Cynanchum resiliens (B.R. Adams & R.W.K. Holland) Goyder	Samburu-Mac Rd, Bachuma-Voi, Galole N (pump stn)		Sarcostemma resiliens B.R. Adams & R.W.K. Holland	S
Apocynaceae	Echidnopsis angustiloba E.A. Bruce & P.R.O. Bally	Longopito, Archer's, Rumuruti			H
Apocynaceae	Glossonema sp. A of FTEA	Turkana: Lomoru Itae 20Km NW, Meru: Lagadema Hill			H
Apocynaceae	Huernia keniensis R.E. Fr. var. grandiflora P.R.O. Bally	Baragoi			H

Apocynaceae	Orbea laikipiense (M.G. Gilbert) Bruyns	Laikipia: Suguta Marmar 20km S, Suguta Naibor, Rumuruti 43km NE & Kerio		Pachycymbium laikipiense M.G. Gilbert	H
Rubiaceae	Afrocanthium kilifiense (Bridson) Lantz	Kwale, A-S, Malindi, Nairobi Ranch, Witu FR, Boni/Lunghi	VU B1+2c	Canthium kilifiense Bridson	T
Rubiaceae	Coffea sessiliflora Bridson ssp. sessiliflora	Kwale/Kilifi, Tana DIP, Tana Delta, Witu FR, Boni, Amu Ranch, TRNPR	vu B1ab(ii,iii,iv) +2ab(ii,iiii,iv)		T
Rubiaceae	Coffea rhamnifolia (Chiov.) Bridson	Hola-Garissa; Som: C1 C2, S1-3	DD		T
Rubiaceae	Coptosperma kibuwae (Bridson) Degreef	Garissa-Dadaab 19km, Korokora (0.61S 39.78E)		Tarenna kibuwae Bridson	S
Rubiaceae	Oldenlandia borrerioides Verdc.	Type only. Kurawa			H
Rubiaceae	Oldenlandia fastigiata Bremek. var. pseudopentodon Verdc.	Type only. Garsen 1km S (2.277S 40.118E)			H
Rubiaceae	Pavetta crebrifolia Hiern var. pubescens Bridson	Boni- Mangai 10km E (1.7167S 41.25E)			S
Rubiaceae	Psychotria crassipetala E.M.A. Petit	Ngangao, Mbololo; Witu FR; S Pare (Chome FR)	VU B1+2c		S
Rubiaceae	Psydrax polhillii Bridson	Kurawa, Dalu, TRNPR, Kwale/Kilifi,			T
Rubiaceae	Psydrax sp. A of FTEA	Shekiko, Kurawa, Nairobi Ranch, Mukurumudzi Mouth			T
Rubiaceae	Rytigynia sp. I of FTEA	Tana River, Ozi; Nairobi Ranch			S
Rubiaceae	Spermacoce sp1	Robertson 3784, Shela			H
Asteraceae	Blepharispermum minus S. Moore	Hola, TRNPR, Garissa-Garsen (I.7S 40.0E)	vu B1ab(iii) +2ab(iii)		S
Asteraceae	Gutenbergia gilbertii C. Jeffrey	Type only. Isiolo 4km S (0.321N 37.572E)			H
Plumbaginaceae	Plumbago stenophylla Wilmot-Dear	Mida, Boni (Basuba)	cr B2ab(iii)		S
Boraginaceae	Heliotropium pectinatum Vaupel ssp. septentrionale Verdc.	Lokori (1.93N 36.0167E), Kangatet 11km S (1.88N 36.1E), Mado Gashi 13km S (0.627N 39.229E), Oropoi (3.808N 34.36E)			
Boraginaceae	Heliotropium rariflorum Stocks ssp. rariflorum	?Kaisut, ?Laisamis 45km N (1.979N 37.909E)			S
Boraginaceae	Heliotropium sp. A of FTEA	Bura Irrigation, 4km N SKT 15 (1.183S 39.85E)			H
Solanaceae	Solanum malindense Voronts.	Lamu: Shela & Kitwa Pembe, Nairobi Ranch (2.55S 40.617E), Malindi 6km N		S. sp. cf monotanthum Dammer	C
Solanaceae	Solanum pampaninii Chiov.	Kiunga, Kui Is, Mkokoni, Sankuri Hills; Som: S2&3			C
Convolvulaceae	Astripomoea longituba Verdc.	Uaso Nyiro R, Isiolo 38km N, Lolokwe, Barsaloi to Baragoi (1.5379N 36.8252E)			H
Convolvulaceae	Convolvulus sp. A of FTEA	Bura-Ijara (1.55S 40.274E), ?Mado Gashi W (0.77N 39.32E)			H
Convolvulaceae	Merremia hemmingiana Verdc.	Wajir, Tarassa T/O 6.7Km North (2.4S 40.13E)			C
Convolvulaceae	Merremia sp. A of FTEA	Mathews: Olkanto (1.0167N 37.33E), Meru NP, Kora, Tsavo E (3.083S 38.567E)			C

Acanthaceae	Asystasia sp. B of FTEA	Tana/Meru Distr - no locality		A.tanaensis Ensermu not published	H
Acanthaceae	Barleria hirtifructa I. Darbysh.	Mt Kulal: Gatab; L Turkana SW (Mugurr); Meru: Isiolo-Wajir, Shaptiga Hill (0.475N 37.833E)	Lc		H
Acanthaceae	Barleria sp. A of FTEA	Magogo 1352, Isiolo-Marsabit Alt = 1050 (nr Isiolo or Lolokwe or Marsabit)			S
Acanthaceae	Blepharis kenyensis Vollesen	Malindi N, Mukunumbe	en B1ab(ii,iii,iv) + B2ab(ii,iii,iv)		H
Acanthaceae	Blepharis sp. A of FTEA	Kitui/Tana: Nthua R No locality			H
Acanthaceae	Blepharis turkanae Vollesen	Kalacha-Marsabit, Lokori-Sigor (1.96N 35.92E), nr Lokori	vu D2		H
Acanthaceae	Megalochlamys tanaensis Vollesen	Garsen 10km NE; Wema East F	cr B2ab(iii,v); D		H
Acanthaceae	Neuracanthus keniensis J.-P. Lebrun & Stork	Isiolo: ?Hadado (1.496N 39.425E); Marsabit 45km N (Bubbisa 2.7N 38.08E); Kargi; Kora; Kalacha - Marsabit	Lc		H
Verbenaceae	Chascanum marrubiifolium Walp. var. A of FTEA	Baragoi-S Horr 12km (1.87N 36.84E)			H
Lamiaceae	Leucas tsavoensis Sebald var. kilifiensis Sebald	Kilifi County. Boni- Bodhei to Basuba (1.8167S 40.75E)	en B1ab(iii) + 2ab(iii)		H
Lamiaceae	Rotheca rupicola (Verdc.) Verdc.	Kula Mawe 5km W (0.57N 38.194E), Dadaab NE, Kora, Meru NP, TRNPR			S
Lamiaceae	Rotheca sp. C of FTEA	Lagadema Hill, Meru NP, Mwingi-Kora 69km			S
Dracaenaceae	Sansevieria francisii B.J.Chahinian	Type only. Garsen			H
Dracaenaceae	Sansevieria itumea (Mbugua) Jankalski	Type only. 30km S of Galole		Sansevieria aethiopica Thunb. ssp. itumea Mbugua	H
Dracaenaceae	Sansevieria pinguicula P.R.O. Bally	Hola			H
Dracaenaceae	Sansevieria powysii L.E. Newton	Kiwayu			H
Aloaceae	Aloe archeri Lavranos ssp. archeri	Isiolo N; Rumuruti 37km NE; Ol Doinyo Lenkiyio (1.3N 37.3E)			S
Amaryllidaceae	Crinum piliferum Nordal	Wajir, Kora, Tsavo E			H
Commelinaceae	Aneilema succulentum Faden	Nr Jilore, Nyangoro, Maungu, Buchuma, Mangea, Kurawa Rd (2.63S 4.19E)			H
Commelinaceae	Aneilema tanaense Faden	Kwale County; Tana - Oda T/O; Lake Dumi (2.67S 40.13E)			H
Commelinaceae	Commelina melanorrhiza Faden	Mathews, Meru NP, Kibwez FR, Ngaia FR, Marsabit?		C. sp. C of UKWF	H
Cyperaceae	Bulbostylis argenteobrunnea C.B. Clarke	Kenyan Endemic: Ngomeni (Machakos), Taita, Mariakani, Meru NP			H
Cyperaceae	Bulbostylis densecaespitosa (Lye) R.W. Haines	K7 Endemic: Mangea, A-S, Garsen 48km S (Kurawa)	en B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v)		H
Cyperaceae	Bulbostylis squarrosa (Lye) Verdc.	Type only, 63km S Mado Gashi (0.0698S 39.509E)			H
Cyperaceae	Bulbostylis trabeculata Rendle var. microglumis (Lye) R.W. Haines	Type only, Turkana, Ekidir - not traced			H
Cyperaceae	Cyperus soyauxii Boeckeler ssp. pallescens Lye	Type only. Garissa-Mado Gashi 26km (0.158S 39.569E)			H
Poaceae	Brachiaria longiflora Clayton	Mida, Mnarani, Kurawa, Kiunga			H
Poaceae	Digitaria aridicola Napper	Wajir, Voi, Garissa			H

Poaceae	Digitaria gymnotheca Clayton	Dandu, Boni, Malindi	H
Poaceae	Eragrostis sp.A of FTEA	Ijara to Lamu 53 km (1.952S 40.772E)	H

Appendix II: Complete Plant Checklist of Garissa Lamu Area (date and number order), annotated with habit, collection/observation locality, IUCN status and comment:

Habit Key – as for Appendix 1

15	No.	Suf.	Family	Species	Hab.	Dups	IUCN	Comment	Locality	GPS	Lat.	ns	Long.	ew	Alt
HS	2437	A	Lamiaceae	Rotheca makanjana (H. Winkl.) Steane & Mabb.	S	EA,K			20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
HS	2437	B	Malvaceae	Corchorus brevicornatus Vollesen	H			1st for Kenya, 2nd for East Africa	20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
HS	2437	C	Acanthaceae	Barleria linearifolia Rendle	S	EA			20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
HS	2438		Malvaceae	Roifia dictyocarpus (Webb) Verdc.	H	EA,K			20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
HS	2439		Asteraceae	Sphaeranthus zavattarii Cufod.	H	EA	DD		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
HS	2440		Acanthaceae	Megalochlamys trinervia (C.B. Clarke) Vollesen	S	EA,K			20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
HS	2441		Vitaceae	Cissus adeyana Masinde & L.E. Newton	C	EA,K			1.8km N of Stn 11	Pt 398	0.2374	S	39.6691	E	250
HS	2442		Solanaceae	Solanum somalense Franch.	S	EA,K			1.8km N of Stn 11	Pt 398	0.2374	S	39.6691	E	250
HS	2443		Capparaceae	Maerua sessiliflora Gilg	T	EA,K			1.8km N of Stn 11	Pt 398	0.2374	S	39.6691	E	250
HS	2444		Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	H	EA,K	en B1ab(iii) + B2ab(iii)		1.8km N of Stn 11	Pt 398	0.2374	S	39.6691	E	250
SR	1		Burseraceae	Commiphora sp.1	T				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	2		Mimosaceae (Leguminosae)	Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan	T				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	3		Capparaceae	Cadaba glandulosa Forssk.	S				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	4		Poaceae	Drake-Brockmania somalensis Stapf	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	5		Lamiaceae	Leucas nubica Benth.	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	6		Malvaceae	Grewia sp.	S				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	7		Acanthaceae	Crossandra stenostachya (Lindau) C.B. Clarke	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	8		Papilionaceae (Leguminosae)	Indigofera hochstetteri Baker?	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	9		Malvaceae	Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	10		Convolvulaceae	Seddera bagshawei Rendle?	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	11		Burseraceae	Commiphora sp.2	T				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	12		Vitaceae	Cissus aphylla Chiov.	C				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	13		Salvadoraceae	Salvadora persica L. var. persica	T				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	14		Lamiaceae	Ocimum americanum L.	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245

SR	15	Peddaliaceae	Pterodiscus ruspolii Engl.	H	Fruits only	20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	16	Peddaliaceae	Pedaliodiscus macrocarpus Ihlenf.	H	Fruits only	20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	17	Asteraceae	Volutaria boranensis (Cufod.) Wagenitz	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	18	Poaceae	Eragrostis cilianensis (All.) Janch.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	19	Poaceae	Aristida sp.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	20	Acanthaceae	Duosperma longicalyx (Deflers) Vollesen ssp. longicalyx	S		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	21	Poaceae	Eragrostis aethiopica Chiov.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	22	Mimosaceae (Leguminosae)	Acacia reficiens Wawra ssp. misera (Vatke) Brenan	S		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	23	Salvadoraceae	Dobera glabra (Forssk.) Poir.	T		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	24	Boraginaceae	Heliotropium sp.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	25	Apocynaceae	Pergularia daemia (Forssk.) Chiov. ssp. daemia	C		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	26	Poaceae	Cenchrus sp.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	27	Peddaliaceae	Sesamothamnus sp.	T		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	28	Poaceae	Panicum sp.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	29	Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	30	Amaranthaceae	Digera muricata (L.) Mart. ssp. trinervis C.C. Towns. var. macroptera C.C. Towns.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	31	Solanaceae	Solanum coagulans Forssk.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	32	Asparagaceae	Asparagus sp.	C		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	34	Boraginaceae	Cordia quercifolia Klotzsch	T		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	35	Burseraceae	Commiphora sp.3	T		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	36	Cucurbitaceae	Cucumis prophetarum L. ssp. dissectus (Naudin) C. Jeffrey	C		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	37	Boraginaceae	Heliotropium sp.2	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	38	Cleomeaceae	Cleome sp.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	39	Capparaceae	Cadaba ruspolii Gilg	S		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	41	Capparaceae	Cadaba gillettii R.A. Graham	S		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	42	Opiliaceae	Opilia campestris Engl. var. campestris	T		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	43	Papilionaceae (Leguminosae)	Alysicarpus glumaceus (Vahl) DC. ssp.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	44	Poaceae	Leptothrium senegalense (Kunth) Clayton	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	45	Malvaceae	Corchorus olitorius L.	H		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	46	Euphorbiaceae	Jatropha spicata Pax	S		20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245

SR	47	Poaceae	Sporobolus helvolus (Trin.) T. Durand & Schinz	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	48	Convolvulaceae	Ipomoea sp.	C				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	49	Asteraceae	Aspilia mossambicensis (Oliv.) Wild	S				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	50	Malvaceae	Corchorus trilocularis L.	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	51	Acanthaceae	Hygrophila schulli (Buch.-Ham.) M.R. Almeida & S.M. Almeida	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	52	Burseraceae	Commiphora kua (R. Br. ex Royle) Vollesen	T				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	53	Cyperaceae	Cyperus sp.	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	54	Molluginaceae	Glinus lotoides L.	H				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	55	Capparaceae	Boscia coriacea Pax	T				20km N Stn 11 to 10	Pt 399	0.1083	S	39.5660	E	245
SR	56	Capparaceae	Maerua endlichii Gilg & Gilg-Ben.	S				1.8km N of Stn 11	Pt 398	0.2374	S	39.6691	E	250
SR	57	Apocynaceae	Strophanthus mirabilis Gilg	S				1.8km N of Stn 11	Pt 398	0.2374	S	39.6691	E	250
HS	2445	Acanthaceae	Anisotes tanensis Baden	S	EA,K			Rd to Kasha	Pt 402B	0.0626	N	39.2399	E	330
HS	2446	Acanthaceae	Duosperma longicalyx (Deflers) Vollesen ssp. longicalyx	S	EA,K			44 km NW Stn10 - Stn9	Pt 403	0.2777	N	38.8454	E	455
HS	2447	Acanthaceae	Neuracanthus tephropyllus Bidgood & Brummitt ssp. tephropyllus	H	EA			44 km NW Stn10 - Stn9	Pt 403	0.2777	N	38.8454	E	455
HS	2448	Malvaceae	Hermannia uhligii Engl.?	H	EA			44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
HS	2449	Euphorbiaceae	Euphorbia fluminis S.Carter	S	EA,K	en B1ab(iii) + B2ab(iii)	in hort died	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
HS	2450	Acanthaceae	Neuracanthus pictus M.G. Gilbert	H	EA,K			44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
HS	2451	Celastraceae	Elaeodendron aquifolium (Fiori) Chiov.	T	EA,K,MO	en B2ab(iii)		44 km NW Stn10 - 9	Pt 404	0.2767	N	38.8460	E	440
HS	2452	Euphorbiaceae	Jatropha dichtar J.F. Macbr.	S	EA,K			1km SE Saka Junction	Pt 405	0.2777	N	38.8454	E	455
SR	58	Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	59	Mimosaceae (Leguminosae)	Acacia reficiens Wawra ssp. misera (Vatke) Brenan	S				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	60	Salvadoraceae	Dobera glabra (Forssk.) Poir.	T				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	61	Capparaceae	Cadaba glandulosa Forssk.	S				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	62	Dracaenaceae	Sansevieria ??	H				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	63	Malvaceae	Abutilon fruticosum Guill. & Perr. var. fruticosum	H				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	64	Poaceae	Eragrostis cilianensis (All.) Janch.	H				44 km NW Stn10 -9	Pt 403	0.2777	N	38.8454	E	455
SR	65	Capparaceae	Maerua edulis (Gilg & Gilg-Ben.) DeWolf	S				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	66	Zygophyllaceae	Balanites rotundifolia (Tiegh.) Blatt. var. rotundifolia	T				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455

SR	67	Capparaceae	Boscia coriacea Pax	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	68	Capparaceae	Maerua denhardtiorum Gilg	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	69	Acanthaceae	Barleria acanthoides Vahl	S	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	70	Euphorbiaceae	Acalypha indica L.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	71	Poaceae	Setaria verticillata (L.) P. Beauv.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	72	Poaceae	Sporobolus helvolus (Trin.) T. Durand & Schinz	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	73	Acanthaceae	Blepharis edulis (Forssk.) Pers.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	74	Boraginaceae	Cordia quercifolia Klotzsch	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	75	Capparaceae	Maerua denhardtiorum Gilg	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	76	Malvaceae	Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	77	Lamiaceae	Leucas nubica Benth.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	78	Poaceae	Panicum sp.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	79	Poaceae	Tetrapogon cenchriformis (A. Rich.) Clayton	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	80	Boraginaceae	Heliotropium sp.1	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	81	Poaceae	Aristida sp.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	82	Solanaceae	Solanum somalense Franch.	S	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	83	Convolvulaceae	Seddera hirsuta Hallier f. var. gracilis (Chiov.) Verdc.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	84	Mimosaceae (Leguminosae)	Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	85	Malvaceae	Corchorus sp.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	86	Burseraceae	Commiphora holtziana Engl.	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	87	Salvadoraceae	Salvadora persica L. var. persica	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	88	Capparaceae	Maerua oblongifolia (Forssk.) A. Rich.	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	89	Boraginaceae	Heliotropium sp.2	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	90	Combretaceae	Terminalia parvula Pamp.	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	91	Amaranthaceae	Amaranthus sparganiocephalus Thell.	H	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	92	Burseraceae	Commiphora sp.2	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	93	Apocynaceae	Pentatropis nivalis (J.F. Gmel.) D.V. Field & J.R.I. Wood	C	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	94	Acanthaceae	Barleria gracilispina (Fiori) I. Darbysh.	S	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	95	Malvaceae	Sterculia rhynchocarpa K. Schum.	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	96	Mimosaceae (Leguminosae)	Acacia bussei Sjøstedt	T	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455

SR	97		Opiliaceae	Opilia campestris Engl. var. campestris	T				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	98		Burseraceae	Commiphora rostrata Engl. var. rostrate	T				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	99		Asteraceae	Volutaria boranensis (Cufod.) Wagenitz	H				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	100		Malvaceae	Roifia dictyocarpus (Webb) Verdc.	H				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	101		Poaceae	Dinebra polycarpha S.M. Phillips	H				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	102		Amaranthaceae	Sericocomopsis pallida (S. Moore) Schinz	H				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	103		Capparaceae	Maerua parvifolia Pax	S				44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
SR	104		Loranthaceae	Phragmanthera sp.	P			star hairs	44 km NW Stn10 - 9	Pt 403	0.2777	N	38.8454	E	455
HS	2453		Cucurbitaceae	Cephalopentandra ecirrhosa (Cogn.) C. Jeffrey	C	EA,K			4.7km W of Stn12	Pt 408	0.4487	S	39.7950	E	210
HS	2454		Acanthaceae	Blepharis tanae Napper	H	EA			4.7km W of Stn12	Pt 408	0.4487	S	39.7950	E	210
HS	2455		Capparaceae	Maerua kaessneri Gilg & Gilg-Ben.	S	EA,K	nt		4.7km W of Stn12	Pt 408	0.4487	S	39.7950	E	210
HS	2456		Euphorbiaceae	Givotia gosai Radcl.-Sm.	T	EA			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2457		Papilionaceae (Leguminosae)	Crotalaria sp.	H	EA		no flws	Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2458		Malvaceae	Hermannia exappendiculata (Mast.) K. Schum.	H	EA,K			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2459		Euphorbiaceae	Euphorbia cuneata Vahl ssp. lamproderma S.Carter	S	EA			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2460		Rubiaceae	Pavetta sp.	T	EA		not matched	Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2461		Amaranthaceae	Celosia fadenorum C.C. Towns.	H	EA,K,MO	EN B2ab(iii)		Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2462	A	Burseraceae	Commiphora pseudopaolii J.B. Gillett	T	EA,K	LR/nt		Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2462	B	Burseraceae	Commiphora confusa Vollesen	T	EA,K			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2463		Poaceae	Aristida barbicollis Trin. & Rupr.	H	EA,K			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2464	A	Capparaceae	Boscia fadeniorum Fici	T	EA			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2464	B	Burseraceae	Commiphora sp.	T	EA		Not matched	Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2465		Lamiaceae	Leucas urticifolia (Vahl) Sm. var. angustifolia Sebald	H	EA			Stn12	Pt 407	0.4440	S	39.8372	E	205
HS	2466		Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	H	EA,K,MO	en B1ab(iii) + B2ab(iii)		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
HS	2467		Asteraceae	Sphaeranthus kirkii Oliv. & Hiern var. cyathuloides (O. Hoffm.) Beentje	H	EA			7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
HS	2468		Vitaceae	Cissus adeyana Masinde & L.E. Newton	C	EA,K			7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
HS	2469		Marsileaceae	Marsilea sp.	F	EA		not matched	7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
HS	2470		Cyperaceae	Schoenoplectiella senegalensis (Steud.) Lye	H	EA			7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205

HS	2471		Mimosaceae (Leguminosae)	Acacia senegal (L.) Willd. var. senegal	T	EA,K		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
HS	2472		Capparaceae	Maerua subcordata (Gilg) DeWolf	S	EA		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
HS	2473		Malvaceae	Sterculia rhynchocarpa K. Schum.	T	EA,K		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2474		Papilionaceae (Leguminosae)	Indigofera tinctoria L. var. tinctoria	H	EA,K		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2475		Amaranthaceae	Allmaniopsis fruticulosa Suess.	H	EA,K,MO		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2476	A	Acanthaceae	Barleria gracilispina (Fiori) I. Darbysh.	S	EA		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2476	B	Amaranthaceae	Centamopsis sordida C.C. Towns.	H	EA,K		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2476	C	Boraginaceae	Heliotropium steudneri Vatke ssp. steudneri var. steudneri	H	EA,K		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2477		Dracaenaceae	Sansevieria pinguicula P.R.O. Bally	H	EA,K	in hort tag 129	11km S of Stn 12	Pt 411	0.5224	S	39.8918	E	195
SR	105		Burseraceae	Commiphora africana (A. Rich.) Engl.	T			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	106		Capparaceae	Boscia coriacea Pax	T			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	107		Acanthaceae	Barleria linearifolia Rendle	S			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	108		Mimosaceae (Leguminosae)	Dichrostachys cinerea (L.) Wight & Arn.	T			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	109		Combretaceae	Combretum aculeatum Vent.	S			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	110		Apocynaceae	Pergularia daemia (Forssk.) Chiov. ssp. daemia	C			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	111		Loranthaceae	Indet	P			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	112		Malvaceae	Hibiscus micranthus L.f.	H			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	113		Poaceae	Dinebra polycarpha S.M. Phillips	H		1st K1?	Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	114		Poaceae	Eragrostis aethiopica Chiov.	H			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	115		Malvaceae	Grewia villosa Willd.	S			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	116		Poaceae	Aristida adscensionsis L.	H			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	117		Capparaceae	Cadaba ruspolii Gilg	S			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	118		Papilionaceae (Leguminosae)	Indigofera spinosa Forssk.	H			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	119		Rubiaceae	Kohautia caespitosa Schnizl.	H			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	120		Mimosaceae (Leguminosae)	Acacia tortilis (Forssk.) Hayne ssp. spirocarpa (A. Rich.) Brenan	T			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	121		Burseraceae	Commiphora kua (R. Br. ex Royle) Vollesen	T			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	122		Mimosaceae (Leguminosae)	Acacia hamulosa Benth.	T			Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	123		Peddaliaceae	Josephinia africana Vatke	S			Stn12	Pt 407	0.4440	S	39.8372	E	205

SR	124	Papilionaceae (Leguminosae)	Tephrosia villosa (L.) Pers. ssp. ehrenbergiana (Schweinf.) Brummitt	H		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	125	Malvaceae	Grewia sp.	S		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	126	Rubiaceae	Gardenia fiorii Chiov.	S		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	127	Capparaceae	Maerua crassifolia Forssk.	T		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	128	Anacardiaceae	Lannea triphylla (A. Rich.) Engl.	T		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	129	Caesalpiniaceae (Leguminosae)	Bauhinia taitensis Taub.	S		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	130	Capparaceae	Maerua kaessneri Gilg & Gilg-Ben.	S	nt	Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	131	Apocynaceae	Strophanthus mirabilis Gilg	S		Stn12	Pt 407	0.4440	S	39.8372	E	205
SR	132	Asteraceae	Geigeria acaulis Oliv. & Hiern	H		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	133	Malvaceae	Grewia tenax (Forssk.) Fiori	S		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	134	Capparaceae	Boscia fadeniorum Fici	T		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	135	Combretaceae	Terminalia orbicularis Engl. & Diels	T		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	136	Mimosaceae (Leguminosae)	Acacia reficiens Wawra ssp. misera (Vatke) Brenan	S		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	137	Salvadoraceae	Dobera glabra (Forssk.) Poir.	T		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	138	Zygophyllaceae	Balanites rotundifolia (Tiegh.) Blatt. var. rotundifolia	T		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	139	Combretaceae	Terminalia brevipes Pamp.	T		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	140	Capparaceae	Cadaba farinosa Forssk. ssp. farinosa	S		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	141	Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T		7.8km E of Stn 12	Pt 410	0.4442	S	39.9088	E	205
SR	142	Burseraceae	Commiphora campestris Engl.	T		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	143	Mimosaceae (Leguminosae)	Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan	T		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	144	Amaranthaceae	Salsola africana (Brenan) Botsch.	S		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	145	Capparaceae	Cadaba glandulosa Forssk.	S		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	146	Capparaceae	Cadaba ruspolii Gilg	S		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	147	Lamiaceae	Ocimum americanum L.	H		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	148	Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	149	Poaceae	Eragrostis aethiopica Chiov.	H		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	150	Poaceae	Aristida adscensionsis L.	H		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	151	Acanthaceae	Barleria linearifolia Rendle	S		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	152	Malvaceae	Roifia dictyocarpus (Webb) Verdc.	H		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	153	Malvaceae	Corchorus trilocularis L.	H		21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215

SR	154	Acanthaceae	Duosperma longicalyx (Deflers) Vollesen ssp. longicalyx	S			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	155	Poaceae	Sporobolus helvolus (Trin.) T. Durand & Schinz	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	156	Burseraceae	Commiphora holtziana Engl.	T			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	157	Malvaceae	Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	158	Asteraceae	Sphaeranthus zavattarii Cufod.	H		DD	21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	159	Poaceae	Drake-Brockmania somalensis Stapf	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	160	Amaranthaceae	Digera muricata (L.) Mart. ssp. ?	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	161	Combretaceae	Terminalia orbicularis Engl. & Diels	T			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	162	Boraginaceae	Heliotropium steudneri Vatke ssp. steudneri var. steudneri	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	163	Malvaceae	Grewia tenax (Forssk.) Fiori	S			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	164	Poaceae	Leptothrium senegalense (Kunth) Clayton	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	165	Mimosaceae (Leguminosae)	Acacia oerfota (Forssk.) Schweinf.	S			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	166	Lamiaceae	Leucas nubica Benth.	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	167	Boraginaceae	Cordia quercifolia Klotzsch	T			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	168	Capparaceae	Boscia coriacea Pax	T			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	169	Acanthaceae	Crossandra stenostachya (Lindau) C.B. Clarke	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	170	Cucurbitaceae	Coccinia grandis (L.) Voigt	C			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	171	Capparaceae	Maerua oblongifolia (Forssk.) A. Rich.	T			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	172	Euphorbiaceae	Euphorbia fluminis S.Carter	S		en B1ab(iii) + B2ab(iii)	21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	173	Vitaceae	Cissus aphylla Chiov.	C			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	174	Acanthaceae	Barleria acanthoides Vahl	S			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	175	Malvaceae	Grewia villosa Willd.	S			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	176	Amaranthaceae	Pupalia lappacea (L.) A. Juss.	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	177	Combretaceae	Terminalia brevipes Pamp.	T			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	178	Poaceae	Eragrostis cilianensis (All.) Janch.	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	179	Acanthaceae	Blepharis edulis (Forssk.) Pers.	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	180	Dracaenaceae	Sansevieria powellii N.E. Br.	H			21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
SR	181	Papilionaceae (Leguminosae)	Indigofera tanaensis J.B. Gillett	H		en B1ab(iii) + B2ab(iii)	21km S of Stn 12	Pt 409	0.6070	S	39.9200	E	215
HS	2478	Capparaceae	Boscia keniensis Beentje	T	EA		Tana R> E Bank Rd to Bura	Pt 414	0.6842	S	39.8257	E	115

HS	2479	Boraginaceae	Cordia sinensis Lam.	T	EA,K			Tana R. E Bank Rd to Bura	Pt 415	0.7368	S	39.8349	E	110
HS	2480	Capparaceae	Maerua denhardtiorum Gilg	T	EA			Tana River E Bank Rd to Bura	Pt 415	0.7368	S	39.8349	E	110
HS	2481	Aloaceae	Aloe citrina S. Carter & Brandham	H	EA,K		in hort MN	Tana R. E Bank Rd to Bura	Pt 417	1.0301	S	39.9139	E	95
HS	2482	Apocynaceae	Caralluma priogonium K. Schum.	H	EA,K			Tana R. E Bank Rd to Bura	Pt 418	1.0368	S	39.9163	E	100
HS	2483	Apocynaceae	Desmidorchis foetida (E.A. Bruce) Plowes	H	EA,K		in hort MN	Tana R. E Bank Rd to Bura	Pt 418	1.0368	S	39.9163	E	100
HS	2484	Acanthaceae	Barleria gracilispina (Fiori) I. Darbysh.	S	EA,K			Tana R. E Bank Rd to Bura	Pt 418	1.0368	S	39.9163	E	100
HS	2485	Capparaceae	Cadaba farinosa Forssk. ssp. farinosa	S	EA,K			Tana R. E Bank Rd to Bura	Pt 418	1.0368	S	39.9163	E	100
HS	2486	Amaranthaceae	Pupalia lappacea (L.) A. Juss. var. velutina (Moq.) Hook.f.	H	EA			Tana R. E Bank Rd to Bura	Pt 418	1.0368	S	39.9163	E	100
HS	2487	Euphorbiaceae	Euphorbia cryptospinosa P.R.O. Bally	S	EA,K			Tana R. E Bank Rd Bura S	Pt 419	1.1088	S	39.9541	E	100
HS	2488	Capparaceae	Maerua mungaii Beentje	C	EA	vu B1ab(iii) + B2ab(iii)		Tana R. E Bank Rd Bura S	Pt 419	1.1088	S	39.9541	E	100
HS	2489	Peddaliaceae	Pterodiscus ruspolii Engl.	H	EA			Bura East	Pt 435	1.0969	S	39.9416	E	90
HS	2490	Aloaceae	Aloe vituensis Baker	H	EA,K	LC	in hort tag 131	Upper Rd Bura to Garissa	Pt 420	1.0670	S	39.9428	E	95
HS	2491	Capparaceae	Boscia fadeniorum Fici	T	EA,K		2nd collection	Upper Rd Bura to Garissa	Pt 421	1.0230	S	39.9469	E	95
HS	2492	Poaceae	Enteropogon barbatus C.E. Hubb.	H	EA,K			Upper Rd Bura to Garissa	Pt 421	1.0230	S	39.9469	E	95
HS	2493	Papilionaceae (Leguminosae)	Crotalaria massaiensis Taub.	H	EA,K			Stn13	Pt 416	0.7185	S	39.9629	E	95
HS	2494	Solanaceae	Solanum hastifolium Dunal	C	EA			Stn13	Pt 416	0.7185	S	39.9629	E	95
HS	2495	Boraginaceae	Heliotropium rariflorum Stocks ssp. hereroense (Schinz) Verdc.	H	EA			Stn13	Pt 416	0.7185	S	39.9629	E	95
HS	2496	Asparagaceae	Asparagus scaberulus A. Rich.?	C	EA,K		no mat. In EA	Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	182	Apocynaceae	Orbea sp.	H			in hort tag 132	Tana River E Bank Rd to Bura	Pt 412	0.6415	S	39.7953	E	120
SR	183	Aloaceae	Aloe sp.	H			in hort tag 133	Tana River E Bank Rd to Bura	Pt 413	0.6746	S	39.8241	E	110
SR	184	Solanaceae	Lycium shawii Roem. & Schult.	S				Tana R. E Bank Rd to Bura	Pt 418	1.0368	S	39.9163	E	100
SR	185	Dracaenaceae	Sansevieria sp. cf. nitida B.J. Chahinian	H			in hort tag 134	Tana R. E Bank Rd Bura S	Pt 419	1.1088	S	39.9541	E	100
SR	186	Rubiaceae	Gardenia fiorii Chiov.	S				Upper Rd Bura to Garissa	Pt 421	1.0230	S	39.9469	E	95
SR	187	Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T				Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	188	Burseraceae	Commiphora campestris Engl. ssp.	T				Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	189	Burseraceae	Commiphora holtziana Engl.	T				Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	190	Amaranthaceae	Salsola africana (Brenan) Botsch.	S				Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	191	Malvaceae	Grewia tenax (Forssk.) Fiori	S				Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	192	Solanaceae	Lycium shawii Roem. & Schult.	S				Stn13	Pt 416	0.7185	S	39.9629	E	95

SR	193	Mimosaceae (Leguminosae)	Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan	T		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	194	Mimosaceae (Leguminosae)	Acacia reficiens Wawra ssp. misera (Vatke) Brenan	S		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	195	Amaranthaceae	Volkensinia prostrata (Gilg) Schinz?	H	Dasysphaera??	Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	196	Convolvulaceae	Seddera bagshawei Rendle?	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	197	Mimosaceae (Leguminosae)	Acacia stuhlmannii Taub.	T		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	198	Acanthaceae	Neuracanthus tephropyllus Bidgood & Brummitt ssp. tephropyllus	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	199	Capparaceae	Cadaba gillettii R.A. Graham	S		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	200	Vitaceae	Cissus adeyana Masinde & L.E. Newton	C		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	201	Salvadoraceae	Dobera glabra (Forssk.) Poir.	T		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	202	Papilionaceae (Leguminosae)	Indigofera schimperi Jaub. & Spach var. baukeana (Vatke) J.B. Gillett	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	203	Papilionaceae (Leguminosae)	Tephrosia sp.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	204	Acanthaceae	Blepharis edulis (Forssk.) Pers.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	205	Poaceae	Aristida adscensionsis L.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	206	Malvaceae	Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	207	Capparaceae	Maerua oblongifolia (Forssk.) A. Rich.	T		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	208	Boraginaceae	Heliotropium steudneri Vatke ssp. steudneri var. steudneri	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	209	Capparaceae	Cadaba ruspolii Gilg	S		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	210	Poaceae	Enteropogon sp	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	211	Capparaceae	Boscia coriacea Pax	T		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	212	Capparaceae	Cadaba glandulosa Forssk.	S		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	213	Lamiaceae	Orthosiphon pallidus Benth.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	214	Malvaceae	Grewia villosa Willd.	S		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	215	Malvaceae	Corchorus trilocularis L.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	216	Amaranthaceae	Pupalia lappacea (L.) A. Juss.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	217	Burseraceae	Commiphora kua (R. Br. ex Royle) Vollesen	T		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	218	Apocynaceae	Desmidorchis retrospiciens Ehrenb.	H		Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	219	Burseraceae	Commiphora sp.	T	Damajaa	Stn13	Pt 416	0.7185	S	39.9629	E	95
SR	220	Euphorbiaceae	Euphorbia cryptospinosa P.R.O. Bally	S		Stn13	Pt 416	0.7185	S	39.9629	E	95

HS	2497	Asteraceae	Blepharispermum minus S. Moore	S	EA,K	vu B1ab(iii) +2ab(iii)	20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2498	Malvaceae	Hibiscus hildebrandtii Sprague & Hutch.	H	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2499	Malvaceae	Sterculia rhynchocarpa K. Schum.	T	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2500	Boraginaceae	Hilsenbergia lyciacea (Thulin) J.S. Mill.	S	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2501	Cucurbitaceae	Coccinia microphylla Gilg	C	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2502	Cucurbitaceae	Zehneria anomala C. Jeffrey	C	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2503	Oleaceae	Jasminum sp. Not matched	H	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2504	Poaceae	Urochloa sclerochlaena Chiov.	H	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2505	Cyperaceae	Cyperus amauropus Steud.	H	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2506	Cyperaceae	Cyperus mollipes (C.B. Clarke) K. Schum.	H	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2507	Burseraceae	Commiphora danduensis J.B. Gillett	T	EA,K		20 km W of Stn 14	Pt 424	1.2625	S	40.1111	E	85
HS	2508	Anthericaceae	Chlorophytum tuberosum (Roxb.) Baker	H	EA,K		20 km W of Stn 14	Pt 425	1.2713	S	40.1170		85
HS	2509	Acanthaceae	Justicia odora (Forssk.) Lam.	S	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2510	Apocynaceae	Glossonema revoilii Franch.	H	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2511	Poaceae	Chrysopogon plumulosus Hochst.	H	EA		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2512	Poaceae	Tetrapogon bidentatus Pilg.	H	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2513	Amaranthaceae	Sericocomopsis pallida (S. Moore) Schinz	H	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2514	Apocynaceae	Buckollia volubilis (Schltr.) Venter & R.L. Verh.	C	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2515	Poaceae	Dactyloctenium scindicum Boiss.	H	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2516	Rubiaceae	Coptosperma wajirensis (Bridson) Degreef	S	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2517	Cucurbitaceae	Kedrostis abdallai A. Zimm.	C	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2518	Apocynaceae	Cynanchum hastifolium K. Schum. ssp. longirostrum Goyder	C	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2519	Boraginaceae	Hilsenbergia lyciacea (Thulin) J.S. Mill.	S	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2520	Capparaceae	Maerua glauca Chiov.	S	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2521	Euphorbiaceae	Croton menyharthii Pax	S	EA		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2522	Cucurbitaceae	Cephalopentandra ecirrhosa (Cogn.) C. Jeffrey	C	EA,K		20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
HS	2523	Malvaceae	Hermannia uhligii Engl.	H	EA,K		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2524	Poaceae	Enteropogon macrostachyus (A. Rich.) Benth.	H	EA,K		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2525	Vitaceae	Cyphostemma sp.?nov.	H	EA		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85

HS	2526		Poaceae	Brachiaria chusqueoides (Hack.) Clayton	H	EA,K			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2527		Burseraceae	Commiphora sp.	T	?			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2528		Commelinaceae	Commelina sp.	H	?			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2529		Commelinaceae	Commelina erecta L. ssp. livingstonii (C.B. Clarke) J.K. Morton	H	EA,K			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2530		Cyperaceae	Cyperus rubicundus Vahl	H	EA			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2531	A	Poaceae	Aristida adscensionsis L.	H	EA,K			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2531	B	Cucurbitaceae	Momordica rostrata A.Zimm.	C	EA			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2531	C	Convolvulaceae	Hildebrandtia sepalosa Rendle	S	EA			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2531	D	Malvaceae	Pavonia blepharicarpa N. Brummitt & Vollesen	H	EA			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2531	E	Malvaceae	Triumfetta flavescens Hochst. ex A. Rich.	S	EA			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2531	F	Poaceae	Schoenefeldia transiens (Pilg.) Chiov.	H	EA,K			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2532		Cyperaceae	Cyperus grandibulbosus C.B. Clarke	H	EA,K	LC		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2533		Papilionaceae (Leguminosae)	Indigofera schimperi Jaub. & Spach var. baukeana (Vatke) J.B. Gillett	H	EA,K			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2534		Cyperaceae	Cyperus neoschimperi Kük.	H	EA,K			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	221		Aloaceae	Aloe ruspoliana Baker	H			in hort tag 135	14km S of Bura E to Masalani	Pt 423	1.1846	S	40.0326	E	90
SR	222		Boraginaceae	Heliotropium sp.	H				20 km W of Stn 14	Pt 426	1.2972	S	40.1346	E	95
SR	223		Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	224		Mimosaceae (Leguminosae)	Acacia reficiens Wawra ssp. misera (Vatke) Brenan	S				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	225		Mimosaceae (Leguminosae)	Acacia zanzibarica (S. Moore) Taub. var. zanzibarica	T				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	226		Salvadoraceae	Dobera loranthifolia (Warb.) Harms	T				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	227		Salvadoraceae	Salvadora persica L. var. persica	T				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	228		Malvaceae	Sterculia rhynchocarpa K. Schum.	T				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	229		Boraginaceae	Cordia quercifolia Klotzsch	T				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	230		Malvaceae	Abutilon fruticosum Guill. & Perr. var. fruticosum	H				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	231		Malvaceae	Grewia tenax (Forssk.) Fiori	S				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	232		Portulacaceae	Talinum portulacifolium (Forssk.) Schweinf.	H				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	233		Capparaceae	Cadaba glandulosa Forssk.	S				12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85

SR	234	Poaceae	Chrysopogon plumulosus Hochst.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	235	Boraginaceae	Heliotropium steudneri Vatke ssp. steudneri var. steudneri	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	236	Capparaceae	Maerua glauca Chiov.?	S		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	237	Capparaceae	Maerua denhardtiorum Gilg	T		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	238	Mimosaceae (Leguminosae)	Acacia bussei Sjøstedt	T		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	239	Poaceae	Tetrapogon tenellus (Roxb.) Chiov.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	240	Commelinaceae	Commelina forskaolii Vahl	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	241	Acanthaceae	Ruellia patula Jacq.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	242	Vitaceae	Cissus rotundifolia (Forssk.) Vahl var. rotundifolia	C		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	243	Acanthaceae	Barleria sp.	S		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	244	Cucurbitaceae	Zehneria anomala C. Jeffrey	C		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	245	Boraginaceae	Hilsenbergia lyciacea (Thulin) J.S. Mill.	S		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	246	Cyperaceae	Cyperus amauropus Steud.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	247	Acanthaceae	Neuracanthus tephropyllus Bidgood & Brummitt ssp. tephropyllus	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	248	Amaranthaceae	Aerva lanata (L.) Schult.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	249	Capparaceae	Maerua mungaii Beentje	C	vu B1ab(iii) + B2ab(iii)	12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	250	Cucurbitaceae	Kedrostis foetidissima (Jacq.) Cogn.	C		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	251	Lamiaceae	Plectranthus sp.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	252	Dracaenaceae	Sansevieria powellii N.E. Br.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	253	Commelinaceae	Commelina benghalensis L.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	254	Poaceae	Chloris roxburghiana Schult.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	255	Poaceae	Enteropogon sp	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	256	Poaceae	Cenchrus ciliaris L.	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	257	Hyacinthaceae	Dipcadi viride (L.) Moench	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	258	Poaceae	Panicum infestum Andersson	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	259	Euphorbiaceae	Euphorbia fluminis S.Carter	S	en B1ab(iii) + B2ab(iii)	12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	260	Convolvulaceae	Seddera bagshawei Rendle?	H		12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85

SR	261	Malvaceae	Hibiscus hildebrandtii Sprague & Hutch.	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	262	Cyperaceae	Cyperus diurensis Boeckeler?	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	263	Lamiaceae	Orthosiphon pallidus Benth.	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	264	Violaceae	Hybanthus enneaspermus (L.) F. Muell. var.?	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	265	Malvaceae	Hibiscus micranthus L.f.	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	266	Cucurbitaceae	Kedrostis abdallai A. Zimm.	C			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	268	Solanaceae	Solanum coagulans Forssk.	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	269	Malvaceae	Grewia villosa Willd.	S			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	270	Cucurbitaceae	Coccinia grandis (L.) Voigt	C			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	271	Phyllanthaceae	Phyllanthus maderaspatensis L. var. maderaspatensis	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	272	Apocynaceae	Pentatropis nivalis (J.F. Gmel.) D.V. Field & J.R.I. Wood	C			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	273	Combretaceae	Terminalia parvula Pamp.	T			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	274	Poaceae	Panicum deustum Thunb.	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	275	Dracaenaceae	Sansevieria sp.2	H		in hort tag 136	12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
SR	276	Poaceae	Leptochloa obtusiflora Hochst.	H			12km SW of Stn 14	Pt 427	1.3902	S	40.2527	E	85
HS	2535	Malvaceae	Melhania ovata (Cav.) Spreng.	H	EA		9km E of Masalani	Pt 430	1.6728	S	40.2072	E	70
HS	2536	Solanaceae	Solanum taitense Vatke	S	EA		9km E of Masalani	Pt 430	1.6728	S	40.2072	E	70
HS	2537	Euphorbiaceae	Tragia hildebrandtii Müll.Arg.	H	EA		9km E of Masalani	Pt 430	1.6728	S	40.2072	E	70
HS	2538	Capparaceae	Cadaba heterotricha Stocks	T	EA		16km E of Masalani	Pt 432	1.6494	S	40.2596	E	95
HS	2539	Boraginaceae	Hilsenbergia teitensis (Gürke) J.S. Mill.	S	EA,K		16km E of Masalani	Pt 432	1.6494	S	40.2596	E	95
HS	2540	Cyperaceae	Cyperus blysmoides C.B. Clarke	H	EA,K		Nr Ijara	Pt 433B	1.5880	S	40.5050	E	65
HS	2541	Lamiaceae	Endostemon tereticaulis (Poir.) M. Ashby	H	EA		Nr Ijara	Pt 433B	1.5880	S	40.5050	E	65
HS	2542	Commelinaceae	Aneilema calceolus Brenan	H	EA,K	K7/T3	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2543	Lamiaceae	Leucas glabrata (Vahl) Sm.	H	EA		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2544	Poaceae	Chloris mossambicensis K. Schum.	H	EA,K		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2545	Cyperaceae	Cyperus rubicundus Vahl	H	EA		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2546	Poaceae	Sporobolus iocladus (Trin.) Nees	H	EA		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2547	Poaceae	Perotis patens Gand.	H	EA		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65

HS	2548	Portulacaceae	Portulaca wightiana Wight & Arn.	H	EA,K		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2549	Polygalaceae	Polygala erioptera DC.	H	EA		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2550	Malvaceae	Hermannia sp.	H	?		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2551	Poaceae	Urochloa panicoides P. Beauv.	H	EA,K		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2552	Acanthaceae	Justicia brevipila Hedrén	S	EA,K	vu B1ab(ii,iii) + B2ab(ii,iii)	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
HS	2553	Malvaceae	Roifia dictyocarpus (Webb) Verdc.	H	?		16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	277	Salvadoraceae	Dobera loranthifolia (Warb.) Harms	T			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	278	Asteraceae	Blepharispermum minus S. Moore	S		vu B1ab(iii)+2ab(iii)	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	279	Anacardiaceae	Lannea cotoneaster (Chiov.) Sacleux	T			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	280	Apocynaceae	Cynanchum gerrardii (Harv.) Liede	C			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	281	Euphorbiaceae	Croton menyharthii Pax	S			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	282	Malvaceae	Grewia villosa Willd.	S			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	283	Malvaceae	Grewia tenax (Forssk.) Fiori	S			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	284	Dracaenaceae	Sansevieria powellii N.E. Br.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	285	Combretaceae	Combretum hereroense Schinz ssp.	T			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	286	Malvaceae	Abutilon fruticosum Guill. & Perr. var. fruticosum	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	287	Acanthaceae	Neuracanthus tephropyllus Bidgood & Brummitt ssp. tephropyllus	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	288	Lamiaceae	Orthosiphon pallidus Benth.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	289	Asparagaceae	Asparagus falcatus L.	C			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	290	Acanthaceae	Ruellia patula Jacq.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	291	Poaceae	Tetrapogon tenellus (Roxb.) Chiov.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	292	Amaranthaceae	Pupalia lappacea (L.) A. Juss.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	293	Amaranthaceae	Aerva lanata (L.) Schult.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	294	Malvaceae	Hibiscus micranthus L.f.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	295	Boraginaceae	Cordia quercifolia Klotzsch	T			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	296	Poaceae	Panicum deustum Thunb.?	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	297	Portulacaceae	Talinum portulacifolium (Forssk.) Schweinf.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65

SR	298	Lamiaceae	Endostemon tereticaulis (Poir.) M. Ashby	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	299	Poaceae	Tragus heptaneuron Clayton	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	300	Convolvulaceae	Seddera bagshawei Rendle	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	301	Boraginaceae	Heliotropium longiflorum (A. DC.) Jaub. & Spach ssp.?	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	302	Convolvulaceae	Seddera hirsuta Hallier f. var. gracilis (Chiov.) Verdc.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	303	Malvaceae	Pavonia blepharicarpa N. Brummitt & Vollesen	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	304	Burseraceae	Commiphora campestris Engl.	T	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	305	Papilionaceae (Leguminosae)	Indigofera schimperi Jaub. & Spach var. baukeana (Vatke) J.B. Gillett	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	306	Burseraceae	Commiphora africana (A. Rich.) Engl.	T	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	307	Vitaceae	Cissus rotundifolia (Forssk.) Vahl var. rotundifolia	C	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	308	Poaceae	Aristida adscensionsis L.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	309	Poaceae	Schoenefeldia transiens (Pilg.) Chiov.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	310	Euphorbiaceae	Acalypha indica L.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	311	Nyctaginaceae	Boerhavia helenae Roem. & Schult.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	312	Poaceae	Digitaria longiflora (Retz.) Pers.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	313	Mimosaceae (Leguminosae)	Albizia anthelmintica Brongn.	T	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	314	Poaceae	Cenchrus ciliaris L.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	315	Commelinaceae	Commelina forskaolii Vahl	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	316	Acanthaceae	Barleria gracilispina (Fiori) I. Darbysh.	S	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	317	Solanaceae	Solanum coagulans Forssk.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	318	Hyacinthaceae	Ledebouria sp.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	319	Cyperaceae	Cyperus blysmoides C.B. Clarke	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	320	Malvaceae	Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	321	Portulacaceae	Portulaca quadrifida L.	H	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	322	Rubiaceae	Gardenia fiorii Chiov.	S	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	323	Mimosaceae (Leguminosae)	Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan	T	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	324	Capparaceae	Boscia coriacea Pax	T	16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65

SR	325	Acanthaceae	Elytraria acaulis (L.f.) Lindau	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	326	Acanthaceae	Megalochlamys trinervia (C.B. Clarke) Vollesen	S			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	327	Cyperaceae	Cyperus pseudovestitus	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	328	Mimosaceae (Leguminosae)	Acacia zanzibarica (S. Moore) Taub. var. zanzibarica	T			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	329	Malvaceae	Sterculia rhynchocarpa K. Schum.	T			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	330	Vitaceae	Cyphostemma adenocaule (A. Rich.) Wild & R.B. Drumm. ssp. adenocaule	C			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	331	Poaceae	Chloris roxburghiana Schult.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	332	Euphorbiaceae	Jatropha spicata Pax	S			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	333	Lamiaceae	Ocimum americanum L.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	334	Malvaceae	Melhania velutina Forssk.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	335	Zygophyllaceae	Tribulus terrestris L.	H			16km E of Masalani	Pt 433	1.5754	S	40.4792	E	65
SR	336	Didieraceae	Calyptrotheca somalensis Gilg	S			20km NW of Stn 15	Pt 434	1.5581	S	40.4531	E	65
SR	337	Sapotaceae	Manilkara mochisia (Baker) Dubard	T			20km NW of Stn 15	Pt 434	1.5581	S	40.4531	E	65
HS	2554	Peddaliaceae	Pterodiscus coeruleus Chiov.	H	EA,K	no mat. In EA	17km NW of Stn 15	Pt 435	1.0969	S	39.9416	E	90
HS	2555	Capparaceae	Boscia fadeniorum Fici	T	EA,K		14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
HS	2556	Burseraceae	Commiphora erosa Vollesen	T	EA,K		14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
HS	2557	Loranthaceae	Oncocalyx kelleri (Engl.) M.G. Gilbert	P	EA	on Cordia	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	338	Opiliaceae	Opilia campestris Engl. var. campestris	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	339	Salvadoraceae	Dobera glabra (Forssk.) Poir.	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	340	Burseraceae	Commiphora bruceae Chiov.	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	341	Mimosaceae (Leguminosae)	Acacia mellifera (Vahl) Benth. ssp. mellifera	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	342	Mimosaceae (Leguminosae)	Acacia reficiens Wawra ssp. misera (Vatke) Brenan	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	343	Salvadoraceae	Dobera loranthifolia (Warb.) Harms	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	344	Capparaceae	Boscia coriacea Pax	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	345	Capparaceae	Cadaba ruspolii Gilg	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	346	Lamiaceae	Leucas nubica Benth.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	347	Capparaceae	Maerua denhardtiorum Gilg	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100

SR	348	Rubiaceae	Gardenia fiorii Chiov.	S	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
					1						
					14km NW of Stn 15						
					4km NW of Stn 15						
					14km NW of Stn 15						
SR	349	Acanthaceae	Neuracanthus tephropyllus Bidgood & Brummitt ssp. tephropyllus	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
					14km NW of Stn 15						
					14km NW of Stn 15						
SR	350	Lamiaceae	Ocimum americanum L.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
					14km NW of Stn 15						
					14km NW of Stn 15						
SR	351	Poaceae	Setaria verticillata (L.) P. Beauv.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	352	Malvaceae	Abutilon pannosum (G. Forst.) Schltdl. var. figarianum (Webb) Verdc.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	353	Papilionaceae (Leguminosae)	Crotalaria sp.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	354	Acanthaceae	Barleria linearifolia Rendle	S	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	355	Solanaceae	Solanum coagulans Forssk.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	356	Poaceae	Sporobolus helvolus (Trin.) T. Durand & Schinz	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	357	Solanaceae	Lycium shawii Roem. & Schult.	S	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	358	Acanthaceae	Ruellia patula Jacq.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	359	Malvaceae	Grewia tenax (Forssk.) Fiori	S	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	360	Burseraceae	Commiphora campestris Engl.	T	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	361	Malvaceae	Abutilon fruticosum Guill. & Perr. var. fruticosum	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	362	Salvadoraceae	Salvadora persica L. var. persica	T	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	363	Apocynaceae	Pergularia daemia (Forssk.) Chiov. ssp. daemia	C	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	364	Amaranthaceae	Pupalia lappacea (L.) A. Juss.	H	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	365	Burseraceae	Commiphora holtziana Engl.	T	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	366	Capparaceae	Maerua oblongifolia (Forssk.) A. Rich.	T	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100

SR	367	Amaranthaceae	Amaranthus sparganiocephalus Thell.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	368	Malvaceae	Corchorus trilocularis L.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	369	Peddaliaceae	Pedaliodiscus macrocarpus Ihlenf.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	370	Capparaceae	Cadaba sp.	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	371	Vitaceae	Cissus aphylla Chiov.	C			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	372	Vitaceae	Cissus adeyana Masinde & L.E. Newton	C			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	373	Acanthaceae	Blepharis sp.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	374	Poaceae	Aristida sp.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	375	Capparaceae	Maerua crassifolia Forssk.	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	376	Mimosaceae (Leguminosae)	Acacia zanzibarica (S. Moore) Taub. var. zanzibarica	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	377	Peddaliaceae	Sesamothamnus sp.	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	378	Malvaceae	Grewia villosa Willd.	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	379	Apocynaceae	Cynanchum hastifolium K. Schum. ssp. longistyl	C			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	380	Capparaceae	Maerua decumbens (Brongn.) DeWolf	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	381	Acanthaceae	Barleria gracilispina (Fiori) I. Darbysh.	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	382	Capparaceae	Cadaba glandulosa Forssk.	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	383	Boraginaceae	Cordia quercifolia Klotzsch	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	384	Cucurbitaceae	Zehneria anomala C. Jeffrey	C			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	385	Asteraceae	Blepharispermum minus S. Moore	S		vu B1ab(iii) +2ab(iii)	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	386	Mimosaceae (Leguminosae)	Acacia hamulosa Benth.	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	387	Euphorbiaceae	Dalechampia parvifolia Lam.	C				Pt 436	1.0343	S	40.1612	E	100
SR	388	Verbenaceae	Chascanum sp.	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	389	Capparaceae	Maerua mungaii Beentje	C		vu B1ab(iii) + B2ab(iii)	14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	390	Boraginaceae	Hilsenbergia lyciacea (Thulin) J.S. Mill.	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	391	Papilionaceae (Leguminosae)	Indigofera tinctoria L. var. tinctoria	H			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	392	Mimosaceae (Leguminosae)	Acacia horrida (L.) Willd. ssp. benadirensis Hillcoat & Brenan	T			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
SR	393	Mimosaceae (Leguminosae)	Acacia oerfota (Forssk.) Schweinf.	S			14km NW of Stn 15	Pt 436	1.0343	S	40.1612	E	100
HS	2558	Rubiaceae	Coffea rhamnifolia (Chiov.) Bridson	T	EA,K	en B2ab(iii)	Hola – Garsen	Pt 437	1.6957	S	40.0031	E	50

HS	2559	Papilionaceae (Leguminosae)	Crotalaria comanestiana Volkens & Schweinf.	H	EA,K			Hola – Garsen	Pt 437	1.6957	S	40.0031	E	50
HS	2560	Cyperaceae	Kyllinga polyphylla Kunth var. polyphylla	H	EA,K			Witu FR Euphorbia site	Pt 437B	2.3939	S	40.5376	E	20
HS	2561	Cyperaceae	Fuirena ciliaris (L.) Roxb. forma ciliaris	H	EA			Witu FR Euphorbia site	Pt 437B	2.3939	S	40.5376	E	20
HS	2562	Lythraceae	Ammania auriculata Willd.	H	EA			Witu FR Euphorbia site	Pt 437B	2.3939	S	40.5376	E	20
HS	2563	Scrophulariaceae	Limnophila indica (L.) Druce	H	EA,K			Witu FR Euphorbia site	Pt 437B	2.3939	S	40.5376	E	20
HS	2564	Alismataceae	Limnophyton obtusifolium (L.) Miq.	H	EA			Witu FR Euphorbia site	Pt 437B	2.3939	S	40.5376	E	20
HS	2565	Nymphaceae	Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.	A	EA,K		flws white/blue (=Gillett 20426)	5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2566	Menyanthaceae	Nymphoides forbesiana (Griseb.) Kuntze	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2567	Hydrocharitaceae	Lagarosiphon cordofanus Casp.	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2568	Cyperaceae	Eleocharis atropurpurea (Retz.) J. Presl	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2569	Cyperaceae	Schoenoplectiella juncea (Willd.) Lye	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2570	Cyperaceae	Schoenoplectiella lateriflora (J.F. Gmel.) Lye ssp. lateriflora	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2571	Cyperaceae	Schoenoplectiella articulata (L.) Lye	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2572	Hydroleaceae	Hydrolea sansibarica Gilg	H	EA,K	VU B2ab(iii)		5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2573	Alismataceae	Burnatia enneandra Micheli	H	EA,K		No K7 in FTEA	5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2574	Cyperaceae	Pycreus sp.	H	EA			5km W of Lamu 5km W of Lamu Maritime Term Maritime Term 5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2575	Scrophulariaceae	Bacopa floribunda (R. Br.) Wettst.	H	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2576	Papilionaceae (Leguminosae)	Vigna unguiculata (L.) Walp. ssp. dekindtiana (Harms) Verdc.	C	EA,K			5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5

HS	2577		Commelinaceae	Murdannia axillaris Brenan	H	EA,K		5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2578		Eriocaulaceae	Eriocaulon elegantulum Engl.	H	EA,K		5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2579		Phyllanthaceae	Phyllanthus harrisii Radcl.-Sm.	H	EA,K	LC	5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2580	A	Lythraceae	Nesaea triflora (L.f.) Kunth ssp. triflora	H	EA	EN B2ab(iii)	5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2580	B	Poaceae	Panicum genuflexum Stapf	H	EA,K		5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2580	C	Poaceae	Brachiaria reptans (L.) Gardner & C.E. Hubb.	H	EA,K		5km W of Lamu Maritime Term	Pt 439	2.1977	S	40.8687	E	5
HS	2581		Amaranthaceae	Digera muricata (L.) Mart. ssp. trinervis C.C. Towns. var. patentipilosa C.C. Towns.	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2582		Vahliaceae	Vahlia dichotoma (Murray) Kuntze	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2583		Poaceae	Sporobolus virginicus (L.) Kunth	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2584		Cyperaceae	Pycreus polystachyos (Rottb.) P. Beauv. var. polystachyos	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2585		Cyperaceae	Abildgaardia triflora (L.) Abeyw.	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2586		Cyperaceae	Fimbristylis cymosa R. Br.	H	EA		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2587		Cyperaceae	Pycreus hildebrandtii C.B. Clarke	H	EA,K	LC	3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2588		Polygalaceae	Polygala conosperma Bojer	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2589		Papilionaceae (Leguminosae)	Crotalaria rhynchocarpa Polhill	H	EA,K	en B1ab(iii) + B2ab(iii)	3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2590		Malvaceae	Melhania rotundata Mast.	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2591		Malvaceae	Hibiscus ceratophorus Thulin	H	EA,K		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2592		Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	EA,K	vu B1ab(iii) +2ab(iii)	3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1

HS	2593	Poaceae	Digitaria argyrotricha (Andersson) Chiov.	H	EA,K			3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2594	Poaceae	Brachiaria leucacrantha (K. Schum.) Stapf	H	EA			3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2595	Papilionaceae (Leguminosae)	Vigna membranacea A. Rich. ssp. hapalantha (Harms) Verdc.	C	EA,K		K7 endemic	3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2596	Papilionaceae (Leguminosae)	Crotalaria malindiensis Polhill	H	EA	vu B1ab(iii) +B2ab(iii)		3km W of Lamu Maritime Term	Pt 440	2.1966	S	40.8897	E	1
HS	2597	Cyperaceae	Cyperus denudatus L.f.	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2598	Papilionaceae (Leguminosae)	Rhynchosia viscosa (Roth) DC. ssp. viscosa var. viscosa	C	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2599	Phyllanthaceae	Phyllanthus leucocayx Hutch.	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2600	Acanthaceae	Justicia bracteata (Hochst.) Zarb	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2601	Erythroxylaceae	Erythroxylum platyclados Bojer	T	EA			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2602	Solanaceae	Solanum usaramense Dammer	C	EA		K7 T3,6 Moz	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2603	Papilionaceae (Leguminosae)	Indigofera cuneata Oliv.	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2604	Papilionaceae (Leguminosae)	Indigofera charlierana Schinz	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2605	Acanthaceae	Asystasia ansellioides C.B. Clarke	H	EA,K			7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
HS	2606	Loranthaceae	Agelanthus subulatus (Engl.) Polhill & Wiens	P	EA,K			8.7km NW of Lamu Maritime Term	Pt 442	2.1801	S	40.8423	E	5
SR	394	Arecaceae	Hyphaene compressa H. Wendl.	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	395	Anacardiaceae	Lannea schweinfurthii (Engl.) Engl. var. stuhlmannii (Engl.) Kokwaro	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	396	Mimosaceae (Leguminosae)	Dichrostachys cinerea (L.) Wight & Arn.	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	397	Rubiaceae	Catunaregam nilotica (Stapf) Tirveng.	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	398	Strychnaceae	Strychnos spinosa Lam. ssp. volkensii (Gilg) E.A. Bruce	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	399	Strychnaceae	Strychnos madagascariensis Poir.	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	400	Salicaceae	Flacourtia indica (Burm.f.) Merr.	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	401	Rubiaceae	Polysphaeria parvifolia Hiern	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	402	Ochnaceae	Ochna mossambicensis Klotzsch	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	403	Lamiaceae	Vitex ferruginea Schumach. & Thonn. ssp. amboniensis (Gürke) Verdc. var. amboniensis	T				Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5

SR	404	Poaceae	Panicum infestum Andersson	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	405	Malvaceae	Waltheria indica L.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	406	Lauraceae	Cassytha filiformis L.	P		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	407	Papilionaceae (Leguminosae)	Vigna membranacea A. Rich. ssp. hapalantha (Harms) Verdc.	C	K7 endemic	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	408	Rubiaceae	Spermacoce filituba (K. Schum.) Verdc.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	409	Commelinaceae	Commelina forskaolii Vahl	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	410	Papilionaceae (Leguminosae)	Indigofera strobilifera (Hochst.) Baker	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	411	Poaceae	Eragrostis ciliaris (L.) R. Br.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	412	Poaceae	Digitaria argyrotricha (Andersson) Chiov.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	413	Polygalaceae	Polygala amboniensis Gürke	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	414	Papilionaceae (Leguminosae)	Rhynchosia velutina Wight & Arn.	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	415	Caesalpiniaceae (Leguminosae)	Chamaecrista telfairiana (Hook.f.) Lock	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	416	Bignoniaceae	Kigelia africana (Lam.) Benth. ssp. africana	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	417	Connaraceae	Rourea orientalis Baill.	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	418	Rubiaceae	Kohautia caespitosa Schnizl.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	419	Lobeliaceae	Lobelia fervens Thunb. ssp. recurvata (E.Wimm.) Thulin	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	420	Orobanchaceae	Striga asiatica (L.) Kuntze	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	421	Rubiaceae	Agathisanthemum bojeri Klotzsch var. bojeri	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	422	Poaceae	Sacciolepis curvata (L.) Chase	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	423	Poaceae	Rottboellia cochinchinensis (Lour.) Clayton	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	424	Poaceae	Perotis patens Gand.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	425	Clusiaceae	Garcinia livingstonei T. Anderson	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	426	Poaceae	Digitaria milanjiana (Rendle) Stapf	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	427	Papilionaceae (Leguminosae)	Tephrosia purpurea (L.) Pers. ssp. dunensis Brummitt	H	(appressed)	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	428	Anacardiaceae	Anacardium occidentale L.	T	Cult/Naturalised	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	429	Phyllanthaceae	Antidesma venosum Tul.	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	430	Orobanchaceae	Striga gesnerioides (Willd.) Vatke	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	431	Amaranthaceae	Psilotrichum sericeum (Roxb.) Dalziel	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	432	Papilionaceae (Leguminosae)	Tephrosia villosa (L.) Pers. ssp. ehrenbergiana (Schweinf.) Brummitt	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5

SR	433	Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	434	Papilionaceae (Leguminosae)	Crotalaria rhynchocarpa Polhill	H	en B1ab(iii) + B2ab(iii)	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	435	Sapindaceae	Deinbollia borbonica Scheff. forma glabrata Radlk.	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	436	Poaceae	Heteropogon contortus (L.) Roem. & Schult.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	437	Vitaceae	Ampelocissus africana (Lour.) Merr. var. africana	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	438	Cucurbitaceae	Ctenolepis cerasiformis (Stocks) Hook.f.	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	439	Convolvulaceae	Jacquemontia tamnifolia (L.) Griseb.	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	440	Lamiaceae	Endostemon gracilis (Benth.) M. Ashby	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	441	Rubiaceae	Feretia apodanthera Delile ssp. keniensis Bridson	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	442	Euphorbiaceae	Dalechampia parvifolia Lam.	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	443	Cyperaceae	Cyperus rotundus L.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	444	Asteraceae	Aspilia mossambicensis (Oliv.) Wild	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	445	Poaceae	Panicum maximum Jacq.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	446	Solanaceae	Solanum campylacanthum A. Rich.	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	447	Annonaceae	Uvaria leptocladon Oliv. ssp. leptocladon?	C	NT; lc	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	448	Salvadoraceae	Azima tetracantha Lam.	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	449	Papilionaceae (Leguminosae)	Philenoptera bussei (Harms) Schrire	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	450	Poaceae	Dactyloctenium aegyptium (L.) Willd.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	451	Phyllanthaceae	Bridelia cathartica G. Bertol.	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	452	Simaroubaceae	Harrisonia abyssinica Oliv.	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	453	Papilionaceae (Leguminosae)	Indigofera hirsuta L.	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	454	Lamiaceae	Volkameria glabra E. Mey.) Mabb. & Y.W. Yuan	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	455	Malvaceae	Grewia plagiophylla K. Schum.	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	456	Malvaceae	Grewia triflora (Bojer) Walp.	T		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	457	Poaceae	Leptothrium senegalense (Kunth) Clayton	H		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	458	Phyllanthaceae	Phyllanthus reticulatus Poir. var. glaber (Thwaites) Müll.Arg.	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	459	Oleaceae	Jasminum fluminense Vell. ssp. fluminense	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	460	Combretaceae	Combretum aculeatum Vent.	S		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	461	Apocynaceae	Ancylobotrys petersiana (Klotzsch) Pierre	C		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5

SR	462	Polygonaceae	Oxygonum atriplicifolium (Meisn.) Martel.	H	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	463	Vitaceae	Cissus rotundifolia (Forssk.) Vahl var. rotundifolia	C	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	464	Malvaceae	Triumfetta rhomboidea Jacq.	S	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	465	Meliaceae	Trichilia emetica Vahl	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	466	Sapotaceae	Mimusops obtusifolia Lam.	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	467	Annonaceae	Uvaria lucida Benth. ssp. lucida	C	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	468	Sapindaceae	Allophylus rubifolius (A. Rich.) Engl. var. alnifolius (Baker) Friis & Vollesen	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	469	Sapindaceae	Lecaniodiscus fraxinifolius Baker ssp. scassellatii (Chiov.) Friis	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	470	Boraginaceae	Ehretia bakeri Britten	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	471	Anacardiaceae	Searsia natalensis (C. Krauss) F.A. Barkley	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	472	Capparaceae	Capparis sepiaria L.	C	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	473	Boraginaceae	Hilsenbergia petiolaris (Lam.) J.S. Mill.	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	474	Capparaceae	Thilachium thomasii Gilg	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	475	Sapotaceae	Sideroxylon inerme L. ssp. diospyroides (Baker) J.H. Hemsl.	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	476	Annonaceae	Monanthotaxis fornicata (Baill.) Verdc.	C	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	477	Capparaceae	Maerua triphylla A. Rich.	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	478	Rubiaceae	Coptosperma graveolens (S. Moore) Degreef	T	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	479	Malvaceae	Hermannia exappendiculata (Mast.) K. Schum.	H	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	480	Malvaceae	Hibiscus micranthus L.f.	H	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	481	Arecaceae	Hyphaene compressa H. Wendl.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	482	Bignoniaceae	Markhamia zanzibarica (DC.) Engl.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	483	Combretaceae	Terminalia spinosa Engl.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	484	Ebenaceae	Diospyros squarrosa Klotzsch	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	485	Mimosaceae (Leguminosae)	Dichrostachys cinerea (L.) Wight & Arn.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3

SR	486	Ochnaceae	Ochna mossambicensis Klotzsch	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	487	Hypericaceae	Vismia orientalis Engl.	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	488	Sapindaceae	Lecaniodiscus fraxinifolius Baker ssp. scassellatii (Chiov.) Friis	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	489	Combretaceae	Combretum aculeatum Vent.	S		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	490	Rubiaceae	Feretia apodanthera Delile ssp. keniensis Bridson	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	491	Malvaceae	Waltheria indica L.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	492	Anacardiaceae	Anacardium occidentale L.	T	Cult/Naturalised	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	493	Malvaceae	Hibiscus micranthus L.f.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	494	Lamiaceae	Ocimum americanum L.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	495	Poaceae	Urochloa trichopus (Hochst.) Stapf	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	496	Papilionaceae (Leguminosae)	Alysicarpus vaginalis (L.) DC. var. vaginalis	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	497	Poaceae	Eragrostis cilianensis (All.) Janch.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	498	Poaceae	Brachiaria leucacrantha (K. Schum.) Stapf	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	499	Papilionaceae (Leguminosae)	Tephrosia pumila (Lam.) Pers. var.?	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	500	Poaceae	Digitaria argyrotricha (Andersson) Chiov.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	501	Euphorbiaceae	Euphorbia hirta L.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	502	Poaceae	Panicum maximum Jacq.	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	503	Rubiaceae	Polysphaeria parvifolia Hiern	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3

SR	504	Simaroubaceae	Harrisonia abyssinica Oliv.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	505	Euphorbiaceae	Dalechampia parvifolia Lam.	C	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	506	Apocynaceae	Pergularia daemia (Forssk.) Chiov. ssp. daemia	C	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	507	Rubiaceae	Kohautia caespitosa Schnizl.	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	508	Poaceae	Panicum infestum Andersson	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	509	Commelinaceae	Commelina forskaolii Vahl	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	510	Phyllanthaceae	Phyllanthus leucocayx Hutch.	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	511	Phyllanthaceae	Bridelia cathartica G. Bertol.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	512	Malvaceae	Triumfetta rhomboidea Jacq.	S	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	513	Malvaceae	Hermannia exappendiculata (Mast.) K. Schum.	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	514	Malvaceae	Grewia plagiophylla K. Schum.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	515	Papilionaceae (Leguminosae)	Indigofera tinctoria L. var. tinctoria	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	516	Meliaceae	Turraea nilotica Kotschy & Peyr.	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	517	Poaceae	Perotis patens Gand.	H	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	518	Anacardiaceae	Lannea schweinfurthii (Engl.) Engl. var. stuhlmannii (Engl.) Kokwaro	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	519	Papilionaceae (Leguminosae)	Rhynchosia velutina Wight & Arn.	C	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	520	Papilionaceae (Leguminosae)	Millettia usaramensis Taub. ssp. usaramensis var. usaramensis	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	521	Ebenaceae	Euclea natalensis A. DC. ssp. obovata F. White	T	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3

SR	522	Papilionaceae (Leguminosae)	Vigna membranacea A. Rich. ssp. hapalantha (Harms) Verdc.	C	K7 endemic	7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	523	Cucurbitaceae	Momordica trifoliolata Hook.f.	C		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	524	Vitaceae	Cissus rotundifolia (Forssk.) Vahl var. rotundifolia	C		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	525	Boraginaceae	Hilsenbergia nemoralis (Gürke) J.S. Mill.	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	526	Poaceae	Sacciolepis curvata (L.) Chase	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	527	Papilionaceae (Leguminosae)	Philenoptera bussei (Harms) Schrire	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	528	Burseraceae	Commiphora africana (A. Rich.) Engl.	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	529	Cucurbitaceae	Peponium vogelii (Hook.f.) Engl.	C		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	530	Papilionaceae (Leguminosae)	Indigofera strobilifera (Hochst.) Baker	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	531	Capparaceae	Thilachium thomasii Gilg	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	532	Burseraceae	Commiphora edulis (Klotzsch) Engl. ssp. boiviniana (Engl.) J.B. Gillett	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	533	Annonaceae	Uvaria acuminata Oliv.	C		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	534	Caesalpiniaceae (Leguminosae)	Senna singueana (Delile) Lock	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	535	Anacardiaceae	Searsia natalensis (C. Krauss) F.A. Barkley	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	536	Moraceae	Maclura africana (Bureau) Corner	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	537	Simaroubaceae	Harrisonia abyssinica Oliv.	T		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	538	Lamiaceae	Endostemon gracilis (Benth.) M. Ashby	H		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	539	Annonaceae	Monanthotaxis fornicata (Baill.) Verdc.	C		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3

SR	540	Anacardiaceae	Sclerocarya birrea (A. Rich.) Hochst. ssp. caffra (Sond.) Kokwaro	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	541	Euphorbiaceae	Erythrococca kirkii (Müll.Arg.) Prain	S				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	542	Malvaceae	Grewia triflora (Bojer) Walp.	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	543	Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T		vu B1ab(iii) +2ab(iii)		7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	544	Amaranthaceae	Digera muricata (L.) Mart. ssp. trinervis C.C. Towns. var. patentipilosa C.C. Towns.	H				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	545	Anacardiaceae	Ozoroa obovata (Oliv.) R. Fern. & A. Fern.	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	546	Olacaceae	Ximenia caffra Sond.	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	547	Rubiaceae	Keetia zanzibarica (Klotzsch) Bridson ssp. zanzibarica	C				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	548	Celastraceae	Gymnosporia heterophylla (Eckl. & Zeyh.) Loes.	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	549	Lamiaceae	Vitex ferruginea Schumach. & Thonn. ssp. amboniensis (Gürke) Verdc. var. amboniensis	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
SR	550	Caesalpiniaceae (Leguminosae)	Tamarindus indica L.	T				7.5km W of Lamu Maritime Term	Pt 441	2.1957	S	40.8495	E	3
HS	2607	Poaceae	Panicum hippothrix K. Schum.	H	EA,K	LC		Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2608	Poaceae	Brachiaria longiflora Clayton	H	EA,K		K7 endemic	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2609	Commelinaceae	Commelina sp.	H	EA,K		mult spathes	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2610	Papilionaceae (Leguminosae)	Tephrosia linearis (Willd.) Pers.	H	EA			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2611	Cyperaceae	Bulbostylis hispidula (Vahl) R.W. Haines ssp. hispidula	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2612	Cyperaceae	Cyperus frerei C.B. Clarke	H	EA,K,MO		does not equal C.crassipes (FTEA)	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2613	Vahliaceae	Vahlia dichotoma (Murray) Kuntze	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2614	Papilionaceae (Leguminosae)	Indigofera wituensis Baker f.	H	EA,K		K7, T36P	Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2615	Molluginaceae	Mollugo cerviana (L.) Ser. var. spathulifolia Fenzl	H	EA,K			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2616	Poaceae	Eragrostis sennii Chiov.	H	EA,K			1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10

HS	2617	Poaceae	Sporobolus coromandelianus (Retz.) Kunth	H	EA,K	K2,K7,SA	1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
HS	2618	Poaceae	Brachiaria leersioides (Hochst.) Stapf	H	EA,K		1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
HS	2619	Poaceae	Echinochloa colona (L.) Link	H	EA,K		1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
HS	2620	Poaceae	Digitaria ciliaris (Retz.) Koel.	H	EA,K		1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
HS	2621	Poaceae	Chloris virgata Sw.	H	EA		1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
HS	2622	Poaceae	Cenchrus mitis Andersson	H	EA,K		1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
HS	2623	Poaceae	Cenchrus echinatus L.	H	EA,K		1.5 Km NW of Lamu Maritime Term	Pt 438B	2.1938	S	40.9099	E	10
SR	551	Convolvulaceae	Merremia tridentata (L.) Hallier f.	C			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	552	Euphorbiaceae	Euphorbia cuneata Vahl ssp.	S			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	553	Cyperaceae	Fuirena ciliaris (L.) Roxb.	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	554	Caesalpiniaceae (Leguminosae)	Tamarindus indica L.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	555	Euphorbiaceae	Jatropha curcas L.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	556	Euphorbiaceae	Suregada zanzibariensis Baill.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	557	Rutaceae	Zanthoxylum chalybeum Engl. var. chalybeum	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	558	Poaceae	Enteropogon macrostachyus (A. Rich.) Benth.	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	559	Acanthaceae	Asystasia ansellioides C.B. Clarke	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	560	Papilionaceae (Leguminosae)	Indigofera trita L.f. var. subulata (Poir.) Ali	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	561	Rubiaceae	Meyna tetraphylla (Hiern) Robyns ssp. comorensis (Robyns) Verdc.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	562	Rubiaceae	Keetia zanzibarica (Klotzsch) Bridson ssp. zanzibarica	C			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	563	Cyperaceae	Kyllinga polyphylla Kunth var. polyphylla	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	564	Poaceae	Dactyloctenium geminatum Hack.	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	565	Orobanchaceae	Buchnera hispida D. Don	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	566	Celastraceae	Gymnosporia senegalensis (Lam.) Loes.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	567	Poaceae	Hyperthelia dissoluta (Steud.) Clayton	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5

SR	568	Boraginaceae	Heliotropium zeylanicum (Burm.f.) Lam.	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	569	Rhamnaceae	Ziziphus mauritiana Lam.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	570	Sapindaceae	Haplocoelum inoploeum Radlk.	T			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
SR	571	Malvaceae	Hibiscus ceratophorus Thulin	H			Lamu Maritime Term	Pt 438	2.2073	S	40.9155	E	5
HS	2624	Malvaceae	Pavonia leptocalyx (Sond.) Ulbr.	H	EA		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2625	Papilionaceae (Leguminosae)	Indigofera tanganyikensis Baker f. var. paucijuga J.B. Gillett	H	EA,K	vu B2ab(iii)	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2626	Boraginaceae	Heliotropium pectinatum Vaupel ssp. pectinatum	H	EA		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2627	Commelinaceae	Aneilema petersii (Hassk.) C.B. Clarke ssp. petersii	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2628	Combretaceae	Combretum padoides Engl. & Diels	C	EA		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2629	Papilionaceae (Leguminosae)	Crotalaria malindiensis Polhill	H	EA,K	vu B1ab(iii) +B2ab(iii)	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2630	Papilionaceae (Leguminosae)	Zornia apiculata Milne-Redh.	H	EA		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2631	Cyperaceae	Bulbostylis hispidula (Vahl) R.W. Haines ssp. hispidula	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2632	Campanulaceae	Wahlenbergia abyssinica (A. Rich.) Thulin ssp. parvipetala Thulin	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2633	Amaranthaceae	Celosia schweinfurthiana Schinz	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2634	Rubiaceae	Kohautia caespitosa Schnizl.	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2635	Poaceae	Eragrostis aethiopica Chiov.	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2636	Poaceae	Digitaria perrottetii (Kunth) Stapf	H	EA,K		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	572	Zamiaceae	Encephalartos hildebrandtii A. Braun & C.D. Bouché	T			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	573	Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T		vu B1ab(iii) +2ab(iii)	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	574	Rubiaceae	Heinsia crinita (Afzel.) G. Taylor ssp. parvifolia (K. Schum. & K. Krause) Verdc.	T			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	575	Malvaceae	Hibiscus surattensis L.	H			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	576	Sapindaceae	Lecaniodiscus fraxinifolius Baker ssp. scassellatii (Chiov.) Friis	T			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	577	Malvaceae	Gossypioides kirkii (Mast.) J.B.Hutch.	C			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	578	Malvaceae	Triumfetta rhomboidea Jacq.	S			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	579	Malvaceae	Waltheria indica L.	H			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	580	Papilionaceae (Leguminosae)	Rhynchosia velutina Wight & Arn.	C			12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15

SR	581	Papilionaceae (Leguminosae)	Tephrosia noctiflora Baker	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	582	Sapindaceae	Allophylus rubifolius (A. Rich.) Engl. var. alnifolius (Baker) Friis & Vollesen	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	583	Rubiaceae	Pentas bussei K. Krause	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	584	Boraginaceae	Hilsenbergia nemoralis (Gürke) J.S. Mill.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	585	Amaranthaceae	Psilotrichum scleranthum Thwaites	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	586	Acanthaceae	Blepharis maderaspatensis (L.) Roth	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	587	Lamiaceae	Ocimum gratissimum L. ssp. gratissimum var. macrophyllum Briq.	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	588	Poaceae	Panicum maximum Jacq.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	589	Annonaceae	Uvaria acuminata Oliv.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	590	Poaceae	Panicum infestum Andersson	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	591	Mimosaceae (Leguminosae)	Dichrostachys cinerea (L.) Wight & Arn.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	592	Ochnaceae	Ochna mossambicensis Klotzsch	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	593	Malvaceae	Grewia plagiophylla K. Schum.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	594	Capparaceae	Maerua triphylla A. Rich.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	595	Phyllanthaceae	Bridelia cathartica G. Bertol.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	596	Thymelaeaceae	Gnidia latifolia (Oliv.) Gilg	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	597	Poaceae	Sacciolepis curvata (L.) Chase	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	598	Asteraceae	Vernonia homilantha S. Moore?	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	599	Commelinaceae	Commelina benghalensis L.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	600	Rubiaceae	Spermacoce filituba (K. Schum.) Verdc.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	601	Annonaceae	Monanthotaxis fornicata (Baill.) Verdc.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	602	Lamiaceae	Endostemon gracilis (Benth.) M. Ashby	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	603	Poaceae	Digitaria argyrotricha (Andersson) Chiov.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	604	Poaceae	Eragrostis ciliaris (L.) R. Br.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	605	Papilionaceae (Leguminosae)	Indigofera trita L.f. var. subulata (Poir.) Ali	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	606	Euphorbiaceae	Suregada zanzibariensis Baill.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	607	Rubiaceae	Psydrax faulknerae Bridson	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15

SR	608	Poaceae	Panicum deustum Thunb.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	609	Thymelaeaceae	Synaptolepis kirkii Oliv.	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	610	Boraginaceae	Ehretia bakeri Britten	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	611	Cucurbitaceae	Momordica trifoliolata Hook.f.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	612	Asparagaceae	Asparagus flagellaris (Kunth) Baker	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	613	Connaraceae	Rourea coccinea (Schumach. & Thonn.) Benth. ssp. boiviniana (Baill.) Jongkind	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	614	Poaceae	Leptochloa obtusiflora Hochst.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	615	Celastraceae	Loeseneriella africana (Willd.) N. Hallé var. richardiana (Cambess.) N. Hallé	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	616	Amaranthaceae	Psilotrichum sericeum (Roxb.) Dalziel	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	617	Rubiaceae	Polysphaeria parvifolia Hiern	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	618	Malvaceae	Grewia holstii Burret	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	619	Lauraceae	Cassytha filiformis L.	P	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	620	Malvaceae	Hermannia exappendiculata (Mast.) K. Schum.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	621	Apocynaceae	Hunteria zeylanica (Retz.) Thwaites	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	622	Poaceae	Perotis patens Gand.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	623	Apocynaceae	Landolphia kirkii Dyer	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	624	Rubiaceae	Feretia apodanthera Delile ssp. keniensis Bridson	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	625	Poaceae	Panicum hippothrix K. Schum.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	626	Papilionaceae (Leguminosae)	Indigofera strobilifera (Hochst.) Baker	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	627	Papilionaceae (Leguminosae)	Tephrosia purpurea (L.) Pers. ssp. dunensis Brummitt	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	628	Rubiaceae	Oldenlandia affinis (Roem. & Schult.) DC. ssp. fugax (Vatke) Verdc.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	629	Rubiaceae	Rytigynia celastroides (Baill.) Verdc. var. celastroides	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	630	Phyllanthaceae	Flueggea virosa (Willd.) Voigt ssp. virosa	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	631	Caesalpiniaceae (Leguminosae)	Chamaecrista telfairiana (Hook.f.) Lock	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	632	Lamiaceae	Vitex schliebenii Moldenke	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	633	Phyllanthaceae	Margaritaria discoidea (Baill.) G.L. Webster	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15

SR	634	Rubiaceae	Oldenlandia corymbosa L.	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	635	Malvaceae	Sida ovata Forssk.	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	636	Papilionaceae (Leguminosae)	Indigofera longiracemosa Baill.	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	637	Cyperaceae	Cyperus compressus L.	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	638	Apocynaceae	Tabernaemontana elegans Stapf	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	639	Celastraceae	Gymnosporia putterlickioides Loes.	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	640	Convolvulaceae	Hewittia malabarica (L.) Suresh	C		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	641	Sapindaceae	Deinbollia borbonica Scheff. forma glabrata Radlk.	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	642	Loranthaceae	Agelanthus subulatus (Engl.) Polhill & Wiens	P		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	643	Rutaceae	Zanthoxylum chalybeum Engl. var. chalybeum	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	644	Mimosaceae (Leguminosae)	Entada leptostachya Harms	C		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	645	Vitaceae	Cyphostemma adenocaule (A. Rich.) Wild & R.B. Drumm. ssp. adenocaule	C		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	646	Cucurbitaceae	Peponium vogelii (Hook.f.) Engl.	C		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	647	Papilionaceae (Leguminosae)	Vigna membranacea A. Rich. ssp. hapalantha (Harms) Verdc.	C	K7 endemic	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	648	Malvaceae	Carpodiptera africana Mast.	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	649	Menispermaceae	Tiliacora funifera (Miers) Oliv.	C		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	650	Menispermaceae	Cissampelos pareira L. var. hirsuta (DC.) Forman	C		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	651	Commelinaceae	Commelina forskaolii Vahl	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	652	Simaroubaceae	Harrisonia abyssinica Oliv.	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	653	Papilionaceae (Leguminosae)	Pseudovigna argentea (Willd.) Verdc.	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	654	Papilionaceae (Leguminosae)	Indigofera hirsuta L.	H		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	655	Annonaceae	Monodora grandidieri Baill.	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	656	Combretaceae	Combretum aculeatum Vent.	S		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	657	Capparaceae	Maerua triphylla A. Rich. var. calophylla (Gilg) DeWolf	T		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	658	Lamiaceae	Premna resinosa (Hochst.) Schauer ssp. holstii (Gürke) Verdc.	S		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	659	Solanaceae	Solanum campylacanthum A. Rich.	S		12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15

SR	660	Polygonaceae	Oxygonum atriplicifolium (Meisn.) Martel.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	661	Arecaceae	Hyphaene compressa H. Wendl.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	662	Strychnaceae	Strychnos spinosa Lam. ssp. volkensii (Gilg) E.A. Bruce	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	663	Papilionaceae (Leguminosae)	Ormocarpum kirkii S. Moore	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	664	Lamiaceae	Tinnea aethiopica Hook.f.	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	665	Anacardiaceae	Ozoroa obovata (Oliv.) R. Fern. & A. Fern.	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	666	Vitaceae	Cissus rotundifolia (Forssk.) Vahl var. rotundifolia	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	667	Capparaceae	Thilachium thomasii Gilg	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	668	Polygalaceae	Polygala amboniensis Gürke	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	669	Capparaceae	Capparis sp.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	670	Papilionaceae (Leguminosae)	Philenoptera bussei (Harms) Schrire	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	671	Lamiaceae	Rotheca microphylla (Blume) Callm. & Phillipson	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	672	Polygalaceae	Polygala sphenoptera Fresen.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	673	Lamiaceae	Vitex ferruginea Schumach. & Thonn. ssp. amboniensis (Gürke) Verdc. var. amboniensis	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	674	Papilionaceae (Leguminosae)	Tephrosia villosa (L.) Pers. ssp. ehrenbergiana (Schweinf.) Brummitt	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	675	Poaceae	Digitaria velutina (Forssk.) P. Beauv.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	676	Lamiaceae	Hoslundia opposita Vahl	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	677	Malvaceae	Hibiscus micranthus L.f.	H	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	678	Convolvulaceae	Merremia tridentata (L.) Hallier f.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	679	Connaraceae	Rourea orientalis Baill.	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	680	Cucurbitaceae	Kedrostis foetidissima (Jacq.) Cogn.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	681	Euphorbiaceae	Dalechampia parvifolia Lam.	C	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	682	Euphorbiaceae	Erythrococca kirkii (Müll.Arg.) Prain	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	683	Anacardiaceae	Lannea schweinfurthii (Engl.) Engl. var. stuhlmannii (Engl.) Kokwaro	T	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	684	Asteraceae	Vernonia hildebrandtii Vatke	S	12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15

SR	685		Cucurbitaceae	Coccinia grandis (L.) Voigt	C				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	686		Cucurbitaceae	Cucumis sacleuxii Pailleux & Bois	C				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	687		Commelinaceae	Commelina benghalensis L.	H				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	688		Poaceae	Brachiaria leucacrantha (K. Schum.) Stapf	H				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	689		Poaceae	Digitaria ciliaris (Retz.) Koel.	H				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	690		Malvaceae	Adansonia digitata L.	T				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
SR	691		Malvaceae	Grewia forbesii Mast.	S				12km SE of Stn 16	Pt 444	2.0168	S	40.7964	E	15
HS	2637	A	Orobanchaceae	Micrargeria filiformis (Schumach. & Thonn.) Hutch. & Dalziel	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2637	B	Annonaceae	Uvaria kirkii Hook.f.	S		NT'; lc		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2638		Poaceae	Dactyloctenium geminatum Hack.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2639		Poaceae	Aristida barbicollis Trin. & Rupr.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2640		Poaceae	Eragrostis perbella K. Schum.	H	EA,K	VU B2ab(iii)		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2641		Poaceae	Diheteropogon amplectens (Nees) Clayton var. amplectens	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2642		Poaceae	Hyparrhenia filipendula (Hochst.) Stapf	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2643		Phyllanthaceae	Phyllanthus leucocayx Hutch.	H	EA			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2644		Euphorbiaceae	Dalechampia trifoliata Peter ex Verdc. & Greenway var. trifoliata	C	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2645		Poaceae	Aristida stenostachya Clayton	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2646		Papilionaceae (Leguminosae)	Aeschynomene sp.B	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2647		Poaceae	Andropogon chinensis (Nees) Merr.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2648		Papilionaceae (Leguminosae)	Sesbania bispinosa (Jacq.) W. Wight var. micrantha (Chiov.) J.B. Gillett	H	EA,K		confirms K7	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2649		Phyllanthaceae	Phyllanthus harrisii Radcl.-Sm.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2650		Poaceae	Echinochloa haploclada (Stapf) Stapf	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2651		Polygalaceae	Polygala conosperma Bojer	H	EA			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2652		Cyperaceae	Cyperus niveus Retz. var. leucocephalus (Kunth) Fosberg	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

HS	2653		Commelinaceae	Commelina erecta L. ssp. erecta	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2654		Euphorbiaceae	Erythrococca pubescens Radcl.-Sm.	S	EA,K	vu B1ab(iii) + B2ab(iii)		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2655		Lamiaceae	Premna velutina Gürke	C	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2656		Malvaceae	Grewia densa K. Schum.	T	EA			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2657		Euphorbiaceae	Acalypha lanceolata Willd.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2658		Commelinaceae	Commelina mascarenica C.B. Clarke	H	EA,K,MO			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2659		Commelinaceae	Murdannia axillaris Brenan	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2660		Papilionaceae (Leguminosae)	Aeschynomene cristata Vatke var. pubescens J. Léonard	T	EA			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2661		Cucurbitaceae	Zehneria peneyana (Naudin) Asch. & Schweinf.	C	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2662		Cyperaceae	Cyperus pectinatus Vahl	H	EA,K		No K7 in FTEA	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2663		Poaceae	Echinochloa stagnina (Retz.) P. Beauv.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2664		Lentibulariaceae	Utricularia gibba L. ssp. exoleta (R. Br.) P. Taylor	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2665	A	Lentibulariaceae	Utricularia inflexa Forssk.	H	EA			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2665	B	Lythraceae	Nesaea pedicellata Hiern	H	EA,K	VU B2ab(iii)		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2666		Cyperaceae	Bulbostylis hispidula (Vahl) R.W. Haines ssp. filiformis (C.B. Clarke) R.W. Haines	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2667		Cyperaceae	Cyperus denudatus L.f.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
HS	2668		Poaceae	Setaria incrassata (Hochst.) Hack.	H	EA,K			17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	692		Arecaceae	Hyphaene compressa H. Wendl.	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	693		Mimosaceae (Leguminosae)	Dichrostachys cinerea (L.) Wight & Arn.	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	694		Simaroubaceae	Harrisonia abyssinica Oliv.	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	695		Anacardiaceae	Lannea schweinfurthii (Engl.) Engl. var. stuhlmannii (Engl.) Kokwaro	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	696		Clusiaceae	Garcinia livingstonei T. Anderson	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	697		Malvaceae	Grewia plagiophylla K. Schum.	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	698		Rubiaceae	Catunaregam nilotica (Stapf) Tirveng.	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	699		Lamiaceae	Vitex ferruginea Schumach. & Thonn. ssp. amboniensis (Gürke) Verdc. var. amboniensis	T				17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

SR	700	Salicaceae	Flacourtia indica (Burm.f.) Merr.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	701	Euphorbiaceae	Suregada zanzibariensis Baill.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	702	Anacardiaceae	Searsia natalensis (C. Krauss) F.A. Barkley	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	703	Phyllanthaceae	Bridelia cathartica G. Bertol.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	704	Caesalpiniaceae (Leguminosae)	Dialium orientale Baker f.	T	vu B1ab(iii) +2ab(iii)	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	705	Phyllanthaceae	Antidesma venosum Tul.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	706	Rubiaceae	Polysphaeria parvifolia Hiern	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	707	Burseraceae	Commiphora africana (A. Rich.) Engl.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	708	Rubiaceae	Afrocanthium kilifiense (Bridson) Lantz	T	VU B1+2c	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	709	Phyllanthaceae	Phyllanthus reticulatus Poir. var. glaber (Thwaites) Müll.Arg.	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	710	Ebenaceae	Diospyros bussei Gürke	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	711	Malvaceae	Grewia stuhlmannii K. Schum.	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	712	Rutaceae	Vepris glomerata (F.Hoffm.) Engl. var. glabra Kokwaro	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	713	Rubiaceae	Chassalia umbraticola Vatke ssp. umbraticola	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	714	Rubiaceae	Lamprothamnus zanguebaricus Hiern	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	715	Ochnaceae	Ochna mossambicensis Klotzsch	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	716	Thymelaeaceae	Synaptolepis kirkii Oliv.	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	717	Asteraceae	Vernonia hildebrandtii Vatke	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	718	Apocynaceae	Ancylobotrys petersiana (Klotzsch) Pierre	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	719	Lamiaceae	Hoslundia opposita Vahl	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	720	Lauraceae	Cassytha filiformis L.	P		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	721	Malvaceae	Waltheria indica L.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	722	Poaceae	Panicum infestum Andersson	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	723	Rubiaceae	Oldenlandia affinis (Roem. & Schult.) DC. ssp. fugax (Vatke) Verdc.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	724	Papilionaceae (Leguminosae)	Indigofera strobilifera (Hochst.) Baker	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	725	Commelinaceae	Commelina forskaolii Vahl	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	726	Rubiaceae	Spermacoce filituba (K. Schum.) Verdc.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

SR	727	Orobanchaceae	Buchnera hispida D. Don	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	728	Capparaceae	Capparis sepiaria L.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	729	Poaceae	Perotis patens Gand.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	730	Poaceae	Digitaria argyrotricha (Andersson) Chiov.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	731	Poaceae	Digitaria milanjiana (Rendle) Stapf	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	732	Cyperaceae	Bulbostylis hispidula (Vahl) R.W. Haines ssp. hispidula	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	733	Poaceae	Brachiaria leucacrantha (K. Schum.) Stapf	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	734	Orobanchaceae	Striga asiatica (L.) Kuntze	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	735	Poaceae	Heteropogon contortus (L.) Roem. & Schult.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	736	Papilionaceae (Leguminosae)	Stylosanthes fruticosa (Retz.) Alston	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	737	Rubiaceae	Agathisanthemum bojeri Klotzsch var. bojeri	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	738	Poaceae	Hyperthelia dissoluta (Steud.) Clayton	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	739	Poaceae	Eragrostis superba Peyr.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	740	Papilionaceae (Leguminosae)	Abrus precatorius L. ssp. africanus Verdc.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	741	Poaceae	Panicum maximum Jacq.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	742	Malvaceae	Sida ovata Forssk.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	743	Olacaceae	Ximenia caffra Sond.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	744	Papilionaceae (Leguminosae)	Dalbergia melanoxylon Guill. & Perr.	T	LR/nt	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	745	Caesalpiniaceae (Leguminosae)	Chamaecrista mimosoides (L.) Greene	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	746	Poaceae	Panicum hippothrix K. Schum.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	747	Rhamnaceae	Ziziphus mucronata Willd. ssp. mucronata	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	748	Lamiaceae	Premna resinosa (Hochst.) Schauer ssp. holstii (Gürke) Verdc.	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	749	Acanthaceae	Blepharis maderaspatensis (L.) Roth	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	750	Poaceae	Sacciolepis curvata (L.) Chase	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	751	Rubiaceae	Pyrostria bibracteata (Baker) Cavaco	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	752	Vitaceae	Cyphostemma duparquetii (Planch.) Desc.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	753	Lamiaceae	Endostemon gracilis (Benth.) M. Ashby	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

SR	754	Poaceae	Eragrostis ciliaris (L.) R. Br.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	755	Rubiaceae	Oxyanthus zanguebaricus (Hiern) Bridson	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	756	Acanthaceae	Asystasia gangetica (L.) T. Anderson ssp. micrantha (Nees) Ensermu	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	757	Sapotaceae	Sideroxylon inerme L. ssp. diospyroides (Baker) J.H. Hemsl.	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	758	Ebenaceae	Euclea natalensis A. DC. ssp. obovata F. White	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	759	Acanthaceae	Justicia flava (Forssk.) Vahl	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	760	Rhamnaceae	Scutia myrtina (Burm.f.) Kurz	S	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	761	Oleaceae	Jasminum fluminense Vell. ssp. fluminense	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	762	Combretaceae	Combretum aculeatum Vent.	S	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	763	Convolvulaceae	Merremia tridentata (L.) Hallier f.	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	764	Strychnaceae	Strychnos panganensis Gilg	S	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	765	Malvaceae	Pavonia leptocalyx (Sond.) Ulbr.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	766	Papilionaceae (Leguminosae)	Alysicarpus vaginalis (L.) DC. var. vaginalis	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	767	Loranthaceae	Agelanthus sansibarensis (Engl.) Polhill & Wiens ssp. sansibarensis	P	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	768	Verbenaceae	Lantana viburnoides (Forssk.) Vahl ssp. viburnoides var. viburnoides	S	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	769	Oleaceae	Jasminum meyeri-johannis Engl.	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	770	Poaceae	Enteropogon macrostachyus (A. Rich.) Benth.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	771	Rutaceae	Zanthoxylum chalybeum Engl. var. chalybeum	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	772	Malvaceae	Grewia forbesii Mast.	S	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	773	Malvaceae	Sterculia rhynchocarpa K. Schum.	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	774	Vitaceae	Cyphostemma hildebrandtii (Gilg) Wild & R.B. Drumm.	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	775	Menispermaceae	Cissampelos pareira L. var. hirsuta (DC.) Forman	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	776	Loranthaceae	Erianthemum dregei (Eckl. & Zeyh.) Tiegh.	P	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	777	Erythroxylaceae	Erythroxylum platyclados Bojer	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	778	Papilionaceae (Leguminosae)	Zornia apiculata Milne-Redh.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

SR	779	Caesalpiniaceae (Leguminosae)	Tamarindus indica L.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	780	Sapotaceae	Mimusops obtusifolia Lam.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	781	Poaceae	Panicum deustum Thunb.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	782	Annonaceae	Monanthotaxis fornicata (Baill.) Verdc.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	783	Papilionaceae (Leguminosae)	Ormocarpum kirkii S. Moore	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	784	Lobeliaceae	Lobelia fervens Thunb. ssp. recurvata (E.Wimm.) Thulin	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	785	Combretaceae	Terminalia spinosa Engl.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	786	Cyperaceae	Kyllinga polyphylla Kunth var. polyphylla	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	787	Salvadoraceae	Dobera loranthifolia (Warb.) Harms	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	788	Boraginaceae	Cordia faulknerae Verdc.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	789	Commelinaceae	Murdannia simplex (Vahl) Brenan	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	790	Poaceae	Eragrostis aethiopica Chiov.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	791	Hydroleaceae	Hydrolea sansibarica Gilg	H	VU B2ab(iii)	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	792	Capparaceae	Maerua calantha Gilg	C	nt	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	793	Violaceae	Hybanthus enneaspermus (L.) F. Muell. var.?	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	794	Icacinaceae	Pyrenacantha kaurabassana Baill.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	795	Malvaceae	Thespesia danis Oliv.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	796	Commelinaceae	Commelina benghalensis L.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	797	Menispermaceae	Tinospora caffra (Miers) Troupin	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	798	Malvaceae	Triumfetta rhomboidea Jacq.	S		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	799	Mimosaceae (Leguminosae)	Acacia nilotica (L.) Delile ssp. leiocarpa Brenan	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	800	Amaranthaceae	Psilotrichum sericeum (Roxb.) Dalziel	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	801	Sapotaceae	Manilkara mochisia (Baker) Dubard	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	802	Amaryllidaceae	Crinum sp.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	803	Euphorbiaceae	Dalechampia parvifolia Lam.	C		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	804	Asteraceae	Vernonia cinerea (L.) Less. var. cinerea	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	805	Malvaceae	Hibiscus cannabinus L.	H		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	806	Mimosaceae (Leguminosae)	Albizia anthelmintica Brongn.	T		17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

					17.3km SE of Stn 16						
SR	807	Caesalpiniaceae (Leguminosae)	Chamaecrista telfairiana (Hook.f.) Lock	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
					17.3km SE of Stn 16						
					17.3km SE of Stn 16						
SR	808	Anacardiaceae	Sclerocarya birrea (A. Rich.) Hochst. ssp. caffra (Sond.) Kokwaro	T	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	809	Vitaceae	Cissus phymatocarpa Masinde & L.E. Newton	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	810	Phyllanthaceae	Flueggea virosa (Willd.) Voigt ssp. virosa	S	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	811	Poaceae	Rottboellia cochinchinensis (Lour.) Clayton	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	812	Cyperaceae	Fuirena ciliaris (L.) Roxb.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	813	Rubiaceae	Pentodon pentandrus (Schumach. & Thonn.) Vatke var.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	814	Alismataceae	Limnophyton obtusifolium (L.) Miq.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	815	Araceae	Pistia stratiotes L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	816	Cyperaceae	Cyperus prolifer Lam.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	817	Poaceae	Paspalidium obtusifolium (Delile) N.D. Simpson	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	818	Poaceae	Oryza punctata Steud.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	819	Onagraceae	Ludwigia adscendens (L.) H. Hara ssp. diffusa (Forssk.) P.H. Raven	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	820	Nymphaceae	Nymphaea nouchali Burm.f. var. zanzibariensis (Casp.) Verdc.?	A	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	821	Alismataceae	Burnatia enneandra Micheli	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	822	Scrophulariaceae	Limnophila indica (L.) Druce	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	823	Cyperaceae	Schoenoplectiella articulata (L.) Lye	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	824	Cyperaceae	Schoenoplectiella lateriflora (J.F. Gmel.) Lye ssp. lateriflora	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	825	Cyperaceae	Schoenoplectiella juncea (Willd.) Lye	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	826	Cyperaceae	Cyperus rotundus L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	827	Molluginaceae	Glinus oppositifolius (L.) A. DC.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	828	Amaranthaceae	Gomphrena celosioides Mart.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	829	Cyperaceae	Pycreus hildebrandtii C.B. Clarke	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

SR	830	Rubiaceae	Oldenlandia corymbosa L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	831	Menyanthaceae	Nymphoides forbesiana (Griseb.) Kuntze	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	832	Mimosaceae (Leguminosae)	Neptunia oleracea Lour.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	833	Convolvulaceae	Ipomoea aquatica Forssk.	C	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	834	Cyperaceae	Cyperus compressus L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	835	Cyperaceae	Cyperus articulatus L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	836	Acanthaceae	Hygrophila schulli (Buch.-Ham.) M.R. Almeida & S.M. Almeida	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	837	Malvaceae	Melochia corchorifolia L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15
SR	838	Papilionaceae (Leguminosae)	Indigofera hirsuta L.	H	17.3km SE of Stn 16	Pt 445	2.0632	S	40.8067	E	15

Appendix III

Botanical Survey Points on (or near) pipeline route in Decimal Degrees

Station Name	Latitude	Longitude
Lokichar Export Facility	2.2330	35.7696
Station 1	2.0931	36.0650
AGI-3	2.0291	36.1405
Station 2	1.8900	36.3056
AGI-6(adjusted By stream)	1.8335	36.4496
Station 3	1.8226	36.6394
Station 4 (PS2)	1.5361	36.8256
AGI-9&10	1.3463	36.8776
Station 5	1.2361	36.9316
AGI-12&13	0.9624	37.2313
Station 6	0.8381	37.4488
Station 7	0.6446	37.6739
AGI-16	0.6369	37.6747
Station 8	0.5171	37.9513
Station 9 (PRS)	0.3674	38.5977
Kimeu 1	0.2241	38.9964
Station 10	0.1030	39.1990
L&M402	0.0323	39.3753
L&M399	-0.1083	39.5660
L&M401	-0.2404	39.6709
Station 11	-0.2537	39.6760
Station 12 (PS3)	-0.4453	39.8269
Kimeu 2	-0.4608	39.8660
L&M409	-0.6070	39.9200
Kimeu 3	-0.6565	39.9252
Station 13	-0.7170	39.9729
L&M436	-1.0343	40.1612
Station 14	-1.3074	40.3179
L&M433	-1.5754	40.4792
Station 15	-1.6849	40.5866
Station 16	-1.9241	40.7415
L&M444	-2.0168	40.7964
L&M445	-2.0632	40.8067
L&M441	-2.1957	40.8495
L&M440	-2.1966	40.8897
L&M439	-2.1977	40.8687
AGI-26	-2.2041	40.9087
Lamu Marine Terminal	-2.2053	40.9160

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.110.B0

TO Paul Mowatt, PPMT

CC Freddy Brookes

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT STAGE 2 BASELINE STUDIES – SITE VISIT REPORT: MANGROVE FORESTS

Preface: The following field report has been provided by mangrove expert Bernard Kirui. Golder has provided minimal editing to maintain the sentiment and expert opinion of Bernard Kirui.

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867.536.A0. This suite of stage 2 baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This focusses on biological data gathering that may be influenced by the short-wet season experienced in 2018 for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the short-wet season, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening;
- Gather observations that will contribute to the ecosystem services report; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Provide input to project routing and design mitigation; and
- Inform the overall baseline biodiversity study for the ESIA.

For mangrove forests, the field work focused on the following objectives:

- Characterise the forest structure of the mangroves that could be directly or indirectly affected by the project;
- Inform the mangrove mapping that will be presented in the baseline report;

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- Identify and characterise any evidence of previous or ongoing anthropic pressures on the mangroves that could be mistakenly attributed to the LLCOP Project in the future.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder Team

The field work was completed by **Bernard Kirui** between 12th and 16th November 2018, under remote technical guidance of **Gustavo Estrada** and **Giovanni Torchia** of **Golder.**

2.2 Study Area and Survey Design

The study area for the mangrove survey is presented in Figure 1. It has been designed as to include the footprint of the project and all the sites that could be affected in the case of an oil spill event. Since oil spill modelling has not yet been carried out, the sediments dispersion modelling conducted for the Lamu Port EIA (2013) has been used to predict which mangroves could be affected by an oil spill.

Twelve plots were sampled in this mangrove survey (Figure 1). Five of them were in mangrove areas located in the footprint of the project (MS1, MS 2A, MS 2B MS3 and MS4), while another seven (MS5A, MS5B, MS7, MS10, and MS11 MS12A, MS12B) were located in order to characterise the mangroves in the whole study area that could possibly be affected by an oil spill. As the sediment dispersion modelling indicates a prevailing transport towards the sea, most of the transects were located in the southern zone of the study area. At each forest structure plot, soil samples were collected for grain size analysis. Another six transects were characterised through a visual survey (MS6, MS8, MS9, MS13, MS14 and MS15).

2.3 Sampling Methods

2.3.1 Visual Surveys

Visual surveys were carried out using a high-resolution camera (at least 8 MP). The field team covered all transects extension taking pictures of the different forest typologies. Other aspects captured includes: evidences of pressure (e.g., stumps of cut trees; high density of dying or dead trees); presence of salt flats (i.e., hypersaline plains) located inside or at the back of the forest; presence of holocenic sandy barriers crossing the mangrove; presence of associated fauna (e.g., crabs, snails, birds, etc.).

2.3.2 Forest Structure

The methods for plots delineation and measurement of trees were based on Cintrón & Schaeffer-Novelli (1984). Plots were marked in the field using a forestry compass and a measuring tape (50 m or 100 m). Plot sizes were $10m^2$. All trees found inside the plot taller than 1 m were taxonomically identified at the species level, classified as alive or dead (leafless) and measured for height and diameter

Heights were measured from the bottom to the top of the tree (reference: estimated highest leave) with a measuring rod (for shorter trees) and with a graduated pole (for taller trees). Stem diameter was measured at 1.30 m from the soil, i.e. diameter at breast height – DBH, using a forest calliper. In situations where the tree was multi-stemmed, one DBH measurement was taken from each stem, and height measured only in the taller one. For *Rhizophora* trees, DBH was measured above the highest stilt root. Trees with DBH higher than 1 cm were considered.

Figure 2 presents pictures of the forest structure characterization in the field.

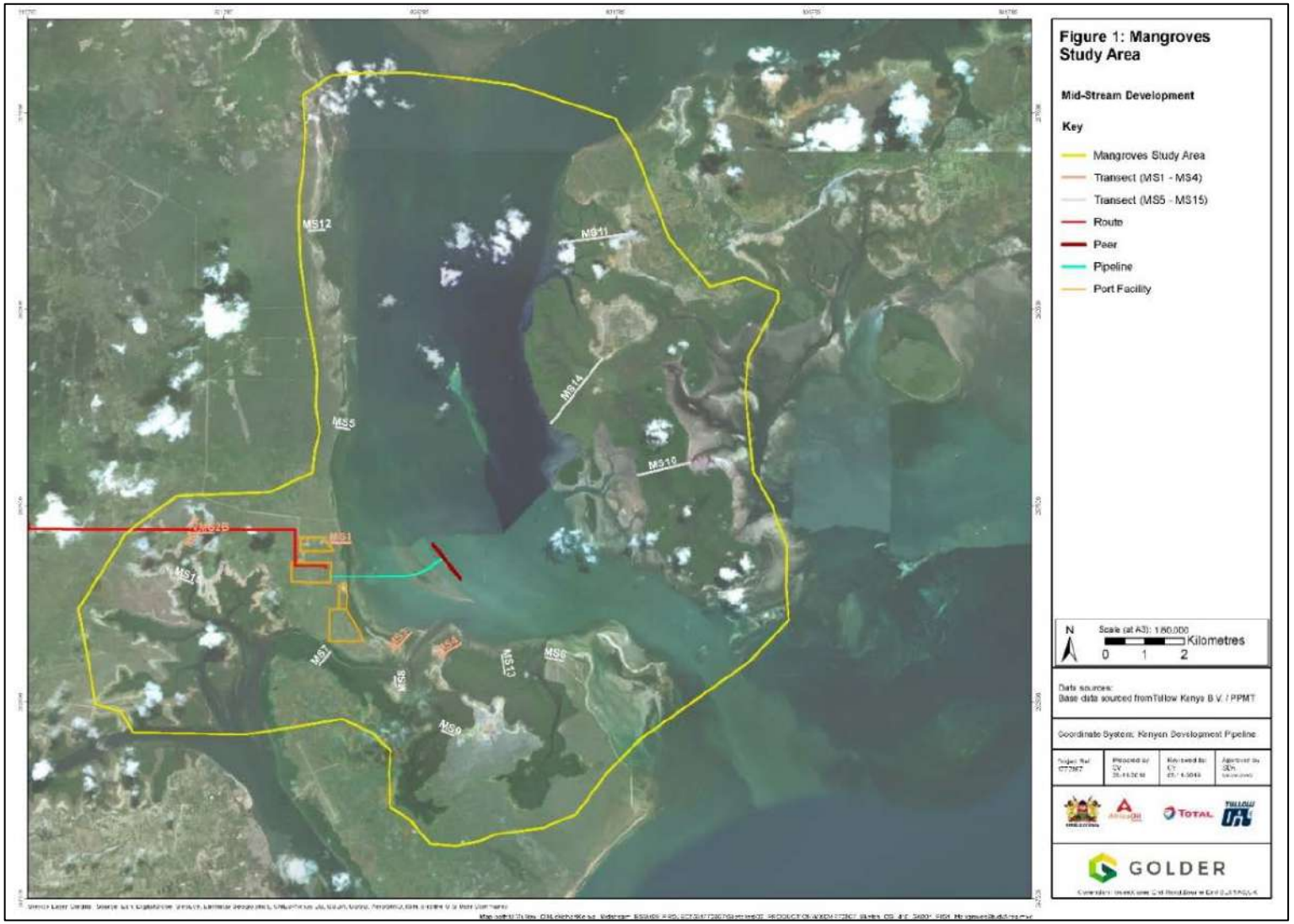

Figure 1: Study area for the mangrove survey

Figure 2: Survey team collecting forest structure data on the Lamu mangroves.

2.3.3 Data Analysis

Plant species identifications were made according to Tomlinson (1986), Duke et al. (1998), Spalding et al. (2010) and The Plant List (2018).

The following structural parameters were calculated per plot:

- Mean height and DBH (Diameter at breast height);
- Trunks density;
- Basal Area;
- Biomass (according to Komiyama et al., 2005, with values from Bosire et al. (2012) on wood density used to calibrate the equation); and
- Relative dominance of species in terms of total, live and dead basal area.

Soil samples were collected in 8 plots, i.e. MS1, MS2, MS3, MS4, MS5A, MS7, MS 11, MS, 12A. The samples were collected using a spatula and then put into a labelled container. The samples were then taken to the laboratories of the Kenya Marine and Fisheries Research Institute for analysis. The samples were then wet sieved using the Mastersizer 3000 Laser diffraction particle size analyser. The samples were then homogenised and a small portion of it is put into a liquid dispersant which passed the sample through a laser beam with numbers of detectors to measure the sizes (diffraction particle size measurements). The Mastersizer 3000 uses the technique of laser diffraction to measure the sizes of particles.

3.0 RESULTS

3.1 Mangrove floristic composition and structure

From the 12 plots were plot structural attributes were measured, a total of 336 trees were encountered, data on diameter at breast height, individual tree height, and tree form factor was captured. Based on field measurements and observations, five typical mangrove tree species ere encountered namely *Ceriops tagal*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, *Avicennia marina* and *Soneratia alba*. Other species that have been identified in Lamu in previous studies (GOK, 2013), but not encountered in this study, are *Xylocarpus granatum, Xylocarpus mollucensis* and *Lumnitzera racemosa*. Figure 3 presents photos of some of the plots. The whole set of pictures will be presented attached to the final baseline report.

Quantitative measurements were not carried out on regeneration, nevertheless, an observation and count in the field showed the dominance of *C. tagal* and *R. mucronata* seedlings and saplings actively growing. Previous studies around Lamu area have reported high regeneration potential sufficient to support future restocking of the forest (FAO, 1994, GOK, 2013). The non-forested areas mainly were made of sandy beaches, mudflats which transformed to sand flats and finally rangelands and agricultural fields away from the sea. Faunal composition consisted mainly of molluscs (oysters such as *Brachydontes* spp. and crabs, e.g., *Scylla serrata*, *Uca* spp., *Sesarmidae*) species (Figure 4). There were few recordings and observations of cut stumps at the plots (Figure 5), indicating that wood extraction by local communities in the region is not a relevant impact vector. Recordings of cut stumps were made at plots MS 7 (6 cut), MS 15 (1 cut). Observations of cut stumps were made at Plot MS8 and MS13. Natural die backs were also recorded and observed in Plots MS2A (4 dead stumps) and MS9 and 13 (one each).

Figure 3: Structural aspects of some of the studied plots in the Lamu mangroves.

Figure 3: Continued.

Figure 4. Examples of crabs (burrows at the left) and oysters (attached to the stilt roots, right) encountered in the plots.

Figure 5. Examples of cut stumps.

3.2 Tree height and Diameter at Breast Height

Mean plot DBH and height varied between plots but were generally lower at the footprint area (MS1 to MS4). The highest mean DBH was in plots MS10 (21.65 ± 3.01 cm) and MS12 (21.18 ± 4.40 cm) respectively. Plot MS10 had the highest mean tree height (14.50 ± 1.83 m), while plot MS4 had the lowest mean tree height (3.46 ± 4.10 m). Mean tree height and DBH for other plots are shown in Table 1 below. In general mangroves exhibited a pattern of zonation in some areas with *Sonneratia alba* being the most outward species followed by *Ceriops tagal*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza* and finally dwarf *Avicennia marina*. However, this was not the case in relatively narrow bands of mangrove formations between the shore and the terrestrial forest.

Table 1: Mean plot DBH and height

	Plot	Mean DBH (cm) ± SD	Mean Ht (m) ± SD
Plots in footprint area	MS1	4.96±1.94	5.76±2.89
	MS2a	8.48±0.97	4.97±1.29
	MS2b	5.67±3.98	3.97±2.97
	MS3	5.56±9.83	4.00±2.11
	MS4	5.10±7.59	3.46±4.10
Plots away from footprint area	MS5a	15.51±5.89	7.42±1.68
	MS5b	8.97±4.90	9.48±2.40
	MS7	7.45±3.24	6.70±2.12
	MS10	21.65±3.01	14.50±1.83
	MS11	10.17±6.51	10.35±2.26
	MS12a	21.18±4.40	9.28±5.86
	MS12b	9.48±5.53	8.78±3.09

3.3 Trunks density

Trunks density was high in plots located in the footprint of the project (Figure 6). Within this area, the plot with the highest density was MS 1 which decreased across plots MS 2a, MS2b, and MS 3 with the lowest tree density being recorded in plot MS 4. Regarding plots outside the project footprint area, high tree density was observed in plots MS 5B, MS7 AND MS 12 with low tree densities noted in plot MS10.

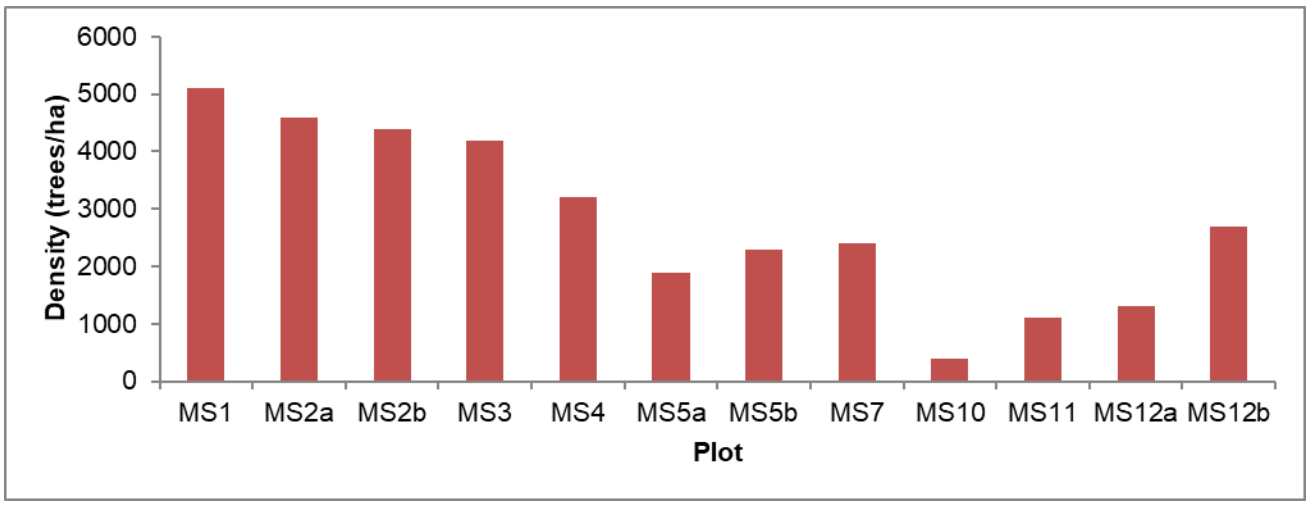

Figure 6: Trees density per plot.

3.4 Basal area

Basal area is variable, but some of the lowest values are observed at the footprint area compared to those outside. Figure 7 shows the distribution of basal area in the plots.

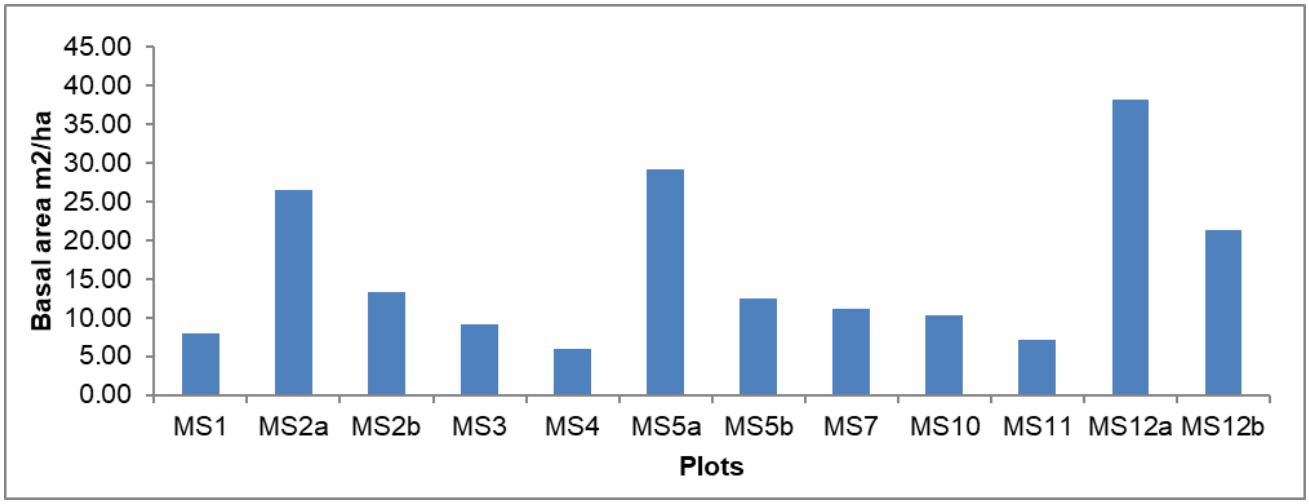

Figure 7: Basal area distribution among plots.

3.5 Above ground biomass

Within the project footprint area, high biomass values are in plots MS 3 (159.87 Kg/plot). Plot MS 1 has the lowest aboveground biomass value of (12.89 Kg/plot). However, these values are comparatively lower than those in plots outside of the project footprint area with high values (458.86) being recorded in plot MS12b (Table 2).

Table 2: Aboveground biomass (Kg/plot) per species, and as a total, per plot.

Species	MS1	MS2a	MS2b	MS3	MS4	MS5b	MS7	MS10	MS11	MS12a	MS12b
A. marina	-	48.20	-	-	-	-	-	-	-	-	-
B. gymnorrhiza	-	-	-	159.87	-	103.74	470.43	-	49.95	-	-
C. tagal	-	-	8.04	13.61	6.54	29.06	31.17	-	-	-	5.47
R. mucronata	12.89	-	62.80	14.31	25.34	74.18	28.36	484.06	55.48	-	67.29
S. alba	-	-	-	-	-	213.12	-	-	-	96.37	458.86
Total	12.89	48.2	70.84	187.79	31.88	420.1	529.96	484.06	105.43	96.37	531.62

3.6 Relative Dominance of Species

In terms of relative dominance of species (% of basal area), *Rhizophora mucronata* is dominant in most of the plots (MS1, MS2b, MS3, MS4, MS5b, MS7, MS10 and MS12b) (Figure 8). *Avicennia marina* occurs only at MS2a, a monospecific plot. *Soneratia alba* formed monoespecif forests at MS5a and MS12a and dominates at MS11. *Bruguiera gymnorrhiza* and *Ceriops tagal* do not dominate at any plot but are widespread.

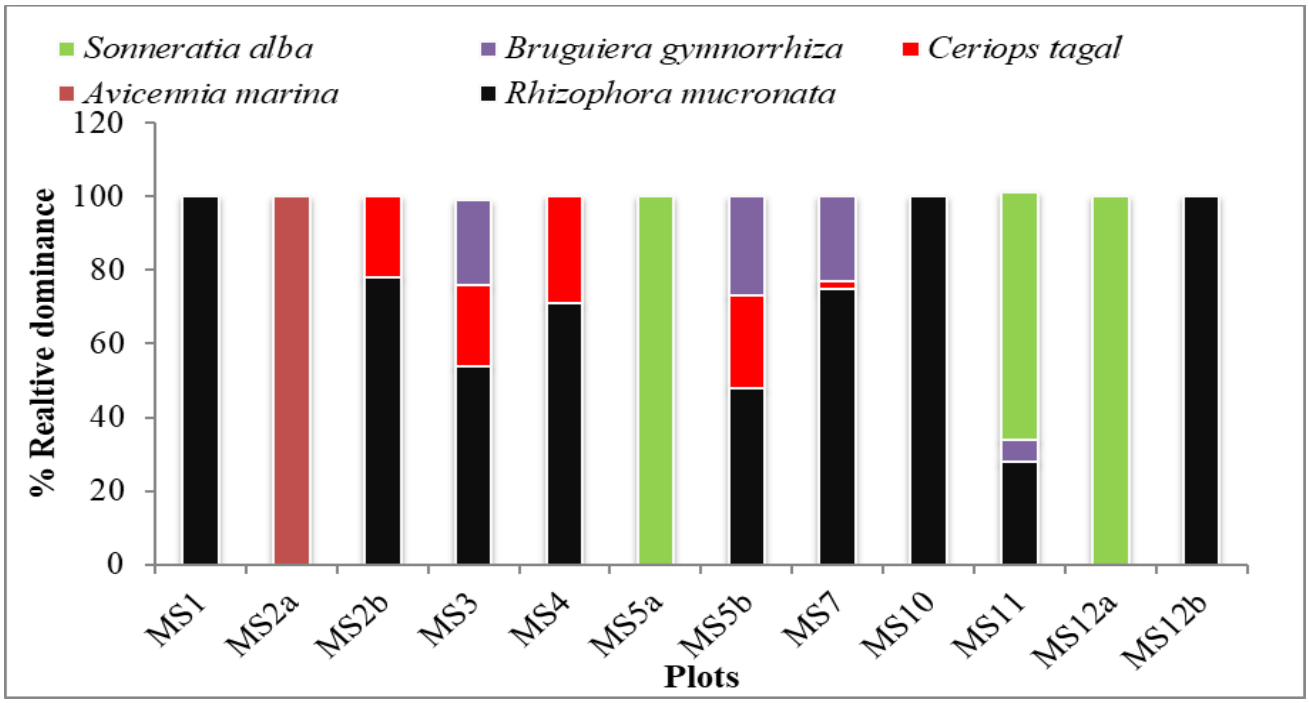

Figure 8. Relative species dominance at each plot in terms of basal area.

3.7 Grain Size Distribution

Sand dominated the soil composition in the entire eight plots except in plot MS 11, where silt composition was comparatively higher (Figure 9). These results indicate higher sensitivity to oil spill events, since the oil tends to percolate deeper in sandy soils, leading to more effects over the plants. Figure 3 shows the percentage concentration of sand silt and clay across the 8 plots sampled.

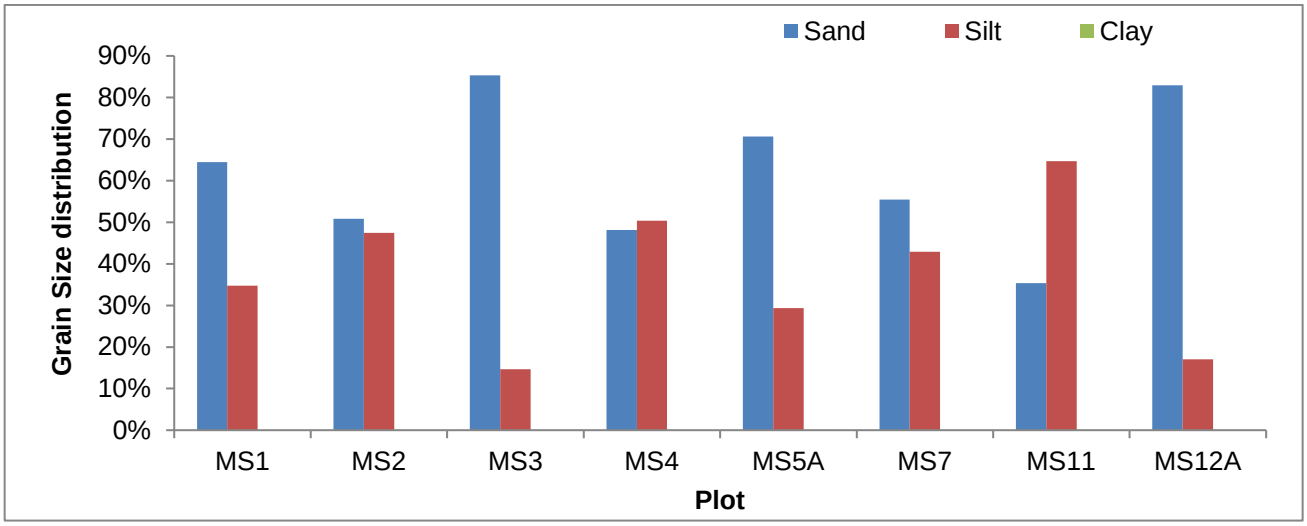

Figure 9: Percentage Grain Size distribution.

4.0 HEALTH AND SAFETY LEARNINGS

Bernard Kirui reported a bee attack that affected one of the support team members, who did not suffer further consequences. This member was using a perfume that probably attracted the bees. For the next mangrove field works additional preventive measures against the risk of bees and wasps' attacks will be implemented, such as the use of repellents and protective masks.

5.0 CONCLUSIONS AND RECOMENDATIONS

The field work revealed that mangrove forests located around the footprint area of the project are generally less developed than those located further north and south in the Lamu estuarine system. This indicates that these forests are under higher pressure associated with natural or anthropogenic causes. The observations made in the field, particularly related to possible signs of deforestation, however, do not support the hypothesis of human-driven pressure. Harsh natural conditions, such as hypersalinity, is the most probable cause.

High sand content in the mangrove soils indicates higher sensitivity to oil spill events, since the oil tends to percolate deeper in sandy soils, leading to more effects over the plants. On the other hand, *Rhizophora*, considered the mangrove plant genera with the lowest sensitivity to oil pollution, is the dominant species in the Lamu mangroves.

The data collected in this field work, together with the available secondary information, is deemed adequate to characterise the mangrove forests associated to the direct and indirect areas of influence of the project. However, in the case new mangrove field works are required in the future, it is recommended that some measurements of pore water salinity are made in the mangrove soils.

Considering the current layout of the pipeline route, an overlapping with mangroves characterised by plots MS2a and MS2b was observed. Considering the status of mangroves as Critical Habitats, any residual impact on this habitat will require offsetting (No Net Loss) and, in addition, Net Gains. As the implementation of such measures is generally expensive and the suppression of mangroves may generate protests by local communities who use the mangroves to extract their livelihoods, it is recommended that this overlapping be reviewed in the project.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

FB/TF/kc

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772856.553.111.B0

TO Paul Mowatt, PPMT

CC Freddy Brookes, Gary Morris Iveson.

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT ADVANCED BASELINE STUDIES – INVERTEBRATES FIELD REPORT

1.0 INTRODUCTION AND SCOPE

The following field report relates to the execution of field activities defined in plan of study 1772867.509/B.0. This suite of advanced baseline fieldwork is designed to support the ESIA for the LLPCOT Project to begin characterisation of biodiversity features of conservation concern (including critical habitat). This baseline element focusses on biological data gathering for key species and habitats identified from the Critical Habitat Screening (CHS) Report and recommendations from our Kenyan experts.

The purpose of the advanced baseline studies is to:

- Commence season-specific baseline studies focused on the short wet season and prolonged dry seasons, and which could have significant implications for critical habitat issues;
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, advanced baseline surveys, including the critical habitat screening (Ecountability, 2017);
- Gather observations that will contribute to the ecosystems services baseline; and
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage.

The results will be used to:

- Refine plans for subsequent biodiversity baseline studies to be conducted before and after pipeline construction;
- Provide input to project routing and design mitigation;
- Provide input to the Scoping Report and Gap analysis; and
- Inform the overall baseline biodiversity study for the ESIA.

Terrestrial invertebrate activity that is evident and particularly active in the wet season was the key focus for the advanced baseline programme. The team also addressed the potential presence of the range-restricted Geophilomorph Centipede (*Mecistocephalus angusticeps*), and the Fungus Beetle (*Coptorhina nitefacta*), both identified in the in the Critical Habitat Screening in locations in the Samburu and Matthews Range areas.

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The primary method for sampling was via sweep netting and direct searches at each sampling location and pit fall traps where possible. Sampling was carried out along the proposed corridor within a radius of 200 m in every location (Table 1).

Targeted terrestrial invertebrate groups included: Coleoptera (beetles); Hymenoptera (bees, wasps, ants); Lepidoptera (moths, butterflies); Orthoptera (grasshoppers, crickets, locusts, katydids); Diptera (flies):

- Sweep-netting entailed trapping invertebrates (mostly insects) using a sweep net for fixed periods along selected sampling sites. The collected specimens were euthanized and carefully kept in labelled butterfly envelopes and specimen vials containing 70% ethanol. Some of the specimens were identified in the field, while the rest were retained for later processing and identification at the National Museums of Kenya invertebrate laboratory;
- Timed direct searches involved walking along a transect within a time limit, collecting invertebrates under tree logs, rocks, on vegetation etc., invertebrates targeted included: longhorn beetles, butterflies, scolytid beetles, etc.; and
- Pitfall traps were mainly used to collect ground crawling invertebrates. Typically, the traps were left in place for 24 hours. The trapped invertebrates were collected and kept in labelled specimen jars containing 70% ethanol (preservative) for later processing and identification at the National Museum of Kenya (NMK) invertebrate laboratory.
- Pan traps were mainly used to collect flower visiting insects e.g. bees, wasps, flies and beetles.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member(s) of the Golder team:

- Morris Mutua (MM).

2.2 Tasks completed

A brief summary of the field programme during visit is provided in Table 1.

Table 1: Terrestrial Invertebrates baseline survey field programme and sampling locations

Date	Activity	Location	Initials of team member attending
1/10/2018	Travel	Nairobi-Lokichar	MM
2/10/2018	Laid pitfall traps, pan traps & conducted general searches	Nakukulas	MM
2/10/2018	Conducted general searches	Nakukulas	MM
3/10/2018	Harvested pitfall and pan traps	Nakukulas	MM
3/10/2018	Conducted general searches	Nakukulas	MM
3/10/2018	Reconnaissance	Nakukulas	MM

Date	Activity	Location	Initials of team member attending
4/10/2018	Removed traps	Nakukulas	MM
4/10/2018	Laid pitfalls and pan traps	Nakukulas	MM
4/10/2018	General searches	Maruangpei	MM
5/10/2018	Removed traps	Nakukulas	MM
5/10/2018	General searches	Nakukulas	MM
5/10/2018	Aquatic sampling	Nakukulas	MM
6/10/2018	Laid pitfalls and pan traps	Kerio River	MM
7/10/2018	Harvested and removed pitfalland pan traps	Kerio River	MM
7/10/2018	General searches	Kerio River	MM
8/10/2018	Travel	Lokichar-Nairobi	MM
8/10/2018	Preserved samples	NMK	MM
9/10/2018	Backing up data from Turkana	NMK	MM
10/10/2018	Travel	Nairobi-Isiolo	MM
11/10/2018	Laid pitfalls and pan traps on a lugga, conducted searches at Ewaso River	Archers post	MM
12/10/2018	Harvested and removed pitfall and pan traps, conducted general searches	Archers post	MM
13/10/2018	Sampled Ewaso nyiro River and the terrestrial habitat	Archers post	MM
14/10/2018	Laid traps in Kula mawe & conducted general searches	Kula mawe	MM
14/10/2018	Conducted general searches in lugga before Kachiuru	Kachiuru	MM
15/10/2018	Harvested and removed traps, conducted general searches	Kula mawe	MM
16/10/2018	Laid pan traps for half day, conducted general searches	Garba tula	MM
17/10/2018	Travel	Maua-Ol Malo	MM

Date	Activity	Location	Initials of team member attending
18/10/2018	General searches at AGI 05, Set traps in Suguta river	Suguta valley	MM
19/10/2018	Harvested traps	Suguta valley	MM
19/10/2018	General searches near AGI 05,	Suguta valley	MM
20/10/2018	Travel	ol malo Baragoi	MM
21/10/2018	General searches, visited Ap camp talked with chief and Ap inspector	Baragoi Suyan	MM
22/10/2018	General searches at AGI 07	Baragoi Nachola	MM
22/10/2018	Laid traps in lugga/river next to Nachola market	Baragoi nachola	MM
23/10/2018	Harvested traps	Baragoi Nachola	MM
23/10/2018	Conducted general searches, In a dry water pan along Baragoi mararal road	Baragoi charida	MM
24/10/2018	Conducted general searches in Barsaloi lugga	Barsaloi	MM
25/10/2018	Conducted general searches	Namunya/kalama conservancys	MM
26/10/2018	Laid traps and conducted general searches	Samburu Swari	MM
27/10/2018	Harvested traps in Swari lugga	Samburu Swari	MM
28/10/2018	Conducted general searches	Samburu nagor oworu river	MM
29/10/2018	Laid traps and conducted general searches in Lengusaka	Samburu Lengusaka	MM
30/10/2018	Harvested traps in Lengusaka and did searches in Lembaras lugga	Samburu Lembaras lugga	MM
31/10/2018	Sarova shaba - Nairobi	Travel	MM
1/11/2018	National Museum of Kenya (NMK)	Preserving samples and backing data	MM
2/11/2018	Nairobi - Garissa	Travel	MM

Date	Activity	Location	Initials of team member attending
3/11/2018	Conducted general searches	Shimbir (Garissa Modagashe road)	MM
3/11/2018	Conducted general searches and laid pan traps for few hours	AGI 20 (Garissa modagashe road)	MM
4/11/2018	Conducted general searches	Rahole	MM
5/11/2018	Conducted general searches and laid pan traps for few hours	Rahole	MM
5/11/2018	Conducted general searches and laid pan traps for few hours	Rahole	MM
6/11/2018	Conducted general searches	Garissa Mondica	MM
6/11/2018	Conducted general searches and laid pan traps for few hours	AGI 21	MM
7/11/2018	Conducted general searches and laid pan traps for few hours	Garissa Korakora 5km from AGI21	MM
7/11/2018	Conducted general searches	Garissa 9 km from Station 22	MM
7/11/2018	Conducted general searches and laid pan traps for few hours	Garissa 9 km from Station 22	MM
8/11/2018	Conducted general searches and laid pan traps for few hours	Shimbir (Garissa Modagashe road)	MM
9/11/2018	Garissa – Hola	Travel	MM
9/11/2018	Conducted general searches	Masalani - Ijara road	MM
10/11/2018	Conducted general searches and laid pan traps for few hours	Bura - Fafi	MM
11/11/2018	Hola – Nairobi	Travel	MM
12/11/2018	Nairobi – Lamu	Travel	MM

Date	Activity	Location	Initials of team member attending
13/11/2018	General searches within Mashidwani at port and Station 26	Lamu port	MM
14/11/2018	General searches in Bargoni 1 km beyond Kenya Army barrier	Bargoni	MM
15/11/2018	General searches in Bargoni before Kenya Army barrier	Bargoni	MM
16/11/2018	Conducted general searches	Kililana village & inside port at berth	MM
17/11/2018	Conducted general searches	Kililana village AGI 26	MM
18/11/2018	Data backing up and specimen sorting	Peponi hotel	MM
19/11/2018	Data backing up and specimen sorting	Peponi hotel	MM
19/11/2018	Lamu - Nairobi	Travel	MM

2.3 Deviation from Planned Scope of Work

The following statement was provided by Morris Matua. *'All the points as reflected in my scope of work were covered despite meeting armed pastoralists at some points who were less concerned with my activities. There were some insecurity alerts in Garissa points but I managed to accomplish my survey after requesting for police escort.*

My proposal to further my survey in Turkana and Lamu counties might be affected if the current community stand off and insecurity alerts persists'.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Different methods were employed to observe record and document invertebrates both in the riparian and terrestrial ecosystems as mentioned in Table 1 above.

A full list of observed invertebrates is provided in Appendix A.

Invertebrate species cumulative curve

Invertebrates were recorded on a daily basis. The cumulative number of species was plotted against the sampling effort which was based on daily species count (Figure 1). This linear regression approach, also called species incidence, helps to provide a species list for an area with an approximate assessment of completeness of sampling (Sutherland 1996, Pomeroy and Tengecho, 1986). The curve didn't reach an asymptote indicating that additional survey effort would have resulted in the collection of additional species (Figure 1).

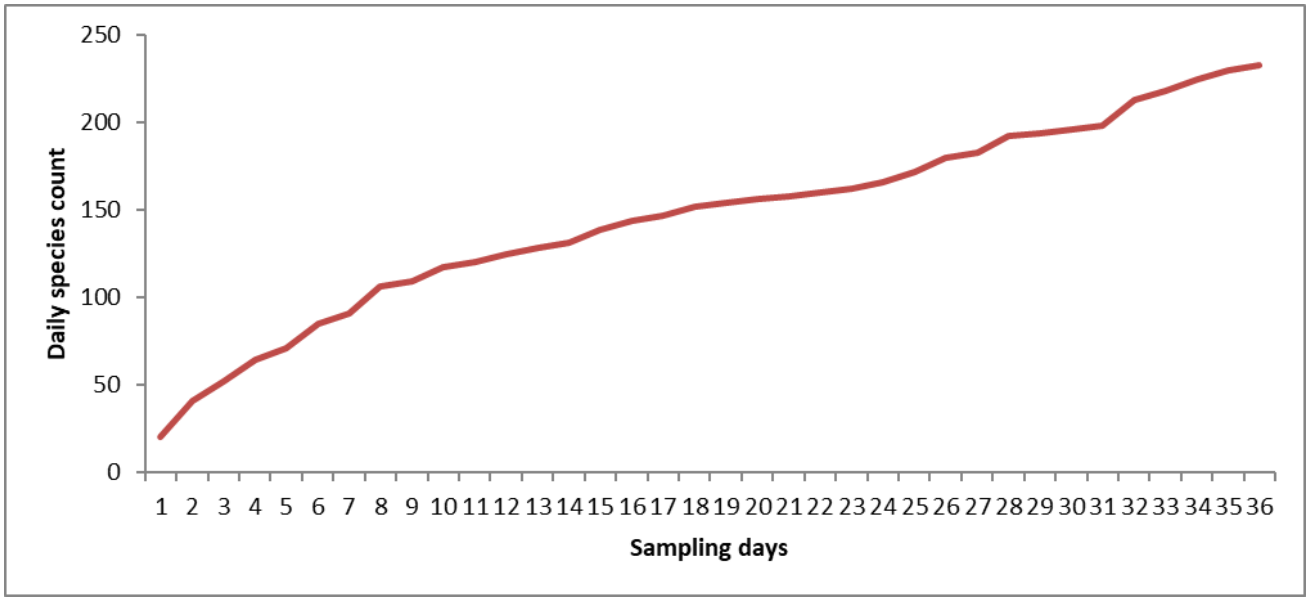

Figure 1: Invertebrate species accumulation curve based on daily species counts over each of the sampling days

The species richness and abundance differed amongst the different areas which were sampled during the October-November 2018 survey (Figure 2). The low species richness and abundance in some of the sites was attributed to the sampling effort employed. Traps were not set in some of the sites due to security concerns in these areas.

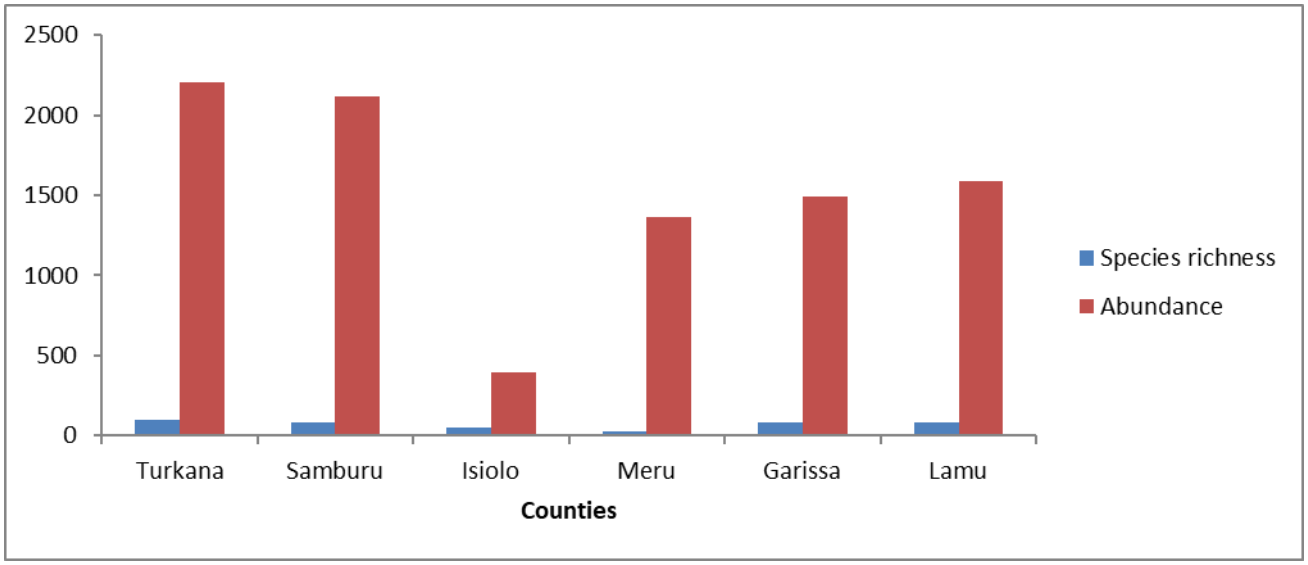

Figure 2: Mean species richness and abundance values in each of the sampled counties

Turkana

Turkana Lokichar forms the beginning point of the pipeline corridor route. Invertebrates surveys were conducted in different points. This included Nakukulas lugga (riparian forest/woodland, Acacia shrubland with ephemeral channels), Maruangpei (highly browsed Acacia shrub/scrubland and dwarf Acacia shrubland, Kaaruko (marshy area/oasis), west Kerio River bank (riverine which is heavily invaded by Prosopis) and west slope of Suguta valley (scrub of *Vachellia reficiens* / barren land). The Nakukulas, area was dominated by *Acacia sp., Cissus quadranqularis and Ziziphus mauritiana* trees. *Z. mauritiana* was flowering at the time of the survey and attracted large numbers of insects.

Some of the observed anthropogenic impacts observed included; charcoal production, livestock grazing and water abstraction from rivers.

The weather condition in the various parts of Turkana was hot and dry with some experience of chilly mornings. All survey methods were employed in most areas within Turkana County.

A total of 95 species and 2206 individual invertebrates' individuals belonging to 3 classes and 14 orders were recorded in different points covering the pipeline route within Turkana County. This included

- Twenty-seven () species of Order Hymenoptera (Bees, Wasps & Ants);
- Twenty (20) species of Order Lepidoptera (butterflies & Moths);
- Nineteen (19) species of the Order Coleoptera (beetles);
- Nine (9) species of the Order Hemiptera (true bugs);
- Six (6) species of Order Orthoptera (Grasshoppers, Crickets and Locusts);
- Three (3) species of Order Diptera (flies);
- Three (3) species of Order Odonata (Dragonflies);
- Two (2) species of Order Scorpiones (scorpions);
- One (1) species of Order Julida (millepedes);
- One (1) species of Order Aranaea (spiders);
- One (1) species of Order Solifugae (camel spiders);
- One (1) species of Order Isoptera (Termites);
- One (1) species of Order Parasitiformes (ticks); and
- One (1) species of Order Zygentoma (silverfish).

Although the documented species play different ecological role in supporting ecosystem services, none of the species are listed as Species of Conservation Concern (SCC)by the IUCN or CITES.

Samburu

The pipeline route passes through community conservancies which are often species rich areas due to some degree of protection. Different sub areas were sampled within Samburu County including; Suyan lugga (riverine/shrubland vegetation), Basaloi lugga (riverine/shrubland vegetation), Swari (riverine/shrubland vegetation) Wamba lugga (riverine/shrubland vegetation), Namunyak conservancy (*Vachellia reficiens* shrubland), Station 14 (Acacia woodland /shrubland) Ewaso River (riverine). The local community are pastoralists and are highly depended on ecosystem services for their livelihood and wellbeing.

The weather conditions for all areas of Samburu County was hot and dry during the full baseline survey.

A total of 81 species and 2113 individual invertebrates belonging to 3 classes and 15 orders were recorded in different points covering the pipeline route within Samburu County. These included:

- Twenty-five (25) species of the Order Coleoptera (beetles);
- Eighteen (18) species of Order Hymenoptera (bees, wasps & ants);

- Thirteen (13) species of Order Lepidoptera (butterflies & moths);
- Eight (8) species of Order Orthoptera (grasshoppers, crickets and locusts);
- Three (3) species of Order Diptera (flies);
- Three (3) species of Order Scorpiones (scorpions);
- Two (2) species of Order Blattodea (cockroaches);
- Two (2) species of Order Odonata (dragonflies);
- One (1) species of snails;
- One (1) species of Order Dermaptera (earwings)
- One (1) species of Order Julida (millepedes);
- One (1) species of Order Geophilomorpha (centipede);
- One (1) species of Order Aranaea (spiders);
- One (1) species of the Order Hemiptera (true bugs); and
- One (1) species of Order Zygentoma (silverfish).

Although the documented species play different ecological role in supporting ecosystem services, none of the species is are listed as SCC in the IUCN Red list or CITES.

Isiolo

The proposed pipeline crosses both seasonal and perennial rivers. A major part of this route is covered by volcanic rocks which have created micro-habitats for some invertebrate species. Areas covered included Ewaso River, and luggas within Archers post area. Some of the noted anthropogenic impacts included charcoal burning, firewood collection and livestock grazing.

All sampling methods were employed in most of the sites within Isiolo County. The weather condition was hot and dry throughout the entire sampling period which did not affect species representation based on the target seasonality.

A total of 51 species and 394 individual invertebrates belonging to 3 classes and 12 orders were recorded in different points covering the pipeline route within Isiolo County. These included:

- Sixteen (16) species of the Order Coleoptera (beetles);
- Eleven (11) species of Order Hymenoptera (bees, wasps & ants);
- Five (5) species of Order Scorpiones (scorpions);
- Four (4) species of Order Lepidoptera (butterflies & moths);
- Three (3) species of Order Orthoptera (grasshoppers, crickets & locusts);
- Thee (3) species of the Order Hemiptera (true bugs);
- Three (3) species of Order Odonata (dragonflies);
- Two (2) species of Order Diptera (flies);
- One (1) species of Geophilomorpha (Centipedes);

- One (1) species of Order Blattodea (cockroaches);
- One (1) species of Order Dermaptera (earwings); and
- One (1) species of Order Aranaea (spiders).

Although the documented species play different ecological role in supporting ecosystem services, none of the species are listed as SCC in the IUCN Red list or CITES.

Meru

This portion of the pipeline corridor route is mainly covered by volcanic rocks. The areas surveyed included Kachiuru and Kula mawe. The only human impact observed was livestock grazing.

The area was secure allowing for deployment of all sampling methods.

A total of 27 species and 1360 individuals belonging to 2 classes and 8 orders were recorded in different points covering the pipeline route within Meru County. These included:

- Seven (7) species Order Hymenoptera;
- Six (6) species Order Coleoptera;
- Five (5) species Order Lepidoptera;
- Three (3) species Order Orthoptera;
- Two (2) species of Order Odonata;
- Two (2) species of Order Diptera;
- One (1) species of Order Hemiptera; and
- One (1) species of Order Aranaea (spiders).

Although the documented species play different ecological role in supporting ecosystem services, none of the species are listed as SCC in the IUCN Red list or CITES.

Garissa

The area is dominated by Somali Acacia- Commiphora thickets and woodland. The soils are sandy with abundant grasses providing suitable habitats for some beetle and grasshoppers. Areas surveyed included; Rahole (woodland /shrubland), Shambir (woodland /shrubland), Masalani (Acacia- Commiphora woodland/shrubland) and Bura (Acacia shrubland).

Locals are generally nomadic camel herders.

The weather conditions differed in various parts of Garissa County. Rahole, Shimbir and Bura areas were hot and dry while Masalani (Ijara) was warm and wet.

Traps weren't set in Rahole and Masalani (Ijara) due to security threats. Pan traps could only be laid for 1 to 2 hours, a duration which would not capture all the present target species. Pitfall traps were not laid at all and this prevented documentation of some target ground crawling species.

A total of 85 species and 1493 individuals belonging to 2 class and 13 orders were recorded in different points covering the pipeline route within Garissa County. These included:

- Thirty-four (34) species of Order Coleoptera;

- Seventeen (17) species of Order Hymenoptera; Twelve (12) species of Order Lepidoptera;
- Four (4) species of Order Orthoptera; Three (3) species of Order Hemiptera;
- Three (3) species of Order Scorpiones;
- Three (3) species of Order Diptera;
- Three (3) species of Order Odonata;
- Two (2) species of Order Blattodea;
- One (1) species of Order Isopoda;
- One (1) species of Order Aranaea;
- One (1) species of snails; and
- One (1) species of Solifugae (camel spiders).

Although the documented species play different ecological role in supporting ecosystem services, none of the species are listed as SCC in the IUCN Red list or CITES.

Lamu

Areas surveyed included Bargoni (pristine mosaic forest, Mashwidani (forest/shrub fragments within farmlands and new port infrastructure and Kililana (forest/shrub fragments within farmlands). The weather was wet and humid throughout the survey period. Sampling habitats ranged from the coastal cliffs, mangroves and terrestrial coastal low land forests.

Only 1 survey method (general searches) was deployed in this area due to security concerns. The general search methodology only gives presence/absence information at the instant and the location where the sample was taken. Not finding a species does not mean that it is absent. The other methods e.g. pitfall traps are usually active throughout the day and night thus increasing chances of capturing cryptic invertebrates.

A total of 79 species and 1592 individuals belonging to 4 classes and 13 orders were recorded in different points covering the pipeline route within Lamu County. These included:

- Twenty-nine (29) species of Order Lepidoptera;
- Sixteen (16) species of Order Coleoptera; Fourteen (14) species of Order Hymenoptera;
- Four (4) species of Order Odonata; Three (3) species of Order Orthoptera;
- Three (3) species of Order Diptera;
- Three (3) species of snails;
- Two (2) species of Order Blattodea;
- One (1) species of Order Hemiptera;
- One (1) species of Order Isoptera;
- One (1) species of Order Aranaea;
- One (1) species of Order Decapoda (crabs); and
- One (1) species of Zygentoma (silverfish).

Although the documented species play different ecological role in supporting ecosystem services, none of the species are listed as SCC in the IUCN Red list or CITES.

3.2 Data collected

The invertebrate data is attached as a separate attachment (Appendix A).

3.3 Key Observations for ESIA

- No invertebrate SCC were recorded during either the advanced or the full field baseline surveys. However, given the limited duration of the field surveys and the limited access to certain areas due to security concerns the potential that some of these species may occur along the pipeline route cannot be discounted and remains moderate;
- *Physcaeneura leda* is a butterfly in the family Nymphalidae. It is found along the coast of Kenya, as well as in north-eastern Tanzania and southern Somalia. The habitat consists of dense woodland, forest margins and grassy forest clearings from sea-level to 1,850 m. Only one individual was observed during the survey in Bargoni Mswakini village. Although currently unlisted by the IUCN this species is considered to be locally rare.

Figure 3: Physcaeneura leda

- *Graphium polistratus*, is a butterfly in the family Papilionidae (swallowtails). It is found in Nigeria, the Democratic Republic of Congo, the coast of Kenya, Tanzania, northern Malawi and Mozambique. It is found in warm and coastal forests. The larvae feed on *Annona senegalensis* and Uvaria species. The butterfly was recorded Bargoni Mswakini area. Given its preference for forest habitats this species could be used to monitor the condition of forest habitats.

Figure 4: Graphium polistratus

- Several species of Ground beetle (Family Carabidae) were recorded along the pipeline corridor. Ground beetles are frequently used to indicate habitat alteration. They have been used in grasslands and boreal forests where species number and/or abundances have been noted to change along a habitat disturbance gradient. A common trend is that large, poorly dispersing specialist species decrease with increased disturbance while small generalist species with good dispersal ability increase. Some species are not affected by moderate disturbance (Tommeros, 2000).

Figure 5: *Pheropsophus insignis*

Figure 6: Amophomerus opacus

Figure 7: Chlaenius sp

- Large numbers of Tiger beetles (Family Cicindelidae) were observed in several luggas during the baseline survey. Tiger beetles are considered to be sensitive to changes in the environment; they are among the

first species to react to pesticides, misuse of habitats, and climate change. They are therefore a useful monitoring target.

Figure 8: Lophyridia imperatrix

- Huge locust swarms were observed at several locations along the pipeline corridor from Turkana down to Lamu. The species are of agricultural importance and the government bodies should be alerted to avert any form of outbreak/heavy infestation.

Figure 9: Schistocerca gregaria

3.4 Significance of Advanced and Full baseline survey

There was a variation in species assemblage and occurrence between the advanced (wet season) and full (dry season) surveys. Most species were recorded only during the advanced survey but didn't recur in the full baseline survey and vice versa.

3.5 Meetings and Discussions

The following was communicated by Morris Matua: *'We held an informal meeting with a delegation of officials from Samburu County and some locals within Lengusaka village on 30 October 2018. They sought some clarification concerning our work and its linkage with the proposed pipeline corridor. Each taxa leader was able to respond to their questions and they were satisfied.*

Health and Safety learnings

The following health and safety learnings were communicated by Morris Matua: '*There were notable populations of horse/deer flies (Tabanidae) which are blood sucking group of flies in Lamu Bargoni area. Care should be taken by people working in that area to avoid mechanical transmission of vector borne diseases. There was recording of several venomous and harmful invertebrates along the entire corridor route including bees, scorpions, solifuges and centipedes. These species can be hazardous to humans because of their bite. Although a bite to an adult human is usually very painful and may cause severe swelling, chills, fever and weakness, it is unlikely to be fatal. Bites can be dangerous to small children and those with allergies to bee stings. The venomous bite of larger centipedes can induce anaphylactic shock in such people. The use of odourless body cream and deodorant is encouraged to people working within the corridor route to avoid bee stings.*

3.6 Gaps and Recommendations

Some areas in Garissa County (Ijara) and Lamu County (Beyond Bargoni) were not surveyed due to security concern. Future plans to cover the areas will be paramount to document the candidate species.

Some notable recommendations include;

- A number of fallen dead tree logs and rocks were observed along the corridor route. The logs and rocks form part of microhabitats for most saproxylic and nocturnal arthropods respectively, hence minimal disturbance is advisable during the pipeline construction phase to ensure such micro-habitats are not disturbed or modified.
- The top soil along the pipeline corridor may contain nests of several invertebrate species. During the construction phase, the top soil should be separated from the lower soil layers and should be returned last to ensure that the eggs are not buried deep underground.
- The coastal remnants forests are home to species which have not been able to penetrate inland hence are endemic to these forests. This endemism is attributed to the presence of vegetation which doesn't grow in the drier interior. Therefore, we recommend minimal clearance of such vegetation as they serve as host plants for endemic invertebrates.
- Based on comparison of species in both advanced and full baseline survey, there was a variation in species occurrence hence the need to carry out a wet season survey in areas not covered during the advanced baseline survey.
- This survey didn't document species that could lead to deviation or diversion of the corridor, although mitigation measures should be adhered to during and after the pipeline construction.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

FB/TF/kc

APPENDIX A

Invertebrate Species List

Date	County	Locality	Habitat type	Genus/species	No. of individuals
02/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Callida angusticollis*	1
02/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Plocaederus bennigseni*	2
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Junonia hierta*	1
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	Libellulidae	6
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	Tenebrionidae	15
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Rhytinota sp*	8
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Schistocerca gregaria*	12
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Acrotylus sp*	2
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Colotis sp*	18
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Colotis protomedia*	2
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Achatina sp*	10
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Ocymyrmex weitzaeckeri*	3
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Rhabdotis sobrina*	2
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Lixus sp*	2
03/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Danaus chrysippus*	1
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Pamelia hildebrandti*	3
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Zophosis sulcata*	2
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Zophosis punctatafasciata*	2
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Platymeris sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Ectomocoris cruciger*	1
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	Araneae	2
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Gryllus bimaculatus*	1
04/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Junonia hierta*	10
04/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Pandinus sp*	2
04/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Schistocerca gregaria*	15
04/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Achatina sp*	5
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Junonia hierta*	6
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Eumenes sp*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Chlaenius sp*	3
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Xylocopa caffra*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Pelopidas mathias*	9
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Coeliades forestan*	2
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Xylocopa nigrita*	10
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Meliponula sp*	5
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Colotis sp*	3
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Chlaenius signatus*	7
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Mylothris rueppeli*	2
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Tarucus grammicus*	12

Date	County	Locality	Habitat type	Genus/species	No. of individuals
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Sarangesa sp*	13
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Rhytinota praeronga*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Campalita chlorosticum*	2
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Psammodes sp*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Gryllus bimaculatus*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Camponotus maculatus*	5
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Agrypnus nitidus*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Zophosis sulcata*	3
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Crematogaster sp*	120
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Catopsilia florella*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Rhytinota gravidula*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Rhytinota pinheyi*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Cypholoba tetrastigma*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Pinacopteryx eriphia*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Hypotrigona sp*	4
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Macrogalea candida*	6
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Lasioglossum sp*	3
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Pinacopteryx eriphia*	2
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Psammodes sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Scarabaeus sp*	2
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Catopsilia florella*	2
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Platymeris sp*	1
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Scarabaeus catenatus*	1
06/11/2018	Garissa	Mondica	Acacia & Commiphora thicket	*Scarabaeus burchelii*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Pandinus sp*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Parabuthus sp*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Rhabdotis sobrina*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Psammodes sp*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Hottentonta sp*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Zophosis sulcata*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Rhytinota praeronga*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Sepidium muscosum*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Heterotarsus tenebriodes*	1
06/11/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Deropeltis sp*	1
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Rhabdotis sobrina*	1
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Achatina sp*	10
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Psammodes sp*	1
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Sepidium muscosum*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Parabuthus sp*	2
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Camponotus maculatus*	10
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Microcerus sp*	1
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Deropeltis sp*	3
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Rhytinota gravidula*	1
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Polyharchis gagates*	1
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Achatina sp*	150
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	Solifugae	2
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	Libellulidae	2
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Schistocerca gregaria*	5
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Pandinus sp*	1
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Ocymyrmex weitzaeckeri*	12
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Deropeltis sp*	4
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Neocleonus mitis*	4
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Musca domestica*	8
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Gryllus bimaculatus*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Apis mellifera*	2
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Bombylius sp*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Hypotrigona sp*	500

Date	County	Locality	Habitat type	Genus/species	No. of individuals
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Cerilocus dohrni*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Rhytinota praeronga*	5
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Brachynus nobilis*	3
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Metallonotus metallicus*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Camponotus maculatus*	3
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Cylistus convexus*	3
08/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Rhytinota sp*	2
08/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Colotis eucharis*	2
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*Camponotus maculatus*	154
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*Achatina sp*	6
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*senepsis*	2
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*Trithermis sp*	1
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	Chrysomelidae	1
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*Bombylius sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*Rhytinota sp*	5
09/11/2018	Garissa	Ijara-Ruka	Ecotone between inland and coastal vegetation	*Paplopleura deceptor*	1
09/11/2018	Garissa	Ijara-Gerile	Ecotone between inland and coastal vegetation	*Callida angusticollis*	7
09/11/2018	Garissa	Ijara-Gerile	Ecotone between inland and coastal vegetation	*Cerilocus dohrni*	1
09/11/2018	Garissa	Ijara-Gerile	Ecotone between inland and coastal vegetation	*Rhytinota sulcata*	2
10/11/2018	Garissa	Bura	Acacia & Commiphora thicket	*Achatina sp*	5
10/11/2018	Garissa	Bura	Acacia & Commiphora thicket	*Ocymyrmex weitzaeckeri*	5
10/11/2018	Garissa	Bura	Acacia & Commiphora thicket	*Trithermis sp*	1
10/11/2018	Garissa	Bura	Acacia & Commiphora thicket	*Gryllus bimaculatus*	1
10/11/2018	Garissa	Bura	Acacia & Commiphora thicket	*Parabuthus sp*	13
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Cerilocus dohrni*	2
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Neocleonus mitis*	4
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Ceroplesis revoili*	1
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Chilocorus digitata*	1
11/10/2018	Isiolo	Archers post	Lugga	*Parabuthus sp*	1
11/10/2018	Isiolo	Archers post	Lugga	*Gonocephalum sp*	3

Date	County	Locality	Habitat type	Genus/species	No. of individuals
12/10/2018	Isiolo	Archers post	Lugga	*Plocaederus bennigseni*	4
12/10/2018	Isiolo	Archers post	Lugga	*Pandinus sp*	1
11/10/2018	Isiolo	Ewaso nyiro	River	*Junonia hierta*	2
11/10/2018	Isiolo	Ewaso nyiro	River	Syrphidae	1
11/10/2018	Isiolo	Ewaso nyiro	River	*Labidura sp*	1
11/10/2018	Isiolo	Ewaso nyiro	River	*Paederus sabaeus*	1
11/10/2018	Isiolo	Ewaso nyiro	River	Araneae	2
11/10/2018	Isiolo	Ewaso nyiro	River	*Blatella sp*	1
11/10/2018	Isiolo	Ewaso nyiro	River	*Lophyra neglecta*	2
12/10/2018	Isiolo	Archers post	Lugga	*Acrotylus sp*	5
12/10/2018	Isiolo	Archers post	Lugga	*Humbe sp*	4
12/10/2018	Isiolo	Archers post	Lugga	*Crematogaster sp*	54
12/10/2018	Isiolo	Archers post	Lugga	*Brachythemis impartita*	10
12/10/2018	Isiolo	Archers post	Lugga	*Parabuthus maximus*	1
12/10/2018	Isiolo	Archers post	Lugga	*Parabunthus pallidus*	1
12/10/2018	Isiolo	Archers post	Lugga	*Hottentonta sp*	1
12/10/2018	Isiolo	Archers post	Lugga	*Zophosis punctatafasciata*	5
12/10/2018	Isiolo	Archers post	Lugga	*Scolia sp*	4
12/10/2018	Isiolo	Archers post	Lugga	Araneae	8

Date	County	Locality	Habitat type	Genus/species	No. of individuals
12/10/2018	Isiolo	Archers post	Lugga	Geophilomorpha	2
12/10/2018	Isiolo	Archers post	Lugga	*Rhytinota praeronga*	4
12/10/2018	Isiolo	Archers post	Lugga	*Junonia hierta*	1
13/10/2018	Isiolo	Ewaso nyiro	Terrestrial	*Ailopus sp*	4
13/10/2018	Isiolo	Ewaso nyiro	Terrestrial	*Danaus chrysippus*	2
13/10/2018	Isiolo	Ewaso nyiro	Terrestrial	*Junonia hierta*	1
13/10/2018	Isiolo	Ewaso nyiro	Terrestrial	*Junonia oenone*	1
13/10/2018	Isiolo	Ewaso nyiro	Terrestrial	*Belenois aurota*	1
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Orthetrum caffrum*	12
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Junonia oenone*	1
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Bombylius sp*	4
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Chlaenius sp1*	1
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Chlaenius sp2*	
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Labidura sp*	1
16/10/2018	Isiolo	Garba tula	Acacia & Commiphora thicket	*Pandinus sp*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Acraea eponina*	14
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Eurema senengalensis*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Nomia sp*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	Mollusca	200

Date	County	Locality	Habitat type	Genus/species	No. of individuals
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Catopsilia florella*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Blatella sp*	7
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Crematogaster sp*	12
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Platythyrea sp*	3
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Cerobates sp*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	Anobiidae	10
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Sarcophaga sp*	2
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Danaus chrysippus*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Cacyreus palemon*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Camponotus maculatus*	150
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Crematogaster sp*	125
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Paplopleura deceptor*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Pachycondyla tarsata*	10
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Phalanta phalantha*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Rhytinota sp*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Belenois subeida*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Acraea quirinalis*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Pachycondyls cribinodis*	12
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Pompilius sp*	2

Date	County	Locality	Habitat type	Genus/species	No. of individuals
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Melyris viridicolor*	3
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Schistocerca gregaria*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Colotis evenina*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Junonia oenone*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Anax sp*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Acraea eponina*	5
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Meliponula sp*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Rhytinota gravidula*	1
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Chilocorus sp*	4
13/11/2018	Lamu	Mashidwani	Open Coastal forest	*Lagria sexvitta*	1
14/11/2018	Lamu	Bargoni	Open Coastal forest	*Haematopota sp*	100
14/11/2018	Lamu	Bargoni	Open Coastal forest	*Eupezus brevicollis*	1
14/11/2018	Lamu	Bargoni	Open Coastal forest	*Lagria sexvitta*	1
14/11/2018	Lamu	Bargoni	Open Coastal forest	*Sternocera castanea*	1
14/11/2018	Lamu	Bargoni	Open Coastal forest	*Isaniris acuticollis*	1
14/11/2018	Lamu	Bargoni	Open Coastal forest	*Nezara sp*	1
16/10/2018	Lamu	Bargoni	Open Coastal forest	*Lagria sexvitta*	1
16/10/2018	Lamu	Bargoni	Open Coastal forest	*Mesoplatys ochroptera*	100
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Eurema hecabe*	4

Date	County	Locality	Habitat type	Genus/species	No. of individuals
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Xylocopa flavorufa*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Acraea uvui*	2
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Nephronia thelassina*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Zizula hylax*	2
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Byblia ilithya*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Eurema hapale*	7
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Belenois aurota*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Trithermis sp*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Belenois subeida*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Platythyrea cribrinodis*	11
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Colotis danae*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Spialia*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Bombylius sp*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Neptis sp*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Junonia oenone*	5
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Colotis evagore*	2
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Acrotylus sp*	1
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Braunsapis sp*	8
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Graphium polistratus*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
15/11/2018	Lamu	Bargoni/Mswakini	Grassland with palms and thickets	*Colotis regina*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Trithermis sp*	5
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Orthetrum caffrum*	3
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Apis mellifera*	12
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Eurema senengalensis*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Sceliphron quartinae*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Achatina sp*	5
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Graphium antheus*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Belenois thysa*	2
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Macrotermes sp*	5
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Bombylius sp*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Byblia ilithya*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Papilio demodocus*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Rhytinota sulcata*	1
15/11/2018	Lamu	Bargoni/Mswakini	Wetland	*Physcaeneura leda*	1
16/11/2018	Lamu	Kililana village	Sea shore line	*Orthetrum caffrum*	5
16/11/2018	Lamu	Kililana village	Sea shore line	*Anax sp*	3
16/11/2018	Lamu	Kililana village	Sea shore line	*Littorina sp*	150
16/11/2018	Lamu	Kililana village	Sea shore line	*Schistocerca gregaria*	53

Date	County	Locality	Habitat type	Genus/species	No. of individuals
16/11/2018	Lamu	Kililana village	Sea shore line	Decapoda	125
16/11/2018	Lamu	Kililana village	Sea shore line	*Belenois aurota*	1
16/11/2018	Lamu	Kililana village	Sea shore line	*Pheidole sp*	6
16/11/2018	Lamu	Kililana village	Sea shore line	*Eurema hecabe*	4
16/11/2018	Lamu	Kililana village	Sea shore line	*Lagria villosa*	1
16/11/2018	Lamu	Kililana village	Sea shore line	*Acraea uvui*	1
16/11/2018	Lamu	Kililana village	Sea shore line	*Zizula hylax*	5
16/11/2018	Lamu	Kililana village	Sea shore line	*Acraea eponina*	2
16/11/2018	Lamu	Kililana village	Sea shore line	*Eurema brigitta*	1
16/11/2018	Lamu	Kililana village	Sea shore line	*Catopsilia florella*	1
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Eurema hecabe*	3
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Junonia oenone*	1
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Acraea eponina*	2
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Catopsilia florella*	1
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Byblia anvatara*	1
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Colotis evagore*	3
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Belenois subeida*	5
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Maxentius pinguis*	3
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Lepisma saccharina*	4

Date	County	Locality	Habitat type	Genus/species	No. of individuals
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Deropeltis sp*	3
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Crematogaster sp*	250
17/11/2018	Lamu	Kililana village	Casythia & Hypeanis vegetation	*Micraspis sp*	2
17/11/2018	Lamu	Kililana village	Sea shore line	*Heteronychus sp*	1
17/11/2018	Lamu	Kililana village	Sea shore line	Araneae	2
17/11/2018	Lamu	Kililana village	Sea shore line	*Pheidole sp*	3
17/11/2018	Lamu	Kililana village	Sea shore line	*Belenois aurota*	1
17/11/2018	Lamu	Kililana village	Sea shore line	*Macrotermes sp*	12
17/11/2018	Lamu	Kililana village	Sea shore line	*Lepisma saccharina*	32
17/11/2018	Lamu	Kililana village	Sea shore line	*Deropeltis sp*	1
17/11/2018	Lamu	Kililana village	Sea shore line	*Apis mellifera*	1
17/11/2018	Lamu	Kililana village	Sea shore line	*Crematogaster sp*	26
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Junonia hierta*	3
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Psammodes sp*	1
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Catopsilia florella*	1
14/10/2018	Meru	Kachiuru	Lugga	*Sceliphron quartinae*	7
14/10/2018	Meru	Kachiuru	Lugga	*Orthetrum caffrum*	5
14/10/2018	Meru	Kachiuru	Lugga	*Acrotylus sp*	20
14/10/2018	Meru	Kachiuru	Lugga	*Anax sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
14/10/2018	Meru	Kachiuru	Lugga	*Cathimeris sp*	2
14/10/2018	Meru	Kachiuru	Lugga	*Catopsilia florella*	2
14/10/2018	Meru	Kachiuru	Lugga	*Leptotes pirithous*	3
14/10/2018	Meru	Kachiuru	Lugga	*Hypotrigona sp*	15
14/10/2018	Meru	Kachiuru	Lugga	*Sarcophaga sp*	2
14/10/2018	Meru	Kachiuru	Lugga	*Gegenes hottentota*	1
14/10/2018	Meru	Kachiuru	Lugga	*Dysdercus cardinalis*	1
14/10/2018	Meru	Kachiuru	Lugga	*Musca sp*	1
14/10/2018	Meru	Kachiuru	Lugga	*Schistocerca gregaria*	4
14/10/2018	Meru	Kachiuru	Lugga	*Schistocerca gregaria*	12
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	Araneae	1
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Catopsilia florella*	3
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Pompilius sp*	4
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Rhytinota sp*	1
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Nephronia thelassina*	1
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Junonia hierta*	1
15/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Xylocopa sp*	1
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Catopsilia florella*	6
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Tetramorium sp*	5

Date	County	Locality	Habitat type	Genus/species	No. of individuals
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Monomorium sp*	3
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Pheidole sp*	2
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Camponotus maculutus*	4
21/10/2018	Samburu	Baragoi Suyan river	Lugga	Araneae	10
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Belanogaster sp*	5
21/10/2018	Samburu	Baragoi Suyan river	Lugga	Sphecidae	100
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Belanogaster sp*	3
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Eumenes sp*	2
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Orthetrum caffrum*	6
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Lophyra neglecta*	4
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Trithermis sp*	2
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Apis mellifera*	4
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Charaxes varanes*	1
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Junonia hierta*	5
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Cacyreus sp*	2
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Lampides boeticus*	4
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Monolepta sp*	500
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Papilio demodocus*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Maxentius pinguis*	5

Date	County	Locality	Habitat type	Genus/species	No. of individuals
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Parabuthus sp*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Rhytinota sp*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Colotis aurigineus*	3
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Leptotes pirithous*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Gryllulus sp*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Gryllus sp*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Byblia ilithya*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Chlaenius sp*	4
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Blatella sp*	4
23/10/2018	Samburu	Baragoi Charda	Waterpan	*Labidura sp*	5
23/10/2018	Samburu	Baragoi Charda	Waterpan	Araneae	3
24/10/2018	Samburu	Barsaloi river	Lugga	*Catopsilia florella*	4
24/10/2018	Samburu	Barsaloi river	Lugga	*Colotis danae*	1
24/10/2018	Samburu	Barsaloi river	Lugga	*Lophyra neglecta*	45
24/10/2018	Samburu	Barsaloi river	Lugga	*Junonia hierta*	3
24/10/2018	Samburu	Barsaloi river	Lugga	*Leptotes pirithous*	3
24/10/2018	Samburu	Barsaloi river	Lugga	*Gryllus bimaculatus*	3
24/10/2018	Samburu	Barsaloi river	Lugga	*Abacetus sp*	4
24/10/2018	Samburu	Barsaloi river	Lugga	*Orthetrum caffrum*	10

Date	County	Locality	Habitat type	Genus/species	No. of individuals
24/10/2018	Samburu	Barsaloi river	Lugga	*Trithermis sp*	5
24/10/2018	Samburu	Barsaloi river	Lugga	Araneae	50
24/10/2018	Samburu	Barsaloi river	Lugga	*Gryllus bimaculatus*	2
24/10/2018	Samburu	Barsaloi river	Lugga	*Deropeltis sp*	1
24/10/2018	Samburu	Barsaloi river	Lugga	*Dymentia subvittata*	1
24/10/2018	Samburu	Barsaloi river	Lugga	*Tridactylus medacassus*	100
24/10/2018	Samburu	Barsaloi river	Lugga	*Lophyridia imperatrix*	100
24/10/2018	Samburu	Barsaloi river	Lugga	*Chlaenius sp*	1
24/10/2018	Samburu	Barsaloi river	Lugga	*Maxentius pinguis*	1
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Parabuthus sp*	1
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Zophosis sp*	2
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	Geophilomorpha	1
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	Julida	5
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Belenois aurota*	3
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Colotis antevippe*	1
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Orthetrum caffrum*	3
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Pandinus sp*	5
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Parabuthus sp*	4
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Hottentonta sp*	3

Date	County	Locality	Habitat type	Genus/species	No. of individuals
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	Mollusca	2
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Pachycondyla tarsata*	5
25/10/2018	Samburu	Namunyak wildlife conservancy	Acacia & Commiphora thicket	*Junonia hierta*	1
26/10/2018	Samburu	Swari river	River	*Ammophilia sp*	1
26/10/2018	Samburu	Swari river	River	*Catopsilia florella*	9
26/10/2018	Samburu	Swari river	River	*Cantatops sp*	1
26/10/2018	Samburu	Swari river	River	*Hypotrigona sp*	3
26/10/2018	Samburu	Swari river	River	*Colotis amatus*	3
26/10/2018	Samburu	Swari river	River	*Grylus bimaculatus*	5
26/10/2018	Samburu	Swari river	River	Araneae	11
26/10/2018	Samburu	Swari river	River	*Lepisma saccharina*	15
26/10/2018	Samburu	Swari river	River	*Pandinus sp*	1
26/10/2018	Samburu	Swari river	River	*Sepidium muscosum*	1
26/10/2018	Samburu	Swari river	River	*Junonia hierta*	1
26/10/2018	Samburu	Swari river	River	*Maxentius pinguis*	2
26/10/2018	Samburu	Swari river	River	*Phryncolus petrosus*	1
26/10/2018	Samburu	Swari river	River	*Rhytinota praeronga*	3
26/10/2018	Samburu	Swari river	River	*Gryllus bimaculatus*	1
26/10/2018	Samburu	Swari river	River	*Pandinus sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
28/10/2018	Samburu	Nagor-oworu river	River	*Psammodes sp*	15
28/10/2018	Samburu	Nagor-oworu river	River	*Rhytinota sp*	14
28/10/2018	Samburu	Nagor-oworu river	River	*Parabuthus sp*	1
28/10/2018	Samburu	Nagor-oworu river	River	*Hottentonta sp*	2
28/10/2018	Samburu	Nagor-oworu river	River	*Camponotus maculutus*	40
28/10/2018	Samburu	Nagor-oworu river	River	*Sarcophaga sp*	1
28/10/2018	Samburu	Nagor-oworu river	River	*Platythyrea sp*	5
28/10/2018	Samburu	Nagor-oworu river	River	*Gryllus bimaculatus*	8
28/10/2018	Samburu	Nagor-oworu river	River	*Crematogaster sp*	100
28/10/2018	Samburu	Nagor-oworu river	River	*Gryllulus sp*	7
28/10/2018	Samburu	Nagor-oworu river	River	*Catopsilia florella*	3
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Psammodes sp*	7
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Rhytinota sp*	10
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Platythyrea sp*	5
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Ocymyrmex weitzaeckeri*	4
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	Carabidae	2
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Phryncolus petrosus*	1
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Dymentia subvittata*	1
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Pimelia hildebrandti*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Scarabaeus catenatus*	1
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Cypholoba tetrastigma*	1
29/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Rhytinota gravidula*	1
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Psammodes sp*	75
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Parabuthus sp*	1
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	Geophilomorpha	4
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Cheilomenes lunata*	1
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Hister sp*	1
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Camponotus maculatus*	300
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Acrotylus sp*	1
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Cantatops sp*	1
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Schistocerca gregaria*	3
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Chlaenius sp*	50
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	Geophilomorpha	4
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Catopsilia florella*	2
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	Araneae	17
30/10/2018	Samburu	Wamba-Lembaras	Acacia woodland	*Rhytinota sp*	10
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Tetramorium sp*	110
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Zizula hylax*	3

Date	County	Locality	Habitat type	Genus/species	No. of individuals
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Junonia hierta*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Catopsilia florella*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Apis mellifera*	10
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Eumenes sp*	3
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Anthophora sp*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota sp*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Colotis euippe*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Schistocerca gregaria*	100
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Schistocerca gregaria*	200
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Vieta senegalensis*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	6
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Danaus chrysippus*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Hypolimnas misippus*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Junonia hierta*	9
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Junonia oenone*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Zizula hylax*	8
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Lophyra neglecta*	100
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Orthetrum caffrum*	3
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Trithermis sp*	2

Date	County	Locality	Habitat type	Genus/species	No. of individuals
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Anax sp*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Gryllus bimaculatus*	2
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Micromeriella sp*	5
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Eumenes campiformis*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Eumenes maxillosus*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Polistes marginalis*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Polistes smithi*	2
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Sceliphron quartinae*	1
03/10/2018	Turkana	Lokichar Nakukulas	Borehole overflow	*Senapsis haemorrhoa*	2
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Buthus sp*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Julida	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Cytocanthacris sp*	400
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Mylothris rueppeli*	1
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Colotis aurigineus*	5
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Colotis evagore*	2
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Colotis regina*	1
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Zizeeria knysna*	5
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Tarucus grammicus*	3
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Hypotrigona sp*	2

Date	County	Locality	Habitat type	Genus/species	No. of individuals
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Macrotermes sp*	3
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Pinacopteryx eriphia*	1
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Hottentonta sp*	1
04/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia & Commiphora thicket	*Apis mellifera*	1
05/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia woodland	*Colotis protomedia*	1
05/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia woodland	*Colotis aurigineus*	2
05/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia woodland	*Junonia hierta*	1
05/10/2018	Turkana	Lokichar Maruangpei Nakukulas	Acacia woodland	*Belenois aurota*	1
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Danaus chrysippus*	1
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	Ixodidae	1
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	Sphecidae	2
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Dineutes sp*	50
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Crematogaster sp*	100
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Anthophora sp*	2
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Meliponula sp*	3
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Zizula hylax*	2
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Trithermis sp*	3
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Paplopleura deceptor*	4
06/10/2018	Turkana	Kerio river	Acacia/Prosopis	*Liris sp.*	3

Date	County	Locality	Habitat type	Genus/species	No. of individuals
07/10/2018	Turkana	Kerio river	Wetland	*Catopsilia florella*	5
07/10/2018	Turkana	Kerio river	Wetland	*Ammophilia sp*	1
07/10/2018	Turkana	Kerio river	Wetland	*yellow abdomen*	1
07/10/2018	Turkana	Kerio river	Wetland	*Danaus chrysippus*	1
07/10/2018	Turkana	Kerio river	Wetland	*Crematogaster sp*	100
07/10/2018	Turkana	Kerio river	Wetland	*Apis mellifera*	10
07/10/2018	Turkana	Kerio river	Wetland	*Apis mellifera*	1
07/10/2018	Turkana	Kerio river	Wetland	*Anisops sp*	1
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Hottentonta sp*	2
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Colotis protomedia*	1
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Colotis evagore*	1
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Colotis amatus*	1
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Catopsilia florella*	1
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Gonocephalum sp*	3
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Lepisma saccharina*	11
18/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Megachile sp*	1
18/10/2018	Turkana	Suguta valley	River	*Lophyra neglecta*	42
18/10/2018	Turkana	Suguta valley	River	*Catopsilia florella*	1
18/10/2018	Turkana	Suguta valley	River	Tabanidae	14

Date	County	Locality	Habitat type	Genus/species	No. of individuals
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Colotis protomedia*	4
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Colotis amatus*	15
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Colotis evagore*	3
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Zophosis sp*	2
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Pherosophus insiginis*	4
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Rhytinota gravidula*	1
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	*Lophyra neglecta*	100
19/10/2018	Turkana	Suguta valley	Rocky with acacia and grass	Araneae	1
08/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Coryna arussina*	1
08/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Tachysphex sp*	1
08/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Anthophora torrida*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Hypotrigona sp*	67
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Lasioglossum sp*	2
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Megachile sp*	1
05/11/2018	Garissa	Rahole	Acacia & Commiphora thicket	*Coryna arussina*	3
07/10/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Macrogalea candida*	4
07/10/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Hypotrigona sp*	10
07/10/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Lasioglossum sp*	3
07/10/2018	Garissa	Korakora	Acacia & Commiphora thicket	*Meliponula sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
07/11/2018	Garissa	Korakora 5km from AGI 21	Acacia & Commiphora thicket	*Macrogalea candida*	3
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Macrogalea candida*	1
07/11/2018	Garissa	9km to AGI 22	Acacia & Commiphora thicket	*Acmaedora virgo*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Paussus sp*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Phaeophilacris sp*	2
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Coryna arussina*	1
07/11/2018	Garissa	AGI 22	Acacia & Commiphora thicket	*Gegenes hottentota*	4
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Ocymyrmex weitzaeckeri*	1
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Hypotrigona sp*	2
10/11/2018	Garissa	Bura-Fafi	Acacia & Commiphora thicket	*Macrogalea candida*	2
12/10/2018	Isiolo	Archers post	Lugga	*Platythyrea cribrinodis*	3
12/10/2018	Isiolo	Archers post	Lugga	*Apis mellifera*	1
12/10/2018	Isiolo	Archers post	Lugga	*Coryna arussina*	1
12/10/2018	Isiolo	Archers post	Lugga	*Monomorium sp*	25
12/10/2018	Isiolo	Archers post	Lugga	*Pheidole sp*	3
16/10/2018	Isiolo	Garba tula	Dam	*Hypotrigona sp*	20
16/10/2018	Isiolo	Garba tula	Dam	*Pheidole sp*	7
16/10/2018	Isiolo	Garba tula	Dam	*Macrogalea candida*	2
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Megachile sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Tachysphex sp*	3
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Lasioglossum sp*	4
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Coryna arussina*	4
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Lixus sp*	2
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Tachysphex sp*	3
21/10/2018	Samburu	Baragoi Suyan river	Lugga	*Pheidole sp*	10
23/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Megachile sp*	4
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Tachysphex sp*	5
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Lasioglossum sp*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Camponotus maculatus*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Musca domestica*	1
22/10/2018	Samburu	Baragoi Nachola AGI-07	Terrestrial	*Bengalia sp*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Gryllulus sp*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Hippoboscidae	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Hypotrigona sp*	64
07/10/2018	Turkana	Kerio river	Riparian	*Pheidole sp*	6
07/10/2018	Turkana	Kerio river	Riparian	*Platythyrea cribrinodis*	1
07/10/2018	Turkana	Kerio river	Riparian	*Pheidole sp*	2
07/10/2018	Turkana	Kerio river	Riparian	*Tachysphex sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	Solifugae	3
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Rhytinota praeronga*	1
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Pheidole sp*	27
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Crematogaster sp*	10
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Camponotus maculatus*	1
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Parabuthus sp*	1
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Ocymyrmex weitzaeckeri*	5
04/11/2018	Garissa	Shimbir along garissa Modagashe rd	Acacia & Commiphora thicket	*Epilamphra pardalina*	1
12/10/2018	Isiolo	Archers post	Lugga	*Platythyrea cribrinodis*	6
12/10/2018	Isiolo	Archers post	Lugga	*Camponotus maculatus*	1
12/10/2018	Isiolo	Archers post	Lugga	*Brachynus leprieuri*	2
12/10/2018	Isiolo	Archers post	Lugga	*Pogonabasis cognata*	1
12/10/2018	Isiolo	Archers post	Lugga	*Pogonabasis costa*	2
12/10/2018	Isiolo	Archers post	Lugga	*Adesmia sp*	1
12/10/2018	Isiolo	Archers post	Lugga	*Camponotus maculatus*	52
12/10/2018	Isiolo	Archers post	Lugga	*Rhytinota praeronga*	5
12/10/2018	Isiolo	Archers post	Lugga	*Zophosis punctatafasciata*	12
12/10/2018	Isiolo	Archers post	Lugga	*Ocymyrmex weitzaeckeri*	3
12/10/2018	Isiolo	Archers post	Lugga	*Pachycondyla tarsata*	32

Date	County	Locality	Habitat type	Genus/species	No. of individuals
12/10/2018	Isiolo	Archers post	Lugga	*Zophosis punctatafasciata*	7
12/10/2018	Isiolo	Archers post	Lugga	*Zophosis sulcata*	5
12/10/2018	Isiolo	Archers post	Lugga	*Camponotus maculatus*	11
12/10/2018	Isiolo	Archers post	Lugga	Araneae	4
12/10/2018	Isiolo	Archers post	Lugga	*Amophorus opacus*	1
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	Araneae	2
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Pheidole sp*	15
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Zophosis plicatipennis*	8
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Chlaenius sp*	2
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Pheidole sp*	1200
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Cypholoba tetrastigma*	4
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Gryllus sp*	1
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Ocymyrmex weitzaeckeri*	3
14/10/2018	Meru	Kula mawe	Acacia & Commiphora thicket	*Zophosis punctatafasciata*	5
14/10/2018	Meru	Kachiuru	Acacia & Commiphora thicket	Araneae	2
14/10/2018	Meru	Kachiuru	Acacia & Commiphora thicket	*Pheidole sp*	15
14/10/2018	Meru	Kachiuru	Acacia & Commiphora thicket	*Zophosis plicatipennis*	8
14/10/2018	Meru	Kachiuru	Acacia & Commiphora thicket	*Chlaenius sp*	2
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Gymnopleurus azureus*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Phaeophilacris sp*	1
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Gryllus sp*	1
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Ammophilia sp*	1
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Chlaenius laetoides*	1
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Tetragonoderus jeanneli*	3
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Pheidole sp*	1
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Crematogaster sp*	1
23/10/2018	Samburu	Baragoi Nachola	Lugga	*Camponotus maculatus*	1
27/10/2018	Samburu	Swari river	Terrestrial	*Meristhus lepidostus*	1
27/10/2018	Samburu	Swari river	Terrestrial	*Camponotus maculatus*	3
27/10/2018	Samburu	Swari river	Terrestrial	*Gryllus sp*	1
27/10/2018	Samburu	Swari river	Terrestrial	Araneae	1
27/10/2018	Samburu	Swari river	Terrestrial	*Cypholoba tetrastigma*	3
27/10/2018	Samburu	Swari river	Terrestrial	*Camponotus maculatus*	205
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Phaeophilacris sp*	1
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Cypholoba tetrastigma*	1
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Camponotus maculatus*	5
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Ocymyrmex weitzaeckeri*	7
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Gryllus sp*	3

Date	County	Locality	Habitat type	Genus/species	No. of individuals
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	Araneae	2
30/10/2018	Samburu	Wamba-Lengusaka lugga	Acacia woodland	*Adoretus pumilio*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	6
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Meristhus lepidostus*	2
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Campsomeriella sp.*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Phaeophilacris sp*	5
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Platythyrea cribrinodis*	5
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Pheidole sp*	31
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Araneae	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	3
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Gryllulus sp*	1
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Platythyrea cribrinodis*	3
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	2
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	5
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Vieta senegalensis*	1
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	9
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	72
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Solifugae	1
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Buthus sp*	1

Date	County	Locality	Habitat type	Genus/species	No. of individuals
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Pimelia hildebrandti*	2
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	18
04/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Pheidole sp*	3
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Phaeophilacris sp*	1
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	19
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	102
03/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Gryllus sp*	3
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	3
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Araneae	4
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	16
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Ocymyrmex weitzaeckeri*	3
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Pheidole sp*	10
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Phaeophilacris sp*	2
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	4
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Araneae	2
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	10
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Rhytinota gravidula*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Ocymyrmex weitzaeckeri*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Pheidole sp*	3

Date	County	Locality	Habitat type	Genus/species	No. of individuals
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Meristhus lepidostus*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Araneae	4
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Zophosis plicatipennis*	1
02/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Gryllus sp*	2
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Tachysphex sp*	2
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Ocymyrmex weitzaeckeri*	3
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Camponotus maculatus*	1
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	Araneae	1
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Gryllus sp*	1
05/10/2018	Turkana	Lokichar Nakukulas	Acacia woodland	*Pheidole sp*	1
07/10/2018	Turkana	Kerio river	Riparian	*Hister sp*	7
07/10/2018	Turkana	Kerio river	Riparian	*Rhytinota pinheyi*	4
07/10/2018	Turkana	Kerio river	Riparian	*Pogonabasis cognata*	1
07/10/2018	Turkana	Kerio river	Riparian	*Anoploplesis sp*	8
07/10/2018	Turkana	Kerio river	Riparian	*Pachycondyla berthoudi*	4
07/10/2018	Turkana	Kerio river	Riparian	*Platythyrea cribrinodis*	6
07/10/2018	Turkana	Kerio river	Riparian	*Plocaederus bennigseni*	1
07/10/2018	Turkana	Kerio river	Riparian	*Gryllus sp*	1
07/10/2018	Turkana	Kerio river	Riparian	*Camponotus maculatus*	10

Date	County	Locality	Habitat type	Genus/species	No. of individuals
07/10/2018	Turkana	Kerio river	Riparian	Araneae	3
07/10/2018	Turkana	Kerio river	Riparian	*Pheidole sp*	3
07/10/2018	Turkana	Kerio river	Riparian	*Polyharchis gagates*	7
07/10/2018	Turkana	Kerio river	Riparian	*Camponotus maculatus*	36
07/10/2018	Turkana	Kerio river	Riparian	*Rhytinota praeronga*	1
07/10/2018	Turkana	Kerio river	Riparian	*Pheidole sp*	1
07/10/2018	Turkana	Kerio river	Riparian	*Polyharchis gagates*	16
13/10/2018	Isiolo	Ewaso nyiro	River	Corixiidae	1
13/10/2018	Isiolo	Ewaso nyiro	River	*Anisops sp*	1
13/10/2018	Isiolo	Ewaso nyiro	River	*Enithares sobria*	1
13/10/2018	Isiolo	Ewaso nyiro	River	*Crocothemis erythraea*	4
13/10/2018	Isiolo	Ewaso nyiro	River	*Orthetrum caffrum*	6
13/10/2018	Isiolo	Ewaso nyiro	River	*Dineutes sp*	25
05/10/2018	Turkana	Kaaruko	Wetland	*Lethocerus niloticus*	31
05/10/2018	Turkana	Kaaruko	Wetland	*Laccotrephes fabricii*	15
05/10/2018	Turkana	Kaaruko	Wetland	*Laccocoris limigenus*	21
05/10/2018	Turkana	Kaaruko	Wetland	*Enithares sobria*	10
05/10/2018	Turkana	Kaaruko	Wetland	*Anisops debilis*	22
05/10/2018	Turkana	Kaaruko	Wetland	*Cybister tripunctatus*	13

Date	County	Locality	Habitat type	Genus/species	No. of individuals
05/10/2018	Turkana	Kaaruko	Wetland	*Eretes sticticus*	8
05/10/2018	Turkana	Kaaruko	Wetland	*Hydaticus servillianus*	3
05/10/2018	Turkana	Kaaruko	Wetland	*Dineutes aerus*	1
07/10/2018	Turkana	Kerio river	River	*Gerris sp*	1
07/10/2018	Turkana	Kerio river	River	*Orthetrum caffrum*	4
07/10/2018	Turkana	Kerio river	River	*Anisops sp*	2
07/10/2018	Turkana	Kerio river	River	*Sphaerodena sp*	5
07/10/2018	Turkana	Kerio river	River	*Ranatra sp*	1
07/10/2018	Turkana	Kerio river	River	*Lestes sp*	1

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.112.B0

TO Paul Mowatt, PPMT

CC Freddy Brookes

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES – ORNITHOLOGY FIELD REPORT

Preface: The following field report has been provided by ornithology expert Philista Malaki. Golder has provided minimal editing to maintain the sentiment and expert opinion of Philista Malaki.

1.0 INTRODUCTION

This field report relates to the implementation of field studies defined in the plan of study (PoS) full baseline 1772867.536. This suite of stage 2 baseline fieldwork is designed to support the ESIA for the LLCOP Project to characterise biodiversity features of conservation concern (including critical habitat). This element focusses on biological data gathering for the species in the avian group along the LLCOP route.

The purpose of the baseline studies is to:

- Visit selected locations along the LLCOP route including coverage of all Counties, habitat typologies and key potential biodiversity 'hot spot' areas identified along the route for investigation;
- Undertake timed species counts (of birds seen and heard) across fixed time periods and routes, which were conducted to sample bird species associated with each broad habitat type/vegetation community.
- Undertake point count and rapid assessment (of birds seen and heard) in areas of rugged terrain, densely vegetated habitats and habitats that are heterogeneous or highly fragmented, where universal sampling designs are unlikely to work;
- Gather observations that will contribute to the ecosystems services baseline;
- Gather data for species and habitats that can be used to inform the critical habitat assessment at a later stage; and
- Investigate features of potential specific biodiversity importance, as identified from the preliminary desk studies, including the critical habitat screening undertaken by Golder (2018) and Ecountability (2017).

The results will be used to:

- Provide input to project routing and design mitigation;
- Inform the overall baseline biodiversity study for the ESIA; and

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- Inform the Impact Assessment for identification of potential short and long-term impacts of the LLCOP on the expected species within each Biotype area and develop recommended mitigation measures as appropriate.

This element of the baseline was focused on the potentially critically endangered species identified in the Critical Habitat Screening, such as Saker Falcon (*Falco cherug*), White-backed Vulture (*Gyps africanus*), and Ruepell's Vulture (*Gyps ruepellii*). A key area is the rocks and crags in the 'gap' section north of the Samburu National Park and other areas of potential migratory importance. Any important bird habitat areas which could be impacted during pipeline construction (seasonal or permanent) were included.

Distance sampling and absolute census – was used to survey colonially roosting water birds and water fowl at wetlands or waterbodies as they were identified. Opportunistic encounters were also recorded while travelling along the route.

2.0 FIELD PROGRAMME SUMMARY

2.1 Golder team

The fieldwork was completed by the following member of the Golder team:

- Philista Malaki (PM).

2.2 Tasks completed

A brief summary of the field programme during (Philista Malaki's) visit is provided in Table 1.

Table 1: (Ornithological) baseline survey field programme

Date	Task	Location	Initials of team member attending
10/10/2018	Travel to Isiolo	Isiolo	PM
11/10/2018	Bird surveys at Ewaso River	Archers Post	PM
12/10/2018-13/10/2018	Bird surveys at Kalama conservancy lugga and Ewaso River	Archers post	PM
14/10/2018-15/10/2018	Bird surveys at Kula Mawe and en route Isiolo Mogadashe Highway	Garbatula	PM
16/10/2018	Bird surveys at Kinna Dam and road *en route* to site	Maralal-Marti	PM
17/10/2018	Travel from Isiolo to Nairobi to transfer collected specimen for preservation in the lab	Maralal-Marti-Maralal	PM
18/10/2018-19/10/2018	Backing up data and Preserving specimens at National Museum of Kenya (NMK)	Nairobi	PM
20/10/2018	Travel from Nairobi to Baragoi	Maralal-Wamba	PM
21/10/2018	Bird Surveys at Suyan Lugga and along Baragoi-Wamba Road	Baragoi	PM

Date	Task	Location	Initials of team member attending
22/10/2018-23/10/2018	Bird Surveys at Nachola Lugga	Baragoi	PM
24/10/2018	Travel from Baragoi to work in Barsaloi and stay in Wamba	Wamba	
25/10/2018	Bird Surveys at Kalama conservancy and Namnyak conservancy	Towards Wamba Junction	PM
26/10/2018-27/10/2018	Bird Surveys at Swarri Lugga	Wamba	PM
28/10/2018	Bird surveys at 0.96238 N, 37.23134 E and travel to stay at Sarova, Isiolo	Wamba	PM
29/10/2018-30/10/2018	Bird Surveys at Lengusaka and Lembarass lagga	Wamba	PM
31/10/2018	Travel to Nairobi from Sarova, Isiolo	Nairobi	PM
01/11/2018	Backing up data and sorting samples at NMK,	Nairobi	PM
02/11/2018	Travel to Garissa	Garissa	PM
03/11/2018-07/11/2018	Bird surveys in Garissa sites including Arahole, Sankuri, Modika, Enroute Garissa Ijara route, 0.96238 N, 37.23134 E, and proximity of Station 13	Garissa	PM
08/11/2018	Travel from Garissa to Hola	Hola	PM
09/11/2018	Bird surveys at Masalani		
10/11/2018	Bird Surveys at Fafi	Garissa/Hola	PM
11/11/2018	Travel from Hola to Nairobi for overnight stay	Nairobi	PM
12/11/2018	Travel by flight to Lamu	Nairobi	PM
13/10/2018	Bird surveys at creek in Mwashindwani and surrounding wetlands	Lamu	PM
14/11/2018-15/11/2018	Bird Surveys at Bargoni	Lamu	PM
16/11/2018-17/11/2018	Bird surveys at Lamu new port and within mangrove wetlands	Lamu	PM
18/11/2018	Data cleaning, backing up and general management	Lamu	PM
19/11/2018	Continue data management and travel from Lamu to Nairobi	Lamu	PM

2.3 Deviation from Scope

The survey was conducted within the scope of the project objectives following standard methodologies. Time spent within areas marked as insecure e.g. in Garissa, Ijara and Lamu, was quite limited and therefore did not allow collection of substantive data, this was taken as a precaution against foreseen security risks. Nevertheless, information gathered from all other sites visited will be able to inform the LLCOP ESIA Baseline as intended.

3.0 OBSERVATIONS FROM FIELD WORK

3.1 General observations made during fieldwork

Scope of survey

All sample points were preselected from satellite images based on expert knowledge of areas considered critical for biodiversity and areas where gaps needed to be filled in order to provide a comprehensive data to guide in the implementation of the proposed development. All sample points selected were visited prioritising more in areas with LLCOP Stations within Turkana, Samburu, Isiolo, Garissa and Lamu though efforts employed on each site varied depending on logistical issues on the ground. Other sites were also selected randomly through visual observations guided by ease of accessibility. Data gathered from desktop review also guided site selection.

Bird Habitat description

Habitats ranging from acacia woodlands, wooded grasslands, open grasslands, bushlands, characterised the survey sites. Aquatic habitats also represented by temporary pools of water and constructed dams for domestic and livestock use were scattered across the proposed pipeline routing. Although during the current survey most of the pools surveyed during the initial study had dried up. These varied habitats provided a representation of the rich diversity of birds observed and expected along the pipeline routing. Cliffs and hilly landscapes characterised the general area especially between Archers Post to Wamba in Samburu. These features provided suitable habitats for raptors and vultures.

Figure 1: Pools of water for bird watering

Figure 2: Extensive grassland habitat along Baragoi Barsaloi route

Bird observation

More than 180 species of birds were observed during the current assessment representing birds from different families. However, from desktop assessment this proportion only makes up 30% of species expected to occur within the general area covered by the pipeline routing. Species recorded included passerines, both resident and a few migrants, raptors, vultures and wetland birds. It was quite evident that the effect of the short-wet season on the species abundance/diversity was not as great as could be expected since it did not rain as was expected. Rainfall patterns in arid and semi arid areas are very unpredictable, most of the area traversed by the pipeline falls under this category. This has a great influence on the species diversity, distribution and physiological processes including breeding and migration.

Figure 3: Black Kite in flight

Figure 4: Superb Starling

The effect is expected more during the long-wet season with more birds choosing to breed around this time when food availability is greater. Migration patterns are also affected by a combination of ecological and different climatic patterns. Much of a bird's life cycle and behaviour is closely linked to cues from the environment, such as changing seasons. Long-distance migrants are particularly at risk of a mismatch as it is harder for bird species to know what conditions might be like along the migration route. This could explain why only a few migratory species were recorded during the LLCOP Baseline survey. The main LLCOP Baseline programme (October and November) coincided with the autumn migration of western Palaearctic birds from Europe to Africa. However, our records show low numbers of migratory birds. The list of species observed is provided at Appendix A.

Species of conservation concern observed included African White-backed Vulture *Gyps africanus*, and the Hooded vulture *Necrosyrtes monachus,* which were observed in the Ewaso Ngiro river at the field work site. Both of these vulture species are listed as Critically Endangered on the IUCN list.

Other notable species of conservation concern by virtue of their behaviour and habitat dependency included Species of Bustards (Kori Bustard, Black-bellied Bustard - a pair observed on display suggesting breeding, and White-bellied Bustard), a Somali Ostrich observed with chicks in Barsaloi was enough evidence that the species is breeding in the area. These species specifically depend on grassland during breeding and most of their life cycle. Species of plovers that nest on the ground near pools and in wetlands; Sandgrouses flocking around any available water pools; other species of gamebirds including Vulturine and Helmeted guineafowl in very high populations were all noted.

Figure 5: Female and Male Somali Ostrich

Figure 6: Male Somali Ostrich

Figure 7: Kori Bustard

Figure 8: Vulturine Guineafowl

Different species may have varying sensitivities to the proposed project activities depending on their behaviour (e.g. habitat preferences/dependency, feeding patterns, diurnal and seasonal movements etc.). It is therefore important to understand species reliance on habitats through their lifecycle or migratory patterns in order to minimise residual effects.

Data collected

Refer to Appendix A.

Key observations for ESIA

The key species listed under IUCN were the African White-backed Vulture, *Gyps africanus CR* (Critically endangered) and the Hooded Vulture *Necrosyrtes monachus CR*. However; more surveys targeting vulture species, likely to be present and triggering critical habitat, would reveal more, especially North of Samburu National Park and in Wamba area, where habitats are suitable for the species. Other species were also recorded though under the *NT* (near threatened) or *Vu* (vulnerable) category. Migratory species have also been recorded though in low numbers.

3.2 Meetings and Discussions

- Meetings held with local administration within different localities that were visited led by our team leader Bernard Agwanda.
- Prior meetings held at county level e.g. in both Garissa and Lamu to ensure we gather information on security situation prior to engaging in any exercise led by our team leader Bernard Agwanda.
- Several casual contacts made with locals some who are already aware some not yet aware of the project e.g. in Barsaloi and Wamba with both local representative in the parliament and with local chief and few members of the community.
- Information emerging from the meetings indicate that there seems to be confusion between the LAPSET and LLCOP project further awareness probably still required.

3.3 Health and Safety learning

The following learnings were provided by Philista Malaki:

- Need to identify strategies to work in those areas under security risk, even with the formal security little can be achieved since they are key targets from Al Shabab sympathisers and also there are time restrictions for collecting adequate data when military or formal police is involved; and
- Working as team proved very fruitful as teams are able to complement and add value to data collection.

3.4 Monitoring and Mitigation

- Additional monitoring for migratory and breeding birds is required in parallel with project implementation. Breeding and nesting periods are generally early April to late August for most birds. However, certain birds do not have a defined breeding or nesting season. While the bird migration peaks in October-November and March-April. Addition summer migration March-April would add much value to the project, this also coincides with the long-wet season; and
- Targeted bird and habitat management plans need to be established, the whole area traversed by the pipeline is an ecosystem with different niche accommodating specific species each niche requires a specialised form of management targeting particular species that are specialised to inhabit those characteristic habitats e.g. 1.Migratory Passerines, 2. Breeding birds survey and monitoring (Game Birds, Raptors and Vultures, Wetland Birds), 3. Important Bird Areas e.g. Boni and Dodori forest, 4. Unique pristine habitat e.g. Suguta Valley, Bird Migration Corridors.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

FB/TF/kc

APPENDIX A

Bird species records

Date	Locality	Species common name	Genus/species	No. of individuals
12/10/2018	Ewaso River	Cinnamon-chested Bee-eater	*Merops lafresnayii*	1
12/10/2018	Ewaso River	African Palm Swift	*Cypsiurus parvus*	1
12/10/2018	Ewaso River	Red-billed Quelea	*Quelea quelea*	1
12/10/2018	Ewaso River	Brubru	*Nilaus afer*	1
12/10/2018	Ewaso River	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
12/10/2018	Ewaso River	Speke's Weaver	*Ploceus spekei*	1
12/10/2018	Ewaso River	Northern Black Flycatcher	*Melaenornis edolioides*	1
12/10/2018	Ewaso River	Grey Wren-Warbler	*Calamonastes simplex*	1
12/10/2018	Ewaso River	Yellow-throated Petronia	*Gymnoris superciliaris*	1
12/10/2018	Ewaso River	Woodland Kingfisher	*Halcyon senegalensis*	1
12/10/2018	Ewaso River	Purple Grenadier	*Granatina ianthinogaster*	1
12/10/2018	Ewaso River	Northern Grey-headed Sparrow	*Passer griseus*	2
12/10/2018	Ewaso River	Crimson-rumped Waxbill	*Estrilda rhodopyga*	4
12/10/2018	Ewaso River	Black-cheecked Waxbill	*Estrilda charmosyna*	6
12/10/2018	Ewaso River	Pallid Harrier	*Circus macrourus*	1
12/10/2018	Ewaso River	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
12/10/2018	Ewaso River	Namaqua Dove	*Oena capensis*	1
12/10/2018	Ewaso River	Barn Swallow	*Hirundo rustica*	1

Date	Locality	Species common name	Genus/species	No. of individuals
12/10/2018	Ewaso River	Fork-tailed Drongo	*Dicrurus adsimilis*	1
12/10/2018	Ewaso River	White-browed Sparrow-Weaver	*Plocepasser mahali*	1
12/10/2018	Ewaso River	Namaqua Dove	*Oena capensis*	1
12/10/2018	Ewaso River	Ring-necked Dove	*Streptopelia capicola*	1
12/10/2018	Ewaso River	Superb Starling	*Lamprotornis superbus*	1
12/10/2018	Ewaso River	White-bellied Go-away-bird	*Criniferoides leucogaster*	10
12/10/2018	Ewaso Ngiro	Chinspot Batis	*Batis molitor*	1
12/10/2018	Ewaso Ngiro	Gabar Goshawk	*Micronisus gabar*	1
12/10/2018	Ewaso Ngiro	Cardinal Woodpecker	*Dendropicos fuscescens*	2
12/10/2018	Ewaso Ngiro	Pale Prinia	*Prinia somalica*	1
12/10/2018	Ewaso Ngiro	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
12/10/2018	Ewaso Ngiro	Brubru	*Nilaus afer*	4
12/10/2018	Ewaso Ngiro	Golden-breasted Starling	*Lamprotornis regius*	4
12/10/2018	Ewaso Ngiro	Yellow-throated Apalis	*Apalis thoracica flavigularis*	1
12/10/2018	Ewaso Ngiro	Black-throated Barbet	*Tricholaema melanocephala*	1
12/10/2018	Ewaso Ngiro	Black-throated Barbet	*Tricholaema melanocephala*	1
12/10/2018	Ewaso Ngiro	Black-throated Barbet	*Tricholaema melanocephala*	1
12/10/2018	Ewaso Ngiro	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	1

Date	Locality	Species common name	Genus/species	No. of individuals
12/10/2018	Ewaso Ngiro	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
12/10/2018	Ewaso Ngiro	Fischer's Starling	*Lamprotornis fischeri*	1
12/10/2018	Ewaso Ngiro	African Grey Flycatcher	*Bradornis microrhynchus*	1
12/10/2018	Ewaso Ngiro	Black-throated Apalis	*Apalis jacksoni*	1
12/10/2018	Ewaso Ngiro	Fork-tailed Drongo	*Dicrurus adsimilis*	1
12/10/2018	Ewaso Ngiro	African Hoopoe	*Upupa epops africana*	1
12/10/2018	Ewaso Ngiro	Ring-necked Dove	*Streptopelia capicola*	1
12/10/2018	Ewaso Ngiro	White-crested Helmetshrike	*Prionops plumatus*	4
12/10/2018	Ewaso Ngiro	Abyssinian Scimitarbill	*Rhinopomastus minor*	2
12/10/2018	Ewaso Ngiro	African Hawk-Eagle	*Aquila spilogaster*	1
12/10/2018	Ewaso Ngiro	Northern Red-billed Hornbill	*Tockus erythrorhynchus*	1
12/10/2018	Ewaso Ngiro	Abyssinian Scimitarbill	*Asio abyssinicus*	2
12/10/2018	Ewaso Ngiro	Cinnamon-chested Bee-eater	*Merops lafresnayii*	2
12/10/2018	Ewaso Ngiro	Speckled Pigeon	*Columba guinea*	1
12/10/2018	Ewaso Ngiro	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
12/10/2018	Ewaso Ngiro	Namaqua Dove	*Oena capensis*	1
12/10/2018	Ewaso Ngiro	White-browed Sparrow-Weaver	*Plocepasser mahali*	2
12/10/2018	Ewaso Ngiro	Superb Starling	*Lamprotornis superbus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
12/10/2018	Ewaso Ngiro	Laughing Dove	*Streptopelia senegalensis*	3
12/10/2018	Ewaso Ngiro	Fan-tailed Raven	*Corvus rhipidurus*	1
13/10/2018	Ewaso River 2	Hooded Vulture	*Necrosyrtes monachus*	1
13/10/2018	Ewaso River 2	Rüppell's Starling	*Lamprotornis purpuroptera*	1
13/10/2018	Ewaso River 2	Black-throated Barbet	*Tricholaema melanocephala*	1
13/10/2018	Ewaso River 2	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	1
13/10/2018	Ewaso River 2	Cinnamon-chested Bee-eater	*Merops lafresnayii*	1
13/10/2018	Ewaso River 2	Cardinal Woodpecker	*Dendropicos fuscescens*	1
13/10/2018	Ewaso River 2	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
13/10/2018	Ewaso River 2	African Grey Flycatcher	*Bradornis microrhynchus*	1
13/10/2018	Ewaso River 2	Fork-tailed Drongo	*Dicrurus adsimilis*	1
13/10/2018	Ewaso River 2	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
13/10/2018	Ewaso River 2	Northern Red-billed Hornbill	*Tockus erythrorhynchus*	1
13/10/2018	Ewaso River 2	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
13/10/2018	Ewaso River 2	White-backed Vulture	*Gyps africanus*	1
13/10/2018	Ewaso River 2	Yellow-billed Stork	*Ciconia abdimii*	1
13/10/2018	Ewaso River 2	Cape Turtle Dove	*Streptopelia capicola*	1
13/10/2018	Ewaso River 2	Superb Starling	*Lamprotornis superbus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
13/10/2018	Ewaso River 2	Brubru	*Nilaus afer*	1
13/10/2018	Ewaso River 2	Red-faced Crombec	*Sylvietta whytii*	1
13/10/2018	Ewaso River 2	Fan-tailed Raven	*Corvus rhipidurus*	1
13/10/2018	Ewaso River 2	Barn Swallow	*Hirundo rustica*	1
13/10/2018	Ewaso River 2	Namaqua Dove	*Oena capensis*	1
13/10/2018	Ewaso River 2	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
13/10/2018	Ewaso River 2	Laughing Dove	*Streptopelia senegalensis*	1
13/10/2018	Ewaso River 2	White-browed Sparrow-Weaver	*Plocepasser mahali*	1
13/10/2018	Ewaso River 2	Meyer's Parrot	*Poicephalus meyeri*	1
13/10/2018	Ewaso River 2	Spur-winged Lapwing	*Vanellus spinosus*	1
14/10/2018	Gichua KulaMawe	Pale Chanting Goshawk	*Melierax canorus*	1
14/10/2018	Gichua KulaMawe	Vulturine Guineafowl	*Acryllium vulturinum*	1
14/10/2018	Gichua KulaMawe	Kori Bustard	*Ardeotis kori*	1
14/10/2018	Gichua KulaMawe	Yellow-necked Spurfowl	*Pternistis leucoscepus*	1
14/10/2018	Kula Mawe2 Garbatula	Nubian Woodpecker	*Campethera nubica*	1
14/10/2018	Kula Mawe2 Garbatula	Barn Swallow	*Hirundo rustica*	1
14/10/2018	Kula Mawe2 Garbatula	Pallid Honeyguide	*Indicator meliphilus*	1
14/10/2018	Kula Mawe2 Garbatula	Banded Prinia	*Prinia bairdii*	12

Date	Locality	Species common name	Genus/species	No. of individuals
14/10/2018	Kula Mawe2 Garbatula	Brubru	*Nilaus afer*	1
14/10/2018	Kula Mawe2 Garbatula	White-backed Vulture	*Gyps africanus*	9
14/10/2018	Kula Mawe2 Garbatula	Tawny Eagle	*Aquila rapax*	1
14/10/2018	Kula Mawe2 Garbatula	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
14/10/2018	Kula Mawe2 Garbatula	Red-fronted Warbler	*Urorhipis rufifrons*	1
14/10/2018	Kula Mawe2 Garbatula	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
14/10/2018	Kula Mawe2 Garbatula	Red-cheeked Cordon-bleu	*Uraeginthus bengalus*	1
14/10/2018	Kula Mawe2 Garbatula	Cape Turtle Dove	*Streptopelia capicola*	1
14/10/2018	Kula Mawe2 Garbatula	Superb Starling	*Lamprotornis superbus*	1
14/10/2018	Kula Mawe2 Garbatula	Slate-colored Boubou	*Laniarius funebris*	1
14/10/2018	Kula Mawe2 Garbatula	Green-winged Pytilia	*Pytilia melba*	1
14/10/2018	Kula Mawe2 Garbatula	White-browed Sparrow-Weaver	*Plocepasser mahali*	1
14/10/2018	Kula Mawe2 Garbatula	Black-cheeked Waxbill	*Estrilda erythronotos charmosyna/kiwanukae*	1
14/10/2018	Kula Mawe2 Garbatula	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	1
14/10/2018	Kula Mawe2 Garbatula	Black-throated Barbet	*Tricholaema melanocephala*	1
14/10/2018	Kula Mawe2 Garbatula	Fork-tailed Drongo	*Dicrurus adsimilis*	1
14/10/2018	Kula Mawe2 Garbatula	Namaqua Dove	*Oena capensis*	1
14/10/2018	Kula Mawe2 Garbatula	Southern Yellow-billed Hornbill	*Tockus leucomelas*	1

Date	Locality	Species common name	Genus/species	No. of individuals
14/10/2018	Kula Mawe2 Garbatula	African Grey Flycatcher	*Bradornis microrhynchus*	1
14/10/2018	Kula Mawe2 Garbatula	Bateleur	*Terathopius ecaudatus*	1
15/10/2018	Kula Mawe1 Garbatula	African Hoopoe	*Upupa epops africana*	1
15/10/2018	Kula Mawe1 Garbatula	Long-tailed Paradise Whydah	*Vidua paradisaea*	1
15/10/2018	Kula Mawe1 Garbatula	Rufous Chatterer	*Turdoides rubiginosa*	1
15/10/2018	Kula Mawe1 Garbatula	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
15/10/2018	Kula Mawe1 Garbatula	Laughing Dove	*Streptopelia senegalensis*	1
15/10/2018	Kula Mawe1 Garbatula	Brubru	*Nilaus afer*	1
15/10/2018	Kula Mawe1 Garbatula	Green-headed Sunbird	*Cyanomitra verticalis*	1
15/10/2018	Kula Mawe1 Garbatula	Little Sparrowhawk	*Accipiter minullus*	1
15/10/2018	Kula Mawe1 Garbatula	Northern Grey-headed Sparrow	*Passer griseus*	1
15/10/2018	Kula Mawe1 Garbatula	Pale Flycatcher	*Bradornis pallidus*	1
15/10/2018	Kula Mawe1 Garbatula	Slate-colored Boubou	*Laniarius funebris*	1
15/10/2018	Kula Mawe1 Garbatula	Golden-breasted Bunting	*Fringillaria flaviventris*	1
15/10/2018	Kula Mawe1 Garbatula	Chinspot Batis	*Batis molitor*	1
15/10/2018	Kula Mawe1 Garbatula	Straw-tailed Whydah	*Vidua fischeri*	1
15/10/2018	Kula Mawe1 Garbatula	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
15/10/2018	Kula Mawe1 Garbatula	Spotted Eagle-Owl	*Bubo africanus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
15/10/2018	Kula Mawe1 Garbatula	Namaqua Dove	*Oena capensis*	1
15/10/2018	Kula Mawe1 Garbatula	Golden-breasted Starling	*Lamprotornis regius*	1
15/10/2018	Kula Mawe1 Garbatula	Barn Swallow	*Hirundo rustica*	1
15/10/2018	Kula Mawe1 Garbatula	Northern Crombec	*Sylvietta brachyura*	1
15/10/2018	Kula Mawe1 Garbatula	Klaas's Cuckoo	*Chrysococcyx klaas*	1
15/10/2018	Kula Mawe1 Garbatula	White-browed Sparrow-Weaver	*Plocepasser mahali*	1
15/10/2018	Kula Mawe1 Garbatula	Superb Starling	*Lamprotornis superbus*	1
15/10/2018	Kula Mawe1 Garbatula	Marico Sunbird	*Cinnyris mariquensis*	1
15/10/2018	Kula Mawe1 Garbatula	Amethyst Sunbird	*Chalcomitra amethystina*	1
15/10/2018	Kula Mawe1 Garbatula	Black-throated Barbet	*Tricholaema melanocephala*	1
15/10/2018	Kula Mawe1 Garbatula	Ring-necked Dove	*Streptopelia capicola*	1
15/10/2018	Kula Mawe1 Garbatula	White-backed Vulture	*Gyps africanus*	6
15/10/2018	Kula Mawe1 Garbatula	Green-winged Pytilia	*Pytilia melba*	1
15/10/2018	Kula Mawe1 Garbatula	Brubru	*Nilaus afer*	1
15/10/2018	Isiolo Mogadashe Highway	Yellow-necked Spurfowl	*Pternistis leucoscepus*	25
15/10/2018	Isiolo Mogadashe Highway	Helmeted Guineafowl	*Numida meleagris*	1
15/10/2018	Isiolo Mogadashe Highway	Pale Chanting Goshawk	*Melierax canorus*	1
15/10/2018	Isiolo Mogadashe Highway	Vulturine Guineafowl	*Acryllium vulturinum*	44

Date	Locality	Species common name	Genus/species	No. of individuals
15/10/2018	Isiolo Mogadashe Highway	Helmeted Guineafowl	*Numida meleagris*	1
15/10/2018	Isiolo Mogadashe Highway	Kori Bustard	*Ardeotis kori*	1
16/10/2018	Kinna Road Garbatula	Black-bellied Bustard	*Lissotis melanogaster*	2
16/10/2018	Kinna Road Garbatula	Golden-breasted Starling	*Lamprotornis regius*	1
16/10/2018	Kinna Road Garbatula	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
16/10/2018	Kinna Road Garbatula	Cape Turtle Dove	*Streptopelia capicola*	1
16/10/2018	Kinna Road Garbatula	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
16/10/2018	Kinna Road Garbatula	Superb Starling	*Lamprotornis superbus*	1
16/10/2018	Kinna Road Garbatula	Eastern Yellow-billed Hornbill	*Tockus hemprichii*	2
16/10/2018	Kinna Road Garbatula	Eastern Yellow-billed Hornbill	*Tockus flavirostris*	1
16/10/2018	Kinna Road Garbatula	Vulturine Guineafowl	*Acryllium vulturinum*	35
16/10/2018	Kinna Road Garbatula	Pale Chanting Goshawk	*Melierax canorus*	1
16/10/2018	Kinna Garbatula Road Dam	Ring-necked Dove	*Streptopelia capicola*	1
16/10/2018	Kinna Garbatula Road Dam	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
16/10/2018	Kinna Garbatula Road Dam	Black-throated Barbet	*Tricholaema melanocephala*	1
16/10/2018	Kinna Garbatula Road Dam	Superb Starling	*Lamprotornis superbus*	1
16/10/2018	Kinna Garbatula Road Dam	Common Hoopoe	*Upupa epops africana*	1
16/10/2018	Kinna Garbatula Road Dam	Chin-spot Batis	*Batis molitor*	1

Date	Locality	Species common name	Genus/species	No. of individuals
16/10/2018	Kinna Garbatula Road Dam	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
16/10/2018	Kinna Garbatula Road Dam	Spurwinged Plover	*Vanellus spinosus*	2
16/10/2018	Kinna Garbatula Road Dam	Nubian Woodpecker	*Campethera nubica*	1
16/10/2018	Kinna Garbatula Road Dam	Northern Crombec	*Sylvietta brachyura*	1
16/10/2018	Kinna Garbatula Road Dam	Brubru	*Nilaus afer*	4
16/10/2018	Kinna Garbatula Road Dam	Slate-coloured Boubou	*Laniarius funebris*	2
16/10/2018	Kinna Garbatula Road Dam	Pale Flycatcher	*Bradornis pallidus*	1
16/10/2018	Kinna Garbatula Road Dam	Golden-breasted Bunting	*Fringillaria flaviventris*	1
16/10/2018	Kinna Garbatula Road Dam	Golden-breasted Starling	*Lamprotornis regius*	1
16/10/2018	Kinna Garbatula Road Dam	Abyssinian Crimsonwing	*Cryptospiza salvadorii*	2
16/10/2018	Kinna Garbatula Road Dam	Northern Grey-headed Sparrow	*Passer griseus*	6
16/10/2018	Kinna Garbatula Road Dam	Namaqua Dove	*Oena capensis*	12
16/10/2018	Kinna Garbatula Road Dam	African Bare-eyed Thrush	*Turdus tephronotus*	2
16/10/2018	Kinna Garbatula Road Dam	Grey Wren-Warbler	*Calamonastes simplex*	1
16/10/2018	Kinna Garbatula Road Dam	Brown-crowned Tchagra	*Tchagra australis*	2
16/10/2018	Kinna Garbatula Road Dam	Northern Puffback	*Dryoscopus gambensis*	3
16/10/2018	Kinna Garbatula Road Dam	Cardinal Woodpecker	*Dendropicos fuscescens*	1
16/10/2018	Kinna Garbatula Road Dam	Bateleur	*Terathopius ecaudatus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
16/10/2018	Kinna Garbatula Road Dam	Black-cheeked Waxbill	*Estrilda erythronotos charmosyna/kiwanukae*	1
16/10/2018	Kinna Garbatula Road Dam	Green-winged Pytilia	*Pytilia melba*	1
16/10/2018	Kinna Garbatula Road Dam	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
16/10/2018	Kinna Garbatula Road Dam	Blue-capped Cordon-bleu	*Uraeginthus cyanocephalus*	1
16/10/2018	Kinna Garbatula Road Dam	Common Drongo	*Dicrurus adsimilis*	1
16/10/2018	Kinna Garbatula Road Dam	White-fronted Bee-eater	*Merops bullockoides*	2
21/10/2018	Baragoi_Wamba Road	Vulturine Guineafowl	*Acryllium vulturinum*	1
21/10/2018	Baragoi_Wamba Road	Northern Fiscal	*Lanius humeralis*	1
21/10/2018	Baragoi_Wamba Road	Common Kestrel	*Falco tinnunculus*	1
21/10/2018	Baragoi_Wamba Road	African Black-shouldered Kite	*Elanus caeruleus*	1
21/10/2018	Baragoi_Wamba Road	Lilac-breasted Roller	*Coracias caudatus*	1
21/10/2018	Baragoi_Wamba Road	Pygmy Falcon	*Polihierax semitorquatus*	1
21/10/2018	Baragoi_Wamba Road	Somali Ostrich	*Struthio camelus*	1
22/10/2018	Baragoi1	African Pied Wagtail	*Motacilla aguimp*	1
21/10/2018	Suyan Lagga	Lilac-breasted Roller	*Lilac-breasted Roller*	1
21/10/2018	Suyan Lagga	Pygmy Falcon	*Pygmy Falcon*	1
21/10/2018	Suyan Lagga	Tawny Eagle	*Tawny Eagle*	1
21/10/2018	Suyan Lagga	Fan-tailed Raven	*Fan-tailed Raven*	1

Date	Locality	Species common name	Genus/species	No. of individuals
21/10/2018	Suyan Lagga	Wahlberg's Eagle	*Wahlberg's Eagle*	1
21/10/2018	Suyan Lagga	Superb Starling	*Superb Starling*	7
21/10/2018	Suyan Lagga	Northern Grey-headed Sparrow	*Northern Gray-headed Sparrow*	1
21/10/2018	Suyan Lagga	Yellow-spotted Petronia	*Yellow-spotted Petronia*	1
21/10/2018	Suyan Lagga	Crested Francolin	*Crested Francolin*	1
21/10/2018	Suyan Lagga	Barred Warbler	*Barred Warbler*	1
21/10/2018	Suyan Lagga	Northern Masked Weaver	*Northern Masked-Weaver*	1
21/10/2018	Suyan Lagga	Eastern Violet-backed Sunbird	*Eastern Violet-backed Sunbird*	1
21/10/2018	Suyan Lagga	Rufous Chatterer	*Rufous Chatterer*	1
21/10/2018	Suyan Lagga	Spotted Palm Thrush	*Spotted Morning-Thrush*	1
21/10/2018	Suyan Lagga	Fork-tailed Drongo	*Fork-tailed Drongo*	1
21/10/2018	Suyan Lagga	Laughing Dove	*Laughing Dove*	1
21/10/2018	Suyan Lagga	Cape Turtle Dove	*Ring-necked Dove*	1
21/10/2018	Suyan Lagga	Cinnamon-chested Bee-eater	*Cinnamon-chested Bee-eater*	1
21/10/2018	Suyan Lagga	Orange-cheeked Waxbill	*Orange-cheeked Waxbill*	1
21/10/2018	Suyan Lagga	Grey-backed Camaroptera	*Grey-backed Camaroptera*	1
21/10/2018	Suyan Lagga	Dark-backed Weaver	*Forest Weaver*	1
21/10/2018	Suyan Lagga	Red-billed Quelea	*Red-billed Quelea*	1

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21/10/2018	Suyan Lagga	Chestnut Weaver	*Chestnut Weaver*	25
21/10/2018	Suyan Lagga	Emerald-spotted Wood Dove	*Emerald-spotted Wood-Dove*	1
21/10/2018	Suyan Lagga	Namaqua Dove	*Namaqua Dove*	1
21/10/2018	Suyan Lagga	Vulturine Guineafowl	*Vulturine Guineafowl*	1
21/10/2018	Suyan Lagga	Common Bulbul	*Common Bulbul*	1
21/10/2018	Suyan Lagga	African Firefinch	*African Firefinch*	4
21/10/2018	Suyan Lagga	White-bellied Go-away-bird	*White-bellied Go-away-bird*	1
21/10/2018	Suyan Lagga	Red-and-yellow Barbet	*Red-and-yellow Barbet*	1
21/10/2018	Suyan Lagga	White-headed Mousebird	*White-headed Mousebird*	4
21/10/2018	Suyan Lagga	Slate-colored Boubou	*Slate-colored Boubou*	2
22/10/2018	Nachola Lagga	Greater Honeyguide	*Indicator indicator*	1
22/10/2018	Nachola Lagga	Laughing Dove	*Streptopelia senegalensis*	1
22/10/2018	Nachola Lagga	Eurasian Hoopoe	*Upupa epops africana*	1
22/10/2018	Nachola Lagga	Black-headed Oriole	*Oriolus larvatus*	1
22/10/2018	Nachola Lagga	Blue-naped Mousebird	*Urocolius macrourus*	8
22/10/2018	Nachola Lagga	White-headed Mousebird	*Colius leucocephalus*	6
22/10/2018	Nachola Lagga	Gray Wren-Warbler	*Calamonastes simplex*	1
22/10/2018	Nachola Lagga	Hooded Vulture	*Necrosyrtes monachus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
22/10/2018	Nachola Lagga	Emerald-spotted Wood-Dove	*Turtur chalcospilos*	1
22/10/2018	Nachola Lagga	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
22/10/2018	Nachola Lagga	Namaqua Dove	*Oena capensis*	1
22/10/2018	Nachola Lagga	Martial Eagle	*Polemaetus bellicosus*	1
22/10/2018	Nachola Lagga	Pale Flycatcher	*Bradornis pallidus*	1
22/10/2018	Nachola Lagga	Purple Grenadier	*Granatina ianthinogaster*	1
22/10/2018	Nachola Lagga	Green-winged Pytilia	*Pytilia melba*	1
22/10/2018	Nachola Lagga	Nubian Woodpecker	*Campethera nubica*	1
22/10/2018	Nachola Lagga	Black-throated Barbet	*Tricholaema melanocephala*	1
22/10/2018	Nachola Lagga	Abyssinian Scimitarbill	*Rhinopomastus minor*	1
22/10/2018	Nachola Lagga	Pied Wheatear	*Oenanthe pleschanka*	1
22/10/2018	Nachola Lagga	Black-cheeked Waxbill	*Estrilda erythronotos charmosyna/kiwanukae*	1
22/10/2018	Nachola Lagga	Pale Prinia	*Prinia somalica*	1
22/10/2018	Nachola Lagga	Barn Swallow	*Hirundo rustica*	1
22/10/2018	Nachola Lagga	White-bellied Canary	*Crithagra dorsostriata*	1
22/10/2018	Nachola Lagga	Brown-backed Scrub-Robin	*Cercotrichas leucophrys*	1
22/10/2018	Nachola Lagga	Golden-breasted Bunting	*Fringillaria flaviventris*	1
22/10/2018	Nachola Lagga	Brubru	*Nilaus afer*	1

Date	Locality	Species common name	Genus/species	No. of individuals
22/10/2018	Nachola Lagga	Fork-tailed Drongo	*Dicrurus adsimilis*	1
22/10/2018	Nachola Lagga	Ring-necked Dove	*Streptopelia capicola*	1
23/10/2018	Nachola1	Spotted Palm Thrush	*Cichladusa guttata*	1
23/10/2018	Nachola1	Barn Swallow	*Hirundo rustica*	1
23/10/2018	Nachola1	Abyssinian Scimitarbill	*Rhinopomastus minor*	1
23/10/2018	Nachola1	Isabelline Wheatear	*Oenanthe isabellina*	1
23/10/2018	Nachola1	Gabar Goshawk	*Micronisus gabar*	1
23/10/2018	Nachola1	Lilac-breasted Roller	*Coracias caudatus*	1
23/10/2018	Nachola1	Grey Wren-Warbler	*Calamonastes simplex*	1
23/10/2018	Nachola1	Eastern Golden Weaver	*Ploceus subaureus*	1
23/10/2018	Nachola1	Black-headed Oriole	*Oriolus larvatus*	1
23/10/2018	Nachola1	African Paradise Flycatcher	*Terpsiphone viridis*	1
23/10/2018	Nachola1	Common Drongo	*Dicrurus adsimilis*	1
23/10/2018	Nachola1	Common Bulbul	*Pycnonotus barbatus*	1
23/10/2018	Nachola1	Common Hoopoe	*Upupa epops africana*	1
23/10/2018	Nachola1	Red-billed Hornbill	*Tockus erythrorhynchus*	1
23/10/2018	Nachola1	Spotted Flycatcher	*Muscicapa striata*	1
23/10/2018	Nachola1	Superb Starling	*Lamprotornis superbus*	11

Date	Locality	Species common name	Genus/species	No. of individuals
23/10/2018	Nachola1	Namaqua Dove	*Oena capensis*	9
23/10/2018	Nachola1	Emerald-spotted Wood Dove	*Turtur chalcospilos*	1
23/10/2018	Nachola1	Northern Grey-headed Sparrow	*Passer griseus*	1
23/10/2018	Nachola1	Brubru	*Nilaus afer*	1
23/10/2018	Nachola1	White-browed Scrub Robin	*Cercotrichas leucophrys*	1
23/10/2018	Nachola1	Northern Black Flycatcher	*Melaenornis edolioides*	1
23/10/2018	Nachola1	Slate-coloured Boubou	*Laniarius funebris*	1
23/10/2018	Nachola1	Grey-backed Camaroptera	*Camaroptera brachyura brevicaudata*	1
23/10/2018	Nachola1	Laughing Dove	*Streptopelia senegalensis*	4
23/10/2018	Nachola1	Ring-necked Dove	*Streptopelia capicola*	1
23/10/2018	Nachola1	Crested Francolin	*Dendroperdix sephaena*	1
23/10/2018	Nachola1	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
24/10/2018	Baragoi_Barsaloi	Kori Bustard	*Ardeotis kori*	1
24/10/2018	Baragoi_Barsaloi	African Black-shouldered Kite	*Elanus caeruleus*	1
24/10/2018	Barsaloi2	Cattle Egret	*Bubulcus ibis*	5
24/10/2018	Barsaloi2	Superb Starling	*Lamprotornis superbus*	1
24/10/2018	Barsaloi2	Three-banded Plover	*Charadrius tricollaris*	1
24/10/2018	Barsaloi2	Spotted Eagle-Owl	*Bubo africanus*	1

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24/10/2018	Barsaloi2	Pale Chanting Goshawk	*Melierax canorus*	1
24/10/2018	Barsaloi2	Dark-backed Weaver	*Ploceus bicolor*	1
24/10/2018	Barsaloi2	Common Drongo	*Dicrurus adsimilis*	1
24/10/2018	Barsaloi2	Laughing Dove	*Streptopelia senegalensis*	1
24/10/2018	Barsaloi2	Eastern Paradise Whydah	*Vidua paradisaea*	1
24/10/2018	Barsaloi2	Common Hoopoe	*Upupa epops africana*	1
24/10/2018	Barsaloi2	Ring-necked Dove	*Streptopelia capicola*	1
24/10/2018	Barsaloi2	Common Quail	*Coturnix coturnix*	5
24/10/2018	Barsaloi2	Red-fronted Warbler	*Urorhipis rufifrons*	1
24/10/2018	Barsaloi2	Cardinal Woodpecker	*Dendropicos fuscescens*	1
24/10/2018	Barsaloi2	Common Bulbul	*Pycnonotus barbatus*	1
24/10/2018	Barsaloi2	Eastern Golden Weaver	*Ploceus subaureus*	1
24/10/2018	Barsaloi2	Abyssinian Scimitarbill	*Rhinopomastus minor*	1
24/10/2018	Barsaloi2	Grey-backed Camaroptera	*Camaroptera brachyura*	1
24/10/2018	Barsaloi2	Nubian Woodpecker	*Campethera nubica*	1
24/10/2018	Barsaloi2	Black Cuckoo	*Cuculus clamosus*	1
24/10/2018	Barsaloi2	Northern Crombec	*Sylvietta brachyura*	1
24/10/2018	Barsaloi2	Spotted Flycatcher	*Muscicapa striata*	1

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24/10/2018	Barsaloi2	Pallid Harrier	*Circus macrourus*	1
24/10/2018	Barsaloi2	Slate-coloured Boubou	*Laniarius funebris*	1
24/10/2018	Barsaloi2	Verreaux's Eagle	*Aquila verreauxii*	1
24/10/2018	Barsaloi2	African Pied Wagtail	*Motacilla aguimp*	1
24/10/2018	Barsaloi2	African Paradise Flycatcher	*Terpsiphone viridis*	1
24/10/2018	Barsaloi2	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
24/10/2018	Barsaloi2	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
24/10/2018	Barsaloi2	White-headed Mousebird	*Colius leucocephalus*	1
24/10/2018	Barsaloi2	Namaqua Dove	*Oena capensis*	1
24/10/2018	Barsaloi2	Emerald-spotted Wood Dove	*Turtur chalcospilos*	1
25/10/2018	NamnyakVantage	Yellow-necked Spurfowl	*Pternistis leucoscepus*	1
25/10/2018	NamnyakVantage	Black-throated Barbet	*Tricholaema melanocephala*	1
25/10/2018	NamnyakVantage	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
25/10/2018	NamnyakVantage	Common Drongo	*Dicrurus adsimilis*	1
25/10/2018	NamnyakVantage	Slate-coloured Boubou	*Laniarius funebris*	1
25/10/2018	NamnyakVantage	Golden-breasted Starling	*Lamprotornis regius*	1
25/10/2018	NamnyakVantage	Nubian Woodpecker	*Campethera nubica*	1
25/10/2018	KalamaNamnyak	Vulturine Guineafowl	*Acryllium vulturinum*	31

Date	Locality	Species common name	Genus/species	No. of individuals
25/10/2018	KalamaNamnyak	Namaqua Dove	*Oena capensis*	15
25/10/2018	KalamaNamnyak	Emerald-spotted Wood Dove	*Turtur chalcospilos*	1
25/10/2018	KalamaNamnyak	Black-throated Barbet	*Tricholaema melanocephala*	1
25/10/2018	KalamaNamnyak	Brubru	*Nilaus afer*	1
25/10/2018	KalamaNamnyak	Ring-necked Dove	*Streptopelia capicola*	1
25/10/2018	KalamaNamnyak	Red-faced Crombec	*Sylvietta whytii*	1
25/10/2018	KalamaNamnyak	Nubian Woodpecker	*Campethera nubica*	1
25/10/2018	KalamaNamnyak	Red-and-yellow Barbet	*Trachyphonus erythrocephalus*	1
25/10/2018	KalamaNamnyak	Grey Wren-Warbler	*Calamonastes simplex*	1
25/10/2018	KalamaNamnyak	Red-billed Hornbill	*Tockus erythrorhynchus*	1
25/10/2018	KalamaNamnyak	Abyssinian Roller	*Coracias abyssinicus*	1
25/10/2018	KalamaNamnyak	Red-winged Grey Warbler	*Drymocichla incana*	1
25/10/2018	KalamaNamnyak	Grey-throated Tit Flycatcher	*Myioparus griseigularis*	1
25/10/2018	KalamaNamnyak	Little Bee-eater	*Merops pusillus*	1
25/10/2018	KalamaNamnyak	Eastern Yellow-billed Hornbill	*Tockus flavirostris*	1
25/10/2018	KalamaNamnyak	Yellow-necked Spurfowl	*Pternistis leucoscepus*	8
25/10/2018	KalamaNamnyak	Crested Francolin	*Dendroperdix sephaena*	6
25/10/2018	KalamaNamnyak	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1

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25/10/2018	KalamaNamnyak	Sahel Bush Sparrow	*Gymnoris dentata*	1
25/10/2018	KalamaNamnyak	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
25/10/2018	KalamaNamnyak	Bateleur	*Terathopius ecaudatus*	1
25/10/2018	KalamaNamnyak	Slate-coloured Boubou	*Laniarius funebris*	1
25/10/2018	KalamaNamnyak	Black-cheeked Waxbill	*Estrilda erythronotos charmosyna/kiwanukae*	1
25/10/2018	KalamaNamnyak	Black-cheeked Waxbill	*Estrilda erythronotos charmosyna/kiwanukae*	1
25/10/2018	KalamaNamnyak	Rosy-patched Bush-shrike	*Rhodophoneus cruentus*	1
25/10/2018	KalamaNamnyak	Pied Wheatear	*Oenanthe pleschanka*	1
25/10/2018	KalamaNamnyak	Steppe Eagle	*Aquila nipalensis*	1
26/10/2018	SwariLagga	Barn Swallow	*Hirundo rustica*	1
26/10/2018	SwariLagga	Cinnamon-chested Bee-eater	*Merops lafresnayii*	1
26/10/2018	SwariLagga	Emerald-spotted Wood Dove	*Turtur chalcospilos*	1
26/10/2018	SwariLagga	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
26/10/2018	SwariLagga	Northern Masked Weaver	*Ploceus taeniopterus*	1
26/10/2018	SwariLagga	Common Bulbul	*Pycnonotus barbatus*	1
26/10/2018	SwariLagga	Slate-coloured Boubou	*Laniarius funebris*	1
26/10/2018	SwariLagga	White-headed Mousebird	*Colius leucocephalus*	1
26/10/2018	SwariLagga	Nubian Woodpecker	*Campethera nubica*	1

Date	Locality	Species common name	Genus/species	No. of individuals
26/10/2018	SwariLagga	Laughing Dove	*Streptopelia senegalensis*	1
26/10/2018	SwariLagga	Ring-necked Dove	*Streptopelia capicola*	1
26/10/2018	SwariLagga	Red-billed Hornbill	*Tockus erythrorhynchus*	1
26/10/2018	SwariLagga	Grey-backed Camaroptera	*Camaroptera brachyura*	1
26/10/2018	SwariLagga	Black-throated Barbet	*Tricholaema melanocephala*	1
26/10/2018	SwariLagga	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
26/10/2018	SwariLagga	Ayre's Hawk Eagle	*Hieraaetus ayresii*	1
26/10/2018	SwariLagga	Pallid Harrier	*Circus macrourus*	1
26/10/2018	SwariLagga	Crested Francolin	*Dendroperdix sephaena*	1
26/10/2018	SwariLagga	Golden-breasted Starling	*Lamprotornis regius*	1
26/10/2018	SwariLagga	Superb Starling	*Lamprotornis superbus*	1
26/10/2018	SwariLagga	Common Drongo	*Dicrurus adsimilis*	1
26/10/2018	Swari	Kori Bustard	*Ardeotis kori*	1
27/10/2018	SwariLagga	Red-and-yellow Barbet	*Trachyphonus erythrocephalus*	1
27/10/2018	SwariLagga	Black-throated Barbet	*Tricholaema melanocephala*	1
27/10/2018	SwariLagga	Steppe Eagle	*Aquila nipalensis*	1
27/10/2018	SwariLagga	Blue-naped Mousebird	*Urocolius macrourus*	1
27/10/2018	SwariLagga	Chestnut Weaver	*Ploceus rubiginosus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
27/10/2018	SwariLagga	Magpie Starling	*Speculipastor bicolor*	1
27/10/2018	SwariLagga	Crested Francolin	*Dendroperdix sephaena*	1
27/10/2018	SwariLagga	Common Drongo	*Dicrurus adsimilis*	1
27/10/2018	SwariLagga	Grey-backed Camaroptera	*Camaroptera brachyura*	1
27/10/2018	SwariLagga	Rufous Chatterer	*Argya rubiginosa*	1
27/10/2018	SwariLagga	Common Sandpiper	*Actitis hypoleucos*	1
27/10/2018	SwariLagga	Ayres's Hawk Eagle	*Hieraaetus ayresii*	1
27/10/2018	SwariLagga	Unidentified	*Unidentified*	1
27/10/2018	SwariLagga	White-backed Vulture	*Gyps africanus*	1
27/10/2018	SwariLagga	Red-billed Hornbill	*Tockus erythrorhynchus*	1
27/10/2018	Swari	Somali Ostrich	*Struthio molybdophanes*	1
27/10/2018	Swari	Somali Ostrich	*Struthio molybdophanes*	1
27/10/2018	Swari	Somali Ostrich	*Struthio molybdophanes*	1
27/10/2018	Swari	Somali Ostrich	*Struthio molybdophanes*	1
28/10/2018	Ngaroni Lugga	White-browed Scrub Robin	*Cercotrichas leucophrys*	1
28/10/2018	Ngaroni Lugga	Chin-spot Batis	*Batis molitor*	5
28/10/2018	Ngaroni Lugga	Pale Flycatcher	*Bradornis pallidus*	5
28/10/2018	Ngaroni Lugga	Red-billed Hornbill	*Tockus erythrorhynchus*	2

Date	Locality	Species common name	Genus/species	No. of individuals
28/10/2018	Ngaroni Lugga	African Silverbill	*Euodice cantans*	1
28/10/2018	Ngaroni Lugga	Cardinal Woodpecker	*Dendropicos fuscescens*	1
28/10/2018	Ngaroni Lugga	Northern Masked Weaver	*Ploceus taeniopterus*	13
28/10/2018	Ngaroni Lugga	Ayresâ€™s Hawk Eagle	*Hieraaetus ayresii*	2
28/10/2018	Ngaroni Lugga	Mottled Swift	*Tachymarptis aequatorialis*	11
28/10/2018	Ngaroni Lugga	Little Swift	*Apus affinis*	21
28/10/2018	Ngaroni Lugga	Grey-headed Silverbill	*Odontospiza griseicapilla*	2
28/10/2018	Ngaroni Lugga	Blue-capped Cordon-bleu	*Uraeginthus cyanocephalus*	1
28/10/2018	Ngaroni Lugga	Spotted Flycatcher	*Muscicapa striata*	1
28/10/2018	Ngaroni Lugga	Golden-breasted Bunting	*Fringillaria flaviventris*	1
28/10/2018	Ngaroni Lugga	Common Hoopoe	*Upupa epops africana*	1
28/10/2018	Ngaroni Lugga	Yellow-spotted Petronia	*Gymnoris pyrgita*	1
28/10/2018	Ngaroni Lugga	Brubru	*Nilaus afer*	1
28/10/2018	Ngaroni Lugga	White-headed Mousebird	*Colius leucocephalus*	1
28/10/2018	Ngaroni Lugga	Namaqua Dove	*Oena capensis*	8
28/10/2018	Ngaroni Lugga	Barn Swallow	*Hirundo rustica*	7
28/10/2018	Ngaroni Lugga	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
28/10/2018	Ngaroni Lugga	Common Bulbul	*Pycnonotus barbatus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
28/10/2018	Ngaroni Lugga	Black-throated Barbet	*Tricholaema melanocephala*	5
28/10/2018	Ngaroni Lugga	Hildebrandt's Starling	*Lamprotornis hildebrandti*	4
28/10/2018	Ngaroni Lugga	Speckle-fronted Weaver	*Sporopipes frontalis*	1
28/10/2018	Ngaroni Lugga	Unidentified	*Unidentified*	1
28/10/2018	Ngaroni Lugga	Steppe Eagle	*Aquila nipalensis*	1
28/10/2018	Ngaroni Lugga	Grey Wren-Warbler	*Calamonastes simplex*	1
28/10/2018	Ngaroni Lugga	Pale Chanting Goshawk	*Melierax canorus*	1
28/10/2018	Ngaroni Lugga	Fan-tailed Raven	*Corvus rhipidurus*	1
28/10/2018	Ngaroni Lugga	Slate-coloured Boubou	*Laniarius funebris*	2
28/10/2018	Ngaroni Lugga	Spotted Palm Thrush	*Cichladusa guttata*	2
28/10/2018	Ngaroni Lugga	Red-and-yellow Barbet	*Trachyphonus erythrocephalus*	4
28/10/2018	Ngaroni Lugga	Superb Starling	*Lamprotornis superbus*	13
28/10/2018	Ngaroni Lugga	African Emerald Cuckoo	*Chrysococcyx cupreus*	1
28/10/2018	Ngaroni Lugga	Laughing Dove	*Streptopelia senegalensis*	13
28/10/2018	Ngaroni Lugga	African Bare-eyed Thrush	*Turdus tephronotus*	1
28/10/2018	Ngaroni Lugga	White-browed Sparrow Weaver	*Plocepasser mahali*	26
28/10/2018	Ngaroni Lugga	Ring-necked Dove	*Streptopelia capicola*	5
28/10/2018	Ngaroni Lugga	Common Drongo	*Dicrurus adsimilis*	1

Date	Locality	Species common name	Genus/species	No. of individuals
28/10/2018	Ngaroni Lugga	Chestnut Weaver	*Ploceus rubiginosus*	14
28/10/2018	Ngaroni Lugga	Nubian Woodpecker	*Campethera nubica*	1
28/10/2018	Ngaroni Lugga	Golden-breasted Starling	*Lamprotornis regius*	1
28/10/2018	Ngaroni Lugga	White-billed Buffalo Weaver	*Bubalornis albirostris*	1
28/10/2018	Ngaroni Lugga	White-bellied Bustard	*Eupodotis senegalensis*	1
28/10/2018	Ngaroni Lugga	Kori Bustard	*Ardeotis kori*	1
29/10/2018	Lengusa	Superb Starling	*Lamprotornis superbus*	1
29/10/2018	Lengusa	Pale Flycatcher	*Bradornis pallidus*	4
29/10/2018	Lengusa	White-headed Buffalo Weaver	*Dinemellia dinemelli*	6
29/10/2018	Lengusa	Brubru	*Nilaus afer*	1
29/10/2018	Lengusa	Chestnut Weaver	*Ploceus rubiginosus*	15
29/10/2018	Lengusa	Red-billed Hornbill	*Tockus erythrorhynchus*	1
29/10/2018	Lengusa	Laughing Dove	*Streptopelia senegalensis*	1
29/10/2018	Lengusa	Northern Wheatear	*Oenanthe oenanthe*	1
29/10/2018	Lengusa	Black-throated Barbet	*Tricholaema melanocephala*	1
29/10/2018	Lengusa	Namaqua Dove	*Oena capensis*	1
29/10/2018	Lengusa	Cut-throat Finch	*Amadina fasciata*	52
29/10/2018	Lengusa	Three-banded Plover	*Charadrius tricollaris*	5

Date	Locality	Species common name	Genus/species	No. of individuals
29/10/2018	Lengusa	Ring-necked Dove	*Streptopelia capicola*	1
29/10/2018	Lengusa	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
29/10/2018	Lengusa	Common Drongo	*Dicrurus adsimilis*	1
30/10/2018	LembarassLagga	Grey Apalis	*Apalis cinerea*	1
30/10/2018	LembarassLagga	Spotted Flycatcher	*Muscicapa striata*	1
30/10/2018	LembarassLagga	Namaqua Dove	*Oena capensis*	1
30/10/2018	LembarassLagga	Common Drongo	*Dicrurus adsimilis*	1
30/10/2018	LembarassLagga	Speckled Pigeon	*Columba guinea*	1
30/10/2018	LembarassLagga	Grey-throated Tit Flycatcher	*Myioparus griseigularis*	6
30/10/2018	LembarassLagga	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	1
30/10/2018	LembarassLagga	Black-cheeked Waxbill	*Estrilda erythronotos charmosyna/kiwanukae*	1
30/10/2018	LembarassLagga	Pale Prinia	*Prinia somalica*	1
30/10/2018	LembarassLagga	Mouse-coloured Penduline Tit	*Anthoscopus musculus*	2
30/10/2018	LembarassLagga	Common Hoopoe	*Upupa epops africana*	1
30/10/2018	LembarassLagga	Grey Wren-Warbler	*Calamonastes simplex*	1
30/10/2018	LembarassLagga	Emerald-spotted Wood Dove	*Turtur chalcospilos*	1
30/10/2018	LembarassLagga	Cardinal Woodpecker	*Dendropicos fuscescens*	2
30/10/2018	LembarassLagga	Vulturine Guineafowl	*Acryllium vulturinum*	25

Date	Locality	Species common name	Genus/species	No. of individuals
30/10/2018	LembarassLagga	Meyer's Parrot	*Poicephalus meyeri*	5
30/10/2018	LembarassLagga	Spotted Palm Thrush	*Cichladusa guttata*	4
30/10/2018	LembarassLagga	Superb Starling	*Lamprotornis superbus*	12
30/10/2018	LembarassLagga	Golden-breasted Starling	*Lamprotornis regius*	1
30/10/2018	LembarassLagga	Golden-breasted Starling	*Lamprotornis regius*	1
30/10/2018	LembarassLagga	African Bare-eyed Thrush	*Turdus tephronotus*	1
30/10/2018	LembarassLagga	Northern White-crowned Shrike	*Eurocephalus ruppelli*	9
30/10/2018	LembarassLagga	Dark-backed Weaver	*Ploceus bicolor*	7
30/10/2018	LembarassLagga	Common Bulbul	*Pycnonotus barbatus*	1
30/10/2018	LembarassLagga	Laughing Dove	*Streptopelia senegalensis*	1
30/10/2018	LembarassLagga	Brubru	*Nilaus afer*	1
30/10/2018	LembarassLagga	Northern Grey-headed Sparrow	*Passer griseus*	1
30/10/2018	LembarassLagga	Red-chested Cuckoo	*Cuculus solitarius*	1
30/10/2018	LembarassLagga	Black-throated Barbet	*Tricholaema melanocephala*	1
30/10/2018	LembarassLagga	African Emerald Cuckoo	*Chrysococcyx cupreus*	1
30/10/2018	LembarassLagga	Slate-coloured Boubou	*Laniarius funebris*	2
30/10/2018	LembarassLagga	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
30/10/2018	Lengusa	Black-bellied Bustard	*Lissotis melanogaster*	1

Date	Locality	Species common name	Genus/species	No. of individuals
30/10/2018	Lengusa	Black-bellied Bustard	*Lissotis melanogaster*	1
30/10/2018	Lengusa	Red-billed Hornbill	*Tockus erythrorhynchus*	1
30/10/2018	Lengusa	White-browed Sparrow Weaver	*Plocepasser mahali*	1
03/11/2018	Garissa	Barn Swallow	*Hirundo rustica*	1
03/11/2018	Garissa	Somali Ostrich	*Struthio molybdophanes*	1
03/11/2018	Garissa	Northern White-crowned Shrike	*Eurocephalus ruppelli*	3
03/11/2018	Garissa	Black Cuckooshrike	*Campephaga flava*	1
03/11/2018	Garissa	Isabelline Shrike	*Lanius isabellinus*	1
03/11/2018	Garissa	Red-fronted Warbler	*Urorhipis rufifrons*	1
03/11/2018	Garissa	Long-billed Crombec	*Sylvietta rufescens*	1
03/11/2018	Garissa	Abyssinian Scimitarbill	*Rhinopomastus minor*	2
03/11/2018	Garissa	Blue-headed Sunbird	*Cyanomitra alinae*	6
03/11/2018	Garissa	Lilac-breasted Roller	*Coracias caudatus*	1
03/11/2018	Garissa	Nubian Woodpecker	*Campethera nubica*	2
03/11/2018	Garissa	Pale Flycatcher	*Bradornis pallidus*	1
03/11/2018	Garissa	Chin-spot Batis	*Batis molitor*	2
03/11/2018	Garissa	Somali Fiscal	*Lanius somalicus*	1
03/11/2018	Garissa	Vulturine Guineafowl	*Acryllium vulturinum*	18

Date	Locality	Species common name	Genus/species	No. of individuals
03/11/2018	Garissa	White-bellied Bustard	*Eupodotis senegalensis*	3
03/11/2018	Garissa	Ring-necked Dove	*Streptopelia capicola*	9
03/11/2018	Garissa	Namaqua Dove	*Oena capensis*	4
03/11/2018	Garissa	Somali Courser	*Cursorius somalensis*	1
04/11/2018	Garissa1	Vulturine Guineafowl	*Acryllium vulturinum*	12
04/11/2018	Garissa1	Vulturine Guineafowl	*Acryllium vulturinum*	35
04/11/2018	Garissa1	Golden-breasted Starling	*Lamprotornis regius*	5
04/11/2018	Garissa1	Vulturine Guineafowl	*Acryllium vulturinum*	27
04/11/2018	Garissa1	Rufous Scrub Robin	*Cercotrichas galactotes*	6
04/11/2018	Garissa1	Red-fronted Warbler	*Prinia rufifrons*	2
04/11/2018	Garissa1	Yellow-throated Woodland Warbler	*Seicercus ruficapilla*	4
04/11/2018	Garissa1	Red-billed Hornbill	*Tockus erythrorhynchus*	1
04/11/2018	Garissa1	Brown-backed Scrub Robin	*Cercotrichas hartlaubi*	4
04/11/2018	Garissa1	Namaqua Dove	*Oena capensis*	5
04/11/2018	Garissa1	Ring-necked Dove	*Streptopelia capicola*	7
04/11/2018	Garissa1	Black-headed Plover	*Vanellus tectus*	2
05/11/2018	Garissa1	Vulturine Guineafowl	*Acryllium vulturinum*	14
04/11/2018	Garissa1	Banded Prinia	*Prinia bairdii*	1

Date	Locality	Species common name	Genus/species	No. of individuals
04/11/2018	Garissa1	Red-billed Hornbill	*Tockus erythrorhynchus*	2
04/11/2018	Garissa1	Superb Starling	*Lamprotornis superbus*	1
04/11/2018	Garissa1	Ring-necked Dove	*Streptopelia capicola*	1
04/11/2018	Garissa1	White-headed Buffalo Weaver	*Dinemellia dinemelli*	1
05/11/2018	Garissa1	Vulturine Guineafowl	*Acryllium vulturinum*	21
05/11/2018	Garissa1	Pied Crow	*Corvus albus*	1
05/11/2018	Rahole	Black-bellied Bustard	*Lissotis melanogaster*	2
05/11/2018	Rahole	Laughing Dove	*Streptopelia senegalensis*	3
05/11/2018	Rahole	Black-headed Plover	*Vanellus tectus*	2
05/11/2018	Rahole	African Palm Swift	*Cypsiurus parvus*	1
05/11/2018	Rahole	Variable Sunbird	*Cinnyris venustus*	4
05/11/2018	Rahole	Black-throated Barbet	*Tricholaema melanocephala*	2
05/11/2018	Rahole	Chin-spot Batis	*Batis molitor*	2
05/11/2018	Rahole	Eurasian Roller	*Coracias garrulus*	2
05/11/2018	Rahole	Pale Prinia	*Prinia somalica*	2
05/11/2018	Rahole	Golden-breasted Starling	*Lamprotornis regius*	5
05/11/2018	Rahole	Namaqua Dove	*Oena capensis*	8
05/11/2018	Rahole	Nubian Woodpecker	*Campethera nubica*	2

Date	Locality	Species common name	Genus/species	No. of individuals
05/11/2018	Rahole	White-browed Scrub Robin	*Cercotrichas leucophrys*	6
05/11/2018	Rahole	Red-fronted Warbler	*Prinia rufifrons*	5
05/11/2018	Rahole	Fischer's Starling	*Lamprotornis fischeri*	10
05/11/2018	Rahole	Common Bulbul	*Pycnonotus barbatus*	4
05/11/2018	Rahole	Vulturine Guineafowl	*Acryllium vulturinum*	19
05/11/2018	Rahole	Barn Swallow	*Hirundo rustica*	4
05/11/2018	Rahole	Black-faced Sandgrouse	*Pterocles decoratus*	2
05/11/2018	Rahole	Red-billed Hornbill	*Tockus erythrorhynchus*	6
05/11/2018	Rahole	Ring-necked Dove	*Streptopelia capicola*	1
05/11/2018	Rahole1	Common Drongo	*Dicrurus adsimilis*	4
05/11/2018	Rahole1	Unidentified	*Unidentified*	15
05/11/2018	Rahole1	Northern White-crowned Shrike	*Eurocephalus ruppelli*	5
05/11/2018	Rahole1	White-browed Scrub Robin	*Cercotrichas leucophrys*	4
05/11/2018	Rahole1	Pale Flycatcher	*Bradornis pallidus*	4
05/11/2018	Rahole1	Nubian Woodpecker	*Campethera nubica*	4
05/11/2018	Rahole1	Northern Crombec	*Sylvietta brachyura*	1
05/11/2018	Rahole1	Streaky Seedeater	*Crithagra striolata*	1
05/11/2018	Rahole1	Fischer's Starling	*Lamprotornis fischeri*	9

Date	Locality	Species common name	Genus/species	No. of individuals
05/11/2018	Rahole1	White-headed Buffalo Weaver	*Dinemellia dinemelli*	9
05/11/2018	Rahole1	Brubru	*Nilaus afer*	1
05/11/2018	Rahole1	Black-throated Barbet	*Tricholaema melanocephala*	3
05/11/2018	Rahole1	Barred Warbler	*Curruca nisoria*	1
05/11/2018	Rahole1	Eastern Yellow-billed Hornbill	*Tockus flavirostris*	1
05/11/2018	Rahole1	Namaqua Dove	*Oena capensis*	5
05/11/2018	Rahole1	White-bellied Go-away-bird	*Criniferoides leucogaster*	3
05/11/2018	Rahole1	Ring-necked Dove	*Streptopelia capicola*	4
05/11/2018	Rahole1	Golden-breasted Starling	*Lamprotornis regius*	4
05/11/2018	Rahole1	Superb Starling	*Lamprotornis superbus*	5
05/11/2018	Rahole1	Vulturine Guineafowl	*Acryllium vulturinum*	4
06/11/2018	Modika	Lilac-breasted Roller	*Coracias caudatus*	1
06/11/2018	Modika	Cattle Egret	*Bubulcus ibis*	1
06/11/2018	Modika	Pied Crow	*Corvus albus*	5
06/11/2018	Modika	Fischer's Starling	*Lamprotornis fischeri*	13
06/11/2018	Modika	White-browed Scrub Robin	*Cercotrichas leucophrys*	1
06/11/2018	Modika	Eurasian Cuckoo	*Cuculus canorus*	1
06/11/2018	Modika	Marabou	*Leptoptilos crumenifer*	5

Date	Locality	Species common name	Genus/species	No. of individuals
06/11/2018	Modika	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	1
06/11/2018	Modika	Yellow-spotted Petronia	*Petronia pyrgita*	5
06/11/2018	Modika	Chin-spot Batis	*Batis molitor*	2
06/11/2018	Modika	White-browed Scrub Robin	*Cercotrichas leucophrys*	1
06/11/2018	Modika	Pale Prinia	*Prinia somalica*	1
06/11/2018	Modika	Blue-capped Cordon-bleu	*Uraeginthus cyanocephalus*	1
06/11/2018	Modika	Black-faced Sandgrouse	*Pterocles decoratus*	6
06/11/2018	Modika	Namaqua Dove	*Oena capensis*	4
06/11/2018	Modika	White-bellied Go-away-bird	*Criniferoides leucogaster*	1
06/11/2018	Modika	Pale Flycatcher	*Bradornis pallidus*	1
06/11/2018	Modika	Brubru	*Nilaus afer*	1
06/11/2018	Modika	Variable Sunbird	*Cinnyris venustus*	4
06/11/2018	Modika	Red-billed Hornbill	*Tockus erythrorhynchus*	1
06/11/2018	Modika	Black-bellied Bustard	*Lissotis melanogaster*	1
06/11/2018	Modika	Black-throated Barbet	*Tricholaema melanocephala*	1
06/11/2018	Modika	Ring-necked Dove	*Streptopelia capicola*	1
06/11/2018	IjaraRoute	African Golden Oriole	*Oriolus auratus*	1
06/11/2018	IjaraRoute	Von der Decken's Hornbill	*Tockus deckeni*	6

Date	Locality	Species common name	Genus/species	No. of individuals
06/11/2018	IjaraRoute	Namaqua Dove	*Oena capensis*	5
06/11/2018	IjaraRoute	Brubru	*Nilaus afer*	4
06/11/2018	IjaraRoute	Red-fronted Warbler	*Prinia rufifrons*	9
06/11/2018	IjaraRoute	White-rumped Swift	*Apus caffer*	5
06/11/2018	IjaraRoute	Northern Puffback	*Dryoscopus gambensis*	4
06/11/2018	IjaraRoute	Green-winged Pytilia	*Pytilia melba*	6
06/11/2018	IjaraRoute	Barred Warbler	*Curruca nisoria*	6
06/11/2018	IjaraRoute	Northern Puffback	*Dryoscopus gambensis*	2
06/11/2018	IjaraRoute	Pale Chanting Goshawk	*Melierax canorus*	1
06/11/2018	IjaraRoute	Barn Swallow	*Hirundo rustica*	6
06/11/2018	IjaraRoute	Common Rock Thrush	*Monticola saxatilis*	4
06/11/2018	IjaraRoute	Black-faced Sandgrouse	*Pterocles decoratus*	6
06/11/2018	IjaraRoute	Nubian Woodpecker	*Campethera nubica*	1
06/11/2018	IjaraRoute	Fischer's Starling	*Lamprotornis fischeri*	12
06/11/2018	IjaraRoute	African Bare-eyed Thrush	*Turdus tephronotus*	4
06/11/2018	IjaraRoute	Laughing Dove	*Streptopelia senegalensis*	6
06/11/2018	IjaraRoute	Northern White-crowned Shrike	*Eurocephalus ruppelli*	2
06/11/2018	IjaraRoute	Common Drongo	*Dicrurus adsimilis*	1

Date	Locality	Species common name	Genus/species	No. of individuals
06/11/2018	IjaraRoute	White-headed Buffalo Weaver	*Dinemellia dinemelli*	10
06/11/2018	IjaraRoute	Pink-breasted Lark	*Mirafra poecilosterna*	4
06/11/2018	IjaraRoute	Black-bellied Bustard	*Lissotis melanogaster*	2
06/11/2018	IjaraRoute	African Pygmy Falcon	*Polihierax semitorquatus*	2
06/11/2018	IjaraRoute	Pale Flycatcher	*Bradornis pallidus*	5
06/11/2018	IjaraRoute	Ring-necked Dove	*Streptopelia capicola*	6
06/11/2018	IjaraRoute	Cinnamon-chested Bee-eater	*Merops lafresnayii*	4
06/11/2018	IjaraRoute	Collared Sunbird	*Hedydipna collaris*	2
06/11/2018	IjaraRoute	Pink-breasted Lark	*Mirafra poecilosterna*	1
07/11/2018	AGI22	Black-headed Plover	*Vanellus tectus*	5
07/11/2018	AGI22	Red-billed Hornbill	*Tockus erythrorhynchus rufirostris*	4
07/11/2018	AGI22	Red-fronted Warbler	*Urorhipis rufifrons*	2
07/11/2018	AGI22	Barn Swallow	*Hirundo rustica*	4
07/11/2018	AGI22	Black-throated Barbet	*Tricholaema melanocephala*	1
07/11/2018	AGI22	Black-bellied Bustard	*Lissotis melanogaster*	4
07/11/2018	AGI22	Ring-necked Dove	*Streptopelia capicola*	1
07/11/2018	AGI22	Namaqua Dove	*Oena capensis*	2
07/11/2018	Korakora	Abyssinian Roller	*Coracias abyssinicus*	1

Date	Locality	Species common name	Genus/species	No. of individuals
07/11/2018	Korakora	Superb Starling	*Lamprotornis superbus*	1
07/11/2018	Korakora	Vulturine Guineafowl	*Acryllium vulturinum*	17
07/11/2018	Korakora	Pale Chanting Goshawk	*Melierax canorus*	1
07/11/2018	Korakora	Fischer's Starling	*Lamprotornis fischeri*	8
07/11/2018	Korakora	Green-winged Pytilia	*Pytilia melba*	4
07/11/2018	Korakora	Willow Warbler	*Phylloscopus trochilus*	1
07/11/2018	Korakora	Northern Puffback	*Dryoscopus gambensis*	2
07/11/2018	Korakora	Heuglin's Courser	*Rhinoptilus cinctus*	2
07/11/2018	Korakora	Variable Sunbird	*Cinnyris venustus*	2
07/11/2018	Korakora	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	4
07/11/2018	Korakora	Northern Grey-headed Sparrow	*Passer griseus*	2
07/11/2018	Korakora	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	1
07/11/2018	Korakora	Barred Warbler	*Curruca nisoria*	2
07/11/2018	Korakora	Red-billed Hornbill	*Tockus erythrorhynchus rufirostris*	2
07/11/2018	Korakora	Black-faced Sandgrouse	*Pterocles decoratus*	6
07/11/2018	Korakora	Barn Swallow	*Hirundo rustica*	4
07/11/2018	Korakora	Nubian Woodpecker	*Campethera nubica*	5
07/11/2018	Korakora	Red-and-yellow Barbet	*Trachyphonus erythrocephalus*	5

Date	Locality	Species common name	Genus/species	No. of individuals
07/11/2018	Korakora	White-browed Scrub Robin	*Cercotrichas leucophrys*	1
07/11/2018	Korakora	Pale Flycatcher	*Bradornis pallidus*	6
07/11/2018	Korakora	Brubru	*Nilaus afer*	4
07/11/2018	Korakora	Ring-necked Dove	*Streptopelia capicola*	4
07/11/2018	Korakora	Namaqua Dove	*Oena capensis*	4
07/11/2018	Korakora	Black-bellied Bustard	*Lissotis melanogaster*	1
07/11/2018	Korakora	Fischer's Starling	*Lamprotornis fischeri*	10
08/11/2018	Shibir	Von der Decken's Hornbill	*Tockus deckeni*	4
08/11/2018	Shibir	Barn Swallow	*Hirundo rustica*	1
08/11/2018	Shibir	Black-throated Barbet	*Tricholaema melanocephala*	5
08/11/2018	Shibir	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	2
08/11/2018	Shibir	Black-bellied Bustard	*Lissotis melanogaster*	2
08/11/2018	Shibir	Pink-breasted Lark	*Mirafra poecilosterna*	1
08/11/2018	Shibir	Common Drongo	*Dicrurus adsimilis*	2
08/11/2018	Shibir	Fischer's Starling	*Lamprotornis fischeri*	5
08/11/2018	Shibir	Willow Warbler	*Phylloscopus trochilus*	2
08/11/2018	Shibir	Scaly-throated Honeyguide	*Indicator variegatus*	2
08/11/2018	Shibir	Red-billed Hornbill	*Tockus erythrorhynchus ruahae*	2

Date	Locality	Species common name	Genus/species	No. of individuals
08/11/2018	Shibir	Abyssinian Scimitarbill	*Rhinopomastus minor*	4
08/11/2018	Shibir	White-throated Bee-eater	*Merops albicollis*	5
08/11/2018	Shibir	Common Rock Thrush	*Monticola saxatilis*	2
08/11/2018	Shibir	European Roller	*Coracias garrulus*	2
08/11/2018	Shibir	White-browed Scrub Robin	*Cercotrichas leucophrys*	2
08/11/2018	Shibir	Chin-spot Batis	*Batis molitor*	2
08/11/2018	Shibir	Pale Flycatcher	*Bradornis pallidus*	1
08/11/2018	Shibir	Namaqua Dove	*Oena capensis*	4
08/11/2018	Shibir	Ring-necked Dove	*Streptopelia capicola*	2
08/11/2018	Shibir	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	2
08/11/2018	Shibir	Black-faced Sandgrouse	*Pterocles decoratus*	2
10/11/2018	Fafi	Vulturine Guineafowl	Acryllium vulturinum	1
10/11/2018	Fafi	Red-billed Hornbill	Tockus erythrorhynchus rufirostris	4
10/11/2018	Fafi	Green-winged Pytilia	Pytilia melba	4
10/11/2018	Fafi	Pale Flycatcher	Bradornis pallidus	1
10/11/2018	Fafi	Fawn-coloured Lark	Calendulauda africanoides alopex/intercedens/macdonaldi	1
10/11/2018	Fafi	Barred Warbler	Curruca nisoria	2
10/11/2018	Fafi	Three-streaked Tchagra	Tchagra jamesi	1

Date	Locality	Species common name	Genus/species	No. of individuals
10/11/2018	Fafi	Buff-bellied Warbler	Phyllolais pulchella	1
10/11/2018	Fafi	Nubian Woodpecker	Campethera nubica	4
10/11/2018	Fafi	Woodland Pipit	Anthus nyassae	4
10/11/2018	Fafi	White-headed Buffalo Weaver	Dinemellia dinemelli	5
10/11/2018	Fafi	Barn Swallow	Hirundo rustica	2
10/11/2018	Fafi	Namaqua Sandgrouse	Pterocles namaqua	1
10/11/2018	Fafi	Spotted Thick-knee	Burhinus capensis	1
10/11/2018	Fafi	White-browed Scrub Robin	Cercotrichas leucophrys	2
10/11/2018	Fafi	Laughing Dove	Streptopelia senegalensis	5
10/11/2018	Fafi	Vulturine Guineafowl	Acryllium vulturinum	20
10/11/2018	Fafi	Ring-necked Dove	Streptopelia capicola	1
10/11/2018	Fafi	Black-throated Barbet	Tricholaema melanocephala	1
10/11/2018	Fafi	Northern White-crowned Shrike	Eurocephalus ruppelli	2
09/11/2018	Ruqa	African Spoonbill	Platalea alba	1
09/11/2018	Ruqa	Superb Starling	Lamprotornis superbus	1
09/11/2018	Ruqa	Superb Sunbird	Cinnyris superbus	1
09/11/2018	Ruqa	Crested Francolin	Dendroperdix sephaena	3
09/11/2018	Ruqa	Cream-coloured Courser	Cursorius cursor	2

Date	Locality	Species common name	Genus/species	No. of individuals
09/11/2018	Ruqa	Black-bellied Starling	Notopholia corusca	8
09/11/2018	Ruqa	Ring-necked Dove	Streptopelia capicola	1
09/11/2018	Ruqa	Barn Swallow	Hirundo rustica	4
09/11/2018	Ruqa	Golden-breasted Starling	Lamprotornis regius	2

TECHNICAL MEMORANDUM

DATE 5 April 2019 **Project No.** 1772867.553.113.B0

TO Paul Mowatt, PPMT

CC Freddy Brookes, Gary Morris-Iveson

FROM Tim Flower **EMAIL** TFlower@golder.com

LOKICHAR TO LAMU CRUDE OIL PIPELINE ESIA PROJECT BASELINE STUDIES – MARINE WATER AND SEDIMENT FIELD REPORT

1.0 BACKGROUND INFORMATION

The Pipeline Project Management Team (PPMT) intends to develop 892 km long Lokichar to Lamu Crude Oil Pipeline in Kenya. In order to ensure compliance with Kenya's Impact Assessment and Audit Regulations, 2003, PPMT commissioned an Environmental and Social Impacts Assessment (ESIA) with an aim of coming up with ESIA report to be submitted to National Environment Management Authority (NEMA) for review and issuance EIA license. Golder carried out baseline characterisation of marine water and sediment quality during the NE monsoon period as part of the ESIA.

This report therefore contains a snap shot of water and sediment quality baseline conditions obtained during the second survey, which was carried out between 13 and 17 November 2018. Water quality survey included three elements: (a) general features such as temperature, salinity, conductivity, TDS, pH; (b) water clarity measured by Total suspended solids (TSS); (c) eutrophication-related factors measured by Dissolved Oxygen, Biochemical Oxygen Demand (BOD5), Ammonia, Nitrites, Nitrates, Phosphates, Chemical Oxygen Demand (COD), Microbial F. coliforms and (d) contamination related parameters such as BTEX, PAHs, TPH, Total Phenols, Total Organic Carbon (TOC), Oil & Grease, VOCs, TPH, Sulphide, Al, As, Ba, Cd, Co, Cr, Cr5, Cu, Fe, Mn, Ni, Pb, Se, Sn, V, Zn, V and Hg total.

Sediments quality survey encompassed: - a) general feature such as grain size, total organic matter, and b) quality related issues i.e. contamination of bottom sediments by toxic or harmful substances such as contamination related parameters such as BTEX, PAHs, TPH, Total Phenols, Total Organic Carbon (TOC), Grain size, Oil & Grease, VOCs, TPH, Sulphide, Ammonia, Nitrites, Nitrates, Phosphates Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Se, Sn, V, Zn, Cr, V and Hg total.

2.0 SAMPLES COLLECTION AND ANALYSIS

Surface and bottom water samples were collected using a Niskin bottle (Figure 1) from 8 stations P1, P2, P3, P4, P5, P6, P7, P8 and 2 control stations C1, C2 on 13 and 17 November 2018. The stations represented areas surrounding petroleum berth and the pipeline (P1 and P3); berth area to the offshore zone of the study area following the prevalent path of the coastal currents 1 (P1 to P8), area in proximity to sensitive biodiversity components, such as coral reefs, seagrass beds, mangrove forests and sea turtles breeding sites (P4 to P8); area at the mouth of tidal channels that may bring effluents from urban settlements to the study area (P2) and control sites: C1 and C2, are positioned to ensure that they would not be directly influenced by the project activities in the future and, at the same time, would not be close to relevant sources of contamination.

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Figure 1: Photo showing Niskin bottle used to collect water samples

Sediment samples were collected from Stations P1, P2 and P3 using Uwitec sediment gravity corer. Stations P4-P8, C1 and C2 had no sediment given that they are located in the channel where current velocity is high and do not support sedimentation. In order to obtain sediment samples for control, samples were collected from Navy 1 and Navy 2. From each site, 3 replicate samples were collected, mixed and homogenised together into one composite sample from which sub-samples for analysis of various parameters were collected.

Figure 2: Photo showing gravity corer retrieved without sediment sample from stations located in the channel

Sediment samples were analysed for BTEX, PAHs, TPH, Total Phenols, Total Organic Carbon (TOC), Grain size, Oil & Grease, VOCs, TPH, Sulphide, Ammonia, Nitrites, Nitrates, Phosphates, Total P, Total N, Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Se, Sn, V, Zn, Cr, V and Hg total. Sediment grain distribution was carried out using dry sieving and referenced to Wentworth (1922) grain size classification while the other parameters were analysed following methods listed in Table 3.

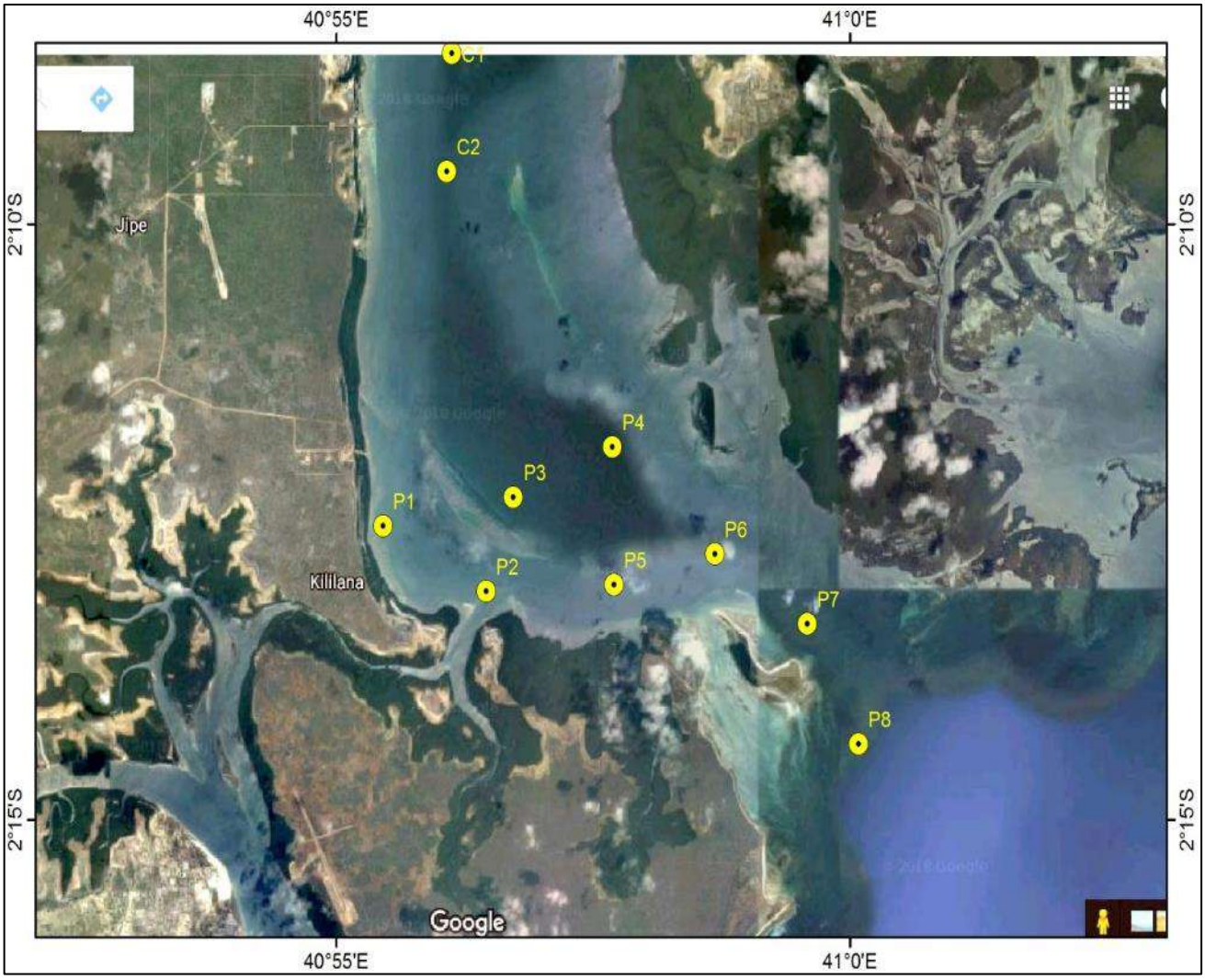

Figure 3: Map of the study area showing water matrix sampling points

Figure 4: Map of the study area showing sediment sampling points

Two sets of water samples (one at the surface and one close to the bottom) were collected from each station with a depth greater than 10 m (P3, P4, P5, P6, P7, P8, C1 and C2) while only surface samples were collected from stations with depths less than 10 m (P1 and P2). Surface water samples were collected from approx. 20 cm of depth, while bottom samples were collected from approximately 1 m from the bottom substrate.

Temperature (°C), DO (mg/L), conductivity (µS/cm), TDS (mg/L), salinity (PSU) and pH measurement were taken in situ using a handheld multi-parameter meter (YSI Professional Plus). The samples for determination of the other parameters were collected and transferred to the various different recommended containers including appropriate preservatives where necessary. The samples were transported in cool boxes with ice packs to NEMA accredited laboratory (SGS Laboratories) for analysis of the following determinands:

- Total suspended solids (TSS);
- Biochemical Oxygen Demand (BOD5);
- Ammonia;
- Nitrites;
- Nitrates;
- Phosphates;
- Chemical Oxygen Demand (COD);
- Microbial F. coliforms;
- BTEX;
- PAHs;
- TPH;
- Total Phenols;
- Total Organic Carbon (TOC);
- Oil & Grease;
- VOCs;
- TPH;
- Sulphide;
- Al;
- As;
- Ba;
- Cd;
- Co;
- Cr;
- Cr5;
- Cu;
- Fe;
- Mn;
- Ni;
- Pb;
- Se;
- Sn;
- V;
- Zn;
- V; and
- Hg total.

Analysis Certificates from the water samples are included as Appendix A and for the sediment samples as Appendix B.

Sediment samples were transported in cool boxes with ice packs to NEMA accredited laboratory (SGS Laboratories) for analysis of:

- BTEX;
- PAHs;
- TPH;
- Total Phenols;
- Total Organic Carbon (TOC);
- Grain size;
- Oil & Grease;
- VOCs;
- TPH;
- Sulphide;
- Ammonia;
- Nitrites;
- Nitrates;
- Phosphates;
- Total P;
- Total N;
- Al;
- As;
- Ba;
- Cd;
- Co;
- Cr;
- Cu;
- Fe;
- Mn;
- Ni;
- Pb;
- Se;
- Sn;
- V;
- Zn;
- Cr
- V; and
- Hg total.

3.0 RESULTS

The results for the water quality parameters are presented in the Tables 1 and 2, while Table 3 presents the results of the sediment quality parameters.

Table 1: Concentration (mg/L) of the various parameters in the water matrix collected from the C1, C2, P1-P3 stations.

PARAMETERS	METHOD	C1	C2	P1R1	P1R2	P2	P3	UNITS	C1	C2	P1R1
		S	B	S	B	S	S	S	S	B	
Station Depth	Hand held Eco sounder	10.4	10.4	12.4	12.4	3.1	3.1	5.6	11.7	11.7	m
DO	YSI Pro plus Multi-Parameter	6.6	5.8	6.9	5.7	6.2	6.0	6.1	6.0	5.8	mg/L
pH	YSI Pro plus Multi-Parameter	8.61	8.60	8.60	8.61	8.55	8.55	8.56	8.62	8.63	-
Temperature	YSI Pro plus Multi-Parameter	29.3	28.9	29.2	28.6	29.2	29.2	29.1	28.6	28.3	ºC
Conductivity	YSI Pro plus Multi-Parameter	58160	57786	58078	57264	58236	58221	58056	57184	57017	µS/cm
Salinity	YSI Pro plus Multi-Parameter	35.38	35.39	35.36	35.36	35.50	35.48	35.51	35.30	35.33	PSU
TDS	YSI Pro plus Multi-Parameter	34.97	34.91	34.10	34.84	35.04	35.04	35.04	38.84	34.84	mg/L
BOD 5 @ 20°C	APHA 5210 B	5.4	8.1	8.1	< 5.0	8.1	5.4	< 5.0	5.4	10.8	mg/L
Nitrite as NO2	APHA-4500-NO2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	mg/L
Ammonia as NH3	APHA-4500- NH3 F	2.36	4.40	3.02	0.22	9.81	13.20	1.10	2.06	3.96	mg/L
Total Suspended Solids	APHA-2540 D	121	175	73	96	27	64	81	143	59	mg/L
Sulphides	APHA-4500 S-F	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	mg/L
Chemical Oxygen Demand	APHA-5220 B	576.96	625.04	528.88	769.28	576.96	673.12	576.96	865.44	625.04	mg/L
Nitrate as NO3	APHA-4500-NO3	4.48	1.54	2.43	3.50	5.30	0.40	2.98	1.56	0.40	mg/L
Phosphate as PO4	APHA 4500 P	3.1	4.7	2.2	1.6	5.4	15.5	3.6	0.9	3.6	mg/L
1112-Tetrachloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
111-Trichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
122-Tetrachlorethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L

PARAMETERS	METHOD	C1	C2	P1R1	P1R2	P2	P3	UNITS	C1	C2	P1R1
		S	B	S	B	S	S	S	S	B	
112-Trichloroethane	EPA 8260B	<10	<10	<10	<10	<10	< 10	<10	<10	<10	µg/L
11-Dichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
11-Dichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
123-Trichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
123-Trichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
124-Trichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
124-Trimethylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dibromo-3-chloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dibromoethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
135-Trimethylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
13-Dichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
13-Dichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
14-Dichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
22-Dichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
2-Chlorotoluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
4-Chlorotoluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L

PARAMETERS	METHOD	C1	C2	P1R1	P1R2	P2	P3	UNITS	C1	C2	P1R1
		S	B	S	B	S	S	S	S	B	
Bromobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Bromochloromethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Bromodichloromethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Bromoform	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
tetrachloride Carbon	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Chlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Chloroform	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
cis-1 2-Dichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
cis-1 3-Dichloropropene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Dibromochloromethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Dibromomethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Hexachlorobutadiene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Isopropylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Chloride (Dichloromethane) Methylene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
MTBE	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Naphthalene	EPA 8260B	<10	<10	<10	< 10	<10	<10	<10	<10	<10	µg/L
n-Butylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
n-Propyl benzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L

PARAMETERS	METHOD	C1	C2	P1R1	P1R2	P2	P3	UNITS	C1	C2	P1R1
		S	B	S	B	S	S	S	S	B	
p-Isopropyl toluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
sec-Butylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Styrene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
tert_Butylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Tetrachloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
trans-1 2-Dichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
trans-1 3-Dichloropropene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Trichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Benzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Ethylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Toluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Xylenes (sum)	EPA 8260B	< 20	<20	<20	<20	<20	<20	<20	<20	<20	µg/L
TPH C6 - C44	EPA 8015C	2.82	2.85	2.97	3.35	3.21	3.31	2.90	1.38	1.55	mg/L
Oil and Greases	SGS TW 6	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	mg/L
Total Phenols	APHA 5530 D	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	mg/L
Acenaphthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Acenaphthylene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(a)anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L

PARAMETERS	METHOD	C1	C2	P1R1	P1R2	P2	P3	UNITS	C1	C2	P1R1
		S	B	S	B	S	S	S	S	B	
Benzo(a)pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(b)fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benz (g h I) perylene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(k)fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Chrysene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Dibenz (a h) anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Fluorene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Indeno (1 2 3-cd) pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Naphthalene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Phenanthrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
PAH (Sum)	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Aluminium as AL	ISO 11885	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Arsenic as (As)	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Barium as Ba	ISO 11885	< 0.004	< 0.004	< 0.004	< 0.04	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	mg/L
Cadmium as Cd	ISO 11885	< 0.007	< 0.007	< 0.07	< 0.07	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	mg/L
Cobalt as Co	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Chromium as Cr	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L

PARAMETERS	METHOD	C1	C2	P1R1	P1R2	P2	P3	UNITS	C1	C2	P1R1
		S	B	S	B	S	S	S	S	B	
Copper as Cu	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Iron as Fe	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Manganese as Mn	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Nickel as Ni	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Lead as Pb	ISO 11885	< 0.004	< 0.004	< 0.04	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	mg/L
Selenium as Se	ISO 11885	0.03	< 0.01	< 0.01	< 0.01	0.02	0.02	0.02	0.02	< 0.01	mg/L
Zinc as Zn	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Vanadium as V	ISO 11885	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	mg/L
Hexavalent Chromium as Cr 6+	ISO 11885	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	mg/L
Mercury as Hg	COLD VAPOUR	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L
Tin as Sn	ISO 11885	0.02	0.04	0.02	< 0.005	0.03	< 0.005	0.02	0.03	0.02	mg/L
S-Total Organic Carbon	DIN EN 1484	1.10	1.10	1.10	1.00	1.30	1.30	1.10	1.00	1.00	mg/L

Table 2: Concentration (mg/L) of the various parameters in the water matrix collected from the P4-P8 stations

PARAMETERS	METHOD	P4		P5		P6		P7		P8		UNITS
		S	B	S	B	S	B	S	B	S	B	
Station Depth	Hand held Eco sounder	29.3	29.3	9.6	9.6	23.3	23.3	23.3	13.6	9.5	9.5	m
DO	YSI Pro plus Multi-Parameter	6.3	5.5	6.9	5.6	7.1	6	6.8	6	7.2	5.5	mg/L
pH	YSI Pro plus Multi-Parameter	8.62	8.63	8.61	8.61	8.65	8.64	8.62	8.62	8.56	8.60	-
Temperature	YSI Pro plus Multi-Parameter	28.4	28.2	28.2	28.3	28.1	27.9	27.9	28.1	27.9	27.8	ºC
Conductivity	YSI Pro plus Multi-Parameter	57079	56831	56941	56963	56732	56492	56518	56622	56451	56436	µS/cm
Salinity	YSI Pro plus Multi-Parameter	35.30	35.28	34.78	35.33	35.25	35.24	35.25	35.28	35.26	36.09	-
TDS	YSI Pro plus Multi-Parameter	34.84	34.84	34.84	34.84	34.78	34.78	34.78	34.84	34,78	34.78	mg/L
BOD 5 @ 20°C	APHA 5210 B	8.1	5.4	13.5	5.4	5.4	< 5.0	5.4	8.1	5.4	8.1	mg/L
Nitrite as NO2	APHA-4500-NO2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	mg/L
Ammonia as NH3	APHA-4500- NH3 F	6.30	3.48	7.10	0.60	7.08	7.74	4.68	0.70	3.92	2.52	mg/L
Total Suspended Solids	APHA 2540 D	72	79	35	45	59	60	8	55	60	29	mg/L
Sulphides	APHA 4500 S-F	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	mg/L
Chemical Oxygen Demand	APHA 5220 B	769.28	673.12	528.88	721.20	672.12	625.04	576.96	625.04	721.20	480.80	mg/L
Nitrate as NO3	APHA-4500-NO3	1.30	2.70	4.26	3.50	2.70	1.88	4.56	2.76	4.15	3.24	mg/L
Phosphate as PO4	APHA 4500 P	1.8	3.6	3.6	3.9	0.9	2.1	3.0	3.4	2.5	2.8	mg/L
1112-Tetrachloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
111-Trichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L

PARAMETERS	METHOD	P4		P5		P6		P7		P8		UNITS
		S	B	S	B	S	B	S	B	S	B	
122-Tetrachlorethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
112-Trichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
11-Dichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
11-Dichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
123-Trichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
123-Trichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
124-Trichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
124-Trimethylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dibromo-3-chloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dibromoethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dichloroethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
12-Dichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
135-Trimethylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
13-Dichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
13-Dichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
14-Dichlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
22-Dichloropropane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L

PARAMETERS	METHOD	P4		P5		P6		P7		P8		UNITS
		S	B	S	B	S	B	S	B	S	B	
2-Chlorotoluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
4-Chlorotoluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Benzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Bromobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Bromochloromethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Bromoform	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
tetrachloride Carbon	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Chlorobenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Chloroform	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
cis-1 2-Dichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
cis-1 3-Dichloropropene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Dibromochloromethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Dibromomethane	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Ethylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Hexachlorobutadiene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Isopropylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Chloride (Dichloromethane) Methylene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L

PARAMETERS	METHOD	P4		P5		P6		P7		P8		UNITS
		S	B	S	B	S	B	S	B	S	B	
MTBE	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Naphthalene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
n-Butylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
n-Propyl benzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
p-Isopropyl toluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
sec-Butylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Styrene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
tert_Butylbenzene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Tetrachloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Toluene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
trans-1 2-Dichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
trans-1 3-Dichloropropene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Trichloroethene	EPA 8260B	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	µg/L
Xylenes (sum)	EPA 8260B	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	µg/L
TPH C6 – C44	EPA 8015C	4.86	3.31	3.28	3.65	3.69	2.45	2.35	1.21	3.50	1.94	mg/L
Oil and Greases	SGS TW 6	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	mg/L
Total Phenols	APHA 5530 D	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	mg/L
Acenaphthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L

PARAMETERS	METHOD	P4		P5		P6		P7		P8		UNITS
		S	B	S	B	S	B	S	B	S	B	
Acenaphthylene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(a)anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(a)pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(b)fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benz (g h I) perylene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Benzo(k)fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Chrysene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Dibenz (a h) anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Fluorene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Indeno (1 2 3-cd) pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Naphthalene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Phenanthrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
PAH (Sum)	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Aluminium as AL	ISO 11885	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Arsenic as (As)	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L

PARAMETERS	METHOD	P4		P5		P6		P7		P8		UNITS
		S	B	S	B	S	B	S	B	S	B	
Barium as Ba	ISO 11885	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	mg/L
Cadmium as Cd	ISO 11885	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	mg/L
Fluorene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/L
Cobalt as Co	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Chromium as Cr	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Copper as Cu	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Iron as Fe	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Manganese as Mn	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Nickel as Ni	ISO 11885	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	mg/L
Lead as Pb	ISO 11885	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	mg/L
Selenium as Se	ISO 11885	0.01	0.01	0.03	< 0.01	0.02	0.03	< 0.01	< 0.01	0.02	0.04	mg/L
Zinc as Zn	ISO 11885	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L
Vanadium as V	ISO 11885	< 0.008	< 0.008	< 0.008	< 0.008	< 0.08	< 0.08	< 0.008	< 0.008	< 0.008	< 0.008	mg/L
Hexavalent Chromium as Cr 6+	ISO 11885	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	mg/L
Mercury as Hg	COLD VAPOUR	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/L
Tin as Sn	ISO 11885	< 0.005	0.03	< 0.005	0.02	0.03	< 0.005	0.02	< 0.005	0.04	0.04	mg/L
S-Total Organic Carbon	DIN EN 1484	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00	mg/L

Table 3: Concentration of the various parameters in the sediment collected from the P1, P2, P3, Navy 1 and Navy 2 stations.

PARAMETERS	METHOD	P1R1	P1R2	Navy 1	Navy 2	P2	P3	UNITS
Sulphides	APHA 4500 S-F	< 0.1	< 0.1	4.8	0.8	1.6	< 0.1	mg/kg
Ammonia as NH3	ICARDA 5.9.3	4.17	4.55	7.00	4.68	4.94	2.56	mg/kg
Nitrite as NO2	ICARDA 5.9.3	0.40	0.08	0.23	0.11	0.07	0.14	mg/kg
Nitrate as NO3	ICARDA 5.9	0.30	4.00	0.02	0.48	0.40	4.00	mg/kg
Total N	ICARDA 5.9	1.78	1.27	5.03	2.38	1.79	2.24	%
Total P	EPA 3050B	132.60	126.21	22.12	32.53	123.63	175.30	mg/kg
Phosphate as PO4	ICARDA 5.10	406.62	386.20	67.98	99.54	378.21	546.42	mg/kg
Mercury as Hg	Gold Vapour	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	mg/kg
1112-Tetrachloroethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
111-Trichloroethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
122-Tetrachlorethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
112-Trichloroethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
11-Dichloroethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
11-Dichloroethene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
123-Trichlorobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
123-Trichloropropane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
124-Trichlorobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
124-Trimethylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg

PARAMETERS	METHOD	P1R1	P1R2	Navy 1	Navy 2	P2	P3	UNITS
12-Dibromo-3-chloropropane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
12-Dibromoethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
12-Dichlorobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
12-Dichloroethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
12-Dichloropropane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
135-Trimethylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
13-Dichlorobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
13-Dichloropropane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
14-Dichlorobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
22-Dichloropropane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
2-Chlorotoluene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
4-Chlorotoluene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Benzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Bromobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Bromochloromethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Bromodichloromethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Bromoform	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Tetrachloride Carbon	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Chlorobenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg

PARAMETERS	METHOD	P1R1	P1R2	Navy 1	Navy 2	P2	P3	UNITS
Chloroform	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
cis-1 2-Dichloroethene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
cis-1 3-Dichloropropene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Dibromochloromethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Dibromomethane	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Ethylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Hexachlorobutadiene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Isopropylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Chloride (Dichloromethane) Methylene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
MTBE	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Naphthalene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
n-Butylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
n-Propyl benzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
p-Isopropyl toluene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
sec-Butylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Styrene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
tert_Butylbenzene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Tetrachloroethene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg

PARAMETERS	METHOD	P1R1	P1R2	Navy 1	Navy 2	P2	P3	UNITS
Toluene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
trans-1 2-Dichloroethene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
trans-1 3-Dichloropropene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Trichloroethene	EPA 8260B	< 10	< 10	< 10	< 10	< 10	< 10	µg/kg
Xylenes (sum)	EPA 8260B	< 20	< 20	< 20	< 20	< 20	< 20	µg/kg
TPH C6 – C44	EPA 8015C	2.69	2.77	2.04	2.19	2.12	1.65	mg/kg
Oil and Greases	APHA 5520E	< 1.000	< 1.000	4	13	2	9	mg/kg
Total Phenols	ICARDA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/kg
Total Organic Matter	EN 13039	217.2	176.3	73.4	53.0	371.7	101.7	g/kg
Acenaphthelene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Acenaphthylene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Benzo(a)anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Benzo(a)pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Benzo(b)fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Benzo (g, h, i) perylene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Benzo(k)fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Chrysene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Dibenz (a, h) anthracene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg

PARAMETERS	METHOD	P1R1	P1R2	Navy 1	Navy 2	P2	P3	UNITS
Fluoranthene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Fluorene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Indo (1 ,2 ,3) pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Naphthalene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
PAH (sum)	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Phenantherene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Pyrene	EPA 8270D	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	mg/kg
Aluminium (Al)	EPA 3050B	8933.11	9040.16	2012.6	1590.29	15636.8	4311.52	mg/kg
Arsenic (AS)	EPA 3050B	10.89	8.12	5.33	9.04	11.14	6.95	mg/kg
Barium (Ba)	EPA 3050B	13.42	13.26	3.83	8.06	19.47	10.12	mg/kg
Cadmium (Cd)	EPA 3050B	< 0.02	0.07	< 0.02	< 0.02	< 0.02	< 0.02	mg/kg
Copper (Cu)	EPA 3050B	4.43	4.82	1.71	2.47	5.93	2.50	mg/kg
Chromium (Cr)	EPA 3050B	8.66	9.66	3.30	2.86	14.34	7.03	mg/kg
Cobalt (Co)	EPA 3050B	1.87	1.69	< 0.02	0.33	2.76	2.03	mg/kg
Iron (Fe)	EPA 3050B	6796.63	6964.94	1441.16	1117.18	9480.29	4560.62	mg/kg
Manganese(n)	EPA 3050B	87.70	94.86	16.15	15.46	115.91	106.65	mg/kg
Nickel (Ni)	EPA 3050B	4.85	5.44	0.47	2.94	7.35	3.52	mg/kg
Lead (pb)	EPA 3050B	12.36	14.38	11.32	10.63	13.24	10.60	mg/kg
Selenium (Se)	EPA 3050B	9.12	6.04	4.62	6.38	2.64	3.71	mg/kg

PARAMETERS	METHOD	P1R1	P1R2	Navy 1	Navy 2	P2	P3	UNITS
Tin (Sn)	EPA 3050B	< 0.02	2.71	2.38	3.53	2.53	3.47	mg/kg
Zinc (An)	EPA 3050B	10.34	10.59	3.26	7.00	14.76	7.00	mg/kg
Vanadium(V)	EPA 3050B	12.37	12.58	3.24	2.89	19.32	8.49	mg/kg
Grain size (%Silt)	Gravimetric Wentworth (1922)	32.8	32.8	6.2	9.6	84.0	17.1	%
Grain size (%Sand)	Gravimetric Wentworth (1922)	67.2	67.2	93.8	90.4	16.0	82.9	%
Grain size class	Gravimetric Wentworth (1922)	Silty sand	Silty sand	Pure sand	Pure Sand	Sandy silt	Silty sand	-

4.0 CONCLUSION AND RECOMMENDATIONS

1) Most of the analysed parameters (except TSS) were below the allowed limits as contained in the third schedule of NEMA water quality regulation (standards for effluent discharge into the environment) and as such the project should endeavour to maintain the levels as at the baseline (Table 1 and Table 2).

2) The study stations indicate that Lamu port area and adjacent stations are pristine ecosystems with no recorded contamination

3) Total Suspended Solids (TSS) were above the allowed 30 mg/L as contained in the third schedule of NEMA water quality regulation (standards for effluent discharge into the environment). The project should maintain the values as at the baseline

4) Comparing the results of the sediment analysis with the sediment quality guidelines (Long et al., 1995), the concentration of all trace metals, PAH and OCP's are below level one thus the sediment could be classified as uncontaminated.

References

Long, E. R., Macdonald, D. D., Smith, S. L., & Calder, F. D. (1995). Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental management, 19(1), 81-97.

Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. The journal of geology, 30(5), 377-392.

Freddy Brookes
Biodiversity Lead

Tim Flower
Project Manager

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APPENDIX A

Sea Water Analysis Reports

Date: 26/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05371.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P1SR1 (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	11	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 26/11/2018

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Analysis Report MA18-05371.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P1SR2 (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	8	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Date: 26/11/2018

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Analysis Report MA18-05371.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P2S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	7	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P3S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	5	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

26112018 1716 0000100333

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Date: 26/11/2018

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Analysis Report MA18-05371.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P3B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	17	MPN/100ml

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Technical Signatory

Morgan Khayoko-Microbiologist

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Date: 26/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05371.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P4S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	11	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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UNITED KINGDOM
SL8

Analysis Report MA18-05371.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P4B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	70	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P5S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	7	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

26112018 1716 0000100333

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Analysis Report MA18-05371.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P5B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	33	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P6S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	26	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P6B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	7	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P7S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	Not detected	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

26112018 1716 0000100333

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Analysis Report MA18-05371.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P7B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	Not detected	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

26112018 1716 0000100333

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Analysis Report MA18-05371.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P8S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	5	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

26112018 1716 0000100333

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Analysis Report MA18-05371.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE P8B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	26	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE C1S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	Not detected	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE C1B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	Not detected	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Date: 26/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05371.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE C2S (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	Not detected	MPN/100ml

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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Analysis Report MA18-05371.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN A GLASS BOTTLE C2B (9)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed. LOD = 2 (FCC)

TESTS	METHOD	RESULT	UNITS
Faecal coliform count	ISO 9308-2:1990	Not detected	MPN/100ml

End of Analytical Results

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Morgan Khayoko-Microbiologist

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UNITED KINGDOM
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Analysis Report MA18-05396.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR1(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P2S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Date: 26/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05396.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1409 0000100306

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Analysis Report MA18-05396.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2S(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05396.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2B(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
Benzene		<10	µg/L
Toluene		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L

End of Analytical Results

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1409 0000100306

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Analysis Report MA18-05397.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

26112018 1502 0000100309

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Analysis Report MA18-05397.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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SGS Kenya Ltd.

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Member of the SGS Group (Société Générale de Surveillance)

Date: 26/11/2018

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BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

26112018 1503 0000100309

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Analysis Report MA18-05397.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P1SR2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05397.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P2S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P2S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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SL8

Analysis Report MA18-05397.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P2S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

26112018 1503 0000100309

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Date: 26/11/2018

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CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Date: 26/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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Analysis Report MA18-05397.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P3B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1503 0000100309

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UNITED KINGDOM
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Analysis Report MA18-05397.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

26112018 1503 0000100309

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Analysis Report MA18-05397.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05397.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

26112018 1503 0000100309

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Analysis Report MA18-05397.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Date: 26/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P4B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1503 0000100309

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UNITED KINGDOM
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Analysis Report MA18-05397.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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BUCKINGHAMSHIRE
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UNITED KINGDOM
SL8

Analysis Report MA18-05397.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05397.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1503 0000100309

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Analysis Report MA18-05397.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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SL8

Analysis Report MA18-05397.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P5B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Date: 26/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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Analysis Report MA18-05397.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P6B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05397.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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Analysis Report MA18-05397.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

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SL8

Analysis Report MA18-05397.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 26/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P7B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1503 0000100309

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Analysis Report MA18-05397.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05397.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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SL8

Analysis Report MA18-05397.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

26112018 1503 0000100309

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UNITED KINGDOM
SL8

Analysis Report MA18-05397.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL P8B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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Analysis Report MA18-05397.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Date: 26/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1503 0000100309

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TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.017

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ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1B(1)
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TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — *Technical Signatory*

Walter Ogara - Multi-Lab Manager — Caroline Chege-Chemist

26112018 1503 0000100309

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Analysis Report MA18-05397.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C1B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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PRODUCT DESCRIPTION:	SEA WATER
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SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05397.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2S(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

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REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1-Dichloroethene		<10	µg/L
Methylene Chloride (Dichloromethane)		<10	µg/L
trans-1,2-Dichloroethene		<10	µg/L
MTBE		<10	µg/L
1,1-Dichloroethane		<10	µg/L
cis-1,2-Dichloroethene		<10	µg/L
2,2-Dichloropropane		<10	µg/L
Bromochloromethane		<10	µg/L
Chloroform		<10	µg/L
1,1,1-Trichloroethane		<10	µg/L
1,2-Dichloroethane		<10	µg/L
Carbon tetrachloride		<10	µg/L
Benzene		<10	µg/L
Trichloroethene		<10	µg/L
1,2-Dichloropropane		<10	µg/L
Dibromomethane		<10	µg/L
Bromodichloromethane		<10	µg/L
cis-1,3-Dichloropropene		<10	µg/L
Toluene		<10	µg/L
trans-1,3-Dichloropropene		<10	µg/L

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Technical Signatory — Caroline Chege-Chemist

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PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,1,2-Trichloroethane		<10	µg/L
1,3-Dichloropropane		<10	µg/L
Tetrachloroethene		<10	µg/L
Dibromochloromethane		<10	µg/L
1,2-Dibromoethane		<10	µg/L
Chlorobenzene		<10	µg/L
1,1,1,2-Tetrachloroethane		<10	µg/L
Ethylbenzene		<10	µg/L
Xylenes (sum)		<20	µg/L
Styrene		<10	µg/L
Bromoform		<10	µg/L
n-Propylbenzene		<10	µg/L
1,2,3-Trichloropropane		<10	µg/L
Bromobenzene		<10	µg/L
1,1,2,2-Tetrachlorethane		<10	µg/L
2-Chlorotoluene		<10	µg/L
4-Chlorotoluene		<10	µg/L
1,2,4-Trimethylbenzene		<10	µg/L
tert_Butylbenzene		<10	µg/L
sec-Butylbenzene		<10	µg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Caroline Chege-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 26/11/2018

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BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05397.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE : DELIVERED IN VOA VIAL C2B(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in water	EPA 8260B		
1,3-Dichlorobenzene		<10	µg/L
1,4-Dichlorobenzene		<10	µg/L
1,2-Dichlorobenzene		<10	µg/L
n-Butylbenzene		<10	µg/L
1,2-Dibromo-3-chloropropane		<10	µg/L
1,2,4-Trichlorobenzene		<10	µg/L
Napthalene		<10	µg/L
Hexachlorobutadiene		<10	µg/L
1,2,3-Trichlorobenzene		<10	µg/L

End of Analytical Results

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Caroline Chege-Chemist

26112018 1503 0000100309

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Member of the SGS Group (Société Générale de Surveillance)

Date: 30/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05398.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P1SR1(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.21	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

30112018 1215 0000100552

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Member of the SGS Group (Société Générale de Surveillance)

Date: 30/11/2018

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Analysis Report MA18-05398.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P1SR1(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.30	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P1SR2(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.31	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

30112018 1215 0000100552

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Date: 30/11/2018

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SL8

Analysis Report MA18-05398.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P1SR2(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.30	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P2S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	2.90	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P2S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.10	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P3S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	1.38	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

30112018 1215 0000100552

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Member of the SGS Group (Société Générale de Surveillance)

Date: 30/11/2018

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UNITED KINGDOM
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Analysis Report MA18-05398.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P3S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P3B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	1.55	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

30112018 1215 0000100552

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Date: 30/11/2018

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Analysis Report MA18-05398.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P3B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P4S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	4.86	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P4S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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UNITED KINGDOM
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Analysis Report MA18-05398.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P4B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.31	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P4B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P5S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.26	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P5S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 30/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05398.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P5B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.65	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P5B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P6S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.69	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P6S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	0.90	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

30112018 1215 0000100552

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Analysis Report MA18-05398.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P6B(5)
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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	2.45	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P6B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P7S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	2.35	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05398.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P7S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Analysis Report MA18-05398.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P7B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	1.21	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P7B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

30112018 1215 0000100552

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Analysis Report MA18-05398.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P8S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.50	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P8S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

30112018 1215 0000100552

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Analysis Report MA18-05398.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P8B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	1.94	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE P8B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05398.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C1S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	2.82	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C1S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.10	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Analysis Report MA18-05398.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C1B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	2.85	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C1B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

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S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.10	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

30112018 1215 0000100552

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Date: 30/11/2018

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GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05398.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C2S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	2.97	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

30112018 1215 0000100552

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Date: 30/11/2018

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GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05398.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C2S(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.01	mg/L
S - Total Organic Carbon	DIN EN 1484	1.10	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

Technical Signatory — Caroline Chege-Chemist

30112018 1215 0000100552

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Date: 30/11/2018

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Analysis Report MA18-05398.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C2B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
TPH C6 - C44	EPA 8015C	3.35	mg/L
Polynuclear Aromatic Hydrocarbons in water	EPA 8270D		
Acenaphthene		<0.05	mg/L
Acenaphthylene		<0.05	mg/L
Anthracene		<0.05	mg/L
Benzo(a)anthracene		<0.05	mg/L
Benzo(a)pyrene		<0.05	mg/L
Benzo(b)fluoranthene		<0.05	mg/L
Benzo(g,h,i)perylene		<0.05	mg/L
Benzo(k)fluoranthene		<0.05	mg/L
Chrysene		<0.05	mg/L
Dibenz(a,h)anthracene		<0.05	mg/L
Fluoranthene		<0.05	mg/L
Fluorene		<0.05	mg/L
Indeno(1,2,3-cd)pyrene		<0.05	mg/L
Naphthalene		<0.05	mg/L
PAH (sum)		<0.05	µg/L
Phenanthrene		<0.05	mg/L
Pyrene		<0.05	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

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Date: 30/11/2018

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Analysis Report MA18-05398.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	22/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC AMBER BOTTLE C2B(5)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

SGS Kenya Ltd. makes no representation and assumes no responsibility for the reliability of analysis by a Sub-Contract Laboratory. The laboratory analysis for the Sub-Contract Laboratory tests are provided by:
S - Subcontracted to SGS ISO 17025 Laboratory

TESTS	METHOD	RESULT	UNITS
Oil and Greases	SGS TW 6	<0.10	mg/L
Total Phenols	APHA 5530 D	0.02	mg/L
S - Total Organic Carbon	DIN EN 1484	1.00	mg/L

End of Analytical Results

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	Pauline Viviane-Chemist	Caroline Chege-Chemist

30112018 1215 0000100552

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Date: 18/12/2018

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Analysis Report MA18-05399.001 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.001 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P1SR1(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.02	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.03	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	576.96	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

18122018 1209 0000101149

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Date: 18/12/2018

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Analysis Report MA18-05399.002 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.002 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P1SR2(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.02	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	<0.005	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	673.12	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.003 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.003 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P2S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.02	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	576.96	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

18122018 1209 0000101149

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Date: 18/12/2018

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Analysis Report MA18-05399.004 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.004 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P3S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0:02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.02	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.03	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	865.44	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.005 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.005 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P4B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.03	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	673.12	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.006 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.006 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P4S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	<0.005	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	769.28	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Stephen Musyoka-Chemist

Technical Signatory — Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.007 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.007 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P3B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	625.04	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.008 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.008 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P5S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.03	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	<0.005	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	528.88	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.009 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.009 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P5B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	721.20	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

18122018 1209 0000101149

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Date: 18/12/2018

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Analysis Report MA18-05399.010 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.010 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P6S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.02	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.03	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	673.12	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.011 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.011 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P6B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.03	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	<0.005	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	625.04	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.012 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.012 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P7S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	576.96	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Stephen Musyoka-Chemist

Technical Signatory — Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.013 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.013 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
REISSUE COMMENT:	ADDITION OF PARAMETER
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P7B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	<0.005	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	625.04	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.014 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.014 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P8S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.02	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.04	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	721.20	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.015 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.015 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P8B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.04	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.04	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	480.80	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.016 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.016 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C1S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	0.03	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	576.96	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.017 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.017 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C1B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.04	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	625.04	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.018 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.018 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C2S(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	0.02	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	528.88	mg/L

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 18/12/2018

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Analysis Report MA18-05399.019 Re-issue: 1

**** This Amended Report cancels and supersedes the Report No.MA18-05399.019 dated 30112018 issued by SGS ****

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C2B(4)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Aluminium as Al	APHA 3120 B	<0.05	mg/L
Arsenic as As	APHA 3120 B	<0.01	mg/L
Barium as Ba	APHA 3120 B	<0.004	mg/L
Cadmium as Cd	APHA 3120 B	<0.007	mg/L
Cobalt as Co	APHA 3120 B	<0.02	mg/L
Chromium as Cr	APHA 3120 B	<0.02	mg/L
Copper as Cu	APHA 3120 B	<0.01	mg/L
Iron as Fe	APHA 3120 B	<0.02	mg/L
Manganese as Mn	APHA 3120 B	<0.01	mg/L
Nickel as Ni	APHA 3120 B	<0.02	mg/L
Lead as Pb	APHA 3120 B	<0.004	mg/L
Selenium as Se	APHA 3120 B	<0.01	mg/L
Zinc as Zn	APHA 3120 B	<0.01	mg/L
Vanadium as V	APHA 3120 B	<0.008	mg/L
Hexavalent Chromium as Cr 6+	APHA 3120 B	<0.007	mg/L
Tin as Sn	APHA 3120 B	<0.005	mg/L
Mercury as Hg	COLD VAPOUR	<0.005	mg/L
Chemical Oxygen Demand	APHA 5220 B	769.28	mg/L

End of Analytical Results

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	Stephen Musyoka-Chemist	Florah Mshimba-Chemist

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Date: 29/11/2018

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BOURNE END BUSINESS PARK,
UNITED KINGDOM
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Analysis Report MA18-05400.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P1SR1(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	9.81	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	5.40	mg/L
Nitrate as N	APHA-4500-NO3	5.30	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

29112018 1350 0000100518

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UNITED KINGDOM
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Analysis Report MA18-05400.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P1SR2(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	13.20	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	15.50	mg/L
Nitrate as N	APHA-4500-NO3	0.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Date: 29/11/2018

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Analysis Report MA18-05400.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P2S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	1.10	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.60	mg/L
Nitrate as N	APHA-4500-NO3	2.98	mg/L

Authorised Signatory *Technical Signatory*

Walter Ogara - Multi-Lab Manager David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05400.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P3S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	2.06	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	0.90	mg/L
Nitrate as N	APHA-4500-NO3	1.56	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05400.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P3B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	3.90	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.60	mg/L
Nitrate as N	APHA-4500-NO3	0.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05400.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P4S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	6.30	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	1.80	mg/L
Nitrate as N	APHA-4500-NO3	1.30	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05400.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P4B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	3.48	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.60	mg/L
Nitrate as N	APHA-4500-NO3	2.70	mg/L

Authorised Signatory | *Technical Signatory*

Walter Ogara - Multi-Lab Manager | David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05400.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P5S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	7.10	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.60	mg/L
Nitrate as N	APHA-4500-NO3	4.26	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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Analysis Report MA18-05400.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P5B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	0.60	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.90	mg/L
Nitrate as N	APHA-4500-NO3	3.50	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05400.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P6S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	7.08	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	0.90	mg/L
Nitrate as N	APHA-4500-NO3	2.70	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05400.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P6B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	7.74	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	2.10	mg/L
Nitrate as N	APHA-4500-NO3	1.88	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

29112018 1350 0000100518

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Date: 29/11/2018

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Analysis Report MA18-05400.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P7S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	4.68	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.00	mg/L
Nitrate as N	APHA-4500-NO3	4.56	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05400.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P7B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	0.70	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.40	mg/L
Nitrate as N	APHA-4500-NO3	2.76	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05400.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P8S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	3.92	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	2.50	mg/L
Nitrate as N	APHA-4500-NO3	4.15	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05400.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P8B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	2.52	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	2.80	mg/L
Nitrate as N	APHA-4500-NO3	3.24	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05400.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C1S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	2.36	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	3.10	mg/L
Nitrate as N	APHA-4500-NO3	4.48	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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Analysis Report MA18-05400.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C1B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	4.40	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	4.70	mg/L
Nitrate as N	APHA-4500-NO3	1.54	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05400.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C2S(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	3.02	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	2.20	mg/L
Nitrate as N	APHA-4500-NO3	2.43	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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Analysis Report MA18-05400.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C2B(3)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Ammonia as NH3	APHA-4500- NH3 F	0.22	mg/L
Nitrite as NO2	APHA-4500-NO2	<0.1	mg/L
Phosphate as PO4	APHA 4500-P	1.60	mg/L
Nitrate as N	APHA-4500-NO3	3.50	mg/L

End of Analytical Results

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

29112018 1350 0000100518

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Analysis Report MA18-05401.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P1SR1(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	8.10	mg/L

Authorised Signatory *Technical Signatory*

Walter Ogara - Multi-Lab Manager Pauline Viviane-Chemist

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Date: 29/11/2018

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Analysis Report MA18-05401.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P1SR2(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Date: 29/11/2018

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Analysis Report MA18-05401.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P2S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	<5.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Date: 29/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05401.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P3S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P3B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	10.80	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P4S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	8.10	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P4B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P5S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	13.50	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

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Analysis Report MA18-05401.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P5B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Pauline Viviane-Chemist

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Analysis Report MA18-05401.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P6S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P6B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	<5.00	mg/L

Authorised Signatory *Technical Signatory*

Walter Ogara - Multi-Lab Manager Pauline Viviane-Chemist

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Analysis Report MA18-05401.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P7S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P7B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	8.10	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P8S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL P8B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	8.10	mg/L

Authorised Signatory *Technical Signatory*

Walter Ogara - Multi-Lab Manager Pauline Viviané-Chemist

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Analysis Report MA18-05401.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL C1S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	5.40	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 29/11/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05401.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL C1B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	8.10	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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UNITED KINGDOM
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Analysis Report MA18-05401.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL C2S(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	8.10	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Pauline Viviane-Chemist

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Analysis Report MA18-05401.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	20/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A BOTTLE WRAPPED IN ALLUMINIUM FOIL C2B(6)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
BOD 5 @ 20oC	APHA 5210 B	<5.00	mg/L

End of Analytical Results

Authorised Signatory *Technical Signatory*

Walter Ogara - Multi-Lab Manager Pauline Viviane-Chemist

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Analysis Report MA18-05402.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P1SR1(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	27.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

26112018 1626 0000100324

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Analysis Report MA18-05402.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P1SR2(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	64.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P2S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	81.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P3S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	143.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P3B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	59.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P4S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	72.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P4B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	79.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P5B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	45.00	mg/L

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — Florah Mshimba-Chemist

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Analysis Report MA18-05402.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P5S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	35.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Date: 26/11/2018

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BOURNE END BUSINESS PARK,
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Analysis Report MA18-05402.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P6S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	59.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P6B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	60.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P7S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	8.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P7B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	55.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P8S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	60.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE P8B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	29.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C1S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	121.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C1B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	175.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Analysis Report MA18-05402.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C2S(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	73.00	mg/L

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

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Date: 26/11/2018

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Analysis Report MA18-05402.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	20/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	524772
MARKS:	CONDITION OF SAMPLE:DELIVERED IN A PLASTIC BOTTLE C2B(7)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Total Suspended Solids	APHA 2540 D	96.00	mg/L

End of Analytical Results

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

Florah Mshimba-Chemist

26112018 1626 0000100324

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Analysis Report MA18-05403.001

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P1SR1(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	3.05	NTU

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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Analysis Report MA18-05403.002

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P1SR2(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.45	NTU

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05403.003

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P2S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.49	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 26/11/2018

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Analysis Report MA18-05403.004

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P3S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	2.27	NTU

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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Analysis Report MA18-05403.005

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	26/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P3B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.53	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.006

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P4S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	2.04	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.007

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P4B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	2.23	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.008

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P5S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	2.24	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.009

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P5B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.94	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.010

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P6S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.63	NTU

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

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Analysis Report MA18-05403.011

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P6B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	2.19	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.012

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P7S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.70	NTU

Authorised Signatory *Technical Signatory*

Walter Ogara - Multi-Lab Manager David Omondi-Chemist

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Analysis Report MA18-05403.013

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P7B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.34	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.014

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P8S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.93	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.015

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL P8B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.44	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Date: 26/11/2018

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Analysis Report MA18-05403.016

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C1S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.82	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

26112018 1146 0000100298

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Date: 26/11/2018

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Analysis Report MA18-05403.017

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C2B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	1.22	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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Analysis Report MA18-05403.018

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C2S(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	0.93	NTU

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

26112018 1146 0000100298

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Date: 26/11/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05403.019

PRODUCT DESCRIPTION:	SEA WATER
SAMPLED BY:	Client
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	21/11/2018
SGS ORDERNO:	
MARKS:	CONDITION OF SAMPLE:DELIVERED IN BOTTLES WRAPPED IN ALLUMINIUM FOIL C1B(8)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Turbidity	APHA 2130 B	3.34	NTU

End of Analytical Results

Authorised Signatory

Walter Ogara - Multi-Lab Manager

Technical Signatory

David Omondi-Chemist

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APPENDIX B

Sediment Analysis Reports

Date: 03/12/2018

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UNITED KINGDOM
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Analysis Report MA18-05404.001

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Oil and Greases	APHA 5520E	<0.100	mg/kg
Total Phenol	ICARDA	<0.01	mg/kg
Volatile Organic Compounds in soil	EPA 8260C		
1,1,1,2-Tetrachloroethane		<10	µg/kg
1,1,1-Trichloroethane		<10	µg/kg
1,1,2,2-Tetrachlorethane		<10	µg/kg
1,1,2-Trichloroethane		<10	µg/kg
1,1-Dichloroethane		<10	µg/kg
1,1-Dichloroethene		<10	µg/kg
1,2,3-Trichlorobenzene		<10	µg/kg
1,2,3-Trichloropropane		<10	µg/kg
1,2,4-Trichlorobenzene		<10	µg/kg
1,2,4-Trimethylbenzene		<10	µg/kg
1,2-Dibromo-3-chloropropane		<10	µg/kg
1,2-Dibromoethane		<10	µg/kg
1,2-Dichlorobenzene		<10	µg/kg
1,2-Dichloroethane		<10	µg/kg
1,2-Dichloropropane		<10	µg/kg
1,3,5-Trimethylbenzene		<10	µg/kg
1,3-Dichlorobenzene		<10	µg/kg
1,3-Dichloropropane		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

03122018 1328 0000100631

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Analysis Report MA18-05404.001

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
1,4-Dichlorobenzene		<10	µg/kg
2,2-Dichloropropane		<10	µg/kg
2-Chlorotoluene		<10	µg/kg
4-Chlorotoluene		<10	µg/kg
Benzene		<10	µg/kg
Bromobenzene		<10	µg/kg
Bromochloromethane		<10	µg/kg
Bromodichloromethane		<10	µg/kg
Bromoform		<10	µg/kg
Carbon tetrachloride		<10	µg/kg
Chlorobenzene		<10	µg/kg
Chloroform		<10	µg/kg
cis-1,2-Dichloroethene		<10	µg/kg
cis-1,3-Dichloropropene		<10	µg/kg
Dibromochloromethane		<10	µg/kg
Dibromomethane		<10	µg/kg
Ethylbenzene		<10	µg/kg
Hexachlorobutadiene		<10	µg/kg
Isopropylbenzene		<10	µg/kg
Methylene Chloride (Dichloromethane)		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Date: 03/12/2018

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UNITED KINGDOM
SL8

Analysis Report MA18-05404.001

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
MTBE		<10	µg/kg
Napthalene		<10	µg/kg
n-Butylbenzene		<10	µg/kg
n-Propylbenzene		<10	µg/kg
p-Isopropyltoluene		<10	µg/kg
sec-Butylbenzene		<10	µg/kg
Styrene		<10	µg/kg
tert_Butylbenzene		<10	µg/kg
Tetrachloroethene		<10	µg/kg
Toluene		<10	µg/kg
trans-1,2-Dichloroethene		<10	µg/kg
trans-1,3-Dichloropropene		<10	µg/kg
Trichloroethene		<10	µg/kg
Xylenes (sum)		<20	µg/kg
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Acenaphthene		<0.05	mg/kg
Acenaphthylene		<0.05	mg/kg
Anthracene		<0.05	mg/kg
Benzo(a)anthracene		<0.05	mg/kg
Benzo(a)pyrene		<0.05	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.001

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R1(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Benzo(b)fluoranthene		<0.05	mg/kg
Benzo(g,h,i)perylene		<0.05	mg/kg
Benzo(k)fluoranthene		<0.05	mg/kg
Chrysene		<0.05	mg/kg
Dibenz(a,h)anthracene		<0.05	mg/kg
Fluoranthene		<0.05	mg/kg
Fluorene		<0.05	mg/kg
Indeno(1,2,3-cd)pyrene		<0.05	mg/kg
Naphthalene		<0.05	mg/kg
Phenanthrene		<0.05	mg/kg
Pyrene		<0.05	mg/kg
Total Petroleum Hydrocarbons in Soil	EPA 8015C		
TPH C6 - C44		2.69	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Date: 03/12/2018

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Analysis Report MA18-05404.002

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R1(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Sulphides	APHA 4500 S-F	<0.1	mg/L
Ammonia as NH4	ICARDA 5.9.3	4.17	mg/L
Nitrites In Soil	ICARDA 5.9.3	0.040	mg/kg
Nitrate	ICARDA 5.9	0.300	mg/kg
Total Nitrogen	ICARDA 5.9	1.78	%
Phosphate in Soil	ICARDA 5.10	406.620	mg/kg
Mercury as Hg	COLD VAPOUR	<0.005	mg/kg
Metals in soil and sediment	EPA 3050B		
Aluminium as Al		8933.11	mg/kg
Arsenic as As		10.89	mg/kg
Barium as Ba		13.42	mg/kg
Cadmium as Cd		<0.02	mg/kg
Copper as Cu		4.43	mg/kg
Chromium as Cr		8.66	mg/kg
Cobalt as Co		1.87	mg/kg
Iron as Fe		6796.63	mg/kg
Manganese as Mn		87.70	mg/kg
Nickel as Ni		4.85	mg/kg
Lead as Pb		12.36	mg/kg
Selenium as Se		9.12	mg/kg
Tin as Sn		<0.02	mg/kg

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

Technical Signatory — Mue Bahati-Chemist

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Date: 03/12/2018

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Analysis Report MA18-05404.002

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R1(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Metals in soil and sediment	EPA 3050B		
Zinc as Zn		10.34	mg/kg
Vanadium as V		12.37	mg/kg
Phosphorus as P		132.60	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Date: 03/12/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
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Analysis Report MA18-05404.003

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Oil and Greases	APHA 5520E	<0.100	mg/kg
Total Phenol	ICARDA	<0.01	mg/kg
Volatile Organic Compounds in soil	EPA 8260C		
1,1,1,2-Tetrachloroethane		<10	µg/kg
1,1,1-Trichloroethane		<10	µg/kg
1,1,2,2-Tetrachlorethane		<10	µg/kg
1,1,2-Trichloroethane		<10	µg/kg
1,1-Dichloroethane		<10	µg/kg
1,1-Dichloroethene		<10	µg/kg
1,2,3-Trichlorobenzene		<10	µg/kg
1,2,3-Trichloropropane		<10	µg/kg
1,2,4-Trichlorobenzene		<10	µg/kg
1,2,4-Trimethylbenzene		<10	µg/kg
1,2-Dibromo-3-chloropropane		<10	µg/kg
1,2-Dibromoethane		<10	µg/kg
1,2-Dichlorobenzene		<10	µg/kg
1,2-Dichloroethane		<10	µg/kg
1,2-Dichloropropane		<10	µg/kg
1,3,5-Trimethylbenzene		<10	µg/kg
1,3-Dichlorobenzene		<10	µg/kg
1,3-Dichloropropane		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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BOURNE END BUSINESS PARK,
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Analysis Report MA18-05404.003

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
1,4-Dichlorobenzene		<10	µg/kg
2,2-Dichloropropane		<10	µg/kg
2-Chlorotoluene		<10	µg/kg
4-Chlorotoluene		<10	µg/kg
Benzene		<10	µg/kg
Bromobenzene		<10	µg/kg
Bromochloromethane		<10	µg/kg
Bromodichloromethane		<10	µg/kg
Bromoform		<10	µg/kg
Carbon tetrachloride		<10	µg/kg
Chlorobenzene		<10	µg/kg
Chloroform		<10	µg/kg
cis-1,2-Dichloroethene		<10	µg/kg
cis-1,3-Dichloropropene		<10	µg/kg
Dibromochloromethane		<10	µg/kg
Dibromomethane		<10	µg/kg
Ethylbenzene		<10	µg/kg
Hexachlorobutadiene		<10	µg/kg
Isopropylbenzene		<10	µg/kg
Methylene Chloride (Dichloromethane)		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.003

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
MTBE		<10	µg/kg
Napthalene		<10	µg/kg
n-Butylbenzene		<10	µg/kg
n-Propylbenzene		<10	µg/kg
p-Isopropyltoluene		<10	µg/kg
sec-Butylbenzene		<10	µg/kg
Styrene		<10	µg/kg
tert_Butylbenzene		<10	µg/kg
Tetrachloroethene		<10	µg/kg
Toluene		<10	µg/kg
trans-1,2-Dichloroethene		<10	µg/kg
trans-1,3-Dichloropropene		<10	µg/kg
Trichloroethene		<10	µg/kg
Xylenes (sum)		<20	µg/kg
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Acenaphthene		<0.05	mg/kg
Acenaphthylene		<0.05	mg/kg
Anthracene		<0.05	mg/kg
Benzo(a)anthracene		<0.05	mg/kg
Benzo(a)pyrene		<0.05	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.003

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Benzo(b)fluoranthene		<0.05	mg/kg
Benzo(g,h,i)perylene		<0.05	mg/kg
Benzo(k)fluoranthene		<0.05	mg/kg
Chrysene		<0.05	mg/kg
Dibenz(a,h)anthracene		<0.05	mg/kg
Fluoranthene		<0.05	mg/kg
Fluorene		<0.05	mg/kg
Indeno(1,2,3-cd)pyrene		<0.05	mg/kg
Naphthalene		<0.05	mg/kg
Phenanthrene		<0.05	mg/kg
Pyrene		<0.05	mg/kg
Total Petroleum Hydrocarbons in Soil	EPA 8015C		
TPH C6 - C44		2.77	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.004

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Sulphides	APHA 4500 S-F	<0.1	mg/L
Ammonia as NH4	ICARDA 5.9.3	4.55	mg/L
Nitrites In Soil	ICARDA 5.9.3	0.080	mg/kg
Nitrate	ICARDA 5.9	4.000	mg/kg
Total Nitrogen	ICARDA 5.9	1.27	%
Phosphate in Soil	ICARDA 5.10	386.200	mg/kg
Mercury as Hg	COLD VAPOUR	<0.005	mg/kg
Metals in soil and sediment	EPA 3050B		
Aluminium as Al		9040.16	mg/kg
Arsenic as As		8.12	mg/kg
Barium as Ba		13.26	mg/kg
Cadmium as Cd		0.07	mg/kg
Copper as Cu		4.82	mg/kg
Chromium as Cr		9.66	mg/kg
Cobalt as Co		1.69	mg/kg
Iron as Fe		6964.94	mg/kg
Manganese as Mn		94.86	mg/kg
Nickel as Ni		5.44	mg/kg
Lead as Pb		14.38	mg/kg
Selenium as Se		6.04	mg/kg
Tin as Sn		2.71	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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UNITED KINGDOM
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Analysis Report MA18-05404.004

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P1R2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Metals in soil and sediment	EPA 3050B		
Zinc as Zn		10.59	mg/kg
Vanadium as V		12.58	mg/kg
Phosphorus as P		126.21	mg/kg

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Date: 03/12/2018

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UNITED KINGDOM
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Analysis Report MA18-05404.005

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY1
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Oil and Greases	APHA 5520E	4.000	mg/kg
Total Phenol	ICARDA	<0.01	mg/kg
Volatile Organic Compounds in soil	EPA 8260C		
1,1,1,2-Tetrachloroethane		<10	µg/kg
1,1,1-Trichloroethane		<10	µg/kg
1,1,2,2-Tetrachlorethane		<10	µg/kg
1,1,2-Trichloroethane		<10	µg/kg
1,1-Dichloroethane		<10	µg/kg
1,1-Dichloroethene		<10	µg/kg
1,2,3-Trichlorobenzene		<10	µg/kg
1,2,3-Trichloropropane		<10	µg/kg
1,2,4-Trichlorobenzene		<10	µg/kg
1,2,4-Trimethylbenzene		<10	µg/kg
1,2-Dibromo-3-chloropropane		<10	µg/kg
1,2-Dibromoethane		<10	µg/kg
1,2-Dichlorobenzene		<10	µg/kg
1,2-Dichloroethane		<10	µg/kg
1,2-Dichloropropane		<10	µg/kg
1,3,5-Trimethylbenzene		<10	µg/kg
1,3-Dichlorobenzene		<10	µg/kg
1,3-Dichloropropane		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.005

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY1
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
1,4-Dichlorobenzene		<10	µg/kg
2,2-Dichloropropane		<10	µg/kg
2-Chlorotoluene		<10	µg/kg
4-Chlorotoluene		<10	µg/kg
Benzene		<10	µg/kg
Bromobenzene		<10	µg/kg
Bromochloromethane		<10	µg/kg
Bromodichloromethane		<10	µg/kg
Bromoform		<10	µg/kg
Carbon tetrachloride		<10	µg/kg
Chlorobenzene		<10	µg/kg
Chloroform		<10	µg/kg
cis-1,2-Dichloroethene		<10	µg/kg
cis-1,3-Dichloropropene		<10	µg/kg
Dibromochloromethane		<10	µg/kg
Dibromomethane		<10	µg/kg
Ethylbenzene		<10	µg/kg
Hexachlorobutadiene		<10	µg/kg
Isopropylbenzene		<10	µg/kg
Methylene Chloride (Dichloromethane)		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Date: 03/12/2018

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80100 Mombasa
Kenya

GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05404.005

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY1
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
MTBE		<10	µg/kg
Napthalene		<10	µg/kg
n-Butylbenzene		<10	µg/kg
n-Propylbenzene		<10	µg/kg
p-Isopropyltoluene		<10	µg/kg
sec-Butylbenzene		<10	µg/kg
Styrene		<10	µg/kg
tert_Butylbenzene		<10	µg/kg
Tetrachloroethene		<10	µg/kg
Toluene		<10	µg/kg
trans-1,2-Dichloroethene		<10	µg/kg
trans-1,3-Dichloropropene		<10	µg/kg
Trichloroethene		<10	µg/kg
Xylenes (sum)		<20	µg/kg
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Acenaphthene		<0.05	mg/kg
Acenaphthylene		<0.05	mg/kg
Anthracene		<0.05	mg/kg
Benzo(a)anthracene		<0.05	mg/kg
Benzo(a)pyrene		<0.05	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 03/12/2018

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Analysis Report MA18-05404.005

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY1
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Benzo(b)fluoranthene		<0.05	mg/kg
Benzo(g,h,i)perylene		<0.05	mg/kg
Benzo(k)fluoranthene		<0.05	mg/kg
Chrysene		<0.05	mg/kg
Dibenz(a,h)anthracene		<0.05	mg/kg
Fluoranthene		<0.05	mg/kg
Fluorene		<0.05	mg/kg
Indeno(1,2,3-cd)pyrene		<0.05	mg/kg
Naphthalene		<0.05	mg/kg
Phenanthrene		<0.05	mg/kg
Pyrene		<0.05	mg/kg
Total Petroleum Hydrocarbons in Soil	EPA 8015C		
TPH C6 - C44		2.04	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.006

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY (2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Sulphides	APHA 4500 S-F	4.80	mg/L
Ammonia as NH4	ICARDA 5.9.3	7.00	mg/L
Nitrites In Soil	ICARDA 5.9.3	0.230	mg/kg
Nitrate	ICARDA 5.9	0.020	mg/kg
Total Nitrogen	ICARDA 5.9	5.03	%
Phosphate in Soil	ICARDA 5.10	67.980	mg/kg
Mercury as Hg	COLD VAPOUR	<0.005	mg/kg
Metals in soil and sediment	EPA 3050B		
Aluminium as Al		2012.60	mg/kg
Arsenic as As		5.33	mg/kg
Barium as Ba		3.83	mg/kg
Cadmium as Cd		<0.02	mg/kg
Copper as Cu		1.71	mg/kg
Chromium as Cr		3.30	mg/kg
Cobalt as Co		<0.02	mg/kg
Iron as Fe		1441.16	mg/kg
Manganese as Mn		16.15	mg/kg
Nickel as Ni		0.47	mg/kg
Lead as Pb		11.32	mg/kg
Selenium as Se		4.62	mg/kg
Tin as Sn		2.38	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.006

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY (2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Metals in soil and sediment	EPA 3050B		
Zinc as Zn		3.26	mg/kg
Vanadium as V		3.24	mg/kg
Phosphorus as P		22.12	mg/kg

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.007

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY 2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Oil and Greases	APHA 5520E	13.000	mg/kg
Total Phenol	ICARDA	<0.01	mg/kg
Volatile Organic Compounds in soil	EPA 8260C		
1,1,1,2-Tetrachloroethane		<10	µg/kg
1,1,1-Trichloroethane		<10	µg/kg
1,1,2,2-Tetrachlorethane		<10	µg/kg
1,1,2-Trichloroethane		<10	µg/kg
1,1-Dichloroethane		<10	µg/kg
1,1-Dichloroethene		<10	µg/kg
1,2,3-Trichlorobenzene		<10	µg/kg
1,2,3-Trichloropropane		<10	µg/kg
1,2,4-Trichlorobenzene		<10	µg/kg
1,2,4-Trimethylbenzene		<10	µg/kg
1,2-Dibromo-3-chloropropane		<10	µg/kg
1,2-Dibromoethane		<10	µg/kg
1,2-Dichlorobenzene		<10	µg/kg
1,2-Dichloroethane		<10	µg/kg
1,2-Dichloropropane		<10	µg/kg
1,3,5-Trimethylbenzene		<10	µg/kg
1,3-Dichlorobenzene		<10	µg/kg
1,3-Dichloropropane		<10	µg/kg

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

Technical Signatory — Mue Bahati-Chemist

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Analysis Report MA18-05404.007

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY 2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
1,4-Dichlorobenzene		<10	µg/kg
2,2-Dichloropropane		<10	µg/kg
2-Chlorotoluene		<10	µg/kg
4-Chlorotoluene		<10	µg/kg
Benzene		<10	µg/kg
Bromobenzene		<10	µg/kg
Bromochloromethane		<10	µg/kg
Bromodichloromethane		<10	µg/kg
Bromoform		<10	µg/kg
Carbon tetrachloride		<10	µg/kg
Chlorobenzene		<10	µg/kg
Chloroform		<10	µg/kg
cis-1,2-Dichloroethene		<10	µg/kg
cis-1,3-Dichloropropene		<10	µg/kg
Dibromochloromethane		<10	µg/kg
Dibromomethane		<10	µg/kg
Ethylbenzene		<10	µg/kg
Hexachlorobutadiene		<10	µg/kg
Isopropylbenzene		<10	µg/kg
Methylene Chloride (Dichloromethane)		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.007

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY 2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
MTBE		<10	µg/kg
Napthalene		<10	µg/kg
n-Butylbenzene		<10	µg/kg
n-Propylbenzene		<10	µg/kg
p-Isopropyltoluene		<10	µg/kg
sec-Butylbenzene		<10	µg/kg
Styrene		<10	µg/kg
tert_Butylbenzene		<10	µg/kg
Tetrachloroethene		<10	µg/kg
Toluene		<10	µg/kg
trans-1,2-Dichloroethene		<10	µg/kg
trans-1,3-Dichloropropene		<10	µg/kg
Trichloroethene		<10	µg/kg
Xylenes (sum)		<20	µg/kg
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Acenaphthene		<0.05	mg/kg
Acenaphthylene		<0.05	mg/kg
Anthracene		<0.05	mg/kg
Benzo(a)anthracene		<0.05	mg/kg
Benzo(a)pyrene		<0.05	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.007

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY 2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Benzo(b)fluoranthene		<0.05	mg/kg
Benzo(g,h,i)perylene		<0.05	mg/kg
Benzo(k)fluoranthene		<0.05	mg/kg
Chrysene		<0.05	mg/kg
Dibenz(a,h)anthracene		<0.05	mg/kg
Fluoranthene		<0.05	mg/kg
Fluorene		<0.05	mg/kg
Indeno(1,2,3-cd)pyrene		<0.05	mg/kg
Naphthalene		<0.05	mg/kg
Phenanthrene		<0.05	mg/kg
Pyrene		<0.05	mg/kg
Total Petroleum Hydrocarbons in Soil	EPA 8015C		
TPH C6 - C44		2.19	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.008

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Sulphides	APHA 4500 S-F	0.80	mg/L
Ammonia as NH4	ICARDA 5.9.3	4.68	mg/L
Nitrites In Soil	ICARDA 5.9.3	0.110	mg/kg
Nitrate	ICARDA 5.9	0.480	mg/kg
Total Nitrogen	ICARDA 5.9	2.38	%
Phosphate in Soil	ICARDA 5.10	99.540	mg/kg
Mercury as Hg	COLD VAPOUR	<0.005	mg/kg
Metals in soil and sediment	EPA 3050B		
Aluminium as Al		1590.29	mg/kg
Arsenic as As		9.04	mg/kg
Barium as Ba		8.06	mg/kg
Cadmium as Cd		<0.02	mg/kg
Copper as Cu		2.47	mg/kg
Chromium as Cr		2.86	mg/kg
Cobalt as Co		0.33	mg/kg
Iron as Fe		1117.18	mg/kg
Manganese as Mn		15.46	mg/kg
Nickel as Ni		2.94	mg/kg
Lead as Pb		10.63	mg/kg
Selenium as Se		6.38	mg/kg
Tin as Sn		3.53	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Date: 03/12/2018

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BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
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Analysis Report MA18-05404.008

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:NAVY2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Metals in soil and sediment	EPA 3050B		
Zinc as Zn		7.00	mg/kg
Vanadium as V		2.89	mg/kg
Phosphorus as P		32.53	mg/kg

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.009

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Oil and Greases	APHA 5520E	2.000	mg/kg
Total Phenol	ICARDA	<0.01	mg/kg
Volatile Organic Compounds in soil	EPA 8260C		
1,1,1,2-Tetrachloroethane		<10	µg/kg
1,1,1-Trichloroethane		<10	µg/kg
1,1,2,2-Tetrachlorethane		<10	µg/kg
1,1,2-Trichloroethane		<10	µg/kg
1,1-Dichloroethane		<10	µg/kg
1,1-Dichloroethene		<10	µg/kg
1,2,3-Trichlorobenzene		<10	µg/kg
1,2,3-Trichloropropane		<10	µg/kg
1,2,4-Trichlorobenzene		<10	µg/kg
1,2,4-Trimethylbenzene		<10	µg/kg
1,2-Dibromo-3-chloropropane		<10	µg/kg
1,2-Dibromoethane		<10	µg/kg
1,2-Dichlorobenzene		<10	µg/kg
1,2-Dichloroethane		<10	µg/kg
1,2-Dichloropropane		<10	µg/kg
1,3,5-Trimethylbenzene		<10	µg/kg
1,3-Dichlorobenzene		<10	µg/kg
1,3-Dichloropropane		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

03122018 1329 0000100631

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Analysis Report MA18-05404.009

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
1,4-Dichlorobenzene		<10	µg/kg
2,2-Dichloropropane		<10	µg/kg
2-Chlorotoluene		<10	µg/kg
4-Chlorotoluene		<10	µg/kg
Benzene		<10	µg/kg
Bromobenzene		<10	µg/kg
Bromochloromethane		<10	µg/kg
Bromodichloromethane		<10	µg/kg
Bromoform		<10	µg/kg
Carbon tetrachloride		<10	µg/kg
Chlorobenzene		<10	µg/kg
Chloroform		<10	µg/kg
cis-1,2-Dichloroethene		<10	µg/kg
cis-1,3-Dichloropropene		<10	µg/kg
Dibromochloromethane		<10	µg/kg
Dibromomethane		<10	µg/kg
Ethylbenzene		<10	µg/kg
Hexachlorobutadiene		<10	µg/kg
Isopropylbenzene		<10	µg/kg
Methylene Chloride (Dichloromethane)		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.009

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
MTBE		<10	µg/kg
Napthalene		<10	µg/kg
n-Butylbenzene		<10	µg/kg
n-Propylbenzene		<10	µg/kg
p-Isopropyltoluene		<10	µg/kg
sec-Butylbenzene		<10	µg/kg
Styrene		<10	µg/kg
tert_Butylbenzene		<10	µg/kg
Tetrachloroethene		<10	µg/kg
Toluene		<10	µg/kg
trans-1,2-Dichloroethene		<10	µg/kg
trans-1,3-Dichloropropene		<10	µg/kg
Trichloroethene		<10	µg/kg
Xylenes (sum)		<20	µg/kg
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Acenaphthene		<0.05	mg/kg
Acenaphthylene		<0.05	mg/kg
Anthracene		<0.05	mg/kg
Benzo(a)anthracene		<0.05	mg/kg
Benzo(a)pyrene		<0.05	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

03122018 1329 0000100631

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Analysis Report MA18-05404.009

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P2(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Benzo(b)fluoranthene		<0.05	mg/kg
Benzo(g,h,i)perylene		<0.05	mg/kg
Benzo(k)fluoranthene		<0.05	mg/kg
Chrysene		<0.05	mg/kg
Dibenz(a,h)anthracene		<0.05	mg/kg
Fluoranthene		<0.05	mg/kg
Fluorene		<0.05	mg/kg
Indeno(1,2,3-cd)pyrene		<0.05	mg/kg
Naphthalene		<0.05	mg/kg
Phenanthrene		<0.05	mg/kg
Pyrene		<0.05	mg/kg
Total Petroleum Hydrocarbons in Soil	EPA 8015C		
TPH C6 - C44		2.12	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.010

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Sulphides	APHA 4500 S-F	1.60	mg/L
Ammonia as NH4	ICARDA 5.9.3	4.94	mg/L
Nitrites In Soil	ICARDA 5.9.3	0.070	mg/kg
Nitrate	ICARDA 5.9	0.400	mg/kg
Total Nitrogen	ICARDA 5.9	1.79	%
Phosphate in Soil	ICARDA 5.10	378.310	mg/kg
Mercury as Hg	COLD VAPOUR	<0.005	mg/kg
Metals in soil and sediment	EPA 3050B		
Aluminium as Al		15636.80	mg/kg
Arsenic as As		11.14	mg/kg
Barium as Ba		19.47	mg/kg
Cadmium as Cd		<0.02	mg/kg
Copper as Cu		5.93	mg/kg
Chromium as Cr		14.34	mg/kg
Cobalt as Co		2.76	mg/kg
Iron as Fe		9480.29	mg/kg
Manganese as Mn		115.91	mg/kg
Nickel as Ni		7.35	mg/kg
Lead as Pb		13.24	mg/kg
Selenium as Se		2.64	mg/kg
Tin as Sn		2.53	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.010

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P2(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Metals in soil and sediment	EPA 3050B		
Zinc as Zn		14.76	mg/kg
Vanadium as V		19.32	mg/kg
Phosphorus as P		123.63	mg/kg

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Analysis Report MA18-05404.011

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P3(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Oil and Greases	APHA 5520E	9.000	mg/kg
Total Phenol	ICARDA	<0.01	mg/kg
Volatile Organic Compounds in soil	EPA 8260C		
1,1,1,2-Tetrachloroethane		<10	µg/kg
1,1,1-Trichloroethane		<10	µg/kg
1,1,2,2-Tetrachlorethane		<10	µg/kg
1,1,2-Trichloroethane		<10	µg/kg
1,1-Dichloroethane		<10	µg/kg
1,1-Dichloroethene		<10	µg/kg
1,2,3-Trichlorobenzene		<10	µg/kg
1,2,3-Trichloropropane		<10	µg/kg
1,2,4-Trichlorobenzene		<10	µg/kg
1,2,4-Trimethylbenzene		<10	µg/kg
1,2-Dibromo-3-chloropropane		<10	µg/kg
1,2-Dibromoethane		<10	µg/kg
1,2-Dichlorobenzene		<10	µg/kg
1,2-Dichloroethane		<10	µg/kg
1,2-Dichloropropane		<10	µg/kg
1,3,5-Trimethylbenzene		<10	µg/kg
1,3-Dichlorobenzene		<10	µg/kg
1,3-Dichloropropane		<10	µg/kg

Authorised Signatory — Walter Ogara - Multi-Lab Manager

Technical Signatory — David Omondi-Chemist

Technical Signatory — Mue Bahati-Chemist

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Analysis Report MA18-05404.011

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P3(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
1,4-Dichlorobenzene		<10	µg/kg
2,2-Dichloropropane		<10	µg/kg
2-Chlorotoluene		<10	µg/kg
4-Chlorotoluene		<10	µg/kg
Benzene		<10	µg/kg
Bromobenzene		<10	µg/kg
Bromochloromethane		<10	µg/kg
Bromodichloromethane		<10	µg/kg
Bromoform		<10	µg/kg
Carbon tetrachloride		<10	µg/kg
Chlorobenzene		<10	µg/kg
Chloroform		<10	µg/kg
cis-1,2-Dichloroethene		<10	µg/kg
cis-1,3-Dichloropropene		<10	µg/kg
Dibromochloromethane		<10	µg/kg
Dibromomethane		<10	µg/kg
Ethylbenzene		<10	µg/kg
Hexachlorobutadiene		<10	µg/kg
Isopropylbenzene		<10	µg/kg
Methylene Chloride (Dichloromethane)		<10	µg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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Member of the SGS Group (Société Générale de Surveillance)

Date: 03/12/2018

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GOLDER ASSOCIATES (UK) LTD
CAVENDISH HOUSE
BUCKINGHAMSHIRE
BOURNE END BUSINESS PARK,
UNITED KINGDOM
SL8

Analysis Report MA18-05404.011

PRODUCT DESCRIPTION:	SEDIMENT
SAMPLED BY:	CLIENT
SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P3(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Volatile Organic Compounds in soil	EPA 8260C		
MTBE		<10	µg/kg
Napthalene		<10	µg/kg
n-Butylbenzene		<10	µg/kg
n-Propylbenzene		<10	µg/kg
p-Isopropyltoluene		<10	µg/kg
sec-Butylbenzene		<10	µg/kg
Styrene		<10	µg/kg
tert_Butylbenzene		<10	µg/kg
Tetrachloroethene		<10	µg/kg
Toluene		<10	µg/kg
trans-1,2-Dichloroethene		<10	µg/kg
trans-1,3-Dichloropropene		<10	µg/kg
Trichloroethene		<10	µg/kg
Xylenes (sum)		<20	µg/kg
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Acenaphthene		<0.05	mg/kg
Acenaphthylene		<0.05	mg/kg
Anthracene		<0.05	mg/kg
Benzo(a)anthracene		<0.05	mg/kg
Benzo(a)pyrene		<0.05	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P3(1)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Polynuclear Aromatic Hydrocarbons in soil	EPA 8270D		
Benzo(b)fluoranthene		<0.05	mg/kg
Benzo(g,h,i)perylene		<0.05	mg/kg
Benzo(k)fluoranthene		<0.05	mg/kg
Chrysene		<0.05	mg/kg
Dibenz(a,h)anthracene		<0.05	mg/kg
Fluoranthene		<0.05	mg/kg
Fluorene		<0.05	mg/kg
Indeno(1,2,3-cd)pyrene		<0.05	mg/kg
Naphthalene		<0.05	mg/kg
Phenanthrene		<0.05	mg/kg
Pyrene		<0.05	mg/kg
Total Petroleum Hydrocarbons in Soil	EPA 8015C		
TPH C6 - C44		1.65	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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SAMPLE RECEIVED:	21/11/2018
ANALYSIS STARTED:	23/11/2018
SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P3(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Sulphides	APHA 4500 S-F	<0.1	mg/L
Ammonia as NH4	ICARDA 5.9.3	2.56	mg/L
Nitrites In Soil	ICARDA 5.9.3	0.140	mg/kg
Nitrate	ICARDA 5.9	4.000	mg/kg
Total Nitrogen	ICARDA 5.9	2.24	%
Phosphate in Soil	ICARDA 5.10	546.420	mg/kg
Mercury as Hg	COLD VAPOUR	<0.005	mg/kg
Metals in soil and sediment	EPA 3050B		
Aluminium as Al		4311.52	mg/kg
Arsenic as As		6.95	mg/kg
Barium as Ba		10.12	mg/kg
Cadmium as Cd		<0.02	mg/kg
Copper as Cu		2.50	mg/kg
Chromium as Cr		7.03	mg/kg
Cobalt as Co		2.03	mg/kg
Iron as Fe		4560.62	mg/kg
Manganese as Mn		106.65	mg/kg
Nickel as Ni		3.52	mg/kg
Lead as Pb		10.60	mg/kg
Selenium as Se		3.71	mg/kg
Tin as Sn		3.47	mg/kg

Authorised Signatory	*Technical Signatory*	*Technical Signatory*
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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SGS ORDERNO:	524772
MARKS:	DELIVERED IN GLASS BOTTLE SAMPLE ID:P3(2)
REPORT COMMENTS:	This report refers to a submitted sample and all details in respect of source; quantities; marks are not verified or confirmed.

TESTS	METHOD	RESULT	UNITS
Metals in soil and sediment	EPA 3050B		
Zinc as Zn		7.00	mg/kg
Vanadium as V		8.49	mg/kg
Phosphorus as P		175.30	mg/kg

End of Analytical Results

Authorised Signatory	Technical Signatory	Technical Signatory
Walter Ogara - Multi-Lab Manager	David Omondi-Chemist	Mue Bahati-Chemist

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ANNEX II

Socio-Economic Baselines

E

E1 Socio-Economic

E2 Cultural Heritage

REPORT

Socio-economic Baseline

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:
Pipeline Project Management Team (PPMT)

Submitted by:
Golder Associates (UK) Ltd

Cavendish House, Bourne End Business Park, Cores End Road,

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1772867.553.209.B0
August 2019

Distribution List

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APPENDICES

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1.0 INTRODUCTION

The Lokichar to Lamu Crude Oil Pipeline (LLCOP) spans six counties across Kenya, commencing at a flange point in Turkana County, southeast of the Lokichar fields, and cuts across Samburu, Isiolo, Meru, Garissa and Lamu counties. The LLCOP terminates at the marine export facility at the new Port of Lamu. In accordance with the Environmental (Impact Assessment & Audit) Regulations 2003 (as amended) the Project will need approval from the National Environmental Management Authority (NEMA) before the Project can proceed. To obtain this approval an Environmental and Social Impact Assessment must be prepared. This report provides the social baseline upon which changes from the Project on the social environment are measured. Changes to the social environment are described in the Environmental and Social Impact Assessment.

A Health Baseline Report has been prepared by Shape Consulting Ltd. (SHAPE). Elements of the health baseline are summarised in relevant county sections. The full report is in Annex II of the ESIA.

2.0 SOCIAL ENVIRONMENT

This section contains a description and characterisation of the socio- economic environment of Project Area of Influence (AOI) counties and communities. The report is organised as follows:

- Approach to data collection and data collection tools;
- National economic, health and social context;
- Regional economic and social profile;
- AOI County and community data and information with specific focus on livelihoods.

Information on the socio-economic conditions in the area of the Project was collected and analyzed in order to:

- describe the socio-economic conditions in the Project's Area of Influence (AoI);
- assemble data on existing socio-economic conditions that can be used to monitor change in Project-affected communities such that the effectiveness of social management can be evaluated, and such that where unforeseen effects occur, these effects can be iteratively addressed as the Project proceeds;
- interact, while collecting baseline data, with potentially affected populations to exchange information on the Project and to provide people the opportunity to express their concerns and preferences with regard to Project development; and
- assess the economic and social effects of the Project and develop the Social Management Plan which is presented in Chapters 7 and 8 of the Environmental and Social Impact Assessment (ESIA Golder 2019).

2.1 Methods

2.1.1 Approach

Socio-economic baseline characterization involved the following steps:

- Identify the AoI within which the effects of the Project on socio-economic conditions will be evaluated, in this case communities within a 25 km radius of the proposed pipeline corridor(s) servitude.
- Identify parameters used to characterise socio-economic conditions in AoI communities, including from review of Scoping Consultations held in June 2018 and detailed in the Scoping Report (Golder 2018).

- Design and carry out literature review and data collection programs to characterise existing socio-economic conditions and collect information to support assessing the effects of the Project on socio-economic conditions.

2.1.2 National and Regional Area of Influence

General information on the economic and social setting of the Project as well as the role of the burgeoning oil industry and its role in the Kenya economy is provided in section 2.2. Information on socio-economic conditions is presented for the following six counties to add context for the AOI communities: Lamu, Garissa, Samburu, Meru, Isiolo and Turkana counties (Section 2.3). Details on AOI communities in each county are described in section 2.4.

2.1.3 Area of Influence Communities

Communities in the Project's AoI correspond to 49 villages and towns located along the approximately 824 km pipeline route, within a 25 km radius buffer of the pipeline. The Project will primarily affect the people living in these communities and their village and county governments. Appendix D includes figures of all counties and AoI communities in each county.

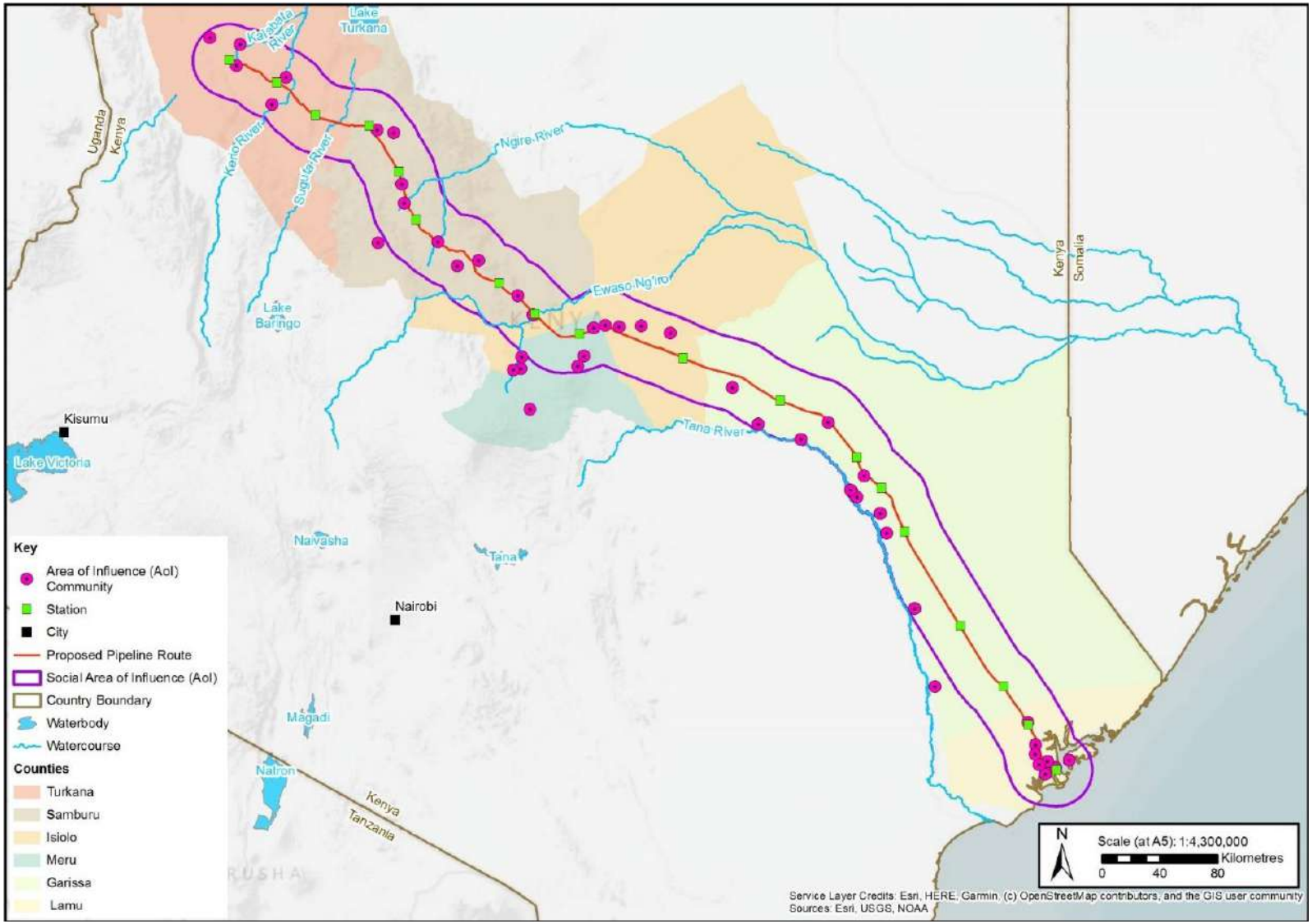

Figure 1: Area of Influence Communities

The communities are identified as potentially affected by virtue of their proximity to the Project; their higher potential to benefit from employment and other Project benefits; and their potential to experience direct environmental effects such as changes to water resources, as well as induced effects such as increased in-migration and disruption to seasonal grazing and pastoral livelihoods. Communities considered in the project AoI are listed in Table 1.

2.1.4 Parameters

The potential effects of the Project on socio-economics were described using the following parameters, and organised by subcomponent:

- national economy: gross domestic product (GDP), foreign direct investment, export earnings, household income, national employment, infrastructure, health and social wellbeing (HDI);
- population demographics, ethnicity and language, economic base and employment;
- social infrastructure including education, health, housing and security;
- physical infrastructure including water, sanitation and waste, energy sources, roads and communication; and,
- land and natural resources: land availability, land and natural resource use including pastoralism, fishing, agriculture, bee keeping, tourism and tangible cultural resources.

2.1.5 Data Collection

Methods for collecting socio-economic data and subsequently describing the socio-economic environment in the vicinity of the Project included:

- collection of secondary data and conducting a literature review
- identifying data gaps;
- designing and implementing a primary data collection programme to fill gaps; and,
- data analysis and reporting.

2.1.5.1 Consultation and Definition of Key Concerns

The Stakeholder Engagement Report (Annex III of the ESIA) provides a summary of consultations that were conducted during the Environmental and Social Impact Assessment (ESIA) process and includes a discussion of key concerns. The results of scoping consultations undertaken early in the ESIA process were used to define the data collection programme for socio-economic and biophysical studies, such that concerns of the people would be appropriately investigated.

2.1.5.2 Literature Review and Secondary Data Collection

Several secondary data sources were used to study existing socio-economic conditions in the area of the Project. These sources included the Kenya National Bureau of Statistics (KNBS 2009), World Bank data (2011-2018), Government of Kenya planning documents and reports such as Kenya Vision 2030, County Annual Development Plans and reports from UNESCO (2017), UNDP (2018) as well as academic literature and information from civil society groups. A complete reference list can be found in section 3.

The various documents were reviewed to gain an understanding of the regional economic and social development context in Kenya and in the six counties that the Project will traverse and guided the development of the community level primary data collection program.

2.1.5.3 Primary Data Collection

The review of literature and secondary data sources indicated gaps related to the age of the available data (for example, the census data are from the most recent census of 2009) and to the lack of data at the level of individual communities. A primary data collection programme was planned to consider the following concerns specific to the Project and the AoI:

- Language – segments of the AoI population are not comfortable conversing in Swahili, indicating that data collection instruments would need to be translated into various languages (i.e. Turkana) and delivered to study participants in the relevant languages. Multiple interviewer/facilitators with relevant language skills were necessary;
- The large size of the potentially affected population, delivering questionnaires to a representative sample of such a large population is impractical; therefore, other methods were needed (below); and,
- Large linear project site – the spatial dimensions of potential effects are critical and therefore livelihood resources and other valued community attributes needed to be mapped.

The primary data programme was conducted from October 2018 to December 2018, with the exception of Turkana County where data collection activities took place in January 2019. Data were collected using methods appropriate to each community and designed to be participatory and inclusive. Community-level data collection methods included interviews with key individuals, focus group discussions, seasonal calendars and land use mapping. Group facilitators and interviewers were hired based on having previous experience and additional training and review of documentation protocols was provided in Nairobi in October 2018.

Interviews with key individuals were held across the AoI. Key individuals are people with specific sector and/or geographic knowledge and expertise. Although there are exceptions, most key individuals are people employed in delivery of government or private sector services, whose jobs include data collection, planning and/or monitoring in their areas of expertise.

Interviews with key individuals are used to encourage people to talk about what they know and discover unexpected knowledge in key areas. The results complement data generated by other data collection methods and also provide information, including quantitative data, on community and location attributes not obtained by other methods, such as school enrolment levels, health services, public security, institutional capacity and local development plans. Key interviews were conducted in each County for a total of 52 altogether.

Focus group discussions bring people of common experience together to discuss specific topics. People describe their experiences, knowledge, histories and expectations in response to directed discussion topics or spontaneously. They are guided by focus group practitioners who use guides to facilitate the discussions. The discussion and consensus amongst participants on normal values, or ranges of values, that pertain to most people provide semi-quantitative data.

This type of discussion can be an efficient means to collect information on topics such as household livelihood strategies, agricultural yields, labour distribution over the year (seasonal calendars), labour returns and intergenerational relations. Results are particularly helpful in understanding socio-economic dynamics and trends, and community and/or subpopulation perceptions, beliefs, opportunities and constraints.

County leadership assisted Project team Regional Coordinators in identifying suitable candidates for focus groups. In total, 161 focus groups were held. The groups comprised of participants that could speak on topics such as pastoralism, bee keeping, fishing, small business, education, community water and sanitation, youth aspirations, women's roles, and traditional beliefs and values. A summary of focus groups by location is provided in Table 1. On average groups consisted of seven participants. Participants were given time to

comment on the Project and ask questions. Altogether, 1,105 people participated in focus group discussions or interviews; 385 were women. Focus group and interview guides and records can be found in Appendix B.

Table 1: Focus Groups and Interviews by Town/Village

County	Town/Village	Focus Groups/Interviews	Total # of Focus Groups/Interviews	Total # of Participants
Garissa	Balambala	Local Government, Elders, Youth, Women	4	11
Garissa	Bola Town, Kamuthe	Youth	1	2
Garissa	Bothai	Elders	1	4
Garissa	Bouralgy	Agriculture, Water & Sanitation	2	3
Garissa	Dagoob	Local Government, Elders, Pastoralists, Women	4	11
Garissa	Galbert Township	Local Government	1	1
Garissa	Garissa Town	Education, Water & Sanitation, Women, Youth, Local Government	5	5
Garissa	Kalagosk, Kamuthe	Water & Sanitation	1	1
Garissa	Kamuthe Town	Agriculture, Elders, Pastoralists	3	9
Garissa	Korakora	Elders, Youth, Women, Pastoralists	4	19
Garissa	Mansabubu	Local Government, Education, Elders, Women	4	8
Garissa	Masalani	Bee Keepers, Pastoralists, Women	3	4
Garissa	Masalani, Bulagolol Village	Youth	1	1
Garissa	Modika	Elders, Local Government, Women	3	15
Garissa	Saka	Local Government, Agriculture, Fishers, Pastoralists, Youth	5	26
Garissa	Sankuri	Local Government, Pastoralists, Agriculture	3	6
Garissa	Shimbiri	Women, Youth	2	6
Isiolo	Boji	Women	1	20

County	Town/Village	Focus Groups/Interviews	Total # of Focus Groups/Interviews	Total # of Participants
Isiolo	Garba Tula	Elders, Women, Youth	3	36
Isiolo	Isiolo, central	Women, Youth	2	13
Isiolo	Ngara Mara	Elders, Pastoralists, Women, Youth	4	74
Isiolo	Yaq Barsadi	Elders, Women, Youth	3	41
Lamu	Barigoni	Bee Keepers, Elders, Fishers, Women, Youth	5	13
Lamu	Hindi	Business, Elders, Pastoralists, Water & Sanitation, Women	5	8
Lamu	Jipe	Agriculture, Bee Keepers, Education, Elders, Water & Sanitation, Women	6	16
Lamu	Kiliana	Agriculture, Fishers, Women, Youth	4	8
Lamu	Mokowe	Fishers, Pastoralists, Women	3	17
Lamu	Pate	Local Government, Fishers, Women, Disabled, Elders, Youth	6	18
Meru	Kaichuru Village	Agriculture, Elders, Pastoralists, Women, Youth	5	49
Meru	Kandebene	Agriculture & Gender, Elders, Pastoralists, Women	4	57
Meru	Laare Town	Agriculture, Bee Keepers, Elders, Water, Women, Youth	6	72
Meru	Meru Town	Youth	1	1
Meru	Mutuati	Local Government, Elders, Women, Youth	4	49
Samburu	Archer's Post	Local Government, Elders Women, Youth	4	35
Samburu	Baragoi	Local Government, Elders, Pastoralists, Women, Youth	5	48
Samburu	Barsaloi	Local Government, Pastoralists, Women, Youth	4	42
Samburu	Lerata	Local Government, Elders, Women, Youth	4	38

County	Town/Village	Focus Groups/Interviews	Total # of Focus Groups/Interviews	Total # of Participants
Samburu	Maralal	Education, Youth, Agriculture	3	8
Samburu	Nachola	Local Government, Pastoralists, Women, Youth	4	41
Samburu	Nkaroni	Local Government, Elders, Women, Youth	4	24
Samburu	Suyian	Local Government, Pastoralists, Women, Youth	4	34
Samburu	Swari	Local Government, Elders, Pastoralists, Women, Youth	5	38
Samburu	Wamba	Elders, Women, Youth	3	30
Turkana	Kapalata	Local Government, Elders, Pastoralists	3	42
Turkana	Katilia	Local Government, Elders, Pastoralists	3	25
Turkana	Lokichar	Local Government, Elders, Pastoralists	3	52
Turkana	Lokori	Local Government, Elders, Pastoralists	3	24
		TOTAL	**161**	**1,105**

Spatial data were derived from assisted land use mapping, where people identified the spatial distribution of resource use, village infrastructure, travel routes and other valued village attributes relative to the pipeline route. Using base maps developed from satellite imagery, village representatives worked together to map land uses in the area of the Project. An example of a land use map developed in Turkana is shown below.

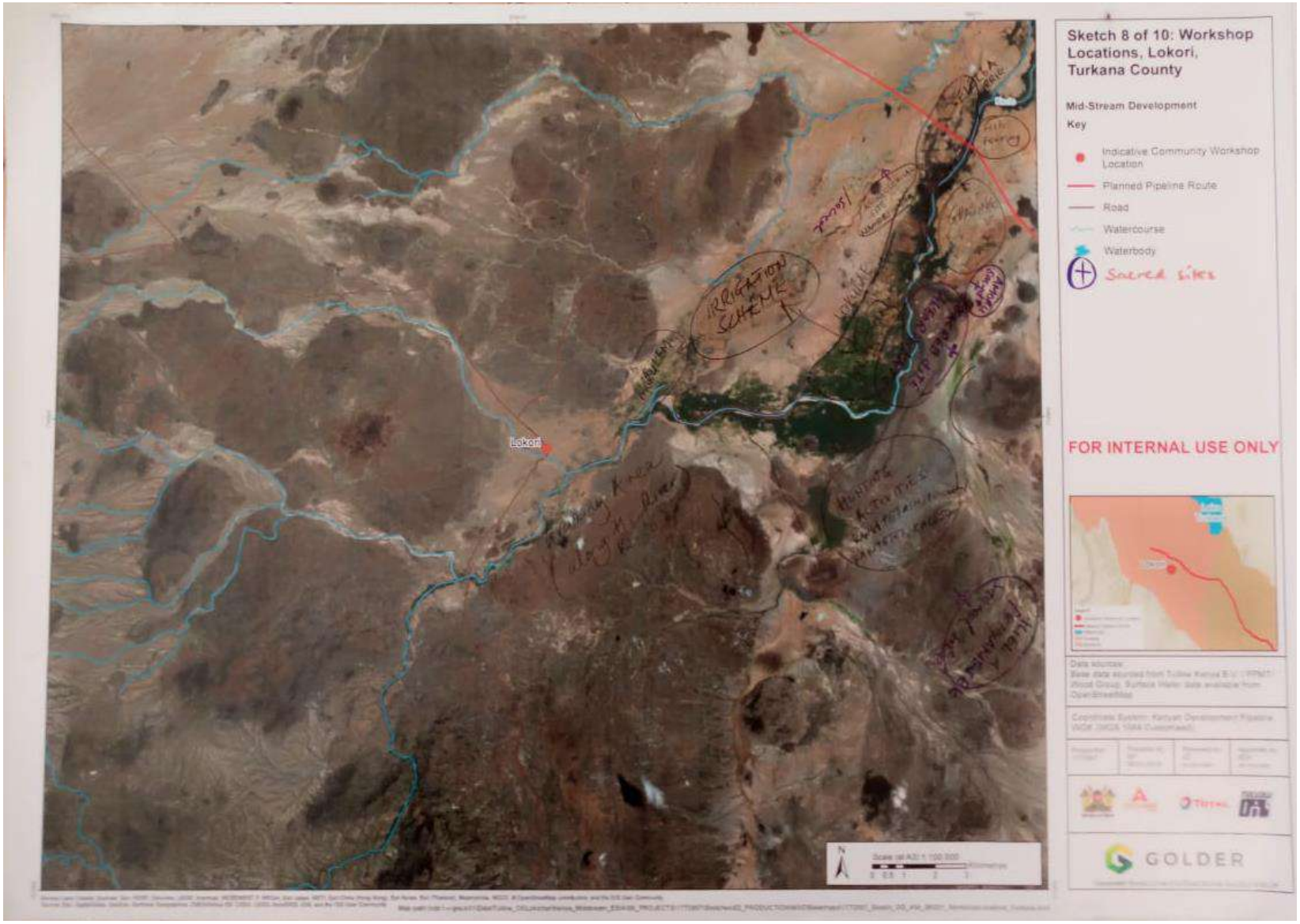

Figure 2: Turkana Land Use Map

2.1.5.4 Data Entry and Analysis

Minutes of focus group discussions and interviews with key individuals were recorded by hand in the language of input (Swahili and English) and reviewed by Regional Coordinators. Regional Coordinators photographed notes and emailed the notes to consultants in Kenya, who provided typed copies to report authors. Land Use maps were photographed and provided to authors. provided to authors.

Quality control procedures included:

- Ttraining of the Kenyan team members to understand the Project, data collection objectives, and methods used to collect and record;
- Interview and focus group guides were adjusted in the training session and were also adjusted in the field as necessary;
- The results were reviewed nightly by Regional Coordinators to confirm that data collection instruments and data entry procedures were being effectively implemented; and,
- After the data collection programme the notes were reviewed by Environnementalistes Sans Frontiers (ESF) staff before finalisation.

Limitations to the data collection process included the following:

- Size of the AOI: in some cases, sub populations (i.e., women) are too small to be considered representative. Efforts were made to include people that could speak generally and with authority on a given topic to give confidence to authors that the information provided is accurate and reasonably representative. The option to add additional focus groups to get further coverage on topics met a few barriers: in some places, consultation fatigue was apparent, and participation was less than enthusiastic. In a number of places, people expected to be compensated for their time to contribute in the focus group discussions. While it was not possible to compensate people in cash, beverages and transportation costs/reimbursements were provided.
- Security issues at times prevented the team from gathering data at Nakukulas in Turkana and in Bodhei Junction in Lamu and Bodhei in Garissa south.
- Discussion with the Awer people of Lamu County was not undertaken for this baseline report; a special study was undertaken to understand impacts to this group prior to completion of the ESIA.
- Mapping exercises, while important to be able to determine direct effects from construction and pipeline operations, was not successful with all focus groups. The number of maps necessary for a long pipeline and the difficulty in orienting focus groups participants so they could point to areas of activity or use, only provided limited data and information. Collaboration with other disciplines (i.e. archaeology) that were walking the area of the pipeline helped to fill some gaps in information on important water points, travel routes and crossings, sacred and important tangible culture and markets.

Nevertheless, the data presented are considered to be accurate reflections of the existing socio-economic conditions of the six counties and AoI communities.

2.2 National Context

The Republic of Kenya (Kenya) has a total population of 49.7 million people, an increase of 30.4% from a decade earlier (38.1 million) (World Bank DataBank 2018). The country is a youthful nation with over half (50.1%) of the

total population below 18 years of age and almost 79% of the population under the age of 35 (KNBS 2009; ITA 2017). Kenya is predominantly rural but is urbanising quickly. In 2017, 26.6% of Kenyans lived in cities with an annual urban population growth of around 4.4% in the last decade (World Bank DataBank 2018). Half of Kenya is expected to reside in urban areas by 2033 (World Bank 2011a). Kenya is a diverse nation with over 40 ethnic groups (also known as "*tribes*"[1]) that are distinguished by two major language groups, Bantu and Nilotic. It is a prominent member of the East African Community (EAC) and is generally considered the economic, commercial, financial and logistics hub of East Africa (ITA 2017).

Government

After independence in 1967, Kenya was characterised by a centralisation of political and economic power that resulted in uneven and unfair distribution of resources and access to social services (World Bank 2012). The 1963 Constitution provided for a system of devolution now referred to as *majimbo* that called for the discharge of a third of the central government's functions in the regions through regional authorities with elected assemblies (The Star 2013; World Bank 2011b). This attempt at devolution was weakened and ultimately abolished in 1964 and replaced by provincial and district administrations. Local authorities were assigned administratively instead of under constitutional authority. From the 1960s to 1980s, political and economic power was further centralised and local government powers were eroded. While Sessional Paper 12 included proposals to strengthen local powers, the *Transfer of Functions Act* in 1969 weakened local governments by transferring many of local government functions and their main sources of revenue, back to the central government (World Bank 2011b). Constitutional amendments in 1982 concentrated powers further and vehicles intended for involving local people in development became vehicles for presidential political patronage. This further undermined local governments and resulted in little meaningful economic redistribution. Piecemeal decentralisation efforts occurred between 1999 to 2010 such as the creation of the Local Authority Transfer Fund, the Road Maintenance Levy Fund, the Rural Electrification Fund, and the Constituency Development Fund. These funds were implemented to address inequality in resource distribution but political tensions persisted. The 2007-2008 election crisis which lead to violent clashes, was the tipping point that led to demands for a new constitution and expectations of greater democracy. The country passed a new constitution in 2010 that made significant reforms to address government accountability and transparency by increasing separation of power with two levels of government at the national and county levels. The 2010 constitution entrenched a devolved government by guaranteeing minimal unconditional transfer of power of key services and resources to newly formed counties (World Bank 2012).

Although devolution is generally viewed positively by the majority of the population, with 77% of Kenyan's supporting the new model, future conflict could still arise especially in the Rift Valley counties which have a history of violence along ethnic and sub-ethnic lines (Crisis Group 2017). Devolution has had benefits of bringing resources and development at the local level to counties that have traditionally been marginalised from national politics (The Conversation 2018a). Ongoing challenges have been the failure to devolve land administrative functions and resolve land issues upon which conflict can arise. Drivers of land-based conflict still remain and devolution has increased a sense of 'ownership' on the part of ethnic majority communities and their demands for land redistribution. Constraints on devolution mirror the constraints at the national level with issues such as corruption, lack of resources and ethnic politics (The Conversation 2018a). The devolution dynamic is an integral part of understanding the relationship between counties and the national government and roles and responsibilities are still being clarified and delineated today.

1 This is a disputed term without precise analytical meaning. The preferred term is "ethnic groups" or simply "people".

Administration

Kenya is divided into 47 counties which are administered by elected governors, replacing the previously appointed provincial administration executives (Crisis Group 2017). Counties are divided into Constituencies that are then subdivided into Divisions, Locations and Sub-locations. Each Constituency is represented by one Member of Parliament who sits in the National Assembly (Parliament of Kenya 2018). Constituencies are also divided into electoral wards with each ward represented by a Member of County Assembly (MCA) who sit in the County Assembly (KLRC 2018). Of the 47 counties, Nairobi County has the largest population (3,138,369) and Marsabit County covers the largest area (70,961 km^2) (KNBS 2009; County Government of Marsabit 2018).

2.2.1 National Economy

2.2.1.1 Gross Domestic Product and Macro-Economic Performance

The World Bank classifies Kenya as a lower-middle income[2] country (World Bank 2017a, World Bank 2018a). In 2017, Kenya had a Gross National Income (GNI) per capita of $1,440 USD per capita, a 34.6% increase from 2012 ($1,070 USD) (World Development Indicators 2018). Kenya is East Africa's second largest economy and is the eighth-largest economy in Africa overall. Since 2014, the country has accounted for an average of 18% of regional output growth (AFDB 2018). Kenya has had long-standing macroeconomic stability although it faces potential challenges with continued subdued credit growth to the private sector and negative spillovers from the global economy caused by tighter financial market conditions and global trade tensions (World Bank Group 2018).

Kenya's Real Gross Domestic Product (GDP)[3] has been high with annual growth averaging 5.4% in the last five years (World Bank Group 2018). In 2017 Kenya had a constant GDP of $58.1 billion USD[4], an increase of 31.0% from 2012 ($47.0 billion USD) and a 63.1% increase from 2007 ($35.6 billion USD) (World Bank Group 2018). Government spending and the public sector have been the key driver of growth in recent years while private sector investment has waned. More recently, Kenya's economy slowed to a real GDP growth of 4.9% in 2017 due to multiple factors that weighed down economic activities. These included drought conditions which negatively impacted agricultural output[5], credit growth slowdown, and election-induced uncertainty. Real GDP growth is expected to recover in the medium term to 6.1% by 2020 due to the impact of improved rains on agricultural output and the dissipation of political uncertainty (World Bank Group 2018). The World Bank projects that these factors will support a rebound in business sentiment as well as a broad-based recovery in private investment.

Kenya has a market-based economy that is dominated by the agricultural sector. The largest industry contributors to the GDP between 2011 and 2017 were the tertiary industries followed by primary and secondary industries. The largest individual sector remains agriculture, forestry, fishing and hunting, which contributes a third of the GDP (Table 2). This sector has grown over the last decade by 32.9% from 9.7 billion USD to 12.9 billion USD[6] (Table 3). Vision 2030 identifies agriculture as one of the key sectors identified to deliver 10% annual economic growth. It requires strategies to transform the subsistence farms to commercially-oriented profitable enterprises. Financing, real estate and business services followed by other tertiary services are the second and third largest contributors to the country's GDP, representing 14.9% and 14.3%, respectively.

2 a country with a Gross National Income (GNI) per capita between $1,006-3,955 USD.
3 Inflation adjusted measure that reflects the value of all goods and services provided by an economy in a given year, expressed in base-year prices and is often referred to as "constant-price" GDP
4 in constant 2010 dollars
5 Agriculture is Kenya's largest sector.
6 in constant 2010 dollars

Table 2: GDP by Sector (Percentage of GDP at Current Prices)

Sector	2011	2016	2017	% Change 2011 to 2017
Agriculture, forestry, fishing and hunting	29.3	35.6	31.5	7.5%
Mining and quarrying	1.0	0.9	0.8	-20.0%
Primary subtotal	*30.3*	*36.5*	*32.3*	*6.6%*
Manufacturing	13.1	10.0	8.4	-35.9%
Electricity, gas and water	2.1	2.6	2.5	19.0%
Construction	4.9	5.5	5.8	18.4%
Secondary Industries Subtotal	*20.1*	*18.1*	*16.7*	*-16.9%*
Wholesale and retail trade, repair of vehicles, household goods; restaurants and hotels	10.5	8.7	8.4	-20.0%
Transport, storage and communication	9.8	9.6	9.1	-7.1%
Finance, real estate and business services	15.2	14.7	14.9	-2.0%
Public administration and defence, security	4.7	4.4	4.3	-8.5%
Other services[(a)]	9.4	7.9	14.3	52.1%
Tertiary industries subtotal	*49.6*	*45.3*	*51.0*	*2.8%*
GDP at basic prices/factor cost	100	100	100	n/a

Source: AFDB 2018

[(a)] *Other services include education, health and social work and other services*

Table 3: Gross Domestic Product by Industry, millions in constant 2010 USD

Sector	2007	2009	2011	2013	2015	2017	% Change 2007 to 2017
Agriculture, forestry, fishing and hunting[(a)]	9,720.3	9,023.7	10,165.2	11,047.3	12,145.7	12,921.4	32.9%
Industry (including construction) [(b)]	6,586.9	6,827.1	7,957.4	8,731.9	9,936.2	10,879.7	65.2%
Manufacturing[(c)]	4,304.8	4,308.1	4,828.3	5,070.2	5,385.0	5,540.0	28.7%

Sector	2007	2009	2011	2013	2015	2017	% Change 2007 to 2017
Services[(d)]	16,336.2	17,870.6	20,437.1	22,613.8	25,570.4	28,921.1	77.0%
Total	**36,948.2**	**38,029.5**	**43,388.0**	**47,463.2**	**53,037.3**	**58,262.2**	**57.7%**

Source: AFDB 2018

[(a)] Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3 or 4.

[(b)] Industry corresponds to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37). It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3.

[(c)] Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are expressed constant 2010 U.S. dollars.

[(d)] Services correspond to ISIC divisions 50-99. They include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3 or 4.

Tourism is part of the tertiary industry and is a growing sector that has become the second-largest foreign exchange earner in the country (Oxford Business Group 2017). In 2017, this sector directly[7] contributed $2.8 billion USD or 3.7% of total GDP. The total[8] contribution of this sector in 2017 was $7.4 billion USD or 9.7% of GDP (World Travel and Tourism Council 2018). The tourism sector has been recovering since a period of decline influenced by perceived insecurity and travel advisories from Western countries. The country's National Tourism Blueprint 2030 aims to transform this sector by dealing with all components of the value chain to create a comprehensive set of offerings that will increase visitor numbers (Oxford Business Group 2018). By 2028, direct contributions from tourism is projected to be $4.9 billion USD and total contribution an estimated $12.9 billion (World Travel and Tourism Council 2017, 2018). The country's numerous parks and reserves, cultural and historic attractions, and 500 km of coastline offers broad appeal for tourists and play an important role in employment and earnings (Oxford Business Group 2018).

Although Kenya is one of the most industrially developed countries in East Africa, manufacturing accounts for less than 10% of its GDP. This is likely because Kenya's key exports such as tea, coffee and floriculture require little to no processing (ITA 2017). The resource extraction industry (which includes mining and quarrying and will include oil extraction) is a small contributor to Kenya's GDP but is expected to grow as development of Kenya's emerging oil industry could eventually generate $1.2 billion USD annually (The Star 2018).

7 GDP generated by industries that deal directly with tourists, including airlines and other passenger transport services, hotels, travel agents, and activities of restaurant and leisure activities that deal directly with tourists.
8 GDP generated directly by travel and tourism sector plus indirect and induced impacts

2.2.1.2 Inflation and exchange rate

Inflation in Kenya has fluctuated in the last five years but has remained mostly within the upper target range of 7.5% with the exception of a spike in 2017 (Business Daily Africa 2018a; KNBS 2018a) (Table 4). The spike was due to food shortages and a sharp increase in food prices related to the severe drought in Kenya. The drought caused agricultural output to decline from a historical average of 1.2 percentage points to 0.2 percentage points for the first three quarters of 2017. Growth in this sector was the lowest since 2009, dropping from 5.0% to 0.8% for the first three quarters, indicating the severity of the drought (World Bank Group 2018). Inflationary pressures eased once improved rains brought relief. In addition, the introduction of government food subsidies also played a role in easing inflation. The average inflation for the first few months of 2018 fell to 4.2% which is more consistent with an economy where demand pressures are still low. (World Bank Group 2018).

Table 4: Inflation Rate (Consumer Price Index, annual variation in %)

Indicator	2013	2014	2015	2016	2017	2018 (average from Jan-Apr)
Inflation Rate	5.7	6.9	6.6	6.3	8.0	4.3

Source: KNBS 2018a

The currency used in Kenya is the Kenyan Shilling (KSh). The value of the KSh against the American Dollar has depreciated in the last five years from a high of 86 KSh to 1 USD in 2013 but has stabilised to approximately 102 KSh to 1 USD in the last two years due to remittances from Kenya's diaspora, tea and horticultural exports, and recovery in the tourism sector (Focus Economics 2018; Central Bank of Kenya 2017).

2.2.1.3 Government Revenue and Expenditure

While government revenue has been rising in Kenya, expenditures have been rapidly outpacing revenue, resulting in a widening budget deficit. This was due to the implementation of an expansionary fiscal policy that began in fiscal year (FY) 2013/2014. (Table 5; Figure 3). This policy was driven by the implementation of the 2010 Constitution, execution of large-scale infrastructure projects[9], increased minimum wages (Refer to Section 2.3.1.6 for details) and interest payment, and transitional factors in FY 2016/2017 (i.e. elections, drought mitigation) (World Bank Group 2018). Total expenditure has increased due to this policy, rising from 23.7% of the GDP in FY 2011/2012 (2.4 billion KSh) to 27.6% of GDP in FY 2016/2017 (12.1 billion KSh) (Central Bank of Kenya 2018).

Despite GDP growth, tax revenues have not kept pace and the fiscal deficit has correspondingly risen, doubling from 4.5% of GDP in FY 2011/2012 to 8.9 % of GDP in 2016/2017 (3.3 billion KSh). External debt has also increased, with an external debt of $49 billion USD or 56.4% of the country's GDP rising from 42.8% in 2008 (The Conversation 2018b). Debt repayments in 2018 will take up as much as 45% of total tax revenue (Business Daily Africa 2018b). To address these elevated fiscal deficit levels, the Government of Kenya has begun fiscal consolidation in 2017/2018 in order to maintain macroeconomic stability and accelerate the country's growth. Kenya has done so by slowing the pace of development spending.

9 Such as the construction of the Standard Gauge Railway project, Jomo Kenyatta International Airport, and new highways throughout the country.

Table 5: Total Kenyan Government Revenue and Expenditure (million Kenyan Shillings)

Indicator	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	% Change from 2007 to 2017
Revenue	2,356,246	2,746,087	3,103,626	3,517,417	3,952,304	4,218,180	5,114,800	6,122,021	6,856,520	7,673,353	8,728,072	270.4
Expenditure	2,619,176	3,197,175	3,685,523	4,533,756	4,936,810	5,903,191	6,776,750	6,899,040	9,207,902	10,368,132	12,103,882	362.1
Budget Balance	-262,930	-451,088	-581,897	-1,016,339	-984,506	-1,685,011	-1,661,950	-777,019	-2,351,382	-2,694,779	-3,375,810	1,183.9

Source: Central Bank of Kenya 2018

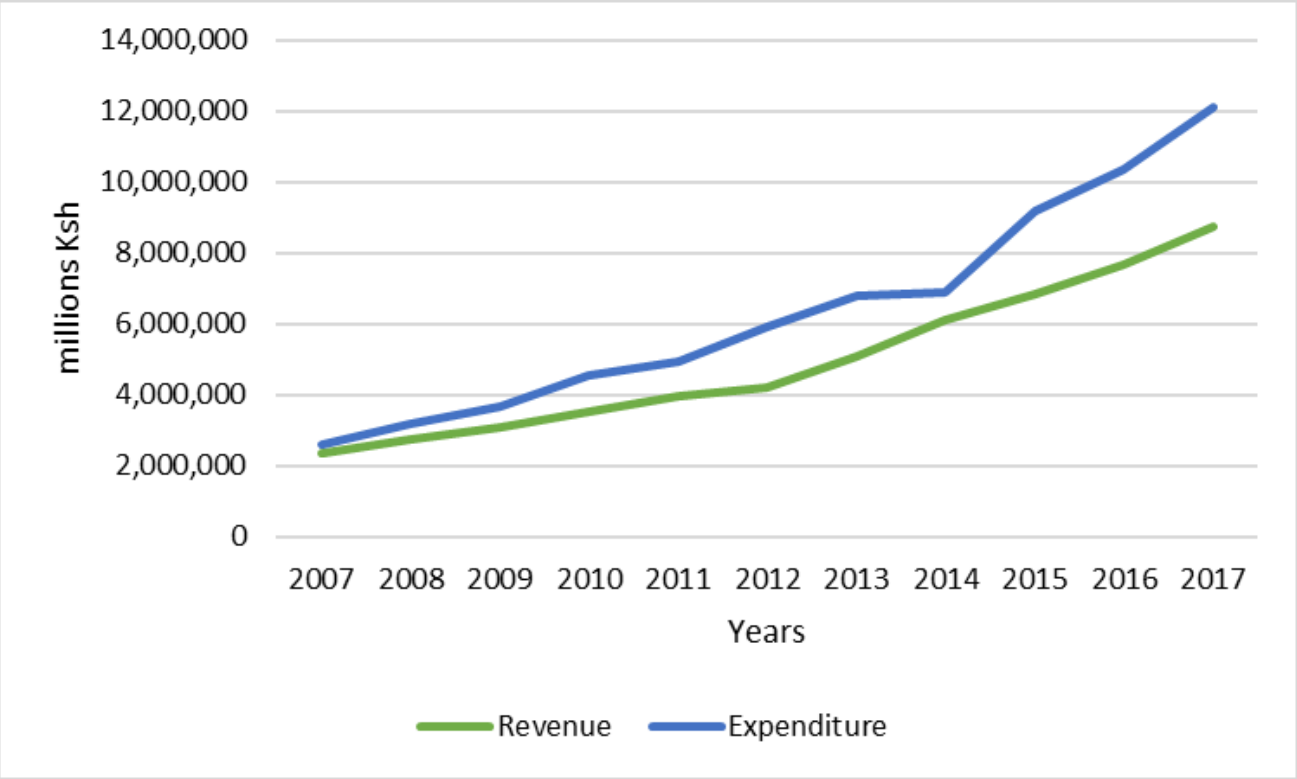

Figure 3: Kenyan Government Revenue and Expenditures

2.2.1.4 Exports and Imports, Balance of Payments,

As the largest industry in Kenya, agriculture and agricultural products play a central role in Kenya's export industry. Agricultural products are the largest commodity export, providing 55.8% of all exports (World Trade Organisation 2017). The most prominent agricultural products are tea ($1.09 billion), cut flowers ($673 million), and coffee ($219 million) (OEC 2017). Kenya has a diverse group of trading partners and strong ties to Africa, Asia, and Europe. Approximately 45% of the country's exports by value are to other African nations, mainly other East African states. Kenya's top exporting partner in 2017 was the European Union (20.9% of total exports) followed by Uganda (10.8% of total exports), and Pakistan (10.6%) (European Commission 2018). Kenya's exports have fluctuated in the last decade and averaged $9.1 billion over the last 10 years. In 2017, Kenya exported a total of $9.7 billion USD[10] in goods and services, a 23.7% increase from a decade earlier when exports totalled $7.8 billion (World Bank 2018a).

Without its own oil resources until recently, Kenya's major imports center around petroleum. The top imported products include petroleum oils, ($3.2 billion), crude palm oil (496 million), and petroleum oils and oils obtained from bitumen ($476 million) (WITS 2013). China, European Union and India are Kenya's largest import partners, accounting for 17.2%, 14.6%, and 7.6% of total imports, respectively (European Commission 2018). China in particular has risen in the last five years to become Kenya's number one import source, increasing its share of Kenya's imports from 12.9% to 17.2%. In 2017, Kenya imported a total of $18.1 billion USD[11] in goods and services, a 77.7% increase from a decade earlier when imports totalled $10.2 billion (World Bank 2018a).

Kenya has a negative balance of trade that has grown by 258.6% in the last decade from 2.3 billion USD to 8.4 billion. This is mainly due to the increasing exports from China in the last five years. Factors propelling the

10 Constant 2010 dollars.

11 Constant 2010 dollars.

growth of Chinese imports include the inexpensive pricing of Chinese goods, aggressive marketing of goods and services, and construction imports from the Standard Gauge Railway infrastructure project (Standard Media 2018a). Table 6 presents the historical data on imports and exports in Kenya.

Table 6: Historical Data on Imports and Exports (Constant 2010 USD, millions)

Indicator	2007	2009	2011	2013	2015	2017	% Change
Imports	10,167.6	12,420.3	15,205.6	15,925.3	17,784.2	18,063.6	77.7
Exports	7,831.0	7,598.4	9,023.8	9,427.5	10,596.8	9,683.6	23.7
Balance of Trade	-2,336.60	-4,821.90	-6,181.80	-6,497.80	-7,187.40	-8,380.00	258.6

Source: World Bank 2018a

Kenya has a negative Balance of Payments[12], indicating that it does not produce sufficient economic output to pay for its growth. Kenya has had a deficit in its balance of payments for the last decade that has widened over the years (Table 7). Diversification away from Kenya's largest exports, agriculture, has been limited and growth in this and other sectors have not been enough to offset the deficit in the merchandise or goods account[13].

Table 7: 12 Months Cumulative Balance of Payments (USD $ million)

Indicator	2007	2009	2011	2013	2015	2017 (nov)
A. Current Account, n.i.e	-796	-1,713	-3,821	-4,838	-4,322	-5157
merchandise A/C	-4222	-4,952	-8,355	-10,243	-9577	-10,243
Goods: exports f.o.b	4,153	4,526	5,834	5,846	5,985	5,770
Goods: imports f.o.b	8,375	9,479	14,189	16,089	15,563	16,013
Oil	1,919	2,192	4,082	3,838	2,500	2,654
Services	1,263	1,084	1,994	2,926	2,329	1,679
Services: credit	2,938	2,904	4,131	5,130	4,496	5,024
Services: debit	1,675	1,820	2,138	2,204	2,167	3,345
Income	2,162	2,156	2,540	2,479	2,795	3,407
B: Capital Account, n.i.e	157	261	235	158	257	223
C. Financial Account, n.i.e	-2,247	-3,782	-3425	-5,183	-5,070	-5,916
Direct investment: net	-1,001	-1,452	-1364	-920	-1,088	-360.6

12 Summary statement of a country's transactions with the rest of the world through trade in goods, services, and finance. It consists of two parts, 1) current account and 2) capital and financial account.

13 At regional level and within East African Countries, it is worth noting that the Kenyan economy has shown to be resilient, and enough diversified to overcome external shocks on exports (Central Bank of Kenya 2017).

Indicator	2007	2009	2011	2013	2015	2017 (nov)
Portfolio investment: net	16	-81	1	-273	156	929.6
Financial derivatives: net	0	0	0	0	0	0
Other investment: net	-1,262	-2,249	-2062	-3,990	-4139	-6,484.8
D: Net Errors and Omissions	-805	-1,215	-734	-134	-1,260	-1,861
E: Overall Balance	-802	-1,115	896	-369	255	880
F: Reserves and Related Items	802	1,115	-896	369	-255	-880
Reserve assets	941	1,322	246	859	-361	-953
Credit and loans from the IMF	116	199	284	177	-107	-73
Exceptional financing	23	8	858	312	0	0
Gross Reserves (USD Million)	4,557	5,064	6,045	8,483	9,794	8,971
Official	3,355	3,847	4,248	6,560	7,534	6,657
Commercial Banks	1,202	1,217	1,797	1,923	2,259	2,314
Imports cover (36 months import)	4.4	3.9	3.4	4.3	4.8	4.5
Memo:						
Annual GDP at Current prices (USD Million)	31,958	37,022	41,953	55,101	63,767	78,948

Source: World Bank Group 2018

2.2.1.5 Employment

Employment in Kenya has been strong with a growing labour force and decreasing unemployment. In 2015/16, an estimated 25.0 million in Kenya were between the ages of 15 and 64, an increase of 25.6% from a decade earlier (KNBS 2018a). The number of employed individuals has also risen by 40.9% while the number unemployed has fallen by 26.3% during the same period from 1.9 million to 1.4 million (Table 8). The majority of workers were engaged in full-time employment, making up almost two-thirds (63.2%) of employment. The remainder of workers were seasonal workers[14], casual workers[15] and part-time workers[16] (KNBS 2018b) (Figure 4). Of note, females accounted for 61.9% of part-time workers.

14 Such as tourism, planting, and coffee picking
15 Persons whose terms of employment provide for payment at the end of each day and who are not engaged for a period longer than 90 days (KNBS 2018b)
16 Those who worked less than 35 hours a week

Table 8: Historical Employment Indicators for the Population Aged 15-64 (in millions)

Indicator		2005/06	2009	2015/16	Percentage Change From 2005/2006
Base Population		19.9	20.5	25.0	25.6
Labour Force	Total Labour Force	14.6	15.8	19.3	32.2
	Employed	12.7	14.2	17.9	40.9
	Unemployed	1.9	1.5	1.4	-26.3
Economically Inactive		5.3	4.7	5.6	5.7

Source: KNBS 2018b

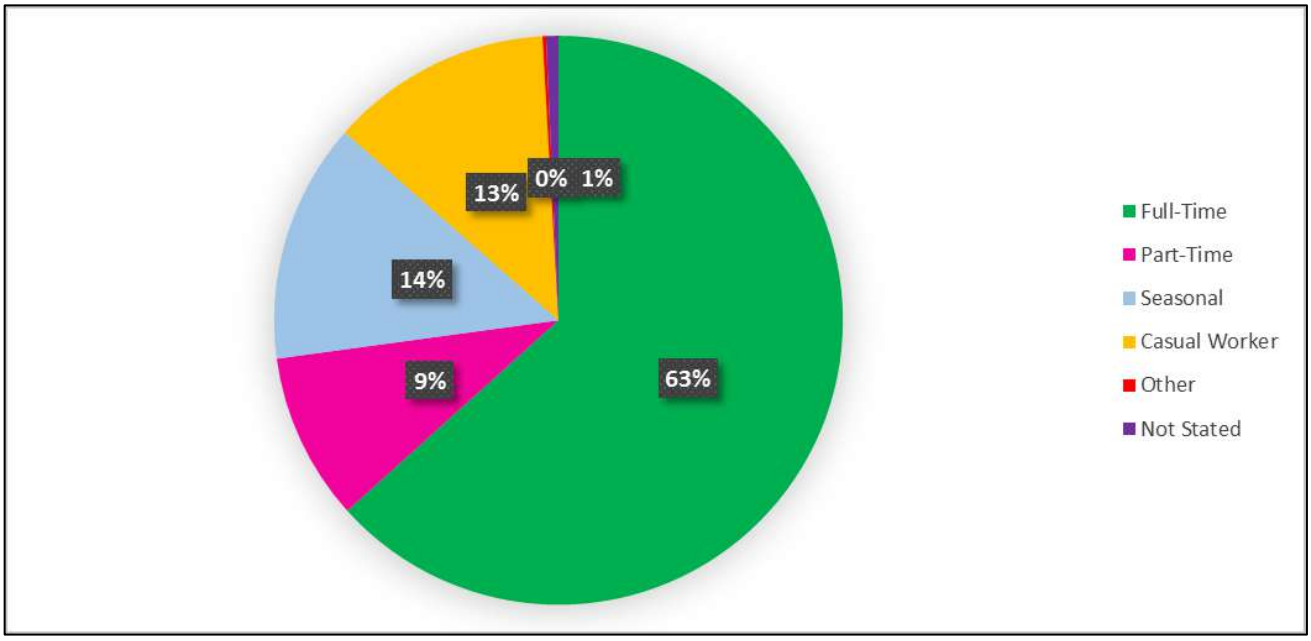

Figure 4: Working Patterns of Population in 2015/16 (Aged 15-64)

Source: KNBS 2018b

Employment in Kenya roughly corresponds with the size of each economic sector (Section 2.3.1.1). The service[17] sector is the country's largest employer, followed by agriculture[18] and industry[19]. The service sector employs nearly half of the population (48%) with agriculture employing approximately 40% (FAO 2018). The industry sector employs the smallest proportion with around 15% of the population. The national participation rate of those 15 and over in 2017 was 65.4%, a marginal increase of 0.2% from a decade earlier (Table 9) (World Bank DataBank 2018). Male participation was higher than female participation in the labour force although the gap has shrunk as male participation decreased by 2.1% during the last decade while female participation increased by 2.8%. Unemployment in Kenya has remained relatively stable in the last decade and has been declining incrementally since 2011 (Table 10). In 2007, total unemployment was 10.8% and has hovered near 12% in the years since. Male unemployment is nearly half of female unemployment. In 2017, Kenya had an unemployment rate of 11.5% (World Bank DataBank 2018).

17 Wholesale and retail trade and restaurants and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services
18 Activities in agriculture, hunting, forestry and fishing
19 mining and quarrying, manufacturing, construction, and public utilities (electricity, gas, and water).

Table 9: Labour Indicators in Kenya (International Labour Organisation Modelling Estimates)

Indicator	2007	2009	2011	2013	2015	2017	% Change from 2007 to 2017
Participation Rate							
Male	70.0	70.5	70.4	69.7	68.9	68.5	-2.1
Female	60.7	61.3	61.8	62.1	62.4	62.4	2.8
Total	**65.3**	**65.8**	**66.0**	**65.8**	**65.6**	**65.4**	**0.2**
Unemployment Rate							
Male	7.7	8.7	8.5	8.2	8.1	7.9	2.6%
Female	14.3	16.1	15.9	15.6	15.4	15.3	7.0%
Total	**10.8**	**12.2**	**12.0**	**11.8**	**11.6**	**11.5**	**6.5%**

Source: World Bank DataBank 2018

Participation Rate: % of total population aged 15 and over

Table 10 presents information on the distribution of working age population (aged 15-64) between rural and urban. The employment ratio[20] has risen for the country and for the urban and rural populations between 2009 and 2015/16 indicating that a larger proportion of the population in the working age category is employed (KNBS 2018c). A breakdown of other detailed employment indicators (i.e. participation rates, unemployment rates) for the urban and rural populations was not available.

Table 10: Distribution of Working Age Population (15-64) by Employment, 2009 KPHC and 2015/16 KIHBS

	Population ('000)	Employed ('000)	Employment Ratio 2009 KPHC	Employment Ratio 2015/2016 KIHBS
Rural	14,796.1	10,826.0	70.7	73.2
Urban	10,159.5	7,049.6	66.8	69.4
Kenya	24,955.5	17,875.7	69.3	71.6

Source: KNBS 2018c

Employment in Kenya can also be categorised by work in the formal[21] or informal sectors[22]. In 2017, Kenya's informal sector employed 14.1 million people, over five times the size of its formal sector, which employed over 2.7 million people (KNBS 2018c). Employment in the informal sector is also more common in rural areas with an estimated 9 million people, close to double the number found in urban areas. Both formal and informal sectors experienced growth between 2013 and 2017, with the number employed in the formal sector rising by 16.4% and the number employed in the informal sector rising by 26.4% (KNBS 2018c). The informal sector has expanded over the years to also include manufacturing activities and information, communication and technology activities (KNBS 2018c).

20 An indicator used to evaluate the ability of the economy to create jobs
21 Includes public and private sector
22 characterized by small-scale activities, easy entry and exit due to fewer regulations, skills from vocational institutions, less capital investment, limited job security and self-employment

Table 11: Wage Employment by Sector ('000)

Sector	2013	2014	2015	2016	2017	Percentage Change
Formal Sector						
Private	1,599.8	1,669.4	1,759.6	1,817.2	1,866.4	16.7
Public	683.3	700.8	718.4	736.3	790.2	15.6
Formal Sector Employment Total	**2,283.1**	**2,370.2**	**2,478.0**	**2,553.5**	**2,656.6**	**16.4**
Informal Sector						
Urban	3,973.7	4,208.1	4,458.0	4,709.9	4,999.8	25.8
Rural	7,176.4	7,637.9	8,104.4	8,599.8	9,097.7	26.8
Informal Sector Employment Total	**11,150.1**	**11,846.0**	**12,562.4**	**13,309.7**	**14,097.5**	**26.4**

Source: KNBS 2018c

Data on the magnitude of pastoral systems in Kenya is scant as there is no common standard of measurement (IUAES Commission on Nomadic Peoples 2014). Data from the decennial Kenya Bureau of Statistics does not disaggregate information on pastoral producers and did not cover northern Kenya (where most pastoralist districts are located) until 2003. Without accurate data, an understanding of the number of pastoralists and magnitude of pastoral systems in Kenya is extremely difficult to ascertain. Livestock holdings are substantially under represented and pastoral mobility is poorly captured especially in relation to livestock production (IUAES Commission on Nomadic Peoples 2014). An estimate of four data sets ranging from 2006-2013 estimated conservatively that the minimum pastoral population of Kenya may be approximately 10% of the national population of 40 million, or 13% of a rural population of 28 million (IUAES Commission on Nomadic Peoples 2014). Pastoralism is discussed in greater detail in the individual county sections (Section 2.4).

2.2.1.6 Minimum Wage

Minimum wage in Kenya is mandated by the *Regulations of Wages and Conditions of Employment Act* which was amended in 2017. There is no standard minimum wage across Kenya as minimum wage is dependent on the region and occupation (Wage Indicator 2018). Wages are higher in more urban areas with the highest minimum wages in cities, followed by municipalities and town councils[23] and lowest in all other areas. Occupations requiring more specialised skills generally have higher minimum wages with Grade I Artisans having the highest minimum wage in all geographic locations[24]. In cities, the minimum wage is 262.8 KSh/hour, 248.2/hour in municipalities and town councils, and 231.5 KSh/hour in all other areas. While unskilled occupations have the lowest minimum wages, it is considerably higher in the city compared to the non-city areas (115.5 KSh per hour in the city compared to 64.6 KSh in all other areas) (Wage Indicator 2018). To address inflation, the minimum wage was increased by 18%[25] in 2017 for low income earners and an additional 5% in

23 These include: Cities (Nairobi, Mombasa and Kisumu); Municipalities; Mavoko Town Council, Riuru Town Council, and Limuru Town Council
24 In cities, cashiers, heavy commercial vehicle drivers, salesmen-drivers also have the highest minimum wage.
25 Non-taxable bonuses and overtime was increased to 100,000 Ksh.

2018 (Standard Media 2018b). A list of minimum wages in Kenya by Occupation and Region as of 2018 can be found in Appendix C.

2.2.2 Social Context

In the early 2000s, the Government of Kenya achieved sustained economic growth. Notable initiatives such as free primary education, improved health services and infrastructure developments were implemented (World Bank 2016). With an improving macroeconomic performance and implementation of social initiatives, Kenya's Human Development Index (HDI)[26] has been steadily increasing over the years. In 2000, the country's HDI was 0.451, rising to 0.543 in 2010 and 0.590 in 2017, for an increase of 26.1% in 17 years (UNDP 2018a, b). Between 2010 and 2017, average annual HDI growth has been 1.18% (UNDP 2018c). By 2017, Kenya is now considered in the medium human development category, ranked 142 out of 189 countries and territories in the world. The rise in Kenya's HDI between 2010 and 2017 has been propelled by increases in life expectancy at birth (by 9.8 years), mean years of schooling (by 2.8 years), expected years of schooling (by 3.0 years) and GNI per capita (28.9%) (UNDP 2018b). Kenya's 2017 rank (0.590) is below the 0.645 average for countries in the medium human development group but above the average of countries in Sub-Saharan Africa (0.537) (UNDP 2018b).

2.2.2.1 Poverty Rates

Basic welfare of Kenyans has shown significant improvements in the last decade, with overall national poverty headcount rate declining from 48.6% in 2005/2006 to 36.1% in 2015/2016 (KNBS 2018d). The total population of poor individuals in this period declined from 16.6 million to 16.4 million during which the total national population increased by approximately 10 million. Poverty in Kenya is below the average in sub-Saharan Africa and is amongst the lowest in the EAC (World Bank Group 2018). Kenya's Gini Coefficient or Gini Index[27], often used as a measurement of inequality in income distribution, has also been decreasing over the years but still reflects a high level of inequality. In 1992, the Gini index for Kenya was 57.5, falling to 48.5 in 2005 and 40.8 in 2015. Poverty in Kenya is more prevalent in rural areas than urban areas (Table 12). About 40% of individuals in rural areas live in poverty, which is about 10 percentage points higher than individuals living in peri-urban and core-urban areas (KNBS 2018d). Hardcore, or extreme poverty is also more prevalent in rural areas with a rate of 11.2% for rural areas, which is nearly double the rate for peri-urban and nearly four times the rate for core-urban areas.

Although progress has been made, inequality remains a major issue in Kenya with exclusion and disadvantages based on class, ethnicity, gender, and geographic region (World Bank 2016). Nearly one-third of total income in the country is held by the top 10% and nearly half (47.5%) of total income in the country is held by the top 20% (UNSD 2018; World Bank 2017b). While poverty rates have moderately declined in Kenya from 2005 to 2015, almost two-thirds of the population are below USD $3.20 in 2011 Purchasing Power Parity (PPP) and one-third are below the international poverty line of $1.90 USD in 2011 PPP (Table 13). Poverty reduction has been fueled by increased consumption for the poorest in the country.

26 Human Development Index is an aggregate measure that assesses long-term progress in three dimensions of human development: 1) a long and health life as measured by life expectancy 2) access to knowledge as measured by mean years of education among the adult population and access to learning and knowledge by expected years of schooling for children of school-entry age, and 3) decent standard of living as measured by Gross National Income (GNI) per capita expressed in constant 2011 international dollars converted using purchasing power parity (PPP) conversion rates (UNDP 2018b)

27 "Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality." (World Bank 2017)

Table 12: Poverty Measures (2015/2016)

Indicator	Headcount Poverty Measures	Poor Individuals		Poor Households	
		% of Population	Number of people (thousands)	% of Population	Number of people (thousands)
National	Food Poverty	32.0	14,539	23.8	2,718
	Overall Poverty	36.1	16,401	27.4	3,126
	Hardcore Poverty	8.6	3,908	6.0	682
Rural	Food Poverty	35.8	10,419	28.1	1,808
	Overall Poverty	40.1	11,687	32.6	2,097
	Hardcore Poverty	11.2	3,273	8.7	560
Peri-Urban	Food Poverty	28.9	965	21.5	173
	Overall Poverty	27.5	920	21.1	166
	Hardcore Poverty	6.0	199	4.6	37
Core-Urban	Food Poverty	24.4	3,155	17.7	736
	Overall Poverty	29.4	3,795	20.6	880
	Hardcore Poverty	3.4	436	2.0	85

Source: KNBS 2018c

Table 13: Poverty Indicators (2005 and 2015)

Indicator	Poverty Headcount (%)		Poverty Gap (%)	
	2005	2015	2005	2015
US$ 1.25 - 2011 PPP poverty line	22.7	14.9	7.5	4.0
US$ 1.90 - 2011 PPP poverty line	43.6	35.6	16.1	11.3
US$ 3.20 - 2011 PPP poverty line	68.7	63.7	33.0	27.5

Source: World Bank 2015a

Note: PPP: Purchasing Power Parity

Like other countries in Africa, poverty in Kenya is concentrated in rural areas. Inequality in Kenya can be attributed to historical factors such as natural resource endowments, political patronage, and policy choices biased towards urban areas (World Bank 2015a). As a result, various ethnic groups and regions in Kenya have lagged behind in terms of political participation and access to resources for socioeconomic development. The World Bank identified the following key drivers of economic decline in rural Kenya as the following: 1) corruption

and/or collapse of formal institutions resulting in compromised service delivery 2) physical security and poor education issues 3) unequal land distribution system 4) impact of HIV/AIDS which places extreme burden and high dependency ratios on rural households to care for the sick[28] (World Bank 2015a).

The Government of Kenya has made efforts to improve access to basic services such as water, roads, health facilities, and electricity in marginalised areas. The Equalisation Fund is a national government fund which allocates 0.5% of all audited approved national revenues to improve services in marginalised areas to the level generally enjoyed by the rest of the nation (CRA Kenya 2018). While a previous marginalisation policy identified marginalised counties, the policy has moved towards identifying specific sub-locations to focus and maximise impacts. In 2017, the Government of Kenya ranked all sub-locations in the country and identified the bottom 20% (1,424 sub-locations out of 7,131) for revenue allocation (CRA Kenya 2018). Another government programme aimed at decreasing poverty are cash transfers which are part of the National Safety Net Program, which provides transfers to primary caregivers of orphans and vulnerable children in the four northern counties (Oxford Policy Management no date). By 2015, transfers reached 480,000 children in 240,000 households, improving overall consumption, resulting in 36% reduction in absolute poverty and an increase in short-term food and health expenditure (Centre for Global Development 2015).

2.2.2.2 Poverty Alleviation

The major source of poverty reduction in recent years has been growth in the agricultural sector. Most poor Kenyans are employed in the agricultural sector. From 2005 to 2015, households benefited the most from agriculture sector growth compared to other economic sectors, with a 2.2% decrease in the poverty rate for Kenyans living in a household engaged in agriculture (World Bank 2015a). The agricultural sector is highly vulnerable to shocks such as the shock in 2010 where agricultural growth slowed and poverty headcounts decreased by less than 1%.

The World Bank states that in order for Kenya to eradicate poverty by 2030, the country requires a combination of higher growth, more inclusive growth, and growth that is increasingly driven by the private sector that would translate to more rapid poverty reduction (World Bank Group 2018). Kenya aims to reduce its poverty rate below 3% by 2030 but based on its current annualised poverty reduction rate (1.8% between 2005 and 2015), it will not be on track to achieve this goal. Maintaining the current poverty reduction rate for the next 15 years would see Kenya with a poverty rate of 25% in 2030. Additional challenges for Kenya in poverty alleviation include factors such as climate risk, disparities in development among geographic regions, decline of private sector investment, and continued dependence on agricultural growth (The Borgen Project 2018; Hansen et al. 2018).

Based off the successes and experience of implementing a devolved system of government, the Government of Kenya has announced a new development agenda for the next five years on “the Big 4”, that will move the country towards a middle-income economy with a high standard of living. The development agenda, which aligns with Vision 2030 targets four priority areas: provide affordable housing; roll out universal health coverage; increase manufacturing; and improve food security (World Bank Group 2018).

2.2.2.3 Access to Health Clinics

Healthcare in Kenya is organised hierarchically with complicated cases referred to higher levels of healthcare (Ministry of Health 2014). The healthcare system consists of six levels (Community; Dispensaries; Health Centres; Primary referral facilities; Secondary referral facilities; and Tertiary referral facilities). In 2018, there are approximately 10,860 health facilities in Kenya of which 772 are hospitals (MOH 2018a). Hospitals in Kenya are classified according to the agency that owns the health facility. Such agencies include the government,

28 Although the prevalence of HIV/AIDs among the general population is lower in rural Kenya, the dependency ratio for rural households is higher (The Futures Group International 1999; National AIDS Control Council 2014).

which manages public health institutions, faith-based organisations (FBOs), non-governmental organisations (NGOs) and private investors. In 2016, 37.1% of health care facilities were privately run, for-profit institutions (Ministry of Health and WHO 2016).

Emergency or acute conditions are notable contributors to mortality (45%) and disability (35%) in low-income and middle-income countries. Access to emergency services is high with over 90% of the population living within two hours of a hospital (Ouma et al. 2018). This exceeds the international recommendation of 80% and is higher than most other African countries, including Ghana which has a similar GNI per capita ($1,490 to Kenya's $1,440), where only 82.5% live within two hours of a hospital.

Although overall emergency healthcare access is high, there are notable differences within the country between counties. Access to the health care services in the counties of Turkana, Wajir, Bomet, Narok, Manderaa, Tano River and Kwala are generally poorer than other counties with smaller health facility densities and budgets (Ministry of Health and WHO 2016). Health facility density is considered a crude indicator of access to outpatient services and is expressed as number of facilities per 10,00 population. While Kenya's Ministry of Health has increased health facility density from 1.9 per 10,000 population in 2013 to 2.2 per 10,000 in 2016, it has not achieved its target of 2.5 per 10,000 population (Ministry of Health and WHO 2016). Most health care facilities in Kenya are in urban areas where only 26% of the population live, indicating that access to health care is not equal for all citizens. In addition, there is major variation between healthcare budgets between counties with a variation of a low of 100 KSh per person per year in the counties of Laikipia, Bomet, Nyandarua, Migori, Kirinyaga and Kajiado compared to the high of 4,000 KSh in the counties of Lamu and 3,835 KSh in Isiolo.

Access to quality healthcare is a constitutional right in Kenya but in reality, millions of Kenyans cannot afford to pay for healthcare services. While public health insurance became available in 1966 only an estimated 20% of Kenyans have access to some sort of medical coverage (World Bank 2014). The Kenyan government launched the Health Insurance Subsidy Program (HISP) in 2014 which provides a subsidy for the country's poorest citizens to use inpatient and outpatient care at both public and private health facilities. The *Health Act, 2017* formalises collaboration between national and county governments and obliges the country to address the health needs of vulnerable groups and mandates provision of emergency and specialised care.

2.2.2.4 Access to Potable Water

Drinking water access at the national level has generally improved between 2000 and 2015, with an increase in the proportion of the national population having access to at least basic drinking water rising from 46% to 58% (WHO and UNICEF 2017). The proportion of the population drinking unimproved and surface water has decreased in this period at the national level and at the rural level (Table *). However, in the urban communities, the proportion of the population with access to at least basic drinking water has decreased (from 88% to 83%) and the proportion drinking surface water has increased (1% to 7%). The decline in access for urban communities has been attributed to the population boom that has taken place in Kenya's cities and towns that has occurred without the corresponding infrastructure development required to keep pace (Construction Review Online 2017a).

Little progress has been made in improving household access to improved sanitary facilities. Kenya had a target of having 75% of households with latrines by 2016 but progress has stagnated with only 52% of households having improved facilities, similar to 2008, 2010 and 2012 surveys. More urban households have access to improved sanitary facilities with 74% access, compared to rural households, with only 41% access. This falls short of the Ministry of Health's targets of 80% and 75%, respectively (Ministry of Health and WHO 2016).

Table 14: Drinking Water Estimates for Kenya in 2000 and 2015 (Percentages)

Year	National					Rural					Urban				
	At least basic	Limited (>30 min)	Unimproved	Surface Water	Annual rate of change in basic	At least basic	Limited (>30 min)	Unimproved	Surface Water	Annual rate of change in basic	At least basic	Limited (>30 min)	Unimproved	Surface Water	Annual rate of change in basic
2000	46	7	18	29	0.8	36	7	21	36	0.93	88	4	6	1	-0.33
2015	58	9	10	23		50	10	11	29		83	4	5	7	

Source: WHO and UNICEF 2017

2.2.2.5 Education

Kenya has made strides in improving access to education, abolishing tuition fees for primary education in 2003 and secondary education in 2018. Enrollment has subsequently increased with the net enrollment ratio for primary education rising from 76.5% to 81.8% from 2008 to 2012 (UNESCO 2018). Enrollment in secondary education has also risen from 28.9% in 2008 to 51.3% in 2016 (The Conversation 2017). Over half (51%) of adults 25 and over have attained a primary education, while only 29% have attained lower secondary education and 22% have attained upper secondary education (UNESCO 2017).

Despite progress, challenges still remain for students transitioning from primary to secondary school, especially those from low income households. Additional school fees (e.g. caution money, lunch money, uniforms) can prevent many children from attending secondary school as the unit cost of education generally negatively correlates with secondary school enrollment (Mutegi et al. 2017). Levies for a day school can cost as much as eight times the average monthly income of an employed parent, 12-17 times a self-employed parent, and 19-20 times for a parent engaged in casual work. School enrollment also varies by region in Kenya, with notably low enrollment in the Coast Region likely due to long travelling distances for pupils, insecurity from terrorist-linked groups and inability of parents to pay for non-fee items (The Conversation 2017). Initiatives such as “Peleka Mtoto Shule” have aimed to improve the primary to secondary transition rate by calling on parents and community members to make sure that students who have completed primary school are enrolled in secondary school. Additional information on education can be found in the county sections (Section 2.4).

2.2.3 Infrastructure

2.2.3.1 Roads

Kenya’s trunk line system of roads is the cornerstone of regional and national connectivity which connects the capital city Nairobi to the Coastal region, the County city capitals, as well as to the inland international border crossings. The road network is the predominant method of transportation with 93% of all freight and passenger traffic carried by road (KRB 2018a). As such, the success of Vision 2030 components that require transportation will depend greatly on the efficiency and extent of the road network (World Bank 2018b). Kenya has made considerable progress in improving the efficiency of road transit time. Average transit time between the port of Mombasa using transit trucks to the Malaba exit point (a distance of 933 km) was 224 hours in January 2015 and has declined to 103 hours by January 2018, still slightly above the government’s target of 72 hours (MPCC et al 2018).

The total road network of Kenya is approximately 161,451.4 km, with 39,995.1 km of national roads and 121,456.4 km of county roads. Approximately 6% of the road network is paved and the remainder are earth and gravel roads (Table 15). The majority of the road network’s paved roads are in fair (47.5%) or good (33.0%) condition. Gravel roads are mostly in fair or good condition however earthen roads are primarily in poor condition (KRB 2018b). A much larger proportion of national roads are in fair and good condition compared to county roads which are either poor or very poor (KRB 2018b). This indicates that county roads require additional resources for upgrade.

Work to repair, maintain and upgrade the road network is ongoing with approximately 1,900 km of additional road currently under construction, the majority of which consist of gravel or earth roads. The Road Maintenance Levy Fund[29] (supported by a fuel levy, transit tolls and interest income) is managed by the Kenya Roads Board which distributes it to various road agencies and county governments for road maintenance (KRB 2018b). The fund has nearly tripled in recent years from 24.8 billion KSh in 2012/2013 to 68.4 billion KSh 2016/2017 and is expected to grow further in coming years due to the increase in the fuel levy rate from KSh 12 to KSh 18 (KRB 2018a). This collection fund is still considered inadequate to address road maintenance needs due to the large backlog (KRB 2018b). The KRB is considered alternative financing mechanisms for additional income and reviewing more cost-effective road construction materials for the future.

29 This fund along with other income accrued to the Kenya Roads Board makes up the Kenya Roads Board Fund (KRBF). The KRBF is distributed to various road agencies that are charged with road maintenance (KRB 2018b).

Table 15: Road Conditions in Kenya (2018)

Surface Type	Good		Fair		Poor		Current Total		Under Construction	Total (including Construction	
	km	%	km	%	km	%	km	%	km	km	%
Paved	4,307.4	33.0	6,212.4	47.5	2,429.1	18.6	12,948.9	5.7	122.3	13,071.2	5.7
Gravel	25,237.1	30.3	33,977.9	40.8	22,872.9	27.5	82,087.9	36.3	1,156.1	83,244.0	36.5
Earth	31,242.4	24.6	29,136.7	23.0	65,956.4	52.0	126,335.5	55.9	581.7	126,917.2	55.7
Others	1,187.8	25.5	31.9	0.7	3,440.4	73.8	4,660.1	2.1	0.5	4,660.6	2.0
Total	61,974.7	27.2	69,358.9	30.4	94,698.8	41.6	226,032.4	100.0	1,860.6	227,893.0	100.0

Source: KRB 2018b

Km: kilometre

2.2.3.2 Rail

Transportation by rail in Kenya is less commonly used as the only rail transportation until recently was the aging narrow-gauge railway constructed in 1891 that had transport backlogs and frequent derailments (Habitat Planners 2016). The narrow-gauge railway was considered to be aging, insufficient and below ideal load capacity. As part of Vision 2030, Kenya began constructing a new high-capacity, high-speed gauge railway (SGR) for passenger and freight transport. The SGR is the country's largest infrastructure project since independence in 1963 (World Bank 2017c). The SGR was designed to address cargo handling issues from the large volume of container freights at the Port of Mombasa which were then transported by road to the interior as well as neighbouring countries. The high cargo volume being transported placed high pressure on Kenya's road network (increased road maintenance costs and increased road accidents), increased cargo freight costs and negatively impacted regional trade development (Habitat Planners 2016).

The first phase of the SGR opened in 2017 and operates from Mombasa to Nairobi covering 485.3 km (World Bank 2017; Habitat Planners 2016). The other sections of the SGR projects are in the financing identification phase and studies phase and commissioning are expected to continue to 2025 (EALA 2016). The completed SGR will connect Mombasa to interior Kenya and East Africa and will be a trunk line for the proposed regional network under East African Community's Railway Master Plan that will eventually revive existing railways in Tanzania, Kenya, Uganda and extend to Rwanda and South Sudan. Cargo handling capacity at the Port of Mombasa is expected to double to 44 million tonnes/year in 2025 and transportation costs are expected to decrease by up to 40% (Habitat Planners 2016). Once complete the SGR will help supplement road transport, increasing efficiencies and reduce the cost of road maintenance (MTI 2014).

2.2.3.3 Ports

Marine transportation in Kenya is managed and operated by the Kenya Port Authority. The country has one major seaport in the city of Mombasa and several smaller ones along its coast in Lamu, Malindi, Kilifi, Mtwapa, Kiunga, Shimoni, Funzi and Vanga (Kenya Port Authority 2018a). The Mombasa seaport, the most significant deep-water port in the region, has been expanded in recent years to increase capacity and use more modern technology in port procedures. These upgrades were implemented to address increases in cargo volume, which nearly doubled from 14.4 million tonnes in 2006 to 27 million tonnes in 2017. Government projections estimate that this will increase to 44.0 million tons by 2025 and 56.0 million tones by 2030. Operational efficiencies have reduced ship turnaround time from 4.9 days to 2.5 days and container dwell time from 7.1 days to 3.5 days (Business Daily Africa 2018c).

A Master Plan Study is currently underway regarding development of Kenya's smaller ports with consideration of the long-term development framework in Vision 2030 (Kenya Port Authority 2018b). Additional assessments are focusing on other potential ports sites on the coast in Takaungu and Ngomeni. The Lamu Port Project is one of the signature infrastructure projects under Vision 2030 which involves developing a new transport corridor linking the new Port of Lamu with neighbouring countries (Kenya Port Authority 2018c).

2.2.3.4 Electricity

With a rapidly growing population, electrical consumption in Kenya is expected to grow as well. The country is focused on meeting this demand through renewable energy such as geothermal power (Kenya Electricity Generating Company 2017). Kenya's growing geothermal industry is ranked ninth in the world and has helped expand access to electricity and reduce electricity rates (New York Times 2018). In 2015, renewable sources were the largest source of electricity production in Kenya (87.5%)[30] with oil providing the remainder (12.5%) (World Bank 2015b). While the government of Kenya previously relied heavily on hydropower as an energy source, hydropower is highly dependent on climatic changes and therefore unreliable (Kenya Electricity

30 39.2% from hydropower and 48.3% from other renewable sources.

Generating Company 2017). In the 1970s, the government began to focus on exploration and development of geothermal energy capability, which has grown from only 45 MW of power was generated in 1985 to 630 MW in 2018, of which nearly 400 MW came online since 2014 (New York Times 2018; Kenya Electricity Generating Company). Current renewable energy power generation is only about 5% of total potential and the Government of Kenya is prioritising development of these geothermal and wind energy plants (RECP 2014). Kenya opened the largest geothermal plant in 2016 and is currently building Africa's largest wind energy farm that will provide a fifth of its energy (Quartz Africa 2017).

Almost a decade earlier, the vast majority of Kenyan households (69.5% or 6.1 million) used paraffin as their main source of lighting (KNBS 2009). Paraffin use was concentrated in the rural areas and electricity use was predominantly in densely populated areas and in urban centres, especially along the great north road. Since then, Kenya has aggressively pursued electrification. Between 2010-2016, electricity access in the country overall nearly tripled from 19% to 56% (World Bank DataBank 2018). Electricity access is still more prevalent in urban areas with 77.6% of urban residents having access while only 39.3% or rural residents have access. Access between 2014 and 2016 expanded by more than 5% annually. In 2017, Kenya had a current installed generation capacity of 2,370 MW (Megawatts) (World Bank 2018c).

Access to electricity can be a driver for socio-economic development, increasing income and productivity, providing access to education and healthcare, enhancing water and food security and improving general well-being (ENCA 2016). To facilitate this, the Government of Kenya has set targets of 9,521 MW of new generation capacity by the year 2035 and universal access to electricity services for its citizens by 2020. An estimated $42-51 billion USD is required to meet these objectives (World Bank 2018). Currently about 1,500 miles of new electrical lines are under construction by the Kenya Electricity Transmission Company (New York Times 2018). The challenges for grid expansion are mainly financing as it can be relatively expensive for those in poor areas to afford electricity and financially unviable for companies to connect them.

2.2.4 Oil and Gas Sector

Oil and gas is a nascent industry in Kenya. Exploration efforts in the coastal Lamu Basin began in the 1950s but commercially viable oil reserves (an estimated 600 million barrels) were only discovered in 2012 in northern Turkana County (KCSPOG 2014). Kenya's oil and gas industry must overcome several challenges in the development of this industry. These include deficiencies in financing, infrastructure, institutional capacity, land access, and legal and regulatory frameworks (UN Environment 2018). Although the country has received assistance from the World Bank which has provided equity investments31 and technical support for oil and gas development, this will cease after 2019 as the World Bank is shifting towards financing cleaner sources of fuel (World Bank 2017d). Development has continued in Turkana County with British-based Tullow Oil working towards exploring and appraising the South Lokichar Basin. While there have been challenges with local protests and security issues which have resulted in temporary closures, Kenya became the second East African country to export oil in 2018 (Daily Nation 2018a).

Oversight over exploration, development and production of oil and gas in Kenya will be under the purview of the newly proposed Kenya Petroleum Regulatory Authority (National Assembly Bills 2017). Kenya is in the process of setting up the regulator which will assume the regulatory powers currently under the purview of the National Oil Corporation of Kenya (Standard Media 2018c). In June 2018, parliament passed the Petroleum Bill that will provide a framework for regulating petroleum contracting, exploration and development (Kenya Civil Society Platform on Oil and Gas 2018).

31 A $50 million USD equity investment in AfricaOil Corp (IFC no date)

2.3 Regional Profile

2.3.1 Demographics

The Project will traverse six counties from northwest to southeast Kenya, beginning in Turkana County and cutting across the counties of Samburu, Isiolo, Meru, Garissa, and ending in Lamu County (Figure 1; Table 16). Each county is divided into districts and then subdivided into divisions, locations and sub-locations. Current population projections were based on the most recent census, conducted in 2009. The counties of Meru and Turkana are the most populous counties and the counties of Lamu and Isiolo are the least populous. In 2009, the counties had youthful populations, with approximately 40% of the total population in the six counties under the age of 14 (KNBS 2009).

Table 16: Counties Overlapped by the Project

County	Area (km^2)	Administrative Units	Census Population (2009)	2017 Population (Projected based on 2009 Census)
Turkana	68,680.3	■ 7 Sub-counties ■ 17 Divisions ■ 56 locations ■ 156 sub-locations	855,399	~1,000,000
Samburu	21,022.1	■ 3 sub-counties ■ 7 divisions ■ 39 locations ■ 108 sub-locations	223,947	319,708
Isiolo	25,700.0	■ 3 sub-counties ■ 10 wards ■ 43 sub-locations	143,294	191,627
Meru	6,936.2	■ 9 sub-counties	1,356,301	1,601,629
Garissa	44,174.1	■ 6 sub-counties ■ 23 divisions	699,534	849,457
Lamu	6,273.1	■ 2 sub-counties ■ 7 divisions	101,539	137,180

Source: Turkana County Government 2013; 2018; Samburu County Government 2013; Isiolo County Government 2013; Meru County Government 2013; Garissa County Government 2013; Lamu County Government 2013.

A diverse mix of ethnic groups live in the six counties. While the majority of the region's ethnic groups are domestic pastoralists, the groups have distinct languages, religions, and cultural practices. In the counties of Turkana, Samburu and Isiolo, the dominant ethnic group are the Turkana, Samburu and Borana people (Fratkin and Roth 2005). The Turkana and Samburu people are Nilotic people[32], people that that share common linguistic features but not necessarily share social or political bonds. The majority of the Turkana and Samburu are either Christians or animists (traditional spiritualism) (Future Aricultures 2014). The Meru, who are of Bantu linguistic origin, are the dominant ethnic group in Meru County. In Garissa County and Lamu County, the dominant ethnic groups are Somali and Bajun and primarily practice Islam. (Pulse 2017; Journey Kenya 2013). While the most recent national data is from the 2009 census[33], the ethnic composition is unlikely to have

32 Nilotic languages are a group of related languages spoken in a relatively contiguous area from northwestern Democratic Republic of the Congo, South Sudan, and western Ethiopia southward across Ugandfa and Kenya into northern Tanzania (Encyclopaedia Britannica 2018)
33 Ethnic composition in each county was not reported.

significantly changed due to migration being more rural to rural than from main cities in Kenya. Border countries in some cases share the same ethnic groups and border crossing is not uncommon. A 2016 report reveals the depth of ethnic diversity found in each county's public service workforce which provides a general indication of the diversity of the six counties overall[34] (KNBS 2013; NCIC 2016) (Table 17).

Table 17: Ethnic Composition in each county's public service (2016)

County	Number of Ethnic Groups	Percentages of Largest Ethnic Group
Turkana	18	67.3 (Turkana)
Samburu	23	73.6 (Samburu)
Isiolo	18	41.0 (Borana)
Meru	23	84.6 (Meru)
Garissa	24	56.9 (Somali)
Lamu	26	32.7 (Bajun)

Source: NCIC 2016

2.3.2 Government and Administrative Authorities

County governments are divided into sub-counties that are further divided into divisions, locations and subdivisions (Appendix D). Counties are led by elected governors for a period of five years and a maximum of two terms. Sub-counties were created to ease service delivery. Key decision-making following devolution has shifted from central to county governments for service delivery in health, agriculture, urban services and local infrastructure (World Bank Group 2018).

County governments consist of two arms: The County Assembly and the County Executive (KNBS 2015a). The functions of the County governments include:

- Finance and Economic planning;
- Roads, Public Works and Transport;
- Health and Sanitation; Education and ICT;
- Agriculture and Irrigation;
- Livestock, Fisheries and Veterinary Services;
- Trade, Industry and Cooperative Development;
- Land, Housing, Physical planning and Urban Development;
- Water Development, Environment; and,
- Natural Resources and Tourism, Culture, Sports and Social Development.

34 While this is not comprehensive enumeration of every ethnic group present in each county, as some ethnic groups may be not be represented in the public service sector, it provides an estimate of the overall diversity in the county.

The county assembly consists of members of county assembly (MCAs) elected from different assembly wards in the county, and nominated MCAs representing special interests, such as persons with disabilities and youth, and the speaker KNBS 2015a.

County governments collect revenue from two main sources: property and entertainment taxes and services charges such as licensing fees (Government of Kenya 2009). The six counties, like the vast majority of Kenya's other counties, have had difficulties meeting net revenue targets in recent years. These difficulties relate to the lack of lucrative sources of revenue from the counties as their economies are primarily pastoral or agro-pastoral. In addition, poor forecasting practices are also a challenge for several county governments (The East African 2017a; Daily Nation 2018b)

The national government established an Equalisation Fund in FY 2011/2012 to compensate for the differences in marginalised areas of the country where access to basic services are not equal to other areas of the country. Based on an index of deprivation[35], the bottom 20% sub-locations were identified as marginalised (CRA 2018). Sub-locations in almost every county crossed by the Project except for Meru County were determined to be marginalised. Turkana County had the largest number of marginalised areas with 357 sub-locations and received the largest allocation of funds among the counties (CRA 2018). Allocation of funding for the five counties was spent primarily for improvements in water, roads, health facilities and electricity. However, as a number of marginalised communities were within the category of hunters and gatherers, nomadic pastoralists and squatters, this posed a difficult challenge for developing infrastructure projects because of the frequent migration of these groups (CRA 2018).

2.3.3 Economic Activities

The dominant economic activities in the six counties are pastoralism, agro-pastoralism, and fishing. (Repcon Associates 2017). In Turkana and Samburu counties, the primary crops grown are food crops such as maize, beans, wheat, barley and millet. In the counties of Isiolo, Garissa, Lamu and Meru, a mix of food crops and cash crops are grown such as bixa[36], bananas, cotton, maize, miraa[37], cassava, and tea. Horticultural farming was also recently introduced in Lamu and Meru County. The main types of livestock bred in the counties are cows, goats, sheep, camels and donkeys. Fishing is also an important economic activity in the counties but is still conducted on a small scale and production is low (Turkana County Government 2013; Samburu County Government 2013; Isiolo County Government 2013; Meru County Government 2013; Garissa County Government 2013; Lamu County Government 2013).

Emerging livelihood systems include trade, game conservancy tourism and oil-based trade. Numerous state protected game conservation areas are found in the region and is a popular source of tourism (LAPSSETT Corridor 2017). Tourism is a major economic activity in Lamu county but has underperformed in the past five years due to travel advisories issued by Western countries (Daily Nation 2018). While tourism performance has improved in the country overall due to enhanced security and domestic and international marketing, hotel (as measured by bed-nights occupancy) occupancy has remained low (KNBS 2018). Tourism and game conservancy tourism are fairly developed in the counties of Meru and Isiolo. High potential for tourism development exists in the other counties as they also have scenic viewscapes, rich traditional cultures, and an abundance of wildlife (Turkana County Government 2013; Samburu County Government 2013; Isiolo County Government 2013; Meru County Government 2013; Garissa County Government 2013; Lamu County Government 2013). Game conservation has also been slowly adopted by pastoralists as an alternative land use as it can provide better returns when it is linked up to the tourist market (Repcon Associates 2017).

35 The deprivation index was based on information on access to safe water, school attendance, access to improved sanitation and electricity and using principal component analysis. The deprivation index ranked 7,131 areas from most deprived to least deprived (CRA 2018).
36 A type of tree with leaves and large pink or rose flowers
37 A flowering plant.

Mining exploration activities are currently underway in all counties. Mineral potential includes soda, salt, graphite, Sillimanite, precious gems, titanium, limestone, and natural gas. Oil exploration is ongoing in the counties of Lamu, Isiolo, and Turkana. The counties of Lamu and Samburu currently have quarrying activities and Meru county produces building stones and ballast (TCG 2013; SCG 2013; ICG 2013; MCG 2013; GCG 2013; LCG 2013).

Wage employment and self-employment play minor roles in the county economies. Workers are primarily unskilled and income is low as pastoralism, which plays a major role in some of the counties, is essentially a subsistence level economy (LAPSETT Corridor 2017). Unemployment is very high in the six counties with the majority of the labour force unemployed in all counties. In 2009, the lowest unemployment was found in Garissa County (29%), most likely due to the higher proportion of wage-earners (from government, NGO and business organizations) in this economy, where close to a third of the labour force were wage-earners (Garissa County Government 2013). Additional details on employment can be found in the county sections (Section 2.4). Table 18 presents a summary of labour force indicators for the six counties.

Table 18: Summary of Labour Force Indicators for the Six Counties (2013)

County	Wage Earners	Self-Employed	Labour Force	Unemployment Levels
Turkana	6% of total population,	Very low since most of the youth population prefer wage employment	49.3% of population	70%, structural unemployment when there is mismatch between skills of workforce and requirements of new job.
Samburu	1.5% or 3,700 are wage earners – mainly teachers, civil servants, NGO employees	Major form of employment, mainly business people and Jua Kali artisans	118,879 in 2012, estimated to be 135,811 in 2017.	45%, primarily youths aged between 18-35 years.
Isiolo	14.5% - employed primarily in hotel and public sector	60% in rural self-employment 15% urban self-employment	51.94% of population or 80,809	Over 70% not formally employed
Meru	10% or 135,630, mainly from public and private sectors	Mainly in agricultural, jua kali and trade sectors 10%	793,177 or 53% of total population	~65% or 515,565 people
Garissa	30.2%, in government departments, NGOs, donor agencies, business organisations. Most wage earners are in formal employment	3% of urban centres and 2% of rural	49.4% of population or 345,299	28.4%
Lamu	Primarily unskilled and employed in agriculture, fisheries and livestock production.	n/a	n/a	n/a

Source: Turkana County Government 2013; Samburu County Government 2013; Isiolo County Government 2013; Meru County Government 2013; Garissa County Government 2013; Lamu County Government 2013

Income inequality is notably less apparent for the counties of Turkana East and Turkana South (Table 19). The Turkana East and Turkana South sub-counties have the lowest Gini coefficients[38] in the county at 0.169 and 0.211, respectively. Turkana County itself has a Gini coefficient (0.283) that is lower than the rural average in Kenya and has about half the Gini coefficient for the country overall (KNBS and SID 2013a).

Table 19: Gini Coefficient by County, Sub-County and Ward (2013)

County/Sub-County/Ward	Gini Coefficient
Kenya	0.445
Rural	0.361
Urban	0.368
Turkana County	0.283
Turkana South Sub-County	0.211
Kaputir	0.207
Katilu	0.162
Lobokat	0.266
Kalapata	0.111
Lokichar	0.250
Turkana East Sub-County	0.169
Kapedo/Napeitom	0.203
Katilia	0.139
Lokori/Kochodin	0.153

Source: KNBS and SID 2013a

2.3.4 Land Tenure

Land is predominantly communally owned in the majority of the six counties with the exception of Meru County and Lamu County where larger proportions of land are privately held (Table 20). In these communal land tenure systems, individual rights are not guaranteed and are a major disincentive for communities to embrace best land use practices. This has led to unsustainable land use practices in many of the counties such as overgrazing (SCG 2013). Development of small-scale agriculture and investment capacity have also been hindered as the lack of title deeds prevent farmers from accessing credit facilities as they lack collateral. The County Development Plans identified the need for faster land adjudication and registration in the land tenure system to assist in the development of these counties and encourage investment.

Landlessness is not an issue in the counties of Turkana, Samburu and Garissa as the land is held in trust by the county governments. Although land ownership in Isiolo County is also low, low title registration has been a

38 A statistical measure often used to gauge economic inequality, measuring income distribution, or less commonly, wealth distribution among a population.

source of resource-based conflicts (ICG 2013). In Meru and Lamu County, where private ownership is more prominent, landlessness is a major issue of concern. It is a source of continuous conflict between farmers and livestock herders. In Meru County, most households have small parcels of land and large-scale farmers hold large tracks of land. Inadequate land has fueled rural to urban migration, increasing slums in urban areas (MCG 2013). Rapid population growth and poverty have also caused inequalities in land sub-divisions, preventing land acquisition and leading to landlessness.

Table 20: County Land Tenureship Status

County	Status	Landlessness
Turkana	■ Almost no land under title deeds with exception of handful of individuals ■ Communally owned, held in trust by County Council of Turkana ■ People are free to graze and settle in rural lands. In urban lands, local authorities allocates land for a fee.	■ No incidences of landlessness
Samburu	■ 5% of population own title deeds ■ Most of land is communally owned	■ No incidences of landlessness
Isiolo	■ 80 % communally owned, under trusteeship of the county government ■ 10%, land for schools, administration, army barracks, health facilities ■ 10% for private investment in housing, industrial and commercial purposes	■ Landless found primarily in towns where the poor from outside the county have not been able to purchase or be allocated plots
Meru	■ 50% of farmers have title deeds ■ Meru North region have the highest number of farmers without title deeds ■ Large scale farmers hold large tracks of land while most households have small parcels of land	■ Unequal distribution of land ■ Inadequate land has fueled rural to urban migration and increase in urban slums ■ Population growth, poverty and lack of income are major sources of landlessness
Garissa	■ 1% of population own title deeds ■ Majority live on communally owned land, held in trust by the county government. Majority of local communities live in informal settlements	■ No incidences of landlessness
Lamu	■ 42% or 13,000 households have land ownership, primarily in Lamu West (where 71% have land ownership)	■ Primary concern for communities (e.g. Swahili, Arabs, Korei, Boni and Orma in particular) ■ Continuous source of conflict between farmers and livestock herders

Source: TCG 2013; 2018; SCG 2013; ICG 2013; MCG 2013; GCG 2013; LCG 2013.

2.3.5 Agency Involvement

Various agencies operate in the counties that provide key roles in the socio-economic development of the counties. They provide services across all sectors, with an emphasis on food security and health. These agencies include bilateral and multilateral agencies, Civil Society Organisations[39] and research organisations. Notable agencies include the following: Action Against Hunger, Action Aid, AMREF, UNICEF, Oxfam-GB, Care International, and World Vision. From 2001 to 2010, Kenya was the 11th highest recipient of international humanitarian aid, receiving $1.9 billion USD (GHA 2012). During this decade 14.9 million people in Kenya were affected by natural disasters and 0.8% of the total population were of concern to the UNHCR or UNRWA. In 2017, an estimated 5.6 million in Kenya were assessed as people in need due to natural hazards and the refugee situation. Turkana, Samburu and Isiolo counties in particular experienced food insecurity and acute malnutrition during the last prolonged drought in 2017 and were identified in need of aid (UN 2017). The majority of the six counties crossed by the Project are in need of humanitarian assistance to address poverty and food insecurity. The counties of Turkana, Samburu, Garissa, and Isiolo are among the ten poorest counties in the country, with the majority of their populations below the poverty line (Development Initiatives 2016a). Turkana County and Samburu County in particular have the highest and third highest levels of poverty in the country with 80% and 76% of their total population in poverty. The counties of Turkana, Samburu and Garissa are also within the top ten counties in terms of food poverty (Development Initiatives 2016b).

2.3.6 Protected Areas

Protected areas in Kenya are gazetted landscapes and seascapes that have been surveyed, demarcated and gazetted as National Parks and/or National Reserves (KWS 2018). In National Parks, natural resources are protected and the only activities permitted are tourism and research. In National Reserves, certain human activities are allowed such as fishing in marine reserves or firewood collection in terrestrial reserves (KWS 2018). Protected areas are not fully fenced and wildlife move in and out during periods of the year to search for pasture and water. Kenya has a total of 23 terrestrial National Parks, 28 terrestrial National Reserves, 4 marine National Parks, 6 marine National Reserves and 4 national sanctuaries (KWS 2018).

Several conservancies are found in the six counties crossed by the Project. There are three types of conservancies in Kenya: Community Conservancies; Private Conservancies and Group Conservancies (KWCA 2018). Community conservancies are established by a community on community land. These conservancies provide the framework, incentives and links to outside expertise for communities to do the following: protect diverse wildlife; manage rangelands fisheries more sustainably; and improve regional peace and security (Northern Rangelands Trust 2017). Private conservancies are set up on private land by a private individual or corporate body for the purpose of wildlife conservation. Group conservancies are created by the pooling of land by private landowners who share a common border for the purpose of wildlife conservation (KWCA 2018).

Ranching in Kenya is practiced privately and collectively in private ranches and group ranches. Private ranches are ranches owned by individuals. A group ranch is a livestock production system or enterprise where a group of people jointly own freehold title to land and maintain agreed stocking levels and herd their livestock collectively which they own individually (Ministry of Agriculture 1968 via Ng'ethe no date). The intention was to increase productivity of pastoral lands, improve pastoralists' earning capacity, prevent landlessness and environmental degradation, and setup a livestock production system that balances the traditional way of life and the modernisation or modification of livestock husbandry (Information Cradle no date).

World Heritage Sites are also protected areas in Kenya. Kenya has seven World Heritage sites.

39 "The wide array of non-government and not-for-profit organizations that have a presence in public life, expressing the interests and values of their members or others, based on ethical, political, scientific, religious or philanthropic considerations. E.g. community groups, NGOs, labour unions, indigenous groups, charitable organizations, faith-based organizations, professional associations and foundations" (World Bank 2013)

2.3.7 Regional Summary

In contrast to other areas of Kenya, the six counties crossed by the Project are characterised by pastoral livelihoods, precarious land tenure and high cash poverty. The counties have rich cultural traditions and potential for tourism development and oil-based trade. The devolution process begun in 2010 have allowed the county governments to make key decisions in key aspects of everyday life such as agriculture, health, local infrastructure.

2.4 County Profiles

2.4.1 Turkana County

Turkana County lies within the arid and semi-arid lands region of Kenya, bordered by four counties: Marsabit to the northeast, Samburu to the southeast, and West Pokot and Baringo to the south, as shown in Figure 5. The county also shares international borders with South Sudan to the northwest, Ethiopia to the northeast and Uganda to the west. Turkana County is the second largest county in Kenya spanning an area of approximately 68,700 km^2.

The permanent and semi-permanent areas in Turkana County are located along the Turkwel and Kerio rivers where irrigation farming is practiced. Water is accessible in this area and the settlements are close to Lodwar town (Muchoki 2015). The main urban centres in Turkana County are Lodwar, Kakuma and Lokichoggio. Of the three, Lodwar is the most developed with more infrastructural services and social amenities (UN-Habitat 2016). There are also nine peri-urban[40] market centres in Turkana County which have social and economic infrastructure such as schools, health facilities and shopping centres.

40 Of or relating to an area immediately surrounding a city or town

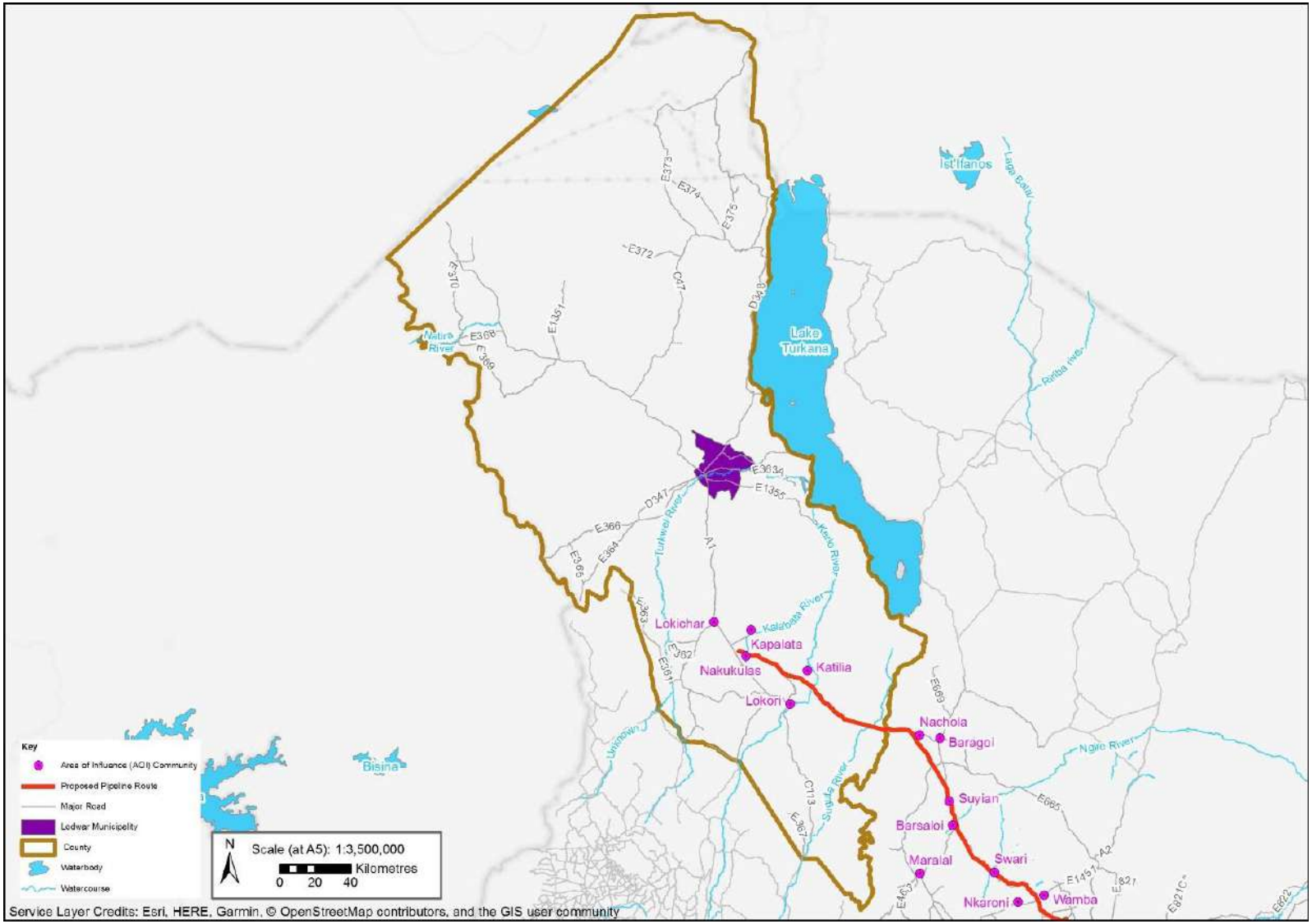

Figure 5: Turkana County

2.4.1.1 Administrative Divisions and Governance Structures

Turkana County is administratively divided into seven sub-counties, 17 divisions, 56 locations and 156 sub-locations as shown in Appendix D (TCG 2013). Each county is also divided into wards represented by a Member of County Assembly (MCA). A total of 40 MCAs represent Turkana County, 30 of which are elected and 10 are nominated by political parties (EMC and Golder 2017). The Project crosses the sub-counties of Turkana East and Turkana South. Table 22 presents the communities in Turkana County nearest to the Project pipeline (the Project). Three of the four communities are located in Turkana East sub-county, with the closest community, Kochodin, located approximately 1 km away from the proposed Project. Focus groups were conducted with local government, Elders, and pastoralists in these communities. However, the focus groups in Nakukulas were cancelled due to issues related to security.

Table 21: County Administrative Units traversed by the Project

Sub-County	Division	Area (km^2)	No. of Locations	No. of Sub-locations
Turkana East	Lomelo	4,215.9	5	9
	Lokori	7,091.2	4	11
Turkana South	Lokichar	4,536.6	3	7
	Kainuk	1,684.1	2	6
	Katilu	1,143.1	1	4

Source: KNBS 2009 via TCG 2013

Table 22: Turkana County Communities nearest to the Project Pipeline

Sub-County	Division	Community	Distance from Pipeline (km)
Turkana East	Lokori	Kochodin	1.0
Turkana East	Katilia	Katilia	5.8
Turkana East	Lokori	Lokori	14.9
Turkana South	Lokichar	Lokichar	20.4

2.4.1.1.1 Local Administration

Pasture committees in the AoI communities plan migrations and grazing patterns as well as mitigate and mediate conflicts and develop peace processes. In Lokori and Kalapata, elders manage and control water points. The Katilia pastoralist groups are called *Arumrum Ekaal Kinon/ Akaal*. Agro-pastoral associations in Katilia plan activities and dykes at the farms, train farmers, and give direction on farm watering patterns.

2.4.1.2 Population Demographics

Among the six counties crossed by the Project, Turkana County is the second most populous with a population of 855,399 in 2009[41], or 2.2% of Kenya's total population (TCG 2013; KNBS 2017). However, as the second largest county in land size, it has a low population density with 12 inhabitants per km^2. Turkana East is the least populous sub-county and Turkana South is the second most populous sub-county. Table 23 presents the 2009 population count and 2017 projections based on the county's estimated growth rate of 6.4% per annum (TCG 2013). More recent demographic data on Turkana County is unavailable as detailed county level statistics are only published every ten years in the national census.

Table 23: Total Population of Turkana County

Sub-County	2009 Census		2017 Projection	
	Population	Density (km^2)	Population	Density (km^2)
Turkana Central	134,674	24	224,792	40
Turkana North	129,087	7	215,467	12
Turkana West	245,327	14	409,490	24
Loima	119,932	13	200,186	22
Turkana East	90,466	5	151,002	8
Turkana South	135,913	18	226,860	31
Total	**855,399**	**12**	**1,427,797**	**21**

Source: TCG 2013 Note: Population figures are presented with a note of caution about data reliability as the nature of moving pastoralist communities makes it difficult to accurately count population figures.

Turkana County has a young population with the vast majority (82%) of the population below 35 years of age in 2009, a trend projected to continue to 2017[42] (TCG 2013) (Table 24). There are three urban centres in the county, constituting 11% of the county's overall population, compared to the national average of urban populations constituting 25% of the overall population (KNBS and SID 2013a). The urban population in Turkana County was 95,025 in 2009 and was projected to increase to 115,153 by 2017 (TCG 2013). Lodwar had the largest population, over two and a half times the size of smallest town, Lokichoggio (Table 25).

Table 24: Population Projections by Age Cohorts

Age Group	2009 Census	2012 Projection	2015 Projection	2017 Projection
0-4	111,579	135,213	163,854	186,243
5-9	138,073	167,319	202,760	230,466
10-14	143,561	173,970	210,819	239,626

41 More recent population data is not available as the national population is conducted on a decennial basis
42 Population projections beyond 2017 were not available as the Turkana County Integrated Development Plan is still in-progress.

Age Group	2009 Census	2012 Projection	2015 Projection	2017 Projection
15-19	119,188	144,434	175,027	198,944
20-24	80,259	97,259	117,860	133,965
25-29	61,553	74,591	90,390	102,742
30-34	45,976	55,714	67,516	76,741
35-39	38,896	47,135	57,119	64,924
40-44	29,370	35,591	43,130	49,023
45-49	23,228	28,148	34,110	38,771
50-54	18,348	22,234	26,944	30,626
55-59	13,715	16,620	20,140	22,893
60-64	11,446	13,870	16,808	19,105
65-69	6,548	7,935	9,616	10,930
70-74	5,120	6,204	7,519	8,546
75-79	2,860	3,466	4,200	4,774
80+	5,271	6,387	7,740	8,798
age not stated	408	494	599	681
Total	**855,399**	**1,036,586**	**1,256,152**	**1,427,797**

Source: TCG 2013

Table 25: Population Projections of Urban Centres in Turkana County

Urban Centre	2009 Census	2017 Projection
Lodwar	45,368	54,978
Kakuma	31,962	38,732
Lokichoggio	17,695	21,443
Total	**95,025**	**115,153**

Source: TCG 2013

The community of Kalapata has a population of 43,076 (Table 26). Almost one-third of the population is under the age of 15. Population trend data for Kalapata was not available. Population data for the other Project communities was not available.

Table 26: Population Data for Kalapata

Indicator	Number
Population (2017)	43,076
Number of Households	6,002
Births	96
Deaths	121
Population Under 15	14,142
Population 15-54	13,226
Population 55 and over	15,710

Source: Focus Group, Kalapata, Local Government 2019; Appendix B

2.4.1.3 Migration

Due to its shared international borders and unrest in the region, Turkana is also home to refugees from South Sudan, Somalia, and Ethiopia. Two refugee camps, the Kakuma Refugee Camp and the Kalobeyei Settlement, are located near the townships of Kakuma and Kalobeyei Township in Turkana West sub-county (UNHCR 2018a, b). The Kakuma Refugee camp was established in 1992 following the "Lost Boys of Sudan[43]" and the fall of the Ethiopian government (UNHCR 2018a). Due to overcrowding and the continuous flow of South Sudanese refugees, the Kalobeyei settlement was established in 2015 (UNHCR 2018b). At the end of December 2018, the Kakuma Refugee Camp housed 149,076 refugees and Kalobeyei Settlement housed 38,273 refugees, housing approximately 40% of all refugees in the country (UNHCR 2018c; 2019a-b).

New refugee arrivals at the Kakuma Refugee Camp have fluctuated year to year from a high of 45,627 in 2014 to 9,880 in 2018 (UNHCR 2019c). South Sudanese refugees represent the vast majority of new refugees at Kakuma Refugee Camp since 2014, accounting for over two-thirds of total new arrivals since 2014[44]. By the end of 2019, Kenya is projected to house a total of over 920,000 refugees from South Sudan (UNHCR 2018d). Disaggregated data on how many new refugees are expected in the two refugee camps in Turkana County was not available.

The only notable form of internal migration in the county is rural to rural movement (UN-Habitat 2016). As semi-nomadic pastoralists, the Turkana people move from one place to another throughout the year depending on the availability of pasture and water for their animals. Migration by the Turkana people is also influenced by insecurity induced by intra-communal conflict, food insecurity caused by drought and famine, natural calamities caused by disease outbreaks for humans and livestock, intermarriages, and job-seeking. Families remain in the *Ere* while the head of the families migrate in search for pasture and water. Migrations and grazing patterns are planned by pasture committees.

While traditionally, the Turkana people had no permanent settlements, following droughts in the 1980s, about half of the population settled in or adjacent to large famine-relief centres. Additional information about pastoral livelihoods is discussed in Section 2.4.1.10.2.

43 This is in reference to a group of over 20,000 boys from Sudan who were displaced or orphaned during the Second Sudanese Civil War, many of whom came to Kenya as refugees.
44 Data on new arrivals at the Kalobeyei Settlement was not available.

2.4.1.4 Ethnicity and Language

The Turkana people are the dominant ethnic group in Turkana County (KNBS 2015a). The El Molo people are the minority community in the county and live on the southern shores of Lake Turkana. Based on the 2009 census, Turkana people were the third largest Nilotic ethnic group in Kenya and the tenth largest ethnicity in all of Kenya (KNBS 2009). The Turkana are closely related to the Maasai and Samburu people (Kenya Information Guide 2015). The language spoken by the Turkana people is called Turkana or Ng'aturkana. In 2009, there was a total of 989,000 people in Kenya who spoke Turkana, of which 593,000 were monolinguals (Ethnologue 2018). Other languages spoken in the County of Turkana include English, Swahili, Daasanach, and Pökoot.

2.4.1.5 Social Organisation

Unlike other tribes in East Africa that follow kinship organisation in the form of lineages, the Turkana can be described as a gerontocracy (EMC and Golder 2017). The head of the household in the family unit has the authority and the Elders' Council has the authority in the community. The position of elders is not based on age but are those that have wealth, display generosity and wisdom. Elders who do not perform well can be ignored and replaced through public opinion (Muller-Demf 1994).

The Turkana have specific geographical affiliation with land including *ere* and *ekitela* or territorial sections. Key terminology related to the traditional social units in Turkana County include:

- ***Awi (pl: ng'awi) or household:*** The most fundamental unit of social aggregation is the family unit which is headed by a male head of household one or multiple wives, children and often other dependent women (EMC and Golder 2017). The family *awi* typically consists of 9-15 people and involves two enclosures. The main enclosure, the *awi napolon,* is where the male head of the family lives. The other enclosure, referred to as the *Awi Abor*, is where the additional wives and their children live (Muchoki 2015).
- ***Adakar (pl: ngadakarin***): A household may cluster and travel together with other *awi* to form this grazing social unit where movement and management decisions are made. The *ngadakarin* disperse during dry periods in different orders to spread risk and exploit existing opportunities (Muchoki 2015). This is the most important of the Turkana traditional institutions and its structures are based on security (i.e. protection from organised raids, natural resources management and social-cultural connections) and headed by the elder's council. As the Turkana do not recognise one global traditional governance or leadership, the *Adakar* units are independent and autonomous (Muchoki 2015).
- ***Ere (pl: ng'ereria):*** The ancestral domain of a family where the family derives and may live (seasonally or more permanently for the old, women and children) and graze their livestock. The *ere* is not necessarily a permanent settlement as seasonal migration may take the *ere* family away from their *ere*. The *ere* family may claim authority over and preferential access to natural resources[45] located within the *ere*, but this claim does not convey land ownership rights and failure to exercise these rights may result in other parties using these resources. Turkana people can therefore access land within a family's *ere* for temporary grazing, but it is understood that permission must be obtained. The man who heads the *ere* family has the right to speak on behalf of people. Borders of the *ere* are usually delineated by features such as a *luggas,* ridgelines, livestock tracks (for moving stock long distances), roads and occasionally certain species of trees. These borders are generally known by everyone living in the vicinity (EMC and Golder 2017);
- ***Epero:*** Herdsmen travel together in a group known as *Epero* in search of pasture and water. This group typically consists of mostly young men and does not include immediate family members (Focus Group, Elders, Lokori 2019; Appendix B). Members can be related or not but have a common goal.

45 i.e. trees and seasonal grazing

- ***Ekilea (pl: ngitela)* or territorial Section:** All herd owners are members of a territorial Section, which are geographic areas often with overlapping boundaries. Sections differ in various ways such as environmental conditions or characteristics. The role of the *Ekilea* has been diminished by government administration (Muller-Demf 1994);
- ***Emacar (pl ngimacarin)* or Clans*:*** Non-territorial social organisation related to kinship and stock associations. All Turkana are born into the clan of one's father and women join the clan of their husbands upon marriage. Clans are exogamous (i.e., a man may not marry a woman from his clan) and membership is symbolised by brands that appear on animals in a herd (Gulliver 1951 in McCabe 2008);
- ***Arumrum: (pl. ng'arumrumio)***: A new form of social organisation starting from the mid-1990s consisting of a large encampment of multiple herd owners under the leadership of a single man. Concentrically built thorn fences and heavy armament are designed to fend off attacks and clustering can include up to 100 households (McCabe 2008; Eriksen and Lind 2009). The *arumrum* can also be used to describe a group of families that travel together for the purposes of scouting for pasture and water and for protection against insecurity (Focus Group, Pastoralists, Kalapata 2019; Appendix B).

The relationship between national, county and traditional leadership is still evolving as county governments implement changes toward more devolved government under the 2010 Constitution. Location and Sub-location leadership, Chiefs[46] and Assistant Chiefs, are aided by their Chiefs' Elders, those who live in settlements throughout a Location or Sub-location and assist the Chief in his or her duties (EMC and Golder 2017). Elders may carry out the Chief's functions when they are absent and are considered part of traditional governance structures and the traditional, county and national governance systems are interdependent. Elders serve the communities by acting as decision makers, mediators, and disseminators of information to and from the community and county government. Elders work with *adakar* or *kraal* elders and Seers, *Emerons* in Turkana language or diviners, also part of a non-formal government system.

The role of elders has changed slightly, and they follow newly introduced structures from the county. Roles on decision making are influenced by more educated people who advise elders on decision making, especially in community projects that involve them as stakeholders. While not legally recognised, the main functions of the traditional governance structures are dealing with pastoralist issues, management of security, disaster and pasture management and early warning (EMC and Golder 2017). Elders work with Chiefs to understand who has migrated into an area and to support the Chief in resolving petty domestic issues that can arise from the household to the wider *adakar* level. In Katilia, Elders are the heads of their families and communities and are considered leaders (Focus Group, Local Government, Katilia 2019; Appendix B). Elders solve both intra and inter-communal disputes or conflicts and work with both levels of government to relay information to other community members. In addition, Elders in Katilia control grazing patterns by using seasonal calendars.

The notable transitions to new stages in life for the Turkana include the transition to adulthood from youth, known as 'Athapan or Asapan", marriage[47] "Akuuta" and death. Elders take the lead in undertaking these cultural practices. Elders can also bless and curse accordingly because they are believed to be connected to the spiritual world. However, elders in Katilia have noted that various traditional cultural practices have been replaced by churches, which have affected the role of elders (Focus Group, Elders, Katilia 2019; Appendix B). In 2012 a group called the Council of Elders was formed as part of a county initiative to improve communication with rural pastoralists. This organisation has its own administrative structure and serves as an intermediary between the county government system and traditional governance systems (EMC and Golder 2017). Although many members are said to live in more urban and populated settlements, they derive their strength from

46 Chiefs are government appointed positions (World Bank 2016).
47 Once young men transition to adulthood, they are elevated to high status and allowed to marry at the age of 20.

consulting elders based in *adakar* and who sit under the tree of men[48]. The tree of men is both an institution and place, being the location where elders from a given area meet and deliberate in the implementation of their work.

To interact with communities, outsiders (such as project proponents) must enter the community through local government (i.e. Administration Office and the Chief) and the Chief will bring them to the community to meet the community elders. Communities must also be involved as stakeholders. In the past, Elders would receive visitors directly and screen them directly. The role of elders has changed due to the modernisation of life as well as the introduction of alternative livelihoods such as farming.

Traditional healers are also found in Turkana communities despite the introduction of dispensaries and hospitals. Traditional healers are known for using natural resources or magic on patients. While some healers perform their services based on compassionate grounds, others require payment for their services (Focus Group, Elders, Katilia 2019; Appendix B). Healers obtain their healing materials from the plains, the rivers, and the hills and mountains.

Public Participation

In all Project-area communities, a higher number of women participate in community initiatives and other community development programs than men. A portion of Katilia are resistant to participating fully in community development programs due to social change, lack of funds to facilitate participation, and lack of employment which can deter unemployed youth from involvement in development programs. In Kalapata, there is also resistance to some programs and projects such as the digging of pit latrines. In addition, barriers to public participation include the lack of incentives given to volunteers, lack of facilitation in meetings, and lack of informed choices about projects or initiatives. Similarly, in Lokichar a lack of motivation and incentives are the main constraints to public participation. Food insecurity is a barrier to women participating as women spend time to search for food for their children (Focus Group, Local Government, Katilia 2019; Appendix B).

2.4.1.6 Economic Base

Although poverty headcounts in the county have declined in the last decade, Turkana County remains the poorest county in Kenya. Poverty prevalence in the county in 2015/2016 was 79.4%, a decrease from a decade earlier when 92.6% of the county was in poverty (Development Initiatives 2018a; Standard Media 2018d). Turkana County is also the county with the highest levels of food poverty, with two-thirds of the county unable to consume the minimum daily caloric requirement of 2,250 Kcal, a decrease from 92.6% a decade earlier. Extreme poverty headcounts have also halved from 19.6% to 8.6% in the last decade. The poverty gap is still the highest in the country with 46% of the total population below the poverty line. The county has been marginalised since colonial times due to its remoteness, harsh environment, poor access to services, as well as typical underlying causes of poverty experienced elsewhere in Kenya (FEG 2016).

According to the National Drought Management Authority, the county has four main livelihood zones. Pastoralism is the main subsistence and economic activity in the county with nearly 60% of the population deriving their livelihood from livestock-based activities (TCH 2018). The remainder of the county's livelihoods are categorised as 20% agro pastoral, 12% fisher folks and 8% in the urban/peri-urban formal and informal employment (TCH 2018). Additional information on livelihoods is discussed in Section 2.4.1.10.

Pastoralism occurs in most parts of the northern and central divisions. Near the border, the pastoral zone receives more rainfall than the central pastoral area and consequently has better pasture and water access for livestock (FEG 2016). The population near the border is more nomadic than the central pastoral area where

48 The tree of men of "Ekitoe a Ngikileok"48 in the Turkana language, is explained as an "institution being of an ancient establishment linked to the history of organisation of Turkana People (EMC and Golder 2017).

permanent settlements are established. Livestock sales, self-employment (e.g., bush products, handicrafts, charcoal) and safety nets in the form of cash transfers are the primary income sources in the pastoral livelihood zone. The agro-pastoral zone is located along the Turkwel and Kerio Rivers where irrigation schemes allow for the growing of food crops (e.g., sorghum, maize, green gram, cowpeas, and vegetables) and small quantities of cash crops) (FEG 2016). Agro-pastoralists keep livestock and also practice small-scale farming. The fishing livelihood zone is located along the western shores of Lake Turkana where fishing is the main economic activity, despite the populations' pastoral background. Fish sales, fishing-related casual labour, handicraft sales, petty trade and livestock sales are the main sources of income in this zone. The Lodwar Urban Livelihood Zone consists of 11 sub-location communities and is situated along the main road between Kenya and South Sudan. Livelihoods in this zone are primarily labour-based and many households rely on the natural resources immediately available. There are casual unskilled, skilled and formal employment opportunities (FEG 2016).

Turkana County has untapped minerals (i.e. known deposits of gold, clay, limeston, gypsum and garnets) throughout the county that have been primarily extracted on a small scale or artisanal basis. Gold is found in the Naduat area of Makutano and in the Sasame region; gemstones are found in Kaleng and Nadung'a; and gypsum deposits are found in the Kapua and Lochwaa (Government of Turkana 2018). Small scale or artisanal gold mining has occurred in the Naduat area for almost 20 years and is a major economic activity for communities nearby (Business Daily Africa 2016). Although there is no official extraction of gypsum, there are reports of extractions of small quantities. Industrial and building minerals[49] are also found in the county with quarrying in Lokore, Makutano and Kakuma areas (Government of Turkana 2018). Sand harvesting also occurs along the riverbanks and wind-deposit pans throughout the county.

2.4.1.6.1 Project Area Communities Economic Development Priorities

Lokori

In Lokori, economic development priorities have focused on physical infrastructure (i.e. need to address water shortages through a proposed dam, road development); security (i.e., need to address security issues and raid hotspots); educational institutions (i.e. need for extra educational centre for the growing population); and food security (i.e., through open market places and increased food production) (Focus Group, Local Government, Lokori 2019; Appendix B). Constraints on economic development include the lack of funds, heighted insecurity at hot spot areas on the outskirts of the community, high levels of economic dependence, tribal conflicts, poor governance, inefficient natural resource extraction, and poor agricultural practices. In Lokori, loans are given by the county government and capital expenditures are given as a result of subsidies.

Katilia

In Katilia, land has been allocated for economic activities such as solar grids and Olsuswa Energy's geothermal energy project. Various irrigation projects are in place (i.e., drip irrigation, Nameliteny spate irrigation, Nataparin irrigation scheme). Land has also been been set aside for drilling boreholes at Echoke and other centres such as Lokorkor, Lopediru, Narkotlem, Nakatomwa, Kidewa and Ngimeyana. Like Lokori, Katilia also lacks sufficient funds from the national and county governments.

Kalapata

In Kalapata, economic development is focused on increasing the capacity of existing physical infrastructure such as schools, roads, and health facilities (Focus Group, Local Government, Kalapata 2019; Appendix B). The community also expects to work on development of its electricity supply. Local administration noted the need for borehole drilling to supply clean water to the community. Constraints on economic opportunities are

49 Eugsterite, tsavorite, halite, pyrope, rhodolite, zircon, mica, beryl, graphite, garnet, and limestone. Turkana County also has building stones, hardcore, ballast, and building sand.

the lack of funding for projects, inadequate security within and beyond the community boundaries, poor physical infrastructure, poorly skilled personnel, lack of community consensus on development projects, and the poor health care system.

Lokichar

In Lokichar, road construction is currently underway linking Lokichar to Lokori. A sub-county hospital is not yet operational. Economic development priorities are focused on infrastructure (i.e., road construction), expanding health facilities, expanding public learning institutions, and promoting the public-private sector partnership to facilitate delivery of quality services and economic growth. Constraints to economic development are the lack of funds to implement proposed development plans. Insecurity is also a deterrent to economic development in the community.

Community Revenue and Expenditures

Revenue from all Project communities are sourced from royalties (from soil harvesting, coarse aggregate and fine aggregate, and ballast and building stones); land leases agreements; fees (i.e. charcoal transportation, quarry extraction and soil harvesting), rents from land plots, and business permits. The main type of expenditure for communities are attributed to salaries entitled to public service employees. Capital expenditures are non-existent (except in Lokori) as no loans are given to start up businesses. Other expenditures would be administrative expenses such as utilities.

2.4.1.7 Employment

In 2009, the county had a labour force (aged 15-64) of 441,979[50], representing 49.3% of the total population. The labour force was projected to rise to 737,733 by 2017[51](TCG 2016a). In 2009, the county had an unemployment rate around 70%, significantly higher than the national unemployment rate of 42% (TCG 2013). More recent unemployment data on Turkana County was not available. The county government has suggested that the high unemployment rate in the county is due to structural unemployment (TCG 2013). Employment in the county is primarily available in urban areas (Müller-Dempf 2014). Regional unemployment as a result of marginalisation has contributed to county unemployment. Youth in the arid and semi-arid regions are more vulnerable and experience a larger share of the challenges of unemployment and lack of access to education, skills, training as well as the lack of business development support and opportunities (Mburugu and Oburu 2016). In addition, youth in these areas do not have the appropriate academic and technical skills. This combined with the limited employment opportunities results in high levels of youth unemployment.

Table 27 presents the results of SMART Surveys from 2015-2017 on households' main source of livelihoods. In recent years, livestock herding has remained the primary livelihood at the county level with around a third of all household livelihoods. In the sub-counties of Turkana South and Turkana East, reliance on firewood/charcoal and petty trade have become more prevalent, surpassing livestock herding as the main occupation. Employed and waged labour have declined noticeably during this same period while selling firewood/charcoal have risen to compensate. Waged earners in the county are employed in sectors ranging from education, government, domestic to humanitarian organisations, although a major portion of the earners are non-residents indicating that the proportion of resident wage earners is even lower than what is reported (TCG 2013).

50 This labour force total differs from the total presented in Table * due to differing sources.
51 The most recent labour force data on Turkana County is from 2009.

Table 27: Main Source of Livelihoods for Households in Turkana County

Main Occupation of Household Head	Turkana South and Turkana East Sub-Counties (%)			Turkana County (%)		
	2015	2016	2017	2015	2016	2017
Livestock herding	22.3	21.8	24.4	27.2	36.1	35.3
Own farm labour	12.4	11.6	12.1	4.6	3.6	4.5
Employed (salaried)	6.1	4.0	2.5	5.1	2.6	1.9
Waged labour (casual)	19.4	16.2	9.5	14.8	10.5	8.7
Petty trade	19.5	17.8	26.5	22.3	14.0	20.2
Merchant/trader	2.4	1.9	3.3	2.7	1.4	1.6
Firewood/charcoal	16.2	23.8	18.3	18.2	21.4	24.1
Fishing	0.0	0.2	0.2	1.5	3.1	1.3
Others	4.5	2.8	3.2	3.7	7.1	2.4

Source: TCH 2018

2.4.1.8 Social Infrastructure

2.4.1.8.1 Education

Turkana County has 380 primary schools, 42 secondary schools, 412 Early Childhood Development (ECD) centres, and 7 community polytechnics (UNICEF 2017). The county also has two polytechnic institutes in Kakuma and Lodwar that focus on medicine and teaching, respectively. Two campus universities, Mt. Kenya University and University of Nairobi are found in Lodwar and Lokichoggio (TCG 2016b). In addition, Lodwar also has a Vocational Training Centre. These learning institutions are few in the context of the county's total population (projected to be 1,427,797 in 2017) and located too far apart, except for those in Lodwar town. The county has 3,190 teachers providing basic education, consisting of 1,166 ECD, 1,651 primary and 373 secondary school teachers (UNICEF 2017).

The majority of Turkana County residents (82.1%) have no formal education (KNBS and SID 2013a). The subcounties of Turkana South and Turkana East have larger proportions of their populations with primary and secondary education compared to the county overall and the residents of Turkana East have received more education than Turkana South. Only 14.5% of county residents have obtained primary education and a mere 3.3% obtained secondary education. Overall, residents of Turkana County have substantially lower levels of educational attainment compared to the national average (Table 28). More recent data on educational attainment is not available.

Schools are dispersed sparsely in the county and poverty is high, adding to access challenges for students in Turkana. Other difficulties for students from the nomadic pastoralist communities is the disconnect between the skills acquired from schools and the skills required for their families' everyday socioeconomic survival practices (The Conversation 2016). Curriculum and school timing do not take into consideration nomadic lifestyle requirements. Students cannot easily participate in their family's survival activities after school such as herding livestock, milking, watering animals, market activities and taking care of siblings (The Conversation

2016). The disconnect of school culture can alienate children from their nomadic families and can be a cause of apathy in the families. The county dropout rate for primary school in 2015 was 46% (TCG 2016b). Children in Turkana County drop out of school due to a lack of interest and motivation, exacerbated by a lack of teachers and good learning facilities. Turkana households frequently divide the children so that some go to school and others remain at home to support the family, a strategy known as "standing with two legs", one leg in education and another in culture (The Conversation 2016).

Table 28: Percentage of Educational Attainment in Turkana County, Turkana East and Turkana South Sub-Counties (2009)

County/Constituency/Wards	None	Primary	Secondary	Total Population
Turkana East Sub-County	71.7	22.3	6.1	84,184
Kapedo/Napeitom	55.4	32.2	12.4	23,671
Katilia	91.1	7.9	1.0	19,574
Lokori/Kochodin	71.7	23.4	4.8	40,939
Turkana South Sub-County	75.3	20.7	4.0	123,812
Kaputir	53.1	39.4	7.5	13,840
Katilu	75.0	21.8	3.2	38,358
Lobokat	44.1	46.4	9.5	9,021
Kalapata	91.0	8.2	0.9	21,943
Lokichar	81.6	14.4	4.0	40,650
Turkana County	82.1	14.5	3.3	749,235
Kenya	25.2	52.0	22.8	34,024,396

Source: KNBS and SID 2013a

Enrollment in early education has been improving. New ECD centres provide free primary education which have seen enrollment increase by 200% (EMC and Golder 2017). The emphasis on ECD has resulted in the county having a higher net enrollment ratio (NER) at the pre-primary level compared to the nation overall (87.8% and 74.6% respectively) (UNICEF 2017). However, enrollment at the primary and especially at the secondary level are below the national averages. The NER enrollment ratio at the secondary level is over four times smaller than the national level (Table 29). This is likely due to the challenges in the provision and promotion of secondary education that had not yet been devolved (UNICEF 2017).

Table 29: Select Education Indicators (2015)

Education Indicator	Turkana County	Kenya
Pre-primary Education		
Gross enrolment ratio (%)	94.1	76.5
Net enrolment ratio (%)	87.8	74.6
Gender parity index	0.79	0.96
Pupil teacher ratio	79.5	31.9
Primary Education		
Gross enrolment ratio (%)	81.5	103.6
Net enrolment ratio (%)	71.6	88.4
Gender parity index	0.70	0.96
Pupil teacher ratio	84.1	35.2
Secondary Education		
Gross enrolment ratio (%)	17.7	63.3
Net enrolment ratio (%)	11.0	47.8
Gender parity index	0.4	0.89
Pupil teacher ratio	25.7	20.7

Source: UNICEF 2017

Notes:

Gross Enrollment Ratio: Total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school year.

Net Enrollment Ratio: Enrolment of the official age group for a given level of education expressed as a percentage of the corresponding population.

Gender parity index: Ratio of females to male values of a given indicator
Pupil teacher ratio: Ratio of pupils to teachers. Note, this indicator only refers to public schools.

Turkana County has a low literacy rate where only 22.2% are literate in comparison to the national literacy rate of 78.7% (World Bank DataBank 2018; TCG 2013). Given the low levels of educational attainment and enrollment, Turkana County's low literacy rate is to be expected. The low literacy rate can be attributed to a variety of causes such as extreme poverty, school understaffing, and cultural practices such as early marriages (TCG 2013). External events such as drought and inter boundary conflicts also disrupt education, resulting in low literacy.

A 2015 survey identified the main challenges to education in Turkana County to be poverty, drug and substance abuse, absenteeism of students and teachers, peer pressure and poor parenting (NCPD 2017). These challenges can lead to poor academic results, early marriages, poor concentration in school and early school leaving. Other challenges cited in improving education include the long commuting distances to schools and

teacher shortage, particularly as many teachers leave education to seek better paying jobs in the newly developed County administration (EMC and Golder 2017). The pupil and teacher ratio at the pre-primary and primary level is notably high at 79.5 and 84.1, many times higher than the national averages of 31.9 and 35.2, respectively. School fees were also noted as being prohibitively expensive (EMC and Golder 2017).

Gender parity is also notably lower in Turkana county compared to the country overall, decreasing as the level of education increases. The United Nations International Children's Emergency Fund (UNICEF) has identified a need for the county government to focus on providing equitable access at all levels of education (UNICEF 2017). The barriers associated with girls' difficulty attending school in the county are related to issues such as poverty[52]; biological changes[53]; early marriage[54]; and girl-child labour[55] (Cultura Critica 2015).

2.4.1.8.2 Health Services

Turkana County has 12 hospitals, 13 health centres, 168 dispensaries, 26 clinics, one health training institution and one stand-alone vocational counselling and testing (VCT) centre (TCG 2016a). The average distance to a health facility in the county is approximately 20 km.

Table 30 presents the health system challenges in Turkana County. Additional information on baseline health conditions in Turkana County is discussed in Appendix A: Community Health Baseline Report.

Table 30: Health System Challenges in Samburu County

Project County	Challenges	Contributing factors
Turkana	■ Inadequate health infrastructure (35 km average distance to a health facility) ■ Inadequate human resources ■ Food insecurity and malnutrition ■ High demand for health services ■ High burden of communicable and infectious diseases ■ Poor health seeking behaviour ■ Poor access to safe drinking water and sanitation ■ Insecurity and ethnic conflict ■ Nomadic lifestyle ■ Emerging burden of non-communicable diseases ■ Referral system challenges ■ High illiteracy level	■ Arid and semi-arid climate (food insecurity) ■ Historical marginalisation ■ Vastness and remoteness of geographical area, that is sparsely populated contributes to poor service delivery ■ Population influx in urban and peri-urban areas ■ Vulnerabilities associated with border location ■ Large refugee population ■ Negative cultural practices (such as use of traditional medicines) ■ Changes in lifestyle and rapid urbanisation

Source: Baseline KIIs in Appendix A.

52 Education costs can be prohibitive for children from poorer backgrounds who are pressured to withdraw from or not start school. In addition, poverty plays a major role in lack of enrollment or early school leaving. When money for school fees is scarce, boys are given preferences over girls, stemming from the cultural tradition that girls leave their parents' village and become a member of the husband's family upon marriage (Cultura Critica 2015).
53 Referring to menstruation which can cause girls to stay at home,
54 Girls may be married off to enable the family to procure dowry or bride prices which also relieves the family of the economic burden of supporting them. In Turkana, early marriage is common (Education Development Trust 2016).
55 A large number of children are used as income earners in households by acting as domestic servants, herding livestock, and engaging in petty market business such as selling milk and foodstuff. Girls in particular may miss school due to activities such as family chores. Once in school, the extent of the chores would also limit their capacity for learning due to exhaustion (Education Development Trust 2016).

2.4.1.8.3 Housing

Three types of housing are found in the county: temporary units, semi-permanent and permanent units. Temporary housing units, known as *manyattas,* are the main type of housing found throughout the county. The temporary units are constructed primarily by male pastoralists as they move their animals throughout the county to pasture and water (TCG 2013; 2016b). Semi-permanent housing has mud walls and are roofed with *makuti*[56] or *mabati*[57] in urban areas. Permanent housing is also mainly found in urban centres. Outside of urban areas, more long-term or permanent housing are constructed by females and are made of acasia There is a housing shortage in the urban areas of Lodwar, Lokichar, Kakuma and Lokichoggio. If prolonged, it can lead to the growth of unplanned and informal urban settlements (TCG 2016b)

Housing quality in Turkana County is generally poor with housing units made of less durable materials than for the nation overall. The majority of households in the county have earth floors and only a small proportion have homes with cement floors (KNBS and SID 2013a). The proportion of cement flooring for Kenya overall is six times the proportion found in Turkana County. The most common wall material in Turkana County is wood (31.0%), followed by grass/reeds (27.8%) and mud/wood (23.6%). In the subcounties of Turkana East and Turkana South, mud/wood is the most common wall material. The most common roof material in the county are makuti roofs (36.6%), grass (34.9%) and other materials (13.7%) (KNBS and SID 2013a). No houses have concrete roofs. Makuti is a much less commonly used roof material for Kenya overall while corrugated iron sheets are nearly six times as common at the national level compared to the Turkana county level. The floor, wall, and roof materials are reflective of the geographic and socio-cultural characteristics of the region where nomadic pastoralists migrate with great frequency.

Permanent homesteads are found in both dry and wet seasons. Stays at short-term or long-term homesteads are available with the permission from Elders and the Chief. In Lokichar, permission is granted by seers and Elders. For short-term stays (i.e. one day), permission is not required if there are no others on site (Focus Group, Elders, Lokori, 2019; Appendix B). Pastoralists from Kalapata construct short-term homesteads during the dry season as they migrate to pasture areas.

2.4.1.8.4 Security

Turkana County and the surrounding region (neighbouring counties and countries) have a long history of conflict related to competition over natural resources (i.e. pasture and water) and cattle raiding. Security is a challenge given the county's limited physical infrastructure and communication infrastructure. Where present, police and the judiciary are under resourced and unable to carry out its functions (Mkutu and Wandera 2013). The county shares borders with three countries and its long porous borders pose a challenge to administrators due to its remoteness and poor infrastructure (Agade 2015). Insecurity has been a major deterrent to economic development and investment in Turkana County. Some areas in the county may be considered as "no man's land" and with little development, there has been a lack of incentive to provide security beyond urban centres. Resource-based conflicts arise when pastoral families migrate to slightly less affected regions and clash with host communities over access to and control of scarce resources. Climatic variability and the mobility of pastoralists are major contributing factors to resource competition (Mkutu and Wandera 2013). Conflict can worsen when there is rainfall in a particular region as large numbers of pastoralists migrate to the area. Drought-related stress escalates conflict and revenge killings and child abductions have recently started to take place (Oxfam 2017).

In the past, resource-based conflicts were predominantly about livestock and its related productive assets of water, pasture and land. Violent theft of livestock, referred to as raiding, have been characteristic of the people living in northern Kenya and the neighbouring region[58] since precolonial times. The Turkana people have

56 Thatching made from the sun-dried leaves of the coconut palm Cocos nucifera.
57 Iron fabricated house
58 Northwestern Uganda, southern Sudan, southern Ethiopia and northern parts of Tanzania

utilised raiding as a means to restock herds, expand grazing lands and gain access to water and pasture resources while increasing social status for more than 9,000 years (Eaton 2008; Moru 2010 cited in Omolo 2011). Raids also have significant cultural value. Organised raids have been described as sport to which young men devote themselves to obtain fame (Lamphear 1991). In addition, organised raids have also been used to facilitate payment of brideprice with large numbers of cattle (Agade 2015). Young people are increasingly organising raids themselves without the consent of elders or diviners and selling cattle off quickly for cash. These dynamics also allow the flourishing of black markets, racketeering and armed banditry on roads (Agade 2015)

In more recent times, the spread of small-arms along with the commercialisation[59] of livestock raiding, dispute over land tenure rights, banditry and predation, have seen raiding become more widespread, violent, sophisticated and destructive (Schilling et al. 2012). The commercialisation of raiding has interfered with pastoral livelihoods and contributed to conflict. Violence has also been more often linked to natural resource disputes due to longer and more frequent droughts in dryland areas and exacerbated by easier access to illicit arms (EMC and Golder 2017). Recent conflict in the region have seen a significant trade in small arms and light weapons being traded along the Turkana County and the South Sudan border (Oxfam 2017). An estimated 70-100% of pastoral men in the northern border areas are reported to be armed due to the prevalence of cattle rustling and resource-based conflict (Oxfam 2017).

Turkana County is resource rich, a factor that can exacerbates conflict among local interest groups and draws in national and international players. Before the discovery of oil, pastoralists moved relatively freely over land searching for pasture and water (with restrictions due to competition with the Karimojong and Pokot communities (Agade 2015). The discovery of oil in Turkana County and the oil infrastructure associated with its development have brought uncertainty and fear of losing land and grazing restrictions, which would directly affect pastoral livelihoods (Agade 2015).

Given the remoteness and large land mass of Turkana State, scant state policing is available. The county has only eight police stations (Agade 2018). Data on the number of police officers in the county and the capacity of security resources was not available. The Kenya Police Reserve (KPR) is a voluntary provider of community security. Reservists come from the local pastoral communities and therefore speak the local language, understand the local security context and are familiar with the area (Mkutu and Wandera 2013). The KPR guard pastoral *kraals* (enclosures) and protect cattle caravans against raids as they move (Agade 2015). Challenges in recent years involve KPRs taking new paid roles as private security guards especially for oil exploration and drilling sites, resulting in KPRs moving away from their original functions of providing community security.

2.4.1.9 Physical Infrastructure

2.4.1.9.1 Water

Turkana County is a water scarce county that has experienced a general decline in the quantity and quality of water for domestic and productive use. Rainfall in the county is bimodal[60], erratic and sparsely distributed, manifesting in droughts and floods (TCG 2017). Long rains occur between March and May, short rains between October and December. Rainfall can range from 120 to 500 mm per year and is more likely to occur in South Turkana due to altitude. The more arid the area the more unreliable the rainfall is. During and between rain seasons, the county faces physical and economic water scarcity. During drought, the falling water tables lead to low yielding boreholes and longer wait times at water points (TCG 2017). The current water infrastructure is at capacity and there is inadequate water for the growing population for domestic use, livestock and crop irrigation (TCG 2016a).

59 where individuals have benefited rather than communities.
60 Two rainy seasons

Lake Turkana contributes to the livelihoods of over 300,000 people in Kenya including pastoralists, fishermen and tourism operators (The Conversation 2018c). However recent developments have placed Lake Turkana and the livelihoods that depend on it in jeopardy. The Oma River in Ethiopia, which feeds into the lake, provides more than 80% of Lake Turkana's freshwater inflow. The construction of the Gibe III hydroelectric dam and irrigation plantation developments on the Oma River have heavily disrupted the lake's seasonal patterns by decreasing the Omo River inflow which has caused nutrients required for fisheries to become concentrated in the northern areas around the Omo Delta (The Conversation 2018c; Future Directions 2017). This has resulted in a rise of violent clashes between the Turkana fishermen and the Dassanech tribes as the Turkana move north to compete for the scarce resources. Lake Turkana is predicted to shrink to 42% of its current volume with water levels declining up to 22 m (Future Directions 2017). Since 2015, satellite data has shown that Lake Turkana's waters have dropped by 1.5 m and data from the Kenya Marine and Fisheries Research Institute have also shown declining catches due to changes in water levels and overfishing (IRIN 2017). If the water levels fall by over 20 m as predicted, the northern end of Lake Turkana will shift southwards by up to 40 km and the Dassanech people would likely migrate south, increasing tensions with the Turkana fishing communities. The combination of poverty, competition for scarce resources, and high concentration of illegal arms is highly concerning for the stability and security of this region. In addition, these conditions would also be worsened by the effects of climate change (Future Directions 2017).

With the exception of Lake Turkana, few naturally occurring surface water bodies are found in the county due to high evaporation rates during the dry season (TCG 2017). Several ephemeral rivers known as *luggas* or *laghas* crisscross the region. The main rivers in the county are the Kalapata, Kerio, Malimalite, Tarach, and Turkwel rivers, of which only the Turkwel and Kerio are semi-permanent (UNICEF 2017; Schilling et al. 2012). Several springs are also found across the county, especially parts of the lake zones and Turkana East.

Without sufficient naturally occurring surface water bodies, the county has constructed man-made water bodies across the county such as dams, water pans[61], and sub surface dams (TCG 2017). The man-made structures are mainly used for domestic and livestock and are especially important during the dry season for livestock. The county has one water supply organisation, Lodwar Water and Sanitation Company Ltd. (LOWASCO), which supplies water in the town of Lodwar. Other urban centres are managed by Water Service Providers. The main water sources in rural Turkana County are bore holes and piped water with the majority relying on unprotected wells and streams (TCG 2017, TCH 2018). In recent years, improvements to the rural water infrastructure has seen over 200 boreholes being drilled and the upgrading or rehabilitation of several water schemes (TCG 2017). In general, urban centres and some market centres have piped water closer to settlements while more remote areas like Kibish, Lomelo, Lorengippi and Mogila have water points further away, ranging from 10-20 km (TCG 2017).

Water for livestock is often not included in designs of community water supplies. Limited water supplies for livestock results in constant migration in search for water which can initiate or exacerbate water use conflicts (TCG 2017). Currently the county does not have any ranches but does have a holding ground at Lomidat abattoir in Turkana West Sub-County and another under construction at Napelilim in Loima Sub-County. There was a holding ground at Kainuk in Turkana South Sub-County but persistent cattle rustling resulted in its collapse (TCG 2017).

To improve water supplies in the county, existing water schemes must be repaired to increase their efficiency and in addition, earth dams and pans must be constructed (TCG 2016a). The county also identifies the need for programmes aimed at protecting the water catchment areas and harnessing water from the Kalapata, Kerio, Malimalite, Suguta, Tarach, and Turkwel Rivers. Excessive grazing pressure in the county can have a

61 A water pan is a small reservoir created by excavating open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands

deleterious effect on soils, stripping them of the capacity to hold any water as well as releasing loose soil into water bodies (TCG 2017). This causes droughts and water stress to persist due to poor catchment management, slow responses, disconnected institutions, information blockages and lack of capacity. The county has identified the need to increase community awareness and participate in the management of water resources and catchments (TCG 2017). Table 31 presents the water supplies for livestock used by Project area communities in Turkana County.

Table 31: Livestock Water Supply for Pastoralists in by Project-Area Communities in Turkana County

Community	Water Supply	Season
Lokichar	■ Water points at Kalapata, Lokichada, Kamanu-Kwee, Kaimegur, and Elelea-Nabolei	Dry
	■ Traditional wells for livestock Kaakali, Kamarese (until it rains) ■ Natural water pans, *Ngataparin,* (Lokulubech, Apa-lolemu and Askim) can hold water for about six months	Wet
	■ Water points Karipun, Kanging'olemogin, Riami-riame, Lokuno	n/a
Lokori	■ Kerio River; ■ Water points at Lohurerei and Lokwamosing ■ Oases at Kaachola, Napeitom, Naskeny, Kanapot, Kangiesei, Kalomesek Sil, and Agolet	Wet and Dry for Oases
Kalapata	■ Kareko, Elelea, Nabolei are the major wells	Mid-Wet
	■ Borehole (Nakiling'a at Loperot) shared by school, community and pastoralists	Dry
	■ Water points at Loturerei, Lokwamosing, Nabolei water well, Kaimegur, and Kaidima ■ Kerio River	n/a
	■ Wells at Lokichada are a central source of water for pastoralists in the different regions of Loperot, Nakukulas, Lokiroe-liwo, Kaching'angar, and Ikalale Akeraan.	n/a
Katilia	■ Wells, springs, boreholes ■ Water catchment (*ngiburin)* and oasis (*ngichwae)* ■ Water (*Eriong'a)* is used on the farms	n/a

Source: Focus Group, Pastoralists, Lokori 2018; Kalapata 2018; Katilia 2018; Lokichar 2018; Appendix B.

n/a = data not available

Pastoralists noted that there was insufficient water for livestock at Lokichar and a lack of water points in Kaemomug due to urbanisation i.e. development of plots along livestock routes (encroachment). (Focus Group, Pastoralists, Lokichar 2019; Appendix B).

2.4.1.9.2 Sanitation and Waste

Limited waste disposal infrastructure is found in the county. Major issues of concern revolve around the lack of storage, transport and disposal of waste (TCG 2017). Sewage service coverage is found only in urban centres with particular challenges in waste disposal in Lodwar as illegal waste is dumped in the Turkwel River that runs through Lodwar (TCG 2017). LOWASCO is the only service that collects liquid waste, mainly sewage discharge from septic tanks across Lodwar, and dumps it separately (EMC and Golder 2017). A $3.9 million waste treatment and transfer station is being built at Kanipetain. The facility will handle hazardous waste from crude oil exploration in the South Lokichar basin and planned commercial production of fossil fuel (The East African 2017b).

The vast majority of the county (82%) does not have access to sanitation facilities and open defecation is five times as prevalent as latrine-use (about 20,200 county households). The prevalence of open defecation is due to poor awareness of good hygiene practices[62], lack of access to adequate safe drinking water[63], social dynamics[64], low literacy levels, low government prioritisation, traditional community practices[65], and lack of appropriate local latrine materials[66] (Karanja et al. 2018). The current means of waste disposal are also a major source of environmental degradation, contributing to air, water and soil pollution. In addition, poor waste disposal poses a health threat to communities. Lack of toilets and potable water combined with poor hygiene habits have contributed to increasing cholera outbreaks in the county (ReliefWeb 2018).

By 2030 an estimated 30% of the county's population is projected to live in urban areas. The county government recognises that this will generate more pollution and large quantities of waste that will require effective waste disposal management systems (TCG 2017). Current efforts are focused towards building and expanding the sewage system in urban towns such as Lodwar to connect households to the sewer line (TCG 2017). While there have numerous sanitation interventions in Turkana County, increased access to sanitation remains below the target of achieving Open Defecation Free status. The county is now working on constructing latrines using local materials and construction techniques appropriate for the county's dry and loose soil conditions (Karanja et al. 2018).

2.4.1.9.3 Energy Sources

The county has very limited electricity infrastructure. Few households have electricity, especially in rural areas. Challenges to electricity development include weak transmission and distribution infrastructure, high power costs, and low per capita power consumption (EMC and Golder 2017). Half of county households use collected firewood as their main source of lighting, followed by paraffin (20%) and dry cell torch (12.5%). Approximately 11% of households in the county have electricity (19% in urban areas and 1% in rural areas) (KNBS and UN 2016). Cooking is also done primarily with collected firewood (80.5%) with smaller amounts of charcoal (9.3%) and purchased firewood (8.1%) (TCG 2016a). Kainuk is the only area connected to the national electricity grid. The town of Lodwar is powered by diesel generators. Some households near Lodwar were observed to have solar panels and wired electricity, but supply was said to be intermittent and data on such infrastructure was not available (EMC and Golder 2017).

Aditional nomadic lifestyle practiced by a large part of the population (TCG 2017).

intaining the status quo regarding open defecation (Karanja et al. 2018).

62 The need for sanitation is not always viewed as a priority by the traditional nomadic lifestyle practiced by a large part of the population (TCG 2017).

63 Only 58.5% of the county have access within 500 m to the nearest water point (the minimum standards for Water Sanitation and Hygiene) (TCH 2018).

64 Social dynamics affect how people perceive sanitation and hygiene and the potential for implementing long-term behavioural changes. Some Turkana people believe that it is taboo for all members of a household to use the same site for defecation while others are adamant about maintaining the status quo regarding open defecation (Karanja et al. 2018).

65 The need for sanitation is not always viewed as a priority by the traditional nomadic lifestyle practiced by a large part of the population (TCG 2017).

intaining the status quo regarding open defecation (Karanja et al. 2018).

66 The need for sanitation is not always viewed as a priority by the traditional nomadic lifestyle practiced by a large part of the population (TCG 2017).

Renewable sources of electricity such as solar and wind are areas of great potential in Turkana County. Solar energy has been used to power schools and to purify drinking water in Lake Turkana (Business Daily Africa 2017a; OpenIDEO 2018). Solar light poles have been installed in Lodwar Town that is expected to boost security and business. Additional solar streetlights are planned for other areas like Kalokol, Kakuma, Katilu, Lokichar, Lokitaung, and Lokori (TCG 2016c). Wind power is another emerging resource that can be developed as the county receives strong, predictable wind streams due to its geography. The county's unique geography creates wind streams known as the Turkana Corridor low level jet stream and has already been used to power the country's largest wind farm in neighbouring Marsabit County (TCG 2013; Lake Turkana Wind Power 2018). Hydroelectric power is also provided in the southwest area of the county at Kengen's Turkwell Hydro Power Plant (TCG 2016c).

Initial steps have been undertaken to increase reliable and affordable electricity access. In 2017, a $17 million USD electricity project was commissioned in Turkana County that will connect the county to the national grid (Construction Review Online 2017b). The Project will cover the towns of Lokichar and Kalemung'orok with plans for extension to Lodwar and other county towns.

2.4.1.9.4 Transportation

Road infrastructure in the county is very poor with many roads in need of repair and maintenance. The county has only one major road passing through Turkana to Sudan, one Class A all-weather road from Kainuk to Lokichogio, a Class B Road from Lodwar to Kalokol, and two Class C roads from Lokichar to Lokori and Lokori to Kapedo (Muchoki 2015). The total road network is 5,496.2 km long, made predominantly of earth (91.1%) with only 8.8% made of tarmack (TCG 2016a). The main challenge to the road network is that seasonal rivers cut through roads rendering them impassable during rainy seasons (TCG 2013). Many roads are corrugated and poorly weathered with potholes (EMC and Golder 2017). In addition, the poor quality soils that make up the roads also increase construction and maintenance costs. During the dry season, the roads facilitate access to trading centres that are not available in the rainy season (EMC and Golder 2017).

The poor infrastructure impacts livelihoods in the county. The lack of quality roads makes sending supplies into rural areas difficult which also limits trade with other regions. In addition, the Turkana people do not have a tradition of using carts and animal power for transportation as they carry everything themselves (Muchoki 2015). No reliable public transportation system exists in Turkana County and most of the population only have the option of walking from one place to another.

As part of the LAPSSET project, the Nginyang'-Lokori-Lokichar road will be upgraded to tarmack standards. The road traverses the East Pokot, Turkana Central, Turkana East and Turkana South sub-counties (Otieno Odongo & Partners 2016). Additional tarmacking of roads in Turkana County is expected in the coming years for a total cost of up to 65 billion KSh (Business Daily Africa 2017b).

Turkana County has one airport in Lokichoggio that is tarmacked[67] and 22 airstrips throughout the county (TCG 2016a). Three airlines operate out of the Lokichoggio airport. The LAPSSET project includes the construction of a new $143 million USD international airport. Currently an intermediary airport is being planned to build up an air transport and logistics business case for the construction of the international airport (LAPSSET 2017).

2.4.1.9.5 Communication

Communication infrastructure in the county is sparse and limited. Traditional forms of communication such as mail and radio offer the most coverage. The county has five post offices in Lodwar and Lokichoggio and six sub-post offices (TCG 2016a; Muchoki 2015). There are four private courier services that also provide mail and parcel delivery. Radio is one of the few forms of media available in the county. Radio Turkana is one of the

67 surfaced with tarmac or a similar material.

main radio stations and provides coverage for approximately 75% of the county, mainly in Turkana Central, Turkana East, Turkana South, and Loima (EMC and Golder 2017). One company, Telekom, is the sole provider of landline services, with 460 telephone connections in the county (TCG 2013).

Telecommunication infrastructure in the county is found mainly in urban centres. In 2016, there were a total of 460 telephone connections in the county (TCG 2016a). The county has three mobile telephone companies but mobile network coverage is limited to the major urban areas, with coverage for about a third of the county population (TCG 2016a; Standard Media 2017). This has a notable impact on communications, investment and security as people must travel long distances to be connected. The limited communication network is due to the logistical challenges of the large land area, lack of infrastructure development and high poverty in the county. No newspapers are published in the county (EMC and Golder 2017). Information on access to the Internet was not available.

2.4.1.10 Land and Resource Use

The county contains pockets of high potential rangelands which are vital to land use patterns. While the ecosystem is diverse, the marginal nature of the environment creates survival risks. Land users cope by exploiting multiple resources by employing multi-species pastoralism, fishing, farming and gathering of wild foods (Muchoki 2015). Land is settled according to grazing and seasonal patterns (Focus Group, Local Government, Lokori 2019; Appendix B). Pastoralism is the dominant land use in the county. Other land use activities include small-scale agriculture along the Turkwel and Kerio Rivers, fishing along the western shores of Lake Turkana and scattered settlements and urban centres (Muchoki 2015). Pastoralists in almost all communities reported no hunter gatherers are found in the county due to a combination of factors such as climate change, change of livelihoods and education on the importance of wildlife (Focus Group, Pastoralists, Lokori 2019; Kalapata 2019; Appendix B). Pastoralists from Lokichar indicated that there were hunters found in Kaamorok, Kachingaror and gazelles could be found around the Turkana South National reserve.

2.4.1.10.1 Land Ownership

The vast majority of land in Turkana County is unregistered community-owned land. As no formal surveys or land adjudication have occurred, the land is held in trust by various communities under customary tenure and is managed by local authorities such as the Turkana County Council and the Lodwar Municipal Council (Muchoki 2015). Community land committees in Lokori govern land use and develop bylaws and fees for various land uses (Focus Group, Local Government, Lokori 2019; Appendix B). In Katilia, the community works with the local government to produce agreed upon laws about land usage by investors (Focus Group, Katilia Local Government, January 17, 2019a). Katilia also has leased out programs with fees that are negotiated by the investor, community, and the local administrator. Elders in Katilia have the final say on the use of land as they are the main stakeholders (Focus Group, Elders, Katilia, 2019; Appendix B). In Kalapata, there is no specific structure that manages land, and so it is controlled by the heads of the Ere. Likewise in Lokichar, while there is no specific structure that governs land utilisation, the community agrees and gives lands for public projects (i.e., schools, hospitals, churches) for free. In most cases, land in Lokichar is managed by a Council of Elders along with Chiefs. Grazing areas are managed by the heads of clans, controlling it according to the grazing patterns and seasonal calendar (Focus Group, Local Government, Lokichar 2019; Appendix B).

There are two categories of trust land in the county: trust land administered as centres[68] that have development plans, and land administered under Turkana County Councils. A small portion of the land is public land held on behalf of the county and national government by the National Land Commission (UN-Habitat 2016). The Turkana County Government owns all community land, known as 'Ngirerea[69]', and provides land in town centres

68 Portion of the land specifically owned and resided by a certain clan (Focus Group, Ka Kalokol where allotment letters are issued.

68 Portion of the land specifically owned an

69 Portion of the land specifically owned and resided by a certain clan (Focus Group, Kalapata Local Government, January 19, 2019a).

on a leasehold basis to private individuals (Muchoki 2015; Focus Group, Local Government, Lokori 2019; Kalapata 2019; Appendix B). All land in the Project-area communities are communal and are owned by the community.

Currently, there is no available land in the communities of Lokori, Katilia, and Lokichar. In the communitiy of Lokori, if investors apply for land, it is leased to them by the Turkana County Government through the Ministry of Lands. In Katilia, while no land is available for new applicants or immigrants, they can still come and co-exist for a certain period of time. In the community of Kalapata, new land applicants are given land parcels for a specified period of time through the legal permission of the communitiy elders. In Lokichar, all land apart from public institutions are intended for livestock grazing. Any land needed for a mega project and investment is leased through the county government in consultation with community representatives but cannot be sold to any new applicant or investor.

The only legal documents for proof of ownership of land are the allotment letters issued by local authorities in urban centres. This is done to control haphazard developments and is most apparent in township areas such as Lodwar, Kainuk, Kakuma and Lokichogio (Muchoki 2015). Outside of urban centres, access is mainly through inheritance (FAO and UN Women 2017). Grazing resources (including water in rivers and streams, open pools and shallow wells) are not owned but are open to all members of a territorial section (Muchoki 2015). However deep wells dug through sand such as riverbank aquifers, clay or rocks are owned by the individuals who dig them and can be used by close relatives and friends. There is no formal documentation for access to communal land in rural Turkana County. The lack of title documents in the face of recent ongoing land developments[70] were noted as eviction threats in a 2017 survey (FAO and UN Women 2017). Without documentation, communities have extreme difficulties negotiating for fair compensation when their land is acquired by the government through expropriation.

Land is traditionally demarcated by the community using indicators such as family graves, large old trees, and watering wells. Deprivation of access to common areas is low and landlessness is not an issue as a community's Council of Elders make sure that each community member has access to land and work to resolve land-related disputes at the community level (FAO and UN Women 2017; TCG 2013). Those who wish to access community land for investment or other business reasons must negotiate with community elders, in consultation with the Chief and relevant government officials.

Pastoral women are "primary" users of land and also significant "secondary" users, collecting rangeland products (e.g. firewood, grass, fodder, wild fruit, medicinal plants, gum and resin). Despite their wide use of land, women, especially poor women, have fewer options for participating in land governance, and this increases their vulnerability and limits their capacity to access, use and own land (FAO and UN Women 2017). Women do not typically have land ownership rights although daughters of chiefs or women from rich families are allocated land (FAO and Women 2017). These allocations however can be taken away by their brothers once the parents are dead. Youth and other vulnerable groups (e.g. those with disabilities, human immunodeficiency virus [HIV]) are also seldom involved in land-related discussion matters. Several factors affect women and youth's land access rights include: religious beliefs that women should not mingle with men; low literacy rates among women; lack of female role models who have succeeded in accessing land; poverty; corruption; lack of political good will; gender inequality due to cultural barriers and discriminatory traditions; and poor access to information and inadequate knowledge about existing legal frameworks on land (FAO and Women 2017).

owned and resided by a certain clan (Focus Group, Kalapata Local Government, January 19, 2019a).

The communal land tenure system has been a contributing factor to the county's lagging development as it prevents local communities and other development agents from investing in the county (TCG 2013). Lack of land ownership also prevents people from having access to loans. There is a need for land tenure security to protect people from displacement, enable access to loans, allow them to promote their livelihoods and build investor confidence (UN-Habitat 2016).

2.4.1.10.1.1 Agro-Pastoralism

Turkana County has approximately 2,500,000 ha of arable land. Food crops such as maize, sorghum, millet and vegetables are grown. No cash crops are currently being grown (TCG 2013). Farm sizes are estimated to be 2 acres on average. While no ranches exist in Turkana County there is one holding ground at Lomidat abattoir in Turkana West Sub-County (TCG 2013). The county also does not have any gazetted and non-gazetted forests. Forest products produced from the county include charcoal, wood carvings, fencing posts, firewood, aloe vera and herbal medicine. Wood is used for fencing and *manyattas*.

Farming occurs in the agro-pastoral zone located along the Turkwel and Kerio Rivers where irrigation schemes facilitate the growing of food and cash crops (FEG 2016). A variety of fruits (bananas, pawpaws, oranges), vegetables (kales, green grams) and other crops (rice, African night shade, and spider wisp) are grown. Farming has helped alleviate food insecurity, diversify diets, and even earn money through cash crops. Crop farming along the Katilu Irrigation Scheme, a 2000 acreage project in the Loima sub-county in Turkana South, has allowed around 1,800 farmers to move from the traditional over-reliance on livestock keeping to sustainable farming (Business Daily Africa 2017c). Land has been subdivided into half-acre pieces with different homesteads owning the pieces (Standard Media 2016). While more interest has been expressed in farming as evidenced by the growing number of farmers registering for the scheme, challenges remain. Locals still depend on the government for assistance in farm inputs, land preparation, and linkage to markets (Business Daily Africa 2017c).

2.4.1.10.2 Pastoralism

Most Turkana people practice nomadic transhumance[71], characterised by flexible mechanisms such as mobility, communal land ownership, large and diverse herd sizes, and herd separation and splitting (Schilling et al. 2012). Livestock, especially cattle, form the core of Turkana culture (Kenya Information Guide 2015). The Turkana manage multiple species of livestock (i.e., cattle, camels, goat, sheep and donkeys) to take advantage of the environmental variability and diverse land and resources. As each species has different dietary needs, the Turkana are able to exploit different expanses of geographic ranges during any period of the year[72] (Muchoki 2015). Camels, cattle, sheep and goats provide most of their subsistence needs by providing products such as milk, meat, hides, skins and ghee. Donkeys are used to transport household goods during migration. In the Project area, herds include large numbers of drought-resistant livestock species such as camels and goats, with relatively few cattle (Dyson-Hudson and McCabe 1983). Average livestock herd size in the Project area communities vary and have a wide range of water consumptions needs. Table 32 presents livestock data in the Project area communities in Turkana County.

71 The action or practice of moving livestock from one grazing ground to another in a seasonal cycle.
72 During the dry season, cattle are confined to the mountain areas and river courses and moved to the plains in the wet season (Muchoki 2015). Sheep, goats and camels can stay in the plains during both the wet and dry seasons.

Table 32: Livestock Data in Project Area Communities in Turkana County

Community	Animal	Average Household Herd Size	Amount of Water Consumed per Animal	Frequency of Water Consumption
Lokichar	Goats	100-400	10-15 litres	Two Days
	Cows	20-220	100 litres	Two Days
	Donkeys	10-80	100-150 litres	One day
	Camels	10-70	10-15 Days	Two Days
Lokori	Goats and Sheep	100-200	7 litres (more during wet season)	Two days
	Donkeys	2-10	40-60 litres	Daily
	Cows	5-10	50-70 litres	Three days
	Camels	10-50	80-100 days	Seven Days
Kalapata	Shoats (Goats and Sheep)	50-100	20 litres (dry season)	Two days
	Donkeys	5-20	90 litres	Three Days
	Cows	15-40	70 litres	Two days
	Camels	30-100	160 litres (dry season) 60 litres (wet season)	Six Days
Katilia	Shoats (Goats and Sheep)	100-200 goats 50-100 or 200-500 sheep	10-13 litres (dry season)	n/a
	Donkeys	20-50	60 litres	Two Days
	Cows	50-150	140 litres	Two days
	Camels	40-100, 70-80, 500-700	100 litres, consuming less during wet season	10 days

Source: Focus Group, Pastoralists, Lokori 2019; Kalapata 2019; Katilia 2019; Appendix B.

While veterinary services are available at the Lokori trading centre, veterinary services are not available to pastoralists in Katilia and Kalapata. All pastoralists they purchase and administer the drugs to the livestock themselves.

Pasture and water resources in the county are characterised by patchiness and do not reoccur year to year with predictable uniformity, therefore movement between pastures varies. The Turkana people's movements are in response to the intermittent rainfall distribution and patchy vegetation productivity. In addition, their movements are also driven by poor security and the particular requirements of the livestock species they rear (Muchoki 2015). The highest numbers of livestock in the county are found in the Lokitaung and Lokori divisions and the heaviest average concentrations are found around the catchment areas of Kakuma, Kalokol, Lokori, and Lorugum and are low around Lodwar and Katilu (Muchoki 2015).

Livestock ownership has multiple functions in the lives of the Turkana people, serving as a form of pastoral capital while also functioning as a means of production, storage, transport, and transfer of food and wealth (Schilling et al. 2012). Livestock provides a regular food source for household members and provides cash income to pay for services such as education and healthcare. Socially, livestock acts as payment of dowry, compensation of injured parties after raids, represents prosperity, and is a store of wealth and security during drought and disease (Schilling et al. 2012).

Table 33 presents a summary of travel routes of the Project area communities.

Table 33: Pastoralist Travel Routes

Community	Season	Travel Route
Lokichar	Dry Season	Lomariamuge through Kachingangor to Aroo (Kalemngorok) Lomokori to Nakabosan Lokitoeliwo to Lokwamosing Ngimeyana to Kochodin
	Mid-Wet Seasons	Aroo to *N'girerea* (permanent homesteads)
	Wet Season	Graze around the *N'girerea*
Lokori	When the river is high	Nakwakaal to Lomomug
	When the river is dry	Nakwakaal to Kerio
	Wet Season	Lomomug to Nakmakaal
Kalpata	Dry Season	Kalapata to Naroo via Kachirgangor Kalapata through Nakukulas to Kailong'kol Kalapata to Lokwamosing Kalapata to Kerio then Karimorega Kalapata to Lorizi
	Wet Season	Around Kalapata area to Kaureta Ngisuroi Kalapata to Lomokamar in Lokichar
Katilia	Dry Season	Katilia to Kailong'kol Katilia to Kaamuge Nakwakaal to Sukuta Katilia to Likayo
	Wet Season	Katilia to Lokitela

Community	Season	Travel Route
		Katilia to Ngikengoi Katilia to Nakwakaal Katilia to Narokatalokinyi

Source: Focus Group, Pastoralists, Lokichar 2019; Lokori 2019; Kalapata 2019; Katilia 2019; Appendix B

Table 34 presents the herding calendar for pastoralists in Turkana County. The herding calendar experiences seasonal changes due to the irregularity of rainfall. The wet, mid-wet and dry seasons have changed over time. Pastoral movements have become irregular, making grazing patterns difficult to determine.

Table 34: Herding Calendar for Turkana Pastoralists

Month	Turkana Term	Season[(a)]	Activities
January	Lokwang	Dry (*nakamu)*	Long distance herding, water access along the river
February	Lodunge	Dry (*nakamu)*	
March	Lomaruk	Dry (*nakamu)*	
April	Titima	Mid-wet	Migration to pasture areas
May	Elel	Mid-wet	
June	Lochoto	Wet	Migration back to permanent homesteads
July	Losuban	Wet	
August	Lotiak	Mid-wet	Herding, watering, traditional rites, weddings
September	Lolong'u	Mid-Dry	
October	Lopoo	Mid-Dry	n/a
November	Lorara	Dry (*ngirerea*)	Breeding for livestock
December	Lomuk	Dry (*ngirerea*)	

Source: Focus Group, Pastoralists, Lokori 2019; 2019; Kalapata 2019; Katilia 2019; Appendix B
[(a)] *Approximate determination of the type of season varies by Project area community.*

2.4.1.10.3 Fishing

The fishing livelihood zone is located along the western shores of Lake Turkana where fishing is the main economic activity. Fish sales, fishing-related casual labour, handicraft sales, petty trade and livestock sales are the main sources of income in this zone (TCH 2018).

Pastoralists indicated that fishing of Tir, Loruk, Tilapia (Epokot), and catfish (Kopito) occurs along the Kerio River (Focus Group, Pastoralists, Lokori 2019). Fishing also occurs along the Sukuta River with fishing of *akiragiragiot* (fish with scales), *koopito (*Nile perch), *etiir* (Tilapia)*, naliba (*Ningu*), loruk* (King Fish) *and losali (*Carpus*).*

2.4.1.10.4 Urban

The Lodwar urban livelihood zone consists of 11 sub-location communities and is situated along the main road between Kenya and South Sudan. Livelihoods in this zone are primarily labour-based and many households rely on the natural resources immediately available. Demand for casual labour is typically in the agricultural or construction jobs (Muchoki 2015). Most casual labour jobs in the agricultural sector are available in the wet season with some herding opportunities in the dry season. There is a general lack of opportunities for waged or salaried labour.

Trade occurs on a small scale with livestock being sold to buy grain and households needs (Muchoki 2015). The Turkana people also engage in cross-border trade with communities along the Kenya-Uganda border (Business Daily Africa 2017d).

2.4.1.10.5 Mining

Gold mining operations have been prevalent in Turkana County for many years. Recent operations are labour intensive one-man operations while previous operations were done on larger scales. Gold mining occurs primarily in Nakoriyek, Kimagur, Lokiriama, Namorupus and Nadunga (Muchoki 2015). Small-scale gold mining also operates out of the southern portion of the county at Nakwamoru and central parts at Makutano between Kakuma and Lodwar. Other mining resources found in the county include building sand and quarry materials (Muchoki 2015).

2.4.1.10.6 Other Land Uses

Other land and resource use focusses on forest products, including charcoal, wood carvings, fencing posts, firewood, aloe vera and herbal medicine[73] (TCG 2013). Although charcoal production is illegal in Turkana County, it offers small returns to those that produce it and is produced along the Turkwel and Kerio Rivers. Charcoal is sold along the main highway between Kainuk and Lokichogio (Muchoki 2015). Wild fruits are sold throughout the county. Common fruits sold include Doum Palm, Ngakalalio, Edong and Edapal, and Ebei (Muchoki 2015). Trade in Prosopis pods around Lodwar and Kakuma is also emerging as an importance source of income.

Honey production is a commercially viable enterprise especially along the Turkwel and Kerio Rivers and higher altitude locations close to the Ugandan border. Honey production is primarily found in the following areas: Turkwel Division (Turkwel, Kalemunyang and Toyarabon); Katilu Division (Lokapel and Kanaodon); Kainuk Division (Kainuk, Loyapat); and Lokwar, Ekwar, Kaptir, Nakwamuru, Kapelibok and Oropio (Muchoki 2015). Beehives are made from logs cut from special types of trees such as the 'Echoke' (locally known as a sycamore) and the 'Edurukoit' (a type of Acacia).

Commercial basket-making and associated activities are important livelihood activities for households located near urban centres and the dry-river valleys close to Lake Turkana. The most important sites for basket-making are in Lodwar, Kalokol and Eliye Springs and the most important sites for mat-making are Kataboi, Kerio and Turkwel (Muchoki 2015). Women are the primary producers of baskets, woven goods and handicrafts and men are the primary producers of wooden products.

2.4.1.10.7 Land Use in Project Area Communities

In Lokori, land is used for agriculture and irrigation; business centres (e.g. for female empowerment); market stalls, livestock yard sales, sand soil harvesting; public institutions (e.g. schools, hospitals, churches); forestry and fishing; airstrip; communal cemetery; recreational centres (e.g. football pitches); residential areas; and archaeological sites (e.g. Namorutunga). In Lokichar, plant gathering (i.e. Edung and Edapal) is done at Okitoe-

73 Some of the local herbs used for medicinal purposes include Kutikuti, Ekabonyo, Eogong, and Siir (Focus Group, Lokori Elders, January 15, 2019a). Herbs are mostly found in the forested and hilly areas. Some of the herbs used for medicinal purposes by traditional healers in Lokichar are Echuchuka (Aloe Vera), Emus (traditional herb), Eogong (medicinal herb), Emoronyit (medicinal herb), Esekon (Salrodora Persica), and Eregis (medicinal herb) (Focus Group, Lokichar Elders, January 19, 2019c).

liwo, Dapar, and Lowoiangikakumok. In Katilia, communal land is mainly used for grazing, farming, water pans, mini-dams and public institutions such as schools and churches. Similarly, in Kalapata, most of the land in the community is used for grazing areas, a business centre, residential areas, water pens and catchment areas, and public institutions (i.e. churches, schools, and government administrative institutions). Land in Kalapata tends to be given freely through the Chief and Elders for the development of public institutions. In Lokichar, communal land is used for sale yards (for animal markets), wildlife, water catchment area, areas intended for solid waste management, areas intended for institutions (i.e. hospital, schools, other government administrative institutions), and sacred sites (i.e. Nakapelman).

2.4.1.10.8 Protected Areas

Turkana had four wildlife conservancies in Kainuk, Katilu, Lochakula and Lokichar but they were closed in 2016 (Northern Rangelands Trust 2017) (Appendix D).

2.4.1.11 Tourism

Currently tourism in the county is underdeveloped and the area is not a popular destination for regional or international tourism despite its tourism potential (TCG 2016a). The county has several natural attractions such as the largest desert lake in the world, three Nationals Parks[74] and archaeological sites such as Koobi Fora (known also as the Cradle of Mankind) and the Dancing Stones of Namoratung'a (Daily Nation 2017; TCG 2013). Other attractions include the beaches alongside Lake Turkana, Turkana South Game Reserve and sand dunes (Information Cradle no date). The rich culture of the Turkana people is also an asset that has potential and has been identified as a tourism product along with eco-sports, auto-cross and water-based tourism (TCG 2016b). Tourist accommodations are undeveloped, and the leading hotels are not above a three-star hotel rating. The county has one tourist class hotel located along the beach side of Lake Turkana around Eliye Springs. Recently, the government also completed furnishing two eco-lodges and expanding the existing capacity (TCG 2018).

Investment in tourism infrastructure is required to develop Turkana's tourism potential. In 2016, the average spending per visitor in the county was 5,000 KSh, a figure that the government hopes to increase to 20,000 KSh for 2019 (TCG 2016b). The county government recognises that investment is needed in diversifying the economy and aims to promote a sustainable environment for tourism, culture, heritage and natural resources preservation and protection (TCG 2018). One initiative implemented was the Explore Turkana Tourism Initiative that was launched to market more than 50 potential tourism sites and develop Turkana into a tourism destination (Daily Nation 2017). Other government initiatives include undertaking tourism market research, mapping important sites and monuments, and undertaking national and international marketing (TCG 2018).

Wildlife conservation is another aspect of tourism in the county. The county has one game reserve, located in the Turkana South District where most of the wildlife are found (TCG 2013). A variety of wildlife can be found in this area such as cheetahs, elephants, hyenas and lions. The county has also undertaken protection and gazettement of unprotected game reserves and has signed a Memorandum of Understanding on how wildlife resources should be managed between the Kenya Wildlife Service and the county government (TCG 2018).

2.4.1.12 Cultural Resources

Cultural heritage and archaeological sites are found in the Turkana region in different sedimentary basins and environments such as open woodland plains, small dry water channels/laggas, river flood plains and rocky and hilly areas. The county contains sites from the Pastoral Neolithic period of early fishers, hunter gatherer and herder communities. The Lokichar area is especially notable for the dense distribution of sites/occurrences of sites and features. The Lokori/Lotubae area is where the Namoratunga, an ancient cemetery with many

74 Collectively listed as a UNESCO World Heritage Site

engraved stone tomb markers encircling the graves, was found. The sites consist of microliths, burial cairns, stone pillar and stone circle burial sites. The Turkana visit these sacred sites and places for prayer and dance to appease the gods (Focus Group, Pastoralists, Lokori 2019; Appendix B). Additional information on cultural resources can be found in the Archaeology Baseline Report (Annex II).

Burial practices of the Turkana people differs from class to class. These classes include prominent persons, women, young persons, middle-aged people, widows, children, and poor people (Lucas 2016). Individuals are buried by their family members and neighbours. The type of burial practices vary depending on the person being buried and the circumstances of their death. The three types of burial practices include: honourable burial practices; insubstantial burial practices, and detestable burial practices. Honourable burial practices are for respected individuals who have made profound contributions to the wellbeing of the family and to the clan. Insubstantial burial practices are for less valued persons who have not in any way contributed to community prosperity. And lastly, detestable burial practices are for unexpected deaths such as cattle rustling, to the family or clan members.

Sacred or important cultural sites for Project Area communities are presented in Table 35.

Table 35: Herding Calendar for Turkana Pastoralists Sacred or Important Cultural Sites for Project Area Communities

Community	Site Name or Type	Notes
Lokichar	*Ekalale Loa Lotimaan*	■ Sacred trees where people conduct their rites of passage
	Individual Graves	■ Located between Lokichar and Kochodin. Graves are indicative of ownership of land by the deceased. Land owners are buried on their lands. ■ All areas with individual graves are said to be owned as 'Ngi'irerea' (specific land portions owned by specific clans)
	Kang'ikakumok	■ Special areas where visitation is forbidden
	Kachingangor, Akalale, Lowoi-angikakumok	■ Cultural sites
Kalapata	Individual Graves	■ Should only be visited by their relatives
Katilia	*Amoru*	■ Visited by community members who pray to prevent calamities
	Edoket Angide Akwangorom	■ Trees around here should not be cut
	Orio, Kakudo, Kalokim	■ Cultural sites where *ng'asenon* stones are gathered together in respect
	Lopeeto and Nachok (graves)	■ Graves for magicians (warlocks)
	Akalale	■ Should not be visited by anyone other than authorised person ■ Trees around here should not be cut

Community	Site Name or Type	Notes
	Natural wells at Kanapeot	■ n/a
	Longaada	■ Red ochre found here is harvested for cultural events
	Special areas of note (individual graves)	■ Taboo and should not be destroyed

Source: Focus Group, Elders, Kalapata 2019; Lokichar 2019; Katilia 2019; Appendix B.

2.4.1.13 Project Concerns

Several concerns and recommendations were expressed by community members and stakeholders about the proposed Project during the consultation meetings held in Lodwar on December 20, 2018. These concerns have been categorised according to socio-economic topic and are listed below.

Land

- County government is interested in information about the distances between construction works and the nearest settlements in order to discuss issues about working hours.

Livelihoods

- Concern that after pipeline construction, no cattle will be allowed to pass over it.

Cultural Resources

- Need to take into consideration if the pipeline passes through culturally sensitive areas; and
- Question about how archaeological excavations may be affected by the Project.

Infrastructure

- Question about disposal facilities in counties.

Social and Health

- Questions about how the Project will impact health issues such as the transmission of HIV and if this will be considered in the Project assessment;
- Safety for people (i.e. children, women going out to fetch firewood) and animals;
- Conflicts with the Pokots and fear that they may cross over; vandalise the pipeline and blame the Turkana;
- Question about the lack of health issues raised during the scoping phase; and
- Questions about potential pipeline leakage and effect on water.

Employment

- Noted the lack of information on potential employment; and
- Tree replanting should be done by locals who are sensitised, trained and employed to conserve and rehabilitate the cleared areas.

Benefits and Compensation

- Stakeholders noted that landowners expect to be compensated for land while acknowledging that people do not have title deeds;
- Request that proponent consider not just built structures (i.e. permanent houses) as part of the land compensation, but also the number of trees that are on the land, how much grass will be cleared, and if there are water pans in the area;
- Need for transparent land acquisition;
- Questions about if precious materials would be discovered and how the Turkana would benefit from the discovery;
- Request that the proponent disclose any discovery of minerals during excavation;
- Concern about the provisions of the Land Act as it is. Noted that land issues must be resolved first before the Project commences;
- Questions about land compensation;
- Questions about compensation for those who are displaced;
- Question about economic benefits, specifically on poverty; and
- Question about security benefits.

Consultation

- Concern that people from Turkana South who will be affected by the Project could not attend the meeting as they did not have transport allowances;
- Lack of budget for stakeholder participation, specifically Elders and transport allowances for Elders to attend the consultation meeting;
- Questions on if the Turkana people in other counties (i.e. Samburu, Isiolo and Meru) will also be compensated;
- Concern about how participants are targeted for consultation meetings given the lack of attendance;
- Concern about how participants have responded to various issues, noting that issues such as CSR, disaster risk management, compensation and pollution were not raised or poorly responded to. Questions about the impact of how these responses have shaped the ToR;
- Concern that poor attendance from Turkana stakeholders during the scoping period and now is poor and a lack of facilitation for people to attend the meeting will further discourage attendance at future meetings;
- Concern about a lack of women representation at the consultation meetings;
- Request to speak to LAPSSET during the next round of consultations;
- Concern about the lack of turnout at the meetings, noting that communities have low literacy;
- Request for additional targeting of stakeholders;
- Request that the Project use Elders as much as possible, especially the Council of Elders;
- County government official noted that a presentation should have been made to them as they are planning projects and are unsure about how they will overlap with the Project;

- Request that Proponent reach out to pastoral communities and gather their input for meetings;
- Questions about how exhaustive the previous scoping session was;
- Note that the county government also needs to be recognised, not just the national government;
- Request that the county government be involved in the EMP and social management plans;
- Request for references in future reports;
- Request for local forest associations to be involved in the process to make sure trees are replanted to maintain cover;
- Note that the concerns from these meetings should be fully captured;
- Request that the proponent consult with those close to the Project, not those from far away; and
- Suggestion that the proponent engage with Elders and local chiefs to generate larger turnout for future meetings.
- Pastoralists from Lokichar expressed concern about the following (Focus Group, Pastoralists, Lokichar 2019; Appendix B):
  - restriction of pastoral movement;
  - conflicts and division among communities;
  - putting traditional practices at risk
  - health risks;
  - increased temperatures;
  - increase in urban to rural migration, leading to moral decay;
  - need for animal human insurance cover;
  - need for institutional and legal frameworks for a clear understanding of process around the Project;
  - community land should be leased instead of sold;
  - degradation of the environment; and
  - fear of livelihood change and change of lifestyle.
- Pastoralists from Lokori expressed concern about the following (Focus Group, Pastoralists, Lokori 2019; Appendix B):
  - dust from the Project potentially causing human health problems and livestock health problems;
  - reduced visibility;
  - negative impacts to normal livestock behavior;
  - livestock diseases;
  - destruction of livestock grazing fields;
  - destruction of water points;

- deforestation and the effect on animal feed resources;
- fear of displacement from their permanent homesteads (Ere); and
- conflict over oil issues.

- Pastoralists from Katilia expressed concern about the following (Focus Group, Pastoralists, Katilia 2019; Appendix B):
  - increase in disease (both livestock and human);
  - land displacement due to a lack of title deeds;
  - fear of effects on cultural sites (i.e. *Ng'asenon);*
  - sustainability of pastoralism through provision of veterinary services, capacity building;
  - security concerns;
  - cattle resettling;
  - influx of people to the area; and
  - increased theft and robbery.
- Pastoralists from Kalapata expressed concern about the following (Focus Group, Pastoralists, Kalapata 2019; Appendix B):
  - health problems;
  - destruction of natural vegetation;
  - injuries and accidents to pastoralists and their livestock;
  - potential destruction of traditional water points and springs for the Project;
  - Project construction may restrict the movement of their people and livestock;
  - influx of urban outsiders to rural areas and theft; and
  - fear of increased Project security personnel, leading to frequent arrests.

2.4.2 Samburu County

Samburu County lies within the arid and semi-arid lands region of Kenya, covering an area of approximately 22,000 km^2, as shown in Figure 6 (SCG 2018). It is situated in the northern part of the Great Rift Valley, and bordered by Turkana to the Northwest, Baringo to the south-west, Marsabit to the north-east, Isiolo to the East and Laikipia to the south. The main administrative centres of Samburu are Maralal, Baragoi and Wamba (Insight Guides 2016).

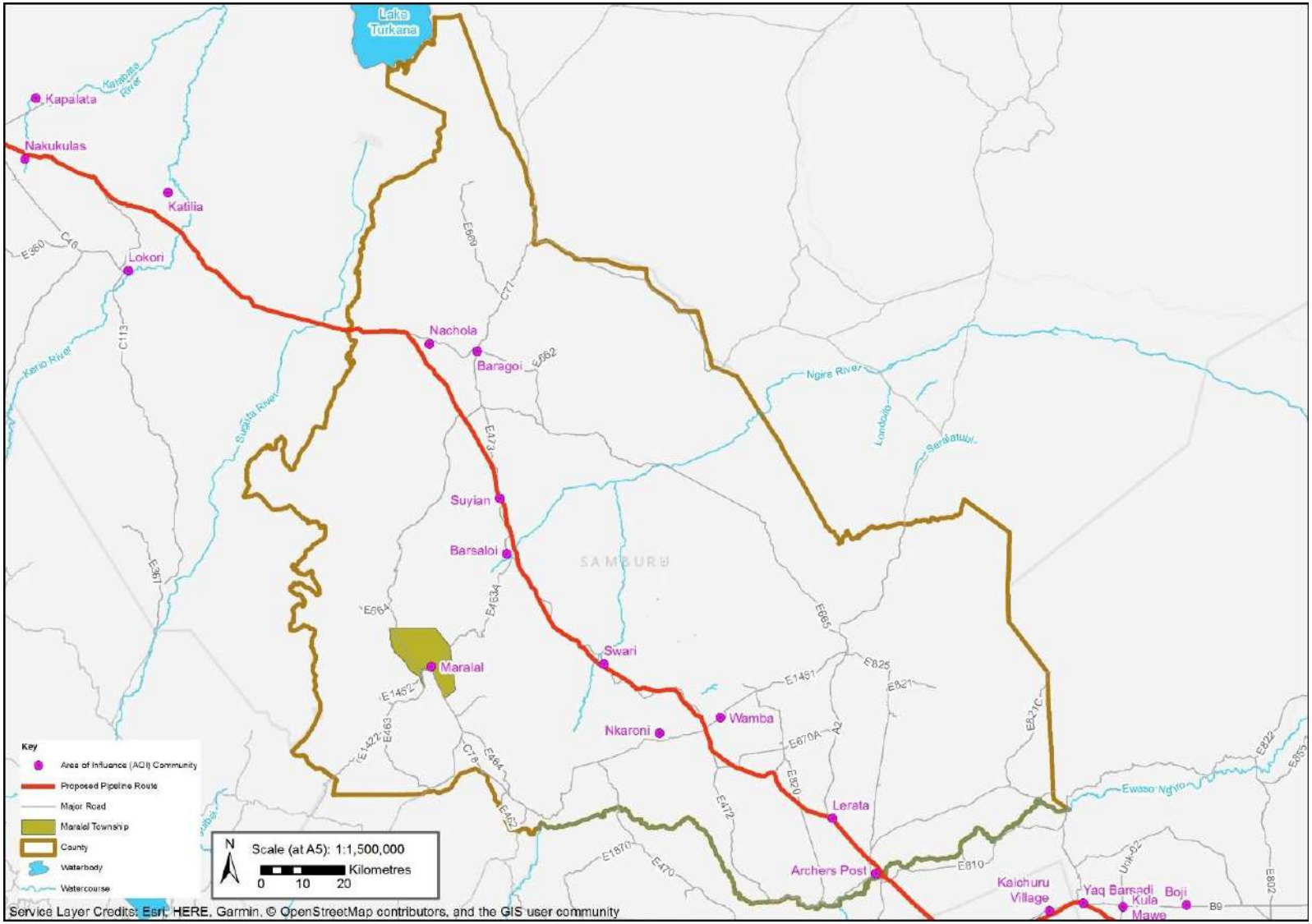

Figure 6: Samburu County

2.4.2.1 Administrative Divisions and Governance Structure

Under national government administration, Samburu County is administratively divided into three sub-counties, 7 divisions, 39 locations and 108 sub-locations, which are shown in Appendix D (SCG 2013). Sub-counties refer to both administrative units of National Government and County Government (KNBS 2015a). In most areas they coincide with the Constituency area, which is an area demarcated as stated under Article 89 of Kenya's Constitution for the purpose of electing a member of the National Assembly. Over the years, the number of sublocations have been increasing in an effort of the government to bring administration closer to the people (KNBS 2012). Table 35 shows the administrative units overlapped by the Project.

Table 36: Samburu County Administrative Units traversed by the Project

Sub-County	Division	Area (km^2)	No. of Locations	No. of Sub-locations
Samburu East	Wamba	4,670.80	8	19
	Waso	5,378.90	4	10
Samburu North	Baragoi	4,024.40	7	17
	Nyiro	3,010.70	6	16

Source: SCG 2018

Wards are electoral areas within each county delimited in accordance with Article 89 of Kenya's Constitution for the purpose of electing a member of the County Assembly. Samburu County has 15 wards and 108 villages (SCG 2018).

The proposed Project footprint is located in Samburu North and Samburu East Sub-Counties, which are the primary focus of the socio-economic baseline report. The Area of Influence (AoI) communities most likely to experience socio-economic effects from the Project in Samburu North and Samburu East are shown in Appendix D and listed in Table 36, including their distance from the pipeline route. The closest communities are Suyian and Lerata, located 0.1 km from the pipeline route. Focus groups were conducted with the local government, department of education, pastoralist groups, and elders, women and youth in most of these communities.

Table 37: AoI Communities in Samburu County

Sub-County	Community	Distance (km)
Samburu North	Nachola	2.9
	Baragoi	11.0
	Suyian	0.1
	Barsaloi	2.2
Samburu East	Archer's Post	1.2
	Swari	0.4
	Nkaroni	9.7

Sub-County	Community	Distance (km)
	Wamba	4.2
	Lerata	0.1

2.4.2.1.1 Local Administration

The local government works closely with the district administration to achieve economic and development goals, and it plays a large role in the day to day operations of the community. The local administration is composed of national government officers (i.e. chiefs), county government officers (village administration) and village Elders. Elders are highly respected and local leaders work closely with them to enhance leadership and make decisions. Women are also involved in decision-making within the local government, although they also face numerous barriers to participation, such as discrimination based on cultural traditions and illiteracy (Focus Group, Women, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). However, the women participate in more local initiatives than men, such as health awareness, youth and education initiatives, social services, poultry rearing and animal breeding programs, greenhouses, bee keeping and aloe vera projects, as well as the promotion of small businesses. Many of these initiatives are carried out in collaboration with NGOs.

The local government has few or no sources of revenue which makes it difficult to implement development plans. Sources of revenue are varied but generally come from conservancies, national research projects and economic activities such as sand harvesting, quarries and salt licks, livestock rearing and markets, small-scale farming and small businesses operated by women and youth.

Although the devolution of government has facilitated accessing resources from other levels of government through annual allocations, in general, access to resources from the county or national government is limited. Local governments have limited capacity to undertake projects without first being approved and funded by other levels of government. Community development plans and priorities are drafted by local government and then presented to the county government or other organisations for approval and implementation. Projects are incomplete in part because of the embezzlement of funds and as a result, development lags. In some cases, group ranches direct their revenue to their accounts rather than to the government. Major projects at the local level are typically undertaken by other organisations because there are not enough resources available for both levels of government.

Local government economic development priorities for the AoI communities vary, but are generally related to improving roads, electricity and housing enhancing security, building or improving health care centres, schools and Early Childhood Development Centres (ECD), improving water sources (dams and water collection systems), re-stocking camels, establishing markets to sell livestock, youth empowerment and establishing conservation units (Focus Group, Local Government, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018; Appendix B). The local governments face several constraints in meeting economic and development goals, including a lack of funds, water scarcity and drought, overstocking and a shortage of pasture. Accessing resources is also difficult due to poor road conditions. The communities generally have poor communication networks, and continue to face high levels of poverty, illiteracy and ongoing security threats. Other constraints faced by local governments include insufficient supply of camels for restocking and a lack of teachers for ECD centres. Issues related to land ownership of group ranches also make it difficult to move forward with building of schools, dams or other projects.

Generally, the perception among women is that their roles are changing and there are more opportunities for them to be political leaders. More women also participate in more political decision-making and events, including voting and campaigning compared to their male counterparts. In Suyian, it was noted that it is difficult for women to get support from political leaders to implement certain projects, and the lack of dams, healthcare centres and network coverage in Suyian have affected women's participation in politics negatively.

Most of the youth in the AoI communities said they participate in politics and are the voice of the community during campaigning, although the youth from Marasal indicated that they are completely excluded from political participation, except those coming from wealthy backgrounds (Focus Group, Youth, Maralal 2018; Appendix B). Youth are developing an active interest in politics because they see it as a step towards employment opportunities and benefits. Political groups were formed in the last general election based on party allegiance or youth's own interests. Youth also participate in elections by running for political positions, and some stated that they plan on seeking political seats in the 2022 elections. They are eligible for any political seat such as members of the county assemble (MCAs), village administrators and parliament members. Money and power influence politics because votes are cast for the wealthier community members.

2.4.2.2 Population Demographics

According to the 2009 Population and Housing Census, the population of Samburu County was approximately 223,947, up 12% from 2006 and accounts for 0.6% of Kenya's total population of just over 38.6 million people (KNBS 2012, SCG 2018). The population density is 11 inhabitants per km^2 (SCG 2018). Samburu North has the highest population and Samburu East has the lowest population. The population of Samburu County was expected to increase to almost 320, 000 by 2017, but precise official statistics are not available (SCG 2018). Table 38 below provides the 2009 population count and population projections based on the county's predicted and steady population growth of 4.45% (SCG 2018). More recent demographic data for Samburu County is unavailable as detailed county level statistics are only published every ten years in the national census.

Table 38: Total Population of Samburu County

Sub-County	2009 Census		2017 Projection		2020 Projection		2022 Projection	
	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)
Samburu West	81,094	21	115,770	29	132,305	34	144,620	37
Samburu North	83,759	14	119,575	17	136,653	19	149,373	21
Samburu East	59,094	6	84,363	8	96,412	10	105,386	10
Total	223, 947	11	319, 708	15	365, 370	17	399, 378	19

Source: SCG 2018

Population data for the 2009 Census for Samburu County were presented with a note a caution given that there is unreliable data due to the vast distances and difficult terrain that complicated logistics, and because of heightened nomadic activity during the census period which made it difficult to count and track population data (SCG 2018).

In 2009, 80% of the population in Samburu County was below 35 years of age, a trend which continued for the projected population in 2017, 2020 and 2022 (Table 39). Approximately, 46% of the total population was between 15 and 64 years of age, which represents the labour force age category.

Table 39: Population Projections by Age Cohorts

Age Cohort	2009 Census	2017 Projection	2020 Projection	2022 Projection
0-4	42,140	60,408	69,035	75,461
5-9	38,144	54,455	62,232	68,025
10-14	32,758	46,766	53,445	58,419
15-19	25,094	35,824	40,941	44,752
20-24	20,031	28,596	32,681	35,723
25-29	14,997	21,410	24,468	26,745
30-34	11,324	16,166	18,475	20,195
35-39	9,824	14,025	16,028	17,520
40-44	6,426	9,174	10,484	11,460
45-49	5,626	8,032	9,179	10,033
50-54	4,454	6,359	7,267	7,943
55-59	2,961	4,227	4,831	5,281
60-64	3,250	4,640	5,302	5,796
65-69	1,920	2,741	3,132	3,424
70-74	1,833	2,617	2,991	3,269
75-79	1,078	1,539	1,759	1,922
80+	1,863	2,660	3,039	3,322
age not stated	50	71	82	89
Total	**223,947**	**319,708**	**365,370**	**399,378**

Source: SCG 2018

There are 6 urban centres in the county accounting for 17.1% of the county's total population, lower than the national average of 25% (KNBS 2012). The urban population in Samburu county was approximately 38,373 in 2009 and was projected to increase to 68,433 by 2022 (SCG 2018). Maralal town had the highest population of the urban centres with a total of 12,437 people according to the 2009 census, while Suguta Marmar had the lowest population. Table 40 presents demographic data for urban centres in Samburu County.

Table 40: Population Projections by Urban Centre

Urban Centre	2009 Census	2017 Projection	2020 Projection	2022 Projection
Maralal	12,431	17,747	20,281	22,169
Suguta Marmar	4,173	5,957	6,808	7,442
Kisima	4,553	6,500	7,428	8,120
Wamba	6,247	8,918	10,192	11,141
Archer's Post	6,275	8,958	10,238	11,191
Baragoi	4,694	6,701	7,658	8,371
Total	38,373	54,782	62,606	68,433

Source: SCG 2018

Patterns of migration in Kenya have been influenced partly by colonial policies concerning land access, demand for labour in European settlements and taxation (KNBS 2012). Northern parts of Rift Valley province experienced low lifetime in-migration compared to other regions in Kenya, and results of the 2009 census indicated that in-migration in the Rift Valley Province has decreased compared to previous census results. Samburu County had one of the lowest lifetime net-migrations, of less than 45,000 migrants (KNBS 2012).

The population of the communities in the vicinity of the Project are presented in Table 40, as provided by administrative officers and planners of the local government in each respective community (Focus Group, Baragoi 2018, Barsaloi 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018; Appendix B). Population numbers for Archer's Post and Lerata were not available at the time of data collection. Baragoi has the highest population, followed by Nkaroni, while Barsaloi has the lowest population with fewer than 1,000 residents. Suyian has the youngest population, with approximately 39% of residents below the age of 15 years, and Barsaloi has the highest proportion of residents over the age of 55.

The total number of households in Samburu County was 47,354 in 2009, of which 12,835 were in Samburu East and 11,699 were in Samburu North (KNBS 2010). Patterns of household headship are influenced by several factors, including changing roles of men and women (KNBS 2012). Samburu County is among one of the counties with the highest proportions of female headed households, ranging from 39 to 48%, compared to a national average of 33%. A high proportion of female headed households may reflect several factors such as a high out-migration rate for men, high rates of widowhood or prevalence of polygamy (KNBS 2012).

Table 41: Population Data for the AoI Communities in Samburu County

Community	Population	< 15 years (%)	15-54 years (%)	+55 years (%)	Households
Archer's Post	n/a	n/a	n/a	n/a	n/a
Nachola	6, 200	32%	52%	16%	610
Baragoi	25, 000	32%	60%	8%	3,500
Suyian	2,800	39%	61%	1%	400
Barsaloi	800	25%	50%	25%	100
Swari	3,943	15%	70%	15%	780
Nkaroni	20,000	30%	50%	20%	5,000
Lerata	n/a	n/a	n/a	n/a	n/a

Source: Focus Group, Local Government, Baragoi 2018, Barsaloi 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018; Appendix B
n/a not available

2.4.2.3 Ethnicity and Language

Samburu county is multi-ethnic and the dominant communities are the Nilotic Samburu and Turkana with the Cushitic Rendille residing in rural areas (KNBS 2015b). Other ethnic groups include the Hamitic Somali and Borana and the Kikuyu and Meru who are Bantus.

The Samburu comprise less than 1% of the national population. They are closely related to the Maasai, with whom they share origins and some traditions and speak a dialect of the same Maa language (Insight Guides n.d.). Following a migration southward from the Sudanese Nile, they settled in the North of Mount Kenya and South of Lake Turkana. The Samburu were previously known as the *Loibor Kineji*, meaning people of the white goats, but today the Samburu refer to themselves as *il-Oikop* which means 'Owners of the land'. The tribe is divided into eight clans, four of which belong to 'white cows' and four to 'black cows', which are further divided into series of sub-clans (Insight Guides 2016). Samburu communities are heterogeneous and diverse, and social distinctions among the Samburu are formed around gender, age, clan, sub-clan, location of residence (highlands or lowlands), level of education, and economic position, among other factors (Pas 2018).

Samburu villages, called manyattas, consist of an extended family of brothers, wives and parents (Insight Guides 2016, Exploring Africa 2018). The villages are generally not permanent and only settled in one location for up to two months before moving to other locations in the constant search for new pastures for livestock. Samburu live in low huts which are built of interwoven sticks, mud and cow dung, which can be easily dismantled and rebuilt elsewhere, which facilitates their semi-nomadic lifestyle.

A fence is built at the centre of the village where cattle stay during the night, and another fence made of thorny branches called a boma, is constructed around the village to protect it from potential raids from cattle thefts or predators (Insight Guides 2016). In the village, the men are responsible for taking care of the cattle and the safety of the tribe while women have the task of milking the cows, gathering the firewood, collecting water and taking care of the huts and children. The number of livestock one holds indicates the wealth of a Samburu family (Exploring Africa 2018). To protect their main asset, the herd is divided into small groups of animals that are located in different places to limit their risk in case of attacks, predation or disease.

Rituals are performed during important rites of passage for important transitions of life stages, including from childhood to adulthood and adulthood to elderhood. The most important rite of passage is circumcision, which is the initiation of a boy or girl from childhood into adulthood (moran for boys and surmelei for girls) (Focus Group, Elders, Archer's Post 2018, Baragoi 2018, Lerata 2018, Nkaroni 2018, Swari 2018; Appendix B). Circumcision typically occurs at the age of 15 years for boys, and traditionally was between the ages 12-14 for girls, but most girls no longer undergo female circumcision because of changing cultural practices. During this ritual, people come together to sing, animals are sacrificed and herbs are collected. The girls get married immediately afterwards, and the boys are married between 18 and 25 years of age. Another rite of passage is the transition from adulthood to Elderhood, called *Lmuget*. The tradition of beading of young girls and warriors is a cultural practice still followed.

Goats are slaughtered during celebrations at *Lkupoket* (when a boy is born), *Lmorr* (a celebration for women after childbirth), *Lbuutan* and *Lkitewenet* (before circumcision) (Focus Group, Elders, Archer's Post 2018, Baragoi 2018, Lerata 2018, Nkaroni 2018, Swari 2018; Appendix B). During the circumcision of boys, Elders take the boys to Lbaa or Siteti and also bring *Silalei* (gum from *Acacia Senegal*) to start the transition to adulthood. Cows are slaughtered by the Elders during community ceremonies, and rituals are held around *Ltepes* (Acacia tortilis) and *Suchai* (*Barleria spinisepala*) trees. *Mungen* (lion skin) and *urauri* (earrings) are put on by the father and married boy and girl initiated together with *sobua* or *bakora* (wooden club) to show respect for their culture and to continue with the clan rituals. After marriage the *Lminoing* ceremony is conducted to give way to the Elders. Most community activities are done during times of rainfall.

2.4.2.4 Social Organisation

Samburu social life has a simple organisation and close ties to tradition. Elders are highly respected and they are considered the heads of the communities and group ranches. The Council of Elders are the primary decision-makers, and they play a big role in the governance of the community and implementing laws and sanctions. The Elders have numerous responsibilities, including carrying out community rituals (e.g. rites of passage, marriage), conservation of the environment, fostering positive relations and resolving conflicts within the community and between communities through barazas. They have authority over community resources (i.e. land, assets) and take a central role in controlling grazing patterns and seasonal calendars, and planning settlements. The Elders are often the bread winners of their families.

The Elders work closely with local government to ensure community initiatives are successfully carried out. The government consults with Elders first before undertaking business in the area, unlike in the past, and both the local and national government invests in Elders because they are trustworthy. However, in some communities Elders currently have less influence with the government and NGOs because of cultural changes, and their views are not valued as highly as they were in the past (Focus Group, Elders, Archer's Post 2018; Appendix B).

Traditional healers still play a role in the community and their services are used by the community as an alternative to doctors or hospitals. Traditional healers use natural resources and herbs for healing purposes, which are gathered from the forests, river banks, hills and plains. Traditional herbs that are used include Lekeek siet (a mix of 8 herbs), Ltepes (umbrella thorn) sagaram (*Acacia tortilis* pods), Lmakutukuti (blue-flowered tinderwood), Serichoi (*Boscia coriacea pax*), Mpopongi (*Euphorbia virgate*) and Siteti (*Grewia Mollis*). Traditional healers are paid for their services either in cash or in exchange of animals. Decision making is carried out by the head of the household, which is generally the husband in a typical two parent family, although in some households, decisions are made by both women and men. Where there is no husband, the mother is the sole decision-maker. Women are generally responsible for the household, including fetching water and firewood, cooking, and looking after livestock, especially when children are in school. Women are also primarily responsible for managing the finances and household budgets, including paying school fees and healthcare bills.

In most communities, women can participate in various social or economic groups related to small scale agriculture, livestock trade, business, or social support groups. However, in Suyian it was reported that women cannot access social services to register for groups because of the remoteness of the community (Focus Group, Women, Suyian, 2018; Appendix B). Women share several responsibilities in the community, including raising money to develop business ventures as groups, assisting the elderly, collecting funds for vulnerable children, supporting new mothers and wedding ceremonies by constructing temporary structures, cooking, fetching water and firewood. In some communities, single women are considered more vulnerable because they receive no support from the community and are excluded and isolated. In Baragoi the women indicated that most of the women are widows and many are single mothers (Focus Group, Women, Baragoi 2018; Appendix B). However, in most communities, it was noted that single women are not segregated or discriminated against and they receive support from other married women, the community or from government programs.

Youth are primarily responsible for herding animals, providing security for the family and community, and they also participate in household chores such as cleaning and cooking. They are often considered the breadwinners of the family. The girls fetch water and firewood, and help build manyattas, and the boys, or morans provide security to the families. Youth head the family when parents are absent, and they contribute to decision-making. In child headed families, most of the responsibilities are handed over to the eldest in the household to take care and lead the family.

Youth tend to follow fewer traditional rituals today, and they can get married at any age, unlike in the past. Boys typically get married at age 20 or older and girls get married at age 18 or older, although some girls are still forced into marriage as early as 14. Education and access to resources to pay dowries can also influence the age of marriage. In the past circumcision was done by the Elders but today it's carried out by a doctor and can happen at any age. Samburu boys are still circumcised before marriage, but most girls no longer undergo circumcision because of changing cultural practices (Focus Group, Youth, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). Youth from Wamba stated that drugs had become one of the main factors contributing to social change (Focus Group, Youth, Wamba 2018; Appendix B).

2.4.2.5 Economic Base

Samburu County is one of the poorest counties in Kenya, with 75.8% of the population living in poverty in 2015 and 2016, compared to only 16.7% in Nairobi (Development Initiatives 2018b). The poverty headcount in Samburu County increased from a decade earlier, when 71.40% of the population was living in poverty in 2005 and 2006. Samburu County also has one of the highest levels of food poverty, with more than half of the population unable to consume the minimum daily caloric requirement of 2,250 Kcal.

Over 90% of Samburu County lies within the ARAL where the main economic activity is nomadic pastoralism, with cattle, camels, sheep and goats being the most important livestock. Ninety-two percent of the County land is rangeland suitable for livestock production and supports 202,700 cattle; 622,000 sheep; 714,000 goats; 36,100 camels and 10,000 donkeys (SCG 2018). There are a few areas of productive land in Samburu County where farming takes place, particularly in the highland areas of Poro in Kirisia Division due to the fertile soils and adequate rainfall in the region (Office of the Controller of Budget 2018). The main crops grown in the County include maize, beans, wheat, barley, pyrethrum and millet (SCG 2018). Approximately 139,000 ha (8%) of the County is classified as arable land with adequate moisture to support crop farming, of which 28,500 ha of land is currently being utilised for crop farming.

Beekeeping is being practiced in the county as an alternative production livelihood to livestock production (SCG 2018). The famers keep bees mainly for crude honey production for use as food and a source of household income. Farmers have organised themselves into beekeeping groups across the three sub-counties and they sell their crude honey to Samburu Bee Keeping Cooperative for processing. Fish farming is an emerging

livelihood production system that the County Government is promoting through the Directorate of Livestock Production. Sand harvesting is an economic activity in the lowlands of Samburu East and North. The sand is deposited in dry river valleys and considered high quality; however, there are no structures currently in place to regulate sand harvesting, and the county government had begun training of communities on sustainable harvesting practices.

The main economic activities in the AoI communities are livestock rearing, conservancy management, small-scale farming and irrigation, quarry activities and sand harvesting (Focus Group, Local Government, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018; Appendix B). The communities are also involved in small business initiatives which generate income, such as greenhouses, bee keeping, beading and tree planting, poultry farming and aloe vera harvesting. The BOMA Project[75] trains people on how to run small businesses, which are generally operated by youth and women. Youth also participate in buying and selling livestock, selling bead work, and loading sands onto lorries for income.

Women's economic activities are limited in the communities near the Project, but they are generally involved in small scale agriculture, livestock trade, and engaging in a variety of other small-scale businesses (Focus Group, Women, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). Women are organised into numerous social groups that carry out various economic activities to generate income. They also participate in table banking[76] where small loans are given out with interest and the money borrowed is used as capital. Women groups under the BOMA Project have savings accounts for their small-scale businesses which includes selling sugar or tobacco. Other small businesses can include selling firewood, charcoal, manure, milk or liquor, selling bead work, running canteens and hotels, and quarry activities.

Other economic activities reported in Suyian include harvesting of aloe vera which is sold in markets in Barsaloi, and harvesting of *acacia tortalis* pods, which is sold for 400 KSh per 50 kg bag (Focus Group, Women, Suyian, 2018; Appendix B). Salt is collected from salt licks which are found naturally along river banks and sold between 200-400 KSh/bag depending on the amount. Some women reported that they wash clothes and sell water to the wealthy or to construction workers.

Despite these economic opportunities, the women face several challenges. Agricultural activities are constrained by wildlife destroying crops, insecurity, shortages of water, delays in issuing 'Mbegu' by the agricultural departments and a lack of agricultural materials (i.e. tanks). Some womens' businesses are affected negatively by high family dependency. Other barriers to participation in economic activities include illiteracy, illness, and being constrained by household activities.

2.4.2.6 Employment

The labour force (aged 15-64) of Samburu County was 103,987 in 2009, representing 46.4% of the total population (SCG 2018). The labour force was projected to rise to 185,446 by 2022. In 2009 there were 4,215 wage earners in the public service, approximately 3,000 wage earners in the private sector, and another 5,000 wage earners were estimated to be working for civil society organiations (FBOs, NGOs and INGOs) (SCG 2018). There were approximately 3,000 self-employed persons in Samburu County engaged in business activities such as livestock marketing, poultry farming, clothing and textile, apiary, horticulture and crop farming (SCG 2018).

75 The BOMA Project is a US NGO and Kenyan NGO that works to provide poor women living in the arid and semi-arid lands of Northern Kenya with the educational, financial, and technological resources to lift themselves out of poverty

76 a group funding strategy where members of a group meet once every month, place their savings, loan repayments and other contributions on the table then borrow immediately either as long-term or short-term loans to one or several interested members (ActionAid Kenya 2018)

Women's employment opportunities are limited in the AoI communities, but they are generally involved in small scale agriculture, livestock trade, and engaging in a variety of other small-scale businesses. Generally, the perception among women is that their roles are changing and there are more opportunities for them to study and be employed as teachers, nurses, or political leaders (Focus Group, Women, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). Women from Wamba and Swari reported there are causal employment opportunities, such as cooks, matrons and teachers, community health volunteers and midwives. Women from Lerata are also employed as community health volunteers (i.e. midwives). In Wamba, women are also employed as drivers, painters, plumbers and contractors.

For youth, in terms of employment opportunities, boys are still regarded more highly than girls (Focus Group, Youth, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Maralal 2018, Nachola 2018, Nkaroni 2018, Suyian, Swar 2018i, Wamba 2018; Appendix B). Most youth indicated that there are few employment opportunities in the area where they live, and even youth with qualifications and an education are having difficulty securing employment. There is more competition for opportunities today compared to their parents' generation, and corruption is an issue. Other barriers to employment include poor road network, drought and insecurity, population increases in some centres, and incompetence because of a lack of education. Youth from Baragoi indicated that jobs are not equitably distributed (Focus Group, Youth, Baragoi 2018; Appendix B). Prospective employers often don't hire youth based on their education or competence and hiring practices are typically marked by corruption and nepotism, based on tribe differences and bias. As a result, many young people are forced to seek employment outside of the county. In Swari, youth stated that many of them have to use illicit or unethical means to generate income due to the lack of employment opportunities (Focus Group, Youth, Swari 2018; Appendix B).

In the past, youth skipped school and were hand picked for jobs by employers; the youth are now more educated and employed according to their skills. A number of young people are educated as teachers, drivers and doctors, and work in these jobs. The county government employs many educated young people and some are self-employed through joint business groups. Manual labour is typically allocated to the young men in the community and those who are educated view employment opportunities which involve manual labour such as construction of toilets and houses unfavourably. The youth indicated that they have good skills and are ready for employment if opportunities arise.

2.4.2.7 Social Infrastructure

2.4.2.7.1 Education

The level of literacy in the Samburu County has increased, and approximately 34% of the population can read and write in 2018 compared to 27% of the population in 2012 (SCG 2013, 2018). Literacy is expected to continue increasing across all education sectors of the County because of the introduction of free primary education and free day secondary and subsidised boarding secondary schools by the Government of Kenya (SCG 2018). The majority (68%) of Samburu County residents have no formal education, and Samburu North has more residents with no formal education than Samburu East (KNBS and SID 2013b). A smaller proportion of the populations in Samburu East and Samburu North have received primary and secondary education or higher compared to the county overall, and the residents in Samburu East have received more education than Samburu North. Only 6% of Samburu County residents have a secondary level of education or above, and 26% have a primary level of education only (KNBS and SID 2013b). Overall, residents of Samburu County have substantially lower levels of educational attainment compared to the national average (Table 42).

Table 42: Educational Attainment in Samburu County (2009)

County/Sub-County/Wards	None (%)	Primary (%)	Secondary+ (%)	Total Population
Samburu North Sub-County	80.9	16.0	3.0	72,287
El Barta	66.8	26.0	7.2	11,972
Nachola	86.7	11.2	2.1	10,645
Ndoto	81.2	16.7	2.1	13,153
Nyiro	85.4	12.2	2.4	17,813
AngataNanyukie	78.5	18.7	2.8	8,565
Baawa	85.6	13.0	1.4	10,139
Samburu East Sub-County	74.1	20.5	5.5	51,214
Waso	70.3	22.0	7.7	15,358
Wamba West	84.5	13.6	2.0	11,828
Wamba East	57.9	32.9	9.2	13,904
Wamba North	89.9	9.0	1.0	10,124
Samburu County	68.1	25.6	6.3	195,312
Kenya	25.2	52.0	22.8	34,024,396

Source: KNBS and SID 2013b

Access to education is a challenge in Samburu County because of poor roads and the long distance that children and teachers have to travel to reach school (NCPD 2017). High insecurity in the region due to banditry and cattle rustling were also cited as barriers to accessing school. There is an inadequate number of schools and teachers in Samburu County, and a lack of adequate facilities necessary to support the delivery of quality education. There is a lack of classrooms, desks, stationary, water, latrines and electricity in primary school, while secondary schools lack libraries, laboratories, adequate classrooms, boarding facilities, computers and electricity.

The cost to educate one child is estimated at 60, 000 KSh per year, and enrolment starts early, at ages 3 to 4 years in pre-school (Focus Group, Education, Maralal 2018). The enrolment in pre-primary school for ages 3 to 5 in Samburu County has increased from 20,420 in 2013 to 42,938 in 2017, which is attributed to investment by the county government in education which has helped to facilitate access and quality of pre-primary education (SCG 2018). As of 2017, the total number of Early Childhood Education (ECD) centres in the County was 529 with 470 teachers. At the county level, there is one teacher for every 91 students, well below the national average of one teacher for every 40 students. Table 43 shows the school enrolment for Samburu County; however, the proportion of children and youth enrolled in school compared to the total number in the County was not available for 2017 statistics.

Table 43: School Enrolment for Samburu County

Pre-School		Primary		Secondary		Tertiary	
Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio
42,938	1:91	49, 491	1:41	8, 014	1:23	2,862	-

Source: SCG 2018

Enrolment in primary school has also risen since the introduction of free primary education and the school feeding programme (SCG 2018). Samburu County has 164 primary schools with 1220 teachers and a total enrolment of 49,897 students, compared to 30,597 students in 2012. However, more boys are attending primary school (53.1%) than girls (46.9%) (SCG 2018). In 2017, there were a total of 38 secondary schools with 319 teachers and a total enrolment of 8,014 students, compared to 2,132 students in 2012 (SCG 2018). More boys (59.1%) attended secondary schools than girls (40.9%). Despite the free tuition secondary education, enrolment rates in secondary are still low.

There are two institutions of higher learning in the county, including Laikipia University Campus and the two privately owned colleges Samburu Teachers Training College and Wamba Nurse training college located in Maralal and Wamba towns, respectively (SCG 2018). Samburu County had less than 0.4% enrolment in university in 2009, compared to the national average of 1.05% (KNBS 2012).

Although the introduction of free primary education in 2003 saw an increase in student enrolment in Kenya, enrolment and transition rates are still significantly low (Espila 2015; Abuya and Mutisya 2018). The introduction of free primary education promoted access to education especially to poorer households, but ancillary costs of education such as school uniforms, notebooks, sanitary towels for girls and distance to schools prevent many parents from investing in their children's education. School enrolment is influenced by a variety of a factors, including cultural practices, such as perceived roles of the male and female child at different ages, value of education in the community, poverty and availability and accessibility of learning institutions (KNBS 2012). In terms of education, girls face more challenges than boys and most of them don't finish school. Girls drop out of school earlier than boys, generally between the ages of 12 and 15 years, but sometimes as early as 10 years. The main reason girls drop out of school is early marriage, early pregnancy or a shortage of schools in the area. The future for girls is considered not very hopeful in some communities because of the disadvantages which limits the potential of girls. Other reasons that children drop out of school early is inability to pay school fees, poverty, security concerns which forces migration, loss of parents, peer pressures (e.g. drugs) and modern technology. Some families are headed by children who have household responsibilities which prevents them from attending school. Boys generally complete high school at age 18 or 20 but fail to transition to tertiary schools due a shortage of funds. Youth also leave secondary school early because of a shortage of funds to pay school fees, and low enrolment rates may also be attributed to a lack of sufficient schools in the region (KNBS 2012).

Youth from Maralal stated that boys are still regarded more highly than girls in terms of education opportunities, while youth in other communities reported that both boys and girls are given equal opportunity and rights to education (Focus Group, Youth, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Maralal 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). Generally, youth recognise the importance of education but many are disillusioned about the need for education because of the lack of employment opportunities after completing school, since many graduates are unemployed in their communities.

The total number of adult educational literacy centres in the county are 67 with the total enrolment of 3,565 adults; in Samburu East there are 15 and in Samburu North there are 24 (SCG 2018). According to the department of education in Maralal, opportunities for adult education have decreased, and the few education offices that exist now are less functional because of confusion brought about by the devolution of resources.

There is some support for education by NGOs which provide uniforms for girls who are considered more vulnerable than boys, as well as chairs and sanitary facilities. The Bright Future Foundation Samburu is a community-based organisation in Samburu west that was founded in 2013, and focuses on education initiatives, particularly empowering girls who are considered more vulnerable (Focus Group, Education, Maralal 2018; Appendix B). World Vision also builds schools for communities and focuses on providing support to vulnerable children. Some of the challenges faced by the department of education are negative attitudes towards education because of cultural influences and requiring more support from the county government and the national government to enable them to better serve the community.

2.4.2.7.2 Health Services

Samburu County has three hospitals, including one in Maralal town (level 4), one faith-based hospital in Wamba and one sub-county hospital in Baragoi town in Samburu North (SCG 2018). Level 4 hospitals are the coordinating and referral centres for the smaller units, and they usually have the resources to provide comprehensive medical and surgical services (KNBS 2015b). The county also has 10 health facilities (level 3), which provide comprehensive primary care and mainly focus on preventative care such as childhood vaccination, 46 dispensaries which are managed by enrolled and registered nurses, and 15 private clinics (Shape Consulting Ltd. 2019; Appendix A). The county has a total of 30 functional community health units, including 9 in Samburu North and 10 in Samburu east. The county target is 63 community health units so that every ward has access to level 1 services (SCG 2018). The average household distance to a health facility is 20 km which is far above the national recommended distance of 4 km.

Community health volunteers (CHVs) provide level 1 health care service on a volunteer basis, and there are 1,113 in Samburu County (SCG 2018). The CHVs provide HIV awareness to the AOI communities, along with the ministry of health, and through workshops and seminars carried out by several organisations that provide healthcare services. Women and youth have a good awareness of HIV, and its causes and prevention measures (Focus Group, Women, Youth, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Maralal 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). The HIV prevalence in Samburu is below the national rate at 2.2%; however, the prevalence among women is higher (3.1%) than for men (1.8%) (SCG 2018). The CHVs also train the communities on the use of family planning and general healthcare, and they bring medications to women's homes. Most of the women from the AOI communities indicated that they have access to family planning and reproductive health care from local healthcare centres or medical services in their respective areas. However, the women from Suyian stated that they don't have access to good family planning because the nearest hospital is in Barsaloi, located 15 km away (Focus Group, Women, Suyian 2018; Appendix B). Similarly, the women from Nkaroni stated that they have limited access to family planning services (Focus Group, Women, Nkaroni 2018; Appendix B). The women also have access to immunisation programs for children (e.g. polio and measles) and other preventative health care services for children and adults.

The top 10 diseases causing morbidity for children aged 5 years and less in Samburu County are respiratory system diseases, diarrhea, pneumonia, skin diseases, eye and ear infections, confirmed malaria, burns and urinary tract infections (SCG 2018). Above 5 years of age the top morbidity conditions include respiratory system diseases, pneumonia, skin diseases, diarrhea, other injuries, arthritis and joint pains, urinary tract infections, eye infection and confirmed malaria. According to the June 2017 SMART survey, Samburu County has an overall global acute malnutrition rate (low weight to height) of 18.3% among children aged 6 to 59 months. Thirty-four percent of children aged 6 to 59 months are considered underweight and 7% are considered

severely underweight (MOH 2017). Childhood stunting is an outcome of maternal undernutrition as well as inadequate infant and young child feeding (MOH 2017). The overall stunting rate (height for age) was 34.0% among children aged 6 to 59 months, with a severe stunting rate of 10.6%. This is above the national stunting levels of 26%.

Vitamin A supplementation is at 47.6% for children aged 6 to 11 months and 26.8% for children aged 12 to 59 months, which is below the national target of 80% (SCG 2018). The proportion of children that are dewormed once and twice is 63.2% and 32.8%, respectively. Iron Folate Acid Supplementation for pregnant mothers is at 72% in Samburu County compared to the national target of 80%. More than three quarters of women (77.8%) in the county consume foods from less than the minimum recommended 5 food groups as per the FAO standards (SCG 2018).

Table 44 presents the health system challenges in Samburu County. The primary challenges are due to poverty, service delivery (due to the vast geographic area and the nomadic lifestyle of the populace) and poor infrastructure and resources (both water infrastructure and healthcare infrastructure). Additional information on baseline health conditions in Samburu County is discussed in Appendix A: Community Health Baseline Report.

Table 44: Health System Challenges in Samburu County

Project County	Challenges	Contributing factors
Samburu	■ Inadequate human resources ■ Inadequate health infrastructure ■ Poor health seeking behaviour ■ Negative cultural practices – such as female circumcision and beading ■ Food insecurity and malnutrition ■ Vastness of geographical area and sparse population ■ Insecurity ■ Poor access to safe drinking water and sanitation ■ High illiteracy level ■ Nomadic lifestyle ■ Poverty	■ High staff attrition rate, insecurity and remoteness makes place less attractive to staff. ■ Vastness of geographical area, poor terrain and hard to reach areas contributes to poor heath seeking behaviour ■ Arid and semi-arid climate (food insecurity) ■ Historical marginalisation

Source: Baseline KIIs in Appendix A.

2.4.2.7.3 Food Security

The Kenya Food Security Steering group leads bi-annual seasonal assessments in 23 counties that comprise the arid and semi-arid region of Kenya, which are generally the most food insecure and exhibit high level of vulnerability (GOK 2018a). The purpose of the 2018 Long Rains Assessment was to analyse and determine the extent and impact of the 2018 March-May long rains season on food and nutrition security, considering cumulative effects of previous seasons and other shocks and hazards.

Samburu County falls under the pastoral north-west livelihood zone, and the current drivers of food insecurity in this zone are rainfall performance, conflict and insecurity, and other hazards such as flooding and disease outbreaks. The key findings of the assessment were that above-average performance of the long rains led to significant improvement in household food availability and access. All areas in the pastoral north-west that were

in the crisis[77] phase of food insecurity in January 2018 moved to the stressed[78] phase by August 2018. Approximately 70% of households had acceptable food consumption in June 2018, compared to January 2018 when less than 50% of households were classified under acceptable food consumption. However, there are still about 700,000 people in the pastoral north-east and pastoral north-west in the Crisis phase of food insecurity. After two to three poor seasons, these households have not fully recovered, and most of them lost productive assets during last year's drought and face considerable food gaps (GOK 2018a).

Most of the women's groups interviewed viewed their households as food insecure (Focus Group, Women, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). Access to and availability of healthy and diverse foods is limited, and there is a lack of water storage facilities. Some youth felt that resources are scarcer today, while others indicated that they are more food secure today because of government relief (Focus Group, Youth, Archer's Post 2018, Baragoi 2018, Barsaloi 2018, Lerata 2018, Nachola 2018, Nkaroni 2018, Suyian 2018, Swari 2018, Wamba 2018; Appendix B). Foods that are frequently consumed in the AoI community households include goat, chicken, beef, milk, yogurt, rice, maize and flour. Food is mainly stored in buckets or boxes to try to avoid rodents and water is stored in jerry cans. Those who don't participate in business activities are generally considered less food secure. Households cope with food insecurity by taking loans from businesses, friends, or borrowing credit from shops for later payment. Other households will slaughter goats for blood and milk when there is limited food. Households are food insecure because of unemployment, poverty and illiteracy, or because of limited access and availability of places to buy food, including large distances to nearby markets to buy livestock or fruits and vegetables. Food security is also threatened because of livestock raiding from neighbouring communities, drought which affects agriculture and livestock production, and animal diseases and pests. Drought is the most persistent and destructive natural hazard in the county, which can decimate crops and livestock, erode the landscape and result in large economic damage and losses (SCG and WFP 2015). The county is often affected by cyclical droughts, which occur every 1 to 3 years, although the frequency of droughts is reported to have increased in recent years because of increasingly erratic weather patterns. Households cope with these threats by moving in search of fertile lands and spraying their animals with pesticides.

2.4.2.7.4 Housing

In Samburu County, most permanent housing units are found in urban areas, consisting of maisonettes, bungalows, flats and bed seaters (SCG 2018). The towns of Maralal, Wamba and Baragoi have decent housing with several government quarters which house civil servants although some are considered inadequate (SCG 2013). Other town centres have semi-permanent houses primarily built with cedar posts and iron roofs (SCG 2018). Outside of the urban centres, temporary housing units called *manyattas* is the main type of housing which are widespread throughout the county (SCG 2013).

Housing quality in Samburu County is generally poor, which is typical of the arid and semi-arid regions of Kenya compared to other regions (KNBS 2012; SCG 2018). The wall, floor and roofing materials used are reflective of the geographical and socio-cultural characteristics of the region. In Samburu County, there are 47,231 houses, of which the majority (82.7%) have earth as the floor material, compared to 56.5% for all of Kenya. More households have earth floors in Samburu North (91%) compared to Samburu East (85.9%). The most common type of wall material in Samburu East and Samburu North is mud/ wood (48.7%), followed by wood (12.1%), 'other' materials (8.9%) and grass/reeds (8.8%). The most common type of roof material in Samburu

77 Phase 3 (Crisis): Even with any humanitarian assistance at least one in five HHs in the area have food consumption gaps with high or above usual acute malnutrition OR Are marginally able to meet minimum food needs only with accelerated depletion of livelihood assets that will lead to food consumption gaps.

78 Phase 2 (Stressed): Even with any humanitarian assistance at least one in five HHs in the area have minimally adequate food consumption but are unable to afford some essential non-food expenditures without engaging in irreversible coping strategies.

East and Samburu North is mud/dung (30.8%), followed by 'other' materials (19%), makuti[79] (17.3%) and corrugated iron (14.3%). The Samburu construct low huts built of interwoven sticks, mud and cow dung which can be easily dismantled and rebuilt elsewhere, which facilitates their semi-nomadic lifestyle. The housing materials are gathered by women from nearby forest and rivers.

2.4.2.7.5 Security

Violent conflict among pastoral communities in the arid lands of northern Kenya has been occurring for hundreds of years. Conflicts and violence usually take the form of cattle rustling, ethnic violence, displacements, massacres and revenge attacks (Okumu et al. 2017). Some conflicts within and between pastoralist communities, such as raiding and cattle rustling have a long history and is considered a part of traditional pastoralist culture (IRIN 2009). In the past, warriors would wield crude weapons such as spears, swords and bows and arrows to steal livestock, which was carried out for prestige and bride prices, as well as competition over scarce water and pasture resources (Okumu et al. 2017). Elders amicably resolved these theft cases between the two communities through traditional conflict resolution mechanisms such as fines, repatriations, and community service (Likaka and Muia 2015). However, these cattle raids have become increasingly violent, less manageable, and have triggered much more organised retaliations (Triche 2014).

Competition for scarce natural resources is widely understood to be a primary cause of conflict in the region. As a result of the scarcity of grazing and water resources they depend on for their livelihoods, pastoralists are under intense pressure and they often find themselves fighting for survival (Likaka and Muia 2015). Rapid population growth, sedentarisation, environmental degradation and privatisation of formerly communally used pastures, the increase in wildlife conservation areas and agriculture, are factors that lead to growing pressure on land and fuelled conflicts in a number of areas (Grenier 2013, IRIN 2009). Remote areas in the north rely on community-organised security groups such as home guards and police reservists to maintain law and order. This has in part led to the proliferation of illegal small arms which enter Kenya from neighbouring war-torn countries and make raids increasingly dangerous and more sophisticated (Likaka and Muia 2015). In addition, stolen cattle are increasingly sold to urban markets for immediate profit rather than to restock a community's herd, which has led to the commercialisation of cattle rustling (IRIN 2007, Wamuru 2014). Commercialised raiding is facilitated by improved access to markets, rising demand for meat as part of strong growth of urban populations and improved road infrastructure reaching pastoral regions (Eaton 2010).

Politics is also a driver of conflict in some pastoral areas (IRIN 2009, Likaka and Muia 2015, Greiner 2013). There are allegations that the economically powerful are funding livestock thefts and politicians are encouraging conflicts to drive away specific ethnic communities who may not support them, to increase their chances of being elected (Likaka and Muia 2015, Okumu et al. 2017). In Samburu and Turkanan communities, these political and business elites influence cattle raids by paying and arming warriors to carry out raids (Okumu et al. 2017).

The principal aggressors of livestock rustling in Samburu County are the Turkana from Baragoi, Pokot from Baringo, the Rendile and the Samburu themselves (Pkalya et al. 2003). Youth from these communities are typically always involved. In Samburu County, there is regular occurrence of conflict between Samburu, Turkana, Rendile and the Borana over limited natural resources (Khisa et al. 2016). The conflict between these communities is more prevalent on the border areas of the two counties. One study (Pkalya et al. 2003) indicated that the proportion of the population that has been displaced in Samburu County because of conflict is prevalent. Livestock rustling contributed to 17% of the displaced population, or 23,707 people, and most of the displaced were Turkana from Baragoi and Nyiro divisions. However, it is difficult to determine the number of displaced

79 Thatching made from dried palm leaves

Samburu since most of them live in Manyattas of their relatives unlike the Turkana who tend to move to urban centers.

Conflict between the Samburu and Turkana communities' dates back to the early 1990s (Shalom Centre 2016). Natural resources, such as land, water and pasture contribute to pastoralist conflict in Baragoi, which often leads to cattle raiding and indiscriminate killing. The violence escalates during the rainy season, when pastoralists restock their herds and it is also when rites of passage take place, increasing the demand for livestock (IRIN 2009). Escalating cycles of attacks and retaliatory attacks eventually led to the killing of 42 police officers in Suguta Valley in November 2012, while they were in pursuit of stolen livestock (Shalom Centre 2016). More recent conflict in Baragoi has led to the displacement of both Samburu and Turkana communities (Bukuno n.d.). Displaced Turkana relocate to Loiyangalani, Archer's Post and Isiolo, which Samburu resettle in Maralal and other areas. In 2017 it was reported that approximately six schools have been closed due to tribal violence in Baragoi, some of them permanently. Villages have also been abandoned and properties in these villages vandalised and destroyed. Before the conflict escalated into violence in 1996, both the Turkana and Samburu cultivated the fertile Namalia belt producing food for the region, but today it is a no-go zone (Bukuno n.d.).

Environmental and political challenges in 2017 also led to an increase in the number of livestock thefts, road banditry and conflict-related fatalities in NRT supported conservancies (NRT 2017). Incidents of livestock theft increased 70% in 2017, with 90 recorded cases in NRT supported conservancies. The main driver of the increase in livestock thefts was drought, and widespread disregard of grazing rules and traditional water and grazing sharing customs. There were a number of 'restocking raids' after people lost a high number of livestock to the drought and sought to restock their herds during the first rains in late 2017. In Samburu County, the highest number of livestock raids occurred around Kalama conservancy in southern Samburu. Fifty percent of the sheep and goats recorded stolen were from Kalama and Nakuprat Gotu conservancies, close to the Samburu-Isiolo boundary. This was because of retaliation raids between Samburu and Turkana communities. Despite the high number of stock theft, there were 1,349 head of livestock recovered in 2017 due to efforts between the conservancies. The number of recorded road banditry incidents increased from 18 in 2016 to 22 in 2017. More than half (12) of these occurred on the Archer's-Wamba-Maralal road which passes through Meibae, Kalama, Westgate, Namunyak and Nkoteiya conservancies. This is likely due to the high concentration to livestock in the area, which enabled morans to collectively plan and carry out attacks (NRT 2017).

The NRT has established multi-ethnic, mobile security teams which are able to respond rapidly to livestock raids and recover stolen stock, which helps to break cycles of retaliation (NRT 2017). The mobile security teams and conservancy rangers work alongside the police, Kenya Wildlife Service, county administration and local leaders to address conflict and violence. Efforts between the conservancies have resulted in the recovery of 1349 head of livestock in 2017 (NRT 2018). Conservancies also employed 748 community rangers in 2017. The NRT peace team and conservancies facilitated and promoted peace dialogues, carrying out 86 peace-related meetings during 2017, and 26 Peace Ambassadors were employed in 2017 (NRT 2017).

Kenyan authorities often have weakened authority over bandits and cattle rustlers who are heavily equipped with sophisticated weapons and carry out violent activities (Sharamo 2014). There are 6 police stations in Samburu County, including in Maralal, Suguta Marmar, Baragoi, Wamba, South Horr and Archer's Post. There are also 11 police posts, located in Suyian, Loruko, Masikita, Nachola, Lerata, Sereolipi, which have been strategically positioned in crime prone areas (SCG 2018). The types of crime experienced in Samburu County are highway banditry, cattle rustling, gender-based violence, intra and inter ethnic violence (SCG 2018). Crime prone areas in Samburu county are Marti, Mbukoi, Suyian, Morijo, Logetei, Nachola, Ngilai, Loget Lusengap, Bendera, NgMugur and Barslinga. Insecurity is considered a major challenge in the communities in the Project area. Livestock herders in general indicated that they travel in large groups for security reasons, and some carry guns for security and to deter thieves (Focus Group, Livestock Herders, Baragoi 2018, Barsaloi 2018, Nachola 2018, Suyian 2018; Appendix B).

2.4.2.8 Physical Infrastructure

2.4.2.8.1 Water

Samburu is generally defined as a water scarce county. Annual rainfall in the county ranges from an average of below 700 mm in the lowlands, which covers more than 80% of the county, to 1,000 mm in the upper highlands (SCG 2018). In general, the long rainy season occurs between March and May and the short rainy season occurs mainly between October and December; however, rainfall is erratic with large spatial and temporal variations (SCG and WFP 2015). The driest months are January and February. The county also experiences cyclical droughts occurring every one to three years, but the frequency has increased because of unpredictable weather patterns. Poor rainy seasons that occur consecutively resulting in prolonged dry periods have resulted in the depletion of water sources and deterioration of grazing resources (SCG and WFP 2015).

The county has two permanent rivers, 35 protected springs and 104 boreholes (SCG 2018). Livestock herders indicated that the only source of water for livestock in their respective communities were the local rivers, including the Nachola River, the Suyian River and the Seiya River (Focus Group, Livestock Herders). The Nachola River is seasonal, and the Seiya River is available throughout the year. There are also dams in the Nachola area but water in unavailable in the dry season. Water is used in the communities for human and animal consumption, and for washing clothes, irrigation and recreational use. Cows need approximately 30 to 60 litres of water daily, while camels require about 120 litres per month.

Improved sources of water comprise of protected spring, protected well, borehole, piped into dwelling, piped and rain water collection (KNBS 2013). Unimproved sources of water include pond, dam, lake, stream/river, unprotected spring, unprotected well, jabia[80], water vendor and others. In Samburu County, only 34% of residents use improved sources of water. There are 17,133 households in Samburu County with piped water, which represents only 13.5% of the population. A total of 5,500 households have access to potable water. There are 112 water pans[81], 213 surface dams, 141 shallow wells, 37 unprotected springs and 9,800 houses with roof catchment. Water quality in the county is generally poor, with most surface water and shallow wells not being protected and at risk of contamination. Human habitation along catchment areas, lack of proper sanitation and sewage services in the major urban centres are major sources of water contamination (SCG 2018). Water quality is promoted in households with the provision of water treatment chemicals (Aqua tabs) by the county department of health, and through ongoing health education on water quality and safety (SCG 2018). Water in major urban centres is supplied and managed by the Samburu Water and Sanitation Company (SAWASCO) in collaboration with the Department of Water (SCG 2018). The major water supply schemes in urban centres are Maralal, Suguta Marmar, Kisima, Baragoi, Wamba and Archer's Post. Rural water supplies in the county are managed by respective water management committees. The county has also established eight Water Resource User Associations which work in partnership with the Water Resource Management Authority to manage water resources.

2.4.2.8.2 Sanitation and Waste

Latrine coverage in Samburu County is 34% which is far below the national target of 100% (SCG 2018). Only 116 villages (20%) have latrine coverage, and seven villages have reached an open defecation free (ODF) status. An additional 477 villages (80%) still require latrine coverage. There are only two public toilets in Wamba and Maralal towns, and the county does not have a sewerage system in all urban centres (SCG 2018).

According to the 2018 SMART survey report, only 26% of respondents washed their hands during four critical times, and 81.2% of those who washed their hands used soap and water (MOH 2018b). Factors contributing

80 A jabia is a term used in Kenya to describe a traditional rainwater storage system

81 A water pan is a small reservoir created by excavating open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands

to poor water and sanitation practices in Samburu County include cultural limitations, ignorance, lack of role models and lack of awareness of proper hygiene and sanitation (Leap Health 2016, SCG 2018). Poor hygiene practices, including a lack of facial hygiene have contributed to the spread of Trachoma in Samburu County, a chronic eye condition caused by Chlamydia Trachomatis bacterium (Leap Health 2016). Poor sanitation is also major risk because of fly breeding and surface water pollution which leads to diarrheal diseases (MOH 2017). In addition, poor sanitation and open defecation is linked to low height for age in children; stunted children are at risk or greater mortality from infectious diseases and are more likely to have poorer cognitive and educational outcomes (MOH and WSP 2014). To address poor water quality and hygiene practices, the public health department provides chlorination tablets across the county, and the water department undertakes health education on sanitation, water treatment and safe storage before consumption.

The county has no proper solid waste management facilities or dumping sites (SCG 2018). The department of Environment has made an effort to fence dumpsites at Wamba and Archer's Post, and a temporary dumping site was fenced in Maralal town. The department has also obtained two garbage collection trucks to transport waste to designated sites for proper disposal.

2.4.2.8.3 Energy Sources

Access to electricity is limited in Samburu County. According to the 2009 census, less than 10% of the county was connected to electricity, compared to a connectivity rate of 72.37% for Nairobi (Business Daily Africa 2014, KNBS 2009). The electricity connection charge is cited as one of the factors contributing to low connectivity in areas that already have high electricity access (Business Daily Africa 2014). More than half of households use fuel wood as the main source of lighting (61%), and use is even higher in Samburu East (74.2%) and Samburu North (76.8%) compared to Samburu West (43.6%). Tin lamps (19.5%) and lanterns (10.7%) are also used by households for lighting, while less than 1% of households use solar energy for lighting (KNBS 2009) (Table 45).

The majority of households also use firewood for cooking (81%), followed by charcoal (17%) (KNBS 2009) (Table 46). Wood is sourced from red cider and *acacia tortalis* and typically gathered by women from nearby woodlots where they have free access. Charcoal is produced by burning red cider or acacia trees, of which production is permitted. Residents also utilise petroleum products such as kerosene/paraffin, liquefied petroleum gas for domestic use, and petrol and diesel fuel for running vehicles and lister engines. Over reliance on wood fuel is considered a health and environmental concern, and the government intends to make efforts to promote sustainable and modern charcoal production technologies, including the use of charcoal Kilns and adoption of renewal energy (SCG 2018).

Table 45: Energy Sources for Lighting in Samburu East and Samburu North

Source	Households in Samburu East	Households in Samburu North
Electricity	1.4%	0.5%
Pressure/Gas Lamp	1.4%	1.4%
Lantern	10.4%	7.5%
Tin Lamp	9.2%	12.5%
Firewood	74.2%	76.8%
Solar	1.9%	0.9%
Other	1.4%	0.5%
Total Households	12,835	11,699

Source: KNBS 2009

Table 46: Energy Sources for Cooking in Samburu East and Samburu North

Source	Samburu East	Samburu North
Electricity	0.1%	0.1%
Paraffin/Gas/Biogas	1.4%	0.2%
Firewood	85.6%	90.1%
Charcoal	12.4%	9.4%
Solar	0.04%	.05%
Other	0.4%	0.1%
Total Households	12,835	11,699

Source: KNBS 2009

Electricity is provided by Kenya Power and Lighting, a public company which provides electricity to customers throughout Kenya. A total of 13 trading centres, 10 health centres and 40 schools are connected to electricity in Samburu County (SCG 2018). Approximately 5,000 households in the main urban centres are connected to electricity, including Maralal, Suguta marmar, Kisima, Loosuk, Loibor nkare, Porro, Wamba, Archer's Post, Sere-olipi, and Baragoi. An additional 250 schools and 1200 households use solar lighting. The county has the potential for geothermal energy, and the largest wind project in Africa is in Marsabit County, which borders Samburu County, and also has the potential to be tapped into.

2.4.2.8.4 Transportation

The road network in Samburu County is generally poor. Accessibility is an issue due to poor road conditions which makes it more difficult for local governments in the AoI communities to meet their economic and development objectives. In addition, the poor road network is a barrier to accessing employment opportunities for youth. The county has a total road network of 1,606.6 km, of which the majority is graveled (1,081 km) and only 10 km is covered by tarmac (SCG 2018). Most of these roads are rural access roads which link to major urban centres in the county. The Rumuruti-Maralal-Baragoi (Road A4) is considered the gateway to the county and covers a length of 116 km from Rumuruti in Laikipia to Maralal, and 108 km from Maralal to Baragoi. Fifty km of this road network is covered by bitumen surface as part of its road network from the planned LAPSSET corridor project, which is expected to enhance connectivity within the county and between neighbouring counties (SCG 2018). Access to Nairobi from Samburu County is via the Nyahururu road (Maralal-Naivasha), to Turkana is via the Maralal-Nyahururu-Nakuru-Eldoret-Kitale and Lodwar, and to East Isiolo is via Maralal-Wamba-Archer's Post.

The County has several foot bridges which facilitate access for children traveling to school, especially during flash floods (SCG 2018). A bridge at Ngeny River provides access to the livestock market in Lolkuniani in Samburu East, and plans are underway to construct a bridge at Seyia Ruver to connect Samburu East and Samburu North. There are 11 air strips in the county which are owned either by the Kenya Civil Aviation Authority, the county government or privately owned (SCG 2018).

2.4.2.8.5 Communication

Communication networks in Samburu County are generally poor. The county has four post offices located in Maralal, Baragoi, Wamba and Suguta (SCG 2018). There is one Huduma centre[82] in Maralal town that offers

82 Huduma Centres are a one stop shop citizen service centre established by the government of Kenya that provide citizens access to various public services and information through integrated technology platforms

government services and provides access to information. Local and international television and radio stations are accessible through Cable networks such as Zuku, Start Times, DSTV and Go TV. The county also has local radio stations, including Serian FM, Watchman FM and Radio Mchungaji (SCG 2018). Radio is one of the most reliable means of communication for the rural population, although coverage does not extend into some remote areas.

The mobile phone network coverage in Samburu County is poor, at 30%, compared to the national connectivity of 85%. The major mobile providers in the county is Safaricom followed by Telkom, Airtel and Equitel. The poor communication network is one of the constraints faced by local governments in meeting economic and development objectives. The poor mobile network means that residents have to travel long distances in order to make a phone call (Standard Media 2017).

2.4.2.9 Land and Resource Use

Samburu County is part of the arid lands of Kenya. It is situated in the northern part of the Great Rift Valley and includes five ecological zones, including the tropical alpine zone, the upper highlands, the lower highlands, the lower midlands and the lowlands (SCG and WFP 2015). The lowlands cover up to 80% of the county and the land is mainly used as grazing fields for wildlife and livestock by pastoralist communities.

Samburu county has a large land mass of approximately 21,022.01 km^2 of which the majority (83.6%) is used for urban centers, group ranches, land set aside for public uses, individual ownership and other natural features. Another 15.5% (3,103.41 km^2) is under gazetted forests, 0.85% (170 km^2) is under game reserves and animal sanctuary, less than 0.1% (1.8 km^2) is under surface water. The dominant land uses include nomadic pastoralism, wildlife conservation areas such as West Gate, Namunyak, Kalama and Samburu National Reserve, urban development and crop farming (SCG 2018). The average small-scale crop farm size is less than 0.4 ha, and primarily found in Poro where farming and livestock activities are practiced. At the large scale, the average crop farm size is 20 ha and mostly for livestock rearing and wheat farming.

Communal land is the predominant land type in the Project area, which are managed by group ranch committees, grazing committees and in some cases conservancies. In most communities, land is available for new applicants but only after consulting with the owners or paying fees.

2.4.2.9.1 Land Ownership

Land in Samburu County is categorised as per the Article 61 of Kenya's Constitution, Land Act, 2012 and Community Land Act, 2016 (SCG 2018). Land in the County is either owned as registered community land (group ranches), unregistered community land (held in trust by County Government), public and private land as leasehold or freehold (SCG 2018).

The majority of lands falls under community lands. The registered community land occupies 39.5% (8,293.72 km^2) of the total land mass of the county and is made up of group ranches which support livestock grazing and wildlife conservation (SCG 2018). There are currently 43 group ranches with approximately 26,551 registered members, with the majority (21) located in Samburu Central, 10 in Samburu North and 11 in Samburu East. All the above registered community lands (group ranches) have collected their title deeds, and unregistered community lands are in the process of being registered, including Kukwar and Naimirimo while Ngare Narok remains undeclared. However, inter-clan conflict in the ranches has been a major challenge and led to delay of the land adjudication process.

Public land is primarily land owned by National, County Governments and public institutions, and they include road reserves, riparian, ridges, lakes, forests and rivers, un-alienated urban areas within various registration sections, schools, water points, livestock sale yards and airstrips (SCG 2018). Public land occupies approximately 16.05% (3,373.09 km^2) of the total area of the county. Private land is owned under freehold tenure system or under leasehold system. Most of the land owned as freehold is located in Samburu West,

especially in the high potential agro-ecological zones of Poro 'A' & 'B", Losuuk, Suguta Marmar, Lpartuk, Loiting and Longewan sections. Those owned as leasehold, are mostly within the urban areas where public land has been allocated to private entities or individuals.

Approximately 59.53% of the total land area in the county is registered land. Areas with no titles are unregistered community lands and land in urban areas that have been allocated for private use (SCG 2018).

2.4.2.9.2 Agriculture

Approximately 139,000 ha (8%) of the County is classified as arable land with adequate moisture to support crop farming, of which 28,500 ha of land is currently being utilised for crop farming. Most crops are grown in the highland areas of Poro in Kirisia Division due to the fertile soils and adequate rainfall (SCG 2018).

There is small-scale and large-scale farming in Samburu County (Focus Group, Agriculture, Maralal 2018; Appendix B). Maize, beans, wheat, sorghum and other crops are grown, but maize and beans are the most common crops grown in the county. Land is cleared in January, followed by weeding in April and harvesting is completed in August. There are two planting seasons in the farming calendar-April and November. Maize is planted in April and beans are planted in November. The farming seasonal calendar in Samburu County is shown in Table 47.

Table 47: Farming Seasonal Calendar for the AOI communities in Samburu County

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Clearing												
Planting and Weeding												
Harvesting												

Source: Focus Group, Agriculture, Maralal 2018; Appendix B

Rotational planting is practiced allowing manure to accumulate and for soils to become more fertile in between planting. Men are responsible for clearing and other land preparation, and both men and women are responsible for planting, weeding, harvesting and post-harvesting activities. Children also assist with planting, weeding and harvesting activities.

Fertilizers are used for wheat and manure is applied to maize and bean crops. Tractors and cultivator machines are also used. Pesticide use is minimal because of good climatic conditions. When services are paid for by the owner, labour is sourced from outside the community where local men and women are hired during the planting and harvesting seasons. Land is typically inherited from parents, but lease-out programs also exist.

Farming is challenging in lowland areas where soil quality is poor and there is little rainfall. There is also a shortage of land available for farming in lowland areas. Some individuals are unable to afford fertilizers which typically costs 3000 KSh or have no access to credits; however, credit can be obtained from local banks or from the Savings and Credit Cooperative Society (SACCOS). Farmers may experience high prices at farm gates or are unable to afford labour from outside the family due to lack of capital. Agricultural extension officers educate and train people on the use of farming and its benefits, and there are various extension services provided by the government and NGOs. The average crop yields and marketing for the Maralal area is presented in Table 48.

Table 48: Average Crop Yields and Marketing for Samburu County

Crop	Yield	Land area (acres)	% sold	Months of sale	Price at harvest (KSh/bag)	Price not at harvest (KSh)
Beans	18,000 bags/ 90 kg	6,000	10	July	5,500	99,000,000
Maize	210,000 bags/ 90 kg	210	20	August-September	2,400	483,000,000
Wheat	38,500	3500	95	September	-	-

Source: Focus Group, Agriculture, Maralal 2018

2.4.2.9.3 Pastoralism

Over 90% of Samburu County lies within the ARAL where the main economic activity is nomadic pastoralism, with cattle, camels, sheep and goats being the most important livestock. Ninety-two percent of the County land is rangeland suitable for livestock production and supports 202,700 cattle; 622,000 sheep; 714,000 goats; 36,100 camels and 10,000 donkeys (SCG 2018).

In 2015, the population of Samburu County was estimated to be 290, 000, and the main livelihoods for the population was pastoralists (56.5%), agro-pastoralists (37%) and other livelihood options (6.5%) including formal employment (SCG and WFP 2015). In the pastoralist livelihood zone, 50% of the population is fully nomadic, and approximately 28% is semi-nomadic. The rest of the pastoralist population is either fully settled, out-migrant labour, occasionally nomadic or internally displaced. In the agropastoral livelihood zone, 60% of the population is fully settled, while 30% are in-migrant labour.

In Samburu County, livestock is typically owned by individuals, and herding activities are carried out by young men between the ages of 18 and 35, but sometimes by children aged 10 years and older (Focus Group, Livestock Herders, Baragoi 2018, Barsaloi 2018, Nachola 2018, Suyian 2018, Swari 2018; Appendix B). Herders follow specific grazing routes in search of pasture and water. Young men who are warriors also provide security against cattle rustling by outsiders. Livestock sales and slaughtering is done on a daily basis apart from Sundays and public holidays. The price of livestock is higher during the rainy season when green pasture is available. The average herd size varies based on climate, but in most communities, herd size is generally about 30 to 40 animals per herder but can extend to 100 or more animals for the wealthy. In Baragoi there are approximately 25 to 30 herders. Table 48 shows the average number of animals per herder.

The pastoralists migrate in groups consisting of various families or lineages moving with their livestock in search of pasture or water depending on the seasons and also due to security concerns in the area. Herders from Suyian stated they travel in large groups and carry guns for security purposes to protect their livestock from predation and against livestock raiding (Focus Group, Livestock Herders, Suyian 2018; Appendix B).

Table 49: Average Herd Size for Barsaloi and Swari

Community	Average Number of Animals per Herder*			
	Goats and sheep	Cows	Camels	Donkeys
Barsaloi	100	50	40	5
Swari	100-200	30-40	30-40	n/a
Suyian	n/a	30	n/a	n/a
Baragoi	n/a	30	n/a	n/a

Source: Focus Group, Livestock Herders, Barsaloi 2018, Swari, 2018, Suyian 2018, Baragoi 2018
n/a not available
**Data was not available for the other communities*

There are some extension services available for herders and their livestock, although it is limited. Livestock herders indicated that extension services are provided for short periods, and feed is distributed during dry periods but in small quantities. Medicines are provided annually to prevent disease outbreaks, and animals are vaccinated and dewormed twice a year. Veterinary services are provided by the county government and education and training concerning livestock is mainly conducted by the National Drought Management Authority and NGOs. However, livestock herders from Nachola stated that there are no extension services (e.g. education for veterinary services) and no veterinary service support provided by the government or other organisations.

In Nachola, herding activities are carried out throughout the area, and there are several travel routes extending from the community that lead to pastures and water points (Focus Group, Livestock Herders, Nachola 2018; Appendix B). Grazing areas are generally located adjacent to the main road, and are in the Suguta Valley and near Naturkan, Lomirok/Natur. Water for livestock is only available in the Nachola river which is seasonal. There are also dams but there is no water during the dry season. There are no permanent settlements or homesteads in Nachola since the community are nomadic pastoralists. Only the Nachola shopping centre has permanent homesteads.

Herding activities in Baragoi are found throughout the entire area (Focus Group, Livestock Herders, Baragoi 2018; Appendix B). During *Lorikine* (winter) most of the livestock graze in the Sikira area, and during the rest of the year they graze in the Siap area. During the fall they graze around Sinkwa. Permanent homesteads are in Bendera, Ngilai and Parkati, and animals move to Nolchuu or Suyian and Loregel in search of pasture and water.

In Suyian, animals graze far from the community because of security concerns. They graze during *Ltumuren* (the long rains that fall from October to December) at Sunya, and during *Lorikine* (the long rains from June to August) the animals graze at Sikira and Marti. The Suyian River is the only source of water. The Barsaloi route is the primary travel route used. Long term homesteads are in Suyian and Lgotoi because of security concerns and herders live in a large homestead as a security measure against threats from other hostile communities (e.g. Turkana). Short-term homesteads are only found where the herders move from area to area in search of green pasture.

Herding activities in Barsaloi are carried out during the short rainy season in October and November near the community (Focus Group, Livestock Herders, Barsaloi 2018; Appendix B). During the dry season, in January and February, herders migrate to the Marti area (west), Wamba (east), and also some parts of Marsabit and Isiolo in search of pasture. They return to Barsaloi during the rainy season in March and April and migrate back to the same areas during the long dry season between May and September. The main source of water is from the Barsaloi River. Several travel routes extend from Barsaloi into different grazing areas. In Barsaloi, there are semi-permanent homesteads. The land is communal, and herders can live anywhere except on grazing areas.

In Swari, herding activities are carried out throughout the area during the rainy and dry seasons (Focus Group, Livestock Herders Swari 2018; Appendix B). The only source of water is the Seyia River, and water is available throughout the year. The main Wamba-Swari-Barsaloi road is the main travel route for livestock and people, but there are several other routes extending out from the community.

Table 50 shows a summary of pastoralist grazing areas, homesteads and travel routes.

Table 50: Pastoralist Grazing Areas, Homesteads and Travel Routes

Community	Season	Grazing Area	Homesteads/Travel Route
Baragoi	Winter *(Lorikine)*	Sikira	Bendera, Ngilai and Parkati (permanent homesteads) Nolchuu/Suyian, Loregel (temporary homesteads)
	Other months	Siap	
	Autumn	Sinkwa	
Barsaloi	short rainy season (October and November)	Barsaloi area	Barsaloi (semi-permanent homesteads)
	long rainy season (March and April)		
	dry season (January and February)	Marti area (west) Wamba (east) Parts of Marsabit and Isiolo	
	long dry season (May and September)		
Nachola	n/a	Suguta Valley Naturkan Lomirok/Natur	Lomirok, Pwakamoe, Nameretha, Nadopua Napandi, Ekalale, Ikore (homesteads)
Suyian	Long rains-*Ltumuren* (October to December)	Sunya	Suyian and Lgotoi (long-term homesteads) Barsaloi route
	Rains-*Lorikine* (June to August)	Sikira Marti	
Swari	Rainy season	Swari area	Wamba-Swari-Barsaloi road
	Dry season		

Source: Focus Group, Livestock Herders, Baragoi 2018, Barsaloi 2018, Nachola 2018, Suyian 2018, Swari 2018

The Elders manage the pastoral groups in terms of grazing and seasonal calendars (Livestock Herders Focus Groups). They bless the animals in the morning and advise the herders. The role of the Elders, or the grazing committee, is to manage grazing patterns, and to resolve disputes related to pasture or grazing lands within the community and between communities. They also have the authority to exclude outsiders from grazing on their lands. The Elders manage the harvesting of *acacia tortalis* pods and leaves which are used as animal feed. They control and oversee other natural resources and valuables such as precious stones to avoid misuse and theft.

The livelihoods of pastoralists are facing increasing pressures in Samburu County, primarily due to institutional change regulating access to land (Lesorogol 2017, Pas 2018). Historically, land use was managed communally in which anyone considered a member of the community was able to access land for grazing and living. The whole range was managed and used as a single resource often under reciprocal arrangements. Today, livestock mobility involves longer periods and more complex distances due to a shrinking resource base and new rules of access (Pas 2018). In some areas, there is increased enforcement of boundaries by private landowners and group ranches (Lesorogol 2017). In the past several years, some group ranches have begun to challenge the right of non-members to settle semi-permanently on group ranch land. There has been a rapid growth in the formation of community-based wildlife conservancies that limit livestock access to large areas of pasture and institute new grazing rules with implications for livestock mobility. Human population growth, increasing sedenterisation and the growth of towns and settlements influence the landscape for herding. Several grazing areas are not used due to insecurity and violent conflict from neighbouring communities, and many Samburu herders have moved to neighbouring Laikipia County where land tenure is insecure. Many younger, more educated Samburu are less committed to pastoralism as a way of life (Lesorogol 2017).

2.4.2.9.4 Protected Areas

There are several community wildlife conservancies in Samburu County which aim to promote community-led wildlife conservation and tourism development initiatives (SCG 2018). The community conservancies are managed by committees of men and women elected by local communities. The Northern Rangelands Trust (NRT) is a community conservancy membership organization which supports community-based organisations in managing their land for the benefit of livelihoods (NRT 2017, 2018). There are currently seven NRT facilitated community wildlife conservancies which are funded by community revenue from tourism, the county government and development partners, and five newly established conservancies which are entirely funded by the county government.

The proposed pipeline traverses through 12 conservancies, both of which support pastoralism. Table 51 shows the community conservancies in Samburu County, and Appendix D shows the protected areas.

Table 51: Samburu County Conservancies

Sub-County	Conservancy Name	Area (ha)*	Supported by
Samburu Central	Ltungai	39,584	NRT
	Nkoteiya	15,501	NRT
	Ltungai-Malaso	39,584	County
Samburu East	Kalama	49,663	NRT
	Meibae	101,517	NRT

Sub-County	Conservancy Name	Area (ha)*	Supported by
	Namunyak (Kalepo, Nalowuon and Ngilai units)	383,804	NRT
	Sera	339,615	NRT
	Westgate	36,299	NRT
Samburu North	Baragoi	n/a	County
	Nyiro	n/a	County
	Ndoto	n/a	County
	Kirisia-Nkoteiya	n/a	County

Source: SCG 2018 and NRT 2017

n/a not available

**Area (ha) was not available for the conservancies in Samburu North Tourism*

2.4.2.9.5 Tourism

The county has a variety of natural landscapes, including plateaus, escarpments, valleys and wildlife which could be tapped to promote tourism in the county. Tourism in Samburu county is still mainly confined within the 165 km^2 Samburu National Reserve, the only game reserve in the County located in Samburu East (SCG 2013). Samburu National Reserve hosts various lodges and game sites, and in 2016, the reserve had a total of 10,785 visitors (SCG 2018). Maralal National Sanctuary is another important conservation area. There are 20 tourist class hotels in the county with a total bed capacity of 700, most of which are located within reserves or other conservation areas.

The County also has a number of community wildlife conservancies as a way of promoting community led wildlife conservation and tourism development initiatives (SCG 2018). Seven community wildlife conservancies are funded by community revenue from tourism, the County government and development partners, while six newly established conservancies are entirely funded by the county government. Tourism in Samburu County is highly affected by external factors, such as poaching, livestock intrusions into wildlife conservation areas, terrorism, drought and insecurity (SCG 2018).

2.4.2.10 Cultural Resources

There were no cultural sites reported along the pipeline corridor near Nachola, Suyian or Barsaloi according to the pastoralists (Focus Group, Livestock Herders, Baragoi 2018, Barsaloi 2018, Nachola 2018, Suyian 2018, Swari 2018; Appendix B). Cultural sites near Baragoi include Sikinte (circumcision for mud spearing) and Loonyeyok (gum from the Acacia Senegal tree). Plants or other materials that are gathered near Baragoi include Sagaram (seed pods from the umbrella thorn tree), Sukuroi (aloe), Nkuuk (for charcoal) and herbs used as medicine. Other traditional herbs that are gathered from elders include *Lekeel siet* and *Sagaram* and the natural resource *Sitet used* for healing. *Acacia tortalis* (umbrella thorn) is gathered in the Swari area and is highly valued for its pods and herbal properties, and is also used for fencing, shades, ropes and timber.

There are no sacred sites along the pipeline route from Archer's Post to Wamba according to Elders from Archer's Post (Focus Group, Elders, Archer's Post 2018; Appendix B). Uaso is the only spiritual site in the area where people visit, pray and gather herbs, but it is not in the Project area. Important routes that are used for obtaining traditional medicines that overlap the pipeline route include Kalifari, Nairobi, Rapunye, Lolboxi,

Ltergesi, Lalpaniai, Geruna, Lolngerdeol, Noltokoon, Lerata chini, Lerata juy, Loolgeresire, Lengusaka and Wamba.

The Elders stated that there is a sacred site in the Nkaroni area across the mina road called "Nagoroworu" where Elders and other people go to pray for rain (Focus Group, Elders, Nkaroni 2018; Appendix B). This site and graves were reported to be in the Project area. Near Wamba there is one sacred site in the area called Kurdop, situated in the river at the foot of the mountain, east of the town (Focus Group, Elders, Wamba 2018; Appendix B). There is also a site where warriors celebrate *Lmuget,* a traditional ceremony for boys transitioning to Morans, which is surrounded by trees that should not be cut down. The Elders stated that graves serve as sacred taboo places in the area and they should be observed and respected. No sacred areas were reported near Lerata along the pipeline corridor.

The Elders emphasised that sacred trees along the pipeline corridor should not be destroyed, and if they are compensation is required (Focus Group, Elders, Archer's Post 2018, Baragoi 2018, Lerata 2018, Nkaroni 2018, Swari 2018, Wamba 2018; Appendix B). Ltepes trees, or *acacia tortalis* are considered sacred, and considered the "father" tree in the area and they should not be cut.

Table 52 shows the sacred and important cultural sites for the AoI communities in the Project area.

Table 52: **Sacred or Important Cultural Sites for AOI Communities**

Community	Site Name or Type	Notes
Archer's Post	Uaso	A holy place in the area where people visit and got to pray
	Ltepes (*Acacia tortalis*) (umbrella thorn tree)	A holy/sacred tree in the area that should not be cut
Baragoi	*Sikinte*	A cultural site used for circumcision for mud spearing
	Loonyeyok (gum) site	A cultural site where gum is collected from the Acacia Senegal tree and mixed with honey and hay. This is fed to dairy cows to enhance milk production
	Ltepes (umbrella thorn)	Sacred trees in the area that are specially taken care of; The cutting of Ltepes is illegal as order by council leadership
Barsaloi	No cultural sites in the area	n/a
Lerata	*Ltepes* (umbrella thorn)	Sacred trees in the area
Nachola	No cultural sites in the area	n/a
Nkaroni	Nagoroworu	A sacred site in the area where Elders and other people go to pray for rain
	Grave sites	There are grave sites in the area

Community	Site Name or Type	Notes
Suyian	No cultural sites in the area	n/a
Swari	No cultural sites in the area	n/a
Wamba	Kurdop	A sacred site situated in the river at the foot of the mountain, east of the town
	Lmuget celebration site	A site where warriors celebrate Lmuget, a traditional ceremony for boys transitioning to Morans, which is surrounded by trees that should not be cut down
	Grave sites	There are grave sites in the area which serve as sacred taboo places and should be observed and respected

Source: Focus Group, Livestock Herders, Baragoin 2018, Barsaloi 2018, Nachola 2018, Suyian 2018, Swari 2018; Focus Group, Elders, Archer's Post 2018, Baragoi 2018, Wamba 2018, Nkaroni 2018, Swari 2018,

2.4.2.11 Project Concerns

The Livestock herders and elders expressed concerns and recommendations about the proposed Project during the Focus Groups discussions held from October 22 to 26, 2018 and October 19 to 29, 2018, respectively. These concerns and recommendations are listed below by topic. Focus Group notes are provided in Appendix B.

Livelihoods

- Potential impacts of the Project on travel routes and grazing areas resulting in poor production of livestock and milk (Focus Group, Livestock Herders, Baragoi 2018; Barsaloi 2018);
- A pipeline leak may result in soil pollution and impact livestock milk production (Focus Group, Livestock Herders, Suyian 2018);
- Injury or loss of livestock because of the trench or other Project activities (Focus Group, Livestock Herders, Baragoi 2018; Barsaloi 2018; Suyian 2018);
- The clearing/loss of important vegetation and trees, which are used for food, medicines and other uses, especially *acacia tortalis* and aloe vera (Focus Group, Livestock Herders, Nachola 2018; Barsaloi 2018); and
- Adverse impacts on livelihoods from the potential disturbance to dams or settlements along the pipeline route (Focus Group, Livestock Herders, Nachola 2018).

Social and Health

- Injury to children who look after livestock because of Project activities (Focus Group, Livestock Herders, Baragoi 2018);
- Noise pollution from construction activities (Focus Group, Livestock Herders, Baragoi 2018); and

- The potential adverse social impacts of the Project because of outsiders working on the Project, such as the spread of HIV/AIDS or other diseases, stealing local girls for wives, livestock and mineral theft (Focus Group, Livestock Herders, Barsaloi 2018).

Cultural Resources

- Potential destruction of graves along the pipeline route (Focus Group Livestock Herders, Barsaloi 2018); and
- Loss of important cultural trees, especially *acacia tortalis*, which is highly valued for its pods and herbal properties (Focus Group, Livestock Herders, Nachola 2018, Barsaloi 2018).

Employment and Compensation

- Employment opportunities should be provided to local communities (Focus Group, Livestock Herders, Barsaloi 2018); and
- Compensation is expected immediately and on an annual basis (Focus Group, Elders, Baragoi 2018).

Several concerns and recommendations were expressed by community members and stakeholders about the proposed Project during the consultation meetings held in Maralal, Archer's Post, Nachola, Baragoi, Suyian, Barsaloi, Nkaroni, Swari, Wamba and Lerata from October 17 to October 29, 2018. These concerns have been categorised according to socio-economic topic and are listed below.

Land

- Fear that the compensation process for land acquisition will be delayed or unfair; many community members have land parcels/plots and are not part of the group ranches or do not have documentation/title deeds to prove land ownership and fear they will be left out of the compensation process (Maralal, October 17, 2018; Archer's Post, October 19, 2018; Nachola, October 22, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018; Barsaloi, October 25, 2018; Nkaroni, October 27, 2018; Swari, October 26, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018);
- Boundary disputes will escalate as people move back to the area or group ranches try to benefit from compensation. The pipeline route must be clearly demarcated on the maps, and the National Land Commission (NLC) should determine the appropriate landowners and not allow others who move into the area to benefit. The NLC should resolve the boundary issue between the group ranches (Suyian, October 24, 2018; Wamba, October 28, 2018);
- Fair and uniform compensation should be given for land in all areas of the pipeline route (Nachola, October 22, 2018; Nkaroni, October 27, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018);
- Fair compensation for people who lose their land and have been forced to leave because of insecurity (Nachola, October 22, 2018); and
- The potential impact on land from an oil spill or fire (Wamba, October 28, 2018).

Livelihoods

- The displacement of people because of Project activities, including the relocation of women away from rivers they depend on for fetching water (Swari, October 26, 2018; Nkaroni, October 27, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018);
- The impact of the project on pastoral livelihoods because of the large amount of land that will be acquired for the corridor (LAPSSET) (Maralal, October 17, 2018);

- The potential adverse impacts or loss of important natural resources along the Project corridor and impact on the livelihoods of people and their livestock who depend on them (Maralal, October 17, 2018; Archer's Post, October 19, 2018; Nachola, October 22, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018; Nkaroni, October 27, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018), including:
  - grazing areas;
  - water points, wells and boreholes;
  - trees, shrubs and other vegetation, particularly the acacia tree;
  - medicinal trees;
  - minerals, precious stones or sand;
  - salt lakes/deposits; and
  - the Barsaloi and Suyian rivers.
- The potential adverse impact on water sources/flow that livestock depend on if water used for project activities (Archer's Post, October 19, 2018; Nkaroni, October 27, 2018);
- Disruption to pastoral movements for people and livestock during project activities, including from trenches or fences (Nachola, October 22, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018; Barsaloi, October 25, 2018; Lerata, October 29, 2018); and
- The potential impact of an oil spill on livelihoods (Maralal, October 17, 2018).

Cultural Resources

- The impacts on cultural or sacred sites, including graves located along or near the pipeline route (Nachola, October 22, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018; Nkaroni, October 27, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018); and
- The communities stated they would like to see these sites not disturbed, or traditional protocols should be followed in the excavation of graves (Nachola, October 22, 2018).

Health and /Safety

- The potential health impacts from the pipeline in general, and from an oil spill/leak, including from consuming contaminated water (Maralal, October 17, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018; Archer's Post, October 19, 2018; Nachola, October 22, 2018);
- The potential impacts of acid generated from the pipeline on people and livestock (Wamba, October 28, 2018);
- The potential health impacts to livestock if the pipeline passes through a natural salt deposit area called Erot that livestock depend on (Nachola, October 22, 2018);
- The potential impact of a fire or oil spill/leak from the pipeline (Maralal, October 17, 2018; Lerata, October 29, 2018; Wamba, October 28, 2018);
- The potential risk of injury to people or livestock from the open trenches (Nachola, October 22, 2018; Lerata, October 29, 2018);

- The potential for accidents between project vehicles/machinery and people and livestock (Nachola, October 22, 2018; Baragoi, October 23, 2018; Swari, October 26, 2018); and
- Potential security issues at camp stations, or in case of a bomb explosion near the pipeline (Maralal, October 17, 2018; Baragoi, October 23, 2018).

Social

- The potential adverse social impacts from the influx of foreigners/outsiders bringing immoral behavior/social vices potentially leading to family break-ups, the spread of HIV/AIDS and other STDs, prostitution and rape, and early pregnancies in young girls (Maralal, October 17, 2018; Nachola, October 22, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018; Wamba, October 28, 2018);
- Potential impacts on families from working long hours on the Project (Maralal, October 17, 2018);
- The potential impact of outside workers and their social vices on culture and traditional way of life (Baragoi, October 23, 2018; Suyian, October 24, 2018; Swari, October 26, 2018);
- The potential impact on social infrastructure located along or near the pipeline route (e.g. primary school, health centre, secondary school, polytechnic, and a women's group area, mosque, technical institute, catholic church and manyattas); the communities indicated that new facilities should be built to replace the ones that will be affected, particularly schools so learning is not affected (Archer's Post, October 19, 2018; Baragoi, October 23, 2018; Nachola, October 22, 2018; Suyian, October 24, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018);
- The potential for pipeline workers to steal minerals and other natural resources in the area (Nachola, October 22, 2018); and
- The potential impact on the tourism industry that communities rely on because of adverse impacts on the environment (Wamba, October 28, 2018; Maralal, October 17, 2018).

Employment

- Interest in employment opportunities for local community members, especially for youth. Communities stated that youth should be provided jobs in monitoring and security or trained to operate machines for the project. Tenders should be given to community members and local businesses for services, such as using their vehicles for transporting people and materials, and for cooks (Maralal, October 17, 2018; Archer's Post, October 19, 2018; Nachola, October 22, 2018; Baragoi, October 23, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018; Nkaroni, October 27, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018).

Benefits and Compensation

- Interest in benefits from the Project for affected communities (Maralal, October 17, 2018; Baragoi, October 23, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018);
- Interest in benefiting from corporate social responsibility programs; for example: scholarships awarded to community members, borehole/tapped water construction, schools, health centres markets, community centers, bridge construction and enhanced security measures (Archer's Post, October 19, 2018; Nachola, October 22, 2018; Suyian, October 24, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018) or programs in which the elderly, orphans and widows can benefit (Barsaloi, October 25, 2018); and

- Compensation should be provided for the loss of land or livelihoods, loss of trees and vegetation, loss of salt lakes and water points and injury to people or livestock (Maralal, October 17, 2018; Archer's Post, October 19, 2018; Nachola, October 22, 2018; Baragoi, October 23, 2018; Suyian, October 24, 2018; Barsaloi, October 25, 2018; Swari, October 26, 2018; Nkaroni, October 27, 2018; Wamba, October 28, 2018; Lerata, October 29, 2018).

Consultation

- The consultation and engagement process started to late, and key stakeholders were not included or informed. The communities stressed the importance of engaging with all community members, and to ensure that engagement is ongoing to increase community awareness, including for the illiterate so they are also informed of the Project (Maralal, October 17, 2018; Nachola, October 22, 2018; Archer's Post, October 19, 2018; Suyian, October 24, 2018; Nkaroni, October 27, 2018; Wamba, October 28, 2018; Baragoi, October 23, 2018).

2.4.3 Isiolo County

Isiolo County covers an area of approximately 25,700 km^{2,} bordering Marsabit County to the north, Samburu and Laikipia Counties to the west, Garissa County to the south east, Wajir County to the north east, Tana River and Kitui Counties to the south and Meru and Tharaka Nithi Counties to the south west, as shown in Figure 7 (GOK 2018a). Isiolo town lies 285 km north of Nairobi by road.

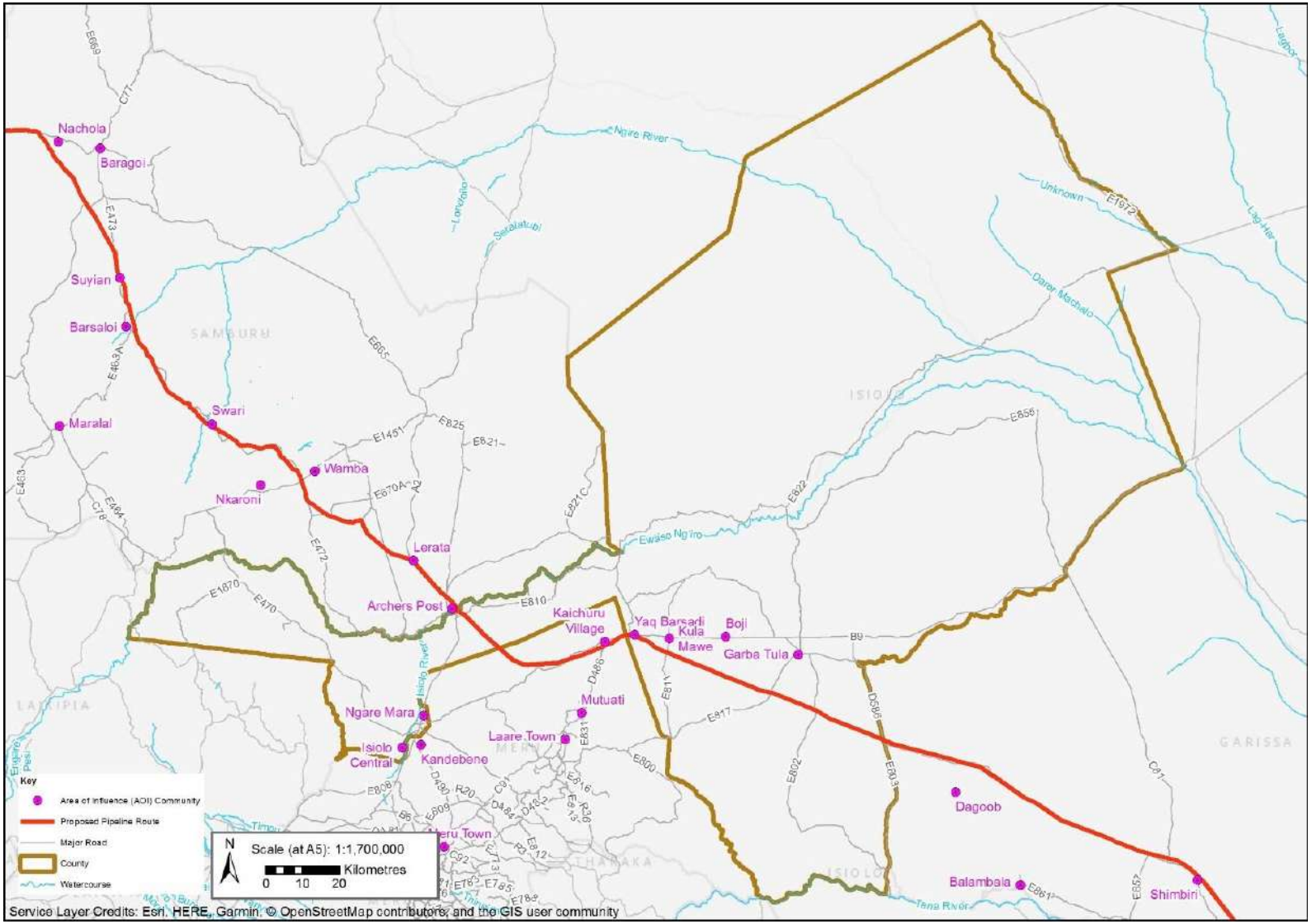

Figure 7: Isiolo County

2.4.3.1 Administrative Divisions and Governance Structure

The county is divided into three administrative sub-counties, including Isiolo, Garbatula and Merti (GOK 2018b). These are further divided into 11 divisions, 22 locations and 44 sub-locations as shown in Appendix D (KNBS 2013). The county has two parliamentary constituencies-Isiolo North and Isiolo South (Table 53) (GOK 2018b). Isiolo North covers the largest area and has the highest number of wards.

Table 53: Isiolo County Administrative Units traversed by the Project

Sub-County	Division	Area (km^2)	No. of Locations
Isiolo	Cental	3,269	Not available
Garbatula	Kinna	9,819	Not available
	Garba Tula		

Source: GOK 2018b

The proposed Project passes through Isiolo and Garbatula sub-counties, which are the primary focus of the socio-economic baseline report. The Area of Influence (AoI) communities most likely to experience socio-economic effects from the Project in Isiolo and Garbatula sub-counties are listed in Table 54, including their distance to the pipeline route. The closest community is Yaq Barsadi, located 0.2 km from the pipeline route. Focus groups were conducted with the local government, department of education, pastoralist groups, elders, women and youth in most of these communities.

Table 54: AoI Communities in Isiolo County

Sub-county	Community	Distance from Pipeline (km)
Isiolo	Isiolo Central	37.2
	Ngare Mara	27.6
Garbatula	Garba Tula	12.1
	Kula Mawe	3.7
	Boji	9.9
	Yaq Barsadi	0.2

2.4.3.1.1 Local Administration

Women's participation in political decision-making is hindered by cultural traditions to some extent, but generally, perceptions of women's roles are changing over time because more girls are achieving an education (Focus Group, Women, Boji 2018, Garba Tula 2018, Isiolo Central 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B). Women are more active in politics and decision making today than in the past, and they manage family resources after the death of their husband. The exception is in Ngare Mara, where women stated they do not have a voice in the community and few end up in leadership positions (Focus Group, Women, Ngare Mara 2018; Appendix B).

The youth are generally active in politics and they join different political parties during elections. The youth are paid to campaign for their chosen party and leader and are easily manipulated by politicians. They are concerned about quality of leadership and are heavily influenced by individuals with wealth and power. The youth of Garba Tula stated that they are not recognised by political leaders or the Council of Elders, and therefore they are not well represented in political or social circles (Focus Group, Youth, Garba Tula 2018; Appendix B).

2.4.3.2 Population Demographics

According to the 2009 population and housing census, Isiolo County had a total population of 143,294 (GOK 2018b). The growth rate between 1999 and 2009 was about 3.7%, and by the year 2022, the total population is projected to increase to approximately 164,949. There are more males than females in Isiolo County, with a sex ratio of 100:92. The population consists largely of Cushite communities (Oromo-speaking Borana and Sakuye), and the Turkana, Samburu, Meru, Somali and other immigrant communities from other parts of the county (GOK 2014).

Isiolo sub-county has the largest population at 79,835 and a population density of 24 persons per km^2, followed by Garbatula sub-county, with 43,118 inhabitants and a population density of 4 persons per km^2. Merti sub-county has the lowest population, with 20,341 inhabitants and a population density of just 2 persons per km^2. The population of Isiolo County was expected to increase to just under 90,000 by 2018, but precise official statistics are not available (GOK 2018b). Table 55 below provides the current projections for the population in Isiolo County based on a predicted and steady population growth of 3.7% (GOK 2018b). Large capital investments that are planned for development, including LAPSSET, Resort City and upgrading of Isiolo Airport to an International Airport are expected to create rapid population growth in the county. Therefore, by the year 2022, the total population is expected to surpass the current KNBS projections, to about 280,000 (GOK 2018b).

Table 55: Total Population of Isiolo County

Sub-County	2009 Census		2018 Projection		2020 Projection		2022 Projection	
	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)
Isiolo	79,835	24	88,427	27	90,130	28	91,900	28
Garbatula	43,118	4	47,759	5	48,678	5	49,634	5
Merti	20,341	2	22,530	2	22,964	2	23,415	2
Total	143,294	6	158,716	6	161,773	6	164,949	6

Source: GOK 2018b

In 2009, almost half of the population (45.3%) was under the age of 17, and 51.9% of the total population was between 15 and 64 years of age, representing the labour force age category (GOK 2018b). Only 3.65% of the population was 65 years or older.

Table 56: Population Projections for Selected Age Groups

Age group	2009 Census			2022 Projection		
	Male	Female	Total	Male	Female	Total
Under 5 (pre-school)	12,075	11,228	23,303	14,109	12,562	26,671
6-13 (primary school)	16,498	16,197	32,695	21,403	19,564	40,966
14-17 (secondary school)	6,757	6,388	13,145	8,012	7,294	15,306
15-35 (youth)	20,526	20,320	40,846	29,264	27,354	56,619
15-49 (female reproductive age)	n/a	32,141	32,141	n/a	33,823	33,823
15-64 (labour force)	38,288	36,137	74,425	45,500	40,774	85,974
65+ (elderly)	2,607	2621	5,228	3,078	2,948	6,027

Source: GOK 2018b; n/a = not applicable

The County has four urban centres, including Isiolo, Garbatula, Merti and Kinna, and in 2009 the total urban population was 59,327. Isiolo town had the highest population accounting for over 74% of the total urban population, and Garbatula had the lowest population, at 6%. The urban population is projected to increase by 110.14% by 2022 because of the county's development plans. Table 57 presents demographic data for urban centres in Isiolo County.

Table 57: Population Projections by Urban Centre

Urban Centre	2009 Census	2017 Projection
Isiolo	44,154	59,047
Garbatula	3,774	5,047
Merti	6,532	8,735
Kinna	4,837	6,469
Total	59,327	79,338

Source: KNBS 2013

2.4.3.3 Ethnicity and Language

Isiolo County is inhabited by five ethnic communities, including the Samburu, Turkana, Borana, Somali and Meru, with the Boranas forming the largest population (Saferworld 2015, Kenya Information Guide 2018). Prior to independence, Isiolo experienced ongoing conflicts between these communities over resources. Political conflict between ethnic groups has also been frequent, particularly around elections and the contest for political control and domination, which occasionally turns violent. Following a number of violent conflicts in Isiolo County between 2008 and 2011, the county moved towards cooperation and peacebuilding between ethnic groups (Saferworld 2015). Isiolo residents are Muslim and Christian, with the majority of the population being Muslim. Most of the Somali and Borana are Muslims, while the Ameru practice Christianity (Kenya Information Guide 2018).

Circumcision and naming ceremonies are practiced in Yaq Barsadi and Garba Tula, which are both Islamic communities (Focus Group, Elders, Yaq Barsadi 2018, Garba Tula 2018; Appendix B). In Ngare Mara *Atha Pan* is the initiation from childhood to adulthood, and during the ceremony animals such as bulls, camels and rams are slaughtered (Focus Group, Elders, Ngare Mara 2018; Appendix B).

2.4.3.4 Social Organisation

The daily activities of the women in the AoI communities entail waking up at around 5 or 6 a.m. to prepare breakfast and get the children ready for school, then participating in household chores until 8 am. Farmers work from 8 am to 4 pm and shopkeepers and stall owners work from 8 am to 6 pm.

Husbands are the sole decision makers in the family where there is a husband and wife, but single mothers make their own decisions. Money is managed by both the husband and wife, and they are both responsible for paying school fees and healthcare costs. Women do all the household chores including collecting water and firewood and purchasing food. Children look after animals, sell eggs and help with household chores; girls clean the house, fetch water, help with the farms, and sell milk while the boys generally help with herding livestock.

Youth are a source of labour and income to the household and are responsible for looking after parents if ill and the elderly. They are involved in decision-making and are responsible for the safety of their families and the community. Youth have many responsibilities, including looking after livestock and the sale of livestock skins, milk and fat. They are also involved in carpentry, sand harvesting, bee keeping, charcoal burning and farming. They run small businesses such as kiosks and *boda boda* (bicycle or motorbike taxis) riding. Females help with cooking and collecting water for the household. Youth from Yaq Barsadi harvest salt from the Magado crater which is sold to local markets. They also sell local building materials (wood poles) for local house construction.

There are numerous women's groups that facilitate the active participation of women in various activities. Work is shared among women in the community and they help with social gatherings by cooking and fetching firewood and water. Single women generally do not face stigmatisation in the communities and are taken care of by the clan and prioritised in terms of receiving support and donations. However, single women in Ngare Mara and Yaq Barsadi receive little assistance from the community. Widows, single mothers and orphans in Ngare Mara are often neglected and they have to work harder than married women to survive (Focus Group, Women, Ngare Mara 2018; Appendix B). Some single women in the communities are forced to resort to prostitution to support themselves and their families.

In the past circumcision was a rite of passage but it's no longer practiced in the communities (Focus Group, Youth, Garba Tula 2018, Isiolo Central 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B). Youth are getting married later than previously because they are prioritising school and employment. They are more educated than their parent's generation but face barriers because of a lack of opportunities to put their knowledge and skills into practice. In Yaq Barsadi, most of the young men in the community are faced with limited opportunities because of traditional customs, which has resulted in young adults being more dependent and having to follow the guidance of their parents (Focus Group, Youth, Yaq Barsadi 2018; Appendix B). The youth face many challenges such as insecurity, unemployment and poverty.

Elders are responsible for protecting and guiding the community and resolving conflict, such as land disputes and community disagreements. They also control grazing patterns of the community, formulate laws and negotiate dowry payments. They are custodians of traditions and customs, and conduct community rituals, sacrifices and ceremonies. Community elders are responsible for protecting sacred land and historical sites.

There are traditional healers in the communities who are considered valuable partners in the delivery of health services. They use natural resources such as honey, roots and leaves to treat malaria, diarrhoea and vomiting, and are paid for their services. Herbs are used by the Turkana traditional healers including *egong* (used for removing worms in the body) and *esokon* (roots used for treating chicken pox). Herbs from Mado Dhula and around Yaq Barsadi are used for healing and treating stomach ulcers.

2.4.3.5 Economic Base

Isiolo County is characterised by a very high poverty rate (72.6%) compared to the national average of 46%, and there is an over-reliance on relief food (GOK 2014). Unemployment, low literacy levels and climate hazards all contribute to high poverty levels in the county. Food insecurity is largely driven by low agricultural productivity, prolonged drought and high temperatures, low and erratic rainfall, periodic outbreaks of livestock pests and diseases, poverty and conflicts (MoALF 2018a). Isiolo County is one of the counties earmarked for development under the Kenya Vision 2030 programme which aims to transform Kenya into a middle-income country by 2030, with plans to develop Isiolo town into a 'resort city' to boost tourism to the area (MoALF 2018a).

Agriculture represents the backbone of the County's economy, and is an important source of income, savings, and social status for the population (MoALF 2018a). Over 80% of inhabitants rely on livestock for their livelihoods and less than a third (26%) practice agro-pastoralism. Along with livestock keeping and subsistence crop farming, there is also some mining, mostly in the form of sand harvesting, trading in urban and peri-urban centres, and charcoal burning in Wambera, Burat and Kinna wards (MoALF 2018a).

The livestock trade makes a large contribution to the income and livelihoods of employers, employees and their dependents (Iruata et al. 2015). In a study of the economic contribution of the pastoral meat trade in Isiolo County (Iruata et al. 2015) 66% of respondents from Oldonyiro and Garba Tula towns were employed in the live animal trade, and 17% were employed in eateries or food kiosks. The livestock traders directly support 470 members of their immediate family, and a further 30% of the population are extended family members who also depend on the traders. The Isiolo County Council receives sources of revenue from the pastoral meat businesses including, livestock transport permits, charges levied on livestock sellers and buyers, slaughter fees, meat inspection fees and medical certificate fees (Iruata et al. 2015).

2.4.3.6 Employment

The labour force (aged 15-64) of Isiolo County was 74,425 in 2009, representing 51.9% of the total population (GOK 2018). The labour force was projected to rise to 85,974 by 2022. Only 14.5% of the county's population are wage earners, the majority of which are employed in the public sector and hotel industry (GOK 2018). Over 85.5% of the population is not involved in formal employment because of high illiteracy levels and lack of industries, and most formal employment is found in Isiolo town. The proportion of skilled labour is also low due a lack of technical and vocational training institutions in the county. The informal sector constitutes small scale activities that are unregulated and uses simple technologies, which facilitates employment creation, especially for youth. Approximately 60% of the population is rural self-employment, engaged in the livestock trade, and 15% is in the urban self-employment and involved in retail trade. The labour force constitutes about 52.12% of the county's population. Over 70% of the labour force is not formally employed, due to high illiteracy and lack of skills. Employment opportunities are expected to increase in the county because of large investments planned to transition Isiolo town into a resort city and LAPSSET project. The county is planning to invest more into developing the capacity of the people to be skilled and more specialised (GOK 2018).

Income diversification is viewed as an increasingly important risk management strategy by pastoral herders because of growing hardships and challenges, such as resource competition and conflict, climate change and droughts, food security stress and population pressure (Ashiba 2018). In a study of income sources from households in Garbatula, Kinna and Kulamawe, livestock herding was the most important income-earning activity for the majority of households (45%), followed by petty trading (12.3%), retail shop activities (10.8%) and casual labour (10.8%) (Ashiba 2018). Other sources of income were trading in livestock (7.7%), gathering and sale of wild products (e.g. charcoal, water) (6.5%), trade in livestock products (4.6%), wage/salaried employment (1.5%) and other sources (0.4%). Male household heads have a greater degree of income diversification and are more likely to engage in high value non-pastoral incomes than female household heads. Male-headed households have significantly higher participation in livestock trade, petty trade and retail shop activities, while female-headed households engage only in a few "low entry-barrier" activities, such as the gathering and sale of wild products (Ashiba 2018).

Changes in pastoral household mobility have also encouraged participation in non-pastoral income activities (Ashiba 2018). Men and young boys herd livestock in satellite camps away from the "home-base" settlement where women, elders and young children are based. Participation in non-pastoral income activities makes it easier to provide for household members at the base camp settlement without having to sell livestock in the satellite camps. Furthermore, the growth of pastoral settlements around service centres and water points has encouraged family labour not involved in herding to be fairly sedentary, which is also a factor that encourages income activities to supplement pastoral livestock income. Petty trading, casual non-livestock labour and retail shop activities are the main income activities that pastoralist households in settlements are engaged in.

Similar results were found from the integrated SMART survey conducted in 2018 (MOH 2018c) from a sample of 560 randomly selected households in Isiolo County (Table 58). The main source of income of households was the sale of livestock and livestock products (34%) followed by causal labour (27%). Petty trading also provides a source of income.

Table 58: Main Source of Income (2018)

Source of Income	Percentage of Total
Sale of livestock and livestock products	34%
Casual labour	27%
Permanent job	10%
No income	8%
Petty trading	8%
Others	7%
Sale of crops	4%
Remittance	2%

Source: MOH 2018c

Women from the focus groups stated that there are generally no employment opportunities for women in their communities (Focus Group, Women, Boji 2018, Garba Tula 2018, Isiolo Central 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B). In Boji, girls are married at a young age and are not educated, and women are typically regarded as housewives and are responsible for buying groceries (Focus Group, Women, Boji 2018; Appendix B).

In general, the women are involved in small-scale farming activities near their homesteads, livestock trading and small businesses. Goats, sheep and cows are sold. During the rainy season in March and April there is an increase in animal production and milk, a decrease in animal disease and the livestock are grazed closer to the communities which increases their market value. During the dry season in November and December, there is inadequate milk and an increase in animal disease. Livestock are grazed further from the communities, decreasing their market value.

The women are self-employed and run shops selling groceries and khat/miraa[83]. They also sell milk, kerosene, tobacco, firewood, charcoal, gum Arabica (acacia gum), as well as *Acacia tortillis* (umbrella thorn) pods, manure and wild fruits. Some women provide tailoring services. Women from Ngare Mara cut posts which are sold for fencing and collect pebbles to sell for household construction (Focus Group, Women, Ngare Mara 2018; Appendix B).

There are also generally few employment opportunities for youth. Youth are eager to find jobs, but they often have to migrate to other towns in search of employment. Many young people from Yaq Barsadi have migrated to the urban centres of Isiolo, Meru or Nairobi for work opportunities (Focus Group, Youth, Yaq Barsadi 2018; Appendix B). The youth from Ngare Mara have skills and knowledge as carpenters, plant operators, drivers, electricians, mechanical engineers, hairdressers and caterers (Focus Group, Youth, Ngare Mara 2018; Appendix B).

Jobs are usually gained through corrupt methods and nepotism is common, which has affected the less affluent youth in the county (Focus Group, Youth, Garba Tula 2018, Isiolo Central 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B). In Garba Tula, the high rate of unemployment has led to increased conflict in households and crime within the community (Focus Group, Youth, Garba Tula 2018; Appendix B). The youth are using drugs and there is a sense of hopelessness among youth. The youth are eager to work but there is a feeling that unless corruption levels decrease, they will not secure jobs easily. There is limited access to technology in most communities, except in Isiolo Central, but youth feel that increased access to technology has led to a decline in morals.

2.4.3.7 Social Infrastructure

2.4.3.7.1 Education

In Isiolo County, 59.8% of the population can read and write, compared to the national average of 66.4% (UNICEF 2013). The literacy rate in Isiolo County for young women aged 15-24 is between 58% and 74%, compared to the national rate of 93% (KNBS 2016). The literacy rate for young men aged 15-24 is between 91-96%, compared to the national average of 95%. Approximately half (54.1%) of residents have no formal education in Isiolo County, greater than the national average of 25.2% (KNBS and SID 2013c). Only 13% of residents have a secondary level of education or above, and 36% of residents have a primary level of education only. At the national level, 22.8% of residents have secondary education or above and 52% of residents have primary education only. Table 58 shows the highest level of education attained in the wards in Isiolo County.

83 a flowering plant native to the horn of Africa and the arabian peninsula, the addictive herb is chewed for its stimulant effect

Table 59: Educational Attainment in Isiolo County (2009)

County/Constituency/ Wards	None	Primary	Secondary+	Total population
Isiolo North Constituency	47.1	37.3	15.7	86,578
Wabera	26.8	44.1	29.1	14,694
BulaPesa	24.3	46.8	29.0	20,127
Chari	52.9	40.9	6.2	4,244
Cherab	53.9	39.0	7.1	13,885
Ngare Mara	61.4%	27.0%	11.6%	4,286
Burat	53.0	38.9	8.1	15,884
Oldonyiro	82.8	13.9	3.3	13,458
Isiolo South Constituency	60.0	33.4	6.6	38,614
Garbatula	67.7%	26.9%	5.4%	14,575
Kinna	55.7%	36.8%	7.5%	13,187
Sericho	54.7	38.2	7.0	10,852
Isiolo County	54.1%	36.1%	12.9%	125,192
Kenya	25.2	52.0	22.8	34,024,396

Source: KNBS and SID 2013c

Enrolment in school starts early, at the age of 4 in pre-primary school. There is a total of 160 Early Child Development Education centres, of which 42 are private (GOK 2018). Total enrolment in 2017 was 16, 295 students, comprising of 55.9% boys and 44.1% girls. The teacher student ratio is 1:87, far above the target of 1:40. Drought, inadequate ECDE infrastructures and pastoralism prevent some children from attending pre-primary school.

Table 60: School Enrolment for Isiolo County

Pre-School		Primary		Secondary		Tertiary	
Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio
16, 295	1:87	33,008	1:37	5,397	1:23	-	-

Source: GOK 2018

The county has 125 primary schools of which 108 are public and 17 are private. There are 33,008 students enrolled in primary schools. According to the NCPD (2017), the primary school net enrolment rate is 84.7%.

There are 2 operational youth polytechnics in the county, and 25 secondary schools of which 17 are public and 8 are private (GOK 2018). Six secondary schools are boarding schools and the rest are day schools. The total enrolment for 2016 was 5,397 students, with a net enrolment of only 23.6% (GOK 2018, NCPD 2017). In 2016 there were 236 teachers, with a teacher -student ratio of 1:23, which was improved from 2013 and a teacher-student ratio of 1:30. In Isiolo County 58.4% of youth between 15-18 years were attending school, compared to the national average of 70.9% (UNICEF 2013).

Both boys and girls leave school between the ages of 12 and 18 years, but often at 12 years of age for various reasons, such as the death of their parents or guardians, adolescence and peer pressure, the inability to pay school fees, poverty, family labour, particularly during times of drought, a shortage of food at home or at school, and family migration because of insecurity to areas without schools. Boys generally drop out because of drugs, especially miraa (khat) and bhang (an edible preparation of cannabis), while girls typically leave school because of early marriages and pregnancies.

There are three tertiary institutions in the county, including Kenya medical Training College, St. Marys secretarial College and Isiolo ECD Training centre (GOK 2018). There is a centre for Nairobi University in Isiolo town offering diploma courses. Isiolo County has 55 adult literacy classes and in 2015/2016, 3,073 students were enrolled. Two vocational training centres are in the county, Uhuru in Isiolo and Merti in Merti sub-county.

Youth from Isiolo County had mixed attitudes towards education (Focus Group, Youth, Garba Tula 2018, Isiolo Central 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B). They noted that obtaining an education is not the only way to earn money. Youth from Ngare Mara generally have positive attitudes towards education. Youth from Yaq Barsadi stated that there are limited education institutions in the area and some schools only teach up to “Form 4”. Similarly, youth from Garba Tula reported that the local education system is poor, and poverty in the area has led to a large number of school dropouts. Students who are poor receive very little support.

Parents’ hope for their children is that they will receive a quality education and job opportunities. They indicated that there is a need for clothing support, and school feeding programs to supplement the food shortage found in households. There is also the need for greater parent support such as counselling, rehabilitation and advice for single women and widows.

2.4.3.7.2 Health Services

Isiolo County has 3 level 4 hospitals, 8 level 3 facilities (health centres),38 level 2 dispensaries, and 3 level 2 medical clinics (Shape Consulting Ltd. 2019) (Appendix A).

Table 61 presents the health system challenges in Isiolo County. The primary challenges are due to poverty, high demand for services, inadequate resources, and service delivery. Additional information on baseline health conditions in Isiolo County is discussed in Appendix A: Community Health Baseline Report.

Table 61: Health System Challenges in Isiolo County

Project County	Challenges	Contributing factors
Isiolo	■ Inadequate health infrastructure (50 km average distance to a health facility) ■ Inadequate human resources ■ High burden of communicable diseases ■ Poor health seeking behaviour ■ Food insecurity ■ Nomadic lifestyle ■ Insecurity and ethnic conflicts ■ High illiteracy level ■ Increasing burden of HIV ■ Poverty ■ Home deliveries and high maternal mortality ■ Poor sanitation coverage	■ Historical marginalisation ■ Vastness of geographical area and poor road network ■ Arid and semi-arid climate (food insecurity) ■ Rapid population influx (especially Isiolo town) ■ Health system inefficiencies such as inadequate ambulances and weak referral systems contribute to high maternal mortality

Source: Baseline KIIs in Appendix A

According to the January 2017 SMART integrated survey, Isiolo County has an overall global acute malnutrition rate (low weight to height) of 18.2% and a severe acute malnutrition rate of 3.3% for children younger than 5 (MOH 2017). The global acute malnutrition rate has increased from the previous year by almost 6%, which is attributed to compromised household food security and poor dietary diversity because of limited food access and availability, increased food prices and seasonal variations. In addition, increased incidences of disease, stock outs for the supplementary feeding programme in all health facilities, and striking health workers contributed to increased malnutrition in 2017.

One in five children are underweight, and 4.5% are severely underweight. Stunting (lower than average height) also remains high, with 17.3% of children younger than 5 stunted compared to the national average of 26% (KDHS 2014). Stunting can be attributed to a deterioration of child health and nutrition status over time related to malnutrition, poor hygiene practices and poor childcare practices. Children who are malnourished are at greater risk of mortality and morbidity. The integrated management of acute malnutrition (IMAM) aims to prevent malnutrition by early identification, public health interventions and nutrition education, and to treat acute malnutrition.

In Isiolo County the IMAM programme is implemented in 45 health facilities including 3 health facilities with stabilisation centers for children with severe acute malnutrition with complications (MOH 2017). Only 16% of children with acute malnutrition were found to be enrolled in IMAM program. Low enrolment was attributed to inadequate case finding at the household level, stock outs, striking health workers and inadequate follow up.

Of the households surveyed in the 2017 SMART integrated survey (MOH 2017), 40.7% of children younger than 5 were reported to be ill two weeks before the survey. The main illnesses were acute respiratory infections (47%), Malaria/fever (19%) and watery diarrhea (19%). The majority of caregivers (86.7%) sought health care for their children at public or private health clinics.

Vitamin A supplementation is at 70.4% for children younger than 5, which is below the national target of 80% (MOH 2017). The proportion of children under 5 that are dewormed more than once is 59.4%. The low rates of vitamin A supplementation and deworming is attributed to poor health seeking behaviours, lack of follow up

after immunisations and early closure of schools before the national campaign in 2016. Iron Folate Acid Supplementation for pregnant mothers is at 97.0% in Isiolo County, but none took the supplements for over 90 days (MOH 2017). Malnutrition among pregnant and lactating women was 7.1% in January 2017, which was attributed to increased workload due to water and pasture shortage, and food shortage because of drought (MOH 2017), the majority of households (41.3%) consumed foods from four or five food groups, while 39.1% only consumed foods from 3 food groups).

Over 68% of people in Isiolo County live in rural areas where the health facilities are inadequate, sparsely distributed and understaffed (GOK 2018). There are two level 3 health facilities (Isiolo and Garbatula hospitals), 51 level 2 health facilities and 36 level 1 community health units. The doctor to population ratio for the county is about 1:5000, and the nurse to population ratio is 1:1500 (GOK 2018). There are no hospitals in Yaq Barsadi and community members have to walk to Kula Mawe for treatment (Focus Group, Women, Yaq Barsadi 2018). There are no hospitals in Boji for maternal care, and mothers with complicated pregnancies are referred to hospitals in outlying areas which leads to high health cost (Focus Group, Women, Boji 2018). According to the women from Boji and Garba Tula, infant and maternal mortality is high due to a lack of proper healthcare (Focus Group, Women, Boji 2018, Garba Tula 2018).

Family planning methods are easily accessed at healthcare centres and pharmacies in Isiolo Central. Women from the other AOI communities also reported that they have access to family planning and other health care services; although the women from Ngare Mara stated that family planning is prohibited in their culture (Focus Group, Women, Ngare Mara 2018; Appendix B).

HIV prevalence in Isiolo County has decreased from 4.9% in 2012 to 3.8% in 2017 (GOK 2018). The areas most affected are Isiolo town, Garbatula, Ngare Mara and Merti. The threat posed by HIV and AIDS is the increase in orphaned and vulnerable children and death of the productive population. It also increases the demand for health services and health care provision (GOK 2018). In general, there is an awareness of the causes, prevention and treatment of HIV among AOI community members, but the women stated that awareness programs are conducted less frequently and more education is needed. HIV campaigns are generally carried out by NGOs, mass media and government health departments. The women from Isiolo town and Yaq Barsadi stated that there is little awareness of HIV in their communities (Focus Group, Women, Isiolo Central 2018, Yaq Barsadi 2018; Appendix B), and HIV cases have increased in the region according to the women from Ngare Mara (Focus Group, Women, Ngare Mara 2018; Appendix B).

Youth from Isiolo Central stated that there is little HIV awareness in Isiolo County and HIV rates are high (Focus Group, Isiolo Central 2018; Appendix B). However, youth from the other communities stated that they have an awareness of HIV and campaigns are carried out through mass media, seminars and maternal health care programs and also taught at school. The youth from Yaq Barsadi noted that the Boran culture is strong and Islam discourages promiscuity in young adults (Focus Group, Youth, Yaq Barsadi 2018; Appendix B). Youth from Garba Tula said the rate of HIV in their community is very low (Focus Group, Youth, Garba Tula 2018; Appendix B).

2.4.3.7.3 Food Security

The most common source of protein consumed in households in the AOI communities is goat which is consumed up to 3 times per week in some communities. The frequency of beef and chicken consumption varies by community (Table 62). Fish is only consumed in Isiolo Central, but rarely. Milk and yogurt are consumed daily in most communities, except in Isiolo Central, but rice is consumed daily in all communities. Wild plants are also consumed in some of the communities when they are in season. In Yaq Barsadi, food is stored in granaries and water is stored in drums and tanks. In Garba Tula, food is stored in the households, and water is stored in pots and jerry cans.

Table 62: Household Foods Consumed

Foods	Isiolo Central		Ngare Mara		Yaq Barsali		Boji		Garba Tula	
	Frequency	Amount/ family	Frequency	Amount/ family	Frequency	Amount/ family	Frequency	Amount/ family	Frequency	Amount/ family
Fish	1x/month	1 kg	never	-	never	-	never	-	never	-
Goat	3x/week	0.5 kg	1x /week	0.25 kg	1x /month	0.5 kg	3x/week	0.25 kg	2x/week	0.25 kg
Chicken	1x /month	0.5 kg	-	-	1x /year	1 kg	1x /month	1 kg	1x /year	1 kg
Beef	3x/week	-	1x /month	0.25-0.5 kg	never		1x/year	0.5 kg	1x week	0.5 kg
Milk/Yogurt	1x /month	1 litre	1x/day	1 litre	1x/day	1 litre	1x/day	2 litres	1x/day	2 litres
Rice	1x/day	1kg	1x/day	1kg	1x/day	1 kg	1x/day	1 kg	1x/day	1 kg
Bush meat	never	never	-	-	never	-	never	-	never	-
Wild plants	never	Never	seasonally	-	never	-	seasonally	-	never	-

Source: Focus Group, Women, Boji 2018, Garba Tula 2018, Isiolo Central 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B

Households reported facing food insecurity because of water shortages, a lack of water storage facilities, climate change, and limited support from extension officers for livestock and agriculture. Food costs are high, therefore some people can only afford one meal a day, and pregnant mothers are considered some of the most vulnerable, since they cannot afford a balanced diet.

Food poverty rates are high in Isiolo County (77%) which has led to a high dependency of the population on relief food (MoALF 2018a). In February 2017, the National Drought Management Authority (NDMA) indicated that up to 80,000 residents of the county were in need of food aid as a result of drought, and there was conflict over water and pasture during the period because of migrating herders and livestock from neighbouring counties (Reliefweb 2017).

Isiolo County falls under the pastoral north-east livelihood cluster, and the current drivers of food insecurity in this area are rainfall performance, conflict and insecurity, and other hazards such as flooding and disease outbreaks (GOK 2018a). The key findings of the 2018 long rains assessment were that above-average performance of the long rains led to significant improvement in household food availability and access. All areas in the pastoral north-east that were in the crisis[84] phase of food insecurity in January 2018 moved to the stressed[85] phase by August 2018, and approximately 70% of households had acceptable food consumption in June 2018. However, there are still about 700,000 people in the pastoral north-east and pastoral north-west in the Crisis phase of food insecurity, mainly because these households have not fully recovered from consecutive poor seasons, with most of them losing productive assets during last year's drought and facing considerable food gaps (GOK 2018).

2.4.3.7.4 Housing

A total of 31,305 houses were recorded in Isiolo County in 2009 (KNBS 2009). In the rural areas most of the houses have been constructed using mud, grass and wood, in settlements called Manyattas which are temporary in nature facilitating the semi-nomadic pastoral way of life. However, there have been fundamental changes in pastoral household mobility, whereby men and young boys herd livestock in satellite camps away from the "home-base" settlement where women, elders and young children are based (Ashiba 2018). Pastoral settlements have become increasingly sedentary, growing around service centres and water points. The risks of drought have also been a factor in the growth of partially settled households (Ashiba 2018).

Of the households in Isiolo County, 31.5% are constructed with mud and wood, 22.3% are made with wood only and 17.5% are made with grass/reeds (KNBS 2009). There are over 5,000 permanent housing structures in Isiolo County which are made of either stone or brick. These permanent housing structures are only found in Isiolo town and other urban centres, but the devolution structure has led to more permanent settlements being established in rural areas (GOK 2018). The most common type of floor material in Isiolo County is earth (70%) followed by cement (28.9%). The most common type of roof material is corrugated iron sheets (60.8%), followed by grass (20.8%), makuti (5.8%) and mud/dung (3.4%).

2.4.3.7.5 Security

Conflict and violence have characterised nomadic pastoral communities in northern Kenya for decades because of competition for scarce resources. This conflict usually takes the form of cattle raiding and rustling, ethnic violence and displacements (Sharano 2014). Environmental changes have brought additional stressors, including land degradation and an increased frequency of droughts. In addition, conflicts in Isiolo County have been aggravated by the presence of small arms and light weapons, shrinking grazing lands and water resources

84 Phase 3 (Crisis): Even with any humanitarian assistance at least one in five HHs in the area have food consumption gaps with high or above usual acute malnutrition OR Are marginally able to meet minimum food needs only with accelerated depletion of livelihood assets that will lead to food consumption gaps.
85 Phase 2 (Stressed): Even with any humanitarian assistance at least one in five HHs in the area have minimally adequate food consumption but are unable to afford some essential non-food expenditures without engaging in irreversible coping strategies.

as a result of increased human settlements and competing land uses for commercial ranching and wildlife conservation (Sharano 2014, Saferworld 2015).

However, the nature of pastoral conflict in Kenya has changed due to a number of factors which are connected to wider political, economic and social dynamics (Saferworld 2015). Pastoral conflicts today are a manifestation of the generalised violence in the country's evolving politics and deep political divisions at clan and ethnic levels (Sharano 2014). Recent conflict in Isiolo County has primarily been between the Turkana and Borana communities, and tensions between these two communities date back to the 2007 elections (Saferworld 2015).

Ethnic violence in Isiolo County has been driven by new dominant political and economic interests, which is more pronounced with the new decentralised political system and ethno-political competition to control and dominate the county government (Saferworld 2015, 2018). Through political dominance, ethnic groups seek to accumulate economic resources to gain wealth and better their positions in relation to rival communities. Under the new devolved system, considerable public resources are channeled through county governments, which leads to intensified competition between county-level elites (Sharamo 2014). Identity politics pit ethnic groups against each other and lead to exclusive service delivery based on patronage rather than need (Saferworld 2018). As a result, many people feel excluded, with little opportunity to participate in formal political processes or have an impact on county policy. Many pastoralist communities feel excluded, with little support from the institutions, and as a result inter-community conflict persists which often results in violence (Saferworld 2018).

There are concerns that Vision 2030 has reinforced rivalries and resource-based conflicts between ethnic groups, as different ethnic groups try to position themselves so they can directly benefit from the project (Saferworld 2015). There have also been allegations that politicians and other influential individuals are using the ethnic rivalries between communities to evict them from lands through incitement to violence if they fail to leave the areas where they have settled (Saferworld 2015). Areas particularly affected by this include Isiolo Central, Tigania East, and disputed areas like Gambella, Ngare Mara, Chumvi, and Kiwanja.

Land ownership rights have been complicated by political and ethnic interests, and politicians in Isiolo have been accused of using land ownership as a political tool, promising people ownership of contested parcels of land in order to gain support from their own ethnic communities (Saferworld 2015). The tensions that relate to land claims are anticipated to increase from the development of the Isiolo Resort City. The establishment of wildlife conservancies in Isiolo County has also created tensions between different ethnic groups, with some communities feeling they have been created to deny communities access to grazing areas (Saferworld 2015).

The environmental and political challenges of 2017 led to an increase in the number of livestock thefts, road banditry, and conflict-related fatalities in community conservancies in several counties (NRT 2017). Incidents of livestock theft increased 70% in 2017, with 90 recorded cases in community conservancies, up from 53 in 2016 (NRT 2017). The main cause of the conflict was drought which increased competition amongst pastoralist groups for scarce resources, and people disregarding grazing rules and traditional water and grazing sharing customs. A number of 'restocking raids' occurred, after pastoralists lost a high number of livestock to drought and sought to restock their herds during the first rains in late 2017. In Isiolo County, the highest number of livestock raids occurred in Leparua conservancy (NRT 2017). Of the recorded cattle stolen in 2017, 50% were from Melako, Biliqo Bulesa and Leparua conservancies in Isiolo and Samburu Counties. The high concentration of livestock at the Isiolo-Marsabit boundary have made raids and counter-raids between the Rendille and Borana people more frequent. Of the sheep and goats recorded stolen, 50% were from Kalama and Nakuprat Gotu, close to the Samburu-Isiolo boundary, which was a cycle of retaliation raids between Samburu and Turkana communities.

The number of recorded road banditry incidents increased to 22 in 2017 from 18 in 2016 (NRT 2017). There were 12 incidents of road banditry on the Archer's-Wamba-Maralal road, likely because of the high concentration of livestock here, which enabled morans[86] to collectively plan and carry out attacks.

The NRT has established multi-ethnic, mobile security teams which are able to respond rapidly to livestock raids and recover stolen stock, which helps to break cycles of retaliation (NRT 2017). The mobile security teams and conservancy rangers work alongside the police, Kenya Wildlife Service, county administration and local leaders to address conflict and violence. Efforts between the conservancies have resulted in the recovery of 1349 head of livestock in 2017 (NRT 2018). Conservancies also employed 748 community rangers in 2017. The NRT peace team and conservancies facilitated and promoted peace dialogues, carrying out 86 peace-related meetings during 2017, and 26 Peace Ambassadors were employed in 2017 (NRT 2017).

Kenyan authorities often have weakened authority over bandits and cattle rustlers who are heavily equipped with sophisticated weapons and carry out violent activities (Sharano 2014). There are seven police stations in Isiolo County and several posts in each sub-county (GOK 2018). The main crimes are burglary, stock theft, robbery, petty theft and armed gangs. Cattle rustling and banditry are major crimes in Garbatula and Merti. Major crimes are focused around resource-based conflict which may be inter-communal and between pastoralists and other groups using the land, inter-county border conflicts which may be political and inter-communal, ethno-political conflict, inter-personal violence such as gender violence and youth violence (GOK 2018).

Kenya Police Reservists (KPRs) are part of the Kenya Police Reserve, an auxiliary force detached from the Kenya Police Service and made up of volunteers operating within their own localities (Mkutu and Wandera 2013). KPRs are armed by the state to supplement the role of the police in providing security where police presence is low. They often guard pastoralist cattle enclosures and move with cattle caravans to protect them against raids by other pastoral groups. However, the lack of an operational mandate has blurred the role of KPRs, which has changed from providing remote livestock security to providing private security for businesses, NGOs, and conservancies (Mkutu and Wandera 2013). Younger KPRs are more easily tempted by the improved pay of private security work, and politicians will sometimes recruit KPRs for their personal needs. There is also the risk of firearm misuse and armed violence by KPRs, and access to the illicit small arms market is increased because of a lack of regulation and other factors (Mkutu and Wandera 2013).

2.4.3.8 Physical Infrastructure

2.4.3.8.1 Water

Isiolo County is hot and dry in most months of the year and it has two rainy seasons. The long rainy season is from March to May, and the short rains from October to December (MOH 2018c). Isiolo County is located in the Pastoral North East livelihood cluster, and is it characterised by recurrent droughts, hot and dry climate with low and erratic rainfall patterns (MOH 2018c). The rainfall in the county averages 580.2 mm annually, and November and April are the wettest months receiving 149 and 143 mm, respectively (MoALF 2018a). The erratic and unreliable rainfall cannot support crop farming which partly explains the high food insecurity and poverty levels in the county (GOK 2013).

Water availability in Isiolo County varies throughout the year and depends on the seasons (Mati et al. 2005). There are severe shortages of water during times of drought, which is a common occurrence in the county. There is no piped water in the rural areas, meaning few households have potable water at home. In general, access to water in Isiolo County comes from four major sources including direct use of natural water sources such as rivers, streams and springs; developed surface water sources, such as earth dams, sand/subsurface

86 A Samburu warrior

dams, tanks and pans; developed groundwater such as wells, waterholes and boreholes; and emergency water supply by the government using tankers (Mati et al. 2005).

Isiolo County has three main rivers, including Ewaso Nyiro, Isiolo and Bisanadhi (GOK 2018). Ewaso Nyiro River originates from the Aberdare ranges and north-western slopes of Mount Kenya and drains into the Lorian Swamp. The Ewaso Nyiro North River is the boundary between Isiolo and Samburu Counties and runs for approximately 157 km along the boundary, before going inland into the Isiolo County for a further distance of 174 km. The Isiolo River originates from Mount Kenya and drains into Ewaso Nyiro River. Bisanadhi River originates from Nyambene ridges and drains to Tana River. Most of the irrigation shemes are found along these rivers (GOK 2018).

Natural water sources form a major source of water for domestic use and livestock (Mati et al. 2005). The Ewaso Ng'iro River is the most important source of water in Isiolo District, especially for livestock watering, and herders and their livestock often come to the river from the north during dry periods. Surface water availability in Isiolo County varies with seasons of the year, and sources include rivers, streams, springs and runoff from the Isiolo sub-catchment of the Middle Ewaso Nyiro catchment (GOK 2018). Surface water abstraction points are mainly along rivers and streams of the three sub catchments. All the rivers from each sub-catchment drain into the Ewaso Nyiro North River which is the main drainage system in the area. Most of the springs are situated within game reserves and are not accessible to local people. Many springs that were previously located along the major rivers are no longer available because of environmental degradation (Mati et al. 2005).

The main aquifers in Isiolo County are the Isiolo-Nyambeni-Mount Kenya aquifer that has high ground water potential, Merti aquifer, Garbatula-Modagashe aquifer that has very low ground water potential and Kachuru-Kulamawe-Boji aquifer which has fairly low ground water recharge in the aquifer (GOK 2018). Groundwater quality of alluvial aquifers is generally good, although they are prone to contamination since they are shallow and unconfined.

Developed water sources are poorly distributed, consisting of 123 water sources//points of which 59% are operational during the rainy season and only 36% are operational during the dry season (Mati et al. 2006). There is no piped/tap water in the rural areas and the district relies mostly on boreholes, accounting for 58% of all developed water sources. Some of the issues with boreholes are attributed to lack of community management, and many are not operational because of an inadequate system for organising the purchase of fuel for pumping or making required repairs. In addition, only 23 (32%) of the boreholes have fresh water (low salinity). There is an over reliance on groundwater, yet only 20% of the county has good groundwater potential. Merti, Garbatula and Sericho Divisions are especially lacking water sources, particularly during the dry season. The reliance on shallow wells for water is 17% in the county, most being traditional hand-scooped holes. In traditional Boran systems which are still practiced, steps are made into the well and women line up to reach down and fetch the water manually, using a "hand-me-up" system with containers. This process is slow and also leads to contamination of the water.

Under suitable conditions, floodwater harvesting is practiced through the excavation of shallow pans or ponds, both of which rely on surface runoff, but ponds also rely on some groundwater (Mati et al. 2005). Water harvesting in Isiolo County is limited to one subsurface dam and five operational pans during the rainy season, and one operational pan during the dry season. The main challenges with earth dams and pans are siltation, contamination and high evaporation losses, but seepage, ownership and community management are also constraints. Water quality is therefore a major issue, and only 42% of the water sources have fresh water (non-saline), of which 23 (32%) are boreholes, which further limits the availability of palatable water, especially for human consumption. Isiolo County is overlapped by several sand rivers whose potential for floodwater harvesting and storage has not been fully tapped (Mati et al. 2005).

Water is supplied in Isiolo town from the Isiolo Water and Sewerage Company (GOK 2018). Other supply schemes are Merti Water Supply and Garbatula water supply.

Approximately 65% of Isiolo County is classified as very arid and accessing water sources in some areas is a major challenge (Jarso et al. 2017). Approximately 93% of the county lacks access to safe and clean water that is available within 5 km distance, which affects over 175 villages (73%) (GOK 2018). Safe, or improved sources of water comprise of protected spring, protected well, borehole, piped into dwelling and piped rain water collection (KNBS 2013). Unsafe water sources include pond, dam, lake, stream/river, unprotected spring, unprotected well, jabia[87], water vendor and others. In Isiolo County, 59% of residents use improved sources of water, with the rest relying on unimproved sources (KNBS 2013).

During the dry seasons, most people rely on piped water (39%) followed by bore hole (34%) and river (10%) (GOK 2018). During the rainy season, 37% of people rely on piped water, followed by boreholes (25%) and river (11%). The reliance on rain water harvesting increases during the rainy season to 10%.

Table 63: Water Sources in Isiolo County

	Dry season	Rainy Season
River	10%	11%
Water pans[88]	4%	7%
Piped water	39%	37%
Boreholes	34%	25%
Rain water harvesting	2%	10%
Other	11%	10%

Source: GOK 2018

A large number of water sources are saline which limits the availability of potable water, especially for human consumption (GOK 2018). Approximately 59% of households use improved sources to access drinking water, but only 12% are treating the water using improved methods. Another 8% of households reported that they do not treat their water, regardless of the water sources. Good hygiene practices such as safe storage of water, treating water before drinking and hand washing, reduces the risk of food and water borne diseases (MOH 2018c). Despite 59% of households being aware of hand washing practices, there was a general decrease in critical hand washing practices from 2017 to 2018, which was attributed to the prevailing acute water shortage.

The proportion of households walking for more than 2 km to access water was 13.4%, up from 4.8% in 2017 because of the long dry spell that left water pans and rivers dry, forcing people to walk long distances to search for water. Another 23.1% of households walked for more than 500 m (MOH 2018c). Women were primarily responsible for fetching water. The proportion of households queuing 30 to 60 minutes to access water was 20.6% (MOH 2018c). Cattle generally can walk up to 10 km without experiencing stress, yet about 74% of the area and 52% of the villages are further than 10 km to a water source (Mati et al. 2005). During the dry season, some villages in Merti, Garbatula and Sericho are located 50-75 km from the nearest water point.

Following the rains in the high elevation areas, water flows down through the catchment along riverbeds and aquifers into the Ewaso Ng'iro North river that runs through the centre of Isiolo County (Jarso et al. 2017). This makes the population in the low-lying areas of Isiolo county vulnerable to floods, which has been exacerbated because of climate change. People and livestock from surrounding counties and other countries also migrate

87 A jabia is a term used in Kenya to describe a traditional rainwater storage system

88 A water pan is a small reservoir created by excavating open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands

towards the Ewaso Ng'iro riverbed in search of water and pasture, particularly during the dry season or droughts. The increased population during these times has placed pressure on the water service infrastructure and what it is able to support. As a result, according to the National Drought Management Authority (NDMA), vulnerable households in Isiolo County have been surviving on as little as 8 litres per person per day (GOK 2016).

The county relies on water tankers to distribute water in emergencies, but these are expensive and not considered a long-term solution (Jarso et al. 2017). Water quality is affected by the high salinity of water in some boreholes, resulting in their underutilisation. Furthermore, the county is constrained because of underfunding, a lack of capacity and governance issues, and some water service investments are vulnerable to destruction from outside pastoralists because of lack of ownership (Jarso et al. 2017). Existing pipelines and pumping systems that transfer water from one part of the system to another frequently malfunction, and additional transfers and dams are periodically used to regulate flows through the catchment. However, the natural flows through the catchment that used to transfer water from upstream are continuing to decrease due to increasing upstream extractions for irrigation and other uses (Jarso et al. 2017).

2.4.3.8.2 Sanitation and Waste

Poor sanitation is one of the leading causes of child illnesses such as respiratory infections and diarrhea and improving sanitation is known to have a significant beneficial impact on the health of a community (MOH 2018c). In Isiolo, 22.4% of households practice open defecation, while most households (41.6%) use their own latrines or traditional pits and 36% using a shared latrine or pit (MOH 2018c). This is an improvement from the 2017 results, where 29% of households were practicing open defecation. The decline may be in part because of the ongoing efforts of communities and public health promotion activities by the department of public health in collaboration with a number of partners supporting water, sanitation and hygiene promotion in the county such as KRCS, Caritas Isiolo and World Vision Kenya (MOH 2018c).

Human and animal waste contribute to water pollution and open defecation leading to pollution of surface water sources is a major challenge in rural areas (GOK 2018). In Isiolo town, flooding during the rainy season due to the poor drainage system has resulted in negative health impacts to the population (GOK 2018). Storm floods often mix with sewage from overflowing latrines and sewers which causes pollution and problems associated with the increased risk of waterborne diseases. In rural areas storm floods mainly occur along the Ewaso Nyiro River which drains into the lorian swamp, but there are isolated cases of high seasonal flooding that affects small pockets of settlements (GOK 2018).

Sanitation facilities and sewer systems in urban areas are inadequate in Isiolo County (GOK 2018). Household domestic sewage is channelled to sewerage treatment ponds, and where there is no sewer system, on-site sanitation facilities are provided through use of septic tanks and pit latrines. In rural areas households mostly rely on pit latrines while institutions use septic tanks.

2.4.3.8.3 Energy Sources

Access to electricity is limited in Isiolo County, with only 0.4% and 18.5% of households relying on electricity for cooking and lighting, respectively (KNBS 2009). The majority (65.2%) of households rely on fire wood for cooking, while 29.1% rely on charcoal for cooking. The main source of energy for lighting is petroleum products, including lantern (31.1%), tin lamp (19.5%), gas lamp (2.5%) and pressure lamp (0.5%). Solar energy is used by only 1.4% of households.

The new 132kV Meru-Isiolo project by Kenya Electricity Transmission Company Limited will construct a 26 km 132 kV single circuit line from Meru substation to the new Isiolo substation (Electric Energy Online 2016). The project is aimed to increase energy access in Isiolo County, as part of the Vision 2030 which aims to promote Isiolo County as an emerging tourist city. The project will supply power to the future tourist hub and facilitate extension of the power grid to the north in the future. In addition, the transmission line will supply reliable

electricity to Isiolo International Airport, the proposed Isiolo Resort City and the LAPSSET Project (Electric Energy Online 2016).

The Kenya Off Grid Solar Access Project is funded by the World Bank and aims to increase access to electricity services in underserved counties in Kenya and is part of the Government of Kenya's Vision 2030 (REA 2018). Under Vision 2030, energy is identified as one of the key sectors that form the foundation for sociopolitical and economic growth. The project is expected to run from 2017 to 2023 and will target 14 marginalised counties, including Isiolo County. The project will implement mini-grids for community facilities, enterprises and households; stand-alone solar systems and clean cooking solutions for households; and, stand-alone solar systems and solar water pumps for community facilities (REA 2018).

2.4.3.8.4 Transportation

The road network in Isiolo County is approximately 1,275.5 km (GOK 2018). Currently only 42 km is paved, while 22% of the total road surface is gravel and the majority (75%) is earth. During the rainy seasons, the earth surface roads are impassable and continuously require upgrading. In March 2017, the ministry of transport announced funding for a 560 km paved road from Lamu to Isiolo, which is part of the Lapsset corridor highway project which will eventually connect Lamu port through Garissa, Isiolo, Samburu county and end at Lokichar in Turkana where it will join the Eldoret-Juba highway (Business Daily Africa 2017e). Construction for the road was planned to start in August 2018 and last four years, after the government secured funding from the development Bank of South Africa (Business Daily 2018b). At Isiolo town the road will intersect the new northbound road to Moyale.

The Isiolo-Marsabit-Moyale road used to be 244 km of rough terrain, but is now 508 km of paved surface, reducing travel time significantly and connecting Kenya with Ethiopia (Capital Business 2016). The road has opened up the area and fostered regional trade. It has increased market access, improved delivery of government services, and led to a rise in land value and created employment opportunities. Economic activities have increased, as shops and residential houses have emerged adjacent to the highway (Capital Business 2016). Along with the planned resort city in Isiolo and the Isiolo International Airport, the Isiolo-Moyale road is expected to boost tourism in northern Kenya, facilitating access to Mt. Kenya, Samburu, Meru, Aberdares and Marsabit National Parks as well as the wildlife conservancies within the region. More importantly, the road has helped boost security in the region, since security agencies are able to respond more quickly to security threats (Capital Business 2016). The entire 1566 km highway, all the way to Hawassa in Ethiopia, also part of the Lapsset corridor project, was expected to be fully complete in December 2016 (Capital Business 2016).

The county has an airport and six airstrips, including Funan, Funan-koricha, and Korbesa in Kinna, Merti, Malkadaka and Garbatulla (GOK 2018). The Isiolo airport was upgraded to an international airport as part of the Lamu Port-South Sudan-Ethiopia-Transport (LAPSSET) corridor development project, as well as Kenya's Vision 2030 program. Construction was completed in 2017 and the airport was rehabilitated to international standards to serve a number of airlines and air operators with domestic and international flights (Airport Technology 2018). With a passenger handling capacity of 125,000 passengers a year, the new terminal building has been built to accommodate more tourists and local residents. The airport is expected to open up the tourist industry in northern Kenya and boost the local economy (Construction Kenya 2017a).

2.4.3.8.5 Communication

Isiolo only has one post office in Isiolo town, and a sub-post office in Garbatula urban centre (GOK 2018). Only 8% (2,090 km^2) of the county has mobile network coverage, and there are about 164 telephone connections (landlines) in the county.

2.4.3.9 Land and Resource Use

Isiolo County falls into three agro-climatic zones, including semi-arid (5%), arid (30%) and very arid (65%) (Mati et al. 2005). The climate in the towns of Isiolo and Kinna is semi-arid and the median annual rainfall is between 400-600 mm. The arid region ranges from the Ol Donyiro region to Archer's Post and Garbatula, and the annual rainfall ranges from 300-350 mm. The very arid zones are in Merti and Sericho where the annual rainfall is between 150-250 mm (Mati et al. 2005). Isiolo has two rainy seasons; the long rains from March to May, and the short rains from October to December (MOH 2018c). The short dry season is from January to March, and the long dry season is from June to October. Isiolo County is located in the Pastoral North-East livelihood cluster, and is it characterised by recurrent droughts, hot and dry climate with low and erratic rainfall patterns (MOH 2018c). It has 5 main livelihood zones, including Casual and waged labour (32%), Pastoral (all species) (15%), Pastoral (cattle and goats) (35%), Agro-pastoral (15%) and Firewood/charcoal (3%) (KFSSG and ICSG 2016).

2.4.3.9.1 Land Ownership

More than 80% of the land in Isiolo County is communally owned and is under the trust ship of the county government (GOK 2018). Public land comprises 10% of total land and includes land for schools, administration, army barracks, health facilities and game reserves. The remaining 10% of land is under private ownership and was alienated for private investment in housing, industrial and commercial purposes. On average, landholding per household amounts to 0.4 ha (1.1 acres), out of which 65% is homestead (MoALF 2018a). At least 7% of the households have title deeds, while 82% hold the land without any formal document (i.e. title deed), and approximately 2% of the farmers lease the land. There are few cases of landlessness, mainly among poor, immigrant communities in urban centres (MoALF 2018a). Frequent conflict because of competition for grazing land and water has resulted in the displacement of communities, but they generally return to their land after the situation has settled (GOK 2018). Typically, the head of the household (husband) owns the land and other assets, and elders decide on the use of the land with the help of morans.

2.4.3.9.2 Agriculture

Agriculture production has varied over the years because of erratic and unreliable rainfall (GOK 2014). Rain-fed crops are grown in Bulla Pesa, Wabera and Kinna wards where the soil retains moisture (GOK 2014). The majority of Isiolo County is arid and cannot support rain fed crop farming and agricultural activities largely depend on irrigation, with the Bisan Adhi, Kinna and Ewaso Ngiro rivers supporting irrigation. There are currently 20 irrigation schemes in the county (GOK 2018). Only 1,497 hectares are under food crops production, but this is expected to increase to 3,000 hectares because of Rapsu and Makadaka irrigations schemes. The average farm size is 1 ha since most of the area is reserved for communal grazing (GOK 2018). Irrigation farming is practiced along the Ewaso Ngiro River, and in Isiolo Central and Kinna. Crops that are produced in these areas include maize, sorghum, beans, green grams, cassava, sweet potatoes, nerica rice, cowpeas, dolicos, kales, tomatoes, onions and watermelons (GOK 2014, GOK 2018). Fruit trees are grown with the crops for subsistence and commercial purposes, and they also act as wind breaks and improve soil quality. Fruit trees that are grown include pawpaw, avocadoes, citrus, mangoes and guavas (GOK 2018).

Only 1,500 hectares are under food crops production, but the area under food and cash crops is expected to increase by 2,000 hectares with the completion of Kilimani –Game Galana, Gafarsa, Malkadaka and Rapsu irrigation schemes (GOK 2018). In the 2012/13 financial year the county allocated 3.3% of its total budget to the food crops sector, and it also received revenues from value chains in the county (GOK 2014). The table below shows the production and value of crops in Isiolo County for 2012.

Table 64: The Production and Value of Crops in Isiolo County (2012)

Category	Indicator	Unit	Production	Value (million KSh)
Field Crops	Maize	Bags	11,182	34
	Sorghum	Bags	236	0.87
	Beans	Bags	820	5
	Cowpeas	Bags	260	1.64
	Green grams	Bags	450	3.64
	Cassava	Tons	70	1.44
	Sweet Potatoes	Tons	70	2.17
Horticulture	Assorted	MT	20,692	646
			Total	**694.58**

Source: GOK 2014

The average farm size in Isiolo County is one acre. Extension services are carried out by technical staff that are distributed across the county and there is also a farmers training centre in Isiolo Central (GOK 2018). There are no agricultural products grown in most of the AoI communities near the Project, except near Isiolo Central and Ngare Mara where small-scale farming occurs close to homesteads. The farming seasonal calendar in Isiolo Central is shown in Table 65.

Table 65: Farming Seasonal Calendar for Isiolo Central

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Preparing land and planting												
Weeding												
Harvesting												

Source: Focus Group, Women, Isiolo Central 2018; Appendix B

Production of crops is more common among female-headed households (20% of all female-headed households), compared to youth-headed households (18%) and male-headed ones (6%) (MoALF 2018a). Female-headed households are the groups most affected by food shortages and malnutrition, due to low access to productive inputs and land, lack of adequate access to clean drinking water, and increased workload, which affects maternal and child health (MoALF 2018a).

The livestock sub-sector is the backbone of the economy with over 80% of its inhabitants relying on livestock for their livelihoods. Beef and milk were the main products from the livestock sub-sector followed by honey and mutton (GOK 2014).

Table 66: The Production and Value of Livestock Products

Product	Unit	Production	Value (million KES)
Livestock			
Cattle	No.	198,424	2976.4
Sheep	No.	361,836	1266.4
Goats	No.	398,903	1595.6
Camels	No.	39,084	977.1
Donkeys	No.	22,189	133.1
Pigs	No.	115	0.3
Indigenous Chicken	No.	35,137	10.5
Commercial Chicken	No.	6,652	2.0
Milk Production			
Cattle	Litres	2,820,000	70.5
Goats	Litres	1,912,818	47.8
Camel	Litres	918,000	27.5
Other Products			
Honey	Kg	499,120	82.5
Mutton	Kg	100,784	20.1
Eggs	Trays	3,600	0.6
Poultry meat	Kg	4,800	0.1
Beef	Kg	794,560	116.2
Fish	Kg	800	0.1
		Total	**7327.8**

Source: GOK 2014

There are ten major livestock markets in Isiolo County, which are found in Isiolo Central, Garba Tula, Belgesh, Eskot, Duse, Kinna, Modogashe, Merti, Kipsing and Oldonyiro (GOK 2018). There is a new but growing market for donkeys at Kiwanja in Ngare Mara that includes export to other counties. The main livestock trading includes cattle, goats, sheep and camels, and buyers generally come from Nairobi, Meru, and as far away as the coast (GOK 2018).

The Eskot market is on the border of Isiolo and Garissa counties, and it operates every Saturday, attracting traders from Danyere, Libaalo, Stele, Skit, Korbesa, Rapsu and Qone and even as far as Garissa County (Iruata et al. 2015). The Duse market is approximately 32 km from Garba Tula town, between Kinna and Garba Tula towns. The Duse market is known for the large herds of camels that are traded every Tuesday, and it mainly targets traders from the nearby towns of Kinna, Meru and Kangeta. The Oldonyiro livestock market is the largest in the county, and the local community and county council co manage the market and revenue collection. Traders are young men and women from as far as Samburu and Marsabit counties, and Nanyuki, Meru and Isiolo towns.

The agricultural sector faces several challenges, and production has declined over the years due to erratic and unreliable rainfall, increasing temperatures, poor soil fertility, poor production practices, low investments in efficient technologies, dependency on relief food, among other factors (MoALF 2018a). There has been low productivity of land because of prolonged drought and poor land management practices including overgrazing and charcoal burning (GOK 2014). Increased pressure has been placed on grazing lands from the influx of pastoralists from neighbouring counties, and the population in Isiolo County is expected to increase even further, placing more pressure on natural resources. Changes in land use, including the establishment of conservancies, new settlements and trading centers, and increased farming along the Ewaso Nyiro river basin, is resulting in the fragmentation of rangeland in certain areas and localised degradation of land (MoALF 2018a, GOK 2016). Although livestock production is the main source of livelihood, the county lacks markets for its products. Land in the entire county has not been adjudicated, which has discouraged meaningful and long-term investment in land (GOK 2014).

Adaptation to climate change in Isiolo County has included pasture establishment and conservation, disease control and surveillance, construction and maintenance of boreholes and watering points for livestock, mass vaccination, destocking, and rearing of drought-tolerant livestock types (MoALF 2018a). Crop farmers are practicing conservation agriculture and using drought-tolerant crop varieties, agro-forestry, and post-harvest management and marketing. Despite these efforts to respond to the hazards of climate change, farmers' adaptive capacity remains low and agricultural yields have continued to decrease over the past years. The lack of adoption of sustainable agricultural practices is due to limited access to water resources, farm inputs, and services, unaffordable productive technologies, and decline in the quality and quantity of water and pastures (MoALF 2018a).

2.4.3.9.3 Pastoralism

Over 80% of the land in Isiolo County is non-arable, accounting for 22,000 km^2, and is used for grazing by pastoralists (GOK 2014). In Isiolo County, livestock is owned by the husband and wife, but the husband typically manages the animals. Pastoralists from Ngare Mara herd cows, goats and sheep. Livestock numbers have reduced recently because of drought and the reoccurrence of dry seasons. Prior to the drought in 2017, an individual had on average, 100 to 150 cows or more, but now the average is around 30 to 50 cows per individual. There are no extension officers or services in the area and livestock drugs are only purchased in Isiolo town.

Pastoral herders move in groups according to lineage. On average a group of between five to ten herders travel together with approximately 600 to 1,000 cows. Two types of movement were described: migration for pasture during peaceful times, and migration due to conflict and fear. Prior to moving from one grazing area to another, small groups of herders will travel to inspect the proposed areas.

During the months of January and February animals are herded close to home since there is plenty of water and pasture. From March to April there is a decrease in pasture, but in May and June, following the late April rains, pasture is abundant. From July to December there is a decrease in pasture again and herders migrate to other areas, including Kaichuru, Chumbi yare and Magado. There is shortage of water during the dry season from July to December. A cow requires an average of 30 to 40 litres of water per day, while goats need

approximately 10 to 15 litres a day. Herders follow routes to places such as Daaba and Hillout which are approximately 20 kilometres from the community of Ngare Mara (Focus Group, Livestock Herders, Ngare Mara 2018; Appendix B). Areas such as Kinna, Kulamawe, Magado and Rapsu are more than 100 km away.

Permission is needed before establishing short- or long-term homesteads which typically involves discussions with elders and pasture management committees. This is especially important when herders travel with their livestock to neighbouring communities. Pastoral groups are represented by pasture management committees, the Council of Elders, youth leaders and traditional decision-makers.

Scarcity of pasture and water, and competition for resources has led to conflict and violence among pastoral communities in northern Kenya, which is in the form of cattle rustling, ethnic violence and displacements (Sharamo 2014). Inadequate rainfall and drought in the surrounding counties have resulted in decreased pasture and the subsequent movement of livestock from the counties of Wajir, Marsabit, Tana River, Samburu, and Garissa into Isiolo County, where they compete with local livestock for grazing resources (Saferworld 2015). Furthermore, communities migrating into Isiolo County in search of water and pasture are failing to follow traditional resource-sharing mechanisms, and although migrating pastoralists are aware of negotiated rules of access, they choose to ignore them. In addition, conflicts in Isiolo County have been aggravated by the presence of small arms and light weapons and competing uses of land for commercial ranching and wildlife conservation (Saferworld 2015).

Rangeland management remains one of the greatest challenges in conservancies where there is high levels of range degradation and soil erosion, especially due to large-scale livestock movements and during the 2016-2017 drought (NRT plan 2018). There continues to be conflict between the traditional grazing systems and the more closed boundary systems that conservancies promote to manage rangelands. Due to large-scale livestock movements, the risk of violent conflict with incursions by heavily armed herders, the rangelands team is moving away from supporting individual conservancy grazing plans and looking at regional and county-level land-use planning (NRT 2017).

2.4.3.9.4 Mining

The county has potential for mining of blue sapphire, Saaer minerals, ruby, limestone and gas, which geographical surveys have shown untapped deposits of (GOK 2018). Sand is also harvested but the practice is currently unsustainable.

2.4.3.9.5 Protected Areas

Currently, there are no gazetted forests in the county but Kinna Forest is earmarked for gazettement (GOK 2014). There are two ranches in the county, including Lewa ranch and Borana ranch (Appendix D). Lewa ranch is private and used for breeding the black rhino, and Borana ranch is a group ranch. There are three game reserves, which includes Shaba, Buffalo Springs, and Bisanadi (GOK 2018).

The Northern Rangelands Trust (NRT) is a community conservancy membership organisation which supports community-based organisations in managing their land for the benefit of livelihoods (NRT 2017, 2018). There are currently 35 member conservancies in northern and coastal Kenya, covering an area of 42,000 km^2. The conservancies have wildlife conservation as a primary objective and also support livelihood development, peace and security, good governance, pastoral movements and grazing, and provide services such as health and education (KWCA 2016). There are five NRT facilitated conservancies in Isiolo County which are used as fattening grounds and migration areas, which are shown in Appendix D (GOK 2018). The NRT through its trading arm, NRT Trading has been supporting communities in these conservancies by way of commercial livestock purchases. The conservancy's commercial revenue, which is also made of tourism income, is allocated towards operating costs (40%) and the conservancy's community fund (60%) (NRT 2018). The proposed pipeline traverses through Nakuprat-Gotu conservancy, which supports pastoralism.

2.4.3.10 Tourism

The county has several tourist attractions that can be categorised under nature and wildlife, culture, heritage and community-based tourism, adventure, eco-tourism and sports (GOK 2018). There are a wide range of hotels and campsites in the county, all of which are located in Isiolo North Sub-county.

The county has three game reserves-Shaba, Buffalo Springs and Bisanadi. Samburu and Meru national parks borders the county. There are five Northern Rangelands Trust facilitated conservancies (Nakupratt-Gotu, Leparua, BiliqoBulesa, Nasulu, and Oldonyiro Community Conservancy) which serve as wildlife corridors and migration routes and also facilitate tourism. Sarova Shaba Hotel is a main tourist attraction located in Shaba National Reserve and in 2017, there were 20,981 visitors of which 50.3% were foreigners. The total revenue in the last 4 years for the 3 game reserves is 238 million KSh.

Isiolo town was identified in the Vision 2030 as one of three resort cities to be developed, to optimise the tourism potential and facilitate access to Mt. Kenya, Meru National park, the Aberdares and Samburu National Park (Vision 2030 2018). The resort city will include high-end tourist facilities including accommodation facilities, amusement parks, water sport facilities, art exhibition, theatres for international festivals, as well as skiing and golf courses (Construction Kenya 2017b). The project is expected to turn Isiolo town into a regional hub, and open up the northern part of Kenya, attracting economic activities and investments. Isiolo town was selected due to its central position in the country, rich culture of the pastoralists, including Borana, Somali, Samburu and Turkana, and its natural heritage (Daily Nation 2012).

2.4.3.11 Cultural Resources

Community members reported several sacred sites along the proposed pipeline route, including shrines, cleansing sites and traditional initiation sites (Focus Group, Livestock Herders, Ngare Mara 2018; Focus group, Elders, Garba Tula 2018, Ngare Mara 2018, Yaq Barsadi 2018; Appendix B). Burial sites and cemeteries are also located near the pipeline route. Elders are responsible for protecting sacred areas and historical sites. Some species of Acacia trees are regarded as sacred and used during ceremonies and community members indicated that they should not be destroyed.

2.4.3.12 Project Concerns

Several concerns and recommendations were expressed by community members and stakeholders about the proposed Project during the consultation meetings held in Isiolo Central, Ngare Mara, Boji, Garba Tula, Kula Mawe from November 9 to November 14, 2018. These concerns have been categorised according to socio-economic topic and are listed below.

Land

- The removal of a large portion of land because of the Project (Boji, November 13, 2018; Garba Tula, November 14, 2018; Yaq Barsadi, November 11, 2018);
- The potential escalation of boundary conflicts between Meru community and Isiolo community because of land acquisition for the Project; the government/courts should resolve the land boundary dispute cases that are pending prior to development so the conflict with Meru County does not escalate conflict management measures should be in place (Garba Tula, November 14, 2018; Boji, November 13, 2018; Kula Mawe, November 12, 2018; Yaq Barsadi, November 11, 2018; Ngare Mara, November 10, 2018); and
- The land acquisition process and potential for unfair compensation if land ownership is not resolved; land is communal and pastoralists do not have land ownership documentation (Isiolo Central, November 9, 2018; Boji, November 13, 2018; Garba Tula, November 14, 2018; Kula Mawe, November 12, 2018; Yaq Barsadi, November 11, 2018); therefore, the communities indicated they would like to be issued land

ownership documents/title deeds before the project starts (Kula Mawe, November 12, 2018; Yaq Barsadi, November 11, 2018; Isiolo Central, November 9, 2018).

Livelihoods

- The displacement of people because of Project activities and potential adverse impacts on pastoral livelihoods (Garba Tula, November 14, 2018; Boji, November 13, 2018; Yaq Barsadi, November 11, 2018; Ngare Mara, November 10, 2018);
- Adverse impacts on grazing areas and grazing patterns (Yaq Barsadi, November 11, 2018; Garba Tula, November 14, 2018; Boji, November 13, 2018; Isiolo, Kula Mawe, November 12, 2018);
- Adverse impacts on the movement of pastoralists and livestock from one grazing area or water point to another, especially during construction due to trenches (Yaq Barsadi, November 11, 2018; Ngare Mara, November 10, 2018);
- The removal/clearing of important natural resources along the Project corridor and impact on the livelihoods of people who depend on them, including the potential loss of the following (Garba Tula, November 14, 2018; Boji, November 13, 2018; Kula Mawe, November 12, 2018; Yaq Barsadi, November 11, 2018; Ngare Mara, November 10, 2018; Isiolo Central, November 9, 2018):
  - Vegetation for grazing;
  - Acacia trees; the trees that produce sagaram (seed pod from *Acacia tortillis*) for goats/sheep;
  - Fruit trees (*Edome etutun*) used by pastoralists while out grazing;
  - Herbal trees;
  - Salt lakes for livestock;
  - Dam/water pans/drinking water for livestock;
  - Gums/resins (tree known as Hurr (*Boswellia Neglecta*) used for selling;
  - Timber/firewood used for selling, especially women;
  - Large stones used for building houses;
  - Minerals; and
  - Trees with bee hives used for honey production.
- The potential negative impacts of an oil spill on vegetation and the health of livestock (Garba Tula, November 14, 2018).

Cultural Resources

- Potential impacts on graves, shrines and medicinal trees that are found along the Project corridor (Garba Tula, November 14, 2018; Boji, November 13, 2018; Kula Mawe, November 12, 2018; Yaq Barsadi, November 11, 2018; Ngare Mara, November 10, 2018); and
- The potential destruction of mosques found along the Project corridor (Isiolo Central, November 9, 2018).

Social

- Potential impacts on poor and vulnerable groups living near the Project corridor (Yaq Barsadi, November 11, 2018);
- Influx of migrant workers and other people may degrade culture and affect the traditional way of life (Ngare Mara, November 10, 2018);
- Influx of workers may result in social problems because of culture clashes (Boji, November 13, 2018; Kula Mawe, November 12, 2018);
- Discrimination or lack of respect for local people by outside contractors (Ngare Mara, November 10, 2018); and
- What measures have been put in place to address the issue of human trafficking because of the project (Isiolo Central, November 9, 2018).

Health and Safety

- Adverse health impacts for those living near the project because of chemicals that may be disposed there, specifically cancer (Garba Tula, November 14, 2018);
- What measures have been put in place to address the potential rise in HIV/AIDS because of the project (Isiolo Central, November 9, 2018);
- Safety hazards of borrow pits if they are potentially left by the project developers (Ngare Mara, November 10, 2018); and
- Potential for children to be harmed if they play near the project (Ngare Mara, November 10, 2018).

Employment

- Would like to see job opportunities provided to the local people, including skilled and non-skilled workers and youth (Garba Tula, November 14, 2018; Kula Mawe, November 12, 2018; Ngare Mara, November 10, 2018; Isiolo Central, November 9, 2018).

Benefits and Compensation

- Would like to see a camp station considered for Isiolo County so residents can accrue the benefits (Garba Tula, November 14, 2018; Isiolo Central, November 9, 2018);
- The people affected by the project or displaced from land will not be compensated appropriately, or the 'wrong' people will receive compensation because of a lack of title deeds for land, for example, there is conflict because outsiders are moving into Isiolo to benefit from compensation (Boji, November 13, 2018; Yaq Basadi, November 11, 2018; Isiolo Central, November 9, 2018);
- There will be no tangible benefits to local communities, pastoralists or vulnerable groups living near the project (Yaq Barsadi, November 11, 2018; Ngare Mara, November 10, 2018; Isiolo Central, November 9, 2018; Garba Tula, November 14, 2018); and
- There should a corporate social responsibility program, such as providing scholarships for youth (Isiolo Central, November 9, 2018; Ngare Mara, November 10, 2018).

Consultation Process

- The consultation process did not start early enough in the project (Garba Tula, November 14, 2018; Boji, November 13, 2018; Yaq Barsadi, November 11, 2018; Isiolo Central, November 9, 2018);
- All members of the community should be engaged on the project and have the opportunity to participate, including pastoralists, leaders from the county assembly, the county government Different communication channels should be used to ensure all community members are informed and have the opportunity to participate (Kula Mawe, November 12, 2018; Ngare Mara, November 10, 2018; Isiolo Central, November 9, 2018);
- Concern that their voices will not be heard (Kula Mawe, November 12, 2018); and
- The ESIA report may be too bulky and difficult to understand; it should be presented in a way that is easy to understand (Isiolo Central, November 9, 2018).

Cumulative effects

- Concern about the potential cumulative impacts of the project (Ngare Mara, November 10, 2018; Isiolo Central, November 9, 2018).

2.4.4 Meru County

Meru County is one of the forty-seven counties in Kenya, strategically located east of Mount Kenya, whose peak cuts through the outskirt of its southern boundary (Figure 8). The county has a total area of 6,936 km^2 of which 972 km^2 is gazetted forest. The county borders five counties; to the north it borders Isiolo County, to the east Tharaka/Nithi County, to the south-west Nyeri County and to the west Laikipia County. It spans the equator lying 0°6' north and 0°1' south and between latitudes 37° west and 38° east. Meru County lies in the eastern region of Kenya and has a surface area of 6 936 km^2 (MCG 2018).

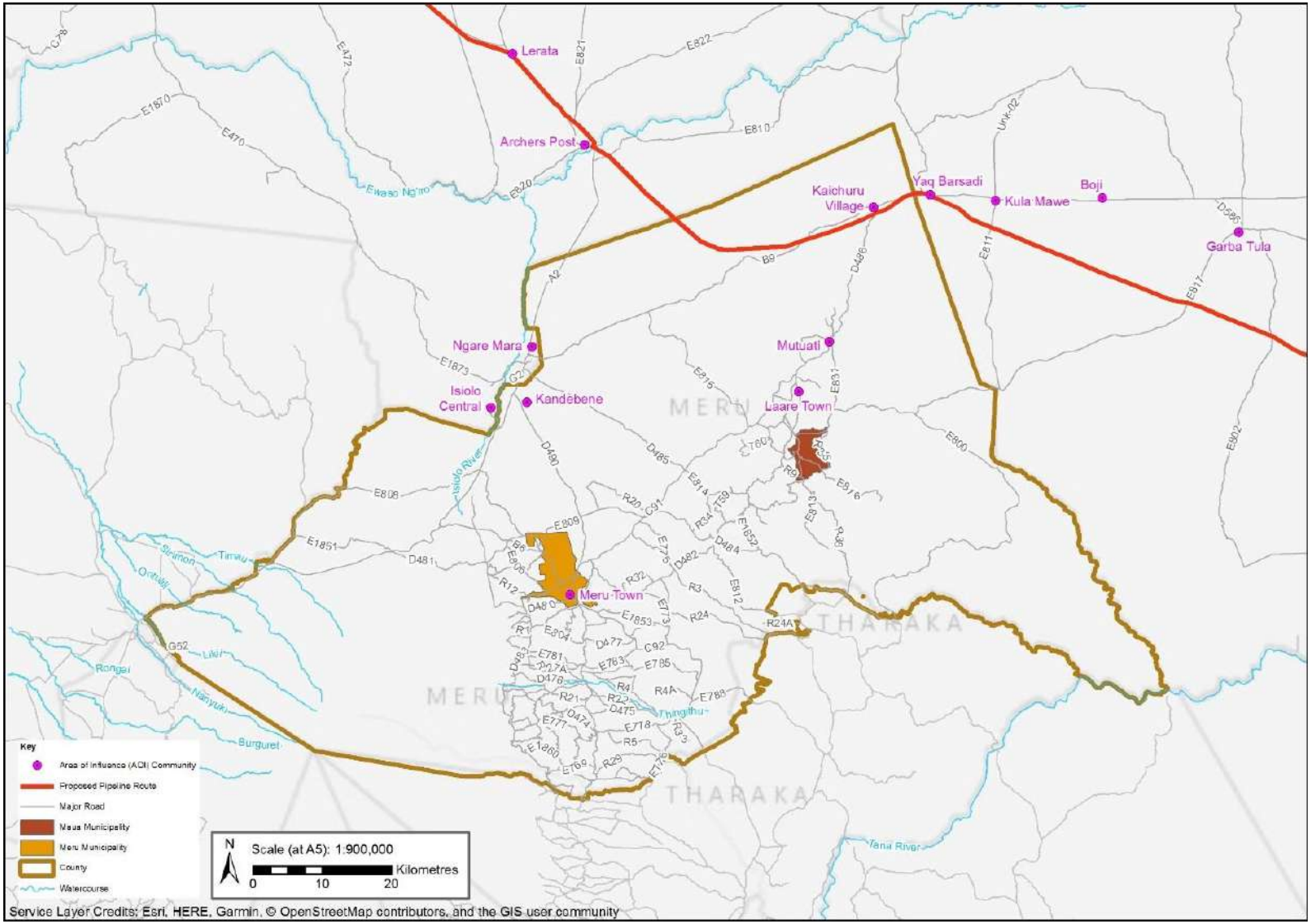

Figure 8: Meru County

2.4.4.1 Administrative Division and Governance Structure

The county government administrative structure comprises nine recognised sub-counties, 45 wards and 392 villages (MCG 2018). Under national government administration, there are 10 recognised sub-counties, 28 divisions, 133 locations and 351 sub-locations, as shown in Appendix D (MCG 2018). Table 67 shows the administrative units overlapped by the Project.

Table 67: Meru County Administrative Units traversed by the Project

Sub-County	Division	Area (km^2)	No. of Locations	No. of Sub-locations
Igembe North	3	1,172.83	20	34

Source: MCG 2018

The proposed Project passes trhough Igembe North, which is the largest sub-county in Meru, and the primary focus of the socio-economic baseline report. The Area of Influence (AoI) communities most likely to experience socio-economic effects from the Project in Igeme North are listed in Table 68, including their distance from the pipeline route. The closest community is Kaichuru Village, located 0.9 km from the pipeline route. Focus groups were conducted with the local government, department of agriculture, water and sanitation, local beekeepers and pastoralist groups, and elders, women and youth in most of these communities.

Table 68: AoI Communities in Meru County

Sub-county	Community	Distance from Pipeline (km)
Igembe North	Kaichuru Village	0.9
	Laare Town	21.2
	Mutuati	15.2
Tigania East	Kandebene	34.1

2.4.4.1.1 Local Administration

The community of Mutuati have plans for the development of public institutions and a hospital (Focus Group, Local Government, Mutati 2018; Appendix B). The community faces safety issues from nearby hostile communities and has a poor road infrastructure and few social amenities. Current initiatives include the drilling of new boreholes and the construction of a new road infrastructure, a dispensary, schools and police stations at Kaichuru Village and Maatati. The main source of revenue for Mutuati is sand harvesting at Ndunguru and Mzalendo, and Miraa[89] plant sales. The community administrators also issue business licenses for shop ownership.

Women from the AoI communities participate in local political activities, such as voting and campaigning for their preferred candidate. However, they still face barriers to participation in political activities and from pursuing leadership roles, mainly because of traditional gender roles and discrimination. Women are also over-burdened by other household and family responsibilities, often have limited resources, and many are uneducated which also prevents them from pursuing political positions.

89 A flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect

During the focus group discussions most of the youth indicated that they participate in politics, including campaigning, and are paid by the politicians to influence decision-making. Some youth run for political positions, but seldom get elected because of a lack of funds to run a campaign.

2.4.4.2 Population Demographics

The county's population growth rate is estimated at 2.1% per year (MCG 2018). According to the 2009 Population and Housing Census, the projected population of Meru County in 2018 is 1,635,264, consisting of 808,596 males and 826,668 females. The growth in population will be a strain on available resources such as land, water and natural resources but on the other hand provides opportunity for growth (MCG 2018).

The population density is widely distributed among the nine sub-counties, with the average density in Meru County estimated at 318 persons per km^2 in 2018 as shown in Table 68. Population density ranges from a low of 152 persons per km^2 in Buuri Sub-County to a high of 616 persons per km^2 in Igembe South Sub-County. The high density in Igembe South is attributed to fertile land, which is good for farming, while the. Low population density in Buuri is attributed to the semi-arid conditions and existence of large-scale farms within the sub-county (MCG 2018). The population density in Igembe North is 132 persons per km^2, the second lowest in the county. Most households in Igembe North have between 4-6 members (42.5%), while 29.7% of households have seven or more members (KNBS and SID 2013d). Table 69 below provides the 2009 population count and population projections based on the county's predicted population growth of 2.1% (MCG 2018).

Table 69: Total Population of Meru County

Sub-County	2009 Census		2018 Projection		2020 Projection		2022 Projection	
	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)
Imenti South	179,604	456	216,545	550	225,640	573	235,117	597
Central Imenti	116,918	351	140,965	423	146,886	441	153,055	459
Tigania East	157,246	243	189,588	293	197,551	305	205,848	318
Imenti North	149,144	509	179,820	614	187,372	639	195,242	666
Igembe North	154,814	132	186,656	159	194,496	166	202,665	173
Igembe Central	193,392	378	233,169	456	242,962	475	253,166	495
Igembe South	134,550	511	162,224	616	169,037	642	176,137	669
Buuri	134,653	126	162,348	152	169,167	158	176,272	165
Tigania West	135,980	298	163,948	359	170,834	374	178,009	390
Total	1,356,301	264	1,635,263	318	1,703,944	332	1,775,510	-

Source: MCG 2018

Settlement patterns in the county are influenced by soil fertility, topography, road networks, urbanisation and rainfall (MCG 2018). High density settlement is concentrated around Nkubu, Maua, Timau and Meru towns because of good road networks, especially the Embu-Meru-Maua road and the Meru-Nanyuki road.

In 2009, 39.9% of the population in Meru County was below 15 years of age, a trend which was projected to increase in 2018, 2020 and 2022 (Table 70). Approximately 56% of the total population was between 15 and 64 years of age, which represents the labour force age category (MCG 2018).

Table 70: Population Projections by Age Cohorts

Age Cohort	2009 Census	2018 Projection	2020 Projection	2022 Projection
0-4	190,899	230,163	239,830	249,903
5-9	183,248	220,938	230,218	239,887
10-14	167,552	202,013	210,498	219,338
15-19	135,628	163,524	170,392	177,549
20-24	125,928	151,829	158,206	164,850
25-29	120,256	144,990	151,080	157,425
30-34	97,438	117,478	122,412	127,554
35-39	76,173	91,840	95,697	99,717
40-44	53,398	64,381	67,085	69,903
45-49	51,149	61,669	64,260	66,958
50-54	38,997	47,018	48,993	51,051
55-59	29,788	35,916	37,424	38,996
60-64	25,810	31,118	32,425	33,787
65-69	15,845	19,104	19,906	20,742
70-74	15,666	18,887	19,681	20,507
75-79	9,357	11,282	11,756	12,250
80+	18,227	21,976	22,899	23,861
age not stated	942	1,136	1,184	1,233
Total	1,356,301	1,635,264	1,703,945	1,775,511

Source: MCG 2018

2.4.4.3 Ethnicity and Language

The dominant tribe in Meru County is the Ameru, and the population comprises several ethnicities and religions. The Meru tribe is a Bantu ethnic tribe. They are a fairly homogeneous group composed of nine sub-tribes*, and* besides Kiswahili and English, Ki-Meru is the ethnic language spoken by this community ("Meru Tribe, People, Language, Culture and Traditions/ softkenya.com, n.d."). The Imenti dialect is common among the sub-tribes. Differences in the dialects reflect their varied Bantu origins and influences from the Cushites and Nilotes, as well as their Kikuyu and Kamba Bantu neighbours.

Meru people are predominantly Christian, but there are sizeable populations of Hindus and Muslims. The majority of Christians are Methodist; the balance are Catholics, African Inland Church, Pentecost, Presbyterians and Anglicans. Methodists have been very active in Meru's education system, building schools and higher learning institutions. Notably, the Methodist Training Institute was established in 1958, and later became the Kenya Methodist University – the largest private university in Kenya (MCG 2018).

2.4.4.4 Social Organisation

The social life in Meru is closely linked to tradition. Elders are highly respected in the community and their primary role is to maintain peace in the community, by solving disputes and counselling community members on issues. Elders solve disputes between individuals related to business, money and loans, and larger community issues related to farming, land and boundary disputes. They also oversee the safety of the community, and work on social issues, such as illegal brewing and children dropping out of school. The elders make decisions on behalf of the community, represent the community at meetings, and are responsible for disseminating information to members, including proposed developments. They facilitate marriage rites and dowry negotiations, maintain and protect cultural values and traditions, such as shrines and ritual sites. The elders are also responsible for managing natural resources.

In most communities, the role of elders has not changed significantly, but it is generally not considered as prominent since the local administration has assumed some of their responsibilities. Many elders are active traditional healers who provide services to the community as an alternative to doctors or hospitals. Traditional healers use natural resources and herbs for healing purposes, which are harvested from the shrubs, hills and forests in the surrounding area. They are paid for their services either by livestock exchange or cash.

In a typical two-parent family, the decision-making is carried out by the head of the household, usually the husband (Focus Groups, Women, Kaichuru Village 2018; Kandebene 2018; Laare Town 2018; Mutuati 2018; Appendix B). In some households, decisions are made by both women and men, and if no husband is present, the woman is the sole decision-maker. In general, both men and women are responsible for managing household finances, including paying school fees and healthcare bills, except in Kaichuru Village and Laare Town where the men typically make the financial decisions. Women are generally responsible for the household chores, including fetching water and firewood and cooking.

Women are empowered by the existence of women groups, and they participate in self-help groups, government and non-government organisations, and often have leadership roles in churches, schools and other establishments (Focus Groups, Women, Kaichuru Village 2018; Kandebene 2018; Laare Town 2018; Mutuati 2018; Appendix B). They practice table banking[90] which allows them to buy water tanks for one another. Women are also over-burdened by other household and family responsibilities, often have limited resources, and many are uneducated. Despite these challenges, the women are encouraged by the changes observed in

90 A group funding strategy where members of a group meet once every month, place their savings, loan repayments and other contributions on the table then borrow immediately either as long-term or short-term loans to one or several interested members (ActionAid Kenya 2018).

their communities since they are more frequently consulted with on community issues, even though they are not allowed to make final decisions.

Women in female-headed households are discriminated against in some communities (Focus Groups, Women, Kaichuru Village 2018; Kandebene 2018; Laare Town 2018; Mutuati 2018; Appendix B) and they receive very little help and are self-reliant in terms of providing for their families. Single women are sometimes mistreated by other women, and the assets inherited from their former husbands are sometimes seized by their in-laws since they are typically not valued in the community. However, in Kaichuru Village and Kandebene, widows and single mothers are not stigmatised by the community, although they still do not receive any support.

The youth are responsible for herding, providing security to herders, farming and selling farm products, providing food for their families, and working and earning an income to help their family (Focus Groups, Youth, Kaichuru Village 2018; Laare Town 2018; Meru Town 2018; Mutuati 2018; Appendix B). In some cases, youth also assist their parents by looking after their siblings, and helping to pay school fees, healthcare bills and for other basic needs. Youth are generally responsible for the safety of the community. Some youth are involved in social activities, such as self-help groups and fundraising events that offer support to other members, musical bands and football clubs. In Meru Town, the youth seldom participate in social forums.

Traditional and modern marriage practices are observed in the communities. The age of marriage for girls varies according to location, but the number of girls under the age of 18 getting married has increased in Mutuati. Young men in Kaichuru Village marry later since the dowry payment is a challenge for unemployed youth (Focus Groups, Youth, Kaichuru Village 2018; Laare Town 2018; Meru Town 2018; Mutuati 2018; Appendix B). As with other Bantu tribes, a bride price in the form of camels, cows, goats, sheep, honey or *miraa* is paid by the groom's family to the bride's family before marriage. Traditionally, the Meru had a strong clan (family) system that controlled the basic operations of all families within the clan. Although the clan system has nearly vanished, in Mutuati community the extended family still retains a very powerful influence on the lives of individual family members. A bride price is paid in a form of honey, *miraa* and goats.

2.4.4.5 Economic Base

Agriculture is the main economic activity of the Ameru people. The land is used for crop and livestock farming. The major income-generating activities in Meru County are farming of potatoes, timber harvesting and charcoal burning. Additionally, the trading sector is important in the county as it generates income and creates employment. Numerous small businesses in the project area trade in a range of basic goods and foods. Some of the income generated from trading is invested in farming activities with the balance used to pay household bills. Most of the county's population derives their livelihood from this sector. Charcoal production is common in the project-affected area and firewood is still used by majority of the households for cooking and lighting. Table 71 below illustrate the economic activities of the women in the communities near the proposed Project.

Table 71: Economic Activities of Women from the AOI Communities

Community	Economic Activity
Kaichuru Village	■ Buying and selling *miraa*[91] ■ Selling firewood and charcoal ■ Running small scale shops and hotels ■ Selling perfumed branches from the Dakar tree
Laare Town	■ Farming ■ Running small businesses ■ Teaching
Mutuati	■ Selling firewood ■ Selling animal feed ■ Agricultural farming ■ Dairy farming ■ Running small businesses e.g farming
Kandebene	■ Agriculture ■ Businesses

Source: Focus Groups, Women, Kaichuru Village 2018; Laarre Town 2018; Mutuati 2018; Kandebene 2018; Appendix B.

Youth engage in small business activities and casual jobs in their communities to earn an income and to help their families (Focus Groups, Youth, Kaichuru Village 2018; Laare Town 2018; Meru Town 2018; Mutuati 2018; Appendix B). Unskilled youth engage mostly in manual labour, such as washing clothes, herding, harvesting and selling of crops and *miraa,* selling eggs and selling ballast for building materials. Teaching and secretarial skills are common among educated youth in Laare Town, and other skills include hairdressing, tailoring, mechanics and driving. In Mutuati, most employed community members are female. The youth are skilled in plumbing and driving and some are skilled in information technology, education, community health and clinical professions, but most of them remain without jobs.

2.4.4.6 Employment

Employment opportunities for women are limited, with most of them engaging in agricultural activities or other small businesses (Focus Groups, Women, Kaichuru Village 2018; Laarre Town 2018; Mutuati 2018; Kandebene 2018; Appendix B). In general, unemployment rates are high among youth, and youth frequently have to migrate to other towns to look for job opportunities; however, choices are limited since there is little access to information concerning jobs. Lack of education and corruption among employers have contributed to the high unemployment rate in most communities. In addition, economic opportunities are more challenging for youth now compared to previous generations because of changing rainfall patterns which have affected farming and herding, and the ban of *miraa* sales in international markets where it was previously allowed. The youth in Meru Town and Mutuati are exposed to business opportunities but they are constrained by a lack of capital and skills. The lack of employment opportunities in most communities, even for educated youth, has resulted in a sense of disillusionment.

91 Miraa, also known as khat, is a flowering plant native to the Horn of Africa and the Arabian Peninsula. The addictive herb is chewed for its stimulative effect.

2.4.4.7 Social Infrastructure

2.4.4.7.1 Education

The county literacy rate in 2012 was 53% (County Meru, 2013). Approximately 20% of residents have no formal education in Meru County, which is lower than the national average of 25.2% (KNBS and SID 2013d). The proportion of people without a formal education in Igembe North is higher than the County, at 31.2%, and only 9.1% of the population has a secondary level of education or above. At the national level, 22.8% of residents have secondary education or above. Table 72 shows the highest level of education attained in the wards of Igembe North Sub-County.

Table 72: Educational Attainment in Meru County (2009)

County/Constituency/ Wards	None (%)	Primary (%)	Secondary+ (%)	Total population
Igembe North	31.2	59.7	9.1	135,384
Antuambui	27.6	62.8	9.5	25,366
Ntunene	23.2	60.5	16.3	17,315
Antubetwe Kiongo	33.2	60.3	6.6	28,314
Naathu	31.6	59.7	8.7	25,991
Amwathi	35.5	56.9	7.6	38,398
Meru County	20.7	61.9	17.5	1,205,470
Kenya	25.2	52.0	22.8	34,024,396

Source: KNBS and SID 2013d

There are 792 early childhood development centres (ECD), 647 primary schools and 192 secondary schools. The county has 15 education divisions and zones. The introduction of the Constituency Development Fund has enabled the construction of various mixed day secondary schools. The two main universities in the county are the Meru University of Science and Technology and the Kenya Methodist University. Other universities with campuses in the county are the University of Nairobi, Co-operative University of Kenya, Africa Nazarene University, Jomo Kenyatta University of Agriculture and Technology and Mount Kenya University. In addition, there are two teacher training colleges, namely, Meru and Igoji, and five technical institutes and various private colleges most of them offering training in information and communication technology (ICT) (MCG 2013).

Staffing in the county is inadequate for both teachers and education officers. Enrolment numbers in primary and secondary school for Meru County are provided in Table 73. Enrolment in primary schools is approximately equal for boys (50.1%) and girls (49.9%), but there are slightly more girls (51.1%) enrolled in secondary school than boys (48.9%) (MCG 2018). The current free primary school education, along with the subsidised secondary education policies by the government are expected to result in higher transition rates in the future (MCG 2018). There is therefore increasing pressure to expand secondary school facilities and improve existing ones to enhance education quality for children and youth.

Table 73: School Enrolment for Meru County

Pre-School		Primary		Secondary		Vocational Training Centre	
Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio
65,396	1:50	263,892	1:60	93,217	-	3,333	1:24

Source: MCG 2018

Children start primary school at four or five years old and leave between the age of 12 and 14 years to attend secondary school. After secondary school (typically 5 years), students can attend university. Many children do not finish school for a variety of reasons. In general, children drop out of school because they lack school fees for uniforms and other materials, and poor living conditions such as a lack of electricity and food shortages make it difficult for children to learn or study. Some children live in hostile environments because of family breakups that also contribute to poor learning environments. Children living in poverty are often forced to drop out of school and seek employment opportunities to help their family, such as selling firewood, selling *miraa* and herding, which is typically why boys leave school. Girls generally leave school because of early marriage or pregnancy. Drug abuse, especially the chewing of *miraa*, was also cited as one of the reasons why children do not complete school. In Kaichuru Village, there are no secondary schools in the area (Focus Group, Women, Kaichuru Village 2018; Appendix B).

Youth are disillusioned with education because of high unemployment rates, even for those who are educated. Youth from Kaichuru Village stated that there is little emphasis on education in their community, therefore most young people drop out of school to pursue business opportunities. However, youth in Mutuati indicated that people are valuing education more now compared to the past and believe that education is the only way to access knowledge and facilitate employment.

2.4.4.7.2 Health Services

The county has two level 5 hospitals, 23 level 4 hospitals, 39 level 3 facilities (health centres),185 level 2 dispensaries, and 247 level 2 medical clinics (Shape Consulting Ltd. 2019; Appendix A). The county has a high population growth and the health facilities are inadequate, the number of health facilities should therefore be increased.

Table 73 presents the health system challenges in Meru County. The primary challenges are due to high demand for services (especially for communicable and non-communicable diseases) and inadequate resources. Additional information on baseline health conditions in Meru County is discussed in Appendix A: Community Health Baseline Report.

Table 74: Health System Challenges in Meru County

Project County	Challenges	Contributing factors
Meru	■ Increasing burden of NCDs ■ High burden of communicable diseases especially upper respiratory infections ■ Inadequate medical supplies and consumables ■ High demand for services ■ Overstretched Meru RRH ■ Increasing burden of road traffic accidents ■ Low immunisation coverage especially in the north	■ Changes in diet and lifestyle ■ Population influx and increasing mobility ■ Overcrowded settlements in some areas ■ Weakness of referral systems ■ Insecurity in the northern border with Isiolo

Source: Baseline KIIs in Appendix A

Focus group discussions with women indicated that health care and family planning services are accessible in the communities located near the proposed Project (Focus Groups, Women, Kaichuru Village 2018; Laarre Town 2018; Mutuati 2018; Kandebene 2018; Appendix B). The women from Mutuati have access to a public hospital in the community and dispensaries are located in Nakuriu, Mwera Omutuwa, Kuirumu and Leeta. Health care and family planning services are also available at dispensaries in the Kaichuru Village area, Kandebene and Kiburu, and at health facilities near Laare Town. However, the women in Kaichuru Village stated that the biggest challenge is accessing healthcare for emergencies and more serious cases, since there are no facilities nearby that provide these services.

In general, the women and youth are aware of the causes, prevention and treatment of HIV. Campaigns are carried out in Kaichuru Village in the form of mobile clinics that provide counselling and awareness on HIV once a month (e.g. the 'zero campaign') and through NGOs (e.g. Samaritan's Purse). In Kandebene, seminars on HIV/AIDS are conducted by hospitals and community health volunteers. The women in Laare Town indicated that public campaigns about HIV/AIDS have decreased recently based on the assumption that everyone is already aware of its causes and prevention. Similarly, the youth from Mutuati stated that publicity on HIV from government agencies has decreased, resulting in some youth being uninformed about HIV. Despite the majority of youth being informed about HIV, its causes and prevention, youth from Meru Town and Mutuati indicated that they do not always take it seriously, in part because of the influence of drugs leading to irresponsible decisions.

The most common source of protein consumed in households in the communities near the Project is goat which is consumed up to once per week (Focus Groups, Women, Kaichuru Village 2018; Laarre Town 2018; Mutuati 2018; Kandebene 2018; Appendix B). The frequency of beef and chicken consumption varies by community, and fish is only consumed in Mutuati. Milk and yogurt are consumed daily in most communities, except in Kaichuru Village, but rice is consumed frequently in all communities.

Access to and availability of fresh farm products is limited in Kaichuru Village since markets are far, with the nearest ones located in Isiolo and Mutuati. Vegetables or fruits are rarely consumed or purchased. The women from Laare Town consume many fruits and vegetables, including kale, avocado, oranges, pawpaw, banana, mangoes, tomatoes and pumpkin. The biggest challenge to food security is drought due to rainfall shortages, and also from pests and worms.

2.4.4.7.3 Housing

Approximately 97.5% of households in Meru County use corrugated iron sheets for roofing, while 0.7% use asbestos sheets and 1.1% use grass, the remaining 0.7% use other roofing material such as concrete, tin and mud. The county is characterised by inadequate and unaffordable housing, particularly for low income earners in urban areas and also in the rural sector. The county also faces the problem of a low level of urban home ownership and extensive and inappropriate dwelling units including slums and squatter settlement (MCG 2018).

2.4.4.7.4 Security

The county has experienced issues such as cross border conflicts in the past and faces some of the highest incidences of crime in the country. Security remains an issue of concern in the areas that border Isiolo and Wajir in the northern part of Meru, including Igembe North Sub-County. Livestock herders from Kandebene indicated they travel in large groups of approximately 50 families because of security reasons. Women from Mutuati and Kaichuru Village also stated that security is a serious concern in their communities, and in Mutuati, cattle rustling by a neighbouring hostile community is common. Incidences of cattle rustling have been reported regularly in these areas as part of the wider pastoralist conflict system of the northern marginal areas of Kenya (CRECO, 2012).

In Igembe North, there are only 3 police stations and 19 police posts, compared to 25 police stations and 120 police posts in the entire county (MCG 2018).

2.4.4.8 Physical Infrastructure

2.4.4.8.1 Water

Rainfall patterns in Meru County are erratic, and rainfall distribution ranges from 300 mm per year in the lower midlands in the north, to 2,500 mm per year in the southeast (MCG 2018). Other areas receive on average 1250 mm of rainfall annually. There are two long rains seasons occurring from mid-March to May, and a short rains season from October to December. However, climate change has resulted in unpredictable rainfall patterns, which now start earlier or later than previously. Water levels have also decreased over time and during dry spells, downstream users receive little or no water at all (MCG 2018).

The county has 11 permanent rivers. The main river is the Kathita which is a tributary to the Tana River. The main water sources for both households and livestock are boreholes, rivers, water pans, water vendors and piped water from community-based projects. Boreholes account for the highest number of users at 53.8% compared to 25%t during the dry season. Rivers and water pans are used equally. The majority of water pans in the grazing areas of the agro-pastoral livelihood zone such as Kachiuru, Ithata, and Njaruine have completely dried up. Boreholes in Kandebene, Inono, Ndumuru, and Mariara are currently the main water sources for both livestock and households.

The main sources of water for livestock herders in Kaichuru Village are the Barajadi and Gachuru boreholes and Magado, Waso and Chapa springs. Households in Kandebene depend on the Kandebene borehole, and in the rainy seasons they also draw water from the Matabithi borehole and the Batalo, Kungu, Karuya and Kandebene dams. The Lanyiru stream flows throughout the year, and the Rikindu River and Wasonara River are seasonal. The Rikindu River flows through the Kandebene community, while the Wasonara River is nearby.

The main water supply in Laare Town is from the diocese of Meru, springs at Laare, Kitawaa, Atununu and Kithingangu, and boreholes in Laare, Ntunene and Kiridora. Spring water is free, and residents pay between KSh 5 to KSh 10 for water from the boreholes. Diocese water is paid for monthly and estimated to be KSh 800. Water committees manage all the water sources and collection of fees. Public water supply facilities are managed through by-laws that set charges and limit usage. Public water kiosks provide free water, but water supply is limited in May, June, July and August, when the community depend solely on water truckers.

Commercial water vendors are also an important source of water, especially in Igembe North sub-county. The cost of a 20-litre jerry can filled with water at source (borehole) ranges between KSh 2 to KSh 5 and can cost over15 KSh with delivery. The county water originates from the catchment areas of Mount Kenya and the Nyambene forest and is used for both domestic use and irrigation. The average distance to the nearest water point in Meru County in 2009 was 1.5 km.

2.4.4.8.2 Sanitation and Waste

Meru town is served by an old sewerage system while the Makutano area of the town has no system. Other major towns within the county lack functional sewerage systems. The major sanitation facilities are pit latrines which are used by over 69% of the population, including in Laare Town, which has reduced open defecation significantly. Other households using flush toilets and ventilated improved pit latrines account for 7.9% and 9%, respectively. Waste and garbage disposal is managed by the county government in the town centres and market places, and in rural areas private firms, garbage pits, burning, public garbage sites and farm manure are the common modes of disposal (MCG 2013).

2.4.4.8.3 Energy Sources

Energy provision to rural communities in the region has proved to be a great challenge. The majority of these people are dependent on the traditional fuels (wood-charcoal, crop residue maize stalks and cobs), often using primitive and inefficient technologies (open fires). Wood fuel is the major source of household fuel in the county with over 86.1% of the total population relying on it for their daily energy needs. For many, this combination barely allows fulfilment of the basic human needs of nutrition, warmth and light, let alone the possibility of harnessing energy for productive use which might begin to permit an escape from the cycles of poverty. The electricity infrastructure in the region covers only a few trading centres and towns implying most households rely on biomass and fossil fuels for energy needs. Those in far remote areas suffer under high and volatile fuel prices, which add to the negative spiral of additional costs.

Table 75 shows the source of energy used for cooking and lighting in Meru County (MCG 2018).

Table 75: Energy Sources in Meru County

Activity	Source	Households
Cooking	Firewood	86.1%
	Charcoal	6.6%
Lighting	Electricity	13.6%
	Paraffin	4.5%
	Gas	2.4%
	Biogas	0.1%
	Solar	6.6%

Source: KNBS, 2009

2.4.4.8.4 Transportation

The county is well served by a road network with the majority of areas accessible during the dry season. The county has 5,968 km of road of which 582 km is bitumen, 581 km is gravel and 4,805 km is earth surface (MCG 2018). However, during the rainy seasons, some sections of gravel and earth surface roads are impassable. There are several major tarmac roads in the county.

Women in Kaichuru Village indicated that access to the nearest town is limited because of poor roads in the area (Focus Group, Women, Kaichuru Village 2018; Appendix B).

2.4.4.8.5 Communication

The Meru County government has focused on investment in ICT to improve governance and service delivery. Most private and public organisations and institutions have embraced ICT in the day-to-day operations. There is a high demand for internet and communication services. Approximately 95 % of the county is served by a mobile phone network (MCG, 2018).

2.4.4.9 Land and Resource Use

Land in Meru County is utilised in diverse ways that include agricultural, residential, educational, public purpose, public utilities, transportation, industrial, recreation and conservation and commercial, but the predominant use is agricultural activities; crop farming and livestock-keeping. Agricultural land use is common in all the sub-counties and is particularly intense in the Imenti Sub-Counties and Buuri while livestock is common in the Tigania and North Igembe Sub-Counties. Other uses include cultural and forestry conservation. Large scale wheat farming is carried out by private companies in the Timau and Buuri Sub-Counties with Kisima farm the largest in the county. Livestock and *miraa* farming are also practised in the Tigania and Igembe areas. Coffee, tea and macadamia are the main crops produced in Imenti Central and Imenti South Sub-Counties. Other crops grown in the county include bananas, maize, beans, sorghum, millet, green grams, potatoes, cabbages, carrots and kales. Urban uses are rapidly emerging in the county with Meru, Maua, Nkubu, Timau developing as urban nodes. The urban areas are also being complemented by other centres in the sub-counties and at ward level. Transportation and forestry use constitute the other main users in the county (MCG 2018).

2.4.4.9.1 Land Ownership

Land in Meru County falls under three categories, public, private or communal (MCG 2018). Public land is defined as land owned by the government, while communal land is land lawfully transferred to a specific community by any process of law and is lawfully held, managed or used by specific communities as community forests, grazing areas or shrines, ancestral lands (MCG 2018). Private land is registered land held by any person under any freehold tenure or under leasehold tenure, and any other land declared private land under an Act of Parliament. More than 60% of the land in Meru County is registered under private ownership (MCG 2018).

Approximately 65% of the farmers in the county have title deeds; however, Meru North region which includes Igembe North has the highest number of farmers without title deeds. In Kachiuru, men predominately own the land but do not possess title deeds. The high number of farmers without title deeds is mainly as a result of the slow process of land registration and numerous land cases in courts (MCG 2018). It was also verified during consultation that the land near the study area is acquired through inheritance and by buying. The high cost of land, poverty and lack of income have hindered land acquisition leading to cases of landlessness in the county.

2.4.4.9.2 Agriculture

Agriculture is the main economic activity in the proposed Project area. However, the size of land for farming has been decreasing in size over time increasing the pressure on land. Farmers practice mixed farming where they grow many types of crops and keep livestock on the same piece of land. The average household income in the area is estimated at KSh 2,000 to KSh 20,000 per month. The economy of Meru is primarily agrarian. The growing of a variety of crops and keeping livestock in some parts of the county form a critical chunk of the economic activities of the people of Meru. *Miraa* is a highly lucrative cash crop grown in the project area. Table 76 shows crops grown near the proposed Project.

Table 76: Main Crops Grown in the Project Area

Area	Types of crops
Kaichuru Village	Beans, peas and maize
Mutuati	*Miraa* and bananas
Laare Town	Black beans, maize, sorghum, peas, potatoes, millet, cow peas, and *miraa*
Kandebene	Beans, sorghum, green, tomatoes, onions, maize, cow peas and sunflower

Source: Women's FG, 2018

Planting and harvesting is carried out twice per year. Land preparation and planting typically begins in March and April, and in June and July harvesting for the first part of the year takes place. The land is prepared and planted again starting in August through October and harvesting usually takes place in January and February. Following harvesting, the products are sold or exchanged for children's school fees at the local schools, and there are no processing facilities near Kaichuru Village to process agricultural products. The farming seasonal calendar for the communities near the proposed Project is shown in Table 77.

Table 77: Farming Seasonal Calendar for the Communities located near the Project

Activity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harvesting beans and potatoes												
Harvesting millet, maize and sorghum												
Land Preparation and planting												
Weeding												
Harvesting												

Source: Women Focus Groups, November 1-3, 2018

Rotation is done seasonally between crops (Focus Groups, Agriculture, Kaichuru VIllage 2018; Kandebene 2018; Laare Town 2018; Appendix B). Manure from livestock is used as a fertiliser for beans, maize and peas, and tractors are hired to till the land. Farmers also buy pesticides. The farmers generally buy seed but it is also sometimes provided by the government. Extension services and training are also available to farmers from the ministry of agriculture and NGOs. Labour is provided by family members and occasionally other people are hired to work on the land. In Kandebene, men, women and children are responsible for clearing, planting, weeding and harvesting activities, but in Kaichuru Village, only the men and women participate in agricultural activities.

Farmers are unable to farm on a large scale because they do not own enough land. Some farmers rent land, but the rates are typically expensive. Poor rainfall is also a challenge for farmers, and the soil quality can only support certain types of crops. Crop yields and marketing is provided in Table 78 and Table 79.

Table 78: Crop Yields and Marketing in Kaichuru Village

Crop	Yield (bags/kg)	Land area (acres)	% sold	Months of sale	Price at harvest (KSh/bag/kg)	Price not at harvest (KSh/bag)
Beans	20,90 per kg bag	1	15 bags	February and August	KSh 8 000/ bag	KSh 10,000/ bag
Peas	6,90 per kg bag	1	100%	February and August	KSh 6 000/kg	KSh 10,000/bag
Maize	25,90 per kg bag	1	75%	February and August	KSh 3 000/ bag	KSh 4000/bag

Source: Focus Group, Agriculture, Kaichuru Village 2018; Appendix B

Table 79: Crop Yields and Marketing in Kandebene

Crop	Yield (bags/ tonnes)	Land area (acres)	% sold	Months of sale	Price at harvest (KSh/bag)	Price not at harvest (KSh/bag)
Beans	10 bags	1	70	March/April	3 000	KSh 4000/bag
Sorghum	25-30 bags	1	90	February	3 300	KSh 4000/bag
Green Grams	7 bags	1	95	March/April	8 000	KSh 12,000/bag
Tomatoes	6 000 tonnes	1	95	December to March	262 500	KSh 600,000/bag
Onions	14 000 tonnes	1	98	December to March	-	KSh 1,050, 000/bag
Sunflower	20 bags	1	95	June to March	4 000	KSh 6000/bag

Source: Focus Group, Agriculture, Kandebene 2018; Appendix B

2.4.4.9.3 Pastoralism

Nomadic pastoralism is a main land use in the semi-arid rangelands of Meru County. In Kandebene, pastoral groups are mainly supported by the county government and the herders do not belong to any representative groups.

In Kaichuru Village, the land use near the proposed Project area is predominantly free grazing. The rangelands are communally grazed. Livestock is typically owned by individuals and herding activities are carried out by men. The main determinant of animal movements is the availability of water and security concerns from occasional livestock raiders. An average of 70 people will travel together from Kaichuru Village. The main sources of water in the grazing areas near Kaichuru Village are the Barajadi and Gachuru boreholes and Magado, Waso and Chapa springs. Herding activities take place from January to May and June to December at different locations as shown in Table 80.

The herders in Kandebene do not settle in one area, but move throughout the year, and travel in groups of 50 families for security reasons. The Lanyiru stream, Rikindu River and Wasonara River are commonly used by herders. The Lobua and Chokaa swamps, which are no longer protected areas, are used to feed livestock.

Table 80: Livestock Herders Travel Routes and Grazing Areas

Months	Travel Routes	Grazing Areas
January to May	Nquutu, Lumbine, Kachiuru, Saba, Ndumuru, Makinya and Koticha	Galdima, Topesi, Mataba, Dakari, Dakarika, Njaro, Dera, Kabumini and Lakuriko
June to December	Benjeere, Kubiaji, Kasabamba, Bada Bamba, Bogasanu, Kaboge, Albore, Boru, Uxuru, Bariji, Bardera and Kabute	
January to December	Mbiriji, Satija, Kajajabu, Kiliwe, Tabasiti, Kutaya, Sitacho, Ladaro, Ntoricha, Barbatana, Buresukira and Hera	

Source: Focus group herders, Kandebene, 2018.

The Meru County farmers keep livestock both for subsistence and commercial purposes. These include dairy and beef cattle, goats, sheep and poultry. The information obtained from the focus group discussions and key informant consultations revealed that the county's main livestock facility, the Kinoru Livestock Resource Centre (KLRC) (a diagnostic facility as well as the county's artificial insemination programme centre) is near the proposed Project area. Table 81 below shows the average herd size, and livestock daily water requirements in the proposed Project area.

Table 81: Average Herd Size for Kaichuru Village and Kandebene

Community	Livestock type	Average number/ herder	Average water required /animal/day
Kaichuru Village	Goats and sheep	500	15-20 litres
	Cows	200	80 litres
	Camels	700	120 litres
	Donkeys	10-20	60 litres
Kandebene	Goats	600-800	5 litres
	Cows	300-400	40 litres
	Donkeys	5-8	40 litres

Source: Focus Groups, Pastoralists, Kaichuru Village 2018; Kandebene 2018
**No available data for Mutuati and Laare Town communities*

Minor extension services (e.g. deworming) are carried out by livestock herders, but in more serious cases government veterinary offices are called for assistance (Focus Group, Pastoralists, Kaichuru Village 2018; Kandebene 2018). Veterinary services are available in Kianjai, Isiolo Mutuara and Karama.

2.4.4.9.4 Beekeeping

In Laare Town, beekeeping is a livelihood and economic activity near the proposed Project area. The beekeepers use their Indigenous Knowledge and locally available materials to keep honeybees in Ndumuru or their homesteads. The beehives are owned individually or as a group, and generally between two and ten hives are owned. The honey production is based on an occupation rate and an average yield is 10 kg per hive. The honey is used domestically and can be used to brew alcohol and is also sold. One kg of honey costs KSh 1000.

Men are typically responsible for bee keeping and harvesting honey, but the whole community is involved in selling honey. Protective gear is needed for harvesting, and sugar is an input cost. Timber, iron sheets and nails are required to build the beehives, which are made by people outside the community who charge for their services. The hives can last up to ten years depending on the materials used. Bees are kept throughout the year and honey is harvested twice a year, between February and March and in June and July. Beekeepers face several challenges, including a lack of harvesting equipment such as bee suits and smokers, inadequate water, and limited training opportunities.

2.4.4.9.5 Protected Areas

The Meru Conservation Area is a major tourism destination in Kenya (Appendix D). The county has Mount Kenya and Imenti Forest, a natural forest with rich biodiversity. The Mount Kenya region is the main source of forest products within the county, and include timber, wood fuel, charcoal, seedling production and poles. The high demand for these products has resulted in deforestation. Conventional tree planting is mainly incorporated in the farms and along the river banks.

The Nyambene National Reserve is a 265 km^2 conservancy named after the famous Nyambene Hills. The reserve is home to the Igombe Crater which is located at the northeast tip of the Nyambene range. The pipeline route crosses the Nyambene National Reserve (Appendix D).

2.4.4.10 Tourism

The county has 39 operational and potential tourist attractions in the county. Currently, the tourism sector in the county is growing with the promotion of Meru National Park, Mount Kenya National Park, Lewa Downs Conservancy and Ngare Ndare Forest Trust as the main tourist attraction sites in upper eastern Kenya. These sites offer competitive sports, and additional activities such as mountain climbing, canopy walks, camping, trekking, diving at waterfalls, bird watching and safari drives (MCG 2013).

The county is endowed with a variety of environmental resources that contribute to the local and national economy. In Meru County the Meru National Park and Lewa Conservancy are wildlife conservation areas that provide an ecosystem rich in flora and fauna (MCG 2018).

The county is in the process of establishing the Nyambene Conservancy with attractions such as the Igombe Crater, bird watching and beautiful sceneries. The tourism sector has a high potential especially since neighbouring Isiolo County has a resort city as a flagship project under the Kenya Vision 2030. The majority of hotels are privately owned; one county-owned lodge within the Meru National Park is being refurbished. There are only two hotels which have been classified by the Tourism Regulatory Authority, namely Ikweta Safari Camp and Nkubu Heritage Hotel (MCG 2018).

2.4.4.11 Cultural Resources

Near Kaichuru Village, *Igembe* is a sacred site surrounded by trees and large stones where natural minerals are found, and it is located near the proposed pipeline.

Sacred sites near Mutuati that are located near the proposed pipeline include Buru shrines and Ndumuru sacred sites. The elders meet there to offer rituals on behalf of the community and the area is also used for prayers. The sites are surrounded by natural salts (*monyo*) and herbs and are used by pregnant women and animals to feed on. These sites may not be visited by individuals who are not community elders. There are also sacred shrines at Igembe. The rites of passage include circumcision, marriage and becoming an elder. Male circumcision is still one of the most significant rituals in Meru culture. This is a rite of passage that transforms a young man into an adult, giving him the right to marry, acquire wealth and property, and make independent decisions.

The sacred places near Laare Town include the Igombe salt lick and Kimeru where white ash is found and used for rituals. In general, other sacred places are where traditional healers go to collect herbs, such as Migombe, Luma and Mea hills, and sacred hills. Rites of passage include circumcision and the naming of new born babies.

Near Kandebene, the sacred places include Muteri, Mutetuia and Mukaria; they are the Njuri Ncheke shrines in the Project area and non-community members may not visit these. Natural resources that are considered sacred or of spiritual importance near Kandebene include the Lobua swamp and Chokaa, where particular plants grow that are used to feed livestock (Focus Group, Elders, Kaichuru Village 2018; Kandebene 2018; Laare Town 2018; Mutuati 2018). The animals also drink *myonwo* from the swamps, which is from natural salt water springs and full of nutritional supplements. *Laaria* is a salt lick used by livestock and considered important, but it does not fall along the pipeline route.

2.4.4.12 Project Concerns

The Livestock herders and elders expressed concerns and recommendations about the proposed Project during the Focus Groups discussions held from October 31 to November 3, 2018, which are listed below.

- Injury to livestock during construction activities (Livestock Herders, Kaichuru Village, October 31, 2018);
- Disturbance to livestock from noise during construction activities (Livestock Herders, Kaichuru Village, October 31, 2018; Laare Town, November 2, 2018);
- Adverse impacts on water sources and livestock from pipeline leaks (Livestock Herders, Laare Town, November 2, 2018);;
- Cultural values of the community should be observed (Elders, Laare Town, November 2, 2018);
- Elders should be engaged during all stages of the Project (Elders, Laare Town, November 2, 2018); and
- Local people should be employed (Elders, Laare Town, November 2, 2018).

Several concerns and recommendations were expressed by community members and stakeholders about the proposed Project during the consultation meetings held in Meru Town, Kaichuru Village, Mutuati, Laare Town and Kandebene from October 30 to November 3, 2018. These concerns have been categorised according to socio-economic topic and are listed below.

Land

- The potential effects of an oil leak on the land (Kaichuru Village, October 31, 2018; Mutuati, November 1, 2018);
- People should be compensated for their land acquired for the Project, by the National Land Commission (NLC), including for inactive land (Mutuati, November 1, 2018; Laare Town, November 2, 2018);
- Land should be compensated based on the average value across all counties (Kandebene, November 3, 2018); and
- People who don't have title deeds to their land may not be compensated. Title deeds for land should be issued by the government before the Project starts so those affected can be compensated fairly (Mutuati, November 1, 2018; Kaichuru Village, October 31, 2018; Laare Town, November 2, 2018).

Livelihoods

- The adverse impacts on land squatters from displacement (Mutuati, November 1, 2018);
- Potential impacts on livestock herders from Project activities (Kandebene, November 3, 2018);
- The removal/clearing of important natural resources along the Project corridor and impact on the livelihoods of people who depend on them (Mutati, November 1, 2018; Kaichuru Village, October 31, 2018), including the potential loss of the following:
  - Iron ore deposits and sand;
  - Gold and mercury;
  - Ballast which is produced in the Mutuati area and sold to generate income;
  - Rocks that are sold to generate income, and the Manora rock is used for sharpening knives and pangas;
  - Beehives;

- Trees which provide food for livestock, shade, fruit, medicines and firewood;
- A tree called Mathii (granite stone) used to preserve milk; and
- Insects which consume trees and produce a fertilizer used in farming.

- Potential impacts on farming areas used for livestock grazing, crops, and miraa[92] and on the livelihoods of people if they are displaced (Mutuati, November 1, 2018; Laare Town, November 2, 2018);
- Adverse impacts on the movement of livestock, including potential accidents; it was recommended that livestock underpasses or crossings should be built (in the corridor) to avoid accidents (Kaichuru Village, October 31, 2018; Mutuati, November 1, 2018); and
- Compensation for impacts on livelihoods from displacement or loss of land, livestock, natural resources, etc. because of the Project (Kachiuru, October 31, 2018; Mutuati, November 1, 2018; Laare Town, November 2, 2018).

Cultural Resources

- The loss of medical trees along the pipeline corridor (Laare Town, November 2, 2018; Mutuati, November 1, 2018).

Social and Health

- The potential adverse social impacts of the project because of the influx of foreigners and outsiders working on the pipeline, such as rape and early pregnancies, increased sexual harassment (Kaichuru Village, October 31, 2018; Laare Town, November 2, 2018; Mutuati, November 1, 2018; Kandebene, November 3, 2018);
- What are the plans to mitigate adverse social impacts on the community? Request to build a police post, hospital and school in order to mitigate the adverse impacts of the Project on the community (Kaichuru Village, October 31, 2018; Kandebene, November 3, 2018); and
- The potential adverse health effects associated with the Project (Mutuati, November 1, 2018).

Tourism

- The potential impacts on the tourist industry from Project activities (Mutuati, November 1, 2018).

Employment

- Would like to see the majority of jobs and offered to the local people, employment opportunities for youth (Kaichuru Village, October 31, 2018; Mutuati, November 1, 2018; Laare Town, November 2, 2018; Kandebene, November 3, 2018);
- Would like to see tenders for supply of materials to local businesses (Laare Town, November 2, 2018); and
- The employment process should be transparent and fair (Laare Town, November 2, 2018).

Benefits and Compensation

- The compensation process for loss of land or resources that people depend on (Kaichuru Village, October 31, 2018; Mutuati, November 1, 2018; Laare Town, November 2, 2018);

92 a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect

- How will farmers, youth, the elderly and people with disabilities benefit from the Project? (Meru Town, Mutuati, November 1, 2018; Laare Town, November 2, 2018);
- Communities would like to see benefits from the Project and the corporate social responsibility programme (Meru Town, October 30, 2018; Mutuati, November 1, 2018; Laare Town, November 2, 2018; Kandebene, November 3, 2018), including the following:
  - Initiatives for conservancy rangers (Meru Town, October 30, 2018);
  - Security policing (Mutuati, November 1, 2018);
  - A health centre, schools, and water points in Kachiuru, Bulu and Ndumuru (Mutuati, November 1, 2018);
  - The development of a dam in a grazing field near the corridor to provide water for livestock (Mutuati, November 1, 2018);
  - A tertiary education centre in Mutuati (Mutuati, November 1, 2018);
  - A railway station in Kachuru, Bulu, and Ndomoru where there are business centres (Mutuati, November 1, 2018);
  - Water and mobile networks (Laare Town, November 2, 2018);
  - Trees for planting to increase coverage in the area (Kandebene, November 3, 2018);
  - Fresh piped water provided in Kandebene because the water in the area is mostly salty (Kandabene, November 3, 2018); and
  - A police post, hospital and a school (Kandebene, November 3, 2018).
- Would like to see a community share of 1-3% from the Project so the community can benefit (Kandebene, November 3, 2018).

Consultation

- The importance of engagement so they have an opportunity to voice their concerns, including people from Igembe Central (Laare Town, November 2, 2018; Meru Town, October 30, 2018).

2.4.5 Garissa County

Garissa County is one of the three counties in the north-eastern region of Kenya, as shown in Figure 9 (GCG 2018). The county borders Somalia to the east, Lamu County to the south, Tana River County to the west, Isiolo County to the north-west and Wajir County to the north. The county has a surface area of approximately 44,000 km^2.

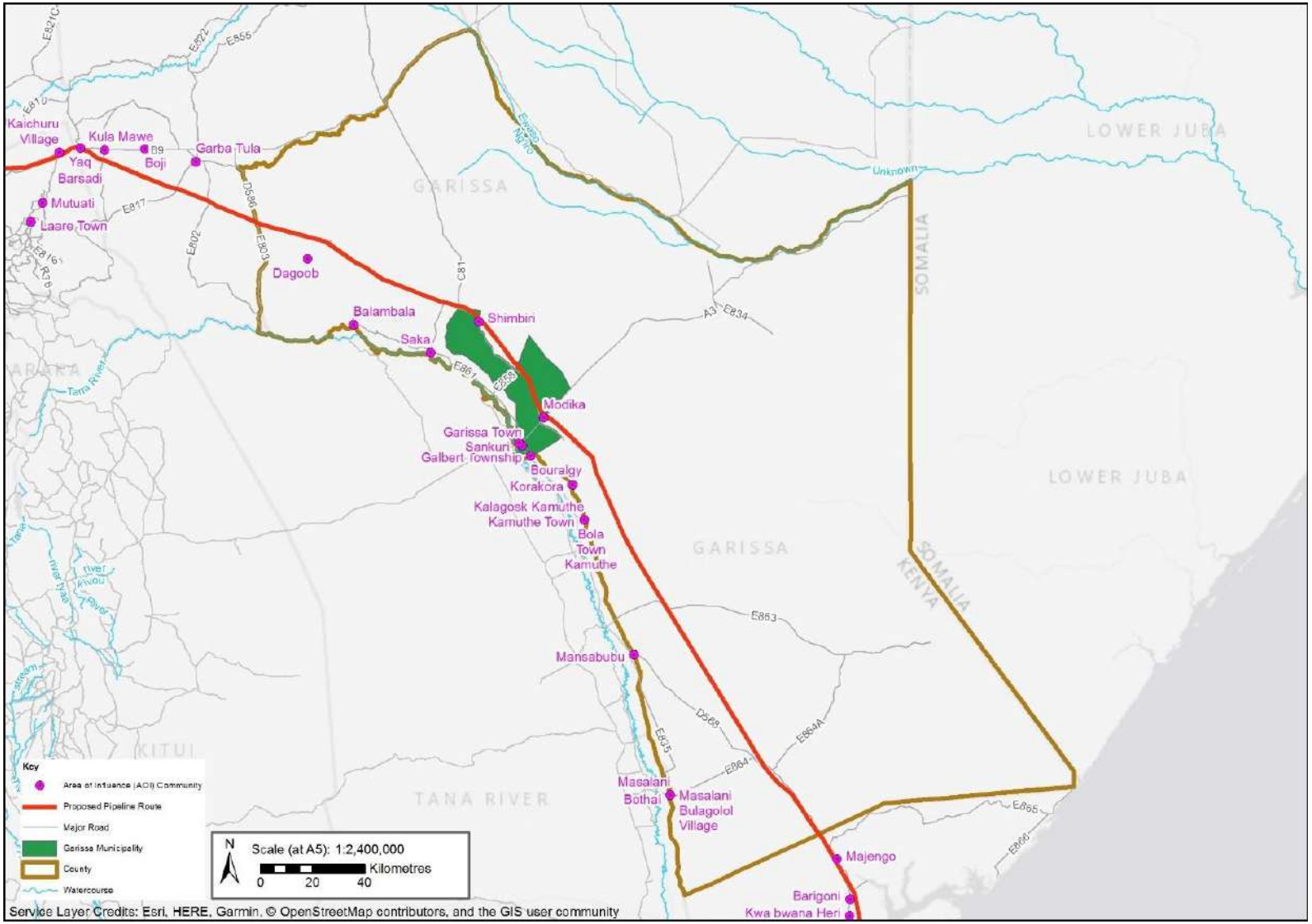

Figure 9: Garissa County

2.4.5.1 Administrative Division and Governance Structure

Garissa County is administratively divided into six sub-counties, 23 divisions and 83 locations which are shown in Appendix D (GCG 2018). Garissa County also has six constituencies which correspond to the sub-counties, and 30 county electoral wards, which represent the political units for the county. The Project crosses Balambala, Garissa, Fafi and Ijara Sub-Counties (Table 82).

Table 82: Garissa County Administrative Units Overlapped by the Project

Sub-county	Division	Area (km^2)	No. of Locations
Garissa	3	2,538.5	10
Balambala	4	3,049.2	12
Fafi	3	15,469	12
Ijara	4	6,709.6	11
Total	**14**	**27,766.1**	**46**

Source: GCG 2018

The proposed Project is located in the sub-counties Balambala, Garissa, Fafi and Ijara, which is the primary focus of the socio-economic baseline report. The Area of Influence (AoI) communities most likely to experience socio-economic effects from the Project in these sub-counties are listed in Table 83, including their distance from the pipeline route. The closest community is Shimbiri located 1.0 km from the pipeline route. Focus groups were conducted with the local government, department of agriculture, education, water and sanitation, and pastoralist groups, elders, women and youth in most of these communities. Focus groups were not conducted in all sub-counties due to security concerns.

Table 83: AoI Communities in Garissa County

Sub-County	Community	Distance (km)
Balambala	Dagoob	8.4
	Balambala	21.0
	Saka	20.2
	Shimbiri	1.0
	Modika	1.1
Garissa	Sankuri	14.7
	Galbert Township	14.9
	Bouralgy	16.3
	Korakora	14.7

Sub-County	Community	Distance (km)
Fafi	Kalagosk Kamuthe	14.9
	Kamuthe Town	14.9
	Mansabubu	24.0
Ijara	Masalani	36.8
	Bothai	36.8

2.4.5.1.1 Local Administration

The women from the most of the AoI communities participate in political decision-making, mobilising voters during elections (Focus Group, Women, Mansabubu 2018; Appendix B). Several women from Modika would like to be elected to positions of authority. The women from Korakora, Ijara and Simbiri stated that they rarely take part in political decision making, and typically follow the decision of the community elders, all of whom are men.

Some share leadership responsibilities, especially as it related to women, and the women from Galbert Township assist in policy making concerning village gender issues (Focus Group, Women, Galbert Township 2018; Appendix B). Female genital mutilation is a concern in Garissa, and educated women are actively formulating policies that will see this traditional practice eradicated.

The youth from Korakora, Saka, Shimbiri and Bola Town Kamuthe actively participate in the election process and campaigning. In contrast, the youth from Garissa Town and Saka stated they are not included in the decision-making processes or the political arena.

2.4.5.2 Population Demographics

According to the 2009 national population and housing census, the population of Garissa County was 623,060 and projected to increase by almost 30% by 2018 (GCG 2018). Garissa Sub-county has the largest population and greatest population density since it is the administrative centre and a relatively well-developed infrastructure. Fafi Sub-county has the lowest population density, with only 6 persons per km^2. Table 84 below provides the 2009 population count and population projections for the county until 2022. More recent demographic data on Garissa County is unavailable as detailed county level statistics are only published every ten years in the national census.

Table 84: Total Population of Garissa County

Sub-County	2009 (Census)		2018 (Projections)		2020 (Projections)		2022 (Projections)	
	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)
Garissa	116,953	173	163,734	242	178,938	265	194,142	287
Balambala	73,109	15	102,353	34	111,857	37	121,361	40
Lagdera	92,636	14	129,690	20	141,733	22	153,776	24
Dadaab	152,487	22	213,482	31	233,305	34	253,128	37
Fafi	95,212	6	133,297	9	145,674	9	158,052	10
Ijara	92,663	9	129,728	19	141,774	21	153,821	23
Total	**623,060**	**14**	**872,284**	**20**	**953,282**	**22**	**1,034,280**	**23**

Source: GCG 2018

Garissa has a relatively young population, where the total population below the age of 15 was estimated to be 41.9% in 2017, due to high fertility rates among women (GCG 2018) (Table 84). The population of 65 years and above was estimated to only be 2% in 2017, based on a low life expectancy rate of 56 years for males and 65 years for females (GCG 2018). Approximately 49.4% of the population is between 15 and 64 years of age, which represents the labour force, and only 3.4% of the population was 65 years of age and above.

Table 85: Population Projections by Age Cohorts

Age Cohort	2009 Census	2018 Projection	2020 Projection	2022 Projection
0-4	90,788	37,762	40,812	44,108
5-9	107,073	36,036	38,946	42,092
10-14	103,091	146,223	158,033	170,797
15-19	79,254	112,413	121,492	131,305
20-24	57,983	82,243	88,885	96,064
25-29	43,523	61,733	66,719	72,107
30-34	34,409	48,805	52,747	57,007
35-39	26,623	37,762	40,812	44,108
40-44	25,406	36,036	38,946	42,092
45-49	14,430	20,467	22,120	23,907
50-54	14,225	20,177	21,806	23,567

Age Cohort	2009 Census	2018 Projection	2020 Projection	2022 Projection
55-59	6,298	8,933	9,655	10,434
60-64	8,477	12,024	12,995	14,044
65-69	3,085	4,376	4,729	5,111
70-74	4,752	6,740	7,285	7,873
75-79	1,598	2,267	2,450	2,648
80+	4,892	6,939	7,499	8,105
Total	**623,060**	**884,348**	**955,774**	**1,032,968**

Source: GCG 2018

Garissa County has six unclassified urban centres (Table 85). The urban population constitutes approximately 16% of the county's total population. Dadaab is a very unique urban centre since it hosts a large population of refugees; mainly from Somalia. The overall level of urbanisation in the county is high because of the influx of people from rural areas, mainly due to loss of livelihoods as a result of persistent drought. This places a strain on the social and physical infrastructure in these urban centres (GCG 2018).

Table 86: Population Projections by Urban Centre

Urban Centre	2009 Census	2017 Projection	2020 Projection	2022 Projection
Balambala	7,035	9,849	10,764	11,678
Bura East	1,492	2,089	2,283	2,477
Dadaab	60,390	84,546	92,397	100,247
Modogashe	21,779	30,491	33,322	36,153
Nanighi	3,884	5,438	5,943	6,447
Hulugho	5,100	7,140	7,803	8,466
Total	**99,680**	**139,552**	**152,512**	**165,468**

Source: GCG 2018

Of the AoI communities, Galbert Township had the largest total population in 2017, and Saka had the smallest population (Table 87). Just over one third of the population in Galbert Township is under the age of 15.

Table 87: Population Data for AoI Communities in Garissa County

Indicator	Galbert Township	Modika	Sankui	Mansabubu	Saka	Balambala	Dagoob
Population (2017)	46,000	n/a	2,000	15,000	750	n/a	10,000
Number of Households	4,600	170	500	2,400	350	1,200	380
Births	300	15	n/a	20	n/a	n/a	50
Deaths	60	5	n/a	10	20	n/a	6
Population Under 15	16,000	n/a	1,000	1,000	n/a	n/a	n/a
Population 15-54	20,000	3,000	n/a	14,500	400	n/a	9,000
Population 55 and over	10,000	150	200	1,200	200	n/a	35
In-migration	420	200	300	240	n/a	100	720

Source: Focus Groups, Local Government, Galbert Township 2018; Modika 2018; Sankuri 2018; Mansabubu 2018; Saka 2018; Balambala 2018; Dagoob 2018; Appendix B.

2.4.5.3 Ethnicity and Languages

The population in Garissa County is 98% Somali. Internally, the Somalis identify themselves by clans, which is a key factor in development and in distribution of resources in the county, employment and leadership selection. The clans found in the county are Abudwaq, the Aulihan, the Abdalla, Muqabuul, Qare, and Dogodia. The remainder of the population includes workers in the county and a large population of refugee communities who are hosted in Dadaab refugee camps. The main languages spoken in the county are Somali, English and Swahili. The county's population is mainly Muslim with a small number of Christians. Due to their diverse economic activities, these communities are occasionally susceptible to inter-clan conflicts (GCG 2013)

The Somali tribe speaks the Somali language. It is the only language spoken by the entire Somali people; however, variations and dialects of the Somali language are spoken by different clans living in various parts of northern Kenya. Between 70% and 80% of Somali in Kenya speak various mutually-intelligible dialects of standard Somali. Linguistic skills including poetry and excellent speech are highly valued among all Somali clans.

2.4.5.4 Social Organisation

Elders are highly respected, and they are considered the role model of the community. They settle family disputes and may act as traditional healers. In Dagoob, approximately 10% of the village's male population are traditional healers. They are also the link between the government and community in the development of new projects or infrastructure.

Traditional healers play an active role in most communities. They use natural resources and herbs for healing and are not typically paid for their services, rather given something in return after the consultation (Focus Groups, Elders, Modika 2018; Korakora 2018; Appendix B). Common ailments treated by traditional healers include kidney pain, malaria, common cold, bone fractures and snake bites. Within the pipeline corridor, natural resources used by traditional healers have been identified by not yet mapped accurately; these include aloe vera, *tira* and *madahbubuq.* They also assist women in childbirth. Most healers treat people for a fee or are paid with livestock. They collect herbs (*dald abas* and *hinta*) from the forest and the Tana River, and some of the trees used include *anariki, darktn* and *hagar*.

Women are the primary caregivers and housekeepers within a household, while men handle money management, fee payment, and healthcare. Women are primarily responsible for milking cows, female circumcision, fetching firewood, water and cooking. Women participate in women's groups (e.g. milk vendors, cultural entertainers or dancers and beekeepers). The challenges that preclude their participation in social groups include religion and a lack of inclusivity, funds and awareness. In some communities, single women are considered more vulnerable because they receive no support from the community and are often isolated. In a typical two-parent family, the decision-making is carried out by the head of the household, usually the husband. In some households, decisions are made by both women and men, and if no husband is present, the woman is the sole decision-maker. In Jibe both women and men contribute to the family expenditures (Focus Groups, Women, Shimbiri 2018; Korakora 2018; Mansabubu 2018; Dagoob 2018; Appendix B).

The youth are primarily responsible for herding animals, weeding at the farm, protecting their families, construction of beehives and informal trading to supplement the family income. Young men typically marry at 20 years old and young women from the age of 12 years.

2.4.5.5 Economic Base

The main economic activities in Garissa are crop farming, livestock and fish production. The main crops grown are watermelons, mangoes, vegetables, tomatoes, paw paws, bananas, cowpeas, maize, beans and green grams. These are usually produced on a small scale under irrigation along the Tana River. The main challenges within the agricultural sector include the lack of access to farm inputs such as fertilisers, improved seed varieties, acaricides, pesticides, machinery, and water for effective irrigation. Garissa County relies on livestock rearing. The main livestock bred are cattle (Boran), goats (Galla), sheep (black headed Persian) and camel (dromedary one-humped) and livestock products include meat, milk, hides and skins.

Fish farming in Garissa County is done on a small scale along the Tana River and in fish ponds. There are five fish ponds with a total area of 1,200 m^2 and mud fish, cat fish, bone fish, tilapia and eel are the types typically caught. There are six landing beaches along the Tana River in Garissa, Fafi, Balambala and Masalani. In addition, there are 19 market centres located in various parts of the county (Republic of Kenya Garissa County Annual Development Plan 2015/2016, 2015).

Quarries near Saka and Balambala also generate economic activity, and beekeeping is practiced by some reidents of Balambala. There are constraints to economic development in the county, notably the lack of capital to expand local businesses, and the lack of a market for products. Local government revenues in Modika come from taxes on sales, gypsum, and construction materials (Focus Groups, Local Government, Modika 2018, Sankui 2018; Appendix B); however most other local governments are challenged with a lack of revenue sources.

Most of the women from the AOI communities are involved in small scale agriculture or businesses (Focus Groups, Women, Modika 2018; Shimbiri 2018; Mansabubu 2018; Balambala 2018; Masalani 2018; Appendix B). They sell vegetables, water, *miraa*[93] , and keep goats, cattle, and sheep for domestic use and to sell milk, meat and hides. They also run kiosks, small hotels and butcheries, and the women from Modika are involved in trading livestock. Approximately 50% of the women in Shimbiri are engaged in economic activities. The women from Dagoob stated that they are not engaged in any economic activities.

2.4.5.6 Employment

Wage earners in Garissa are formally employed by government departments, NGOs, donor agencies and business organisations. A small number of the county population is self-employed, mainly engaged in milk and livestock selling. Local farmers in Garissa have poor access to markets, making it difficult to sell their produce

93 a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect

and earn an income. Such challenges result in a continual cycle of poverty (GOK 2015). The collection of firewood and production of charcoal is another important livelihood for some.

Wage employment is sparse relative to the local labour force, and unemployment is high. It is particularly difficult for youth to find employment, even for those who are educated (Focus Group, Youth, Korakora 2018; Garissa Town 2018; Appendix B). Due to the high rate of unemployment, many young people from Garissa Town join militia groups or turn to drug abuse. Youth from Korakora and Bola Town, Kaluthe are generally employed in farmin and animal herding. The youth from Korakora also burn and sell charcoal, while the youth from Bola Town are engaged in cleaning the town and small-scale businesses. The youth from Saka are also employed in fishing or farming industries, and work as drivers, barbers or in other local businesses. In Shimbiri, the youth have jobs as watchmen, drivers and cooks. The youth are eager to work, but employment opportunities are often not given to the local people.

2.4.5.7 Social Infrastructure

2.4.5.7.1 Education

The county has 219 ECD centres, 209 primary schools and 33 secondary schools (GCG 2018). There is one teacher training college, one national polytechnic college (North-Eastern National Polytechnic College) and three youth polytechnics based in Garissa, Bura and Ijara, two of which are not operational. There is a polytechnic under construction in Balambala. The county also has a vocational training institute in Dadaab, the Kenya Medical Training College, a public university (Garissa University), a satellite campus (Kenyatta University), a private university (Umma University) and an Islamic University (Mustaqbal University). In addition, there are six accredited private colleges. These colleges include Garissa Commercial College and Garissa School of Health Sciences among others.

Approximately 40% of the population are able to read and write (GCG 2018). Approximately 75% of the population in Garissa County has no formal education (KNBS and SID 2013e). In Balambala and Dagoob Sub-counties, less than 15% of the population have a primary education only, and in almost all the counties less than 6% of the population have secondary education or higher. The population of Garissa County have significantly lower levels of educational attainment compared to the national average (Table 88).

Table 88: Education Attainment in Garissa County (2009)

County/Sub-County	None (%)	Primary (%)	Secondary+ (%)	Total Population
Garissa Township	52.2	32.0	15.9	101,89
Balambala	89.5	9.1	1.4	66,776
Lagdera	84.9	12.8	2.4	86,062
Dagoob	82.8	14.6	2.7	61,717
Fafi	83.5	14.1	2.4	32,815
Ijara	68.9	26.3	4.8	84,530
Garissa County	74.4	19.7	5.9	433,709
Kenya	25.2	52.0	22.8	34,024,396

Source: KNBS and SID 2013e

The enrolment rate for primary education in the county is low. There are 1,622 teachers and a teacher-pupil ratio of 1:42. The primary school net enrolment rate is 24% while the completion rate is 63%. The transition rate is 58%, which is due to the nomadic lifestyle of the people and early marriages among girls (GCG 2018). Table 89 shows school enrolment for the county.

Table 89: School enrolment for Garissa County

Pre-school		Primary		Secondary		Tertiary	
Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio	Enrolment	Teacher/ Student Ratio
16,377	1:105	68,457	1:42	12,497	1: 52	-	-

Source: GCG 2018

Children generally start school between the ages of five and eight and finish primary school between 14 to 15 years old. They finish secondary school between the ages of 15 to 20 years. In Shimbiri, only 30% of children are able to finish secondary school; the balance leave school after primary school. Children leave school for a variety of reasons, including a shortage of teachers, poverty and the inability to pay for school fees (Focus Group, Women, Modika 2018; Shimbiri 2018; Balambala 2018; Focus Group, Education 2018; Appendix B). Girls typically drop out of school because of early marriage. The nomadic way of life of pastoralists prevents children from staying in school, since they move with their families during the dry season in search of pasture and water. Some areas are prone to flooding from the Tana River. Security is an issue in some areas, and when there is a conflict between communities, children sometimes avoid going to school. There is no technical college in Kamuthe, and the youth go to nearby towns to obtain an education. Improving educational attainment is a priority for the county.

2.4.5.7.2 Health Services

Health facilities and services within the Garissa County are inadequate. Garissa County has four level 4 hospitals, seven level 3 facilities (health centres),31 level 2 dispensaries, and 18 level 2 medical clinics (Shape Consulting Ltd. 2019); Appendix A). Health facilities are distributed all over the county. Patients often travel long distances to access health services (average distance to the nearest health facility is 35 km), or do not go for medical treatment at all because of the poor road network (GCG 2018). Additionally, existing health facilities do not have sufficient equipment and drugs to undertake crucial medical services (GCG 2015).

Most of the health facilities are along the Tana River where there are settlements. The number of trained health personnel is very low with the doctor population ratio currently 1:41,538 while the nurse population ratio is 1:2,453 (GCG 2018). The five most prevalent diseases in Garissa County are malaria, upper respiratory tract infections, stomach-ache, diarrhoeal diseases and flu; with a prevalence of 47%, 5%, 7%, 3% and 4%, respectively. HIV and AIDS prevalence rate is low at 1%, compared to 5.6% at national level (GCG 2018), and most of the women and youth from AOI communities are aware of the causes, prevention and treatment of HIV and AIDS, except in a few communities where awareness was low.

Table 90 presents the health system challenges in Garissa County. The primary challenges are due to poverty, inadequate healthcare infrastructure and resources, and service delivery (due to the vast geographic area and the nomadic lifestyle of the populace). Additional information on baseline health conditions in Garissa County is discussed in Appendix A: Community Health Baseline Report.

Table 90: Health System Challenges in Garissa County

Project County	Challenges	Contributing factors
Garissa	■ Inadequate health infrastructure (35 km average distance to a health facility) ■ Inadequate human resource capacity ■ Inadequate medical supplies and equipment ■ High illiteracy and poor awareness ■ Food insecurity and malnutrition ■ Nomadic lifestyle ■ Insecurity ■ Large refugee population (Dadaab camp) ■ High maternal mortality ■ Vastness of county and remoteness of certain locations ■ Poor immunisation coverage ■ Poverty	■ Historical marginalisation ■ Vastness of geographical area and poor road network ■ Arid and semi-arid climate (food insecurity) ■ Health system weaknesses ■ Porous borders contribute to influx from Somalia

Source: Baseline KIIs in Appendix A

2.4.5.7.3 Housing

Housing remains a great challenge in the county with a high percentage of the population living in shanties/ *manyattas* (huts) which are susceptible to accidents. The Garissa population use available resources as wall materials for building houses. The majority of residents (43%) use grass straw, while 19% live in houses with mud/wood walls. Only 13% of Garissa's population reside in brick/block walled houses (GCG 2015).

2.4.5.7.4 Security

The prevention of organised crime is a national issue in Kenya and terrorist attacks are common in Garissa County. Road bandits are also an issue. The increase in gangs and militias is linked unemployment and poverty, exclusion, culture which legitimises the use of violence, a poor relationship with official security and the political support for violence (Mkutu et al. 2014).

Unresolved land disputes and tenure in various counties are also feeding into intra-county and inter-county conflicts. Unresolved conflicts over resources such as land and oil are often high in the Garissa County. In rural areas of northern Kenya, inhabited mainly by pastoralist communities, resource-based conflict over pastoral resources such as land, and competition for water and pasture, and raiding of livestock is high.

The road networks in Garissa County are poor, making a large proportion of the county inaccessible during the rainy season. The road network comprises of 1,479 km of earth surface roads, 304 km gravel roads and 22 km tarred roads. The county has three bridges on the Tana River which are all in good condition (GCG 2015).

2.4.5.8 Physical Infrastructure

2.4.5.8.1 Water

Garissa County has one permanent river (Tana River), 25 shallow wells, 109 boreholes, 195 water pans and one dam (GCG 2018). Water from other sources is generally unsafe and as such it is treated at household level with aqua tabs, water guards and other chlorine-based purifiers supplied by the relevant government departments. Other areas of the county rely on shallow wells, boreholes and water pans (Focus Group, Water and Sanitation, Kamuthe 2018; Appendix B). The county is generally water-scarce with acute water shortages

experienced during the dry season. Various interventions have been undertaken to mitigate against these water shortages. These include water tinkering and the activation of the rapid response team charged with the responsibility of repairing boreholes during drought (GCG 2018). Water services are organised through the Garissa Water and Sewage Company, which is staffed volunteers. Households pay a fee of between 500 KSh and 3,000 KSh per month for water services in Garissa Town (Focus Groups, Water and Sanitation, Kamuthe, October 15, 2018; Garissa Town, October 12, 2018). In Bouralgy, water is brought from the Tana River, and households pay a rate of 20 KSh per litre (Focus Group, Water and Sanitation, Bouralgy 2018; Appendix B).

Approximately 24% of the population in Garissa County have access to safe water (GCG 2018). Access to piped water is limited to the sub-county headquarters where approximately 27,725 households have a connection to piped water. The remaining population make use of unsafe water directly from the river, Laghas, boreholes, shallow wells and pans. The average distance to the nearest water point is 25 km, suggesting that a large section of the county's population cannot access safe water for domestic purposes. For residents of Garissa Town, however, this distance has reduced considerably. Table 91 shows the main sources of water for the AOI communities.

Table 91: Table 90: Water Supply in the Project Area

Community	Water Supply	Season
Bouralgy	■ Water pans at Bukurey ■ Water trucks bring water from Tana River	n/a
Garissa Town	■ Traditional wells and piped water	n/a
Korakora	■ Water pans and boreholes	n/a
Sankuri	■ Piped water ■ Local River	n/a
Kamuthe	■ Water pans (e.g. Daad Seinab, Adnaan, Kalagose and Eey Dure) ■ Boreholes (e.g. Daad Buuce) ■ Piped water from Tana River	n/a
Saka	■ Tana River ■ Taps (paid) ■ Borehole	n/a
Masalani	■ Water pans	n/a
Dagoob	■ Earth dam and seasonal dams ■ River	River is seasonal

Source: Focus Group, Livestock Herders, Korakora 2018, Sankuri 2018, Kamuthe 2018, Saka 2018, Masalani 2018, Dagoob 2018; Focus Group, Water and Sanitation, Kamuthe 2018, Bouralgy 2018.

n/a = data not available

2.4.5.8.2 Sanitation and Waste

Sanitation facilities within the county is poor. Half of the population make use of other means of sanitation such as bushes, and the remaining half use pit latrines. The lack of sanitation facilities within the county has often led to the spread of diseases such as cholera. A smaller percentage of the population is connected to sewer and septic tanks (GCG 2015). Only one sewerage connection was being constructed in Garissa town, and the other towns in the county do not have sewerage connections.

Residents of the Garissa municipality are not aware of any outlined method and responsibility of waste management adopted by authorities to keep the county clean. Residents living within Garissa County have no adequate waste disposal mechanism, technologies or facilities available, hence the waste situation in Garissa is poor. Furthermore, surface dumping of household waste is the most common form of waste disposal applied by residents. Other methods include burning and burying in the ground however, burying of domestic waste is quite rare (Mule 2013).

There is a sewerage system in Bouralgy but it is poorly maintained (Focus Group, Water and Sanitation, Bouralgy 2018; Appendix B). Residents of Garissa municipality complain that the Garissa Water and Sewerage Company have not repaired broken sewer lines in more than a month which poses a risk of a waterborne disease outbreak. The Northern Water Service Board (NWSB), through funding from the national government, are implementing a new sewer system in Daadab, Balambala, Masalani and Modogashe. The NWSB is also expanding supply of water in Bura and Balambala.

2.4.5.8.3 Energy Sources

Approximately 84% of the county's population use fire wood as a source of energy for cooking while 40% of the population use charcoal (Table 92). Electricity is available in Garissa, Ijara, Dadaab, Bura East, Balambala and Modogashe and surrounding environment, with only 1.5% of the population having access to electricity. In Hulugho, a power installation project was started but stopped before completion. The Ministry of Energy has facilitated the installation of solar systems in health facilities, schools and watering points. Other sources of energy such as biogas and solar are used on a limited scale (GCG 2018). Approximately 32% of the Garissa population use tin lamps for lighting purposes, followed by 25% who use fuelwood.

Table 92: Source of Energy in Garissa County

Activity	Source	Households
Cooking	Electricity	25.7%
	Firewood	84%
	Charcoal	40%
	LPG/Biogas/Paraffin	2.4%
	Solar	0.3%
	Other	0.5%

Activity	Source	Households
Lighting	Electricity	12%
	Fuelwood	25%
	Gas Lamp	23.4%
	Pressure Lamp	0.6%
	Lantern	22.6%
	Tin Lamp	32.1%
	Solar	0.6%
	Other	6.9%

Source: CGC 2018

2.4.5.8.4 Transportation

The county has a total road network of 2,700 km of which 1,638 km is managed by the county government and 1,063 km by the national government (GCG 2018). The road network is made up of 36 km of bitumen surface, 2,245 km of earth surface and 420 km of gravel surface. The county government is responsible for developing, rehabilitating and managing all unclassified roads. County roads are in poor condition and most of them are impassable during the rainy season thus curtailing all movement by road in the county. The county has three bridges crossing the River Tana, which are in good condition. Movement across Laghas is facilitated through concrete drifts that are also impassable during floods. There are eight airstrips in the county with one in Garissa, Lagdera, Hulugho, Fafi, Balambala and Ijara, and two in Dadaab. The county has no railway line and no bus park, jetties or ports.

During focus group discussions it was indicated that the Kenya Rural Roads Authority is currently tarring access roads within Garissa town such as Garissa-Ndogo and Bula-Masalani roads. The project is being funded by the national government. The community benefits from this project in terms of employment.

2.4.5.8.5 Communication

The county is served by three mobile phone service providers, with a coverage of 62% (GCG 2018). However, a large section of the county still has no network coverage especially in Balambala and Fafi. The total landline connection stands at 800. The radio coverage is over 95% since most of rural population depends on radio for news coverage. There is only one Huduma centre in the whole of Garissa County. There are four post offices in the county, namely in Garissa, Modogashe, Dadaab and Masalani. The county is served by several internet cyber cafes.

2.4.5.9 Land and Resource Use

2.4.5.9.1 Land Ownership

The new Constitution (Chapter 5 Sections 60 – 68) classifies land into public, private and community and states that all land in Kenya belongs to the people collectively as a nation, communities and individuals (GCG 2018). Community land in Kenya is held by communities on the basis of ethnicity, culture or similar interest, or ancestral heritage. Community land comprises land registered in the name of group representatives, transferred to a specific community and land held, managed or used by communities as community forests, grazing areas or

shrines. Land can be purchased through the community Chief for between 200,000 KSh and 500,000 KSh per acre (Focus Groups, Local Government, Mansabubu 2018; Saka 2018; Appendix B).

Land in the county is communally owned and belongs to the people which is recognised not just as a commodity for trade, but also as a principal source of livelihood (GCG 2018). In urban centres, people have acquired individual plots and most have allotment letters stating ownership. In rural areas subdivision of land has not been done, therefore land is used communally by the local people and held in trust for the community by Garissa County Government. The majority of the local communities in the county live in informal settlements. People who live in urban centres benefit from well-developed and accessible infrastructure. Only 1% of the population hold title deeds since the majority of the population live on communal land. This has resulted in increased cases of land-related inter-clan conflicts in recent years, sometimes with a loss of human life. There is a need to fast track the issuing of title deeds especially in urban centres (GCG 2018). It is not typical for women to own land or hold it in their name (Focus Group, Women, Modika 2018; Appendix B). Most farmers do not own enough land to subdivide amongst their children (Focus Group, Agriculture, Sankuri 2018; Appendix B).

2.4.5.9.2 Agriculture

Garissa County is principally a semi-arid area and receives an average rainfall of 275 mm per year (GCG 2018). There are two rainy seasons, the short rains from October to December and the long rains from March to May. Rainfall is normally in the form of a short torrential downpour making it unreliable for vegetation growth. The southern parts of the county such as Hulugho, Masalani and Bura receive more rainfall than the northern parts. Balambala and Fafi Sub-counties practice rain-fed agriculture on a small scale.

Farming is developing Garissa into a breadbasket. Already, waters from River Tana are transforming the region into a valley of opportunities where individuals and groups are engaged in mixed farming. The valley stretches from Fafi constituency and covers all of Garissa Township and parts of Lagdera. It is estimated that Garissa has 44,100 acres of land along the Tana River Basin which can be used for irrigation. Currently, only 5,121 acres of land (12%) along the basin is under irrigation. The main crops grown in the county are watermelons and sweet melon, mangoes, vegetables, tomatoes, paw paws, bananas, cowpeas, simsim, rice, sorghum, lentils, peas, chiles maize and green grams (Focus Groups, Agriculture, Garissa Town, 2018; Sankuri 2018; Kamuthe 2018; Appendix B). These are usually produced on a small scale under irrigation along the River Tana. Garissa County does not only export fruits and vegetables to other parts of Kenya, but also to neighbouring Somalia and Ethiopia. The average small-scale farm size in Garissa County is 1.5 hectares, 20 hectares for a large-scale farm. These are individual group farms mainly found along the Tana River.

The focus group discussions revealed that farmers in Kamuthe and Bouralgy consume and sell their produce to the markets, while farmers in Saka are only engaged in crop production for household consumption. Manure is used as a fertiliser. Only farmers from Kamuthe have access to tractors for cultivation and ploughing, and they are supported by Red Cross through the provision of watermelon seeds. The main crops grown in Saka include maize, tomatoes and mangoes. Table 93 shows the crops grown in Kamuthe and Bouralgy.

Table 93: Average Crop Yields and Marketing in Bouralgy and Kamuthe

Community	Crop	Yield (kg)	On how much land (acre)	% sold	Months of sale	Price at harvest (KSh)
Bouralgy	Maize	20 (50 kg sacks)	1 acre	100	August	50 per kg
	Tomato – 20 kg per day	1 acre	95%	January - August	80 to 20 kg	2 at 20 KSh
Kamuthe	Beans	3 sacks	1 acre	100	June	1 sack 3,500 KSh
	Maize	High amount	5 acres	80	March	1 sack 2,000 KSh
	Leafy greens	High amount	5 acres	90	March	-

Source: Focus Groups, Agriculture, Bouralgy 2018; Kamuthe 2018; Appendix B.

Apart from the planting of food and cash crops, farmers also rear livestock such as cows, goats and camels. Men engage in all agricultural activities, and women do most activities except clearing the land and livestock herding. Children primarily participate in livestock herding (Table 94).

Table 94: Family Labour Distribution for Agricultural Activities

Village	Activity	Adult male	Adult female	Child male	Child female	Aged
Bouralgy	Clearing	√		√		
	Other land preparation	√	√	√	√	√
	Planting	√				√
	Weeding	√	√	√	√	√
	Harvesting	√	√	√		√
	Post harvesting processing	√	√	√	√	√
	Herding	√	√	√	√	√
Kamuthe	Clearing	√				
	Other land preparation					
	Planting	√	√			
	Weeding	√	√			
	Harvesting		√			
	Post harvesting processing	√	√			
	Herding			√	√	

Source: Focus Groups, Agriculture, Bouralgy 2018; Kamuthe 2018; Appendix B.

There are a number of challenges faced by those practicing agriculture. Floods during the rainy season can wash away crops, particularly vegetables. Temporary burst floods from the release of water by the Kenya Electricity Generating Company also poses a risk of washing away crops adjacent to rivers. There is limited access to extension or veterinary services which reduces the quality of animal products. There is also limited access to farming inputs from the county or national government, and little to no training or workshops to teach people how to farm or use the land effectively, which can result in lower yields than otherwise possible. Finally, seasonal fluctuations in market conditions introduce instability for farmers and pastoralists alike (Focus Group, Agriculture, Boralgy 2018; Kamuthe 2018; Saka 2018; Appendix B).

2.4.5.9.3 Pastoralism

According to the focus group discussions, the pastoralists responsible for livestock rearing belong to different types and sizes of groups which include both family and lineage groups. Herders migrate in family groups comprising two to three families, and up to 10 families. The permanent residence for pastoralist includes Saka, Kamuthe, Dagoob, and Masalani communities. During the rainy season the animals are kept at home or at the permanent structures, in the dry season the herders move their animals to other areas, sometimes up to 30 km away, where pasture is available and the community settles temporarily (Focus Group, Pastoralists, Masalani 2018; Appendix B). The types of animals herded in the area include camels, cattle's, goats and donkeys. However, herds are typically composed of mostly goats and cattle.

Livestock herd sizes vary greatly among livestock herders (Table 95). Camel herds range from 80 to 100 head, while cows are typically kept in groups of 20 to 100. Goat herds range in size dramatically, from 20 to 700 (Focus Group, Pastoralists, Korakora 2018; Masalani 2018; Appendix B). Cow's milk is sold for 50 KSh per litre. Camels are sold for approximately 35,000 KSh, while cattle and goats fetch comparatively lower prices (16,000 and 7,000 KSh, respectively).

Table 95: Average Herd Size in Garissa County

Community	Average Number of Animals per Herder*			
	Goats	Sheep	Cows	Camels
Korakora	20-700	n/a	30-60	80-100
Kamuthe	100	100	100	100
Masalani	100	100	100	n/a

Source: Focus Groups, Livestock Herders, Korara 2018; Kamuthe 2018; Masalani 2018; Appendix B.
n/a not available
**Data was not available for the other communities*

There are no groups responsible for the management of herders except in Kamuthe, where pastoral youth groups are responsible for ensuring the security of their pasture land from invasion by neighbouring communities; they also discourage the cutting of trees.

There are several challenges associated with the herding of livestock. Livestock moving between grazing areas can carry and spread disease, damaging herds. Drought is also a problem during the dry season, particularly given the high water requirements of livestock. Finally, veterinary assistance is limited, and typically not provided by the county or national government, meaning they must be paid for by the herders themselves which increases the risk of livestock loss. Livestock herders from Dagoob and Saka indicated they receive veterinary treatment once a year.

Water is required in large quantities for livestock, with camels requiring up to 100 litres every ten days, and cows requiring 50 litres every three days. However, water for pastoral use is scarce, and is often sourced from water pans and boreholes (Focus Group, Pastoralists, Korakora 2018; Appendix B). Where water is purchased for livestock, it costs approximately 10 KSh per day per animal (Focus Group, Pastoralists, Sankuri 2018; Appendix B).

2.4.5.9.4 Fishing

There are few fishing activities in the area, and fish is not an important food source since community members prefer goat, cow or camel meat. Nevertheless, oil from the fish is used for medicinal purposes. Fishing is practiced in Saka by one man only, mainly on the Tana River as this is the only water source in the area (Fishers Focus Group, Saka 2018; Appendix B). Fish produce is sold to locals, Chinese contractors (constructing the Nairobi-Garissa road) and Garissa Township. Challenges related to fishing include a poor transportation system, limited access to markets, and a lack of fishing equipment and boats.

2.4.5.9.5 Beekeeping

Beekeeping occurs in Masalani, and beehives in this village are kept near households. The Gares tree is used to construct beehives traditionally, though beekeepers are increasingly using timber to construct hives. On average, a person may own two beehives. One beehive can produce approximately 24 litres of honey. The harvested honey is used for household food, and traditional medicine, and is sold at a cost of about 3,000 KSh per three litres. Honey production is typically the job of men (Focus Group, Beekeepers, Masalani 2018; Appendix B).

2.4.5.9.6 Protected Areas

Garissa County has a number of game parks, reserves, conservancies and game ranches, including Garissa Giraffe sanctuary, Ishaqbin Community Conservancy, Waso Conservancy, Arawale National Reserve, Rahole National Reserve and Boni National Reserve. The Project does not overlap any of the protected areas in Garissa County (Appendix D).

2.4.5.10 Tourism

The county has a high potential for tourism development in the form of a wide range of wildlife species such as hirola, lions, giraffes, and zebras, a rich Somali traditional culture and a highly developed hospitality industry in Garissa town. The proximity of the county to the tourist coastal town of Lamu makes it ideal for as a destination link. This coupled with the rich traditional culture of the Somali people will boost tourism in the region. Garissa County relies heavily on domestic tourism from the many local and international NGOs operating in the area throughout the year.

Garissa County has a large population of game animals and birds, which are an important resource for tourist attraction. The main wildlife types found in the county are elephants, lions, cheetahs, leopards, hippopotamus, crocodiles, Grant's gazelle, Thomson's gazelle, gerenuk, jackals, spotted hyena, buffalo, hirola (endemic to Garissa), grey zebra, topi, reticulated (Somali) giraffe, white giraffe, wild dogs, dik-dik and Baboons. The wild animals are not confined to parks, they move freely.

2.4.5.11 Cultural Resources

There are several sacred grave sites near the project area in Boulargy, Mansabubu, Balambala, Modika and Ijara; these sites are visited during burial occasions. There are no prohibited sacred sites in Korakora, Balambala or Ijara areas. Circumcision is performed during cold seasons and is done by specific local people. Wedding ceremonies occur in Kora and Mansabubu. In Kora proponents who enter the village must be respectful when they are directed to the elders for orientation on the village norms. There is a sacred tree in Kamuthe which is used by the villagers for traditional ceremonies. Sacred trees also exist in Masalani, some of which also provide fruit (Focus Group, Elders Masalani 2018; Appendix B)

In Ijara the community regularly conduct traditional rites or prayers to ward off drought. There are no sacred sites in Dagoob, however the land used for grazing and farming must be respected.

2.4.5.12 Project Concerns

The Livestock herders expressed concerns and recommendations about the proposed Project during the Focus Groups discussions held from October 14 to October 18, 2018, which are listed below:

- The displacement of people because of the Project (Korakora, October 14, 2018);
- The potential for noise pollution due to the roads (Korakora, October 14, 2018);
- The adverse impacts of an oil spill on the land, including grazing areas, which may lead to a reduction in milk production and loss of income for the people (Korakora, October 14, 2018);
- The potential impact of the Project on natural resources such as soil, trees, water, etc. (Kamuthe, October 15, 2018), forests (Saka) plants, traditional herbs and grazing land (Masalani, October 17, 2018; Dagoob, October 18, 2018);
- Safety risks to children in excavation and trenching areas (Kamuthe, October 15, 2018);
- Disturbance to sacred sites (e.g. graves and places of worship) and impact on the community (Kamuthe, October 15, 2018);
- Potential harm to animals from the trenches created during construction (Saka, October 16, 2018);
- The consultation process and consideration of community concerns (Saka, October 16, 2018);

  The impact of a pipeline leak on land, including risk of an explosion and loss to pastoralists (Saka, October 16, 2018; Sankuri, October 14, 2018);
- The impact of a pipeline leak on vegetation (Sankuri, October 14, 2018);
- Disturbance to the production of animals and milk (Saka, October 16, 2018; Dagoob, October 18, 2018);
- The potential impacts on famers and beekeepers (Masalani, October 17, 2018); and
- Restrictions on the movement of community members (Dagoob, October 18, 2018).

Several concerns and recommendations were expressed by community members and stakeholders about the proposed Project during the consultation meetings held in the following locations in Garissa County: Balambala, Bouralgy, Dagoob, Kamuthe, Korakora, Sankuri, Shimbiri, Mansabubu, Saka, Masalani and Modika from October 12 to 18, 2018. These concerns have been categorised according to socio-economic topic and are listed below.

Land

- Potential for impacts to or loss of land for pastoral use and grazing (Balambala, October 17, 2018; Bouralgy, October 13, 2018; Dagoob, October 18, 2018; Kamuthe, October 15, 2018; Mansabubu, October 16, 2018; Sankuri, October 14, 2018; Shimbiri, October 15, 2018);
- Potential for land degradation (Balambala, October 17, 2018; Shimbiri, October 15, 2018), including the loss of future grazing quality resulting from a loss of nutrients from pipeline trenching (Kamuthe, October 15, 2018);
- Potential for the Project to release toxins that could affect animal pasture (Modika, October 13, 2018);
- Potential for oil spillage or leakage to result in negative effects on the land and environment and communities would like to be informed the mitigation measures that will be implemented to prevent this (Bouralgy, October 13, 2018; Dagoob, October 18, 2018; Lantern Resort, October 12, 2018; Masalani, October 17, 2018; Sankuri, October 14, 2018);
- Potential for emissions resulting from heating the oil (Lantern Resort, October 12, 2018);
- Request that the pipeline be located approximately 10 km away from their homestead (Shimbiri, October 15, 2018);
- Restrictions in burning that are conducted to allow new grass to grow (Masalani, October 17, 2018); and
- Potential for impacts to the fertile land of Ijara and trees that are important for food (Masalani, October 17, 2018).

Livelihoods

- Potential for displacement of people (Lantern Resort, October 12, 2018; Modika, October 13, 2018);
- Potential for displacement of livestock (Lantern Resort, October 12, 2018) and a risk of animal fatalities (Kamuthe, October 15, 2018; Shimbiri, October 15, 2018);
- Loss of houses, homesteads and property (Balambala, October 17, 2018; Masalani, October 17, 2018). Request to be informed about how these impacts will be mitigated (Masalani, October 17, 2018);
- Restrictions to the movement of people and livestock and resulting impacts to pastoral livelihoods (Balambala, October 17, 2018; Kamuthe, October 15, 2018; Masalani, October 17, 2018; Modika, October 13, 2018; Saka, October 16, 2018; Shimbiri, October 15, 2018);
- Potential negative economic impacts to livelihood (Masalani, October 17, 2018; Modika, October 13, 2018);
- Mitigation measures must be put in place to reduce effects on pastoral livelihoods (Dagoob, October 18, 2018);
- Potential loss of production and economic loss (Kamuthe, October 15, 2018);
- Potential for loss of livelihood and other issues if the pipeline crosses their house or land (Korakora, October 14, 2018);
- Potential for the Project to affect water pans or other water sources (e.g., dams, water catchment areas) (Kamuthe, October 15, 2018; Mansabubu, October 16, 2018; Shimbiri, October 15, 2018). Specific reference was made to water pans filled with water from Laggar during the Kamuthe meeting; and
- Potential environmental effects to livestock keepers (Shimbiri, October 15, 2018).

Health and Safety

- Potential for personal safety risk similar to what has been observed with other non-pipeline projects in the area (Bouralgy, October 13, 2018);
- Potential for the Project to result in hazards (Balambala, October 17, 2018; Saka, October 16, 2018) and environmental pollution (Balambala, October 17, 2018);
- Risk of human fatalities (Kamuthe, October 15, 2018);
- Potential for accidents while the trench is open (Modika, October 13, 2018);
- Potential for explosions (Modika, October 13, 2018);
- Concerns about the psychological effect of being 'careful' around the pipeline (Modika, October 13, 2018) and residents are afraid of the effects of crude oil (Masalani, October 17, 2018); and
- The community would like to be informed of the mitigation measures that will be implemented to prevent harm to humans (Sankuri, October 14, 2018).

Cultural Resources

- Potential for impacts to cultural, sacred and heritage sites that occur along the Project route (Kamuthe, October 15, 2018; Lantern Resort, October 12, 2018);
- The Project is in an area where it as the potential to affect graves and graveyards (Balambala, October 17, 2018; Kamuthe, October 15, 2018; Masalani). Grave sites are not to be removed, the pipeline route should be revised to bypass areas where there are known graves (Masalani, October 17, 2018);
- Possible impacts to a grave called *Sheikh Ali* (Mansabubu, October 16, 2018);
- Potential for impacts to *qushin cade*, which is a type of tree used for medicinal purposes (Mansabubu, October 16, 2018); and
- Effects on the trees used for medicine and construction (Masalani). The Project must not affect the trees that are used as herbs for children or other important resources including the trees *Garas, Warade, Chana, Ohiya, Deka, Kamasha, Gora, Maembe Kamuthe,* and *Donaney* and the salts *Madax bue bue, tuqa, tira* (Masalani, October 17, 2018).

Social

- Potential for the Project to result in a population influx to the region and resulting increases in poaching (Bouralgy, October 13, 2018);
- Potential social effects to livestock keepers (Shimbiri, October 15, 2018);
- Potential for the Project to affect schools (Balambala, October 17, 2018);
- An influx of people from other part of the country in search of employment will bring insecurity and other social problems (Balambala, October 17, 2018; Masalani, October 17, 201). The current insecurity in Ijara is a result of people coming from other areas and they do not want more people coming to the area (Masalani, October 17, 2018); and
- An influx of migrants looking for work will bring diseases such as human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) (Balambala, October 17, 2018).

Tourism

- Potential effects to Arawela game reserve (Mansabubu, October 16, 2018; Masalani, October 17, 2018).

Employment

- Why export crude oil when Kenya is still importing refined products. Why not build and refine the oil in Mombasa or Kenya? (Lantern Resort, October 12, 2018); and
- Expectations that local employment opportunities will result from the Project (Lantern Resort, October 12, 2018; Kamuthe, October 15, 2018; Modika, October 13, 2018; Sankuri, October 14, 2018; Saka, October 16, 2018). Requests that youth be especially provided employment opportunities on the Project (Balambala, October 17, 2018; Modika, October 13, 2018; Saka, October 16, 2018; Shimbiri, October 15, 2018), as well as elders (Shimbiri, October 15, 2018).

Benefits and Compensation

- Communities identified the follow requests for development within their communities and some communities noted that this could be accomplished as part of the Project's Corporate Social Responsibility Programme:
  - Provision of school fees and scholarships for local studies (Saka, October 16, 2018, Sankuri, October 14, 2018);
  - Building of new schools (Balambala, October 17, 2018; Dagoob, October 18, 2018; Shimbiri, October 15, 2018) and building of additional classrooms at the Dagoob school (Dagoob, October 18, 2018);
  - Rebuilding of and equipment for the Saka dispensary, especially the maternity wing (Saka, October 16, 2018);
  - Building of a dispensary in Dagoob (Dagoob, October 18, 2018);
  - Building of other infrastructure to improve local livelihood including mosques, hospitals, dams, earth pans, water pumps and piped water (Balambala, October 17, 2018; Dagoob, October 18, 2018; Saka, October 16, 2018);
  - Re-channeling of the Tana River to its previous channel to enable the community to get waters to their homes and land again (Balambala, October 17, 2018); and
  - Drilling of new boreholes (Shimbiri, October 15, 2018).
- Concerns were raised about the potential for the Project to provide benefits to the region, to communities, and to pastoralists (Balambala, October 17, 2018; Bouralgy, October 13, 2018; Modika, October 13, 2018; Saka, October 16, 2018; Sankuri, October 14, 2018; Kamuthe, October 15, 2018);
- Some communities expressed concerns that they will not receive benefits from this Project based on their experience on past projects (Bouralgy, October 13, 2018);
- Concerns were also expressed that the Project will result in more harm than benefit (Shimbiri, October 15, 2018);
- Communities indicated that they should receive benefits from the pipeline (Shimbiri, October 15, 2018; Masalani, October 17, 2018). Including the need for long-term benefits from the project not only temporary employment (Balambala, October 17, 2018);

- Some community members indicated that they feel the Project will improve the lives and will bring benefits to the people of the area (Balambala, October 17, 2018; Dagoob, October 18, 2018), including urbanisation, employment opportunities, investment and growth opportunities and improved transport infrastructure (Balambala, October 17, 2018).
- Communities were also concerned about what profits they will receive from the Project (Korakora, October 14, 2018) and indicated that there should be a requirement that the community receive revenue from the pipeline (Shimbiri, October 15, 2018);
- Questions were also raised about what revenue the local government will receive from the Project (Sankuri, October 14, 2018);
- It was also requested that Garissa County receive 10% of the pipeline revenue because the pipeline passes through the county for more than 300 km (Saka, October 16, 2018) and that the government should lease the land for the Project from the community (Modika, October 13, 2018); and
- Communities requested to receive compensation for the following:
  - Houses, farms, grazing lands, shops and shrines impacted by the Project (Modika, October 13, 2018);
  - Farm land and grazing land that has been cleared of vegetation (Dagoob, October 18, 2018);
  - Affected land and properties (Dagoob, October 18, 2018; Saka, October 16, 2018; Shimbiri, October 15, 2018);
  - Affected homesteads, schools and graveyards (Balambala, October 17, 2018);
  - Displaced people by the Project and resettlement should also be provided (Modika, October 13, 2018);
  - Loss of land and expressed concerns that compensation may not be received because the lands are held communally rather than with title deeds (Balambala, October 17, 2018; Sankuri, October 14, 2018);
  - Registered and non-registered boreholes (Kamuthe, October 15, 2018);
  - Water pans (Mansabubu, October 16, 2018; Masalani, October 17, 2018);
  - Destruction of any *quishin cade* (Mansabubu, October 16, 2018); and
  - The event of a pipeline accident during construction or operation phases (Balambala, October 17, 2018; Dagoob, October 18, 2018).
- Concerns were expressed about compensation that had been promised but not paid on other projects (Balambala, October 17, 2018; Mansabubu, October 16, 2018; Masalani, October 17, 2018). Some community members indicated that outstanding compensation issues need to be resolved before further activity in their lands (Balambala, October 17, 2018; Mansabubu, October 16, 2018).

Consultation

- Timing of the Environmental Impact Assessment, and why it is being conducted after the Project route and design has been selected (Lantern Resort, October 12, 2018);
- Request for more information on the Project and pipeline issues (Sankuri, October 14, 2018; Shimbiri, October 15, 2018; Saka, October 16, 2018) and to ensure that communities receive adequate information about the Project (Lantern Resort, October 12, 2018);

- Provide more and continuous civic education to inform communities about pipeline issues, the Lamu Port-South Sudan-Ethiopia Transport Corridor (LAPSSET) project and the Project (Balambala, October 17, 2018; Dagoob, October 18, 2018; Saka, October 16, 2018);
- Community member representatives should be appointed to engage during consultation to promote ownership of the Project (Lantern Resort, October 12, 2018);
- Lack of representation from some portions of the community including Elders and women during the engagement process. Would like to ensure the whole community is consulted about the Project (Bouralgy, October 13, 2018);
- Requests for further meetings and consultation and an effective stakeholder engagement process (Bouralgy, October 13, 2018);
- Respect for cultural norms around providing tokens of appreciation or covering costs for attendance (Bouralgy, October 13, 2018);
- The community should be consulted about possible impacts to sacred places, including graves (Kamuthe, October 15, 2018);
- Concerns about possible governmental corruption in these types of projects (Shimbiri, October 15, 2018);
- Work with the community-based organisations that deal with conservancy of water and the environment (Mansabubu, October 16, 2018);
- Request for a written memorandum of understanding with the pipeline company before any work on the Project commences (Balambala, October 17, 2018); and
- Want to ensure that the comments and concerns expressed by the community are documented (Masalani, October 17, 2018).

2.4.6 Lamu county

Lamu County is located on the northern coast of Kenya and is shown in Figure 10 (LCG 2016). It borders the Tana River County to the southwest, Garissa County to the north, the Somalia to the north-east and the Indian Ocean to the south. The county has a land surface area of approximately 6,275 km^2 which includes the mainland and over 65 islands in the Lamu Archipelago. The total length of the coastline is 130 km.

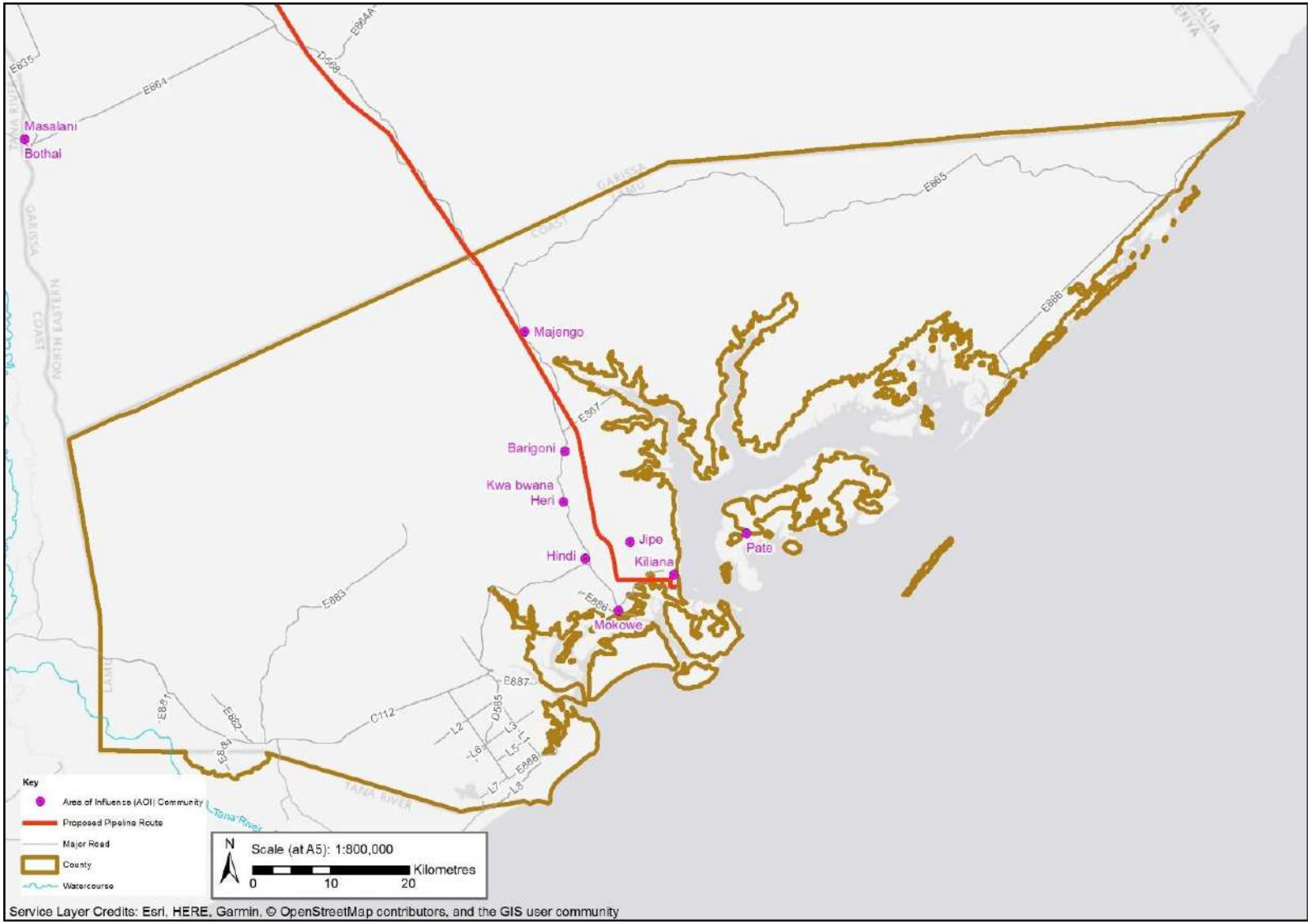

Figure 10: Lamu County

2.4.6.1 Administrative and Governance Structure

Lamu County is administratively divided into two sub-counties- Lamu West and Lamu East, seven divisions, 23 locations and 38 sub-locations which are shown in (Appendix D) (LCG 2016). Lamu County also has two constituencies which correspond to the sub-counties, and 10 county assembly wards, which represent the political units for the county. The Project crosses Lamu West Sub-County (Table 96).

Table 96: Lamu County Administrative Units traversed by the Project

Sub-County	Division	Area (km^2)	No. of Locations	No. of Sub-locations
Lamu West	Amu	99.7	4	6
	Hindi	1150.8	2	4
	Mpeketoni	1727.7	6	10
	Witu	975.4	2	4
Total		2703.1	14	24

Source: LCG 2016

The proposed Project is located in Lamu West which is the primary focus of the socio-economic baseline report. The Area of Influence (AoI) communities most likely to experience socio-economic effects from the Project in Lamu West are listed in Table 97, including their distance from the pipeline route. The closest community is Kiliana, located 0.7 km from the pipeline route. Focus groups were conducted with the local government, department of agriculture, education, water and sanitation, and local business, fishers, beekeepers and pastoralist groups, and elders, women and youth in most of these communities. Focus groups were not conducted in Majengo or Kwa bwana Heri, due to insecurity.

Table 97: AoI Communities in Lamu County

Sub-County	Community	Distance from Pipeline (km)
Lamu West	Barigoni	2.1
	Hindi	3.5
	Jipe	2.6
	Kiliana	0.7
	Kwa bwana Heri	3.5
	Majengo	0.8
	Mokowe	4.1
	Pate	11.3

2.4.6.1.1 Local Administration

The Pate community is governed by the chief and a Council of Elders. The main economic activities in the community are mangroves and fishing. Access to resources from the county government is limited. Information on local administration for the other AoI communities was not available.

Most of the women from the AoI communities engage in politics and political decision-making. However, the women in Hindi and Barigoni are not permitted to participate in politics (e.g. campaigning) because of cultural norms and the perception that they lack power to lead the community (Focus Group, Women, Hindi 2018; Barigoni 2018; Appendix B). The youth from Kiliana are interested in politics and enhancing their understanding of their rights and the issues affecting the community (Focus Group, Youth, Kiliana 2018). The youth from Barigoni and Pate are actively involved in politics, including voting for leaders who advocate for development in their communities, and acting as peace ambassadors in their communities (Focus Group, Youth, Barigoni 2018; Pate 2018; Appendix B).

2.4.6.2 Population Demographics

According to the 2009 national population and housing census, the population of Lamu County was 101,539, representing an increase of approximately 29,000 people from 1999 (LCG 2016). Lamu West has a larger population than Lamu East. Table 98 below provides the 2009 population count and population projections based on the county's predicted population growth of 3.3% (LCG 2016). More recent demographic data on Lamu County is unavailable as detailed county level statistics are only published every ten years in the national census.

Table 98: Total Population of Lamu County

Sub-County	2009 Census		2012 Projections		2015 Projections		2017 Projections	
	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)	Population	Density (km^2)
Lamu West	82,698	21	91,421	23	101,065	26	111,726	28
Lamu East	18,841	8	20,828	9	23,025	10	25,454	11
Total	**101,539**	**16**	**112,251**	**18**	**124,092**	**20**	**137,180**	**22**

Source: LCG 2016; Note: Population figures are presented with a note of caution about data reliability as the nature of moving pastoralist communities makes it difficult to accurately count population figures.

Lamu County has a relatively young population, and in 2009, the majority of the population (76.5%) was below 35 years of age, a trend which was projected to continue to 2017[94] (LCG 2016) (Table 99). Approximately 54.8% of the population was between 15 and 64 years of age, which represents the labour force, and only 3.4% of the population was 65 years of age and above.

94 Population projections beyond 2017 were not available as the updated Lamu County Development Plan is still in-progress.

Table 99: Population Projections by Age Cohorts

Age Cohort	2009 Census	2012 Projection	2015Projection	2017 Projection
0-4	15,719	17,377	19,210	21,005
5-9	14,559	16,095	17,793	19,272
10-14	12,052	13,323	14,729	16,066
15-19	10,817	11,958	13,220	14,953
20-24	9,597	10,609	11,729	13,118
25-29	8,060	8,910	9,850	10,858
30-34	6,838	7,559	8,357	9,703
35-39	5,649	6,245	6,904	8,023
40-44	4,281	4,733	5,232	6,175
45-49	3,534	3,907	4,319	4,939
50-54	2,906	3,213	3,551	3,977
55-59	2,040	2,255	2,493	2,909
60-64	1,941	2,146	2,372	2,746
65-69	1,051	1,162	1,284	1,524
70-74	1,009	1,115	1,233	1,393
75-79	425	470	519	596
80+	1,005	1,111	1,228	1,249
85+	56	62	68	112
Total	**101,539**	**112,251**	**124,092**	**137,180**

Source: LCG 2016

The main urban centre in Lamu County is Lamu town, which had a population of 16,833 in 2009, constituting 16.6% of the county's overall population (LCG 2016). Approximately 72% of the county population is rural. The community of Pate has a population of 3,720. Population data for the other AoI communities was not available.

Table 100: Population Projections by Urban Centre

Urban Centre	2009 Census	2012 Projection	2015 Projection	2017 Projection
Lamu	16,833	18,609	20,572	21,994

Source: LCG 2016

2.4.6.3 Ethnicity and Language

Languages are a fundamental part of Lamu culture and heritage. Numerous languages are spoken in Lamu due to the cosmopolitan nature of the county and its rich history of trade with Middle Eastern and Asian countries. However, Kiswahili has emerged as a unifying language among the people of Lamu.

There are several ethnic groups in the county, namely, Giriama, Mijikenda, Swahili, Mount Kenya, Pokomo, Kamba, Luhya, Arab and Somali. Bajuni is the dominant ethnic group in Lamu County. Swahili is the national language of Kenya and is also spoken in the Lamu County, together with Banjuni language.

The Boni people (also referred to as Awer) live in the forested corridor between the Boni and Dodori National Reserves, and southwest of the Dodori Reserve towards the tip of the Dodori Creek known as the Boni-Lungi forest (Doyle 2011). They depend on resources in forested lands between are inhabitants of the forest Dodori and Boni National Reserves for collecting natural fruits, honey, plants for traditional medicine and building materials They identify as Muslim but maintain sacred shrines to protect the sacred world. There are about 3,500 Awer people, and they are one of the most marginalised people in the Kenya, threatened with losing their land and livelihoods. They have occupied traditionally held land for over one thousand years and have been considered "squatters" without legal standing to advance their social and economic aspirations (Nunow 2012). They have been denied resource rights in the gazetted reserves despite these rights being provided for by law, for example, community members that live and gather fruits and honey in Dodori National Reserve are harassed by the wildlife management officials and often arrested and prosecuted (Nunow 2012).

2.4.6.4 Social Organisation

The elders in the AoI communities are highly respected and act as a bridge between the government and the community. They control security, settle disputes and inform the community about government developments projects and the benefits thereof. Traditional healers play an active role in most communities and use natural resources and herbs for healing. In Hindi, individuals use and pay for their services as an alternative to doctors. In Pate and Barigoni traditional healers work as volunteers and are not paid for services.

Women are generally responsible for fetching water, firewood, cooking and doing other household chores. Children help with household activities such as fetching water, firewood, cooking and cleaning. Girls help to wash clothes, look after siblings and sell vegetables. Boys are expected to fetch water, look after the cattle and poultry and watch farms to prevent wildlife from destroying crops.

In a typical two-parent family, the decision-making is carried out by the head of the household, usually the husband, but if no husband is present, the woman is the sole decision-maker. In Mokowe, women are responsible for family expenditures, including paying for food and school fees, but in Pate, the men pay for household costs. In other communities, both men and women contribute to household expenditures. Single women are not stigmatised in their communities, but they generally receive no support from the government and face challenges as the sole income earners in their families (Focus Group, Women, Mokowe 2018, Kiliana 2018, Jipe 2018, Hindi 2018, Barigoni 2018, Pate 2018; Appendix B). In Barigoni, single women receive help from non-governmental organisations (NGOs) such as World Vision and they also depend on their relatives for support (Focus Group, Women, Barigoni 2018; Appendix B).

Women participate in various social groups in their communities. In Kiliana, adults generally do not support the advancement of youth (Focus Group, Youth, Kiliana, 2018; Appendix B). However, youth are engaged in social activities and self-help groups that they actively participate in. The youth in Barigoni and Pate are play important roles in their communities, and are engaged in awareness campaigns for education, drug abuse and HIV/AIDS. In 2016, a disabled self-help group in Pate formed to empower disabled people, create community awareness and assist each other economically (Focus Group, Disabled Self-help 2018; Appendix B). The group has over 15 people, consisting of both adults and children. They receive some financial support from the community, the county government and donors.

2.4.6.5 Economic Base

The economic activities in Lamu County are agriculture, livestock, fisheries, forestry, mining and tourism (MoALF 2018b). Agriculture is the main sector of the county, engaging 73% of the population and contributing 90% of total household incomes. Other sources of household income for the county include tourism (5%), wage employment (2%) and urban self-employment (1.5%) and rural self-employment (1.5%). Seventy-two percent of the county population is rural, therefore most of the labour force works in agriculture.

The key sub-sectors under the agriculture sector are crops and livestock. The main crops grown are maize, cowpeas, dolichos, cassava, pigeon peas, and green grams. Mangoes, coconut, cotton, bixa, and simsim are produced for commercial purposes. Cotton production remains the highest source of income for households, contributing 42% to household incomes, and followed by banana (14%), maize (8%), cassava (7%), bixa (6%) and mangrove (5%). Those living in the Lamu peri-urban areas practice subsistence farming (LCG 2016). Cattle, sheep, goat and poultry are the most common livestock reared in the county. Cattle and goat rearing is mainly found in Hindi and Witu, and dairy cattle farming and rearing is practiced primarily in areas of Mpeketoni and parts of Hindi and Witu (LCG 2016). Thirty percent of the county's population depends on livestock directly or indirectly (GoK 2017).

Beekeeping is also practiced in the county. Fishing is also an important economic activity in the county providing food and employment, and it engages 3,500 artisan fishermen (MoALF 2018b). The County produces over 1,500 metric tons of fish annually valued at KSh111.8 million, of which 85% is from marine fishing and 15% is from fresh water fishing (LCG 2016). The gazetted forest area in Lamu is about 50,093.4ha of land 85% of which is of mangrove forests. Some communities in Lamu, such as the Bajuni, depend on mangrove harvesting as their main source of income (GoK 2017). The Boni people also depend on the forest as a source of food and they also sell honey and other wood products (MoALF 2018b). The main forest product includes the mangrove poles used for construction of houses and boats, and others include fuel wood, fire wood, seedlings, charcoal and casuarinas poles (LCG 2016). The county is also rich in minerals like titanium, salt, limestone, coral stones, sands and cement.

The county has a very underdeveloped commerce and industry sector, with no manufacturing industry in the county (LCG 2016). Small scale cottage industries include bakers, flour makers, oil processors, furniture makers and craftsmen. Challenges within the industry and commerce sectors include the lack of infrastructure such as electricity, good road network and reliable markets. There are also traders in small scale retail and wholesale shops. The 2009 recorded 857 registered retail traders, and 29 registered wholesale traders spread among 22 trading centres. Main trading centres with electricity include Lamu, Faza, Shela, Mpeketoni, Hindi, Mokowe, and Witu (LCG 2016).

The economic activities of the women from the AoI communities vary but are generally related agricultural activities and small businesses. The women from Mokowe and Kiliana buy and sell fish locally during the rainy season. The women from Mokowe and Jipe look after chicken during the dry season, goats and also engage in garden farming, growing and selling Sukuma wiki (colewart), pili (chilies) and spinach. Other vegetables, cashews and cotton are also sold in Jipe, and the women from Barigoni also engage in group farming. Women

participate in merry-go-round[95] or micro-finance groups that assist them in starting businesses and other projects (Focus Group, Women, Kiliana 2018, Hindi 2018, Barigoni 2018; Appendix B). The women from Pate are not involved in any economic activities and receive no income from the fishing industry (Focus Group, Women, Pate 2018; Appendix B). They depend on the earnings of their husbands who are fishermen.

Youth from Kiliana are self-employed and engaged in selling trees from nurseries, and some are involved in the *boda boda* (motorbike) business. They receive some assistance from Kikozi Lamu Court to buy beehives and contribute to tree nurseries. There are no formal employment opportunities available for youth in Barigoni, and they are engaged in farming, bee keeping and fishing to earn income. Youth from Pate are also engaged in merry-go-round groups which contribute funds to enable youth to start small businesses selling bread, fish and other items. The profits are then shared among group members.

2.4.6.6 Employment

The county's total working population (15-64 years) is 68,026 which represents 54% of the population and slightly more than half of the labour force is male (52%) (LCG 2016). Most of the workforce is unskilled with only a small proportion engaged in fishing, boat making, wood carving and embroidery. Approximately 46% of the workforce is literate, suggesting that only a small proportion can be absorbed as skilled labour (LCG 2016).

There are no formal employment opportunities for women in the AOI communities, but they engage in self-employed agricultural activities and small businesses. There are also few employment opportunities for youth, and most of them are self-employed in small businesses such as *boda* (motorbike services), farming, bee keeping, painting boats and fishing. Although jobs are available in Pate, youth find it difficult to benefit from these opportunities because of corruption (Focus Group, Youth, Pate 2018; Appendix B).

The Hindi business group encourages and supports small-scale businesses and advises people on good business strategies and how to grow (Focus Group, Business, Hindi 2018; Appendix B). The group also participates in cleaning the environment and planting trees around the community. Businesses are unsuccessful due to security threats which scare away investors, and because of marginalisation, and lack of information on new developments to allow locals to obtain access to tenders and employment opportunities.

2.4.6.7 Social Infrastructure

2.4.6.7.1 Education

Lamu County has 150 Early Childhood and Development (ECD) centres, most (132) of which are in Lamu West. There are 92 primary schools and 19 secondary schools, with 71 and 16 located in Lamu West, respectively. There are two youth polytechnics in the county, including Mpeketoni Polytechnic and Lamu Youth Polytechnic which was recently established as a constituent college of Mombasa Polytechnic. In addition, the county has set aside land for two proposed universities. There are also 58 adult learning centres; however, there are no adult education centres in the Jipe area (Education Focus Group, Jipe, October 26, 2018).

Approximately one third (32.8%) of the population in Lamu County has no formal education (KNBS and SID 2013f). In Lamu West Sub-County, just over half (55.2%) of the population have primary education only, and only 14.6% have secondary education or higher, which are slightly higher proportions than the county overall. The population of Lamu County have slightly lower levels of educational attainment compared to the national average (Table 101). Approximately 67.3% of the county population can read and write (LCG 2016).

95 A group in which members pay a certain amount of money every week or month and the money is then used by the group to invest, give member loans or pay them monthly dividends from their micro-savings

Table 101: Educational Attainment in Lamu County (2009)

County/Sub-County/Wards	None (%)	Primary (%)	Secondary+ (%)	Total Population
Lamu West	30.3	55.2	14.6	75,527
Shella	35.1	49.3	15.6	2,653
Mkomami	34.1	48.8	17.1	16,830
Hindi	32.5	54.8	12.7	8,980
Mkunumbi	28.2	59.1	12.1	10,581
Hongwe	21.8	65.0	13.3	8,077
Witu	44.1	47.9	8.0	11,331
Bahari	18.2	61.4	20.4	14,075
Lamu County	32.8	53.9	13.3	89,394
Kenya	25.2	52.0	22.8	34,024,396

Source: KNBS and SID 2013f

The enrolment rate for pre-school in the county is high, at 92.6%, but drops significantly by secondary school (Table 102). The 2009 census recorded the primary school completion rate in Lamu County as 61%, and a transition rate of 73% from primary to secondary school (LCG 2016). The secondary school completion rate is 94%. The total enrolment at both polytechnics in 2012 was 1,200 students. Most schools in Lamu County have inadequate facilities such as laboratories (LCG 2017). Many schools have no facilitates to effectively educate children with disabilities, which affects access and enrolment opportunities. Furthermore, Lamu County does not have a public library to promote effective knowledge and information flow.

Table 102: School Enrolment for Lamu County

Pre-School (2014)		Primary (2014)		Secondary (2014)		Tertiary (2012)	
Net Enrolment	Teacher/ Student Ratio	Net Enrolment	Teacher/ Student Ratio	Net Enrolment	Teacher/ Student Ratio	Net Enrolment	Teacher/ Student Ratio
92.6%	1:23	74.7%	1:30	42.7%	1:18	3%	n/a

Source: LCG 2016; n/a = not available

Children typically start pre-school at age three and primary school between the ages of four to six. Challenges such as distance to school, poverty, family break up and insecurity affect school attendance and children frequently drop out of school between the ages of 10 to 15. In November 2018, the Pate girls secondary school opened but some families from Kiliana have moved to Lamu Island because of a lack of schools in their community. Other families have been forced to migrate frequently between communities due to security threats, which prevents children from staying in school (Focus Group, Women, Hindi 2018; Appendix B). Girls typically drop out of school because of early marriage due to poverty. School fees are KSh 500 per child per month, which is a challenge for some families facing poverty (Focus Group, Education, Jipe 2018; Focus Group, Youth,

Pate 2018; Appendix B). The youth in Kiliana receive assistance from Kikozi Lamu Court which contributes KSh 200 per month to their school fees (Focus Group, Youth, Kiliana 2018; Appendix B).

There are NGOs (i.e. World Vision) that provide some support in the form of donations, such as school chairs and uniforms, and training of ECD teachers; however, schools continue to lack equipment and trained teachers, and parents who are uneducated do not value children's education highly (Focus Group, Education, Jipe 2018; Appendix B). Similarly, the youth from Kiliana and Barigoni feel that education is not valued highly by adults (Focus Group, Youth, Kiliana 2018, Barigoni 2018, Appendix B). The youth in Barigoni and Pate are engaged in awareness campaigns for education in their respective communities.

2.4.6.7.2 Health Services

Lamu County has four level 4 hospitals, seven level 3 facilities (health centres), 31 level 2 dispensaries, and 18 level 2 medical clinics (Shape Consulting Ltd. 2019; Appendix A). There are 13 medical officers, 172 nurses, 36 registered clinical officers, one dentist, five pharmacists, three physiotherapists, five nutritionists and one mortuary attendant (LCG 2017). The health facilities in Lamu are owned by government or faith-based and NGOs, or privately owned. The county has insufficient qualified medical personnel with a doctor to patient ratio of 1:9,000 which is inadequate compared to the ration of one doctor for every 1,000 patients recommended by the World Health Organisation (LCG 2017). The county also has inadequate access to healthcare, with the average distance to the nearest health facility being 5 km.

The five most prevalent diseases in the county are malaria (63.3%), upper respiratory tract infections (23.7%), stomach-ache (9.7%), diarrhoea (3.8%) and flu (0.5%). The total number of children under one year who are fully immunised is 71%. Overall, 64% of Lamu households have access to family planning services (County Government of Lamu, 2013).

Table 104 presents the health system challenges in Lamu County. The primary challenges are due to high demand for services (especially for communicable and non-communicable diseases), inadequate resources (water infrastructure and healthcare infrastructure) and service delivery (difficulties in reaching small islands). Additional information on baseline health conditions in Lamu County is discussed in Appendix A: Community Health Baseline Report.

Table 103: Health System Challenges in Lamu County

	Challenges	Contributing factors
Lamu	■ Increasing burden of NCDs ■ High burden of communicable diseases ■ Maternal health challenges ■ Inadequate health infrastructure ■ Inadequate medical supplies and consumables ■ Accessibility challenges ■ Poor access to safe drinking water (in rural areas)	■ Changes in diet and lifestyle ■ Overcrowded settlements in some areas (especially Lamu Island) ■ Insecurity especially in Lamu East ■ County is made of several small islands (65 in number) some of which are hard to reach. ■ Poor road network

Source: Baseline KIIs in Appendix A

Women and other members from the AoI communities are generally aware of the causes, prevention and treatment of HIV (Focus Group, Women, Mokowe 2018, Kiliana 2018, Jipe 2018, Hindi 2018, Barigoni 2018, Pate 2018; Appendix B). There are ongoing HIV awareness campaigns in some of the communities which are sometimes carried out by youth.

In Mokowe, family planning is typically not practiced in the Swahili culture, and women are expected to give birth until the end of their child-bearing years (Focus Group, Women, Mokowe 2018; Appendix B). There are no dispensaries in the Kiliana area, and some families have moved to Lamu Island to access health services. Family planning services are therefore only available for women who have the finances to travel and pay for consultation. Access to family planning services is available in Jipe, Hindi, Barigoni and Pate.

The most common source of protein consumed in households in the AoI communities is fish which is consumed frequently in Mokowe and Kiliana, but only occasionally in Jipe. Chicken is the main source of protein in Hindi, which is frequently consumed, but it is only occasionally consumed in most other communities. Households in Jipe also occasionally consume beef. Rice, milk and yogurt are also an important component of diet for the households in the AOI communities.

2.4.6.7.3 Housing

In 2009, there was a total of 22,184 households in Lamu County (KNBS and SID 2013f). The average household size consists of seven people. The most common wall material used in the county is mud/wood (46.9%) followed by brick/block (18.9%) which are predominantly houses found in the main trading centres (LCG 2016).

Commonly used roofing materials include Makuti (thatch) (34.8%), corrugated iron sheets (36.6%), and grass (16.4%). Most households in rural areas have an earth floor (62.3%), and a smaller proportion of households construct cement floors (37%), which are households that are mainly located in the trading centres (LCG 2016). Several factors influence the type of housing, including the availability of raw materials, culture, climate and settlement patterns (LCG 2016).

2.4.6.7.4 Security

Security provision is through the central government office of the Ministries of Internal Security and Defence. The county government has therefore little capacity to deal with security issues in the region, which are typically in areas that are less accessible i.e. poor road infrastructure and conditions, forest thickets and intermittent development areas. Areas of resource competition such as pasture and water create a security threat and result in potential livelihood conflicts (LCG 2017). Rural areas in Kenya have high rates of crime, and inter-ethnic or inter-clan resource-based conflict is experienced in pastoral areas within Lamu County.

Insecurity in Lamu County began in 2011 when a British tourist was abducted by suspected Al-Shabaab militants from Kiwayu Village Resort in Lamu East (Kazungu 2017). Since then, Lamu County has had numerous attacks, the worst case being that of the terror attack in Mpeketoni on June 15, 2014. Over 100 people were killed by Al-Shabaab militants and property worth millions destroyed in Mpeketoni, Hindi, Kibaoni, Witu, Baure, Mangai and Basuba that year. Al-Shabaab claimed responsibility for the attacks, explaining that they were revenge for the Kenyan government's actions in Somalia; however, their greater strategy emerged - to entrench divisions and mobilise support over localised issues – which it applied in several parts of Kenya over the following year (Nyagah et al. n.d.). In response these attacks, the national government launched a multi-agency security operation dubbed 'Linda Boni' whose major objective was to flush out Al-Shabaab militants believed to be hiding inside the dense Boni forest.

As of October 2018, Al-Shabaab maintains a base of operations in Boni Forest despite a three-year Kenyan military operation to clear the area (Barnett 2018). It uses the base to prepare attacks in Lamu County and southern Garissa County. Al-Shabaab's IED campaign throughout the Kenya-Somali border zone has weakened Kenyan security forces.

2.4.6.8 Physical Infrastructure

2.4.6.8.1 Water

The county has four major catchment areas, including Dodori, Coastal zone, Duldul, the Lamu Bay drainage and Tana River catchments (LCG 2016). There are no permanent rivers in the county, but only a few seasonal streams which flow from the west towards the south eastern part of the county. The only permanent open water site in the county is Lake Kenyatta in Mpeketoni which at times dries up during exceptionally dry years. The county also has several swamp areas which are supplied by rain water.

There are three major rainfall zones, including the arid areas along the northern borders, mainly Kiunga, which receives rainfall below 540 mm annually; the semi-arid areas of Amu, Faza and Kizingitini Divisions which receives between 550 mm - 850 mm of rainfall annually; the sub-humid zone covering areas of Witu and Mpeketoni Divisions receiving rainfall between 850 mm-1,110 mm annually (LCG 2016). There are typically two rainy seasons-the long rains occur from mid-April to the end of June, and the short rains occur in November and December.

There is an inadequate supply of clean water in many parts of Lamu County (LCG 2017). Available sources of fresh water are experiencing pressure of over utilisation, inadequate quantity due land use practices and other sources contain water that is unsafe for human use. The county is experiencing rising demand for water because of rapid population growth and urbanisation. People rely on shallow wells that have high salinity levels, which poses a major problem for residents since they have access to little fresh potable water. There are several lakes where clean water can be collected from but even those are under threat, including Lake Amu (LCG 2017). The numerous water catchment areas and wetlands in Hindi ward are also under threat because of the encroachment by people, which leads to decreasing water quantity. The main sources of water in the county are groundwater, surface water, rainfall and desalination of sea water (LCG 2016). Ground water is used for most water supplies in Lamu County, but most areas have saline groundwater. Surface water sources include the sea, lakes, pans, dams and seasonal rivers. Water in the county is managed by different companies (LCG 2016).

Lamu Water and Sewerage Company manage Lamu and Mokowe water systems, and Lake Kenyatta Water Association supplies water to Mpeketoni Division. Hindi Water Association and Witu User Association manage water supplies in Hindi and Witu Divisions, respectively, and are community-based schemes. Other public water sources such as djabias and dams are managed by community committees. Rain harvesting structures are used to collect water for domestic use and desalination of sea water is mainly done by private individuals and in hotels because the process is costly. The average distance for a household to access clean water in the county is 5 km, and the prevalence of waterborne diseases is 20% (LCG 2016).

Water is supplied for household consumption in the areas of Hindi and Magogoni. In Jipe, ground water is the primary source of water, which is accessed through boreholes and pipelines rising from wells to elevated tanks. The distribution line extends for 10 km from the main tanks to consumers. There are three types of water supply in Lamu County, including private connection, communal water points and water tracking. Areas such as Mkondoni, Sina Mbio, Bora Imani, Mokowe and Barigoni use a water tracking system. Water boozers are provided by the county government and National Government and the water is drawn from the Hindi Magogoni Water Association (HIMWA) at Hindi station. The cost of water from the water boozers supplied from HIMWA is 4 KSh per 20 litre jerry-can. There are challenges in the distribution of water to all consumers, due to a lack of funding and other factors.

Water is mainly collected from boreholes in Mokowe and used for livestock and community members. Community members often have to collect water at night because of the congestion at boreholes (Focus Group, Women, Mokowe 2018; Appendix B). Water is occasionally supplied by non-governmental organizations, and piped water can be bought for KSh 30 per jerry. Livestock herders from Mokowe source water from boreholes,

seasonal dams and ponds for their cattle. Livestock herders from Hindi obtain water from seasonal dams during the rainy season and buy water from HIMWA during the dry season. Piped water is available and distributed to the community and surrounding area, and kiosks supply water to the public for a fee of 4 KSh per 20 litres of water (Focus group, Water and Sanitation, Hindi 2018; Appendix B). Water tanks are supplied to the community and schools. Table 104 shows the main sources of water for the AoI communities of Mokowe, Hindi and Jipe. Data for the other communities was unavailable.

Table 104: Water Supply in the Project Area

Community	Water Supply*	Season
Mokowe	■ Boreholes (pastoralists and community) ■ Seasonal dams (pastoralists) ■ Ponds (pastoralists) ■ NGO (community) ■ Piped water (community)	n/a
Hindi	■ Seasonal dams (pastoralists) ■ Hindi Magogoni Water Association (HIMWA) ■ Piped water (community) ■ Kiosks ■ Water tanks	Rainy season Dry season
Jipe	■ Hindi Magogoni Water Association (HIMWA) (pastoralists) ■ Boreholes (community) ■ Piped water (community)	Rainy season (seasonal dams) Dry season (HIMWA)

Source: Focus Group, Women, Mokowe 2018; Focus Group, Livestock Herders, Mokowe 2018, Hindi 2018; Focus Group, Water and Sanitation, Jipe 2018, Hindi 2018
n/a not available
**Data was not available for the other communities*

2.4.6.8.2 Sanitation and Waste

There are numerous inadequacies with solid and liquid waste disposal management and human waste disposal in the county (LCG 2017). There are few dumping sites resulting in the careless dumping of waste in the county. In Bahari ward, there is no dumping site and inadequate personnel to keep the town clean. There is no sewer system in Mkomani, Bahari and Hindi wards, and therefore the communities rely on pit latrines, which poses a health risk since the latrines are situated near shallow wells. This increases the chance of the water mixing with waste, which when consumed leads to an outbreak of diseases. In Hongwe ward there is no sewage plant. Sanitation and the management of landfills are the responsibility of the Ministry of Health and the County Government.

In 2008, 77.5% of households in the county had access to increased sanitation infrastructures with pit latrines (covered and uncovered) (LCG 2016). The methods for disposing both liquid and solid wastes are disposal pits and sewerage pits. The prevalence of water borne diseases is 20% in the county.

2.4.6.8.3 Energy Sources

Currently Lamu County has a variety of energy sources both for domestic, commercial and industrial use. Firewood (70.9%) and charcoal (22.8%) remain the main source of energy used for cooking purposes. Other sources include electricity, gas (LPG) and paraffin which are consumed mostly in the urban centres. The main source of lighting in the county is paraffin, used by 72% of households. Other sources of lighting include fuel-wood, electricity, solar and gas. Table 105 summarises the source of energy for cooking and lighting in the Lamu County.

Table 105: Energy Sources in Lamu County

Activity	Source	Households
Cooking	Liquefied petroleum gas (LPG)	1%
	Paraffin	3%
	Firewood	71%
	Charcoal	23%
Lighting	Electricity	17%
	Lanterns	33%
	Lamps	39%
	Fuel	2%

Source: KNBS 2009

2.4.6.8.4 Transportation

The road network in most wards of the county is good, linking various human settlements within Lamu County (LCG 2017). Despite a good network, the roads are in poor condition which often limits accessibility to those areas. Other wards such as Mkomani, Basuba and Kiunga have a poor road linkage and their accessibility by road is highly limited. The county's physical infrastructure has remained underdeveloped (LCG 2016). Lamu County has a total road network of 6,886 km with only 6 km of tarred road surface, which makes most of the roads impassable during the rainy season. The main roads in the county are the Mokowe-Garsen and Mokowe-Kiunga roads.

The main Class C road from Mokowe to Witu is in a poor condition and often floods, and large potholes make the road impassable for small vehicles (LCG 2017). This is the main economic corridor of the county and needs the most immediate intervention if the economic potential of Lamu is to be realised. Other Class D roads connecting to Mpeketoni from Mkunumbi; and Kibaoni and to Bodhei from Hindi are also poorly maintained. These are agriculturally rich areas where improvement in the roads will enhance accessibility to market.

There are eight main jetties in the county which are mostly found in Amu Division, including Amu, Mokowe, Manda, Matondoni, Lamu Customs, Fisheries and Hospital jetties (LCG 2016). Amu and Mokowe jetties are in fairly good condition and are used by passengers, fishermen and for loading goods. Lamu Customs and Matondoni jetties are under rehabilitation, but all the other jetties are in poor condition. The Lamu–Faza seaway is a major transport route in the county but the dredged part near Manda remains a dangerous part for sea users due to unfinished construction work which stalled in 2005.

The county has 13 airstrips; 11 public and two private (LCG 2016). Manda airstrip is the main facility used by passengers in the county and is fairly well-maintained.

2.4.6.8.5 Communication

Most areas in the county have poor network connectivity estimated at approximately 60% (LCG 2016). The poor network connectivity is particularly prevalent in Kiunga and Basuba Wards and also parts of Witu and Hindi Wards. Poor communication results in a lack of development, with business activities rarely occurring in these areas (LCG 2017). Internet access is only available to 15% of the county (LCG 2016). Radio and television access also remain poor and the Kenya broadcasting cooperation, Radio Rahma and Radio Jambo are signals received in the county without the use of a satellite dish. The county has five branches of the public post office evenly distributed across the county, and private couriers that also operate in the county (LCG 2017).

2.4.6.9 Land and Resource Use

2.4.6.9.1 Land Ownership

The county has a land surface area of 6,273 km^2 with 5,517 km^2 of arable land, 650 km^2 of non-arable land, 130 km^2 coastline and 308 km^2 under water mass. The land surface area in Lamu West is 3,971 km^2 (63%). The bulk of arable land is in Lamu West while most of the water mass is in Lamu East (LCG 2016).

Approximately 13,000 households in Lamu County have title deeds, meaning only 42% of households own land (LCG 2016). Most county residents who have no title deeds live on ancestral land as squatters. The county experiences poor land use with the establishment of unplanned villages placing increasing pressure on existing social services (LCG 2016). A large portion of land in the county remains unregistered. These include areas in Kiunga, Faza, parts of Hindi, Manda Island, Witu and Bahari, which are mostly ancestral land. The government is working on resettlement in these areas, with the goal of also conserving the Swahili communities in the county. A large portion of land is set aside for ranches, but they remain under resourced and many are not in use. Landlessness, land ownership and squatter occupation is a large concern for the communities such as the Swahili, Arabs, Korei, Aweer and Orma, and an ongoing source of conflict between farmers and livestock herders.

Most community members in Kiliana follow Islam Sharia Law which defines the inheritance for children, and also permits women to own land (Focus Group, Agriculture, Kiliana 2018; Focus Group, Women, Kiliana 2018; Appendix B). Parents also purchase land for their adult children. In Pate, there is no communal land available, and both men and women are able to own land, but in Hindi and Barigoni, the men own the land. In Jipe, there is no communal land available for use, and squatters are allocated land by the government. Land is shared with their adult children.

2.4.6.9.2 Fishing

The fishing industry is the economic backbone of Lamu County, with 75% of communities depending on fishing for their livelihoods either directly or indirectly (LCG 2019). Fishing is practiced for subsistence and commercial purposes. The annual fish production for the county is estimated as 2,500 metric tonnes valued at KSh 180 million; however, approximately 40% of the district's productivity is exported each year to areas outside the county.

Fishing in the county consists of marine in-shore and fresh water fishing (LCG 2016). Marine in-shore fishing is carried out in 3,100 km^2 of territorial marine water and extending 144 km from Dar-es-salaam in Kiunga to Ras Teweni. Freshwater fishing is concentrated in channels, ox-bow lakes of Tana River and other inland water bodies. Along the coast, the local communities are well-known for their fishing skills as well as skills in boat building, sailing and other marine activities (MOT 2013). The fishing grounds within 5 nautical miles (NM, 1.15 miles) offshore are mainly utilised by the artisanal fishers, while industrial fishers with seine and long line boats fish beyond 5 NM (MOT 2013). The fisheries sector in Lamu County supports approximately 3,500 artisan

fishermen who use various fishing techniques, including hand lining, gill-netting, trapping and diving (LCG 2016). Fishing is more intense during the Northeast monsoon (September to February) when the sea is calm and fishermen are able to access their fishing grounds more safely. In addition, migrant fishers from outside Lamu County also arrive mostly during the Northeast monsoon season (MOT 2013).

Fish landing sites are important infrastructure that supports the fishermen and other fisher community operations at the beach (MoALF 2014). There are legally gazetted landing sites and most of them have been lost due to coastal developments and fishers have introduced many other informal landing sites. The proliferation of these informal sites is influenced by numerous factors, including socio-cultural reasons, availability of land, travel routes and proximity to fishing grounds, access to markets and availability of enabling infrastructure (MoALF 2014). In 2014, there were 28 landing sites recorded in Lamu County, 15 of which were located on islands. The main fish landing sites in Lamu County are presented in Table 106, excluding sites at Mpeketoni and Witu.

Table 106: Fish Landing Sites in Lamu County

Division	Landing Site
Faza	Dodori, Shanga Ishakani, Shanga Rubu, Tchundwa, Rasini, Pate
Kiunga	Kiunga Kiunga, Mkokoni
Kizingitini	Kiwayu, Ndau, Mbwajumwali, Kizingitini
Amu	Langoni (Amu), Shella, Mkomani (Amu), Matondoni, Kipungani
Hindi	Ndununi, Mokowe

Source: Fisheries Department Frame Survey 2006

The trends in fishing effort in terms of the number of fishers, fishing crafts and fishing gears in Lamu County has been captured based on the frame surveys that were conducted by the Fisheries Department in 2004, 2006, 2008, 2012 and 2014. The number of fishers in Lamu County in 2014 was 2,880, an increase of 26% from 2004 (MoALF 2014). Similarly, the number of fishing crafts increased approximately 25% from 2004 to 2014 when 523 fishing crafts were recorded in the county. Fishers recorded as foot fishers increased from 140 to 224, from 2004 to 2014, respectively. The majority of fishing crafts used in 2014 were non-motorised sail boats, constituting 80.1% of all craft types. Another 8% of crafts had outboard engines, 2.1% had inboard engines, and the remaining fishing crafts used poles or paddles. The main type of fishing gear used by fishers include gill nets, hand lines, beach seines, long lines, fence traps (uzio) and basket traps (malema). In addition, diving masks are used to fish for lobsters (MOT 2013). Production in the county is low because of a lack of fishing equipment and the government plans on introducing cage fishing to increase catches and foster sustainability (LCG 2016).

Fishery is managed by the technical arm of the Ministry of Fisheries Development, the Fisheries Department. To promote co-management in the fisheries sector, the Fisheries Department established Beach Management Units (BMU) in all the main fish landing beaches (MOT 2013). The key responsibilities of the BMU include law enforcement, such as registration of boats, enforcement of gear regulations and protection of fishing grounds; beach development; collection of fisheries data; conflict resolution and welfare issues and handling of emergencies (IOC 2011). Currently there are about 73 BMUs in coastal Kenya, and there were 19 registered BMUs in Lamu County in 2014 (MoALF 2014).

Fishing is the main livelihood activity in the AoI communities of Mokowe, Kiliana, Barigoni and Pate and fish and crabs are staple foods in these areas. Fishers in Mokowe, Kiliana and Barigoni are organised into formal groups, while fishers in Pate fish individually and some of them are formally employed. The number of registered members in the fishing organisations ranges from 30 to 430 (Table 107). Only the fishing group in Kiliana is managed by a BMU.

Table 107: Fishing Groups and Management System for the AoI Communities in Lamu County

Community*	Name of group	No. of members	Management
Mokowe	Bandari Salam Fisheries group	30	n/a
Kiliana	Zipporah's fisheries	430	Fishers are under the auspices of the Beach Management Unit (BMU)
Barigoni	Crab and lobster fishers Snail fish fishers	Not specified	n/a
Pate	No formal organisations, community members fish individually	n/a	n/a

Source: Focus Group, Fishers, Mokowe 2018, Kiliana 2018, Barigoni 2018, Pate 2018
n/a not available

The fishing industry is also organised according to the species targeted for harvesting, for example, some fishers catch crabs and lobsters, while others catch snail fish, which determines both the area where harvesting occurs, and the type of fishing gear used. The type of fishing crafts varies; some fishers in the AoI communities have access to boats and outboard motors, while other use dhows. Those who have access to boats and outboard motors fish in the deep sea while others fish closer to shore. Fishers move to different areas based on fish catchment quantity and quality. The type of fish that are caught depends on the season and life cycle stage, with fishers moving to different areas to allow fish the opportunity to hatch and mature.

There are approximately 40 fishing grounds in Lamu County with a diversity of fish species (LCG 2016). Figure 11 shows the major fishing grounds in Lamu County.

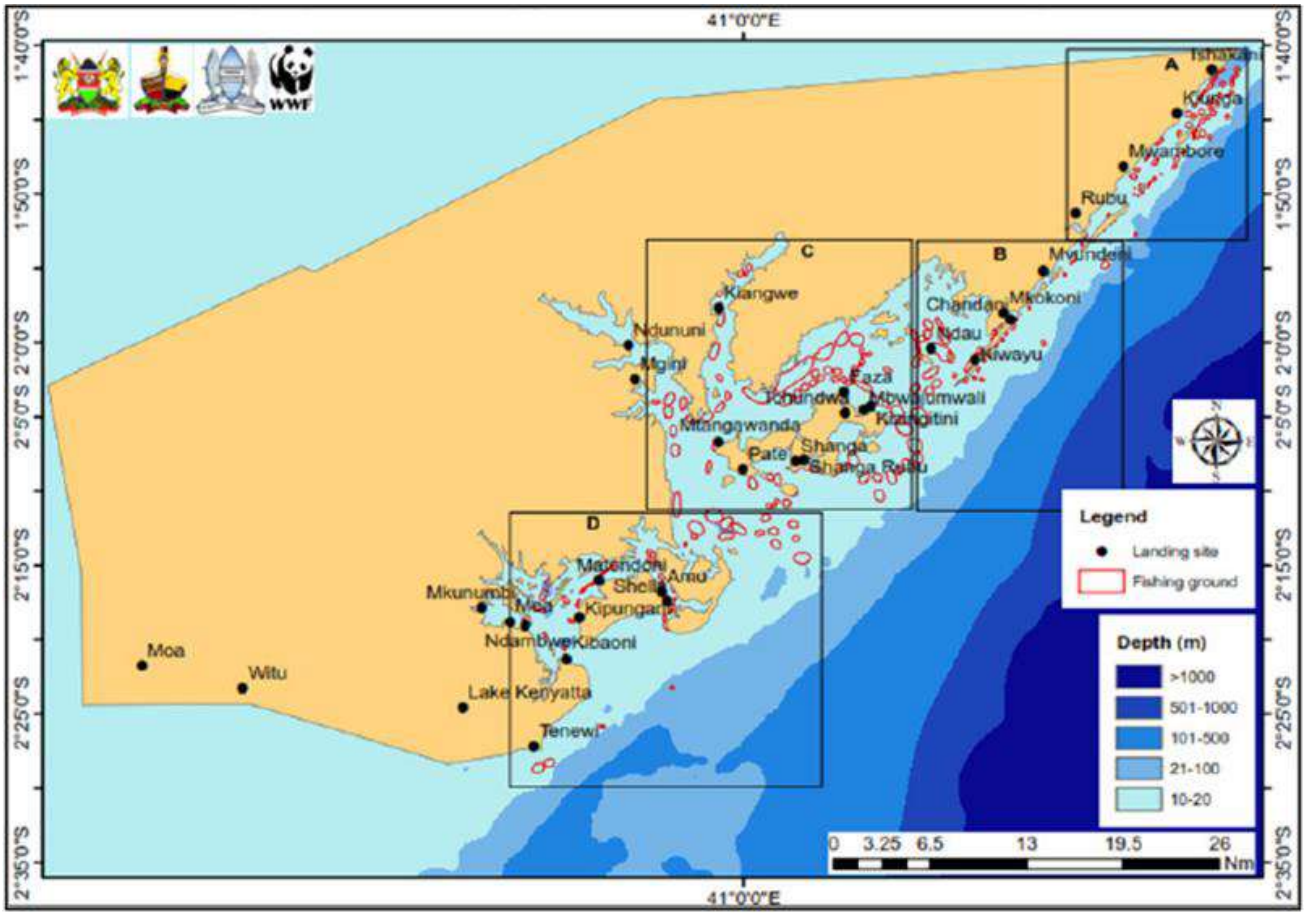

Figure 11: Fishing grounds in Lamu County (Kurrent Technologies 2016)

The main fishing grounds used by fishers from the AoI communities are listed in Table 108.

Table 108: Fishing Grounds for the AoI Communities in Lamu County

Community	Name of group	Fishing grounds	Types of seafood
Makowe	Bandari Salam Fisheries group	■ Ndununi ■ Kiunga ■ Kipungani ■ Kiliana ■ Manda ■ Bruno	■ Crab ■ Lobster ■ Tuku ■ Tafi (rabbit fish) ■ Mbawa ■ Mkizi (bluespot mullet) ■ Tewa (redmouth grouper)
Kiliana	Zipporah's fisheries	n/a	■ Changu (snapper) ■ Tewa ■ Tazanda ■ Tafi ■ Mkizi

Community	Name of group	Fishing grounds	Types of seafood
Barigoni	Crab and lobster fishers Snail fish fishers	■ Ndununi ■ Kibaoni ■ Mngiini	■ Tamamba ■ Red snapper ■ Mkizi ■ Tewa ■ Kaa (crab) ■ Lobster/crabs ■ Prawns
Pate	No formal group, individual fishing	■ Bruno ■ Dudune ■ Wange ■ Kiunga ■ Dodori	■ Tasi ■ Jodari (tuna) ■ Tewa ■ Tamamba ■ Fumi (lemur) ■ Lobster and crabs ■ Prawns ■ Tachawa

Source: Focus Group, Fishers, Mokowe 2018, Kiliana 2018, Barigoni 2018, Pate 2018
n/a not available

According to the fishers from Mokowe and Pate, tourism in the area has opened markets for fishers to sell their produce. The fishers also benefit tourists who hire boats for deep sea touring and fishing. Unfortunately, however, the tourism industry is monopolised by foreign investors who do not contribute to the local community in any significant way. Nevertheless, fishers from Mokowe and Pate reported that they sell their produce to hotels on Lamu Island in addition to the residents. Fishers from Mokowe also sell their catch to the towns of Malindi and Mombasa. Fishers from Barigoni stated there is no tourism in the area because of security issues (Focus Group, Fishers, Barigoni 2018; Appendix B). Fishers from Barigoni and Pate have no access to markets nearby, and transportation costs to markets further away is expensive (Focus Group, Fishers, Barigoni 2018, Pate 2018; Appendix B). During the rainy season the market value of fish is low because of a surplus in the supply of fish, but during the dry season, the demand for fish is high based on the low supply, and the market flourishes (Focus Group, Fishers, Kiliana 2018).

Collectively, the Bandari Salam Fisheries group can catch up to 3 tonnes of fish per day, and each individual can make up to KSh 2000 per day (Focus Group, Fishers, Mokowe 2018; Appendix B). The incomes for individuals varies per job, according to net makers, outboard motor and boat providers. Fishers from Kiliana reported harvesting 200 kg of fish using a fishing line, and 300 kg of fish using a fishing net (Focus Group, Fishers, Kiliana 2018; Appendix B). Table 109 shows the average price that fish and other marine resources are sold for.

Table 109: Marine Resources Sold for the AoI Communities in Lamu County

Community	Type	Volume/ quantity (kg)	Price (KSh/kg
Mokowe	Crab/Lobster	2-5	1,000 KSh/kg
	Tuku, Tafi, Mbawa, Mkizi, Tewa	Up to 200 kg	200 KSh/kg
Kiliana	Changu	500	120-150
	Tewa	400	120-130
	Tazanda	300	120-130
	Tafi	400	120-140
	Mkizi	300	120-130
Barigoni	Tamamba	10	170
	Red snapper	9	170
	Mkizi	7	150
	Tewa	6	150
	Kaa	6	450
	Lobster and crab	6	400
	Prawns	6	400
Pate	Tasi	n/a	n/a
	Jodari (tuna)	n/a	n/a
	Tewa (redmouth grouper)	n/a	n/a
	Tamamba	n/a	n/a
	Fumi (lemur)	n/a	n/a
	Lobster and crabs	5	4000
	Prawns	n/a	n/a
	Tachawa	n/a	n/a

Source: Focus Group, Fishers, Mokowe 2018, Kiliana 2018, Barigoni 2018, Pate 2018; n/a not available

The fishers face numerous challenges which affect their livelihoods. Lack of adequate equipment is one of the most significant constraints facing fishers, including a lack of protection from the rain, and inadequate boats to sustain heavy waves and strong winds, a shortage of machines, nets and fuels (Focus Group, Fishers, Mokowe 2018; Appendix B). Transportation of fish to the markets is a constraint faced by fishers, since fish are perishable, and fishers lack refrigerated vehicles. In some cases, fishermen take low prices to sell the fish before it spoils (MoALF 2018b).

Extension services such as boats, outboard motors, education/capacity building on the fishing grounds, fishing nets, marketing etc. services are provided by the industry, but these are limited. In addition, sea transport using boats to the islands to deliver inputs and extension services as well as produce to the market is expensive (MoALF 2018b). Fishers using traditional methods feel they can no longer compete with competitors, especially those from Somalia and Tanzania who have modern fishing equipment and have been invading the local fish market (Business Daily Africa 2018d). The inputs and costs required for fishing are provided in Table 110.

Table 110: Fishing Inputs and Costs for the AoI communities in Lamu County

Inputs	Cost (KSh)		
	Kiliana	Barigoni	Pate
Nets	8,000	4,000	5,000
Net bundles	n/a	5,000	n/a
Fishing/long lines	1,000	n/a	2,000
Hooks for prawns	n/a	100/hook	500/100 hooks
Cooler Box	n/a	15,000	n/a
Glass (diving)	n/a	n/a	2,000
Outboard motor/boat	n/a	n/a	500,000

Source: Focus Group, Fishers, Kiliana 2018, Barigoni 2018, Pate 2018; n/a not available

Although tourism has affected the fishing industry by creating a larger market for Products, the industry in Lamu County is monopolised by foreign investors who do not contribute to the local community in any significant way (Heddon 2006). Poverty levels are high and most of the fishers depend solely on the proceeds from fishing, leaving the local people with few resources or limited ability to compete with national and international tourist markets who have more modern equipment (Heddon 2006, MoALF 2018b).

The seasonality of the tourist industry also contributes to an already inconsistent market. The artisanal fishing industry in Lamu is largely seasonal and affected by two wind and weather patterns known as the South East and North East monsoons (Heddon 2006). The North East (Kaskazi) winds create calm sea conditions and occur from November to February, when most small-scale fishing occurs. The South West (Kusi) winds, are characterised by strong winds and rough sea and occur between March and October, making offshore fishing difficult with traditional, small-scale fishing techniques.

Due to the county's proximity to the Somali border, insecurity has been high, and in 2011 the government imposed a ban on night fishing in response to increased Al-Shabaab attacks and kidnappings of fishermen and tourists (MoALF 2018b; Business Daily Africa 2018d). The ban on night fishing has affected fishermen directly, and although it was lifted in May 2017, fishermen still say they are still being harassed when they go to the sea at night (Business Daily Africa 2018d; Focus Group, Fishers, Kiliana 2018, Barigoni 2018; Appendix B). Furthermore, some fishermen are subjected to security harassment even during the day, including from marine authorities enforcing rules such as the requirement to carry life jackets and personal identification (Focus Group, Fishers, Kiliana 2018; Appendix B). The insecurity has also reduced the traffic of tourists that created a big demand for local farm produce.

Destructive over-fishing and fishing techniques have resulted in dwindling inshore fish stocks (MoALF 2018b, LCG 2019). The pressure on the fisheries industry is in part due to lack of alternative livelihoods for the fishing communities and an inability to harness offshore fisheries (LCG 2017). Kenya's offshore coastal marine resources have been vastly untapped and the fishing industry extremely underdeveloped.

2.4.6.9.3 Beekeeping

Beekeeping in carried out in Jipe and Barigoni by individuals or on group farms. In Jipe, there are 15 beehives on the group farm, and an average of five or six on individual farms. In Barigoni, each beekeeper has an average of 10 hives and they are located in Braden, Magumba. Duduni, Marma, Ndodeni, Locho, Munyuni, Baghala, Reseni and Ginda. Access to the area is generally good, but sometimes beekeepers are unable to access their hives around Barigoni due to security issues from al-Shabaab (Focus Group, Beekeepers, Barigoni 2018; Appendix B).

In Jipe, both men and women are engaged in beekeeping, and in Barigoni, family labour is relied on, but the men are typically responsible for bee keeping, production and marketing. Both man-made hives and natural hives consisting of holes in trees are used. The cost for one beehive ranges from KSh 500 to 2,500, with traditional hives costing less, and they are typically fenced off to prevent bees from harming other animals (Table 111). Inputs required for the hives in Jipe include wood and nylon ropes, and in Barigoni axes (to cut branches), buckets and matchsticks are required. If constructed well, the hives used in Jipe typically last more than 10 years, and the traditional hives used in Barigoni last approximately two years.

There are no beekeeping associations or extension services available for beekeepers; however, there are plans in Jipe to educate and recruit more members into beekeeping. Beekeepers face financial challenges from lack of capital to enable the purchasing of beehives; however, the youth in Kiliana receive assistance from the Kikozi Lamu Court to buy beehives.

Table 111: Beekeeping in Jipe and Barigoni, Lamu County

Community	No. of beehives	Cost of a beehive	Average honey harvested	Revenue
Jipe	5-6/individual	KSh 2,500	10 litres/hive (rainy season) 6 litres/hive (dry season)	KSh 450/litre
Barigoni	10/individual	KSh 500 (traditional hive)	20 litres/hive	n/a

Source: Focus Group, Beekeepers, Jipe 2018, Barigoni 2018
n/a not available

The harvested honey is used for food, herbal medicine, and to brew alcohol. Honey is harvested twice per year, with generally more honey harvested during the rainy season because of increased availability of water and production of flowers. During the rainy season between 10 and 20 litres of honey is harvested per beehive, and during the dry season only six litres is harvested. The raw honey is sold in the market for KSh 450 per litre. The revenue from smaller beehives are used to pay for school fees and other basic needs. Beekeepers in Barigoni sell 100% of their harvest since it is their only source of economic activity. The market price increases when there is insecurity ion the area, since the hive cannot be accessed.

2.4.6.9.4 Pastoralism

The livestock herders in the AoI communities keep cattle and goats. Herd size is influenced by the seasons and availability of pasture and water. Scarcity of land and water is a major challenge for herders in Lamu County. During the rainy season cattle have access to adequate water and pasture resulting in a milk and cattle surplus which are sold. However, herders can experience livestock loss during the rainy season due to disease. Extension services in the area are poor and herders are typically required to buy drugs and treat livestock themselves (Focus Group, Livestock Herders, Mokowe 2018, Hindi 2018; Appendix B). In addition, communities are unable to access funds from the county government or donors in order to improve livestock productivity.

During the dry season, the herders travel from one area to another in search of pasture and water. A shortage of grazing lands often leads to conflict between herders and farmers or beekeepers. Livestock herders from Hindi obtain their water from seasonal dams which are only available during the rainy season. There are no boreholes available, and herders must buy water for livestock from the Hindi Magogoni Water Association (HIMWA) during the dry season. Herders from Mokowe obtain water for their animals from boreholes, seasonal dams and ponds. Cows consume approximately 40 litres of water per day.

Herders from Mokowe stay at non-permanent homesteads at Belebele, Jabiani, Kibokoni, Roka, Chomo and Sirini. Their movement from one area to another depends on the availability of green pasture and water. Herders from Hindi stay at Jabiani and Chomo. The herders travel from one area to another with their families, and their travel routes are shown in Table 112.

Table 112: Livestock Herder Homesteads and Travel Routes

Community	Homestead	Travel Route
Mokowe	■ Belebele ■ Jabiani ■ Kibokoni ■ Roka ■ Chomo ■ Sirini	■ Mokowe-Birikani-Kibokoni-Sirini ■ Mokowe-Belebele-Jabiani-Roka-Choma
Hindi Town	■ Jabiani ■ Chomo	■ Hindi-Kibokoni-Koreni-Mpeketoni ■ Hindi-Roka-Bobo-Kwasasi-Sirini ■ Hindi-Roka-Bobo-Barigoni-Bothei-Milimani-Basuba ■ Hindi-Mokowe ■ Hindi-Port ■ Hindi-KDF camp

Source: Focus Group, Livestock Herders, Mokowe 2018, Hindi 2018

Lamu County provides grazing land for nomadic pastoralists from Garissa and Tana River counties which experience extended periods of drought. While these pastoralists are not formally documented residents of Lamu County, they travel into and remain in the county for prolonged durations in search of pasture and water.

There are a number of pastoralist groups in the Mokowe area such as the Mokowe Kibokoni Ufugaji group and Kilimani Livestock. These groups assist the herders with communicating their issues with the local government. In Hindi, the livestock herders are represented by the Wadajir Hindi Livestock Community, who assist in fund raising to help members buy livestock, drugs, water and other resources, and also to reimburse farmers for damages caused by livestock.

2.4.6.9.5 Agriculture

Approximately 85% of the land in the county is arable, with 7,000 ha classified as high potential, 319,000 ha classified as medium potential, and 321,000 ha classified as low potential (LCG 2016). Of the arable land, 56,923 ha is being utilised; 37.4% for food crops, 39.5% for cash crops and 23.1% for farm forest. The main agricultural areas are Mpeketoni, Witu and Hindi Divisions, and consist of land parcels ranging from 5 to 10 acres. The average farm size per household is four acres.

The primary crops grown in the county are maize, cowpeas, dolichos, cassava, pigeon peas and green grams (LCG 2016). The county also produces mangoes, coconut, cotton, bixa and simsim as cash crops. Cotton production remains the highest source of income for households, contributing 42% to household incomes, and followed by banana (14%), maize (8%), cassava (7%), bixa (6%) and mangrove (5%). Those living in the Lamu peri-urban areas practice subsistence farming (LCG 2016).

Livestock production is also an important livelihood for approximately 30% of the population (MoALF 2018b). The main livestock reared are cattle, sheep, goat, donkeys and poultry. Most of the livestock are produced under small-scale production. Cattle and goat rearing is mostly found in Hindi and Witu, while dairy cattle farming/ rearing is practiced mainly in Mpeketoni and parts of Hindi and Witu (LCG 2016).

There are 20 ranches in the county that act as grazing reserves and are used by pastoral farmers from Lamu County as well as from the neighbouring Garissa County (MoALF 2018b). Five are operational covering 65,620 hectares, seven are non-operational covering 81,420 hectares, three are idle covering 56,000 hectares and five are proposed ranches covering 56,000 hectares (LCG 2016).

Most of the farming in Lamu County is rain-fed, and only 1% of households practice irrigation farming (MoALF 2018b). Agricultural inputs include new breeds of cattle, pesticides and livestock drugs, the use of fertilisers, manure and pesticides for pest and disease control (Agriculture Focus Group, Kiliana, October 25, 2018; Jipe, October 26, 2018). The use of fertiliser is still low in this county, with approximately 7% and 9% of farmers using basal chemical fertiliser and manure during the first and the second season, respectively (MoALF 2018b). Approximately 10% of farmers used top dressing fertiliser in the first season and 16% in the second season. Only 10% of farmers use herbicides in both seasons, 31% and 57% use field pesticides in the first season and second season, respectively (MoALF 2018b).

Challenges faced in the agriculture sector are related to production, service provision and market access (MoALF). Decreasing and unpredictable rainfall has resulted in reduced production, crop failure, scarcity of pasture and loss of livestock. Irrigation practice is limited in the county because of the prevalence of saline groundwater, relatively flat topography, and drying of lakes and rivers. The cost of labour during land preparation, planting and harvesting is high, and farmers have no access to credit facilities for assistance (Agriculture Focus Group, Jipe, October 26, 2018). Farm mechanisation equipment for land preparation and transport is inadequate, and farmers primarily depend on tractors form neighbouring counties (MoALF 2018b). Post-harvesting equipment for crops and livestock products is also inadequate.

The ranches and grazing reserves attract livestock from neighbouring counties of Garissa and Tana River, causing conflict and increased risk of disease (MoALF 2018b). Farmers also have to contend with the incursion of wildlife which destroy crops and predate on chickens and livestock (Agriculture Focus Group, Jipe, October 26, 2018).

The land available for farming is limited, since there is no communal land available and most farmers have no title deeds for legal ownership (Focus Group, Agriculture, Kiliana 2018, Jipe 2018; Appendix B). Farmers are therefore limited in their level of investment since only 24% of them have title deeds to their land, and coupled with low financial means, they face barriers to adopting new technologies that increase productivity and enhance market access (MoALF 2018b; Focus Group, Agriculture, Kiliana 2018; Appendix B). Financial and human resources in the agriculture sector in the county is inadequate. Access to farming inputs, markets and extension services is limited because of poor road infrastructure in the county (MoALF 2018b). There are also few farming education and training facilities, and little information provided to farmers on pesticide use and animal health by extension workers (Agriculture, Kiliana 2018; Appendix B). Extension workers and NGOs do not provide access to farm inputs such as fertilisers, seeds, machines and animal breeds; however, in Jipe, the government occasionally provides seeds to farmers.

Residents of Kiliana and Jipe are involved in traditional, small-scale farming, mainly relying on family labour or casual labourers who clear, plant, weed and harvest if necessary. Livestock and agriculture is a family-owned in Kiliana. There are two seasons per year-one rainy season and one dry season. During the rainy season cashew nut and mango crops are grown in Kiliana, and other seasonal crops include maize, sunflowers, cowpeas, and simsim (sesame seeds). In Jipe, the main cash crops are *Bixa Orellana* ('annatto') and cotton, and the main food crops are maize, cowpeas and green grams. The crop yields and marketing for major crops in Kiliana and Jipe are presented in Table 113.

Table 113: Crop Yields and Marketing for Lamu County

Community	Crop	Yield	On how much land (acre)	Percentage sold (%)	Months of sale	Price at harvest (KSh)	Price at harvest (KSh)
Kiliana	Maize	90 bags; 20 kg	1 acre	80	August and September	2,500	3,500 per bag
	Simsim (sesame seeds)	6-12 bags; 50 kg	1 acre	90	September	6,000	8,000 per bag
Jipe	Maize	8-10 kg	1 acre	80	August and September	1,800	3,500 per kg
	Cotton	350 kg	1 acre	100	November and December	60 per kg	100 per kg

Source: Focsu Group, Agriculture, Kiliana 2018, Jipe 2018

The farming seasonal calendar for Kiliana is presented in Table 114. The seasonal crops are rotated consecutively with one season left fallow to allow the land to generate nutrients.

Table 114: Farming Seasonal Calendar for Kiliana

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Clearing land												
Planting												
Harvesting												

Source: Focus Group, Agriculture, Kiliana 2018, Jipe 2018

Apart from the planting of food and cash crops, farmers also rear livestock such as cattle, chickens, sheep and goats. Men engage in all agricultural activities, and women do most activities except herding livestock, which is also undertaken by male children or the elderly in some cases (Table 114). In Kiliana, there are two market days a week when cattle are sold to butchers. The price of cattle depends on the size and quality of meat. In Jipe, Chickens and eggs are sold to the local market.

Table 115: Family Labour Distribution for Agricultural Activities

Community	Activity	Adult male	Adult female	Child male	Child female	Elder
Kiliana	Clearing	X				
	Other land preparation	X	X			
	Planting	X	X			
	Weeding	X	X	X	X	
	Harvesting	X	X			
	Post harvesting processing	X	X	X	X	
	Herding	X		X		
Jipe	Clearing	X	X			
	Other land preparation	X	X	X	X	
	Planting	X	X			
	Weeding	X	X	X	X	
	Harvesting	X	X	X	X	
	Post harvesting processing	X	X			
	Herding	X				X

Source: Focus Group, Agriculture, Kiliana 2018, Jipe 2018

2.4.6.9.6 Protected Areas

The county has two national reserves and several private ranches (LCG 2016). The reserves managed under the Kenya Wildlife Service are Dodori National Reserve and Kiunga Marine National reserve. Some of the ranches include Amu, Nairobi and Bujra Ranches, and Kiweni Conservancy. There are four community conservancies supported by the National Rangelands Trust, including Awer, Hanshak-Nyongoro, Kilunga and Pate (NRT 2017), but none of them are overlapped by the pipeline route. Appendix D shows the protected areas in Lamu County.

2.4.6.9.7 Other

Lamu County is rich in minerals such as titanium, salt, limestone, coral stones, sands and cement (LCG 2016). The main sand and ballast quarrying sites are in Manda, Matondoni, Lake Kenyatta, Kizingitini and Faza. However, most of these activities are uncontrolled and support about 2,000 people. Oil and gas exploration is ongoing on Pate Island. The commerce and industry sector is highly underdeveloped in the county, which are attributed to a lack of enabling infrastructure such as electricity, good road network and reliable markets (LCG 2016).

2.4.6.10 Tourism

Many tourist attractions are found in Lamu County, such as wild animals and birds, beaches, mangroves, a marine park and heritage sites. Lamu town, which has been declared as a UNESCO world heritage site, is famous for its old stone houses made from coral and a mixture of sand and lime, narrow streets and delicate woodcraft of ancient design, and four museums that have ethnographic collections (LCG 2016). There are archaeological sites and other cultural attractions including traditional dhow making, woodcraft, weaving and henna painting, and cultural festivals which are annual events.

The county has two national reserves and several private ranches (LCG 2016). The reserves under Kenya Wildlife Service are Dodori National Reserve and Kiunga Marine National Reserve. Some of the ranches include Amu, Nairobi and Bujra Ranches, and Kiweni Conservancy.

The county is capable of attracting more tourists, but hotels have limited capacity to accommodate the number of visitors (LCG 2017). Attacks on the archipelago by Al Shabaab have impacted tourism (Kazungu 2018). Raids on the Lamu-Garsen road, Ishakani, Pandanguo, Maleli, Poromoko, Basuba and Boni forest have negatively impacted the sector, which is the backbone of region's economy. Stakeholders in the tourism industry stated that al-Shabaab was the reason for the low number of tourists visiting the region in 2018 and part of 2017.

2.4.6.11 Cultural Resources

Jipe community members worship at a local ancient mosque; a sheikh is believed to be buried there (Focus Group, Elders, Jipe 2018; Appendix B). Sacred sites in Barigoni includes Kwa Mwalimu, Jadha, Gela, Komuri and Araseli (Focus Group, Elders, Barigoni 2018; Appendix B). Community ancestors are buried at some of these sites, and visitors are not permitted to visit them. The community visits sacred sites to pray for sick people and for God's protection against their enemies, and men and women visit separate sacred sites. No sacred sites have been discovered along the pipeline route in Hindi and Pate (Focus Group, Elders, Hindi 2018, Pate 2018; Appendix B). In Pate, most rites of passage are done within the homestead, and circumcision is done immediately after the child is born (Focus Group, Elders, Pate 2018; Appendix B).

2.4.6.12 Project Concerns

The Livestock herders, beekeepers, fishers, elders and business group expressed concerns and recommendations about the proposed Project during the Focus Groups discussions held from October 24 to October 30, 2018, which are listed below.

- The potential impact of the Project on livestock movement (Focus Group, Livestock Herders, Hindi 2018);
- The potential impact of the Project on beekeeping resources, and the beekeepers expect to be compensated for their loss (Focus Group, Beekeepers, Barigoni 2018);
- The Project is expected to improve security to attract investors to the area, and the growth of Hindi town and development of social amenities such as good schools and colleges (Focus Group, Business Group, Hindi 2018);
- The Project developers should consider local people for employment opportunities (Elders, Pate, October 30, 2018), including for youth (Focus Group, Business Group, Hindi 2018);
- Title deeds should be provided to people for the lands allocated to them, and awareness should be created related to land compensation (Focus Group, Elders, Pate 2018);
- The potential adverse impacts of oils spills, including fish mortality, drying up of mangroves which will in turn affect fish numbers, pollution of water and bioaccumulation in the ecosystem (Focus Group, Fishers, Mokowe, 2018, Kiliana 2018, Pate 2018);

- The potential for Project odours to kill fish (Focus Group, Fishers, Pate 2018);
- The potential for decreased fish harvest/catches because of the Project (Focus Group, Fishers, Barigoni 2018);
- Changes in fish migration from the Project, resulting in depleted fish stocks in the area (Focus Group, Fishers, Pate 2018);
- The Project may restrict access to the water for fishers (Focus Group, Fishers, Kiliana 2018);
- The Project may limit access to fishing areas and will make it difficult to fish with boats at the current levels in those areas (Focus Group, Fishers, Pate 2018);
- The potential adverse impacts of noise pollution from the Project (Focus Group, Fishers, Kiliana 2018);
- Fishers expect that the Project will create market opportunities which will lead to increased income (Focus Group, Fishers, Mokowe 2018); and
- The potential for increased transmission of disease and infections to the community from outsiders because of the Project (Focus Group, Fishers, Mokowe 2018).

Several concerns and recommendations were expressed by community members and stakeholders about the proposed Project during the consultation meetings held in the following locations in Lamu County: Barigoni, Hindi, Jipe, Kiliana, Mokowe, Mwanarafa (two meetings) and Pate, between October 23 and November 13, 2018. These concerns have been categorised according to socio-economic topic and are listed below.

Land

- Concern about loss of land for agriculture and pastoralists (Hindi, October 27, 2018; Mwanarafa, November 13, 2018);
- Concerns about corruption in the National Land Commission that is overseeing the land acquisition process (Hindi, October 27, 2018; Kiliana, October 25, 2018; Mwanarafa, October 23, 2018);
- The land should be leased directly from the county government who owns the land on behalf of Lamu residents (Mwanarafa, October 23, 2018). The land is owned by residents of Lamu, not Lamu Port-South Sudan-Ethiopia Transport Corridor (LAPSSET) or the National Land Commission;
- Concerns about effects on land belonging to people without title deeds and the lack of title deeds affecting compensation offered to residents (Pate, October 30, 2018; Barigoni, October 28, 2018; Hindi, October 27, 2018; Jipe, October 26, 2018; Kiliana, October 25, 2018; Mokowe October 24, 2018; Mwanarafa, October 23, 2018). Requests that the land is measured properly, marked and title deeds issued to land owners before Project development begins (Barigoni, October 28, 2018; Hindi, October 27, 2018; Kiliana, October 25, 2018; Mwanarafa, November 13, 2018);
- Concerns about people obtaining false title deeds and claims to the land (Barigoni, October 28, 2018; Hindi, October 27, 2018; Pate, October 30, 2018);
- Concerns about land being seized unlawfully (Barigoni, October 28, 2018; Jipe, October 26, 2018; Mwanarafa, November 13, 2018) and with being forcefully evicted from their ancestral lands (Barigoni, October 28, 2018);
- Concerns about lack of notification about the acquisition of land (Hindi, October 27, 2018);

- Potential for oil spillage and leakage (Mokowe, October 24, 2018; Mwanarafa, October 23, 2018; Mwanarafa, November 13, 2018), including concerns about oil spillage at the port (Mwanarafa, October 23, 2018; Pate, October 30, 2018); and
- Preference to lease the land for the Project rather than selling it (Barigoni, October 28, 2018).

Livelihoods

- Potential for the Project to affect people's livelihood (Barigoni, October 28, 2018; Kiliana, October 25, 2018; Mokowe, October 24, 2018; Mwanarafa, November 13, 2018; Pate, October 30, 2018);
- Concerns about possible eviction from property and ongoing effects of the Project once its built (Jipe, October 26, 2018);
- Potential for the Project to affect beekeepers (Hindi, October 27, 2018; Mwanarafa, November 13, 2018), pastoralists and farmers (Hindi, October 27, 2018);
- Potential for pipeline spillage to affect the livelihoods of fishermen in Lamu East (Mwanarafa, November 13, 2018);
- The Project may affect different pastoral activities differently. The main pastoral activities include agro-pastoralists (who farm and keep livestock), rangers (who have farms specifically for livestock) and nomads (who move with their livestock in search of water and pasture) (Mwanarafa, November 13, 2018);
- Restrictions in the movement of people due to additional security concerns from the Project (Mwanarafa, November 13, 2018);
- Potential impacts to and the need to protect resources important to the community (Barigoni, October 28, 2018; Hindi, October 27, 2018; Mwanarafa, October 23, 2018), including:
  - Honey and trees with natural beehives (Barigoni, October 28, 2018);
  - Animals (Barigoni, October 28, 2018);
  - Water and water catchment areas (e.g. boreholes, water pans, water pipelines) (Barigoni, October 28, 2018; Mwanarafa, November 13, 2018); and
  - Forest, trees and medicines (Barigoni, October 28, 2018; Mwanarafa, November 13, 2018).
- Need to identify the mitigation measures will be implemented to avoid impacts to natural resources found along the pipeline route (Mwanarafa, October 23, 2018).

Health and Safety

- Potential for increased human-wildlife conflict resulting from the reduction in available lands (Mwanarafa, October 23, 2018; Mwanarafa, November 13, 2018);
- The safety of the Project area should be improved by securing the surrounding forested area (Jipe, October 26, 2018; Mokowe, October 24, 2018);
- People do not want to be moved to a more insecure areas as a result of the Project (Jipe, October 26, 2018);
- Beacons should be erected for people to known clearly where the pipeline is buried (Kiliana, October 25, 2018);
- Request from more information about what mitigation measures will be implemented to protect people's safety (Hindi, October 27, 2018; Jipe, October 26, 2018);

- Potential for a pipeline burst to harm people (Hindi, October 27, 2018; Jipe, October 26, 2018) and fatalities to result from shock and other risks (Jipe, October 26, 2018);
- Concerns that the Project will bring diseases to the region that are not currently found here (Barigoni, October 28, 2018); and
- Potential for human health impacts resulting from an oil spillage (e.g., from consuming fish that ingest lead or heavy metals) (Mwanarafa, November 13, 2018).

Cultural Resources

- The Project may pass through graveyards and sacred places (Hindi, October 27, 2018; Mwanarafa, November 13, 2018); and
- Potential impacts to shrines and sacred sites (Mwanarafa, November 13, 2018).

Social

- What security measures have you put in place to curb insecurity, especially against Al-Shabaab (Mwanarafa, October 23, 2018);
- The Project should consider human rights (Mokowe, October 24, 2018) and the rights of local people (Jipe, October 26, 2018);
- Healthcare will suffer as a result of the influx of people (Mokowe, October 24, 2018);
- Women need to be included in and benefit from the Project (Jipe, October 26, 2018; Kiliana, October 25, 2018);
- Youth and vulnerable people need to be involved in the Project (Pate, October 30, 2018);
- Potential for local infrastructure to not be able to support a population increases as a result of the Project (Hindi, October 27, 2018); and
- Potential for the Project to increase uncertainty and food insecurity (Kiliana, October 25, 2018).

Employment

- Employment opportunities should be provided for local communities and especially to youth (Pate, October 30, 2018; Barigoni, October 28, 2018; Hindi, October 27, 2018; Jipe, October 26, 2018; Kiliana, October 25, 2018; Mokowe, October 24, 2018; Mwanarafa, October 23, 2018; Mwanarafa, November 13, 2018);
- Wages are often too low when compared with the high cost of living (Jipe, October 26, 2018);
- Provide 40% of the employment opportunities for the LLCOP and other LAPSSET projects to Lamu residents (Mwanarafa, October 23, 2018);
- Request to train youth in the technical skills required to work on this project and other projects in other roles beyond manual work (Mwanarafa, October 23, 2018; Mwanarafa, November 13, 2018);
- There should be a range of positions available for local people that may have differing levels of education, ranging from non-technical services (e.g., security) to the most important positions (Jipe, October 26, 2018; Mokowe, October 24, 2018; Pate, October 30, 2018);
- Employment should be given to people fitting their education status and the process for applying for positions should be simplified (Mokowe, October 24, 2018);

- There is a need for transparency and inclusiveness in decision-marking and tendering opportunities (Mokowe, October 24, 2018);
- Concerns about the inability to get tenders (Hindi, October 27, 2018); and
- Suggestion that a refinery is built in Lamu (Mwanarafa, November 13, 2018).

Benefits and Compensation

- Lamu residents wanted to ensure that they are compensated fairly for the Project (Jipe, October 26, 2018; Kiliana, October 25, 2018; Mokowe, October 24, 2018; Mwanarafa, November 13, 2018; Pate, October 30,2018; Hindi, October 27, 2018);
- Concerns were expressed about the identification of those eligible to receive compensation and the potential that compensation may be given to the wrong people (Mwanarafa, October 23, 2018). Questions were raised about whether compensation would be paid directly to landowners or to other parties (Mokowe, October 24, 2018);
- Concerns were also expressed about how and whether compensation would be paid for the following:
  - Pollution, cultural and heritage impacts, and effects to endangered species (Mwanarafa, October 23, 2018);
  - Land ownership and to farmers (Kiliana, October 25, 2018; Mokowe, October 24, 2018);
  - Impacts to houses and fruit trees (Hindi, October 27, 2018); and
  - For those who had to leave their farms because of *Shiftas* (i.e., rebels, outlaws, bandits) but have or will return once the safety issues are resolved (Kiliana, October 25, 2018).
- People in Lamu County derive their livelihood from the land, therefore, land issues and compensation should be sorted before any land is leased (Mwanarafa, October 23, 2018);
- Lamu residents have not received benefits from previous projects and they request the settling of outstanding benefits before any further projects move ahead (Barigoni, October 28, 2018; Hindi, October 27, 2018; Jipe, October 26, 2018; Kiliana, October 25, 2018; Mokowe, October 24, 2018; Mwanarafa, October 23, 2018);
- Concerns that some community members will misuse money given as compensation or have it stolen (Barigoni, October 28, 2018). Will money management education be provided to those who are given compensation (Jipe, October 26, 2018)?
- The communities feel that the Project should benefit and uplift the local people and requested further information about what type of benefits they might receive (Barigoni, October 28, 2018; Mokowe, October 24, 2018; Mwanarafa, October 23, 2018; Mwanarafa, November 13, 2018; Pate, October 30, 2018);
- Specific requests and recommendations were made regarding potential benefits that could be offered communities including:
  - The provision of scholarships and education (Barigoni, October 28, 2018; Hindi, October 27, 2018; Jipe, October 26, 2018; Mokowe, October 24, 2018);
  - Project benefits should be provided to everyone in Lamu, regardless of social status or education level. Concerns that only educated people will receive the benefits (Hindi, October 27, 2018; Jipe, October 26, 2018; Mokowe, October 24, 2018);

- Medical centres should be built or improved as a result of the Project (Mokowe, October 24, 2018);
- Improvements in local infrastructure, such as water and hospitals (Barigoni, October 28, 2018; Hindi, October 27, 2018; Mwanarafa, October 23, 2018);
- Benefits specific to pastoralists including a meat processing plant, livestock market, country fodder feed reserve and a dock yard and ship for cattle (Mwanarafa, November 13, 2018); and
- Benefits specific to fishermen including improvement of the beach management units, fish markets, docking cottages and preservative structures, better fishing equipment, and research to confirm that fish produce are fit for marketing and consumption (Mwanarafa, November 13, 2018).

- Will the Project be allowed to continue if it will negatively affect people (Jipe, October 26, 2018)?
- The county government and Lamu communities should receive a portion of Project revenue (Mokowe, October 24, 2018; Mwanarafa, October 23, 2018);
- Concerns and questions were also raised specific to relocation:
  - Relocation is not an acceptable form of compensation (Jipe, October 26, 2018);
  - Where will people be relocated to (Hindi, October 27, 2018)?
  - Resettlement issues need to be resolved (Hindi, October 27, 2018);
  - Resettlement plans should be elaborate and include scholarships and the equitable sharing of benefits (Hindi, October 27, 2018); and
  - Some individuals indicated that compensation should be paid as cash, rather than by land (Hindi, October 27, 2018.

Consultation

- Multiple concerns were expressed about the need to include the local people in the Project so that they can protect their rights (Kiliana, October 25, 2018; Mwanarafa, November 13, 2018), specific examples include:
  - Priority must be given to those who will be directly affected, by the Project, including landowners, and the addressing of issues requires the involvement of Lamu residents (Barigoni, October 28, 2018; Mokowe, October 24, 2018; Mwanarafa October 23, 2018);
  - Committees should be formed with Lamu representation to address issues that arise (Kiliana, October 25, 2018; Mwanarafa, October 23, 2018);
  - The Lamu people must be consulted in all areas of the pipeline corridor (Mwanarafa, October 23, 2018);
  - Representatives from Lamu East and Lamu West should act as community liaison officers in order to establish a feel for Project ownership (Mwanarafa, October 23, 2018);
  - Create a community trust committee to help with community stakeholder responsibility programmes, to act as liaison officers, and to help in identifying mitigation measures (Mwanarafa, October 23, 2018);
  - Include Lamu residents (e.g., elders, youth, women) in the research and report writing related to the environment, such as mangroves and marine life (Mwanarafa, October 23, 2018);

- Engagement should occur directly with the people from Kiliana rather than through LAPSSET and the National Land Commission (Kiliana, October 25, 2018);
- Included locals on the land surveyor teams (Jipe, October 26, 2018) or in the identification of land ownership (Hindi, October 27, 2018); and
- How will the beach management unit committees and the farming sector be involved in the identification of Project concerns and mitigation measures (Mwanarafa, October 23, 2018)?

- Multiple concerns were also expressed about the need for additional information and further engagement on the Project, such as:
  - The need to disseminate Project information to Kiliana (Mwanarafa, October 23, 2018);
  - Request for more information about both the benefits and impacts of the Project (Hindi, October 27, 2018);
  - Request for capacity building and education so that community members can better understand the Project and its potential impacts (Mwanarafa, November 13, 2018);
  - Request that the whole LAPSSET team come to speak to the communities together so that they can provide complete answers to the communities' questions (Hindi, October 27, 2018);
  - Concerns that not all the views of the community are being gathered during the meetings (Pate, October 30, 2018);
  - More time is required to engage with the pastoral groups so they can raise their issues and concerns (Mwanarafa, November 13, 2018);
  - Land officials should be present at consultation activities to answer questions (Hindi, October 27, 2018); and
  - Would like further information about the process for residents to bring Project concerns forward (Mokowe, October 24, 2018)?
- Concerns that the content of community meetings will not be shared with the government (Kiliana, October 25, 2018);
- Concerns about corruption and lack of trust with the National Lands Commission and LAPSSET (Jipe, October 26, 2018; Mwanarafa, November 13, 2018);
- Representatives from Lamu should be involved in all components of LAPSSET projects so that the communities and county government will benefit economically (Mwanarafa, October 23, 2018);
- Consultation should start with the communities rather than the government (Mwanarafa, November 13, 2018); and
- The community is experiencing consultation fatigue (Mwanarafa, November 13, 2018).

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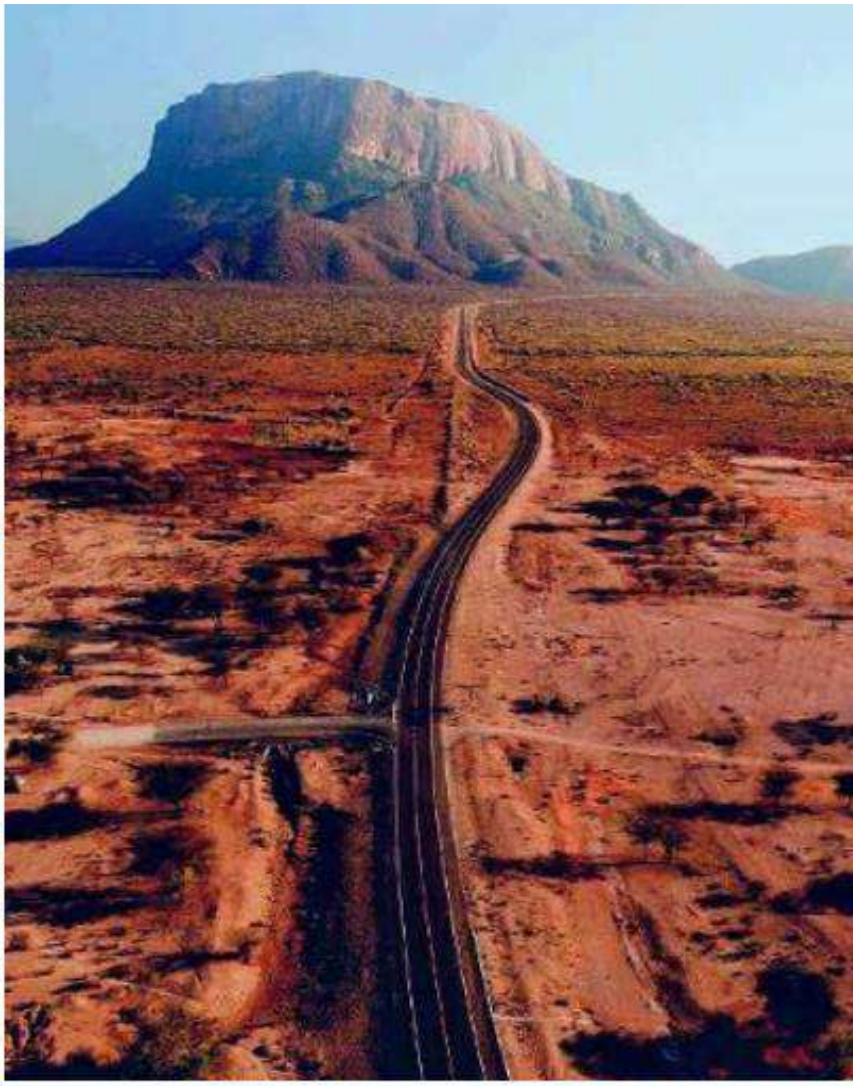
APPENDIX A

Health Baseline Report



Community Health Baseline Report

Tullow Kenya BV

Lokichar-Lamu Crude Oil Pipeline
Republic of Kenya

January 2019

For Golder Associates

SHAPE CONSULTING LIMITED
"STRATEGIC HEALTH ANALYSIS PLANNING AND EXECUTION"

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GLOSSARY AND ACRONYMS

A	
AIDS	Acquired Immunodeficiency Syndrome
AFP	Acute Flaccid Paralysis
ANC	Antenatal Care
ARI	Acute Respiratory Infection
ART	Anti-Retroviral Treatment
B	
BCG	Bacille Calmette-Guerin
C	
CHMT	County Health Management Team
CIDP	County Integrated Development Plan
CLTS	Community Led Total Sanitation
D	
DHIS	District Health Information System
E	
EHA	Environmental Health Area
ESF	Environnementalistses Sans Frontieres Consultants Limited
G	
GAM	Global Acute Malnutrition
GBV	Gender-Based Violence
GDP	Gross Domestic Product
H	
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
I	
IHME	Institute for Health Metrics and Evaluation
IPC	Integrated Phase Classification
IRS	Indoor Residual Spraying
K	
KDHS	Kenya Demographic and Health Survey
KEPH	Kenya Essential Package for Health
KEMRI	Kenya Medical Research Institute
KII	Key Informant Interview
KMSA	Kenya Medical Supplies Agency

L	
LF	Lymphatic Filariasis
LLCOP	Lokichar-Lamu Pipeline Project
LLIN	Long Lasting Insecticidal Net
M	
MARPs	Most-At-Risk Populations
MDR-TB	Multi-Drug Resistant Tuberculosis
N	
NASCOP	National AIDS Control Programme
NCD	Non-Communicable Disease
NHIF	National Hospital Insurance Fund
NMCP	National Malaria Control Programme
NTLD	National Tuberculosis and Lung Disease Programme
P	
PMTCT	Prevention of Mother to Child Transfer
R	
RDT	Rapid Diagnostic Test
RRH	Regional Referral Hospital
RVF	Rift Valley Fever
S	
SAM	Severe Acute Malnutrition
SARA	Service Availability and Readiness Assessment
SMART	Standardized Monitoring and Assessment of Relief and Transitions
STI	Sexually Transmitted Infection
T	
TB	Tuberculosis
TM	Traditional Medicine
V	
VCT	Voluntary Counselling and Testing
VHF	Viral Haemorrhagic Fever
W	
WHO	World Health Organisation

1. COMMUNITY HEALTH BASELINE REPORT

1.1. Purpose and Scope of Report

SHAPE Consulting Limited (SHAPE) has been contracted by Golder Associates Ltd. to perform a health impact assessment (HIA) for the Lokichar-Lamu Crude Oil Pipeline (LLCOP) Project in Kenya. The approach of the HIA is in compliance with good international practice, specifically with the International Finance Corporation (IFC) Performance Standard (PS) of environmental and social sustainability.

This methodology requires that the baseline health status of the communities who reside in the area of influence (AOI) for the construction and operations phase of the project be effectively described, to better understand their specific vulnerabilities in relation to the project as well as serving as a departure point against which future comparisons in health status can be made.

The objective of the socio-economic and health baseline report is to provide a description of the socio-economic and health conditions of the Project Affected Communities (PACs) in their regional and national context.

The geographic scope of this report is limited to the counties through which the subterranean, thermally insulated pipeline is expected to run as well as the anticipated location of project facilities, including above ground installations (including pumping stations, pressure reduction stations and generators) as well as the marine export terminal at the Port of Lamu. From east to west, the proposed pipeline will traverse the counties of Turkana, Samburu, Isiolo, Meru, Garissa and Lamu. A geographic representation of the proposed pipeline is reflected in Figure 1 below.

1.2. Area of Influence (AOI) and Study Boundaries

1.2.1. AOI

The Area of Influence (AOI) for the construction and operation phases of the project consists of three spheres of influence:

- A primary sphere which consists of PACs. These are all the villages and towns in the vicinity of the project, which could be directly impacted by project activities.
- A secondary sphere of influence which consists of the administrative entities in which the PACs are located. These include counties and regions.
- a tertiary sphere of influence which refers to the national context

To identify and quantify potential health impacts during the impact assessment phase of the HIA, an accurate population profile is required, and it is important to distinguish between differences in exposure and sensitivity.

Thus, besides a demographic profile of the at-risk population and the identification of the most vulnerable groups, it is crucial to understand how the construction and operational activities of the project are likely to affect individuals, households and communities. This ‘exposure pathway’ is a key aspect to consider when evaluating potential project influences on PACs.

A PAC is a defined community within a clear geographical boundary where project-related health impacts may reasonably be expected to occur. PACs are inherently prospective and simply represent best professional judgments. PACs are likely to change over the course of project implementation; as there may be changes in the project design, and thus its longer-term implications are not fully known. This implies that the definition of PACs may need further adaptation as the project moves ahead; therefore, the specification of a PAC should be viewed as time-dependent as it will evolve over the project cycle.

Mitigation strategies may also require specific considerations for the different PACs. On one hand, not all the EHAs may be of concern for mitigation at the level of individual PACs, but on the other, a separate risk analysis for a PAC may be indicated due to a particular susceptibility to a specific health impact.

The following PACs relevant to the project have been considered:

1. <u>PACs affected by direct impacts:</u>
    - Communities / people affected through physical resettlement;
    - Communities people affected by economic displacement;
    - Communities in close proximity to construction activities; and
    - Communities in close proximity to construction camps.
2. <u>PACs affected by indirect impacts:</u>
    - Larger centres that that act as attractors to influx, placing pressure on:
        - Provision of basic services; and
        - Access to health services
3. <u>PACs affected by cumulative impacts:</u>
    - Communities in proximity to other development projects and industries in proximity to the pipeline route, notably communities (trade centres) in proximity to both main roads and the pipeline route as well as existing infrastructure projects such as the development of the Lamu Port and the Lamu-Southern Sudan-Ethiopia Transport Corridor.

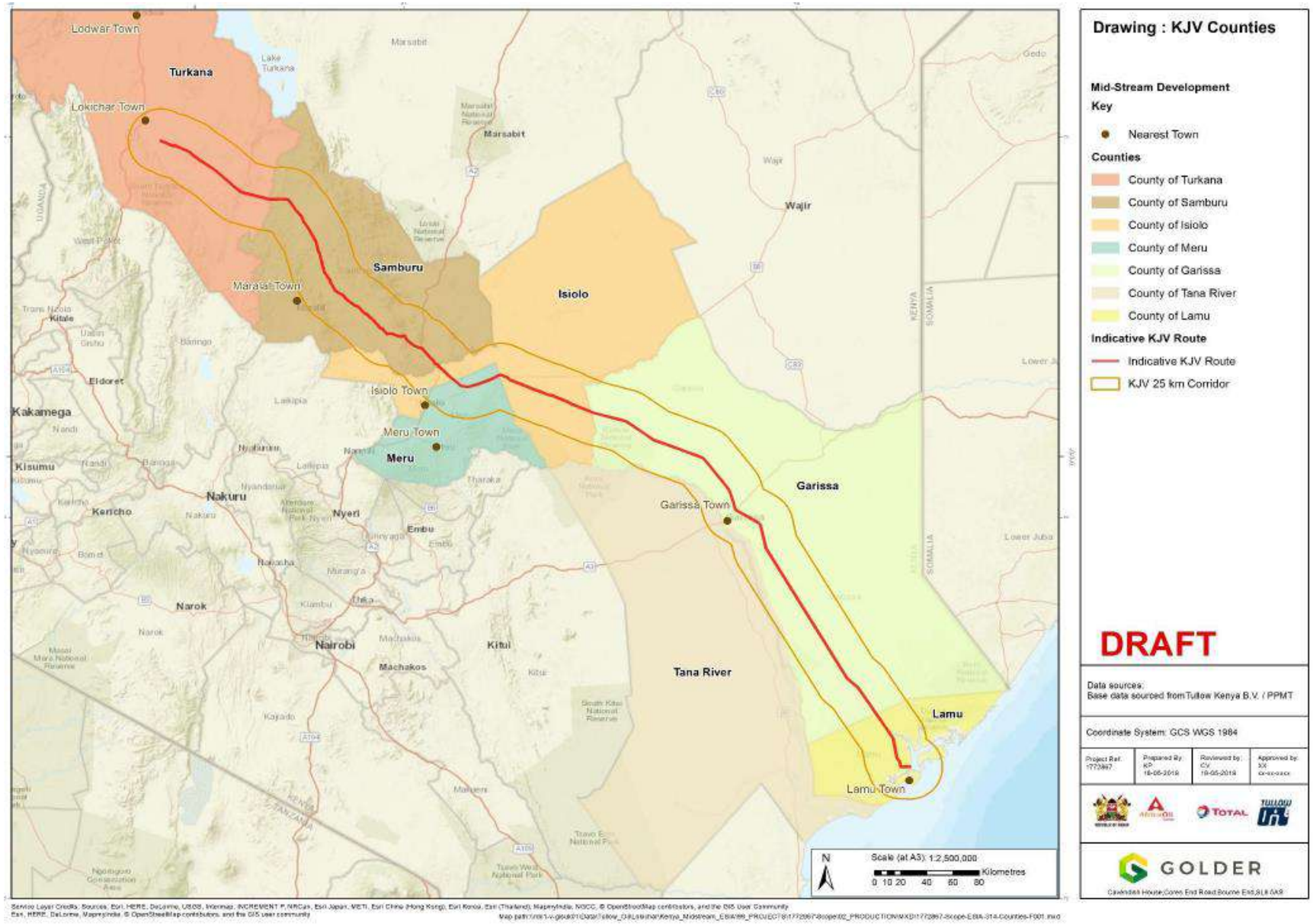

Figure 1: Geographic scope of the Project

1.3. Methodology, Activities and Outputs

Data for the community health baseline were collected through various activities, including:

1.3.1. Desktop Literature Review

A desktop literature review was performed by SHAPE epidemiologist, Dr Milka Owuor, with inputs from local Kenyan specialists. This review was utilised to inform the health profiling of the communities in the Project area, describing a broad health status of the population, based on a systematic review of the 12 Environmental Health Areas (EHAs) with reference to data at national, county and local level. Core documents consulted during the review include:

- Kenya Economic Survey 2018
- Kenya Demographic and Health Survey (KDHS) 2014
- Kenya AIDS Response Progress Report 2018
- Kenya Tuberculosis Prevalence Survey Report 2018
- Kenya Malaria Indicator Survey 2015
- County Integrated Development Plans (CIDPs)

1.3.2. Fieldwork and Stakeholder Engagement

Prior to mobilisation, survey protocols and interview tools were developed, based on the findings of the literature review. Stakeholder engagement was supported by Environnementalistses Sans Frontieres Consultants Limited (ESF) and formal letters of invitation were sent to each Chief Officer for Health in the affected counties to introduce the survey, secure meetings with the relevant stakeholders and obtain assistance in the arrangement of meetings. Appointments were confirmed telephonically, prior to mobilisation.

Field work was conducted by Drs Milka Owuor and Vincent Otieno in three phases from 12 to 14 November 2018 covering Lamu County, 21 to 30 November covering Turkana County, and from 9 to 19 December 2018 covering the counties of Garissa, Meru, Isiolo and Samburu. Activities performed during these county visits include the following.

1.3.2.1. Participatory Group Meetings

A crucial part of the field visits was to consult stakeholders who have special knowledge of the health status and the social health determinants of the Project area. The objective was to gain an understanding of the general health situation and the potential health impacts of the Project. The activities started off with participatory meetings with County Health Management Teams (CHMTs) in each of the Project counties. A semi-structured questionnaire was used to guide a formal discussion on the existing health needs/challenges and burden of disease in the study area. Participants also shared their experiences and observations on various aspects of health in their county. In addition, the potential impacts of the Project were discussed. The dates and lists of participants in the CHMT meetings are shown in Table 1

Figure 2: Participatory Group Meeting

Source: Fieldwork December 2018

1.3.2.2. Key Informant Interviews

Specific departmental heads or programme managers were interviewed individually using a semi-structured interview tool. The key informant interviews (KIIs) focused on specific topics of interest such as communicable diseases including tuberculosis, reproductive health and sexually transmitted infections and HIV/AIDS, food and nutrition, non-communicable diseases, maternal and child health, social determinants of health, water and sanitation, malaria and vector-related diseases. Figure 3 shows a photo from KII session.

Figure 3: Key Informant Interview Session

Source: Fieldwork December 2018

Table 1: List of stakeholders consulted during the health baseline

County	Stakeholder	Position/Organisation	Contact	Date
Lamu	Dr Badawi A. Sura	County Chief Officer for Health	+254722621081	13/11/2018
	Dr Victor Tele	Assistant County Director of Medical Services	+254721778971 victortole@lamu.go.ke	
Turkana	Alfred Emaniman	Deputy Director of Public Health and Sanitation	emanimanalfred@gmail.com +254711580860	21/11/2018
	Innocent Sisuna	Chief Public Health Officer	innocentmunyefu@gmail.com +254717257979	
	Fredrick Lokoriyara	County Principal Administrator	fredrickloko@yahoo.com +254713219698	
	Joyce Illikwel	County Deputy Director of Administration	joycewpe@gmail.com +254713073936	
	Daniel Esimit	Director Health Promotion and Disease Control	esimitdaniel@gmail.com +254722454696	
	Reuben Kibiego	County Water, Sanitation and Hygiene Coordinator	kibiegor@gmail.com +254713337973	
	Samuel Lokomer	County Malaria Coordinator	lokomer0999@gmail.com +254721429133	
	Concepta Longole	County Disability and Rehabilitation Coordinator	+254710668536	
	Salim Otieno	County Registered Clinical Officer	sotieno20@gmail.com +254710410416	
	Haron Sifuna	Maternal and Child Health Coordinator	sifunaharon@yahoo.com +254718770323	
	Wycliffe Machani	County Nutritionist	cliffemachani@gmail.com +254722420394	
	Musa Abdirahman	Non-Communicable Disease Coodinator	jabdirahammusa@gmail.com +254727385414	
	Samuel Pulkol	County AIDS and Sexually Transmitted Infections Coordinator	spulkol@yahoo.com +254725875180	
	Namoru Ekitela	Lodwar Hospital Chief Executive Officer of Health/ Director	+254726507840	22/11/2018
	Ann Sifuna	Lodwar Hospital Deputy Nursing Officer in Charge	anneswanyonyi@gmail.com +254715126526	
	Leah Khakasa	Lodwar Hospital Public Health Officer in Charge	+254717613446	
	Rhoda Yator	Lodwar Hospital Health Records Officer in Charge	yatorrhoda15@gmail.com +254724575663	
	Veronica Ngatia	Turkana South Medical Officer of Health (in Charge)	verongatia@yahoo.com +254714938753	29/11/2018
Garissa	Abdirashid Mohamed	County Tuberculosis and Leprosy Coordinator	+254720918149 ardiney5@yahoo.com	10/12/2018
	Shahmat Warsame	County Nutrition Officer	shahmat1930@hotmail.com	
	Salah Hassan	Deputy County Tuberculosis and Leprosy Coordinator	+254720267715 sadaha2005@yahoo.com	
	Hassan Hussein	County Lab Coordinator	+25472417908 hhnuriye@yahoo.com	

County	Stakeholder	Position/Organisation	Contact	Date
	David Abdullahi	County Director of Health and Administration	+254722845857	
	Fatuma Maalim	County Reproductive Health Coordinator	+254721661125	
	Mohamed Omar	Deputy County AIDS and STI Coordinator	+254722376974	
	Dr Ernest Siwo	Garissa County Hospital Director of Clinical Services	+254705871497 siwomed@gmail.com	11/12/2018
	Paul Mwanzia	Garissa County Hospital Public Health Officer	+254720726129 pmmwanzia@gmail.com	
Meru	Dr KananaKimonye	County Chief Officer for Health	+254723425177 kananakimonye@gmail.com	13/12/2018
	Dr Lilian Bruno	County Director of medical services	+254721301724	
	HallanNguku	County Immunisation Logistician	+254721686178 ngukumu@yahoo.com	
	Joseph Murungi	County AIDS and STI Coordinator	+254729928393 josmurungi@yahoo.com	
	Andrew Mugura	County Health Promotion Officer	+254722444026 andrewmugura@gmail.com	
	Eunice Kanana	County Tuberculosis Coordinator	+254721264674 Ekanana40@gmail.com	
Isiolo	Hussein Abubakar	County Director of Health	+254725313153 abuabdalah2nd@gmail.com	14/12/2018
	Guyo Abdi	Deputy County Director of Planning, Monitoring and Evaluation	+254721708980 guyoabdi036@gmail.com	
	DibaGalma	County AIDS and STI Coordinator	dibagalma@yahoo.com	
	Amina Falana	County Reproductive Health Coordinator	falanaamina2@gmail.com	
	Alice Mwirigi	County Nutrition Officer	mwirigialice@yahoo.com	
	GurachaSarite	County Public Health Officer	gurachasarite@gmail.com	
	Stephen Mwini	County Health Promotion Officer	mwinistephen@gmail.com	
	Abdulkadir Tutu	County Tuberculosis and Leprosy Coordinator	girotutu@yahoo.com	
	Abdullahi Jillo	County Health Records Information Officer	+254718838701 ajillo77@yahoo.com	
	Ali Badha	County Surveillance Officer	+254726344342 alibadha@yahoo.com	
	Hussein Mahamud	Isiolo Hospital Medical Superintendent	+254712277404	
	John Mugambi	Isiolo Hospital Nursing Officer	+254722642009	
	Aden Roba	Isiolo County Hospital Administrator	+254727136774	
Samburu	Martin Thuranira	County Director of Health	+254722423038 thuran1975@gmail.com	17/12/2018
	Silas Lodeke	County Clinical Service Manager	+254701363515 silaslodeke@gmail.com	

County	Stakeholder	Position/Organisation	Contact	Date
	Peter Lekaite	County Tuberculosis and Leprosy Coordinator	+254710579377 plekaite@gmail.com	
	Sammy Leseewa	Deputy County Clinical Officer	+25472376586	
	Ruth Kiunga	County AIDS and STI Coordinator	+254725102642 kruthgacheri@gmail.com	
	John Losusui	County Senior Nutrition Officer	+254726155859 latifflosusui@gmail.com	
	Joseph Rotich	County Public Health Officer	+254720444225 rotichkipj@gmail.com	
	John Letiwa	County Health Promotion Officer	+254726736035 johnletiwa@gmail.com	
	JelisaLekoki	Wamba Catholic Hospital Nursing Officer in Charge	+254729899071	18/12/2018
	Bernadette Lorunguiya	Wamba Health Centre Nursing Officer in Charge	+254720733565	

1.3.2.3. Health Facility Assessment

Assessment of the quality of health care in the study area was carried out in five health facilities: Lamu County Referral Hospital, Garissa County Referral Hospital, Isiolo County Referral Hospital, Wamba Catholic Hospital and Wamba Dispensary. The assessment was conducted using a modified Service Availability and Readiness Assessment (SARA) tool, a conceptual framework of measuring quality in health care developed by the World Health Organisation (WHO). Key informants at the respective health facilities, generally the person in charge, were interviewed to gain an understanding of the main health challenges in their target population as well as potential structural and operational challenges at facility level.

Figure 4: Health facility assessment

Source: Fieldwork December 2018

1.3.2.4. Routine Health System Data and Reports

A review of data available from the health management information system (HMIS) in each of the Project Counties was performed. The data is routinely collected through the District Health Information System (DHIS) and provides an evidence base for longitudinal monitoring of key health indicators and performance of the health system in general. County-level reports were also reviewed, including the County Integrated Development Plans (CIDP), annual health sector performance reports, annual work plans, and programme specific reports.

1.4. Data Considerations

Data collection in the baseline phase of the HIA consisted of a number of methodological processes as presented in Section1.3 above. This procedure of data collection enabled a process of data triangulation to be followed, ensuring that only verifiable data is reflected in this report. This process is illustrated in Figure 5 below.

Following this process supports the definition of important health outcomes and determinants and how these may be affected by the project. The three elements considered during data triangulation, include:

- A review of open-source data, statistics and reports;
- Stakeholder input from key informant interviews and focus group discussions; and
- Direct observation of health determinants in the area- from health service delivery capacity and health facilities to levels of general environmental health and sanitation in the community.

Data received from the HMIS were used to evaluate and compare district level findings to regional and national statistics as well as identify trends in individual district settings.

It has to be noted, that the quality of the data collected by the national HMIS system may not be of a sufficient quality to reliably and accurately determine the actual burden of disease in PACs. This is, in part, due to challenges associated with health system utilisation and data management. It is, however, considered to be sufficiently accurate in tracking disease trends at a district and health facility level. When considering the longitudinal monitoring of potential community health impacts by the project proponent, care has to be taken that the methodology used, is comparable to the baseline data.

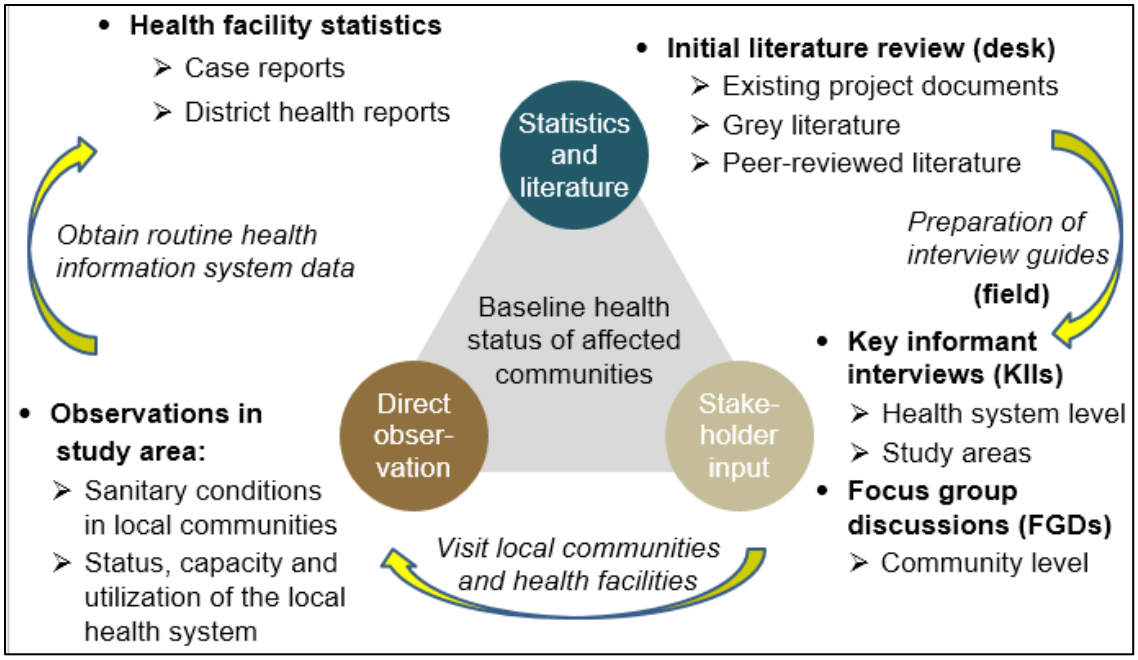

Figure 5: Process of data triangulation

1.5. National Health Overview

Wide disparities exist in health status across Kenya, closely linked to underlying socio-economic, gender and geographical differences. The country ranks in the low human development category at position 142 out of 189 countries/territories with a score of 0.59, according to the 2018 Human Development Index report [1]. Life expectancy at birth increased by 13 years between 2000 and 2016 [2].

1.5.1. Burden of Disease, Causes of Mortality and Risk Factors

The burden of disease in Kenya is predominantly as a result of communicable diseases, although there is a growing burden of non-communicable diseases and injuries. At the current trend, it is projected that non-communicable and communicable diseases will cause an equal burden of disease in the country by 2025 (refer Figure 6) [3].

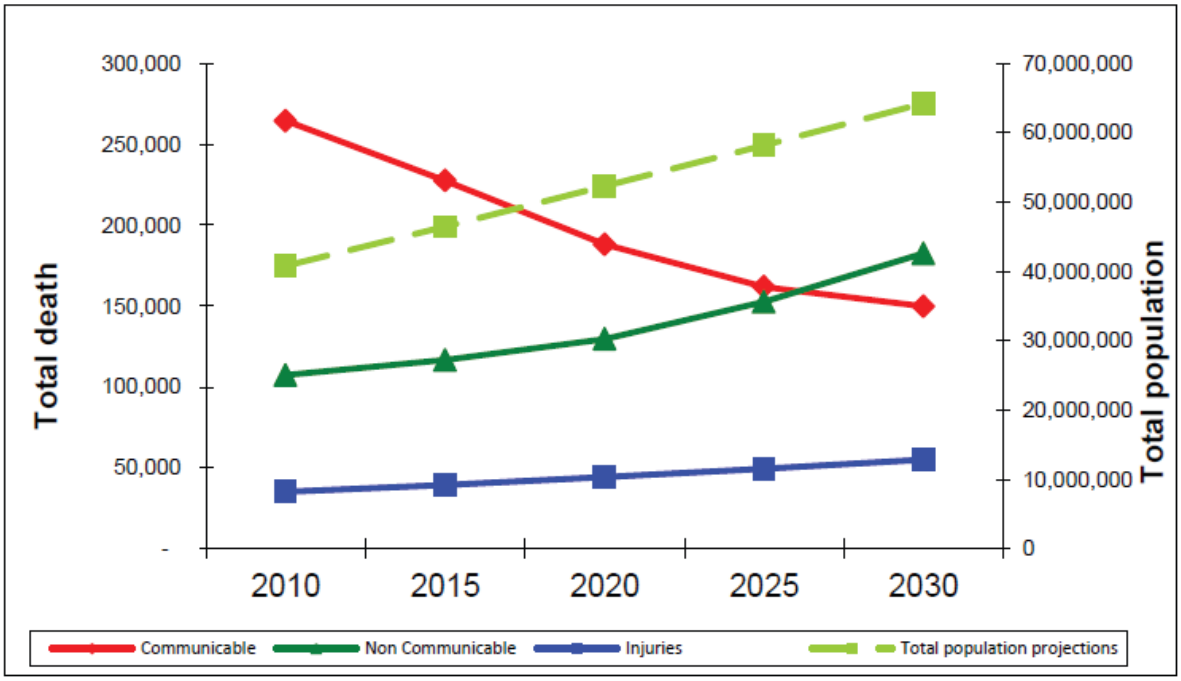

Figure 6: Projections of disease burden in Kenya, 2011-2030

Source: Health Sector Strategic and Investment Plan 2013-2017

Table 2 indicates the leading causes of disease burden in Kenya as measured by Disability Adjusted Life Years (DALY[2]). HIV/AIDS remain the foremost cause, followed by perinatal conditions, malaria, lower respiratory infections and diarrhoeal diseases [4]. The burden of disease due to HIV/AIDS and malaria has been reduced by over half (60%) over the last decade [4]. Tuberculosis, on the other hand, has recorded a significant increase in the burden of disease at an estimated increase of 18%. The burden from mental illness has also increased, most notably from depression.

[2] DALY's refers to time lost due to incapacity arising from ill health

Table 2: Leading causes of disease burden (DALYs) in Kenya (2016)

Rank	Disease/Morbidity	% of DALY	%Change (2005-2016)
1.	HIV/AIDS	24.2	-60% (decrease)
2.	Perinatal conditions	10.7	-10% (decrease)
3	Malaria	7.2	-59% (decrease)
4	Lower respiratory infections	7.1	-22% (decrease)
5.	Diarrhoeal diseases	6.0	-28% (decrease)
6	Tuberculosis	4.8	+18% (increase)
7.	Road traffic accidents	2.0	-
8.	Congenital anomalies	1.7	-
9.	Violence	1.6	-
10.	Depressive disorders	1.5	+30% (increase)

Source: Institute for Health Metrics and Evaluation (IHME) Burden of Disease estimates 2016

1.5.1.1. Causes of Mortality

The primary causes of death in Kenya, according to the 2016 Institute for Health Metrics and Evaluation (IHME) burden of disease estimates, are graphically represented in Figure 7 [4]. Diarrhoeal diseases was identified as the top cause of deaths in 2016, followed by HIV/AIDS and lower respiratory infections. Ischaemic heart disease and cerebrovascular disease (stroke) emerged among the top-five, increasing by 37% and 21% respectively since 2005, underlining the increasing burden from non-communicable diseases. During the same period, deaths due to malaria declined by 58% [4].

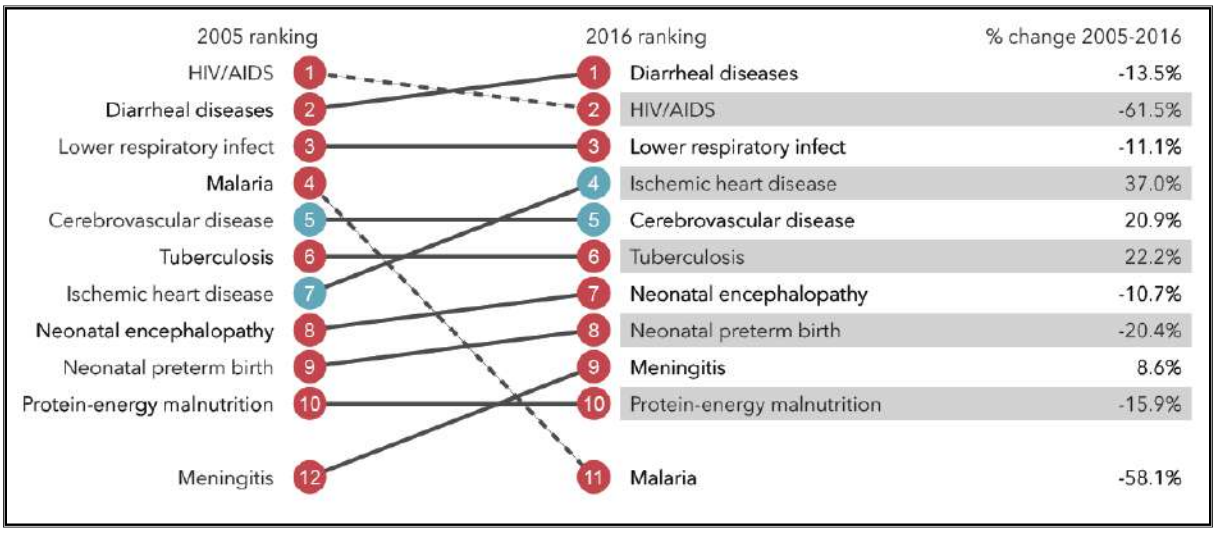

Figure 7: Leading causes of deaths in Kenya, 2016

Source: IHME Burden of Disease estimates 2016

1.5.1.2. Risk Factors for Disease

The leading risk factors for disease burden in Kenya are malnutrition, water, sanitation and hygiene related risk factors (WASH), high-risk sexual conduct, air pollution, alcohol/drug abuse, high blood pressure, dietary- and occupational risks, tobacco use and elevated blood glucose [4].

1.5.2. Health Policy Framework and Linkages with Development Agenda

Strategic directions and government priorities in health are determined and articulated in a number of key statements and policy documents (refer Table 3).

Table 3: Kenya health policy framework

Policies and Strategic Plans	Summary
The Constitution of Kenya (2010)	The Constitution provides an overarching legal framework for ensuring more comprehensive and people-driven, rights–based approach to health. These are premised on the principles of equity and participation. Additionally, two critical chapters of the Constitution, the Bill of Rights and the devolved government, introduce new ways of addressing health problems, and have direct implications on the health sector's focus, priorities and functioning.
The Kenya Vision 2030	The document is a national long-term development plan for the Kenya with an aim to create "a globally competitive and prosperous country by 2030, transforming from a low income to an industrialising middle-income country, providing a high quality of life to all its citizens in a clean and secure environment". To improve the overall livelihoods of Kenyans, the country aims to provide an efficient, integrated, high-quality and affordable health care system. Priority is given to preventive care at community and household level, through a devolved system of health care.
The Kenya Health Policy 2014-2030	The health sector has established a national health policy to guide attainment of the long-term health goals sought by the country as outlined in the Constitution of Kenya 2010 and Vision 2030. It focuses on adopting a 'human rights-based approach' and maximising the 'health contribution to overall national development'.
The Kenya Health Sector Strategic and Investment Plan 2014-2018	This document defines the medium-term focus, goal, mission, objectives and priorities of the health sector which will facilitate the attainment of the Kenya Health Policy objectives. It guides national and county governments plus partners on the operational priorities that they need to focus on in addressing the health agenda.
Global Health Commitments	While these are numerous, the critical ones that have informed the country's strategy focus and priorities include: • The International Health Regulations – to guide the country on key actions needed to assure adherence to international health regulations.

Policies and Strategic Plans	Summary
	• The Ouagadougou Declaration on Primary Health Care (PHC) and Health Systems – a reiteration of the principles of the PHC approach, within the context of an overall health system strengthening approach. • International Health Partnerships on Aid Effectiveness. • The Sustainable Development Goals (SDGs) – a focus on global efforts towards improving health impacts. • The Abuja Declaration – to support the improvements of health systems in the country by domesticating the provisions through national legislation. By signing the Abuja Declaration, Kenya committed to allocate 15% of government expenditure to health. • International Human Right agreements such as International Declaration for Human Rights, Convention on the Elimination of all Forms of Discrimination against Women, Child Right Convention, the International Conference on Population and Development programme of action and the Beijing Declaration and Platform of Action.

Source: Information from various sources

1.5.3. Health System and Service Delivery

Kenya has implementied a decentralised system of health governance, through which health services have been fully devolved to 47 counties. At the national level, health leadership is provided by the Ministry of Health (MoH). The country's health care is organised in a four-tiered system (see

Table 4) [5, 6].

This has replaced the six levels defined under the Kenya Essential Package for Health (KEPH). Counties manage and supervise community health units, primary care units and county hospitals. The national referral facilities are semi-autonomous units managed by a board under the supervision of the MoH. Other semi-autonomous national health actors include:

- The Kenya Medical Supplies Agency (KMSA) which procures and provides drugs and other medical and non-medical supplies to all public health facilities,
- The National Hospital Insurance Fund (NHIF) which finances or subsidizes medical bills for members and their dependants,
- The Kenya Medical Research Institute (KEMRI),
- The National AIDS Control Council, and
- Public medical training colleges [5, 6].

Table 4: Tiers of the health care system in Kenya

Tier	Description (Current classification)	KEPH Level (Old classification)	Catchment
I	**Community health units:** Serve as the first level of care and virtually comprises all community-based demand creation activities, that is, the identification of cases that need to be managed at higher levels of care	I - Community	5,000
II	**Primary care units:** This level is made of all dispensaries, health centres and maternity homes for both public and private providers and is essentially the first level of contact with a health facility	II - Dispensaries	10,000
		III - Health Centres	30,000
III	**County referral services:** These are county referral hospitals operating in, and managed by a given county and comprise the former level 4 and level 5 district hospitals	IV - District Hospitals	100,000
		V - Provincial Hospitals	1,000,000
IV	**National referral services:** These consist of facilities that provide highly specialised services and include all tertiary referral facilities.	VI - National Hospitals	Entire Country

Source: Kenya Health Sector Human Resources Strategy 2014-2018

1.5.4. Health Management Information System

Kenya has a routine health management information system (HMIS) to record, generate and manage health information to guide evidence-based decision making in the provision of health and related services at the national, county and local levels. Inherent weaknesses in the health information system has been identified as one of the key challenges of the country's health sector. The weaknesses include inadequate capacities of HMIS staff, unskilled personnel handling data, lack of integration, many parallel data collection systems, and poor coordination, amongst others.

1.6. General Health Profile of the Project Counties

The leading causes of morbidity in the Project area are shown in Table 5. This is based on secondary data from HMIS and primary data from key informant interviews and health facility assessments. In general, the leading causes of morbidity in the area are respiratory infections/diseases, diarrhoeal diseases, skin diseases, pneumonia, and unspecified fevers. Malaria (confirmed) was listed among the top-five cause of morbidity in Turkana County. The burden of malaria in Lamu has significantly reduced and the disease no longer features among the top-ten. Infections of the eye and ear are also common, as well as intestinal worms. Non-communicable diseases, notably hypertension, are an emerging concern. Malnutrition featured prominently among child morbidities in Turkana, Garissa, Isiolo, and Samburu but the burden could be underestimated as many mild to moderate cases remain at the community level and are not reported through the HMIS.

Table 5: Leading causes of morbidity in the Project area

Project County	Morbidity (children <5 years)	Morbidity (>5 years)
Turkana	• Upper respiratory infections (44.4%) • Malaria, confirmed (16.0%) • Diarrhoeal diseases (15.0%) • Other respiratory diseases (5.7%) • Pneumonia (4.5%) • Skin diseases (3.6%) • Malnutrition (1.7%) • Other diseases (fevers, ear, eye infections, tonsillitis, etc)	• Respiratory diseases (36.2%) • Malaria, confirmed (19.7%) • Diarrhoeal diseases (6.5%) • Pneumonia (4.9%) • Skin diseases (4.5%) • Urinary tract infections • Other diseases (eye infections, injuries, arthritis, etc)
Lamu	• Upper respiratory infections (40.1%) • Skin diseases (11.9%) • Diarrhoeal diseases (10.5%) • Other respiratory diseases (7.5%) • Pneumonia (4.9%) • Fevers, unspecified (3.9%) • Other diseases (tonsillitis, intestinal worms, ear and eye infections, asthma, etc)	• Respiratory infections (25.6%) • Skin diseases (9.2%) • Urinary tract infections (7.8%) • Other respiratory diseases (7.3%) • Diarrhoea diseases (4.3%) • Hypertension (3.2%) • Other diseases (joint, dental and eye disorders, injuries, etc)
Garissa	• Upper respiratory infections (22.1% • Diarrhoeal diseases (6.5%) • Skin diseases (2.7%) • Other respiratory diseases (2.7%) • Pneumonia (2.5%) • Other diseases (tonsillitis, intestinal worms, urinary tract infections, eye and ear infections, malnutrition etc)	• Respiratory diseases (33.2%) • Urinary tract infections (19.3% • Skin diseases (4.7%) • Diarrhoeal diseases (4.1%) • Pneumonia (3.7%) • Other diseases (typhoid fever, joint, ear, dental, eye diseases, malaria, hypertension, etc)
Meru	• Upper respiratory infections (46.7% • Intestinal worms (8.1%) • Other respiratory diseases (7.5%) • Diarrhoeal diseases (6.8%) • Skin diseases (5.9%) • Pneumonia (4.5%) • Other diseases (tonsillitis, ear/eye infections, urinary tract infections, malaria etc)	• Respiratory diseases (34.6%) • Arthritis/joint disorders (13.7%) • Intestinal worms (8.4%) • Skin diseases (5.5%) • Urinary tract infections (4.6%) • Hypertension (4.2%) • Other diseases (diarrhoea, injuries, ear, dental, eye diseases, etc)
Isiolo	• Upper respiratory infections (41.5%	• Respiratory diseases (31.5%)

Project County	Morbidity (children <5 years)	Morbidity (>5 years)
	• Diarrhoeal diseases (11.7%) • Other respiratory diseases (6.2%) • Skin diseases (5.3%) • Pneumonia (4.1%) • Other diseases (tonsillitis, ear/eye infections, intestinal worms, fevers, malnutrition, malaria etc)	• Arthritis/joint disorders (6.1%) • Urinary tract infections (5.1%) • Skin diseases (5.1%) • Diarrhoeal diseases (3.8%) • Other diseases (intestinal worms, injuries, ear, dental, eye diseases, malaria, etc)
Samburu	• Upper respiratory infections (44.2% • Diarrhoeal diseases (13.6%) • Pneumonia (9.7%) • Other respiratory diseases (9.0%) • Skin diseases (5.1%) • Eye infections (4.6%) • Malaria, confirmed (3.3%) • Other diseases (tonsillitis, ear infections, intestinal worms, fevers, malnutrition, injuries etc)	• Respiratory diseases (46.2%) • Skin diseases (5.9%) • Ear infections (3.9%) • Malaria, confirmed (3.9%) • Diarrhoeal diseases (3.5%) • Urinary tract infections (2.2%) • Other diseases (eye infections, injuries, arthritis, sexually transmitted infections, etc)

Source: HMIS 2018 and primary data from key informant interviews

1.6.1. Health Infrastructure

Health service provision in the Project counties is centred around the tenets described by both the Kenya Essential Package for Health and Schedule IV of the Kenya Constitution 2010. These define mandates, roles and responsibilities for interventions and service delivery at Level 1 (community), Level 2 (dispensary), Level 3 (health centre), Level 4 (sub-county hospital) and Level 5 (county referral hospital) of the health system.

At a national level, the MoH directs the overall policy direction and the overarching goals for which the county governments align their strategies and plans. Table 6 provides a summary of the health infrastructure in the Project counties. An estimated half of the facilities are public (government owned) [7], 38% private-for-profit, 10% faith-based organisations (FBOs) and 3% owned by non-governmental organisations (NGOs) [7].

Table 6: Health facilities in the Project area, 2018

Cadre	Samburu	Isiolo	Meru	Garissa	Lamu	Turkana	Kenya
Tertiary Hospital (Level 6)	0	0	0	0	0	0	4
Secondary Hospital (Level 5)	0	0	2	1	0	1	28
Primary Hospital (Level 4)	3	3	23	17	4	5	712
Health Centre (Level 3)	10	8	39	34	7	27	1,715
Dispensary (Level 2)	46	38	185	53	31	169	4,507
Medical Clinic (Level 2)	15	3	247	61	18	22	3,351
Other	1	0	4	0	0	1	217
Total	**75**	**52**	**500**	**166**	**60**	**225**	**10,534**

Source: Kenya Health Facility Master List (accessed December 2018)

1.6.2. Health System Challenges

A summary of the high-level health system challenges in the study area are noted in Table 7, based on primary data collected during KIIs conducted during field work.

Table 7: Health system challenges in the Project area

Project County	Challenges	Contributing factors
Samburu	• Inadequate human resources • Inadequate health infrastructure • Poor health seeking behaviour • Negative cultural practices – such as female circumcision and beading • Food insecurity and malnutrition • Vastness of geographical area and sparse population • Insecurity • Poor access to safe drinking water and sanitation • High illiteracy level • Nomadic lifestyle • Poverty	• High staff attrition rate, insecurity and remoteness makes place less attractive to staff. • Vastness of geographical area, poor terrain and hard to reach areas contributes to poor heath seeking behaviour • Arid and semi-arid climate (food insecurity) • Historical marginalisation
Isiolo	• Inadequate health infrastructure (50 km average distance to a health facility) • Inadequate human resources • High burden of communicable diseases • Poor health seeking behaviour • Food insecurity • Nomadic lifestyle • Insecurity and ethnic conflicts • High illiteracy level • Increasing burden of HIV • Poverty • Home deliveries and high maternal mortality • Poor sanitation coverage	• Historical marginalisation • Vastness of geographical area and poor road network • Arid and semi-arid climate (food insecurity) • Rapid population influx (especially Isiolo town) • Health system inefficiencies such as inadequate ambulances and weak referral systems contribute to high maternal mortality
Garissa	• Inadequate health infrastructure (35 km average distance to a health facility) • Inadequate human resource capacity • Inadequate medical supplies and equipment • High illiteracy and poor awareness • Food insecurity and malnutrition • Nomadic lifestyle • Insecurity • Large refugee population (Dadaab camp) • High maternal mortality • Vastness of county and remoteness of certain locations • Poor immunisation coverage • Poverty	• Historical marginalisation • Vastness of geographical area and poor road network • Arid and semi-arid climate (food insecurity) • Health system weaknesses • Porous borders contribute to influx from Somalia

Project County	Challenges	Contributing factors
Meru	• Increasing burden of non-communicable diseases • High burden of communicable diseases especially upper respiratory infections • Inadequate medical supplies and consumables • High demand for services • Overstretched Meru RRH • Increasing burden of road traffic accidents • Low immunisation coverage especially in the north	• Changes in diet and lifestyle • Population influx and increasing mobility • Overcrowded settlements in some areas • Weakness of referral systems • Insecurity in the northern border with Isiolo
Lamu	• Increasing burden of NCDs • High burden of communicable diseases • Maternal health challenges • Inadequate health infrastructure • Inadequate medical supplies and consumables • Accessibility challenges • Poor access to safe drinking water (in rural areas)	• Changes in diet and lifestyle • Overcrowded settlements in some areas (especially Lamu Island) • Insecurity especially in Lamu East • County is made of several small islands (65 in number) some of which are hard to reach. • Poor road network
Turkana	• Inadequate health infrastructure (35 km average distance to a health facility) • Inadequate human resources for health coupled with low capacity • Food insecurity and high rates of malnutrition • High demand for health services • High burden of communicable and infectious diseases (HIV, TB, ARIs, etc) • Frequent outbreaks of diseases (cholera, typhoid fever, malaria) • Poor health seeking behaviour • Poor access to safe drinking water and sanitation • Insecurity in certain areas • Population mobility/nomadic lifestyle • Emerging burden of non-communicable diseases • Referral system challenges	• Arid and semi-arid climate predisposes to food insecurity • Historical marginalisation • Vastness and remoteness of geographical area, that is sparsely populated hampers service delivery • Population influx in urban and peri-urban areas • Vulnerabilities associated with border location • Large refugee population • Low literacy levels • Negative cultural practices (such as use of traditional medicines) • Ethnic conflicts • Changes in lifestyle and rapid urbanisation

Source: Baseline primary data

1.7. Baseline Status according to Environmental Health Area

1.7.1. EHA 1: Communicable diseases linked to the living environment

1.7.1.1. Baseline Condition

Housing

The mean size of a Kenyan household is estimated at 3.9 persons per home, a reduction from 4.2 recorded in 2008. Rural households are generally larger (4.4 persons) than urban households (3.3 persons) [8, 9]. Over half (54%) of Kenyan households live in dwellings made of earthen floors and more than half (53%) utilise only one room for sleeping [9]. Three-quarters (75%) of households use solid fuels (wood, charcoal, dung, etc) for cooking and these remain the predominant fuel (94%) in rural areas [9].

Use of solid fuels for cooking increases indoor pollution and the risk for respiratory diseases. Poor housing emerged as a major theme in all the Project counties and was directly linked to poverty and exposure to disease causing vectors. Table 8provides a summary of the prevailing housing characteristics in the Project area.

Table 8: Housing characteristics in the Project area

County	Housing Characteristics
Turkana	Temporary structures (*manyattas*) constitute the majority of housing in all areas; both rural and urban. The temporary units are mainly constructed by nomads (who form the bulk of the County population) because of their migratory lifestyle. Semi-permanent houses are largely mud-walled and roofed with *makuti* (grass) or iron sheets in towns or peri-urban areas. Permanent housing structures are generally few and mainly found in urban centres.
Lamu	Factors that influence housing in the county include availability of raw materials, culture, climate, and settlement patterns. Mud/wood remains the most used walling material at 47%. Commonly used roofing materials are m*akuti* (35%), corrugated iron sheets (37%), and grass (16%). Earthen floors are the predominant flooring material at an estimated 63%. The majority of housing structures are poorly ventilated.
Garissa	High percentage of the population live in shanties/manyattas which are prone to fire disasters among others. The majority of housing (43%) is constructed use grass walls, while 19% are mud/wooden walls. Only 13% of households reside in brick/block walled houses. The demand for housing is currently greater than the supply. The county is large and sparsely populated with concentration of population in areas with infrastructural facilities.
Meru	The county is characterized by inadequate and unaffordable housing, particularly for low income earners in urban areas and equally so, in rural areas. The county also faces the problem of low level of urban home ownership and extensive and inappropriate dwelling units including slums and squatter settlements that are poorly ventilated. Corrugated iron sheets accounts for 98% of roofing materials while walls and floors vary from mud, wood and bricks/blocks.
Isiolo	Most housing (74%) are temporal poorly ventilated structures made of mud, grass and stick/wood (manyattas). Permanent housing structures are only found in Isiolo town and other urban centres.
Samburu	*Manyattas* are the predominant housing structure. Maralal, Wamba and Baragoi towns have some decent housing with several government quarters which house civil servants. Informal settlements are emerging in the town centres.

Source: Official county documents

Acute Respiratory Infection

Acute respiratory infection (ARI) is a leading cause of disease burden in Kenya [4, 10]. According to facility based data, respiratory diseases account for at least one-third of health consultations in public facilities (34% in 2017, 39% in 2016 and 40% in 2015) [10]. The burden of ARI is more pronounced among children under five years of age, where it accounts for 18% of all deaths [11]. Respiratory infections were found to be prevalent in the entire study area and were consistently listed among the top three cause of morbidity in each of the Project counties by stakeholders. In many cases, these were attributed to environmental conditions such as poor housing, dry and dusty weather in Turkana, Garissa, Isiolo, Samburu and Lamu and cold weather in Meru. Pneumonia was reported as one of the leading causes of hospitalisation and deaths among young children. Figure 8shows the incidence rate of pneumonia according to outpatient records for 2018. All of the Project counties recorded pneumonia rates above the national average of 8.5%, with the highest proportion noted in Samburu County.

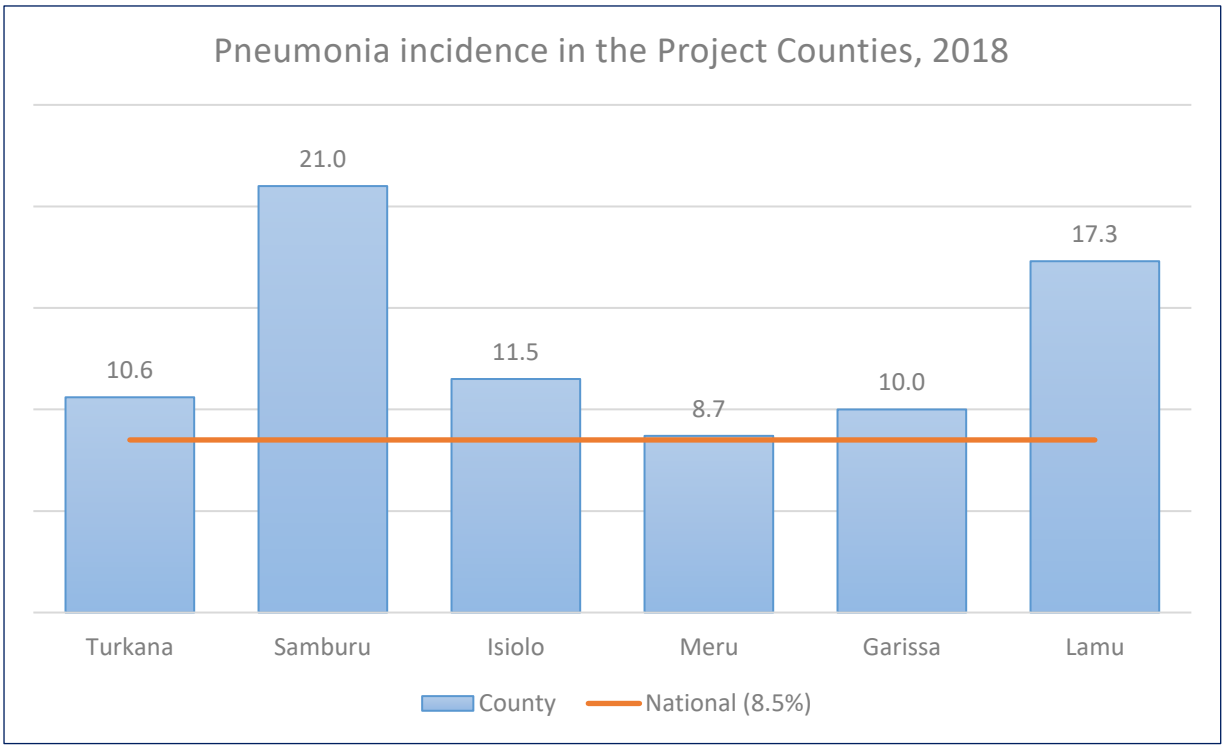

Figure 8: Pneumonia incidence in children under five years, 2018

Source: HMIS 2018

Tuberculosis

The burden of disease associated with tuberculosis (TB) in Kenya is among the highest in the world. The country currently ranks among the thirty high TB burden countries that collectively account for more than 80% of the global TB cases. The disease affects all age groups, but has its greatest toll in the country's most productive age-group of 15-44 years [12]. Nearly a third (31%) of the TB patients are co-infected with HIV/AIDS [13]. This is further complicated by the emergence of multi-drug resistant TB (MDR-TB). Rifampicin resistance is as high as 26% among new cases and occurs in 42% of relapsed cases [14]. A national TB prevalence survey conducted in 2016, reported a prevalence of 558 per 100,000 people, more than double the 2015 estimates of 233 per 100,000. No official survey has been conducted on the incidence rate of TB, but it was estimated at approximately 348 per 100,000 in 2016. The country has managed to maintain a 70% case detection rate and 85% treatment success rate since 2006. The current diagnostic criteria , i.e. symptom screening for TB through the use of questionnaires and sputum analysis, has low detection rates and it is estimated that nearly half (50%) of all cases may go undetected [12].

TB is endemic in the Project area with the case notification rates as shown in Figure 9. Among the five counties, Isiolo recorded the highest case notification rate of 372 per 100,000, followed by Meru (268/100,000) and Lamu (255/100,000) [15]. Findings from KIIs show that Meru County ranks among the top-five TB burden counties nationally and the majority (75%) of cases are concentrated in the north. Health seeking behaviour for TB cases remains a challenge in the entire study area with delays of presentation to health facilities confounded by use of alternative medicine. Lack of isolation facilities for treatment of confirmed TB cases was also a concern with cases being managed from home, increasing the risk for further transmission.

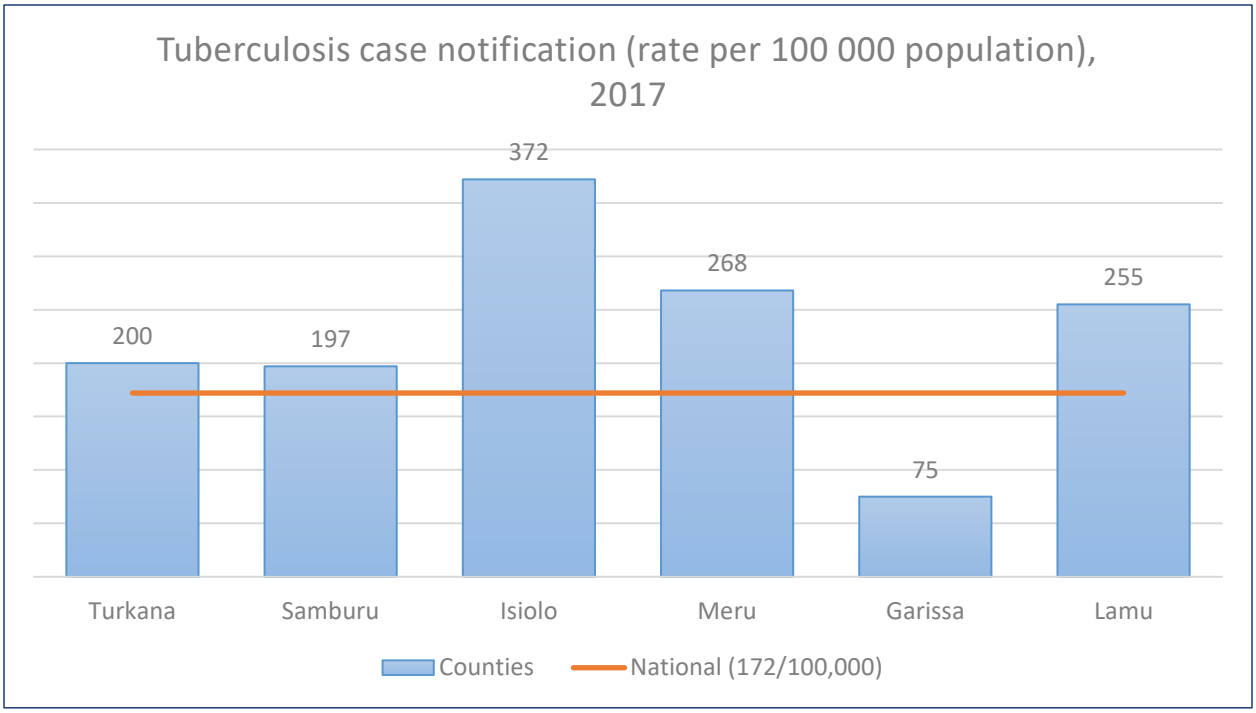

Figure 9: Tuberculosis case notification rates in the Project counties, 2017

The total number of TB cases recorded in the study area during 2017, are shown in Figure 10. Meru County recorded the highest number, with a total of 2,655 bacteriologically confirmed cases as well as the highest number of drug resistant TB cases at 45 in 2018. Turkana County recorded the second highest

number of TB cases (1,182 cases bacteriologically confirmed) while Lamu County registered the lowest number of TB cases at 138 [15].

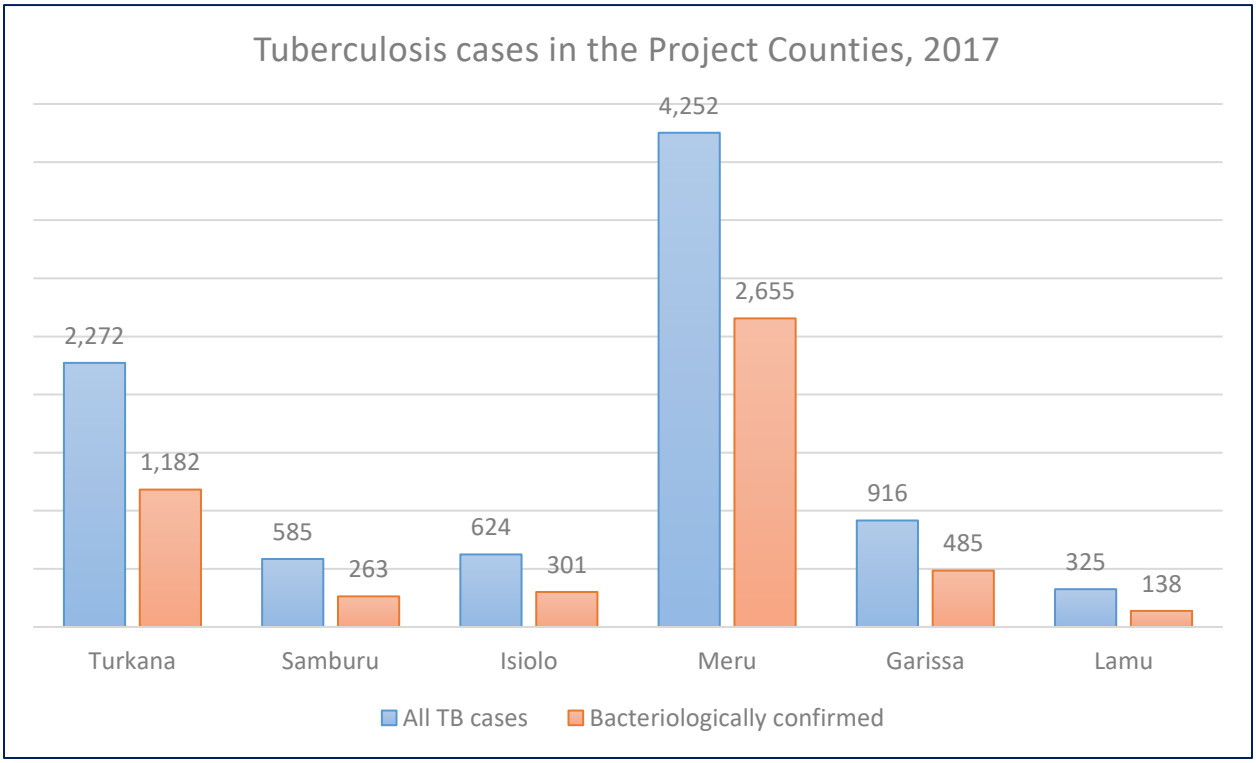

Figure 10: Tuberculosis cases in the Project counties, 2017

Source: NTLD-Programme Annual Report 2017

A summary of other TB indicators from each Project county as well as the comparative metric from the national level, is provided in Table 9. These give a summary of other TB indicators including treatment success rates, TB-HIV co-infection, access to services, etc. All the Project counties recorded limited access to diagnostic and treatment services with <50% GeneXpert utilisation rate. Treatment success rate for confirmed new TB cases was generally good and above the minimum threshold of 80% (except for Turkana County which recorded this at 79%) [15].

Table 9: Tuberculosis indicators in the Project counties, 2017

Indicator	Turkana	Samburu	Isiolo	Meru	Garissa	Lamu	Kenya
TB case notification rate (per 100,000)	200	197	372	268	75	255	172
Diagnostic sites, smear microscopy (num	27	5	8	73	30	14	537
GeneXpert sites (num)	2	1	2	5	2	1	32
GeneXpert utilisation rate (%)		-	19	43	21	33	49
TB treatment sites (num)	49	34	26	122	31	24	3,618
Treatment success rate (% confirmed cases)	79	90	82	84	89	86	81
TB cases that are children (<15 years) (%)	19	15	12	7	14	15	9
Drug resistance (num, all forms)	21	-	4	29	69	1	577
TB-HIV co-infection rate (%)	22	25	17	19	3	13	28
TB death rate (% new cases)	2	5	4	5	3	5	6

Note: Source: NTLD-Programme Annual Report 2017 and baseline primary data

Leprosy

Kenya is currently in the post elimination phase of leprosy control, having achieved the WHO elimination target of less than 1 case per 10,000 people in 1989 [12]. However, there are some recent concerns over increasing cases in the coastal region and pockets of re-emergence [16]. In 2017, 20 counties reported at least one leprosy case. Leprosy surveillance is well integrated in the health care system. Baseline findings show that Meru County recorded two new confirmed cases of leprosy in 2018 compared to 1 in 2017. Turkana, Samburu, Isiolo, Garissa and Lamu have not recorded any confirmed leprosy cases over the past three years.

Measles

Measles remain a public health challenge in all parts of Kenya, with sporadic outbreaks [17].Routine measles vaccine coverage at a national level is generally high (80-89%) [9]. The proximity of Somalia and South Sudan, however, has led to the influx of refugees and immigrants, many of whom are not vaccinated against measles. This has led to several outbreaks in the past few years, often occurring in refugee camps or informal communities [18].

Therefore, the risk of measles in the study area remains the greatest in Garissa County which hosts the largest refugee camp in Kenya with further risk of imported cases from Somalia. HMIS data (see Table 10) show that a total of 119 measles cases were notified in the study area during 2018 with most cases occurring in Garissa followed by Turkana (35 cases), Samburu and Isiolo (17 cases). Only Garissa County recorded measles deaths.

Table 10: Measles cases and deaths in the Project counties, 2016-2018

County	2018		2017		2016	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Turkana	35	0	232	0	14	0
Samburu	17	0	6	0	5	0
Isiolo	17	0	4	0	1	0
Meru	9	0	12	0	1	0
Garissa	41	0	40	7	106	3
Lamu	0	0	0	0	0	0

Source: HMIS and Baseline primary data

Meningitis

The north-western tip of Kenya lies within the African meningitis belt which covers 26 countries in sub-Saharan Africa. Outbreaks of meningococcal meningitis in the belt are generally associated with seasonality linked to semi-arid areas (dust being a predisposing factor). The risk of meningococcal meningitis outbreak in the country remains generally low. The disease did not emerge as a public health concern in the Project area, but it remains an important consideration.

1.7.1.2. Trend in Condition

The burden of disease associated with ARIs remains high with no particular change over the preceding years. Seasonal spikes in both the dry and rainy seasons were also reported by stakeholders.

All Project counties reported increasing cases of new TB infections. These were partly attributed to improved diagnostics, especially the use of GeneXpert machine that provides immediate and more accurate results, as well as active case finding through the screening of suspected cases at facility level. Drug resistance has also shown an upward trend, especially in Meru County where 45 drug resistant cases were reported in 2018 compared to 29 reported in 2017, 22 reported in 2016, and 12 reported in 2015.

1.7.2. EHA2: Vector-related diseases

1.7.2.1. Baseline Condition

Malaria

Malaria remains a public health problem in Kenya with around 70% of the population at risk of contracting the disease [19]. Children under fifteen years of age are considered to be at particular high risk. The predominant malaria parasite is noted as *Plasmodium falciparum* [19], with the major vectors being the anopheles species, notably *An. gambiae*, *An. arabiensis*, *An. funestus*, and *An. merus*. The country is divided into four malaria epidemiological zones as shown in Table 11 [20, 21].

Table 11: Epidemiological zones of malaria in Kenya

Malaria Zone	Description	Prevalence	Project County
Endemic areas	Areas of stable and intense malaria transmission throughout the year with high annual entomological inoculation rates. Includes the Lake Endemic and Coastal Endemic areas which are home to 29% of the country's population.	>20%	Lamu
Highland and epidemic-prone areas	Malaria transmission in the western highlands is seasonal with considerable year-to-year variation. The entire population is vulnerable and case-fatality rates during an epidemic can be greater than in endemic regions. Approximately 20% of Kenyans live in these areas.	5-20%	None
Seasonal transmission areas	This epidemiological zone includes the arid and semi-arid areas of northern and central parts of the country, which experience short periods of intense malaria transmission during the rainy seasons. Although geographically the largest zone, only 17% of the population lives in these areas.	1–5%.	Turkana Samburu Isiolo Garissa Meru
Low risk areas	This zone covers 10 counties in the central highlands of Kenya including Nairobi. Approximately 34% of the population lives in this zone.	<1% to none	None

The National Malaria Control Programme (NMCP) in Kenya is responsible for the design and implementation of malaria control strategy. The core vector control strategies are the distribution of long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS) in targeted areas, and larval source management.

Malaria prevalence

The latest survey data from the national malaria indicator survey, conducted in 2015, show that the burden of malaria has shifted to older children. The disease prevalence amongst 10-14 year old is 11%, amongst children 5-9 years it is estimated at 10%, while the prevalence in children under5 years has been recorded at 5% [21]. The prevalence among children under5 years has dropped from an estimated 8% in 2010 [20]. The prevalence in children aged below 15 is demonstrated in Figure 11, stratified by epidemiological zones. The lake endemic zone recorded the highest prevalence of 27% followed by coastal endemic zone at 8% [21].

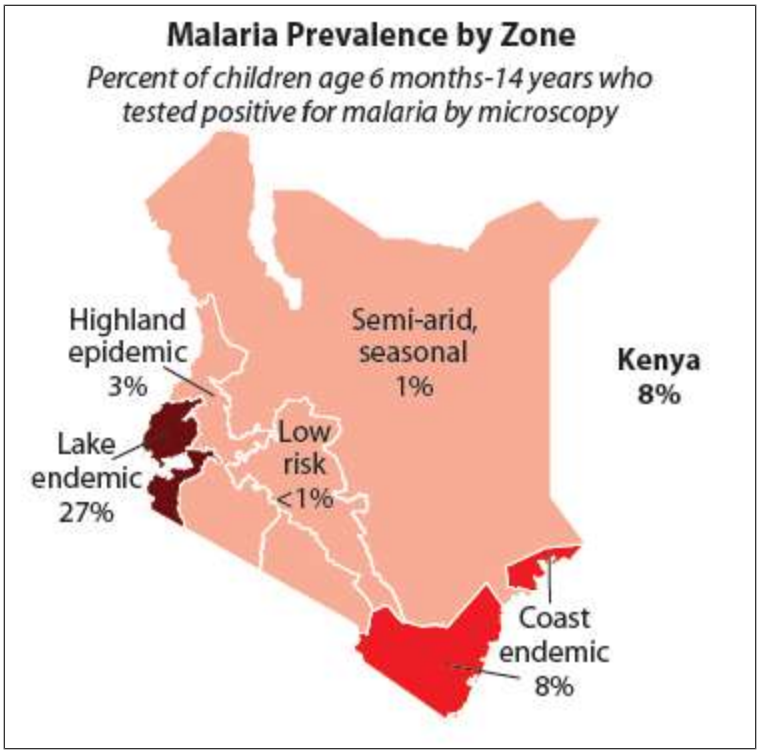

Figure 11: Malaria prevalence in children under 15 years, 2015

Source: KMIS 2015

Lamu County falls in the endemic coastal zone with a malaria prevalence of 8% among children under 15 years and LLIN coverage of 73% in 2015. Findings from KIIs however, indicate that malaria is no longer a major public health concern in Lamu due to a low recorded a positivity rate of just 3.5% in 2018. The county benefits from mass targeted malaria control strategies including free mass distribution of LLIN every three years and year-round facility-based issuance of LLIN to high risk groups (pregnant women and children under-5 years). The last mass LLIN distribution campaign was performed in early 2018. The rest of the Project counties (Turkana, Samburu, Isiolo, Meru and Garissa) lie within the low risk and seasonal malaria transmission zone with an overall prevalence of 1% [21]. Turkana County in particular, recorded a high case load for malaria, the disease ranking among the top-five morbidities [22]. Spike in case numbers during rainy season was reported as a concern in the seasonal transmission zone, which according to government policy, does not benefit from any malaria control measures aside from treatment and care. As a result, LLIN coverage in the seasonal malaria transmission zone remains very low and the population is considered vulnerable to severe malaria attacks during rainy-season epidemics. No IRS activity has been reported in the entire Project area.

Figure 12 shows the confirmed cases of malaria and deaths during 2018 as measured by rapid diagnostic test (RDT). Turkana County recorded the highest number of malaria cases despite being considered a low malaria risk zone. Samburu, Isiolo, Meru and Garissa also recorded a significant number of malaria cases. Key informants attributed this to increasing vector densities in the absence of any formal control measures. These findings have triggered the affected counties to formally request the NMCP to review their malaria epidemiological risk status and implement appropriate control measures, as required. Lamu recorded the lowest number of malaria cases, indicating a positive impact of malaria control programmes in the county.

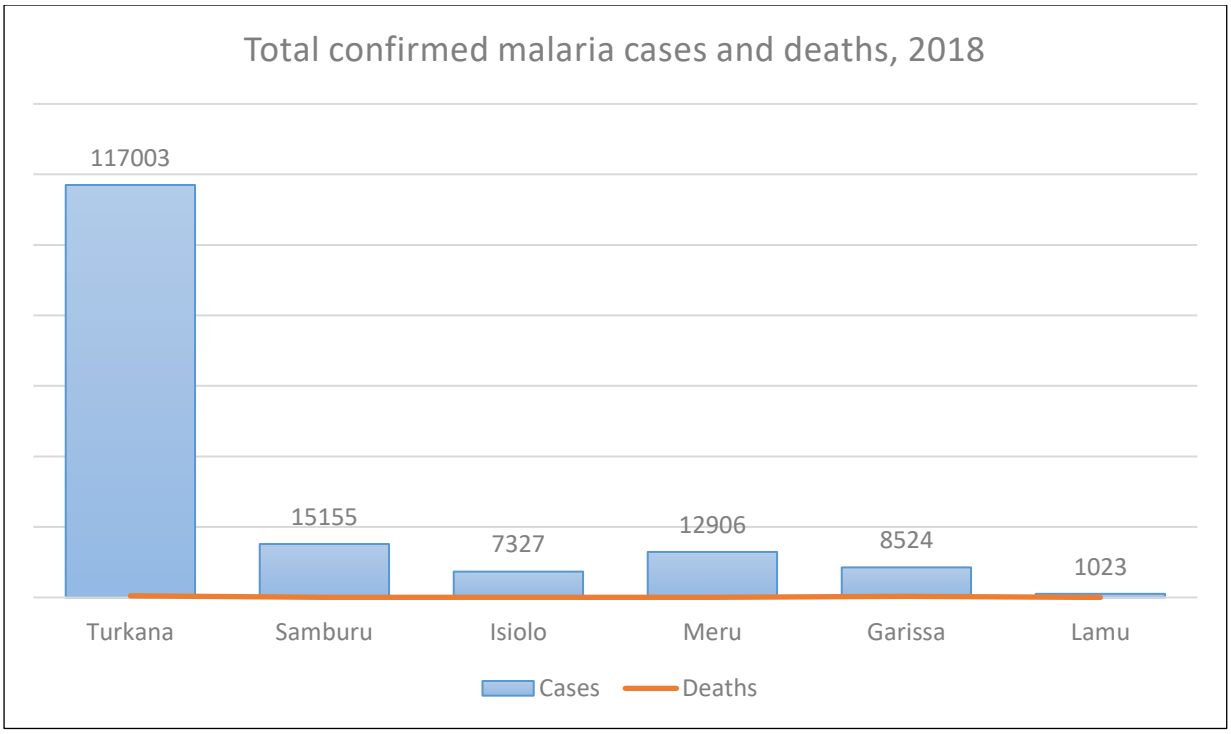

Figure 12: Confirmed malaria cases and deaths in the Project counties, 2018

Source: HMIS 2018

Arboviral Diseases

Arboviral diseases (arthropod borne viruses) occur in the Project area. These acute viral fevers (such as dengue, chikungunya, yellow fever, Rift valley fever) are transmitted by the day-biting Aedes mosquitoes which breed mainly in human-made containers. These diseases are often poorly documented in this kind of setting owing to limited awareness by health care providers and lack of diagnostic capability. Surveillance for yellow fever and Rift valley fever (RVF) is routinely conducted through the HMIS.

In 2017, Lamu county recorded twelve suspected cases of chikungunya of which five were laboratory confirmed. No deaths related to arboviral infections were recorded. The county also suffered a dengue outbreak in 2016 with several confirmed cases.

RVF is of particular concern in the pastoral communities of Lamu, Garissa, Turkana Isiolo and Samburu. The latest outbreak of RVF occurred in July 2018 and affected four counties (Wajir, Isiolo, Meru and Marsabit), resulting in 10 human deaths and several confirmed animal cases. The RVF cases in Isiolo County occurred in the sub-counties of Merti and Garbatulla and were confined to animals. Confirmatory diagnosis services for arboviral diseases are available at Kenya Medical Research Institute (KEMRI) reference labs.

Other Vector-borne diseases

Lymphatic filariasis (LF) is endemic in parts of Kenya, particularly the coastal region. The disease is transmitted by the same vector species of Anopheles mosquitoes that transmit malaria and are likely to share common environmental risk factors and overlap in geographical space. Within the Project area, the risk of LF is only relevant in Lamu County where an entomological study by the Kenyan Medical Research Institute (KEMRI) performed in 2015 reported a prevalence of 3%. The county implements an LF elimination programme which includes annual mass drug administration of ivermectin and albendazole. Onchocerciasis is present in a few areas, but at low, hypo-endemic levels. *Loa loa* and *Mansonella perstans* do not occur in Kenya.

Leishmaniasis, especially the visceral form (Kala-azar), is endemic in parts of Kenya, particularly in the Rift valley, eastern and north-eastern regions [23]. About 600 cases of leishmaniasis are expected annually with a case fatality rate of 7%. Kala-azar is a high risk in Turkana, Isiolo and Meru within the Project area [23]. The disease is an on-going epidemic and remains neglected and poorly reported. Findings from Isiolocounty show high endemicity in the sub-counties of Merti (where a treatment centre is located) and Garbatulla with a total of 51 confirmed cases in 2018. Diagnostic capabilities for Kala-azar using rapid serological tests were available in endemic areas and treatment is offered at no cost. Lamu, Samburu, Meru and Garissa did not record any cases of Kala-azar.

Human African Trypanosomiasis (sleeping sickness), a disease transmitted by tsetse fly, is endemic in the Lake Victoria basin and remains a risk to the rest of the country. The predominant species is *Trypanosoma b. rhodesiense*[24].The rural populations whose livelihoods depend on agriculture, fishing, animal husbandry or hunting are the most exposed to the tsetse bites. The disease is generally low risk in the Project area with few cases recorded.

1.7.2.2. Trend in Condition

Lamu County reported a subtle increase in the number of malaria cases and positivity rate from 2% in 2017 to 3.5% in 2018. Turkana County consistently recorded at least 100,000 confirmed malaria cases over the past three years. The rest of the Project area (Meru, Garissa, Samburu and Isiolo) did not report any particular trend in number of malaria cases but emphasized on seasonal spikes which were more severe during the 2017 and 2018 rainy season.

No reported trend on other vector-related diseases occasioned by challenges of documentation and data gaps.

1.7.3. EHA3: Soil-, water- and waste-related diseases

The prevalence of soil, water and waste-related diseases are highly dependent on the availability of sanitation facilities, sanitation practices and access to safe drinking water. These factors often show strong variations on national and regional levels.

1.7.3.1. Baseline Condition

Access to Drinking Water

According to the 2014 KDHS, access to safe drinking water is varied, as shown in Figure 13[25]. Within the Project area, access to safe drinking water was highest in Isiolo County (82%) and lowest in Turkana County (44%) while the rest of the counties recorded coverage between 49% and 71%.

Ground water (boreholes and shallow wells) was noted to be the most common source of drinking water in the Project area. Use of unsafe surface water (dams, seasonal rivers, lagoons) was reported, especially in Turkana, Samburu and Garissa and more so in rural areas. Most fresh water springs are situated within game reserves, and as such, not accessible to people. High water salinity was reported in Isiolo (affecting 58% of water sources), Turkana, and Lamu (affecting the bulk of ground water sources). Figure 14 shows some of the water sources in the study area. The counties considered access to safe drinking water a priority area and were implementing initiatives to improve the situation. In Meru County alone, 25 public boreholes were sunk in the 2017/18 financial year. A further hundred boreholes are planned to be constructed every year. Each of the counties has a water and sewerage company in place but the supply of piped water remains erratic and only limited to large urban areas.

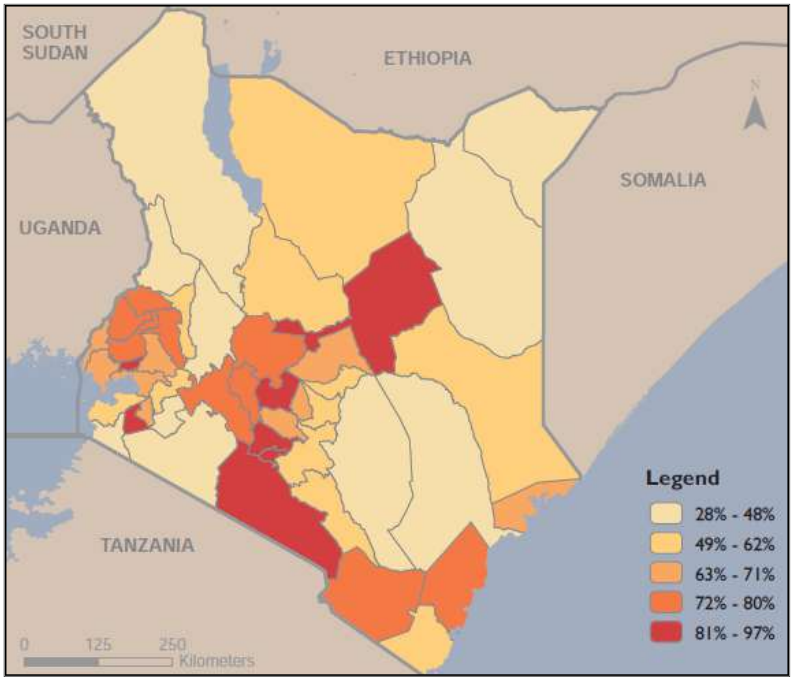

Figure 13: Access to safe drinking water in Kenya, 2014/15

Source: 2014 KDHS County Level Health Indicators Report

Figure 14: Examples of water sources in the study area

Access to Sanitation

Only 23% of Kenyan households have access to improved sanitation facilities, defined as non-shared facilities that prevent people from coming into contact with human waste and thus reduce transmission of waste related diseases. An additional 30% have shared toilet facilities [26].

Access to improved sanitation facilities shows a wide variation across the country, see Figure 15 [25], based on data from the 2014 KDHS. In terms of the Project counties, Turkana (at 3%) and Samburu (at 4%) recorded the lowest access to improved sanitation facilities. In regard to coverage of pit latrines, Meru County recorded high coverage of 98% followed by Lamu with coverage of 60%. Pit latrine coverage remained very low in Garissa (23%), Samburu (22%) and Turkana.

Open defecation was noted as a significant challenge in Garissa, Isiolo, Samburu and Turkana. This practise was directly linked to a high burden of waste-related diseases. The counties are implementing Community Led Total Sanitation (CLTS) strategy, an innovative community led drive to set up pit latrines with an aim of promoting sustainable sanitation through behaviour change and achieving open defecation free status.

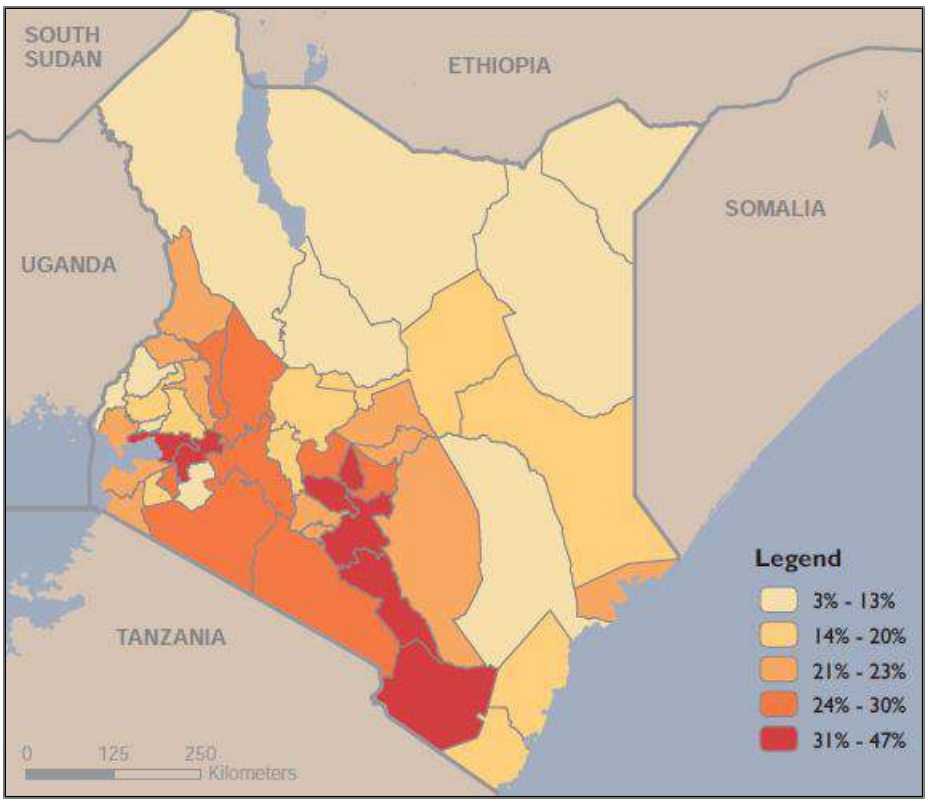

Figure 15: Access to improved sanitation in Kenya stratified by County, 2015

Source: KDHS 2014 County Level Health Indicators Report

Diarrhoeal Diseases

Diarrhoea is among the top five causes of disease burden nationwide, especially among young children, where it is responsible for 7% of all deaths. The high burden is associated with contaminated water, unhygienic practices in food preparation and improper waste disposal. Findings from KIIs show that diarrhoea was among the top five diagnosis in the study area with a variable burden across the different counties. The burden of diarrhoea was highest in Lamu, Turkana and Isiolo where it contributed at least one-third of the morbidity in children younger than five (see Figure 16).

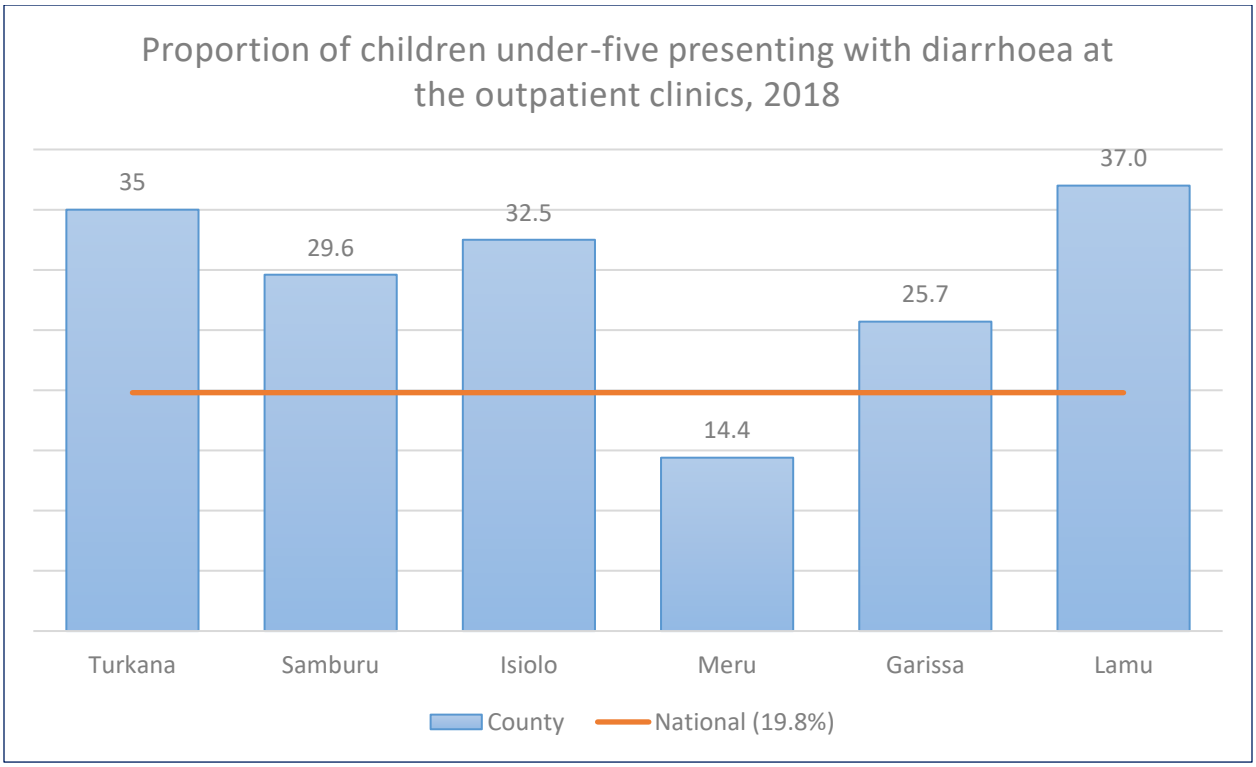

Figure 16: Diarrhoeal disease in the Project counties, 2018

Source: HMIS (2018)

Cholera, Dysentery and Typhoid Fever

Cholera is endemic in Kenya with widespread outbreaks occurring between 1997and 1999, 2007 and 2010 and more recently between 2015 and 2018. In 2017, the country recorded 3,967 cases of cholera and 76 deaths associated with this disease. The case fatality rate for this latest outbreak was calculated as 1.9% [27]. The outbreak occurred in 20 out of 47 counties (43%) including the counties of Garissa and Turkana where transmission was largely linked to the two large refugee camps, Dadaab and Kakuma, respectively [27]. Table 12 shows recent cholera outbreaks in the Project area and the number of cases and deaths. Turkana County experienced a large outbreak of cholera in 2018 that resulted in 1,042 cases and 11 deaths [28].

Table 12: Recent cholera outbreak in the Project area

County	Year of most recent outbreak	Number of cholera cases	Number of cholera deaths
Turkana	2018	1,042	11
Samburu	2008	unknown	unknown
Isiolo	2018	188	4
Meru	2018	4	1
Garissa	2018	122	15
Lamu	2016	14	0

Source: HMIS and Baseline field data

Typhoid fever is endemic in the Project area with thousands of cases recorded every year. Dysentery also remains a significant public health concern. These diseases are notifiable, and surveillance is done by weekly reporting of cases. HMIS data for 2018 show that Turkana (3,243 cases) and Meru (1,548 cases) recorded the highest number of dysentery cases (see Figure 17) [22]. Mortality as a result of dysentery was generally very low.

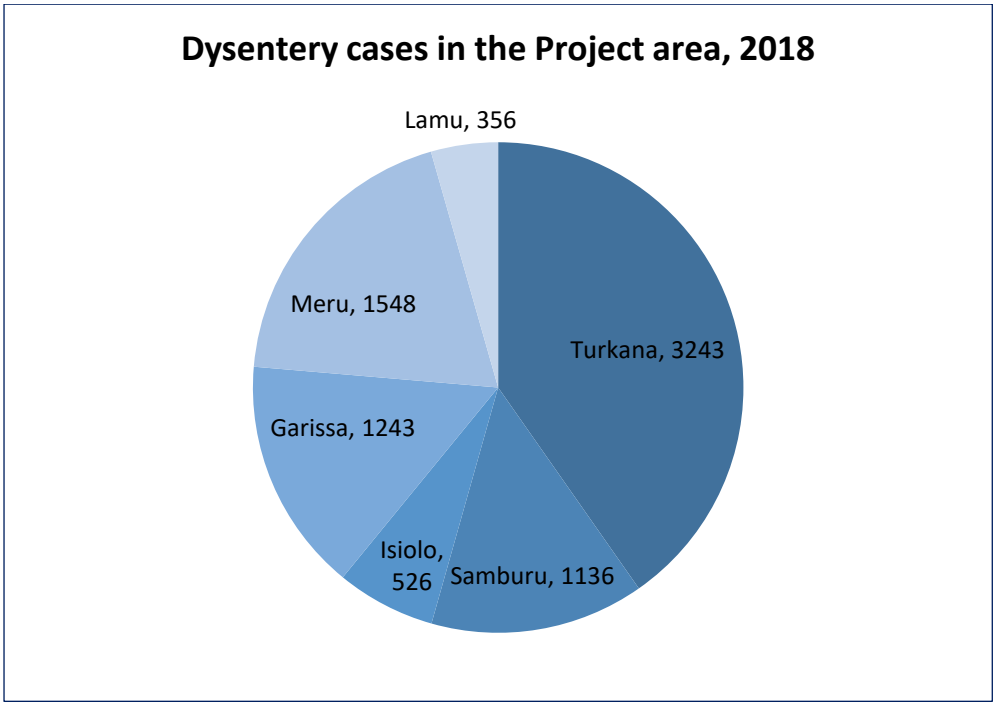

Figure 17: Dysentery cases in the Project area, 2018

Source: HMIS 2018

Intestinal Worms and Schistosomiasis

Intestinal worms are endemic throughout the study area with a higher prevalence in Samburu, Isiolo and Garissa due to underlying poor sanitation coverage. Intestinal worms are targeted for control through biannual mass drug administration of albendazole delivered through school health programme and child health clinics.

Schistosomiasis is endemic in parts of Kenya. Surveys have reported hotspots for *S.mansoni* (intestinal bilharzia) infection in the western lake region and a high prevalence of *S. haematobium* (uro-genital bilharzia) in the coastal region (14.8%) [29]. Findings from KIIs show that schistosomiasis occurs mainly in the southern part of Garissa (Ijara and Hulugho).

In Lamu County, uro-genital bilharzia is mainly reported in specific pockets, notably the Witu and Bargoni areas. Turkana County recorded 131 cases of schistosomiasis in 2018 and survey data shows a lower prevalence (<1%) [30]. Findings on the occurrence of schistosomiasis in Samburu, Isiolo and Meru were not conclusive.

Poliomyelitis

Kenya achieved polio free status in 2003 but recent imports of the virus from neighbouring countries have led to sporadic outbreaks in 2006, 2009, 2010, 2011 and 2013. These outbreaks occurred especially in northern Kenya and have been linked to ongoing polio circulation in Somalia and Southern Sudan [31]. Active surveillance is done through the HMIS notification of any cases of acid flaccid paralysis (AFP). In 2018, Isiolo and Meru recorded five and four cases respectively, while the rest of the Project counties recorded no cases. Garissa recorded its last AFP case in 2015 and Lamu in 2016.

Trachoma

Trachoma remains a public health concern in parts of Kenya, especially in the arid and semi-arid regions. The country is working towards elimination of the disease, which is a leading cause of preventable blindness. Baseline findings show that trachoma is present in certain foci in Turkana, Samburu and northern areas of Meru County. The rest of the Project area is considered free from trachoma but a theoretical risk remains.

1.7.3.2. Trend in Condition

Access to safe drinking water has shown a positive trend in the study area with the majority of counties allocating funds for construction of boreholes and working in collaboration with partners to provide safe water sources.

The burden of diarrhoeal diseases has declined, especially in the counties of Meru and Lamu. This was partly attributed to improvements in sanitation and hygiene behaviour such as hand washing. The potential for cholera, dysentery and typhoid outbreaks remain high in the entire area but the risk is greatest in Turkana and Garissa County which host large refugee population.

1.7.4. EHA4: Sexually-transmitted infections, including HIV/AIDS

1.7.4.1. Baseline Condition

HIV/AIDS

The HIV epidemic in Kenya has evolved, since the first case was diagnosed in 1984, to become one of the major causes of morbidity and mortality, placing tremendous demands on the health system and the economy in general. The epidemic has affected all sectors of society including children and the youth [32]. The latest data from Kenya AIDS Response Progress Report dated 2018, indicate that 1.5 million people in Kenya are living with HIV with the adult prevalence estimated at 4.9%.The report shows that, in 2018, the country recorded 52,800 new HIV infections and 28,200 AIDS-related deaths (see Figure 18).

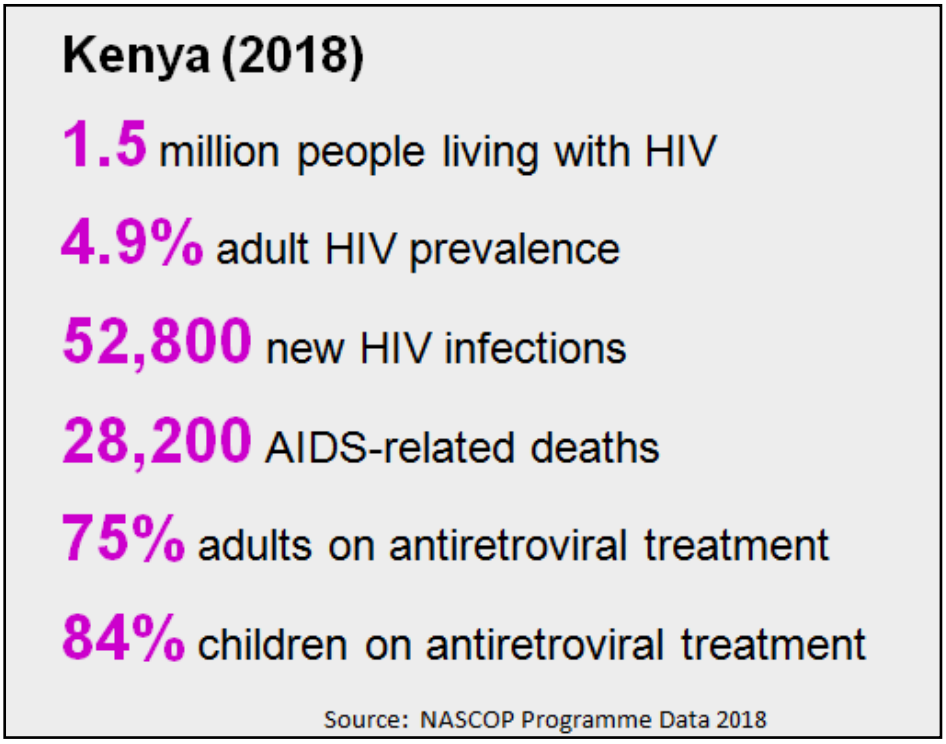

Figure 18: HIV Indicators for Kenya, 2018

HIV Prevalence

The prevalence at national level has shown a sustained decline from 9.0% in 2003 to 7.6% in 2007, 5.6% in 2012 and finally to 4.9% in 2017 [33, 34]. Women are more affected with a prevalence of 5.2% compared to 4.5% amongst men in 2018 [35].

HIV Prevalence among Most-At-Risk Populations

The prevalence of HIV is higher among Most-At-Risk Populations (MARPs) particularly female commercial sex workers (29.3%), gay men (18.2%) and people who inject drugs (18.3%) as shown in Figure 19 [34].

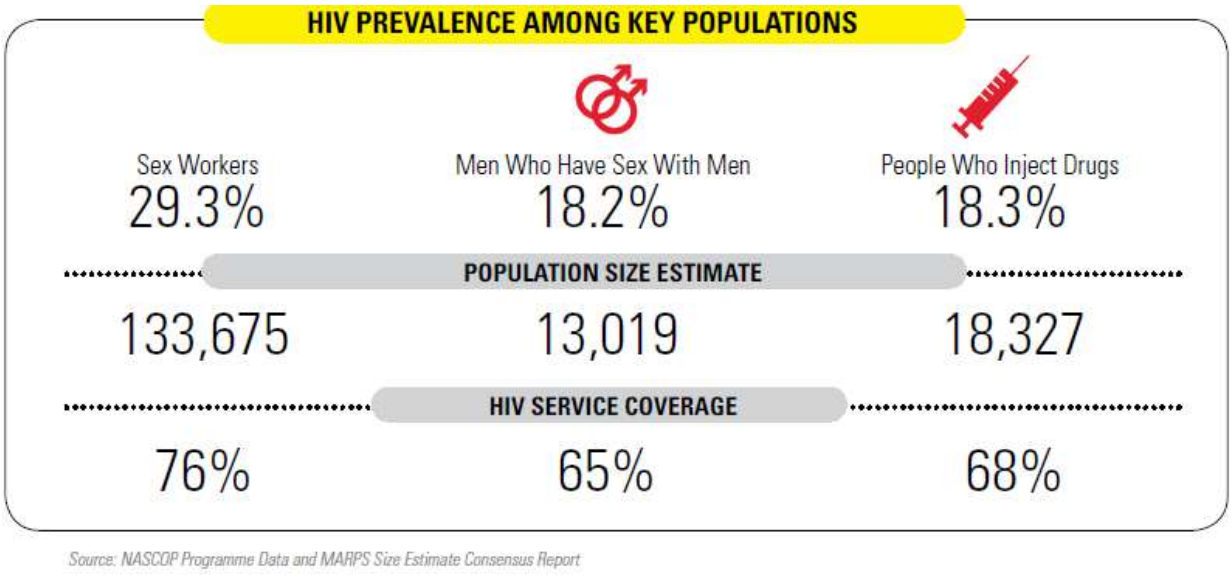

Figure 19: HIV Prevalence among most-at-risk populations in Kenya, 2018

The prevalence of the HIV epidemic varies across the country as shown in Figure 20. The study area lies within areas that are considered low to medium HIV prevalence. Baseline findings indicate the current prevalence (2018 estimates) as follows [35] :

- Turkana – 3.2%
- Garissa - 0.8%;
- Samburu - 1.8%;
- Meru - 2.4%;
- Isiolo- 3.2%; and
- Lamu- 3.0%.

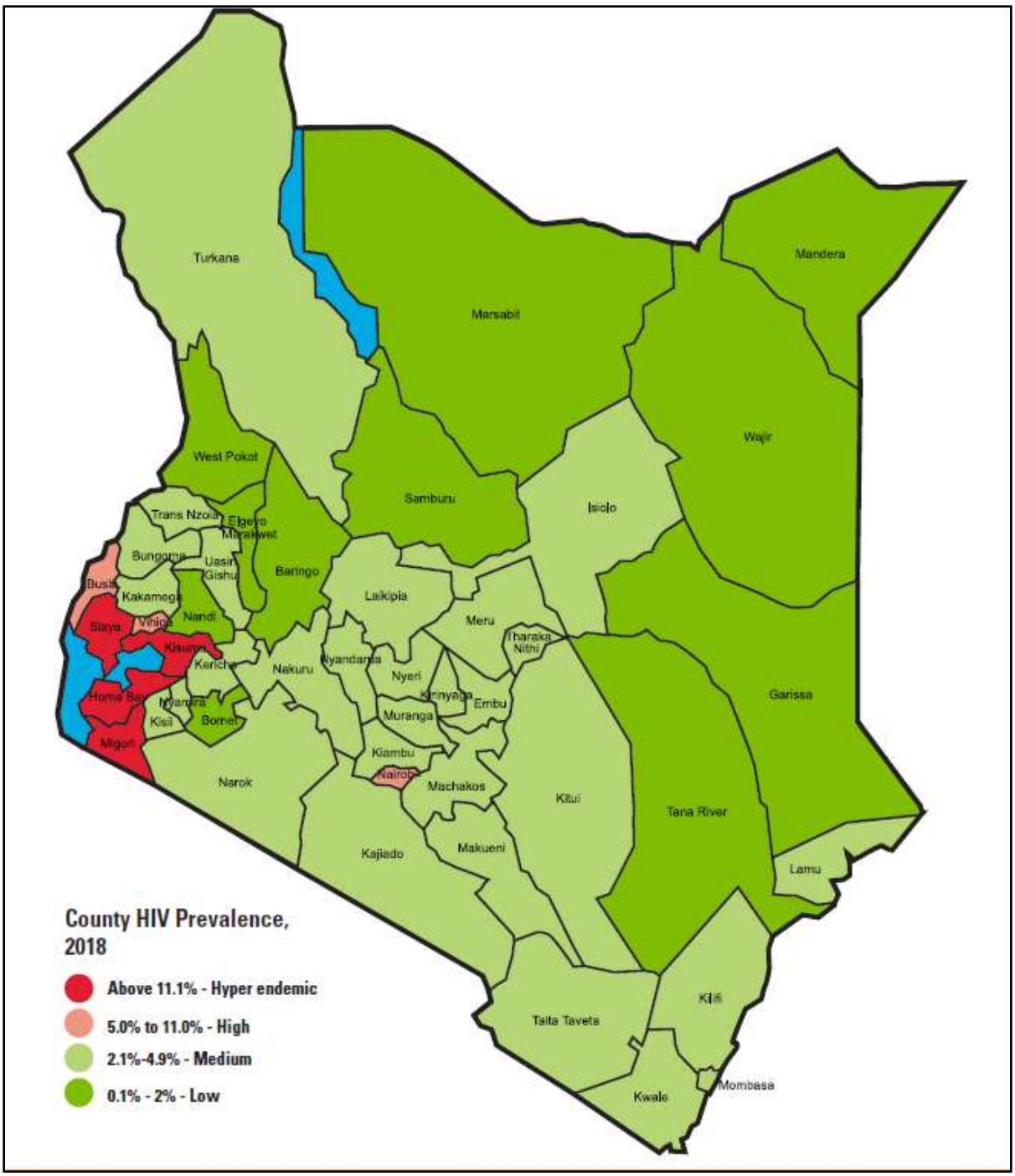

Figure 20: HIV Prevalence by County, 2018

Source: National AIDS Control Council (NASCOP) HIV Response Progress Report 2018

HMIS data considers and reports the HIV positivity rate; a facility-based record of positive tests results out of all HIV tests conducted. The data is derived from health facilities and voluntary counselling and testing (VCT) centres. Data for 2016 (see Figure 21) shows an HIV positivity rate of 3.8% in Isiolo County and lowest in Garissa County (0.8%). Data for 2017 and 2018 were not available.

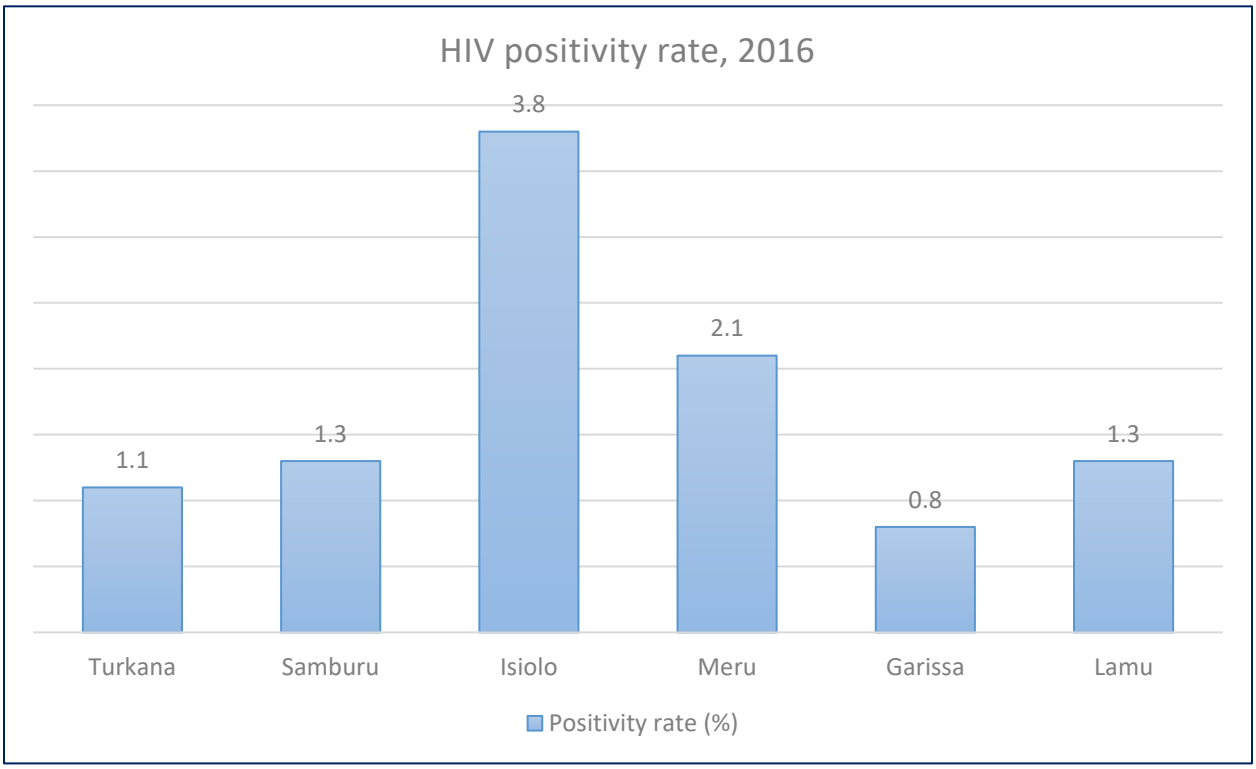

Figure 21: HIV positivity rate in the Project Area, 2016

Source: HMIS (2016)

Incidence Rate and new HIV Infections

The 2018 national HIV incidence rate was reported at 0.18% based on 2017 data. Among the Project counties, Lamu recorded the highest incidence rate (0.08% - 0.13%) followed by Meru, Isiolo and Turkana (0.04%-0.08%) with the lowest rate reported in Garissa and Samburu (<0.04%) [34]. Unprotected heterosexual contact within a regular partnership is the most common mode of HIV transmission, contributing nearly half (44%) of new infections. MARPs make a significant contribution to new HIV infections in the Project area [34]. The impact on rates from ongoing and planned infrastructure projects such as the Lamu Port and the ongoing construction of the Lamu-Southern Sudan-Ethiopia Transport Corridor was also highlighted by stakeholders.

Hotspots for HIV transmission were identified by name but, in general, these were located along major transport routes and urban/trade centres. Key drivers of HIV infection in the Project area include:

- High population mobility (linked to tourism) in Lamu County.
- Commercial trade (all county urban centres)
- Locations along major transport routes, specifically Isiolo and Turkana
- Injection drug users in Lamu and Meru.

HIV Awareness, Knowledge, Care and Treatment

A comparison of HIV indicators in the Project counties and their comparison to national indicators are presented in Table 13: based on data from the KDHS 2014 [9] and the Kenya HIV/AIDS estimates report 2018 [35]. In summary:

- HIV testing, care and treatment services were generally available and accessible in the Project area. The services are offered free of charge in all public facilities.
- More than three-quarters of adults are aware of the primary modes of HIV prevention (condom use and fidelity)
- Comprehensive knowledge[3] of HIV/AIDS have increased in both men and women
- HIV-related stigma is generally high across the country, including the study area
- Male circumcision is cultural practiced in all communities in the Project area except Turkana. In addition, efforts are being made towards voluntary medical male circumcision.

Table 13: HIV indicators in the Project area

Indicator		Turkana	Samburu	Isiolo	Meru	Garissa	Lamu	National
2018 NASCOP estimates								
New HIV infections (number, annual)		556	73	126	960	55	110	52,800
People living with HIV (number)		23,230	3,069	3,139	24,005	2,888	2,638	1.5 million
AIDS related deaths (number, annual)		588	78	66	503	42	49	28,200
Adults ART coverage (%)		23	42	68	78	55	39	75
Children ART coverage (%)		38	93	99	86	13	51	82
PMTCT coverage (%)		48	32	44	58	16	77	76
Survey data (KDHS 2014)								
Prevalence of male circumcision (%)		26	86	98	92	100	98	93
Knowledge of HIV prevention (%)	F	49	78	74	78	31	68	77
	M	2	79	71	86	69	84	85
Comprehensive knowledge of HIV (%)	F	24	46	39	48	19	50	56
	M	2	47	61	70	52	69	66
HIV-related stigma (%)	F	-	70	81	81	97	84	74
	M		53	65	65	69	56	56
Know where to get an HIV test (%)	F	75	84	94	92	62	91	91
	M	82	97	99	92	97	94	97
Coverage of prior HIV testing (%)	F	70	73	89	86	55	84	85
	M	67	70	77	68	60	59	71

[3]Comprehensive knowledge means knowing that consistent use of condoms during sexual intercourse and having just one uninfected faithful partner can reduce the chance of getting the AIDS virus, knowing that a healthy-looking person can have the AIDS virus, and knowing that a AIDS cannot be transmitted by mosquito bites or by sharing food with a person who has AIDS.

Indicator		Turkana	Samburu	Isiolo	Meru	Garissa	Lamu	National
Condom use* (%)	F	-	41	42	42	-	27	40
	M	-	51	50	50	-	32	44

F= Female, M=Male, *Condom use during last sexual contact among those with 2+ partners

Source: 2014 KDHS and NASCOP 2018

Sexually Transmitted Infections

Sexually transmitted infections (STIs) are prevalent in Kenya. Studies have demonstrated nationwide occurrence of active syphilis infection, herpes simplex virus-2, hepatitis B virus, gonorrhoeal disease, chlamydia infection, bacterial vaginosis and other unspecified genital ulcers and warts.

Findings from KIIs and health facility assessments show that STIs are common among adults in the study area. It was noted that many patients with STI symptoms prefer treatment at private clinics and that this data is not reflected in the HMIS. Unsafe sexual practices, especially among the youth and adolescents, were seen as an underlying risk once daily increased spread, despite the widespread availability of condoms. STI services were available in almost all public health facilities. The driving factors and hotspots for STIs in the Project area were generally similar to those for HIV/AIDS as described above.

1.7.4.2. Trend in Condition

In general, Kenya recorded a 56% reduction in HIV incidence in the period 2013 to 2017. HIV programmatic data shows, however, that Lamu, Meru and Isiolo recorded an increase in HIV infections during 2013 to 2016 followed by a decrease in 2017. Turkana, Garissa and Samburu all recorded a consistent decrease in HIV infections during the period (see Figure 22) [34].

The decrease in 2017 was attributed to scale up of interventions such as health education, free condom distribution, increased availability and uptake of HIV testing, care and treatment as well as reduction in HIV-related stigma. The increase recorded in Lamu (during 2013-2016) was linked to commercial sex activity stimulated by the Lamu port construction, tourism activities and injection drug use.

Increase in HIV infections 2013-2017	Decrease in 2015 then increase in 2017	Increase in 2015 then decrease in 2017		Decrease in HIV infections 2013-2017	
1 county	8 counties	19 Counties		19 counties	
• Nairobi	• Nakuru	• Machakos	• Bungoma	• Migori	• Muranga
	• Narok	• Makueni	• Busia	• Homabay	• Baringo
	• Uasin Gishu	• Kiambu	• Kwale	• Siaya	• Samburu
	• Kajiado	• Meru	• Kilifi	• Kisumu	• Nyeri
	• Nandi	• Embu	• Lamu	• Kisii	• E. Marakwet
	• Laikipia	• Tharaka Nithi	• Taita Taveta	• Turkana	• Nyandarua
	• West Pokot	• Mombasa	• Kitui	• Bomet	• Kirinyaga
	• Vihiga	• Isiolo	• Marsabit	• Nyamira	• Mandera
		• Kakamega	• Tana river	• Transzoia	• Garissa
			• Wajir	• Kericho	

Figure 22: Trend in new HIV infections in Kenyan counties, 2013-2017

Source: Kenya AIDS Response Progress Report 2018

1.7.5. EHA5: Food- and nutrition-related issues

1.7.5.1. Baseline Condition

Nutrition and Food Security Situation

Agriculture plays a significant role in Kenya's economy and directly contributes 18% of the country's Gross Domestic Product (GDP). More than 75% of the population, especially those living in rural areas, derive their livelihoods from agriculture. The arid and semi-arid areas of the country are extremely vulnerable to food insecurity.

Between February and July 2018, around 2.6 million people in Kenya were reported as being food insecure. From August 2018 through January 2019, food availability and access are likely to be favourable owing to improved harvests in 2018 [36]. The Ministry of Health (MoH) in collaboration with partners conducts an annual Standardized Monitoring Assessment on Relief and Transition (SMART) survey in food stressed counties. This includes the Project counties of Samburu, Isiolo and Garissa. Table 14 provides a summary of the food and nutrition situation in the study area at the time of this baseline assessment.

Table 14: Food and nutrition status in the Project counties, 2017/18

County	Food Security and Nutrition status
Turkana	• The County has four main livelihood zones: pastoral (60%), agro-pastoral (20%), fisher folks (12%) and urban/ peri-urban formal and informal employment (8%). Food insecurity is a chronic problem. • A SMART survey completed in January 2018 showed significant reduction in levels of acute malnutrition across the County compared to a similar period in 2017. • The County was classified in critical nutrition situation with Global Acute Malnutrition (GAM) score of 16.2% in January 2018 compared to 30.1% in January 2017. Severe Acute Malnutrition (SAM) rates decreased to 2.2% in 2018 compared to 5.7% in a similar period in 2017. • Global stunting was measured at 20.3% in January 2018 and was highest in Turkana South (23.9%) followed by Turkana Central (20.8%). Food consumption score and dietary diversification remained a challenge. Contributing factors to the chronic food insecurity include high level of poverty, harsh climate with inadequate rainfall, frequent droughts, diminishing greener pastures for livestock and poor road infrastructure that hamper delivery of foodstuffs [37].
Samburu	• More than half of the population (57% in 2018) derived their livelihoods directly from livestock. • According to a SMART survey completed in June 2018, food security situation slightly improved in the county compared to same season in 2017. • Nutrition status of children in the county remained critical in 2018 with a GAM score of 15.7% compared to 18.3% in 2017 [38]. • There was a slight increase in children with SAM in June 2018 compared to the same period in 2017 [38]. • Food consumption score and dietary diversification remained a challenge. Prolonged droughts interspersed with periods of flooding were the underlying factors affecting food security.
Isiolo	• Isiolo is characterized by recurrent droughts, a hot and dry climate with low and erratic rainfall patterns. • It has 3 main livelihood zones: pastoral, agro-pastoral and formal/informal employment representing 67%, 26% and 7% respectively. • GAM rate was recorded at 13.8% in February 2018 (classified as serious according to WHO thresholds), decreasing from 18.2% in February 2017. Food

County	Food Security and Nutrition status
	consumption score is generally good at 88%.
Garissa	• Garissa County continues to face major challenges (e.g., drought, internal/cross-border civil strife, insecurity etc.) that contribute to increased vulnerabilities among its population. • The County has three main livelihood zones namely; pastoral-all species (85%), pastoral cattle (5%) and agro-pastoral (7%) [38]. • In February 2018, the county was classified as being in the Crisis Phase (IPC Phase 3) particularly in the Lagdera, Balambala, Fafi, and Ijaara sub-counties. • The pastoral livelihood zone is also classified in the same phase while the agro-pastoral livelihood zone is classified in the Stressed Phase (IPC Phase 2). • Underlying factors include acute water stress, declining pasture, high food commodity prices, low livestock sales, escalating insecurity, and conflict over forage. • The latest SMART survey conducted in July 2018 reported a GAM rate of 13.7% and SAM prevalence of 2.1% [38].This is classified as serious based on WHO thresholds.
Meru	• The economy of Meru is primarily agrarian encompassing growing of a variety of crops and keeping livestock in some parts. It is largely endowed with soils and climatic conditions that allow for the production of a variety of commodities including wheat, barley, potatoes, millet, sorghum and maize. • The county is generally food secure, but there are still challenges of dietary diversification.
Lamu	• Agriculture is the main livelihood of the county, contributing approximately 88% of all households' income. Fishing and tourism also play a key role. • At least 80% of the county's land surface is arable but this has not been fully exploited, leaving it food insecure. • The main crops grown include maize, cowpeas, cassava, pigeon peas and green grams. Crops grown for commercial purposes include mangoes, coconut, cotton, bixa and simsim. • Cotton is the highest source of household income at 42%.

Source: SMART Nutrition Surveys 2018 and official county documents

Malnutrition and Anaemia

Nutritional status in children has significantly improved over the years. Survey data (KDHS 2014) show that at national level, about a quarter (26%) of children under five years are stunted (low height-for-age), 11% are underweight (low weight-for-age) and 4% are wasted (low weight-for-height) [26].Figure 23 shows the nutritional indicators in the Project counties based on survey data from KDHS 2014. Wasting, an indicator for acute food insecurity was highest in the counties of Turkana (23%), Samburu (14%) and Garissa (11%). The most recent findings from the SMART surveys conducted in 2018 (available for Turkana, Samburu, Isiolo and Garissa) show that stunting, indicator for chronic food insecurity, stood at 35.8% in Samburu, 20% in Turkana, 18% in Isiolo, and 13% in Garissa [38].

Micronutrient deficiencies are highly prevalent among young children and women countrywide. The most common deficiencies are vitamin A deficiency, iron deficiency anaemia, iodine deficiency disorders and zinc deficiency. Findings from KIIs show that anaemia is a frequent diagnosis among children and women in the study area. This was largely due to nutritional anaemia, but some cases were linked to illnesses such as malaria.

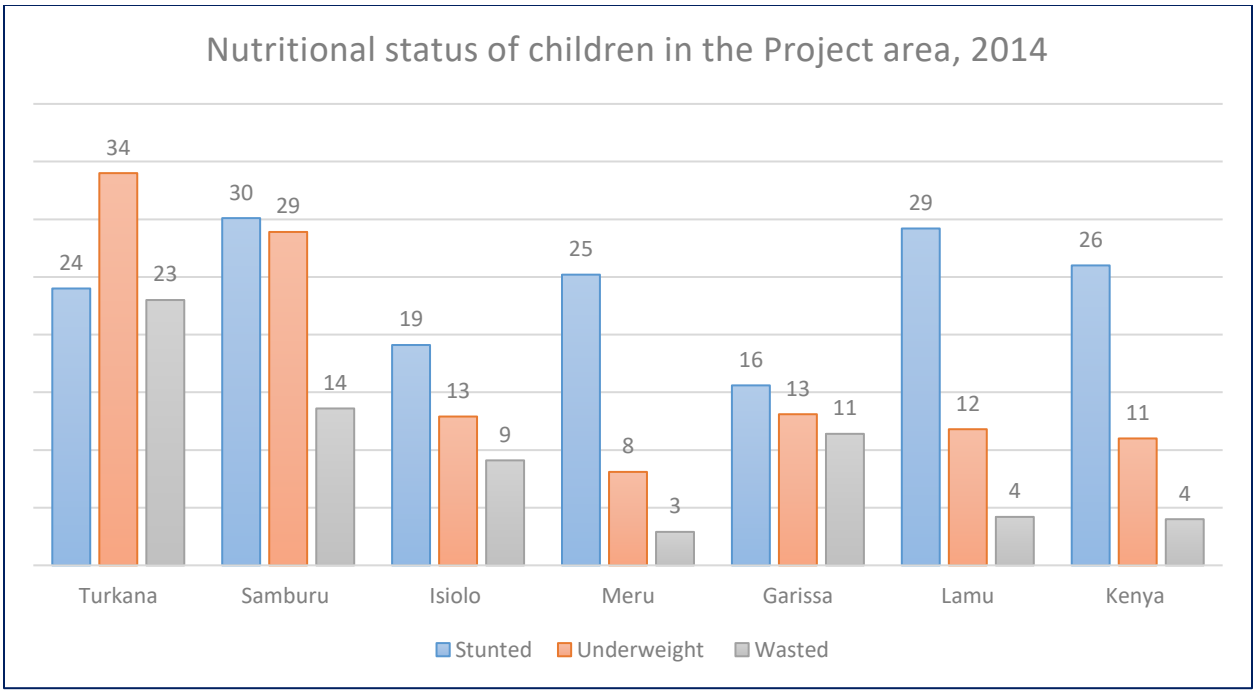

Figure 23: Nutritional status of children under five in the study area, 2014/15

Source: KDHS 2014

Surveillance for acute malnutrition is done through the HMIS. Turkana and Garissa recorded the highest cases of acute malnutrition in 2018, while Lamu recorded the lowest number of cases (see Table 15). Malnutrition-related deaths were also reported especially in Turkana (36 deaths in 2017) and Lamu (39 deaths in 2016). Meru County, which hosts the Regional Referral Hospital (RRH), indicated that most of the cases of malnutrition are referrals from neighbouring counties.

Table 15: Acute malnutrition cases and deaths in the Project counties

County	2018		2017		2016	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Turkana	963	4	1,530	36	600	1
Samburu	222	0	44	0	33	0
Isiolo	340	0	181	0	80	0
Meru	329	2	145	6	117	1
Garissa	794	0	532	2	261	0
Lamu	182	0	719	1	602	39
National	**23,284**	**121**	**23,051**	**135**	**8,113**	**161**

Source: HMIS (2018)

1.7.5.2. Trend in Condition

Chronic malnutrition rates have increased in Samburu County from 30% in 2014 to 35.8% in 2018, while rates decreased in Turkana (from 34% in 2014 to 20% in 2018) and Garissa (from 16% in 2014 to 13% in 2018). Lamu and Turkana recorded a significant decrease in acute malnutrition cases while the number of cases increased in Garissa, Meru, Isiolo and Samburu.

1.7.6. EHA6: Non-communicable diseases

1.7.6.1. Baseline Condition

The demographic and nutritional transitions taking place in Kenya are leading to accelerated growth of non-communicable disease (NCD). Cardiovascular disease, diabetes, cancer and chronic respiratory conditions are the leading NCDs. The underlying risk factors for developing NCDs are an unhealthy diet, physical inactivity, alcohol consumption and smoking.

Hypertension, Diabetes and Cardiovascular disease

Baseline findings show that NCDs are an emerging health concern in the study area, particularly hypertension, diabetes and cardiovascular disease. Meru recorded the highest number of cases, but this was partly attributed to the location of the RRH that captured metrics from referrals from other counties. Changes in diet and lifestyle were seen as the key driving factors. Obesity was also reported as an emerging concern particularly in urban areas. Table 16 provides a synopsis of the number of cases of NCDs in the Project area.

Table 16: Non-communicable diseases in the Project area, 2018[4]

Indicator	Turkana	Samburu	Isiolo	Meru	Garissa	Lamu
Hypertension	838	1212	2046	59345	5822	6248
Diabetes	378	391	477	18119	2119	2037
Cardiovascular disease	59	73	48	1141	248	214

Source: HMIS 2018

Dispensaries and health centres lacked the basic equipment required for the screening of blood glucose level and demonstrated limited capacity to diagnose diabetes. In general, the management of NCDs remains challenging with patients often referred to higher level hospitals for specialist care. Meru RRH, Garissa, Lamu and Isiolo County Referral Hospitals all had functional dialysis units for management of patients with renal failure. A renal unit is under construction at Lodwar Hospital. NCDs were considered to have contributed to at least half of the renal failures, increasing the demand for and placing an additional burden on available dialysis services. Garissa County Referral Hospital had a total of 30 patients on routine dialysis (as at December 2018) against a bed capacity of 5 patients per session.

Cancers

Cancers are the second leading cause of NCD-related deaths in Kenya after cardiovascular disease. The country records close to 37,000 new cases every year with a death rate of 76%. The leading cancers among women are breast-, cervix- and oesophageal cancers. The commonest among men are cancers of the oesophagus and prostate as well as Kaposi sarcoma.

Findings from KIIs indicate an increasing burden of cancers in the study area but reliable data remained scarce. HMIS data shows that a total 542 cases of unspecified neoplasms were registered in the area in 2018 with records of 472 cases in Meru, 38 cases in Garissa, 28 cases in Turkana, 21 cases Samburu, seven cases in Lamu and four in Isiolo [22]. Garissa County reported a marked increase in cancers of the oesophagus. Screening services for cervical cancer was available free of charge in most public hospitals.

[4] The number shown in the table are cumulative instances of patient review (chronic illness) and not unique patient count

Cross cutting challenges included low awareness of cancer, inadequate early detection services, weak referral systems, poor treatment and lack of palliative services.

Chronic Respiratory Disease

This disease group includes conditions such as asthma, chronic obstructive pulmonary disease, occupational lung diseases and pulmonary hypertension. The most important risk factors for these diseases are smoking and air pollution. Data on chronic respiratory diseases in the study area were generally limited. Asthma was reported as the most common chronic respiratory disease in the area.

1.7.6.2. Trend in Condition

Baseline data show that NCDs are an increasing burden in the study area, particularly hypertension, cardiovascular disease and diabetes. The increase is occurring nationwide and has been linked to urbanization and changes in lifestyle.

1.7.7. EHA7: Accidents and injuries

1.7.7.1. Baseline Condition

Road Traffic Accidents

Road traffic accidents contribute significantly to overall morbidity and mortality in Kenya, impacting markedly on the social and economic well-being of individuals, their families and society. Data from the National Transport and Safety Authority show that at least 3,000 people die on Kenyan roads every year [39]. Nearly one-third of road traffic accidents in the country are fatal.

Baseline findings show that road traffic accidents are an emerging health concern in the study area. This has led to an increase in demand for emergency and surgical services. Motorcycle-related accidents were the most common with Figure 24 showing a summary of the number of road traffic injuries and deaths recorded in the Project counties during 2018. Meru County recorded the highest number of road accidents and related deaths. Lamu Island which primarily relies on boats and other forms of non-vehicular transport, reported the least number of accidents. The A2 highway from Nairobi through Isiolo to Marsabit was cited as a major contributor to road accidents. Poor road network in some areas, drunk driving, over-speeding and lack of adherence to traffic rules were the leading contributing factors to road accidents in the area.

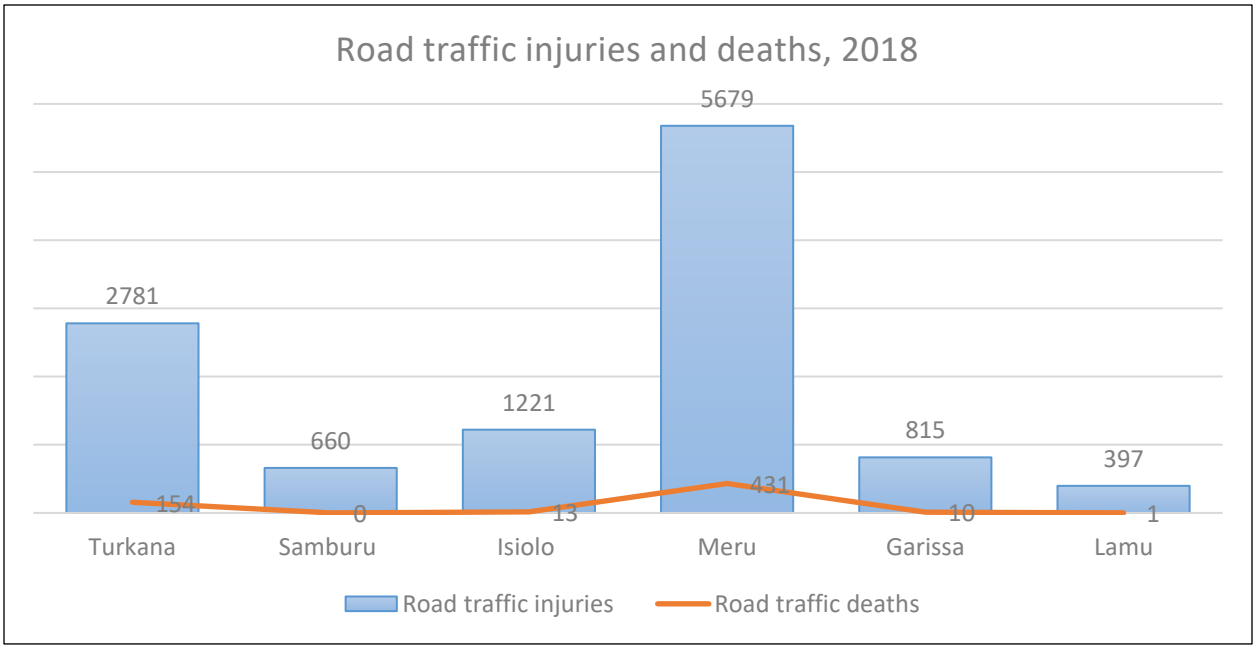

Figure 24: Road traffic injuries and deaths in the Project counties[5]

Source: HMIS 2018

Violence-related and other Injuries

Frequent ethnic conflicts, especially among pastoral communities are a common cause of violence-related injuries in the Project area. Other forms of violence including domestic, interpersonal and sexual violence also occur. Table 17 shows a breakdown of the various types of injuries recorded in the area

[5] Note: The number of deaths shown in the figure does not include fatalities that occur at the scene of accident

during 2018. The type of injuries ranged from gunshot wounds, stab wounds, bowstring/archery injuries, lacerations and blunt trauma.

Snake and dog bites were also common. Generic snake antivenom was available in most local hospitals but less often in lower level health facilities. Nearly half of the dialysis patients at Garissa County Referral Hospital were snakebite victims.

Table 17: Records of injuries in the Project area, 2018

Indicator	Turkana	Samburu	Isiolo	Meru	Garissa	Lamu
Road traffic injuries	2781	660	1221	5679	815	397
Other injuries	12874	6569	5235	29454	8152	4684
Sexual violence	439	134	82	765	57	114
Violence related injuries	3193	287	1411	4013	528	257
Burns	3553	1788	793	6933	1559	812
Snake bites	1661	179	119	518	291	95
Dog bites	1685	991	328	1871	31	231
Other bites	10302	773	816	2698	1691	1005
Total	**36488**	**11,381**	**10,005**	**51,931**	**13,124**	**7,595**

Source: HMIS 2018

1.7.7.2. Trend in Condition

Road traffic accidents have shown an increasing trend in the study area. The increase threatens to overburden already limited emergency care and surgical services in the area. Cases of physical assault and other forms of injuries were also increasing. Concerns were raised about the likelihood of the Project contributing further to ethnic conflicts and increasing cases of injuries.

1.7.8. EHA8: Veterinary medicine and zoonotic diseases

Zoonotic diseases are caused by infectious agents that can be transmitted between animals and humans. These include diseases such as bovine tuberculosis, pandemic influenza (swine flu or avian influenza), viral haemorrhagic fevers (Ebola, Marburg, Rift Valley fever etc,), rabies, brucellosis and leptospirosis. Many factors lead to the emergence of zoonotic diseases, including environmental changes, human and animal demographic changes, pathogen changes and changes in farming practices as well as social and cultural factors such as food habits and religious beliefs. Emerging zoonotic diseases have potentially serious human health and economic impacts and their current upward trends is a cause for concern.

1.7.8.1. Baseline Condition

The most common zoonotic diseases in the study area are rabies, brucellosis, RVF, and bovine tuberculosis.

Brucellosis

Brucellosis is common among pastoral communities particularly in Turkana, Garissa, Isiolo and Samburu (see Figure 25). Rapid serological tests are the mainstay of diagnosis with good availability in most local health facilities at the time of this report.

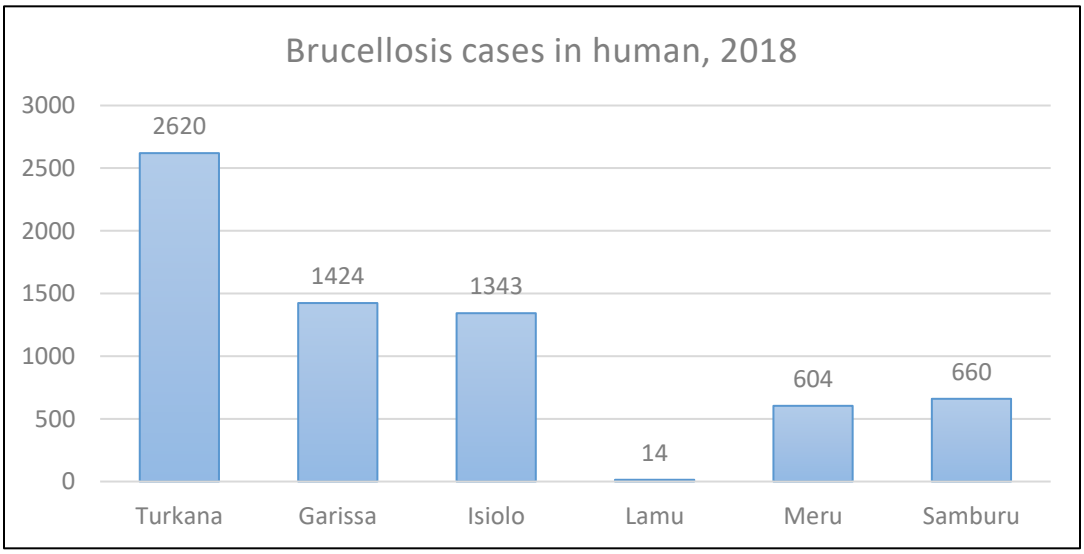

Figure 25: Brucellosis cases in the Project counties, 2018

Source: HMIS (2018)

Rabies

Rabies is endemic throughout Kenya owing to high population of unvaccinated domestic dogs. From 2016 to 2018, a total of 14 cases of suspected rabies were notified in the Project area, including 2 deaths. Most of the cases occurred in Isiolo (seven cases) and Meru (five cases). Turkana and Garissa did not

report any rabies cases. Post exposure vaccine against rabies was available in local health facilities but the minimum cost of US$100 for a complete dose was considered prohibitive.

Pandemic influenza

These remain an important global threat because of increasing population mobility and mixing. Both influenza A and B are present in Kenya with several strains already reported. A study conducted between 2006 and 2011 reported a prevalence of 28% for influenza A (H1N1) 2009, pandemic, influenza B at 31%, seasonal influenza A (H3N3) at 24%, seasonal influenza A (H1N1) at 10% and other unspecified subtypes at 7% [40]. An outbreak of H1N1 prototype 9 influenza virus was confirmed in central Kenya in March 2018 resulting in 1 death and at least 60 suspected cases [41]. Seasonal influenza was reported as a common cause of respiratory illness in the study area.

Viral haemorrhagic fevers

These conditions are a significant risk in Kenya, particularly RVF or dengue. Ebola, which causes a more serious form of VHF, has not been documented in the country. The threat however remains due to increasing population mobility and mixing. A surveillance system for VHFs is in place and diagnostic services available at KEMRI reference labs. Isiolo reported 17 suspected cases of VHFs in 2018 but none were confirmed. The rest of the Project area did not report any case or VHFs over the period 2016-2018.

1.7.8.2. Trend in Condition

The trend in cases of brucellosis, bovine TB and rabies could not be ascertained due to inconclusive data.

1.7.9. EHA9: Exposure to potentially hazardous materials, noise and malodours

1.7.9.1. Baseline Condition

These may also be listed as environmental health determinants and include items such as pollution of air, soil and water as well as possible exposure to pesticides or other organic or inorganic pollutants, noise and malodours. The pathway to human exposure to pollutants can be complex and can occur from a variety of sources as is shown in Figure 26. No further baseline description will be documented as is expected that other specialist biophysical studies will be documenting this as part of the environmental impact assessment.

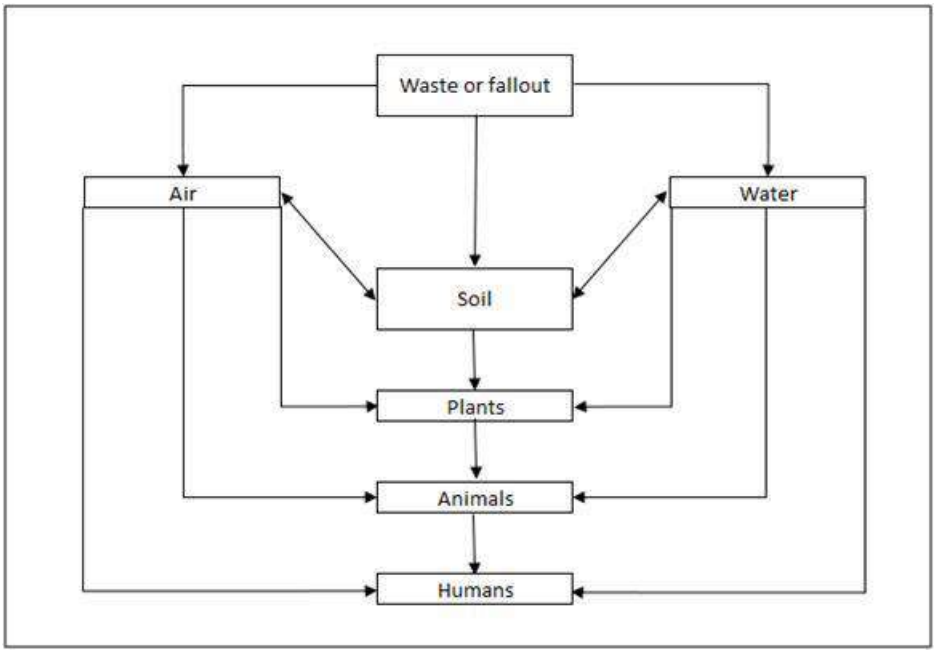

Figure 26: Pathway of human exposure to pollutants

1.7.10. EHA10: Social determinants of health

Social determinants of health are the conditions in which people are born, grow, live, work and age, including the health system. These circumstances are shaped by the distribution of money, power and resources.

1.7.10.1. Baseline Condition

Mental Health

Reliable evidence on the prevalence of psychiatric disorders in Kenya remains scarce. It is estimated that up to 25% of outpatients and 40% of in-patients suffer from psychiatric conditions [42]. The Mathare Psychiatric Hospital located in Nairobi, with a bed capacity of 700, is the only specialised psychiatric hospital in the country. Figure 27 shows the number of psychiatric disorders recorded in the study area during 2018. The most frequent diagnoses were depression, substance abuse, stress and anxiety disorders. Based on feedback from stakeholders, suicide and homicide rates were generally low. Neuropsychiatric conditions such epilepsy also occur. The Meru RRH has a dedicated psychiatric ward that offers specialised services and receives referrals from neighbouring counties. Challenges include inadequate human resources and facilities to manage mentally ill patients.

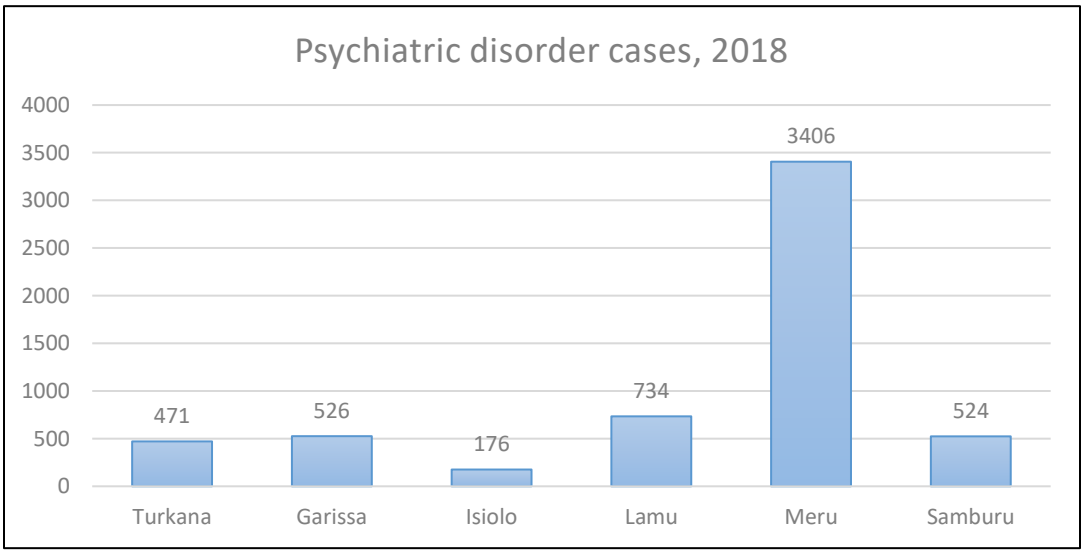

Figure 27: Psychiatric disorder cases in the Project area, 2018

Source: HMIS 2018

Substance Abuse and Social Ills

Substance abuse is a growing public health concern in the study area. Lamu County, in particular, reported drug abuse as a big problem, especially in Lamu Island. This has necessitated the establishment of rehabilitation centres commonly referred to as medically assisted therapy clinics. Substance misuse is particularly common among the youth with high prevalence of intravenous drug use and consumption of illicit drugs such as cocaine, heroin and cannabis. The coastal town is also known for peddling and trafficking of illicit drugs.

Garissa County reported increasing cases of drug abuse along the border with Somalia and among street children. Meru County reported abuse of narcotics, alcohol and khat (*miraa*) which is locally grown and considered a cash crop. Khat is also widely consumed in Isiolo and Garissa. Samburu County reported

increasing abuse of cannabis among the youth in urban areas – some of whom have required rehabilitation. Commercial sex activity was reported as a concern in Lamu, Meru, but less so in Garissa, Isiolo and Samburu. Substance abuse and commercial sex activity are emerging health challenges in Turkana.

Gender-Based Violence and Inequalities

It is generally recognised that women are primarily impacted by domestic gender-based violence (GBV) which creates both a health and psychological burden. It also recognised that in many societies, women are socialised to accept, tolerate and even rationalise the practice. Baseline findings show that GBV is common in the study area. In 2018, a total of 1,591 cases of sexual violence were recorded, the majority taking place in Meru with 765 reported cases and Turkana with 439 cases [22]. Substance abuse was seen as contributing factor. Additionally, women were perceived as marginalized in many aspects including education, employment opportunities and decision-making capabilities.

Teenage Pregnancies and Early Marriages

Adolescent childbearing has multiple negative health, social, and demographic consequences. Children born to women aged 15 to19 are more likely to die in infancy and early childhood. Women who start having children in this age group, often do not complete school, limiting their future economic possibilities and other life choices. Teenage pregnancies and early marriages are an important concern in the study area. Survey data (KDHS 2014) show a high rate of teenage pregnancies in Samburu, Isiolo and Meru above the national average of 18%. Garissa and Lamu recorded a lower rate of 10% (see Figure 28). These were corroborated by primary data from KIIs and health facility assessments. The teenage pregnancies were largely attributed to the societal practice of early marriages in most of the study area.

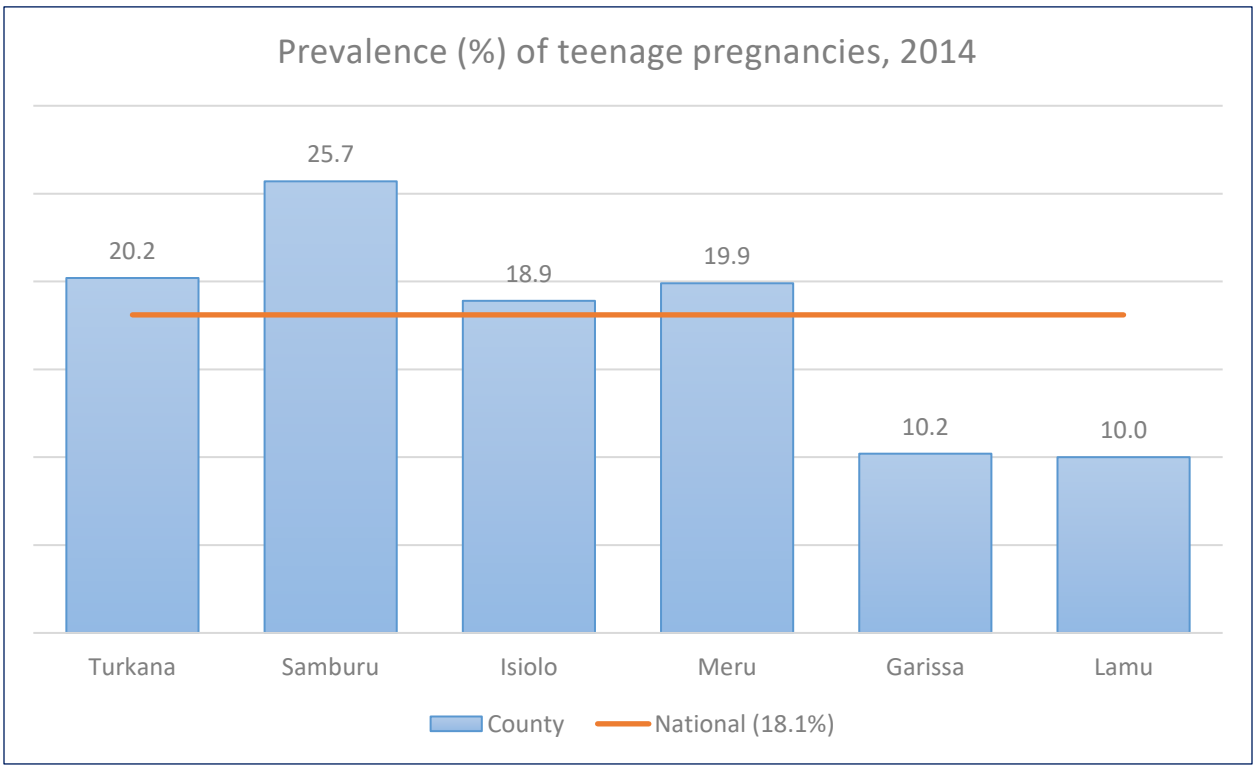

Figure 28: Rates of teenage pregnancies in the Project area

Source: KDHS 2014

1.7.10.2. Trend in Condition

Mental health disorders have demonstrated an upward trend in the study area. Psychosocial stressors (economic strife, poverty and other social challenges) and substance abuse were identified as contributing factors. The Project Counties reported increasing cases of substance abuse. Samburu, Isiolo and Garissa reported increasing cases of GBV.

1.7.11. EHA11: Cultural health practices

1.7.11.1. Baseline Condition

Health Seeking Behaviour

Health seeking behaviour is a significant challenge in the Project area. This was characterized by the use of self-medication utilising over-the-counter drugs, visit to small private clinics as well as the use of alternative medicine (spiritual healing and traditional medicine). While the majority of the population preferred to seek formal health care, there were impediments such as costs, long distance to a health facility (particularly in Turkana, Samburu, Isiolo and Garissa) and inadequate services at dispensaries and health centres. According to stakeholders, late presentation to health facilities and poor adherence to treatment were a common concern in all counties.

Traditional Medicine

The use of traditional medicine (TM) is a routine practice in the study area as it is in most parts of the country. Findings from KIIs show that traditional herbs are commonly used in the treatment of chronic illness such as HIV, TB, diabetes, hypertension as well as common diseases such as diarrhoea. In most cases, TM is the treatment of choice for psychiatric disorders. This has reportedly impacted negatively on adherence to treatment and contributed to poor outcomes. Factors that promote the use of TM were reported to include local beliefs, ignorance, stigma associated with certain diseases (especially HIV/AIDs and TB), misconceptions and negative perceptions about quality of modern health care, and weaknesses in the health care system (access to health care, affordability, drug shortage, etc).

Polygamy, Nomadic Lifestyle and Cattle Rustling

Polygamy is practiced in the Project area in the form of customary and religious marriages. It was reported that multiple sexual partners complicate decisions at household level. Nomadic lifestyles are practiced in Turkana, Samburu and Garissa and to a lesser extent in Isiolo and Lamu. Cattle rustling is a common practice in the area and has been a frequent source of conflict among communities.

Female Circumcision

Female circumcision is considered a violation of human rights and has been outlawed in Kenya. However, the cultural ritual is still prevalent in certain ethnic communities including the Somali (94%), Samburu (86%), Kisii (84%), Maasai (77%) and the Meru (31%) [9]. The practice is uncommon among the Turkana (1.7%). It is associated with negative health consequences some of which are serious. Health education, poverty alleviation and promotion of women’s rights are key interventions to reducing the practice.

1.7.11.2. Trend in Condition

Health seeking behaviour has generally improved as the majority of the population was reportedly using the formal health care system. This was attributed to ongoing efforts on health promotion and system strengthening including provision of outreach services. This is evidenced by increasing demand for services in health facilities in the area. Use of TM also continues to decline as more people embrace modern health care.

1.7.12. EHA12: Health systems issues

A good health system delivers quality services to all people, when and where they need them. This requires a robust financing mechanism, a well-trained and adequate workforce, reliable information on which to base decisions and policies, well maintained facilities and logistics to deliver quality medicines and supplies. Reproductive health, maternal and child health are some of the key measures of a health system.

1.7.12.1. Baseline Condition

Reproductive Health

Women have an average of 3.9 children in their lifetime. Fertility rates (see Figure 29) in the Project area are highest in Turkana (6.9 births per woman), Samburu (6.3 births per woman) and Garissa (6.1 births per woman), and lowest in Meru (3.1 births per woman). This correlates to findings of high contraceptive uptake in Meru County (78% among married women) and low uptake in Garissa (5%), Turkana (10%) and Samburu (23%). Family planning is an essential component of reproductive health.

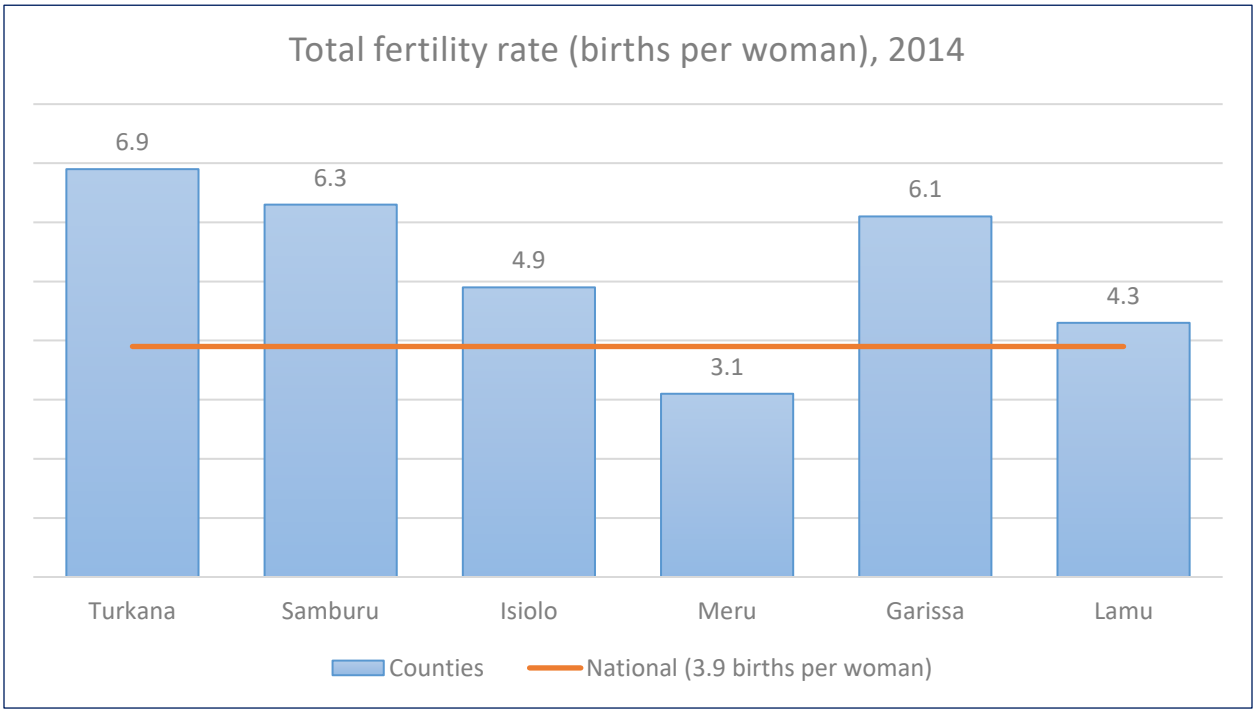

Figure 29: Fertility rates in the Project area

Source: KDHS 2014

Maternal Health

Maternal health is an important measure of health system functionality. Key indicators include maternal mortality, access to antenatal care (ANC) and delivery care. Maternal and perinatal conditions account for approximately 20% of the disease burden in Kenya with the lifetime risk of maternal death (for every reproductive woman) at 1 in 42. Table 18 gives a summary of maternal health indicators in the study area based on findings from the 2014 KDHS [9].

Turkana recorded the lowest proportion of institutional deliveries (23%) followed by Samburu (25%), Garissa (37%), Isiolo (42%) and Lamu (44%). This indicates that majority of child births in the five counties occur at home. Meru County on the hand, scored high on maternal care indicators, with near universal access to ANC and high rate of institutional deliveries (82%) [9].

Table 18: Maternal care indicators in the Project area, 2014

Indicator	Turkana	Samburu	Isiolo	Meru	Garissa	Lamu	National
Skilled ANC (%)	91	74	96	97	87	96	96
4+ ANC visits (%)	49	52	50	45	48	62	58
Skilled delivery care %)	23	29	44	83	40	47	62
Institutional births[6] (%)	23	25	42	82	37	44	61

Source: 2014 KDHS

Figure 30 demonstrates the number of maternal deaths occurring in health facilities in the study area [22]. Turkana, Meru and Garissa counties recorded the highest number of maternal deaths. The leading causes of maternal mortality were obstructed labour, postpartum haemorrhage, eclampsia, anaemia and sepsis. According to KIIs in Meru, the high number of maternal deaths was contributed to by late referrals from peripheral facilities including some from outside the county. Turkana and Garissa counties cited high rates of home deliveries by unskilled attendants and poorly equipped peripheral facilities with limited capacity to handle obstetric emergencies among the contributing factors.

[6]Institutional births refer to births at health facilities

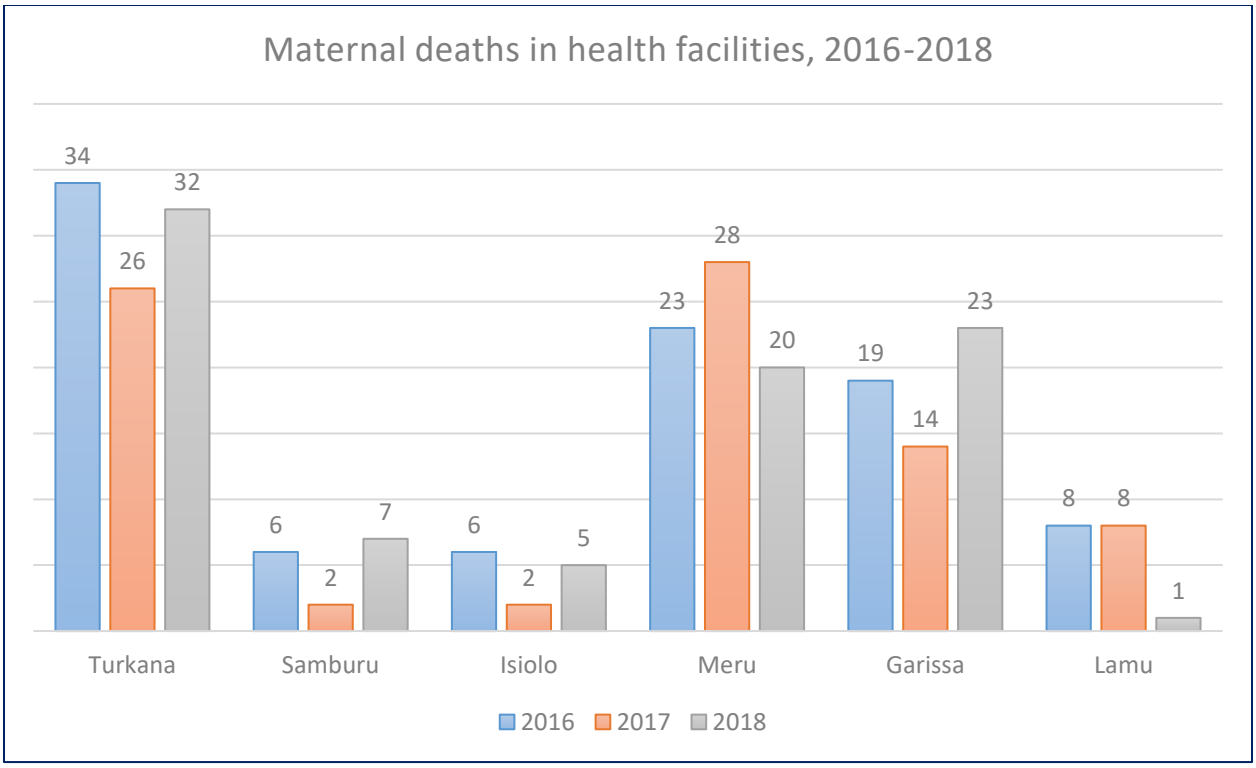

Figure 30: Maternal deaths in the Project area, 2016-2018

Source: HMIS (2018)

Child Health and Immunisation

The country has made marked progress in child survival. Statistics from the 2014 KDHS show that the infant mortality rate has dropped to 39 deaths per 1,000 live births from 52 and 77 per 1000 live births in 2008 and 2003, respectively. The under-five mortality rate has decreased by more than half from 115 per 1000 live births in 2003 to 52 deaths per 1,000 live births in 2014 [9]. Nearly half (46%) of the deaths occur during the neonatal period.

Baseline KIIs determined that the leading causes of child deaths in the study area are pneumonia, birth complications, prematurity, congenital conditions, diarrhoeal diseases, and malnutrition. Deaths from malaria were also reported especially during seasonal epidemics. Data on child mortality rates in the study area were not conclusive.

Childhood immunisation is an effective way of protecting children against a number of infectious diseases. The Kenya Expanded Programme on Immunization is aligned to the WHO guidelines which calls for every child to receive vaccination against TB (BCG), three doses each of the DPT+Hep+HiB to protect against diphtheria, whooping cough, tetanus, hepatitis B and *Haemophilus influenzae*, polio vaccines and a measles vaccine, all by one year of age. The desired goal is to ensure full immunisation of 90% of children under one year of age at the national level, with at least 80% coverage in every district or equivalent administrative unit [43]. Immunisation coverage in the study area is summarized in Table 19 and Figure 31. The Project counties except Turkana recorded full immunisation coverage below the minimum threshold of 80%. As a result, the counties remain vulnerable to outbreaks of vaccine preventable diseases especially measles. Primary findings show that the risk of outbreaks are greatest in

Turkana and Garissa which share porous borders with lawless South Sudan and Somalia, respectively, and also host large refugee populations in Kakuma and Dadaab camps, respectively.

Table 19: Vaccine coverage in the Project area, 2018

Vaccine	Turkana	Samburu	Isiolo	Meru	Garissa	Lamu	National
BCG	>100*	91.5	97.4	79.3	76.7	96.8	78.4
DPT/Hep+HiB3	>100*	91.5	91.0	85.5	82.8	95.4	81.4
Oral polio vaccine3	91.0	91.2	91.0	84.8	82.6	95.6	80.3
Pneumococcal3	99.0	91.0	91.0	85.2	82.7	95.4	81.3
Measles and Rubella	94.8	68.1	80.8	79.3	82.5	80.6	79.0
Fully immunised	**84.2**	**64.7**	**65.5**	**70.1**	**78.3**	**78.7**	**76.8**

Source: HMIS (2018)

* Coverage >100% indicates incorrect population estimates and gaps in data recording system

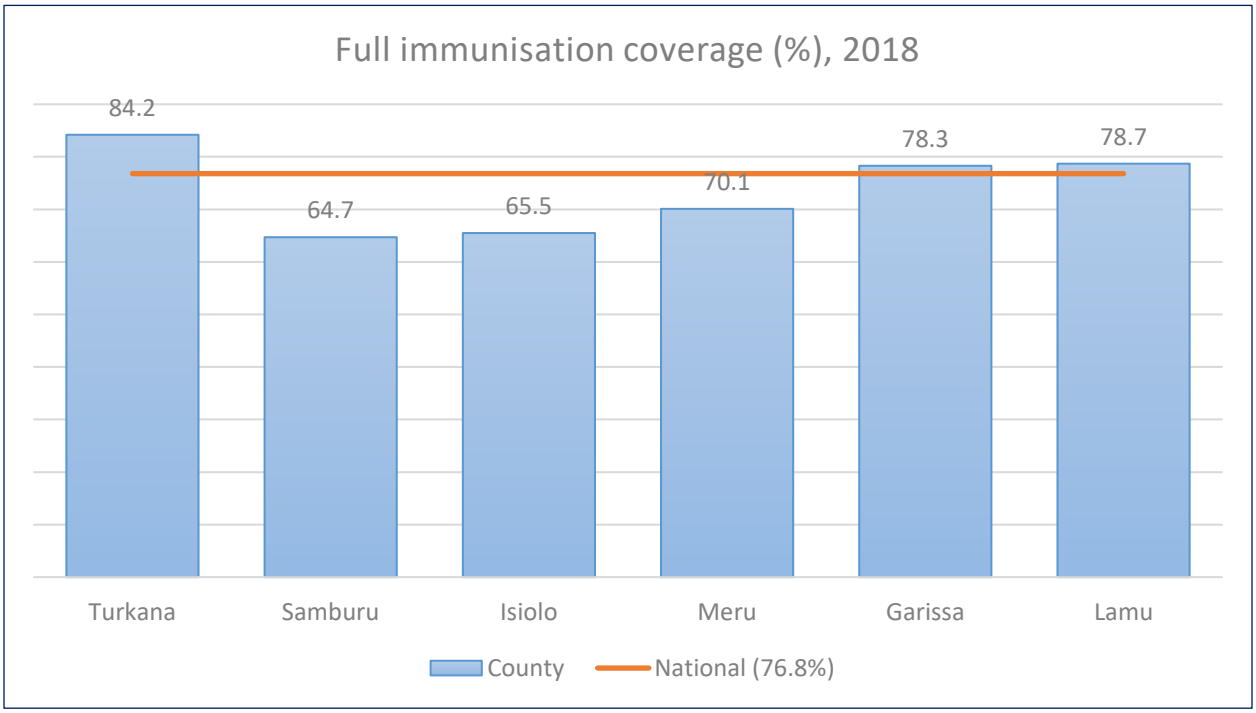

Figure 31: Full immunisation coverage in the Project area, 2018

Source: HMIS (2018)

1.7.12.2. Trend in Condition

The health facility utilisation rate shows an upward curve in the study area. This is evidenced by increasing outpatient attendance and institutional deliveries. Maternal deaths, however, remain a challenge. Garissa County recorded an increase in maternal deaths in 2018 compared to 2017 while Meru and Lamu recorded a significant decrease during the same period. The Project counties all recorded an increase in full immunisation coverage in 2018 compared to 2017 and 2016.

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APPENDIX B

Focus Group/Interview Guide and Records

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Turkana, Lokori
Meeting Date and Time:	15 January 2019
Meeting Venue/Group:	GPS co-ordinates: Zone 37 1˚57'22" N 36 ˚2'19" E
Facilitator/Documenter:	Alex Nadome/ Dennis Erot
Number Present:	**M:** 6 **F:** 1

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Lokori is a village located in Lokori ward in Turkana East sub-county in Turkana County.
- Lokori originated in the 1950s and the name means '*place inhabited by the giraffe*'.
- Losuron (full name not known) and his group were the first people to discover the place and named it after the giraffe because they witnessed a female giraffe giving birth to a dead calf. Giraffes were the only dominant species in the area at that time.
- People began to migrate to Lokori from the Kalapata areas. The immigrants came in groups (clans) - the Ngibilae followed by the Sonyoka clan. Since the Ngibilae were the first clan to arrive, Lokori is said to belong to them.
- The Ngibilae were hunters which resulted in the giraffe moving to other areas.
- The Sonyoka clan later joined the Ngibilae, mainly in search of pastures and water, and over the years the two clans have mixed and intermarried.
- Indians also came into Lokori as traders. The first Indian was called Angatubae (full name not known).
- Another group of traders were the Somalis. The first Somali trader was Jamah Hussein who influenced other Somalis to move to Lokori for trading purposes.
- Two European missionaries also feature in Lokori's history; the first missionary was Dr Dick Anderson, who built a hospital, health facilities and schools; the second missionary developed the Lokori irrigation schemes in 1978.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land?).

- There is no available land. All land is communal and owned by the community, and typically referred to as *ngirerea*.
- Forestry and hilly areas belong to the government.
- Turkana County is entrusted to own the communal land on behalf of the community.
- The land is settled according to grazing and seasonal patterns.
- Currently, no land has been given to any new applicant. If investors apply for land, it is leased to them by the Turkana County government through the Ministry of Lands.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)?

- Community land is entrusted to the Turkana County Government.
- Most communal land is used for:
    - agriculture and irrigation
    - business centres e.g. women empowerment

- market stalls, livestock sale yard, sand soil harvesting, public utilities
- public institutions e.g. schools, hospitals and churches
- airstrip
- forestry and fishing
- communal cemetery
- recreational centres e.g. football pitches
- residential areas
- archaeological sites e.g. Namoratunga[1].

- Community land is managed by a land committee who develop and implement the bylaws and fees for various land uses.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Land use planning progress; there are expansion plans for developed existing institutions, for instance, there is an irrigation scheme that is due to be expanded.
- Electrical power station has been developed.
- The economic development priorities are:
  - **Water**: there is need for water and there is a proposed dam construction in the area to address water shortages.
  - **Education institution**: due to an expanding and growing population there is a need for an additional educational centre
  - **Infrastructure**: roads are needed for access and a road development plan is proceeding
  - **Security**: there are several vulnerable areas which are prone to raids and security issues need to be streamlined
  - **Food security**: food security is a challenge in the area, but there are plans to pen market places and increase food production and livestock.

Constraints and opportunities:

- Severe lack of funds
- Security concerns at hot spots on the village outskirts
- High level of dependence which increases poverty
- Boundary conflicts as a result of tribal confrontations
- Political differences among the leaders which lead to poor governance
- Natural resources along the boundaries are not optimally extracted due to tribal conflict and security issues
- Poor agricultural practices.

5. Current ongoing village initiatives, what is the progress?

- There are ongoing village initiatives including a football tournament (funded by the Constituencies Development Fund (CDF) – this was aimed to nurture young talents and foster peaceful coexistence.
- There is a community-based organisation called NODO that organises human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS) campaign awareness programmes.
- The education development trust runs a programme called '*wasichana wote wasome*' which is an initiative to educate girl children and empower them.
- Techno Save is a company contracted by Tullow to educate the business community and small-scale businesses about financial literacy, table banking and how to manage loans provided by the Tullow company.

[1] *"Namoratunga"* is an archaeological site also known as the Kalokol pillar site. It is in the west of Lake Turkana. The name means people of stone. The site contains basalt pillars surrounded by circular formation of stones. According to legend the stones were once men.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

Sources of revenues:

Revenue is collected by the Turkana County government from soil and sand harvesting, business permit and licensing, stage fees, natural resource harvest and livestock market fees.

Total annual revenues:

- These figures are yet to be confirmed by the county government ward administrator.

Type of expenditure:

- Loans are provided by the county government and capital expenditure is handed out as a result of subsidies.

Public and female participation:

- There is a higher number of female participation in village initiatives than male, and several initiatives are managed by women.
- Women are permitted to join any initiatives freely.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- The local government has the capacity to plan and develop Lokori only when the funds are available to them by the Turkana County government
- Through the local government, both the county government and the national government are aware of various economic development priorities, areas and plan for implementation of the same.
- All revenue is collected by the county government whose employees work as members of local government.

8. Request for village statistics if available

Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in-migrants	

Sketch 8 of 10: Workshop Locations, Lokori, Turkana County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
Road
Watercourse
Waterbody
FOR INTERNAL USE ONLY
Lokori
Scale (at A3) 1:100,000
Kilometres
0 0.5 1 2 3
N
GOLDER
TOTAL

2

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Turkana, Lokori
Meeting Date and Time:	15 January 2019
Meeting Venue/Group:	GPS coordinates: 1˚57'22" N 36 ˚2'19" E
Facilitator/Documenter:	Alex Nadome/ Dennis Erot
Number Present:	**M:** 8 **F:** 1

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Resolving disputes.
- Knowing the well-being of the people in the village and their general welfare of the community.
- Ensuring the children in the village attend school.
- Solving theft cases and refer complicated matters to the chief and to the police station.
- Deciding on the course of action for cases reported in the village.
- Investigating rape cases.
- Making decision at village level.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers. They use local herbs for medicinal purposes.
- *Kutikuti* (local herb) is used for treating infertile women.
- *Ngimuputi* (first teeth of a toddler) – it is believed that this has a relationship with childhood illness and traditional healers have their remedies for this.
- In the past, in Turkana, disease fell into two categories; children and adults.
    - *Ekabonyo* was a herb used to induce vomiting;
    - *Eogong* (herb) was used to treat tuberculosis. The herb would make the patient vomit and lead to healing;
    - *Siir* was used by traditional healers for oedema. The patient was subjected to small superficial cuts, which would bleed and lead to healing.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Traditional healers are usually compensated with goats or cows and but this does not occur often due to an increase of contemporary medical treatment at the health facilities.
- *Loriwo* (liver disease) was treated by the healers who used make small cuts on the patient, below the last rib.
- Herbs are mostly found in the forest and hilly areas.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- Refer to the map.

5. Important rites of passage (what are they and how are they observed?).

- There are rite of passage, they include:

• *Asapan* (transformation or transition from childhood to adulthood which involves the killing of animals and the smearing of different kinds of ore. • Other important occasions are marriage and death.
6. What should the proponent know about entering a village? How is respect shown?
• In the past, village elders receive developers and direct them to the appropriate authorities. • Currently developers must approach the village through the local government and the chief then introduces them to the village elders.
7. **Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).** • Village elders are working closely with the local and national governments. • Any development from potential proponents are passed through community leaders and the community.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Turkana County, Lokori
Meeting Date and Time:	15 January 2019
Meeting Venue/Group:	GPS co-ordinates: 1˚57'22" N 36 ˚2'19" E
Facilitator/Documenter:	Maurice Ikaal/ Dorcas A. Ejore
Number Present:	**M:** 8 **F:**

1. Herding activities (use seasonal calendar).

- In the dry month of January the herders migrate to look for pasture areas.
- The herders scout because of security issues.
- They herd within the river to get wild fruits for livestock.
- Livestock are lead to water sources along the river.
- Experience long rains late due to climate change.
- Rains used to start typically in April, but with changes in weather patterns this seldom occurs.
- Herders move when rains start.
- Livestock are currently at Kerio River.
- Herders migrate in search of pastures but their families remain in Ere.
- Security issues cause the herders to move especially when it rains.
- May is the middle of the wet season.
- In June the herders are settled with enough pasture for livestock.
- In July grazing occurs some distance from Ere.
- August is the start of the migration when the herders move back to river to utilise acacia tree pods.
- Between September and October the herds migrate to hilly areas; this is the dry season.
- Short rains arrive between November and December.

2. Requirements for water, when, from where, in what quantities per animal.

- Water is need for domestic and livestock.
- Water for livestock is sourced from the Kerio River.
- Water points are at Lohurerei and Lokwamosing.
- Oasis are used during the wet and dry seasons, and they are named Kaachola, Napeitom, Naskeny, Kanapot, Kangiesei, Kalomesek Sil and Agolet.

Quantities per animal:

- Goats and sheep consume seven litres of water each over a period of two days.
- During the wet season they drink water frequently.
- A donkey consumes between 40 to 60 litres of water per day.
- A cow needs 50 to 70 litres of water over a period of three days.
- A camel drinks around 80 to 100 litres of water every seven days.

3. Economics: average herd size.

- Goats: 100-200 animals.
- Cows: 5-10 animals.
- Donkeys: Between 2 and 10 animals.
- Camels: Between 10-50 animals in a herd.

4. Extension services; veterinary services.

- The herders have no access to extension services.
- They buy drugs and administer these to their livestock.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

- From Nakwakaal to Lomomug the herders migrate via the bridge when the river is full.
- Migrate to Nakwakaa to Kerio when the river is dry.
- They migrate from Lomomug to Nakwakaa during the wet season.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere)?

- Yes there are such places, and permission must be granted by the elders' chief.
- For a short-term stay no permission is needed if there are no other people at that site.

7. Travelling in what size of group? Are these family or lineage groups?

- Herders travel in groups (*epero*[1]).
- An *epero* is a team of herders migrating together in search of pastures and water without immediate family members.
- The young men may or may not be related but have a common goal.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Yes. Fishing along the Kerio River. Species of fish include tilapia and cat fish.
- Hunters and gatherers were present in the past but seldom now because of climate change, change of livelihoods and education on the importance of wildlife.
- There are varieties of foods available.
- Cultural and sacred sites are located at Naker aikaito and Namorutung`a.
- People visit these sacred sites to prayer and to dance to appease the gods.

9. Groups representing pastoral groups. Mandate, range management, etc.

- Pasture committees plan migration and grazing patterns, and also manage and control water points.
- They mitigate and mediate on conflicts and peace processes.

10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?

- Dust can cause health problems to humans and livestock; reduce visibility.
- Adverse effects on normal livestock behaviour.
- Increase in livestock diseases.
- Destruction of livestock grazing fields.
- Fear of water points destruction.
- Deforestation leading to a reduction in animal feed resources.
- Fear of displacement from permanent homesteads (Ere[2]).
- Increased conflict on oil issues.

[1] Epero - a group of herdsmen.
[2] Ere- permanent homesteads.

Sketch 8 of 10: Workshop Locations, Lokori, Turkana County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
Road
Watercourse
Waterbody
FOR INTERNAL USE
Data sources:
Coordinate System: Kenyan D
WGK (WGS 1984 Customised
Project Ref: 1772867
Prepared By: KP 08-01-2018
Scale (at A3) 1:100,000
Kilometres
Lokori
Nakwakaal
Lomomug
Takaa
Kolong
Lokwamoning
Lokebus
Lopii

3

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Turkana, Katilia
Meeting Date and Time:	17 January 2019
Meeting Venue/Group:	Katilia Ward Administrator Office
Facilitator/Documenter:	Alex Nadome/Dennis Erot
Number Present:	**M:** 5 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Katilia is named after a stream in the area.
- Around 1940 the first chief was Lotawa Achuka (first chief). He was succeeded by Mekede Lotawa. The third chief in Katilia was Merimug Mekede.
- New immigrants came from Kochodin in the 1950's and consisted of five families. They interacted and intermarried with the first family which is how the population grew.
- Some families migrated to Paragati, Baragoi, Loyangalani and Isiolo. The main reasons for migration was inter-conflict between the residents of Katilia and the neighbouring community of Pokot, and intra-conflict within the community.
- The missionaries arrived in1973 and started the schools, church and hospital. The first missionary was Dr Dick Anderson. He was followed by Ben Webstar who initiated food security programmes by introducing an irrigation scheme in Elelea and rain-fed farms.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Currently there is no available land, all land is communal and is fully utilised. Some of the land parcels belong to the community.
- No land is available for new applicants or immigrants. New people to the area typically stay for a certain period of time.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- Communal land is used for grazing, farming, water pans, mini-dams and public institutions such as schools and churches.
- The community work together with the local government, and agree by law concerning land usage by an investor.
- Lease out programmes and fees are negotiated by both an investor and the community together with the local administration.
- Grazing committee manage land in terms of grazing patterns and resolving conflicts.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Schools and other facilities are operational with the exception of a school called Kaibole primary school. It was relocated to Nagisa where it is operational.

- Portions of land have been allocated for:
  - Solar grids for electricity
  - Olsuswa Energy (geothermal development)
  - Katilia micro project for drip irrigation: Nameliteny spate irrigation/ Nataparin irrigation scheme.
  - There is land set aside for drilling boreholes at Echoke and other centres such as Lokorkor, Lopediru, Narkotlem, Nakatomwa, Kidewa and Ngimeyana.

Constraints and opportunities

- There is lack of funds from both the national and county governments and other potential non-governmental organisations.

5. Current ongoing village initiatives, what is the progress

- Community health volunteers provide extensive health care service to the village.
- The *Nyumba Kumi* initiative –complements the community policing initiative which requires each person to ensure his safety and that of his neighbour.
- Peace groups which comprise mainly village elders and reformed warriors who work together to bring about peace and co-existence in the community.
- The Education Development Trust (EDT) runs a programme (*Wasichana Wote Wafaulu*) that focuses on educating girl children. They sponsor girls and provide health education and rehabilitative support.
- Other village initiatives include the clearing and uprooting of the invasive *Prosopis juliflora*, locally known as e*tirae/mathenge* that has infested farming land in Katilia.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

Sources of revenue

- Royalty fees - from soil harvesting, coarse aggregate and fine aggregate and ballast and building stones from the quarry.
- Lease of land - leased with agreement of the county government. The lease is for an agreed period of time and is paid through an ex-chequer account.
- Land rates - charged according to the size of its plot.
- Business permits - revenues are collected from business permit issued to small scale business owners.
- Total annual revenue data may be collected from the revenue officer.

Types of expenditure

- The main expenditure is in the form of salaries to public service employees. Few loans are granted.

Public and female participation

- There is a higher number of women participating in village initiatives and other community developmental programmes than men.
- Food security, however, constrains the participation of many women since they have to search for food for their children.
- Some members of the community resist participation in community development programmes.
- Social change is a constraint to public participation in certain projects. Certain values do not allow elders or grown men to share facilities such as toilets. This can make locals reluctant to participate in public health projects such as toilet construction in their homesteads.
- Lack of food to facilitate participation.
- Lack of employment can cause unemployed youth not to be involved in community development programmes.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).
• Local government are well informed on the matters of development in their area (Katilia), and are coordinating well with both national and county governments as are far as development is concerned. They are well-organised.

8. Request for village statistics if available	
Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in migrants	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Turkana, Katilia
Meeting Date and Time:	17 January 2019
Meeting Venue/Group:	Katilia Ward Administrator Office
Facilitator/Documenter:	Maurice Ikaal / Dennis Erot
Number Present:	M: 8 F: 1

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders are leaders that serve other community members. They are heads of the village.
- They resolve intra- and inter community disputes and conflicts, and adjudicate accordingly.
- They report community e.g. the number of pregnant/expectant women and report this information to the chief's office.
- Elders are heads of their families and the sole decision makers in the community.
- They lead cultural events such as rites of passage, marriage (in terms of dowry) and transitions to other stages of life.
- They control grazing patterns using a seasonal calendar.
- They work together with the national and county government to relay information to members of their community.
- Elders can bestow blessings or curses since it is believed they are connected to the spiritual world.
- Their roles have, to some extent, changed due to the modernisation of life. Elders used to receive and screen visitors to the village, and subsequently allow them to co-exist within the community. Currently all visitors are required to visit the administration office before they see or meet the elders.
- The new political dispensation and political alignments have changed the roles of elders.
- Churches perform various cultural practices rendering those activities null and void for the elders.
- The introduction of alternative lifestyle such as farming has also affected these roles.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- Some traditional healers use natural resources for medication, others combine magic and herbs for their patients.
- The traditional healers using magic are given goats and other commodities to perform healing. They are typically paid in kind, usually because most people depend on livestock as source of livelihood.
- Some healers prefer to be paid cash or in the form of livestock. Others heal people on compassionate grounds.
- The resources used by healers are obtained from the plains, along the rivers and on hills and mountains depending on the type of illness that is to be treated.
- Healers are still consulted despite the introduction of dispensaries and hospitals.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Refer to the map.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.
Sacred sites • There is a place called *Amoru* which is visited by community members during prayers to prevent calamities. The place is along the River Kerio. • *Edoket Angide Akwangorom* is also a sacred place, found near Amoru. • There are a number of magicians (warlocks) graves at Lopeeto and Nachok. • A natural well (physical feature) is located next to the graves at Kanapeot. • *Longaada* is a physical feature where red-ochre is harvested mainly for use in cultural events. All the sites mentioned above are visited by the elders and other members of the community (women and warriors). All the areas around the area of the pipeline can be visited. There are no special areas except individual graves that are taboo and which should not be destroyed. There are trees that cannot/should not be cut around the *Edoket Angide Akwang'orom* area. The other sacred treeis the *Akalale,* which isnot to be cut or visited by anyone other than the authorised persons. Authorised persons who can visit this tree are village elders. Persons who oversee rites of passage can also lead members of the community to visit the tree.
5. Important rites of passage (what are they and how are they observed?)
Several rites of passage are observed: • The young male adult transition to adulthood. This is presided over by the elders and the person then elevates to a high status. Being of high status, he is allowed to marry at the age of 20. Marriage is also another rite of passage. • During death ceremonies, other members of the family are shaved, and animals are slaughtered so as to cleanse the family. This applies only to male adults who are married. • The transition from youth to adulthood is called *Athapan*. • Marriage is called *Akuuta*. • Death.
6. What should the proponent know about entering a village? How is respect shown?
• First the visitor must be registered to visit the administration office. The chief then introduces the visitor to the elders of the village for advice on how to co-exist with others.

FACILITATOR OBSERVATIONS

Comment
• Elders are also conversant with the administrative boundary of Katilia village. They have the final say on the use of land as they are the main stakeholders. They are the only ones who are authorised to visit places or areas that are taboo.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Turkana, Katilia
Meeting Date and Time:	17 January 2019
Meeting Venue/Group:	Pastoralists and Agro-pastoralists, Katilia Ward Administrator Office
Facilitator/Documenter:	Maurice Ikaal/Dorcas A Ejore
Number Present:	**M:** 9 **F:** 2

1. Herding activities (Use seasonal calendar).

Month	Season	Activities
January – Lokwang	Dry (*nakamu*)	Long distance herding, water access along the river.
February - Lodunge		
March - Lomanuk		
April - Titima		Migration to pasture areas.
May - Elel		
June - Lochoto	Wet	Migration back to permanent homesteads.
July - Losuban		
August - Lotiak	Dry (*n'girerea*)	
September - Lolong'u		
October - Lopoo		Breeding livestock for food.
November - Lorara		
December - Lomuk		

- There are seasonal changes due to the irregularity of rainfall. The wet, mid-wet, and dry seasons have changed over time. Pastoralists' movements have become irregular making grazing patterns hard to determine.
- The herders search for pasture and water over far distances during the dry season. They harvest wild fruits such as *en'gol* (Doom palm), *ngiminae* (gum Arabic), *edome* (grey-leafed cordia, *cordia sinensis*), *edung* (shepherd's tree, *Boscia albitrunca*), *edapal (Dobera glabra)* during the dry season (*nakamu*).
- Water shortages remain a challenge to both humans and livestock resulting in nights spent outside their homestead or pens.

Pastoralist-herder

- Economic and social activity provide for dowry payments and basic family needs (food).
- Dig shallow wells during the wet season - an activity done by strong men (*akiwad ng'akujan*)
- Supplement their livelihood with acacia pods (*akiloilo*) and with *ngitit* (dry leaves from shading trees, eaten by shoats and camels).
- *Prosopis juliflora*, locally known as *etirae/mathenge* has become the major source of livestock feeds and tubers (*lorimoch*).

Agro-pastoralists

- Supplementation from crop residue, cutting of grass during harvest for use in the dry season.
- Land preparation, weeding (*edoaan*).
- Desilting of the canal.
- Clearing bushes.
- Individual land preparation and fencing of farms.
- Tubers from Esekon, Eng'ol and Ekabonyo.

2. Requirements for water, when, from where, in what quantities per animal.

Requirements for water:

- Water is used for domestic use e.g. cooking, drinking by livestock and humans. Fetching water for the young ones of shoats (kids/lambs).
- Water is collected from wells, springs, boreholes. Donkeys are used to carry water to far homesteads during the dry season.
- Water comes from the water catchment (*ngiburin*) and the oasis (*ngichwae*)**.**
- Water is used on the farms.

Water quantities per animal

- Camels need an estimated 100 litres per week. During the wet season camels consume less water at intervals of one month.
- Cows consume 140 litres of water over two days. During the wet season water is readily available in pools and/or in rivers. The cows can drink whenever they want, usually every day.
- Donkeys consume 60 litres of water over a period of two days.
- Shoats (goats & sheep) consume 10-13 litres over a period of two during the dry season.

3. Economics: average herd size.

- Goats: 100-200
- Sheep: 50-100 or 200-500
- Cows: 50-150
- Camels: 40-100, 70-80, 500-700
- Donkey: 20-50

4. Extension services; veterinary services.

- Often, at specific times especially during periods of disease out-break.
- Livestock owners purchase drugs and treat their own livestock.
- Veterinary services are based in Lokori trading centre.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

Travel routes and paths

Dry season:

- From Katilia to Kailong'kol
- From Katilia to Kaamuge.
- From Nakwakaal to Sukuta
- From Katilia to likayo

Wet season

- From Katiia to Lokitela
- From Katilia to Ngikengoi
- From Katilia to Nakwakaal
- From Katilia to Narokatalokinyi

Note: as shown and marked in the map.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere)

- Temporary migrants with livestock do not need permission to settle.
- Permission to stay in Ere is required from elders and administrators.
- Every Ere consists of elders (Mr Elimlim Locheriakio), Looyan Nyangkoda, Lokuja In'olan, Ewalam Erogo.

7. Travelling in what size of group? Are these family or lineage groups?

- The herders travel in groups (*arumrum*).
- Comprise of different families to form *adakar* i.e. organised grazing groups.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Yes. *Ngikalokak* (hunters), and *ngikenbolak (gatherers)* - feed on Eng'ol, egilae, eng'omo, Ng'akalio, edome edapal, dig magadi salt.
- Cultural sites - *ng'asenon* stones gathered together for respect of cultural site at Orio, Kakudo, Kalokim.
- Fishing along the Kerio and Sukuta Rivers – types of fish include *akiragiragiot* (fish with scales), *koopito* (Nile perch). *etiir* (Tilapia), *naliba* (Labeo), *loruk* (King Fish) and *losali* (Carpus).

9. Groups representing pastoral groups. Mandate, range management, etc.

Arumrum Ekaal Kinon/Akaal (pastoralists groups):

- Control grazing patterns.
- Patrol in advance of releasing herds for grazing.
- Give direction for migration during the dry season.

Agro-pastoralists associations:

- Plan activities and dykes at the farms.
- Give direction on farm watering patterns.
- Train farmers.

10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals).

Concerns:

- Increase in livestock and human diseases.
- Concerns about displacement due to a lack of title deeds.
- Fear of effects on cultural sites (*Ng'asenon*).
- Sustainability of pastoralism through provision of veterinary services, capacity building.
- Security concerns.
- Cattle resettling.
- Migration hence an influx of people in the area.
- Increased theft and robbery.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Turkana, Kalapata
Meeting Date and Time:	18 January 2019
Meeting Venue/Group:	Kapalata
Facilitator/Documenter:	Alex Nadome/Dennis Erot
Number Present:	**M:** 11 **F:** 1

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Kalapata originated in 1963 and is named after a stream of the same name, which starts in the Nakukulas and extends towards Nakalei.
- The Kalapata ward comprises Loperot, Kalapata and Nakalei.
- Some people migrated to Loporot in the 1940s and they settled for short period of time before migrating again to Lodwar.
- An Indian by the name Mu Patel came to Kalapata as a trader.
- Lokorifieu is a renowned witchdoctor in Kalapata and was respected in the community.
- The first chief for Kalapata was called Akolile (a Turkana name).
- People leave Kalapata in search of pasture and water since food is scarce during the dry season.
- Intra communal conflicts and natural disasters such as the outbreak of diseases also play a role in forcing people to migrate to other areas.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Only communal land is available. It is optimally utilised and owned in terms of *ngirerea* (i.e. land portion specifically owned and occupied by a certain clan).
- Incoming migrants are allocated land parcels for a specified period of time.
- Local authorities and village elders oversee the allocation of land to applicants.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- Kalapata land is communal land.
- Most of the land in Kalapata is used for grazing, residential areas, public institutions (churches, schools and government administrative institutions) and business centres.
- Land is set aside for water pans and catchment areas.
- The community give land freely for the development of public institutions through elders and chief area.
- There are no specific structures that manage land issues but are probably controlled by the heads of *Ere* (area inhabited by specific clan).

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Land use planning progress.
- Economically, Kalapata depends on pastoralism, small scale businesses, mat making and charcoal burning.

- There are numerous development plans and economic priorities:
  - Education – although there are established primary and secondary schools in the area, plans are in place to increase education facilities and expand the existing ones. There is an urgent need for secondary schools for both boys and girls.
  - Road infrastructure is also prioritised to improve accessibility.
  - Health facilities are needed to supplement the existing centres.
  - An electricity supply is planned for Kalapata ward.
  - Boreholes must be drilled to alleviate the water scarcity in the village.

Constraints and opportunities

- Little money to fund projects.
- Inadequate security within community as well as at the community boundaries.
- Poor road infrastructure.
- Unskilled personnel.
- Community disintegration - community cannot agree on some developmental projects.
- Inadequate health care system.

5. Current ongoing village initiatives, what is the progress?

- There are ongoing village initiatives, for example:
  - NAPEI - a group that empowers women in matters of business and financial literacy (table banking) and encourages business ownership.
  - Soap making initiative - uses extracts from available natural resources known as *echuchuka* (aloe vera) to produce soap.
  - Community health volunteers - work hard to ensure health care services are extended to community households.
  - Loperot demo farms - an initiative that spearheads food insecurity reduction in the community by enhancing food production for subsistence use.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with district administration).

Sources of revenue

- Charcoal transportation permit fee.
- Issuance of business permits to business communities.
- Fee charge on quarry extraction and soil harvesting (sand soil).
- Total annual revenue (TAR0) yet to be confirmed by the ward revenue office.

Types of expenditure

- Salaries of public officials and national and county government employees.
- No capital expenditure since no loans are granted to start up business entrepreneurs.

Public and female participation

- There is high participation of women in village initiatives and other potential village development projects.

Constraints to participation

- Resistance by community members to some programmes/projects i.e. digging of pit latrines.
- There are no incentives given to those who opt to volunteer.
- Facilitation to the meeting gathering points are not provided.
- Lack of enough informed choices about projects or initiatives.
- Community mainly work together with district administration.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).
▪ The local government has no capacity to implement development plans as it depends on other level of the government (national and county government). ▪ Women are actively engaged in village initiatives.

8. Request for village statistics if available	
Current population (m/f)	43,076
No. of households	6002
Births 2017	96
Deaths 2017	121
Population <15 **Population 15 – 54**	14,142 13,226
Population 55+	**15,710**
No. of in-migrants	**N/A**

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Turkana, Kalapata
Meeting Date and Time:	18 January 2019
Meeting Venue/Group:	Kalapata
Facilitator/Documenter:	Alex Nadome / Dennis Erot
Number Present:	**M:** 10 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders fulfil many roles in the community such as:
  - control livestock watering points
  - settle disputes and solve theft issues
  - cleanse and bless the community children
  - preside over marriage issues
  - lead in prayers and curse and bless the community
  - control grazing land
  - give advice to and direct young community warriors
  - consult with other elders to finalise decisions
- Their roles have changed over time; a typical example is that elders no longer give out daughters for marriage, since the introduction of schools has reduced early marriages among girls.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the community.
- They use traditional natural resources for healing. These resources are wide spread with most found in the hills and in the forest.
- *Echuchuka* (aloe vera) is found in the mountainous regions.
- Traditional healers are paid in cash (typically TSh 100 to TSh 200) depending on the disease treated and the severity.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Refer to the map.
- There are no specific migration routes.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- Special places that are taboo exist. They are typically individual graves and can only be visited by their relatives.

5. Important rites of passage (what are they and how are they observed?).

- There are rites of passage such as *Athapan* (a transitional stage from childhood to adulthood).
- During *Athapan* goats are slaughtered and the person undergoing the rite of passage is dressed up (i.e. wearing of sheets and beads at the neck).

• The second rite of passage after *Athapan* is marriage. The person that has undergone *Athapan* is treated as an adult and entitled to be responsible and initiate a family through marriage.
6. What should the proponent know about entering a village? How is respect shown?
• Visitors to the village should first liaise with the chief to communicate their main objective and task to be carried out. • It is the responsibility of the chief to take visitors to the village elders who are then also informed about the nature of the visit.

FACILITATOR OBSERVATIONS

Comment
• Elders, especially the chiefs, work closely with the local and county government officials. • Elders are conversant, knowledgeable and have a good understanding of their community • They are familiar with the community boundaries.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Turkana, Kalapata
Meeting Date and Time:	18 January 2019
Meeting Venue/Group:	Kalapata
Facilitator/Documenter:	Maurice Ikaal / Dorcas Akai Ejore
Number Present:	**M:** 20 **F:**

1. Herding activities (Use seasonal calendar).

Month	Season	Activity
January - *Lokwang*	Dry	Migration for pasture and water Random herding
February - *Lodunge*		
March - *Lomaruk*		
April - *Titima*	Mid to dry	Supplementation of acacia pods (*Akiloilo*)
May - *Elel*		
June - *Loatoto*	Wet	
July - *Losuban*		
August - *Lotiak*	Mid to wet	
September - *Lolong'o*	Mid to dry	
October - *Lopoo*		
November - *Lorara*	Dry	
December - *Lomuk*		

Note: Months vary in the calendar according to them in February.

- **James Echoho (goat and camel herder):** It is the dry season where there is supplementation of livestock feeds with acacia pods, watering animals and desilting water wells. Camels, donkeys and cattle are driven to springs (Ataiko, lojemei, Nakipurat, Lokwakipi, Kaemokinon and Lopei-sajait).
- **Ng'aher Lomeyan (camel herder):** Migrate to Napak Elim, Lokidir, Lopii, Lokwamosing, Lokoriokor to Karinorega. Return during the wet season through Lokwamosing.
- **Lokit Ereng:** Migrate through Namwa to Naroo (Kalemng'orok, Kaakongu. Return during the wet season return through Nakalale, Nakukulas then Kalapata - June (Lochoto).
- **Elabo Lomairei (goat herder):** Migrate during the dry season towards Lorii ranges with enough pasture but little water for livestock. Return in the wet season through Kerio River. Trek for two days before accessing the water point.
- **Ekipetot Ereng (donkey herder):** Migrate to Kochodin for pasture and water (Loturerei). Also to the Nadikam area for pasture and Lokwamosing for water.
- **Eyaan Akai (goats herder):** Feed livestock on *Ngahir* (dried tree leaves) around Loperot. When dry season worsens the livestock are driven to Ng'atieket where the livestock feed on trees such as *Ereng, Emekwi, Eipa* (drought-resistant trees). The water points used during this season are the Nabolei water well, and Kaimegur and Kaidima.

2. Requirements for water, when, from where, in what quantities per animal.

- Water is needed for livestock, people and domestic use.
- Wells are used during the mid-wet season; Kareko, Elelea and Nabolei are the main sources.

- During the dry season water is drawn from the boreholes in Nakiling'a at Loperot, which is shared by the school, community and pastoralists.
- The wells at Lokichada become the central source of water for pastoralists in different regions of Loperot, Nakukulas, Lokitoe-liwo, Kaching'angor, Ikalale Akwaan.

Quantities per animal

- Donkeys require 90 litres at 3-day intervals (estimate of 20 litres/10 litres jerry can). During the wet season they drink frequently.
- Camels consume 160 litres at 6-day intervals during the dry season. In the wet season it is 660 litres; 70 litres during the dry season at interval of two days.
- Shoats (goats and sheep) need 20 litres during dry season at two-day intervals.

3. Economics: average herd size.

- Camel: 30- 100
- Cattle: 15-40
- Donkeys: 5- 20
- Shoats (goats and Sheep): 50 -100

NB: animal herd size estimated per household.

4. Extension services; veterinary services.

- There are no extension services to the community (since 2008).
- Livestock owners buy veterinary drugs and administer to their own animals.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

- Yes. Refer to the map.
- From Kalapata to Naroo via Kachirgangor
- From Kalapata through Nakukulas to Kailong'kol
- From Kalapata to Lokwamosing
- From Kalapata to Kerio then Karimorega
- From Kalapata to Lorizi

Wet season

- Around Kalapata area to Kaureta Ngisuroi
- From Kalapata to Lomokamar in Lokichar

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- During the dry season routes they draw up routes as they migrate to pasture areas.
- Permanent homesteads are established during both the dry and wet seasons.

7. Travelling in what size of group? Are these family or lineage groups?

- Travelling is by groups of families (*Arurum*) because of security issues and also to scout for pasture and water.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- No hunters.
- Wild life belongs to Kenya Wildlife Services, said one of the respondents.

9. Groups representing pastoral groups. Mandate, range management, etc.
• Pasture committees. • Plan grazing patterns particularly to control use in the dry season.
10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
• Health problems. • Concerns about the destruction of natural vegetation. • Injuries and/or accidents to pastoralists and their animals. • The destruction of traditional water points and springs. • Restrictions in the movement of livestock and people. • The influx of people from urban areas to rural areas, resulting in an increase in theft. • Concerns about increased security personnel for the pipeline leading to frequent arrests.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Turkana, Lokichar
Meeting Date and Time:	19 January 2019, 10h00
Meeting Venue/Group:	Riamakori Hotel
Facilitator/Documenter:	Alex Nadome / Denis Erot
Number Present:	**M:** 17 **F:** 6

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- The village is named after the Lokichar stream. Lokichar means branched stream.
- The Sonyoka clan is the dominant clan in the area. The first sub-clans to migrate into Lokichar were the Ng'ng'olereto, followed by the Ng'ikosomoroko clans. Other sub-clans were the N'giponga, N'giil Kai and Ng'idocha. The last clan to migrate to Lokichar was Ng'ikaleso, Lokoli's family.
- Another clan by the name of Ngibilae moved to Lokichar between 1968 and 1978. Samal was the first chief in Lokichar.
- The Somalis came to Lokichar to trade. They were the main traders in the area during the early 1960s.
- An Indian by the name Arigatubae also came to Lokichar as a trader and settled.
- Migration to Lokichar was typically to search for water and pasture.
- Clans left Lokichar also in search of pasture and water during dry seasons, intra-communal conflicts, job opportunities and intermarriage.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Currently there is no land available for new applicants since ownership of land is communal. The land is categorised into *ng'irerea* (portions of land entitled to certain clans).
- All lands, apart from public institutions are intended for livestock grazing.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)?

- Communal land is utilised for:
  - Sale yards- for marketing and selling animals
  - Wildlife areas
  - Water catchment areas i.e Achukule
  - Areas set aside for solid waste management
  - Schools, health facilities and other government institutions.
- There are no specific structures that govern and control land utilisation but the community confer and donate land for public projects (schools, hospitals, churches). In most cases land is managed by the council of elders together with the government authorities.
- Grazing areas are managed by clan heads. These areas are controlled according to grazing patterns and seasonal calendars for pastoralists.
- Land needed for mega project investments and development is leased through the county government in consultation with the community representatives and it cannot be sold to any new applicant/investor.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Road construction linking Lokichar to Lokori is underway.
- The Lokichar sub-county hospital is not yet operational.
- There is an established airstrip that is available to the public.
- To help revitalise business activities, the economic development priorities are focused on infrastructure (road construction), security, expansion of health facilities and promoting the public-private sector partnerships to facilitate delivery of quality services and achieve economic growth.
- There is a need to expand the existing public learning institutions.

Constraints and opportunities

- Mostly there is a lack of funds to implement proposed development opportunities.
- Lack of security also hinders development.

5. Current ongoing village initiatives, what is the progress?

- There are ongoing village initiatives. One is facilitated by the ministry of health in partnership with other non-governmental organisations. Some of these, which are done through community health workers, include:
  - Circumcision awareness to reduce the spread of human immunodeficiency virus, acquired immunodeficiency syndrome
  - Cancer screening awareness
  - Water, sanitation and hygiene (WASH) programmes.
- The education development trust runs a girls education programme to ensure the girl child has an education.
- The Neema Women's Poultry Enterprise is a women-based organisation involved in egg production; it empowers women socio-economically.
- Theatre groups, drama clubs and cultural dances shape and convey behavioural change messages to the community.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

- Most sources of income originate from:
  - Single business permits
  - Auction and slaughter fees
  - Transport fees
  - Levies from laying pipes (water pipes, oil pipes etc.)
  - Land rates
  - Electricity poles
  - Plots and rents
- Total annual revenue is still to be confirmed.
- Typical expenditure includes salaries and wages paid to public officials working for both the county and national government. There are also administrative expenses such as utilities and personal wages.

Public and female participation

- More women participate in village initiatives than men. Only a few men actively participate.
- Constraints to public participation are a lack of motivation and incentives.
- There is a close and defined relationship with the district administration.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).
• The county government lacks funds to execute its development plans. • There is a good relationship between the community and its administration.

8. Request for village statistics if available	
Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in migrants	

FACILITATOR OBSERVATIONS

Comment
• Village statistics are yet to be confirmed.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Turkana, Lokichar
Meeting Date and Time:	19 January 2019, 10h00
Meeting Venue/Group:	Riamakori Hotel
Facilitator/Documenter:	Alex Nadome / Denis Erot
Number Present:	**M:** 12 **F:** 2

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elders disseminate information between the community and county government.
- They create awareness concerning matters about education, security and land issues.
- They represent both the county and national governments.
- The role of the elders is to serve the community. They solve land disputes and livestock theft in the pastoral community.
- They typically make all the decisions within the pastoral community, and ensure there is peaceful coexistence although in recent times educated people have more influence in this process especially in community projects where they are stakeholders.
- Over time, however, the role of the elders has changed and currently they follow newly introduced structures from the county administrators, including handing over complicated situations to the chief and the police.
- Decision-making is influenced

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources, they need?

- There are traditional healers in the community. They use natural resources for healing, for instance:
  - ***Echuchuka*** (aloe vera) is used to treat malaria and also induces vomiting.
  - ***Emus*** (a traditional herb) is used to treat the common cold.
  - ***Eogong*** (medicinal herb) used to induce diarrhoea to remove toxins from the body.
  - ***Emoronyit*** (medicinal herb) is used to treat internal body growth. It is also taken with fatty meat.
  - ***Esekon*** (*Salvadora persica*) roots are used to induce vomiting in patients and its branches are used for cleaning teeth. Its juicy sap contains antibacterial properties that minimises bad breath.
  - ***Eregis*** (medicinal herbs) are used to treat fractures in animals
- Traditional healers are paid for their services.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Refer to the map.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- Special areas that exist include:
  - **sacred trees** (*Ekalale Loa Lotimaan*) are special trees where rites of passage such as *Alhapon* (transition to adulthood) are performed.

- **individual graves** are located between Lokichar and Kochodin. Graves are indicative of ownership of land by the deceased. Land owners are buried on their lands.
- ***Kang'ikakumok*** are special areas where visitation is forbidden.

- All areas with individual graves are said to be owned as *ng'irerea* (i.e. specific land portions owned by specific clans).

Refer to map.

5. Important rites of passage (what are they and how are they observed?)

- *Etal wa Anapet* is performed after a birth to welcome the new born into the family.
- *Lokoit* is done during the childhood stages. A sheep is slaughtered. The fatty parts are fried, and the oil smeared on the skin of both the baby and the mother.
- *Athapan* is the transition into adulthood. The person undergoing the ritual is dressed in a particular way. Animals are slaughtered for the occasion.
- *Athapan* is followed by marriage. The man is now entrusted with responsibilities of starting and heading a family.

6. What should the proponent know about entering a village? How is respect shown?

- All visitors to the village must first liaise with the chief, who will then direct them to the elders. Only then can visitors communicate their business to the community, who must also be involved as stakeholders.

FACILITATOR OBSERVATIONS

Comment
• The exact alignment of the pipeline was an issue that kept coming up. People wanted to know exactly where the pipeline would pass. • There are areas that are taboo and should not be tampered with in anyway. • Individual graves are located from Lokichar to Kochodin. These are special places that must not supposed to be disturbed. • The land is occupied by groups of clans (as *ng'irerea*) and therefore all spaces are occupied/utilised with there is no areas set aside for immigrants or new applicants. • The elders understand the administrative boundaries of Lokichar. They oversee day-to-day community activities. This gives them the power to reject or accept project implementation on community land.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Turkana, Lokichar
Meeting Date and Time:	19 January 2019 10:00 am
Meeting Venue/Group:	Riamakori Hotel
Facilitator/Documenter:	Facilitator: Maurice Ikaal Documenter: Dorcas Akai Ejore
Number Present:	**M:** 14 **F:** 1

1. Herding activities (Use seasonal calendar).

Month	Season
January - Lokwang	Dry
February - Lodunge	
March - Lomanek	
April - Titima	Wet
May - Elel	
June - Locholo	
July - Losuban	Mid wet
August - Lotiak	Dry
September - Lolon'gu	
October - Lopoo	
November - Lorara	
December - Lomuk	

Activities

- Herding over long distances in the hills of Kalongot, Nakalale, Kaitaokol, Kacing'angor is for pasture only. There is no water in these areas. Water points used during the dry seasons are in Kalapata, Lokichada, Kamanu-Kwee, Kaimegur and Elelea-Nabolei.
- The herders used to water their animals in Lokichar but currently there insufficient water for livestock.
- There is also a lack of access to water points in Kaemomug due to urbanisation, i.e. development of plots along livestock routes (encroachment).
- The livestock migrate towards Aroo, along River Turkwell and Kerio.
- During the wet season they return to their Ere (permanent homesteads) i.e. Lokitoliwo, Kang'ikakumok, Lomeyana, Dapar, Kapese, Lomokamar, Lowoidapal, Kamarese, Kaakali and Kaaripun.
- During the mid-wet season supplementation of livestock feed is done with indigenous tree leaves with climbers (Ereng, Esekon, Ebei, Ewoi, Edapal,Elim, Ekalale and Esanyanait). Some of the listed trees have more value than others e.g. Ewoi (acacia), Lokitoe-Kayep (climber) and Ekalale.
- During this season livestock drink water at Kaakali and Kamarese (traditional wells are used until the start of the rains (Karipun, Kangingolemongin, Kangikakumok, Riami-name and Lokuno).
- During the wet season water is available and most people and livestock have easy access. Ngataparin (natural water pans) namely Lokulubech, Apa-lolemu and Askim (used to hold water for about six months).

2. Requirements for water, when, from where, in what quantities per animal.

- Water is required both during the wet and dry seasons for domestic and livestock use. Required quantities for animals are:

Camels - 200 litres of water over a two-week interval.
Donkeys- 100 to 150 litres every day.
Cattle - 100 litres over two days.
Goats – 10-15 litres of water over two days.

3. Economics: average herd size.

- Camels: 10-70
- Cows: 20-220
- Donkeys: 10-80
- Goat: 100-400

4. Extension services; veterinary services.

- Veterinary services were available in the past but currently there are no such services available to the community. Prediction of diseases is done by seers (a person of supposed supernatural insight who sees visions of the future).
- The pastoralists can differentiate between fake, generic and efficient drugs. This enables them to understand which drugs are best for their animals. They prefer to buy the drugs themselves instead of getting them via veterinary services.
- Untimely vaccination campaigns lead to animal stress.

NB: Locusts consume vegetation.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

- From Lomariamuge through Kachingangor to Aroo (Kalemngorok)
- From Lomokori to Nakabosan
- From Lokitoeliwo to Lokwamosing
- From Ngimeyana to Kochodin

Mid-wet season:

- From Aroo to *ng'irerea* (permanent homesteads)

During wet seasons they graze around the *ng'irerea*.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- Yes. Permission is granted by seers and elders.

7. Travelling in what size of group? Are these family or lineage groups?

- When there is peace they travel individually. They migrate in groups when there is conflict.
- They move in organised pastoral groups (*arumrum*).

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Hunters are found in Kaamorok and Kachingaror. Gazelles can be found around the Turkana South National reserve.
- Plant gathering is done at Okitoe-liwo, Dapar and Lowoiangikakumok; wild fruits (*edung and edapal* – bitter bean-shaped fruits found in most desert areas).
- Cultural sites are found at Kachingangor, Akalale and Lowoi-angikakumok.

9. Groups representing pastoral groups. Mandate, range management, etc.

- Pastoral committees comprise well-known elders to plan and control grazing patterns
- They give permission to immigrants to graze in their lands.

10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals).

- Implementation of the project may lead to restriction of movement of pastoralists.
- Conflicts and division among communities.
- Reduced interaction (traditional practices are at risk).
- Health risks.
- Fear of increased temperatures.
- Increase in urban-rural migration leading to moral decay.
- Need for animal human insurance cover.
- Need for institutional and legal frameworks for a clear understanding of the process around the project.
- Community land should be leased instead of being sold.
- Degradation of the environment.
- Concerns about changes in livelihood and lifestyle.

FACILITATOR OBSERVATIONS

Comment
Additional questions on land availability • The land is given by the community, not by individuals. • Land is mainly used for grazing. • There is no land for sale. • Cultural sites are sacred and this land is not available. • Land is in the custody of the community, led by elders, who decide whether it is occupied or not. • People migrating from outside are welcome, at the discretion of elders. • Unused/unoccupied land is viewed as a reserve for livestock and livelihood. • Permission to graze is granted by the dwellers (Ere leaders). NB: immigrants pay for grazing rights for their entire stay.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

EDUCATION FOCUS GROUP

Village Name:	Samburu, Maralal
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Samburu Guest House/World Vision and Bright Future Foundation; Department of Education
Facilitator/Documenter:	Alex Nadome / Lelekong Job
Number Present:	**M:** _____ **F:** 1

1. At what age do children start school (is there kindergarten)?

- The children start nursery school at the age of five.
- According to the World Vision representative, some schools only offer pre-school.

2. What age do children leave school? Males and females? Does it coincide with important exams?

- There is no set age for Samburu children to join or finish school. Some join at five years old and some join at seven years old. However, in most cases, they finish school between the age of 18 and 20.
- Girls are frequently challenged in that most of them do not finish school. They drop out of school for various reasons that include:
  - Early marriage.
  - Insufficient capacity to progress with their education as Samburu is a remote area.
  - Early pregnancies.
  - Child-headed families. In these circumstances, children will find it difficult to balance the competing demands for their time and meagre resources, robbing them of opportunities to get an education.
  - Poverty.
  - Safety issues where it forces migration.

3. Is there adult education?

- There are only a few educational offices.
- The few that exist are less functional now than they were before because of the confusion brought about by the devolution of resources.

4. Budgets/partners/private donors?

- There are no donations, but several organisations provide uniforms for girls since they are more vulnerable than boys.
- Chairs and sanitary facilities are also provided by non-profit organisations.

5. Priority areas and plans

- Housing is provided for teachers. However, the housing provided is not always deemed to be adequate.

6. Household costs associated with education (i.e. tuition, supplies, uniforms, etc.).

- The household cost per year to educate one child is KSh 60 000.

7. Parental involvement (parent committees?).
▪ The objective of the Bright Future Foundation is education and the empowerment of vulnerable girls. ▪ World Vision build schools for communities and also focus on providing support to vulnerable children.
8. Teachers housing? Teacher education? Ongoing support?
9. Constraints and challenges?
Challenges include: ▪ Negative attitudes towards education because of culture influences. ▪ The education focus group require support from the county and the national governments to enable them to better serve the community.
10. Available statistics on

Enrolment	
Attendance and absenteeism	
Early school leavers	
Graduating	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Maralal
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Samburu Guest House
Facilitator/Documenter:	Parison Loongonyo/Juma Philip
Number Present:	**M:** 4 **F:** 2

1. Contributions/responsibilities to households.

- The youth in the community are responsible for looking after and herding animals.
- They are the breadwinners in the household.
- Morans (younger unmarried male) are also responsible for the safety of their families and the community.
- Girls fetch water and firewood.
- Women and especially girls build *manyattas* (typical Samburu home - a group of huts forming a unit within a common fence).

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

Age at marriage:

- For males, marriage is controlled by the rite of passage and the customary laws. Females typically marry at a young age.
- Presently the youth do not follow tradition and marry at any age.

Age at childbirth:

- Women ululate to mark the birth of a baby.
- Fewer members of the community observe the traditional rituals and rites of passage.

Adherence to traditions/rites of passage:

- In the past circumcision was done by the elders. Currently the procedure is carried out by a doctor.
- Circumcision for girls is now marked by a small celebration where the girl is cut slightly on the leg rather than on the genitals to signify rite of passage). This is to officialise the circumcision procedure.
- Circumcision can be done at any age.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The Samburu people understand the importance of education and aim to educate both boys and girls.
- The 'folk-societies" are still within the local's minds. They therefore prefer to work close to their area of origin and family or support group.
- In terms of education and employment opportunities, however, males are still regarded more highly than girls.
- The youth are swayed by money and take on any jobs to earn a source of livelihood.

4. General labour force characteristics and job readiness.

- The youth are ready to work, but jobs are scarce.

5. Human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS) awareness.
▪ HIV/AIDS awareness is extremely poor apart from the communities in big towns such as Wamba, Maralal and Baragoi. ▪ HIV prevalence is high. ▪ Illiteracy is high.
6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ The youth and women are completely excluded from politics. ▪ Young adults from an affluent background are usually considered for leadership, hence the upliftment of the same rich families. ▪ The youth are involved but women are still held back from participating. ▪ Money plays a big role in many aspects of community life; a more powerful and influential youth is usually given more opportunities.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name:	Samburu, Maralal
Meeting Date and Time:	18 October 2018
Meeting Venue/Group:	Agriculture Office Samburu County
Facilitator/Documenter:	Alex Nadome/Phillip Juma
Number Present:	**M:** 1 **F:**

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted).

- The community is made up of farmers ranging from small-scale to large scale.
- They produce maize, beans, wheat, sorghum. A large number of crops are grown in Samburu county.
- Maize and beans are the primary crops.
- Preparation starts in January as planting begins.
- Weeding is usually done in April, and crops are harvested in August.
- There are fertile areas, particularly around Baawa.
- In the northern parts of Samburu county the communities keep livestock and grow crops.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans	18 000 bags 90 kgs	6 000 acres	10%	July	5 500 per bag	18 000 x 5 500 = 99 000 000
Cassava						
Peas						
Maize	210 000 90 kgs	210 acres	20%	August and September	2 400	21 000 000 x 2 400 = 483 000 000
Yam						
Rice						
Leafy greens						
Cash crops						
Wheat	38 500	3 500	95%	September	TBC	TBC

3. Rotational system description, years in and out of cultivation, rotation of what crops.

- There are two planting seasons in the farming calendar - April and November.
- Maize is planted in April and beans are planted in November.
- Rotational planting is practised to allow for an increase in manure and increase soil re-fertilisation.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix).

- Fertilisers are applied to wheat and manure is applied to maize and beans crops.
- Tractors and cultivator machines are used.
- When services are paid for by the owner, labour is sourced from outside the community.
- Pesticide use is minimal due to good climatic conditions.

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Land is inherited from parents.
- Lease-out programmes are also available.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- The livestock is typically owned by individuals.
- There are specific routes and paths that herders lead their animals along to reach grazing and watering areas.
- The herders are typically between 18 and 35 years old.
- Natural grasses are also considered pasture.
- No processing of animal products because of its natural character.
- Animal sales and slaughtering take place daily except for Sundays and public holidays.
- During the rainy season, when green pasture is available, livestock prices escalate and during the dry season prices generally fall.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.).

- Farming is challenging in the lowland areas where soil quality is poor and rainfall levels are low.
- Individuals cannot afford fertilisers and have no access to credit.
- Prices at farm-gates levels may be unfavourable.
- People cannot afford labour from outside the family due to a lack of capital.
- Lowland areas are inaccessible because of a scarcity of land for farming.
- Agricultural extension officers educate and train people on the use of farming and its benefits.

8. Family labour distribution for agriculture and livestock activities – use matrix

Activity (confirm activities with participants first)	Adult Male	Adult Female	Child Male	Child Female	Aged
Clearing	X				
Other land preparation	X				
Planting	X	X	X	X	
Weeding	X	X	X	X	
Harvesting	X	X	X	X	
Post harvesting processing	X	X			
Herding			X	X	

9. Available extension services (government, non-government organisation - NGO) for agriculture and livestock, quality.

- Various extension services are provided by the government and NGO's.

10. Map to the extent possible/relevant with the group
▪ No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Archers Post
Meeting Date and Time:	19 October 2018
Meeting Venue/Group:	The County Great Inn, Archers Post
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	**M:** 3 **F:** 1

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Archers Post was named after a British Commissioner, Frederick Archer, who was posted to the area.
- The locals refer to Archers Post as Machini.
- The area is inhabited mainly by the Samburu, Turkana and Borana communities.
- Conflict and clashes occur in the region due to poaching by migrants.
- Archers Post has grown and is now regarded as a cosmopolitan centre. It is home to many communities and tribes.
- In-migration is driven by a search for pasture and markets for products.
- To avoid misunderstanding, the LAPSSET project proponent should liaise with local leaders.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Most of the land is communal land.
- Group ranches are owned in some areas.
- No immigrants are allowed to own land.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- There are three group ranches in the area.
- There are regulations in place to manage the use of land. Regulations relate to the role and management of grazing committees and conservancies.
- The primary economic activities in the area include livestock keeping and conservancy management.
- Livestock keeping is the primary economic activity of the typical individual.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- The locals do not support the Kenya Meat Commission's (KMC) initiative to rear and sell animals to them.

5. Current ongoing village initiatives, what is the progress.

- Human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) awareness is done by the community health volunteers.
- Women are more involved in health and HIV/AIDS issues than men.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with district administration).

- Revenue is received from conservancies, national research projects, sand selling and harvesting, livestock and markets.
- Ninety per cent of the resource mobilisation in the area is done by women.
- According to local government officials, all genders are represented at meetings and given equal opportunity to participate. Where appropriate, separate meetings for men and women are held to get their views.
- Women are also involved in community leadership.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- Archers Post was initially used for military training. These activities are ongoing.
- They are unexploded bombs in the area which were dropped during training. They may pose a danger to the community and workers during the pipeline construction.
- Those who will be working on the pipeline project should be conscious and liaise with the police and the administration to ensure that the area is screened before any construction work is done.
- There have been a number of explosive accidents which resulted in fatalities and injuries.
- The government, which includes the district administration, plays a large role in the day-to-day operation of the villages.
- Development plans and priorities are done at this level of government and then presented to the county government or other organisation for implementation.
- Community statistics are available from the administration office, making it easier for organisations (both government and non-government) to implement village initiatives.
- There is a higher percentage of women participating in the village initiatives such as HIV awareness, youth initiatives and education initiatives. Men view these activities as 'women tasks' and show little interest.
- The village government can access resources from the county government to enable them to undertake public participation programmes on land and socio-economic issues.
- Both levels of the government lack resources, so major projects are done by other organisations in most cases.

8. Request for village statistics if available

Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in migrants	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Samburu, Waso, Archers Post
Meeting Date and Time:	19 October 2018
Meeting Venue/Group:	Waso Archers Post
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 12 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The council of elders is head of the society and surrounding communities, and are they considered 'elders' when they reach a certain age.
- They are the most important seniors of the society.
- The elders currently have less influence with government and non-government organisations (NGOs) and the county government because of changes brought about by education. Their views are not considered to be as important as they were in the past.
- *Wazees* (the elders) live out of town on reserves.
- There is no substitute in the absence of the elder.
- There are traditional healers 'small doctors' who cure and treat diseases using powerful herbs and other society rituals.
- Herbs are mostly found in the Waso area. These are special sites where elders obtain their medicines. This area falls within the pipeline route.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources, they need?

- The sacred trees along the pipeline corridor may not be destroyed or cut away unless special compensation is paid immediately.
- *Ltepes* trees (umbrella thorn) are special trees where ceremonies (*Lmuget*) are held. The tree is considered the father tree in the area.
- Kalifari, Nairobi, Rapunnye, Lolboxi, Iderkezi, Loolgerger, Lerata, Lorurani and Lenkusaka are the special routes.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are no sacred places.
- Waso is the only holy site in the area; community members visit and pray here.
- *Ltepes* trees along the pipeline corridor may not be cut down because they are holy trees.
- The pipeline route traverses the areas of Kalifari, Nairobi, Lolboxi, Rapunye, Ltergesi, Lalpaniai, Garuna, Lolngerded, Loltokoon, Lerata Chini, Lerata Juu, Loolgeresire, Lengusaka and Wamba.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map?
▪ There are no sacred or special areas. ▪ A visit can be made during the sketching of the pipeline corridor. ▪ No sacred areas have been identified from Archers Post to Wamba. ▪ *Ltepes* is the only sacred tree.
5. Important rites of passage (what are they and how are they observed?)
▪ When a boy is born, men fetch water. ▪ Goats are slaughtered at *Lkupoket*[1] or *Lmorr*[2] and finally at *Lbuutan* and *Lkitewenet*[3]. ▪ During the circumcision of boys, elders take the boys to Lbaa or Siteti and also bring gum (*Silalei*) to start the transition to adulthood. ▪ Cows are slaughtered by the elders during community ceremonies. Rituals are held around *Ltepes* (Acacia Tortilis) and *Suchai*[4] (Barleria Spinisepala) trees. ▪ When a young girl has been circumcised, she is ready for marriage. ▪ *Mungen* (lion skin) and *urauri* (earrings) are put on by the father of a married girl or a boy initiated together with *sobua* or *bakora*[5] to show respect for their culture and to continue with the clan rituals. ▪ After marriage the *Lminoing* ceremony is conducted to give way to the elders. ▪ Most community activities are done during times of rainfall.
6. What should the proponent know about entering a village? How is respect shown?
▪ Elders teach children to behave well, to care for the people in their community and to avoid sexual contact at an early age. ▪ Members of the community respect the cultural differences of other community members, for example, the Muslim and Samburu. ▪ The proposed pipeline project should not bring negative impacts or rob the community of their livelihood. ▪ Elders consider the youth as the neediest generation in the area.

FACILITATOR OBSERVATIONS

Comment
▪ The cutting down of ceremonial trees such as *Ltepes* requires immediate compensation.

[1] Lkupoket- a goat is slaughtered immediately when a boy is born to celebrate.
[2] Lmoor- this is a celebration which is only done by women and the women alone eat the meat that has been slaughtered after child birth.
[3] Lbuutan and Lkitewenet- are both celebrations conducted before circumcision when a goat is slaughtered.

[4] Silalei is the local name for **gum** that comes from Acacia Senegal.
[5] Soboa/bakora is a **club** which is a heavy usually tapering staff especially of wood wielded as a weapon.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Archers Post
Meeting Date and Time:	19 October 2018
Meeting Venue/Group:	The County Great Inn, Archers Post
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	9

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- There are no agricultural activities since the area is dry for most of the year.
- Women keep livestock, sell charcoal, make beads and wash laundry to generate an income.
- Mothers are considered the most active people in the area.
- A large amount of *kokoto* (gravel) is sold to build houses.
- Beads are marketed well and sold to the many cultural villages in the area.
- The women use the 'merry-go-round' (financial) system, where every member benefits, to control their money.
- Table banking is also done by the groups.
- Their main source of capital is through bank loans.
- In the past women had few opportunities, but they are now considered even for leadership.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- A man is the head of the house or family (*Loitore pamalia*). Single women are the head in their homes.
- Women are the most active members of the household, e.g, they pay school fees, prepare meals and pay hospital bills.
- Men frequent bars more than they did in the past.
- Women and all children fetch water for the family.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- The men of the community resolve land quarrels and other conflicts.
- Men own the family resources such as livestock and other assets.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Both men and women can follow their own political aspirations, and vote for any person they choose.
- The fundraising is done mostly by groups and sometimes by an individual to uplift one another.
- The responsibility for looking after the animals is shared by all women.
- *Sokoni* (market), education issues and society rituals (*Lkereti*) hinder home activities.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?).

- Many women in the area are single parents, and they are stigmatised.
- Society rituals (*Lkereti*) must be completed.
- The less privileged report their cases to chiefs, council of elders and at the court.
- There is no help for single mothers in the community; they are dependent on their own resources for income.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Training in family planning and female genital mutilation awareness is provided by medical experts.
- Women are aware of HIV and AIDS (acquired immunodeficiency syndrome) in the county but to date there have been no cases in the community.
- They are aware of the causes of HIV/AIDS and that using condoms will prevent its transmission.
- *Mpango ya Kando Kuacha itazuia* HIV (meaning that refraining from sex with unknown people will prevent the transmission of HIV).
- Condoms are used to protect against HIV.
- Transit drivers are deemed to be HIV transmitters. The community hopes that LAPPSET will not bring such drivers to the area.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	***How often***	***How much for an average family***	***Other comments***
Fish	Rarely	Rarely	
Goat	Frequently	Mostly used	
Chicken	At times	At times	
Beef	Frequently	Mostly	
Milk/yogurt	Always	Mostly used	
Rice	Frequently	Mostly by many	
Bush meat	Rarely	Rarely	
Wild plants	Rarely	Rarely	

- Women understand the meaning of a good diet, and theirs incorporate rice, *Ugali* and *Unga ngano* (wheat flour).
- They store food in tankers and jerry cans.
- Food constraints include drought, theft, disease and food expiry.
- Thieves are reported to the police stations, and theft during the night is dealt with by the family elders.
- In times of drought the government must provide relief to the community.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- Children join *bodaboda* (motorbike) and *sunyai* (sand) businesses, and partake in harmful practices that lead to school dropout.
- Orphans frequently drops out of school at any age.
- Children are responsible for fetching water and firewood and looking after animals.

9. Map to the extent possible/relevant with the group.
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Archers Post
Meeting Date:	19 October 2018
Meeting Venue	The County Great Inn, Archers Post
Facilitators:	Alex Nadome/ Job Lelekong
Number Present:	**M:** 7 **F:** 3

1. Contributions/responsibilities to households.

- The youth are responsible for herding, watering livestock, the environment and fetching water.
- They also in charge of the safety of the community.
- They help with decisions, and head the family when parents are not present.
- In child-headed families most of the responsibilities of the household are handed over to the eldest children.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

Differences:

- There is more competition for opportunities, and corruption is an issue.
- Tribal differences and bias are more apparent than in the past.
- There are political differences depending on party affiliation; nepotism and exclusion are an issue too.

Opportunities/constraints:

- The youth have opportunities to sell and buy livestock.
- They use beads to make necklaces and belts and sell them to tourists.
- They also help with loading sand onto trucks and are paid once the job is complete.

Marriage:

- There is no specific age limit, but a young man should only marry at the age of 20 or older.
- Young girls should marry at 18 years and older.
- Young men are sometimes pressured by their parents or other community members to marry when they are younger than 20 years old.
- According to Samburu culture a man must be circumcised before marriage and this is usually done during adolescence.
- Forced marriages lead to girls marrying as young as 14 years old.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The failure of graduates to secure employment in the area results in intimidation. The youth are disillusioned about the need for education because they remain unemployed.
- A shortage of money to pay school fees causes many young adults to leave school early.
- There is no migration to other counties for employment.
- The leaders in government are employing people in Archers Post who are incompetent. The illiterate get employed while the graduates remain unemployed.

4. General labour force characteristics and job readiness.

- The youth are prepared for any jobs and employment opportunities.
- Notices and vacancy advertisements should be sent out early so that the youth have the opportunity to apply.

5. Human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) awareness.

- HIV/AIDS awareness campaigns are often conducted in the area
- These campaigns are mostly initiated by organisations and not by the youth in the area because of a lack of funding.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The young adults of the community are developing an active interest in politics because they see it as a step towards employment opportunities and benefits.
- Politicians recruit the youth for their own election campaigns.
- The youth do not see any benefit in being aligned to a particular politician. This bias is encouraging the youth to form groups which serve their own interests.
- Political youth groups were formed in the last elections, and they are based on party allegiance, each group supporting its party.
- The young adults of the community put themselves up for election.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Nachola
Meeting Date and Time:	22 October 2018
Meeting Venue/Group:	Nachola
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 8 **W:** 1

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Nachola sub-locations - Kipurat, TirTir, Lonyangateny.
- Nachola was registered in the 1979 as a Marti sub- location, where Marti was the mother village of Nachola in the 1980's.
- Most of the Turkana pastoralists lived in the areas.
- In 1912 people migrated from the Suguta valley to the Marti plains.
- There are a lot of migrants in search of pasture, water and security.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land?).

- Around 80% of the land within the Nachola communities is available.
- Locals accept applications to acquire a portion of land from new applicants.
- The community council owns the land and hands it out for settlement.
- They allow permanent settlement.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed?).

- There is a communal land in Nachola for building schools, hospitals and churches, and for new developments i.e. Kalomadang.
- It is also used for animal grazing and farming.
- Communal land is available for shrines.
- No migrant can interfere with the community regarding land issues.
- Local leaders share views concerning land.
- The land is managed by the local leaders, group ranches and other seniors in the community.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Economic activities include farming and irrigation, apiaries, fish farming, mineral prospecting (in the quarry) and sand harvesting.
- Available minerals include salt licks, fertile land is available.
- Land use planning already underway for conservation areas (TirTir and Kuprat).
- Demarcation of towns is ongoing.
- The community face several constraints such as the nomadic way of life, scarcity of water in the area from Kawap to TirTir, overstocking and minimal pasture.
- Accessibility is also a constraint due to poor road conditions.
- The communication network in the area is deficient.

- There are high levels of poverty and illiteracy, and disease remains a risk to both humans and animals.

5. Current ongoing village initiatives, what is the progress?

- The community are involved in small business initiatives which generate income, such as:
  - greenhouses
  - bee keeping
  - *Sukuma wiki* (kale) irrigation.
- The Boma Project training people on small business matters is currently ongoing.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with district administration).

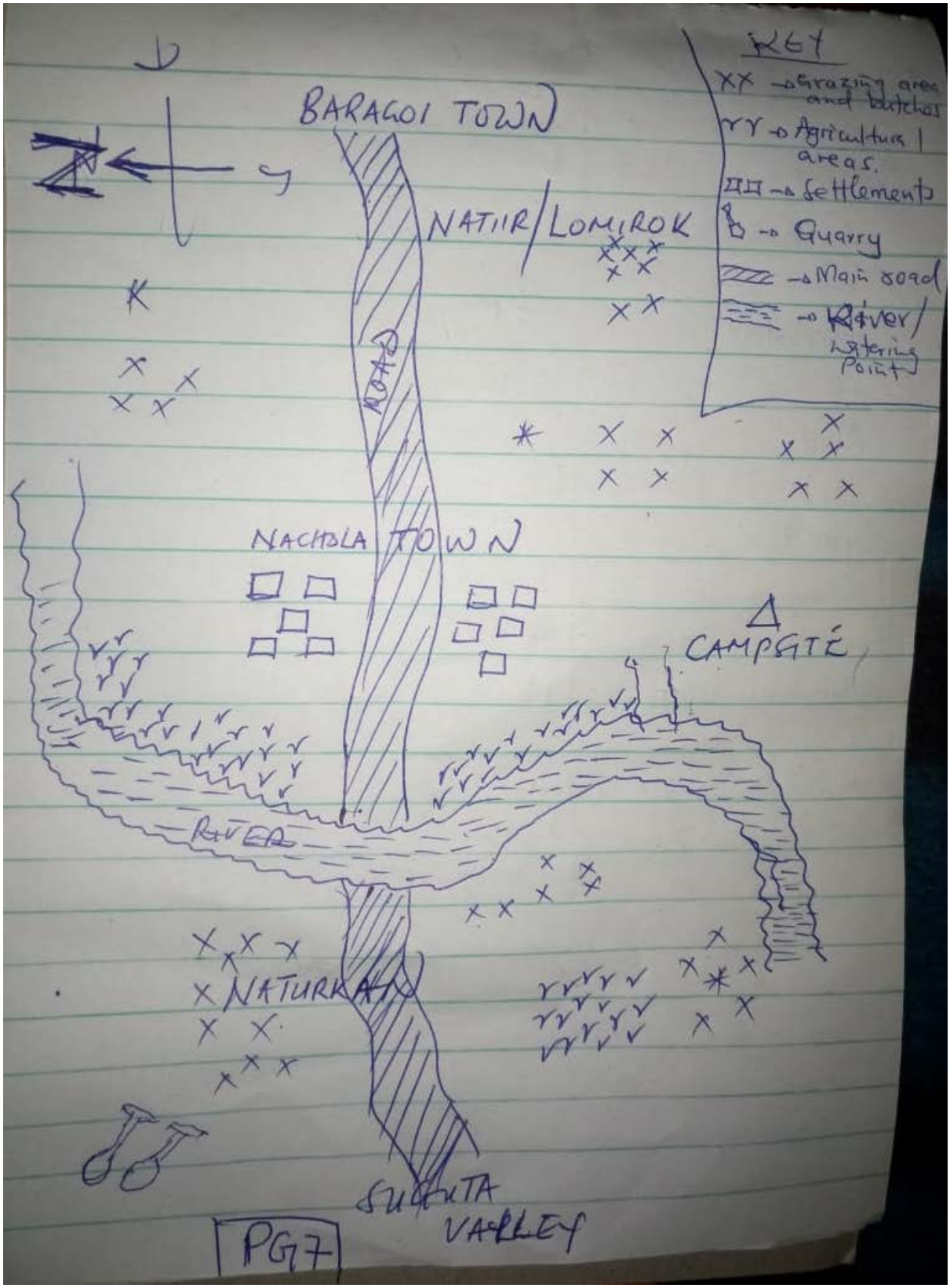
- Revenue comes in from sand harvesting, the quarry (prospecting) and salt licks.
- Firewood tax is also paid to the village administration by the user.
- KSh 600 000 per year is the total annual revenue allocation, and this is used for:
  - bursaries, health issues and vulnerable people (orphans and the elderly).
- Women participate actively in the village events and initiatives.
- Challenges include ignorance, illiteracy and cultural practices.
- The village administrators work together in terms of the hierarchy of the national government leadership.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- The village administration comprises national government officers (chiefs), county government officers (village administration) and the village elders (who are at the lowest level).
- Their capacity in terms of all aspects of administration (social-economic and political) is good.
- Women participation is fair, and they are involved in various decision-making processes.
- Resource sharing with the national government is positive in terms of allocation from the country's national government.

8. Request for village statistics if available

Current population (m/f)	6 200
No. of households	610
Births 2017	high
Deaths 2017	low
Population <15 **Population 15 – 54**	2 000 3 200
Population 55+	1 000
No. of in migrants	400 per year


BARAGOI TOWN
NATIIR/LOMIROK
ROAD
NACHOLA TOWN
CAMPSITE
RIVER
NATURKAN
SUGUTA VALLEY
KEY
Grazing area and butches
Agricultural areas.
Settlements
Quarry
Main road
River/ watering Point
PG7

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name: Samburu, Nachola

Meeting Date and Time: 22 October 2018

Meeting Venue/Group: Nachola

Facilitator/Documenter: Alex Nadome/Job Lelekong

Number Present: **M:** 10 **F:**

1. Herding activities (Use seasonal calendar).

- Herding is being done by both the young men, children ten years and above old.
- Security while herding is provided by the young men who are the warriors against cattle rustling by outsiders.

2. Requirements for water, when, from where, in what quantities per animal

- Water is available in Nachola river which is seasonal.
- There are also dams but no water during dry seasons.

Quantity of water per animal

Animal	Litres
Cow	80
Camel	250
Goat	10
Donkey	50

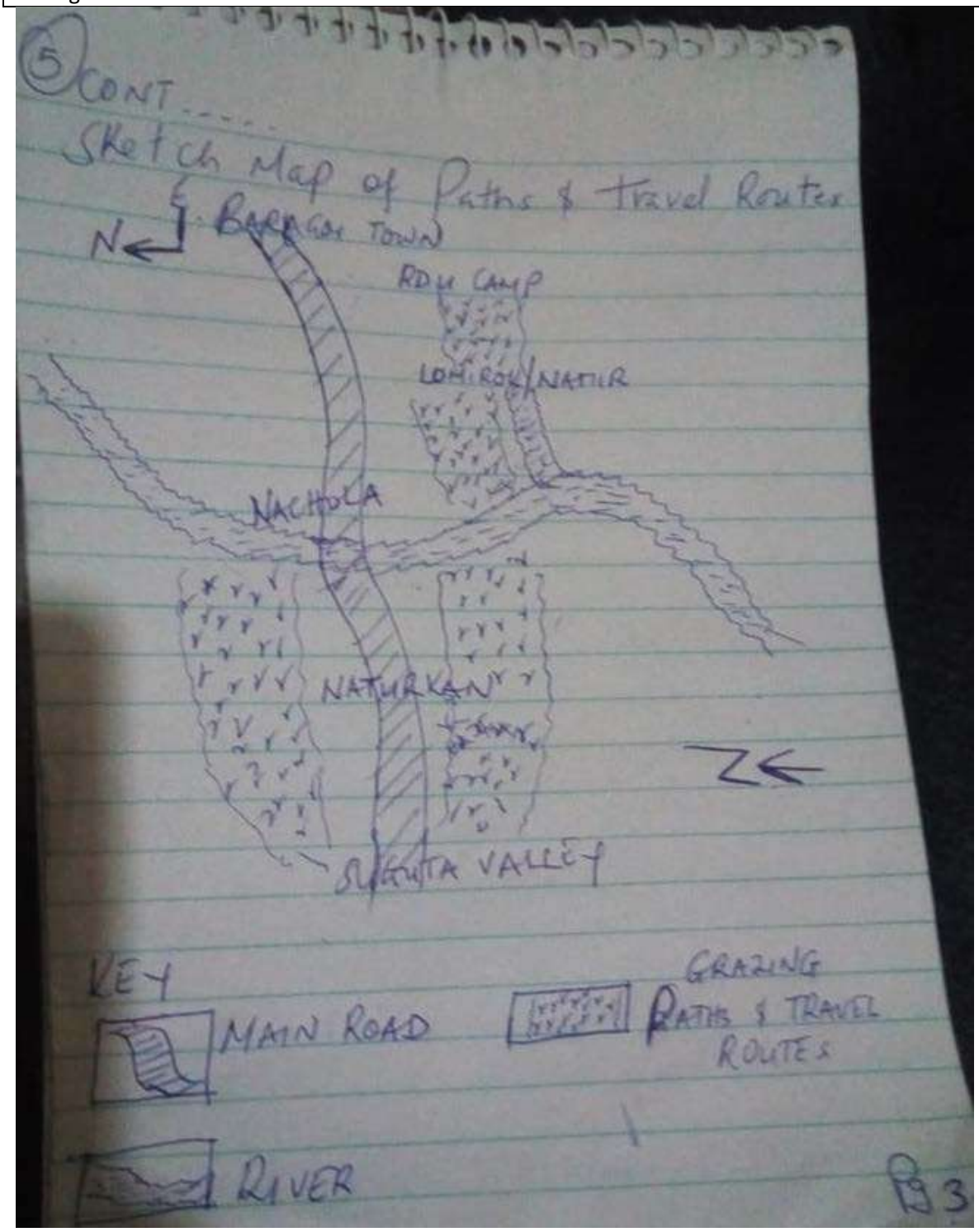
3. Economics: average herd size

The average herd is 30 animals.

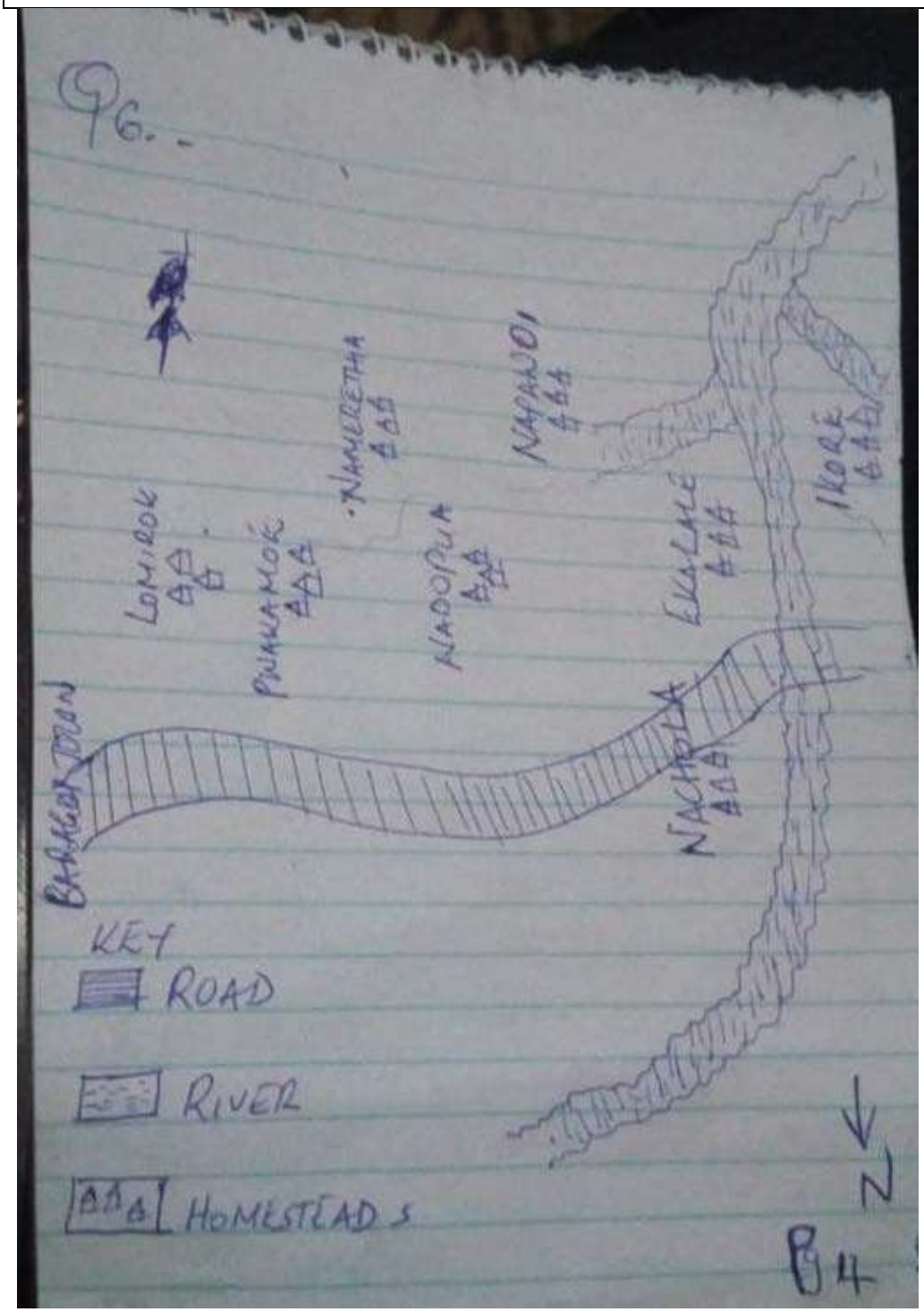
4. Extension services; veterinary services.

- There are no extension services e.g. education for veterinary services, so everyone herds as an individual.
- No veterinary services support from government and other organization.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable
The travel routes are the ones that lead to pasture/ grazing fields and water points. See figure below:



6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent hh on Ere)
▪ There are no permanent settlements or homestead in Nachola since the community people are nomadic pastoralists who migrate from place to place in search of water and pasture. ▪ Nachola shopping centre is the only permanent homesteads in the area. ▪ The map below shows the points where there are homestead in the area.



7. Travelling in what size of group? Are these family or lineage groups?
▪ Nomadic movements in search of pasture and water. ▪ They migrate in groups because of security issues in the area. ▪ They migrate with their livestock and whole families.
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
No cultural sites in the area (Nachola)
9. Groups representing pastoral groups. Mandate, range management, etc.
The role of grazing committee ▪ Protect and organize grazing patterns. ▪ Solve disputes relating to pasture or organizing land between communities. ▪ Control grazing land when comes to migration and movements to areas to find pasture and water, where to graze first before the other part.
10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)
Concern about the project ▪ The project will affect pasture and grazing hence poor production of livestock in the area. ▪ Felling of trees especially the indigenous like an acacia which is much valued because of the pods, herbal purpose, fencing, shades, ropes and timber is also provided by the acacia tree. ▪ Aloe Vera: It is used by the community for medical purpose and sold, hence support economy. ▪ There may be passing of the pipe through dams, settlements areas it will affect the livelihood of the community.

FACILITATOR OBSERVATIONS

Comment

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Nachola
Meeting Date and Time:	22 October 2018
Meeting Venue/Group:	Nachola
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	12

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- Women are grow vegetables, tomatoes and fruits and, during the rainy season, sorghum and beans.
- They also engage in quarry activities.
- They manage savings and loans and work small business units such as canteens and hotels.
- They find markets at Baragoi town to sell their vegetables and fruits to generate income.
- They frequently spend a half or whole day at their farm.
- Cultivation is done in April during the rainy season.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Both parents are responsible for household decisions.
- Women are responsible for managing the household expenditure.
- A man will pay for school fees in a typical household, but a woman is responsible when she is the head of the house.

3. Ownership of land use rights, agricultural product, livestock, other assets.

Land ownership:

- The group ranches own the land.
- Public land belongs to the local government.
- Conservancy.

Agriculture produce:

- Women sell livestock to butchers for meat.
- They also sell vegetables and other agriculture produce to the market in Baragoi and Nachola.
- They keep poultry and sell the eggs to Baragoi market.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are many women groups in the community:
  - the Alakara, Milima Wae, Anupit, Moru achakan, Tumaini, Atitiny, Kiponit and Lotiro womens groups
  - the Asanti group
  - the Nachola self-help group
  - the Terter quarry women group
- The majority of women in community are more involved in political decision making than the men.
- They share work by assisting the elderly, raising funds to assist community members in need and fetching water and firewood during weddings preparations.

- The roles of the women have changed, and they are more likely to become teachers, politicians and midwives. They also contribute more at home.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women are not recognised in the community, thus vulnerable.
- There is no financial support to sustain their families (children).
- They are stigmatised.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus, (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Women in this community have good access to reproductive health care from the health facility at Nachola.
- There is an immunisation programme for children under two years old.
- The community is well-informed and aware of HIV and AIDS (acquired immunodeficiency syndrome).
- Causes of HIV/AIDS include prostitution, sharing of sharp objects and improper PMTCT (protection of mother to child transmissions).
- To prevent HIV/AIDS informed community members go for tests, especially those who inherit the wives of other men.
- They also practise abstinence.
- Giving birth in the health facility helps to preventing mother to child transmissions.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

- There is no access to food in markets, and insufficient food for all members of the community.
- There are no water storage facilities.
- They cope by taking food on credit and paying later.
- Loans are used for their small-scale businesses.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school between the age of three and four years old.
- Girls drop out of school around the age of 15 years old, which is earlier than boys who continue until they complete school. This is typically because of early marriage.
- Financial instability also contributes to school drop outs in the community.
- Orphan children are seldom able to continue with school.
- The role of girls in the community is to fetch water and firewood and help with house chores.
- Boys look after and herd livestock.

9. Map to the extent possible/relevant with the group.
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Nachola
Meeting Date and Time:	22 October 2018
Meeting Venue/Group:	Nachola
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 6 **F:** 4

1. Contributions/responsibilities to households.

- The youth herd livestock.
- They act as the eyes of the community and enhance security.
- They help with manual labour tasks and are the main providers of family income.
- Education is more important to the youth than it was for their parents and ancestors.
- The youth also help with charity works, i.e. in church and other events in the community.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- There is a greater availability of jobs currently than in the past.
- Poverty levels are high.
- Life expectancy is low.
- Education is the main factor that has provided the youth with more opportunities.
- Medical facilities are available.
- Mixed farming is highly practiced in the area.
- There is diversity of land ownership.

Age at marriage:

- Youths typically marry between the age of 18 and 30 years, and older.
- Marriage traditions are not observed.
- Cohabiting and unregistered marriages are permitted.

At childbirth:

- When a boy is born a gun is used to cut the umbilical cord and when a girl is born, a razor blade is used.
- Women ululate when a child is born.

Adherence to the rite of passage:

- *Asapan* is an initiation ceremony where a group meet, dress in traditional custom and discuss the circumcision rite of passage.
- Girls are not circumcised in the area nor in the entire Turkana community.
- Death rituals are still observed.

Please note: In Nachola there is interaction between the Turkana and Samburu communities because the area borders Turkana and Samburu County. Hence the mention of the Turkana community.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth enjoy education and view it positively.
- The community supports education and encourage the building of schools.
- There is easy access to technology.
- There are more girls than boys in school.

- Education sponsorship is usually provided for girls.
- The youth travel to other areas in search of work.
- Corruption is a challenge to the job market because of nepotism and clannism.

4. General labour force characteristics and job readiness.

- People are ready to work but there are few job opportunities.

5. Human immunodeficiency virus (HIV) awareness.

- The youth are aware of the HIV and AIDS (acquired immunodeficiency syndrome).
- They know it is caused through sexual intercourse with infected persons.
- Poverty also contributes to spread of HIV as girls engage in prostitution.
- There are no HIV awareness programmes in the area, people are not informed.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youth participate directly in politics in the area. They also contest political positions such as MCA (Member of County Assembly).
- Politics is controlled by the elders in the community.
- Money and power influence politics because votes are cast for the wealthier community members.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Baragoi
Meeting Date and Time:	23 October 2018
Meeting Venue/Group:	El-Barta Children Fund Hall
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	**M:** 8 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- The village originated from three locations, namely El-barta, Kawal and Ngilai.
- After independence the locations were sub-divided further.
- Group ranches with title deeds were established; Ngilai, Masikita, El-barta and Nachola.
- The town started as a business centre in 1930s.
- The centre was named after a chief called Parragoi.
- Nachola is a nearby market and the name Nachola means a mixture of Samburu and Turkana, (cosmopolitan).
- There are 13 location in Baragoi area now.
- The main businessmen are the Somali men who were also trading in the years leading up to independence.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)?

- The town occupies approximately 15% of the land.
- Grazing land makes up 70%.
- Land applicants are temporarily accommodated if need be.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)>

- The land available for group ranches mainly serve the grazing activities, salt licks points and livestock watering points.
- Group ranches (with title deeds) are owned by the community.
- Town infrastructure and shopping centres are located on public lands.
- Owners control grazing patterns on community land, and grazing committees monitor and organise the grazing activities.
- Community leaders work together with the grazing committee to organise grazing patterns.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- There are various forms of small-scale farming in the area such as quarry work, sand harvesting, livestock keeping and markets and wildlife conservation and small businesses operated by the youth and women.
- All members of the community are encourage to participate in economic activities.
- The opening of roads has improved access to schools and enhanced security in the area.
- The community growth is constrained by group ranch owners refusing to hand over land for the building schools, dams and other projects; they say the land belongs to them.
- Foreigners are discouraged from building development projects on group ranch land.

- Most residents are not aware of the importance of the development projects brought in by the government.
- The community faces ongoing security issues.
- Accessing resources from the county or national government is challenging.
- There are numerous incomplete projects in the area as a result of corruption (embezzlement of funds) and development in the area is lagging.

5. Current ongoing village initiatives, what is the progress?

- World Vision in collaboration with the county and national government are building toilets and training community health volunteers to improve health in the area.
- There are business initiatives by The Boma Project.
- Conservancies.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

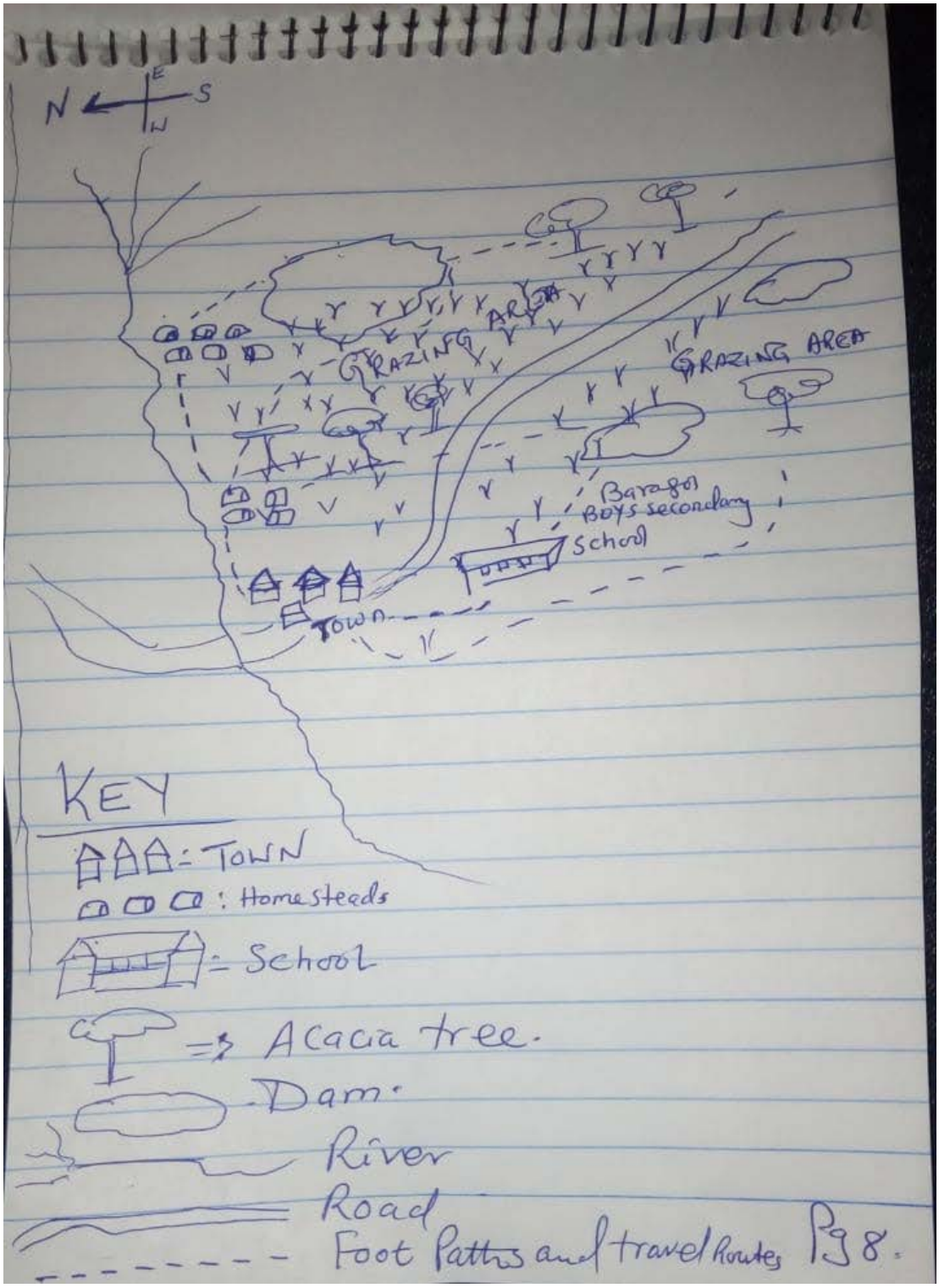
- Sources of revenue include livestock markets, sand harvesting, the quarry and licensing.
- Total annual revenue in Baragoi is almost KSh 3 million per annum.
- Baragoi town should be improved to enhance revenue collection.
- Typical expenditure are loans (capital expenditure), salaries and remuneration.
- Village initiatives are mostly done by the women in the area.
- The community are faced with corruption when collecting revenue.
- The owners of the group ranches land direct their revenue to their accounts and not to the government.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- No information provided.

8. Request for village statistics if available

Current population (m/f)	25 000
No. of households	3 500
Births 2017	No information provided.
Deaths 2017	No information provided.
Population <15 **Population 15 – 54**	8 000 15 000
Population 55+	2 000
No. of in migrants	None


N
S
E
W
GRAZING AREA
GRAZING AREA
Baragoi BOYS secondary School
Town
KEY
: TOWN
: Homesteads
= School
=> Acacia tree.
Dam.
River
Road
Foot Paths and travel Routes
Pg 8.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

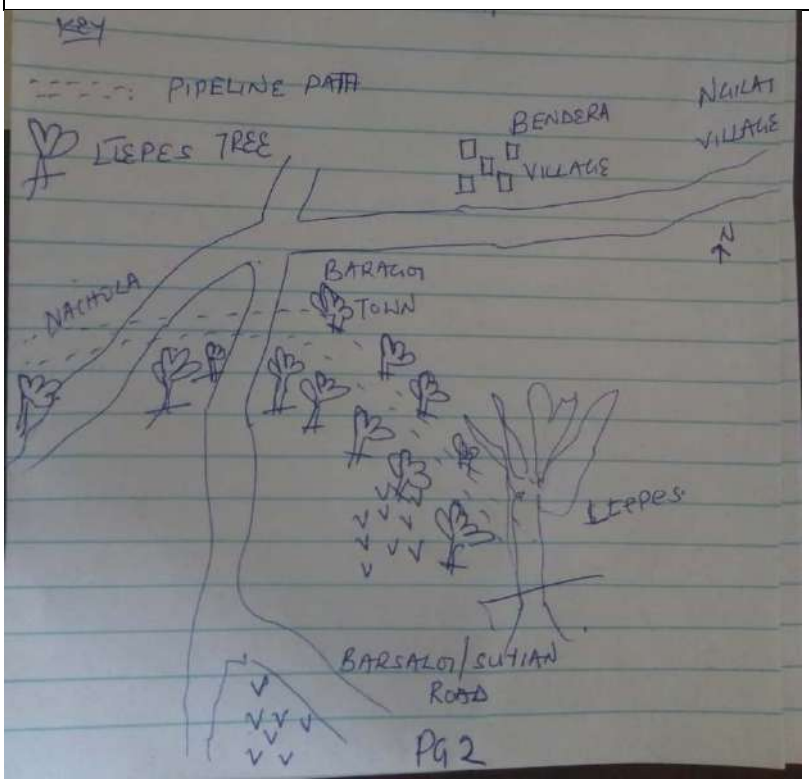
Village Name:	Samburu, Baragoi
Meeting Date and Time:	23 October 2018
Meeting Venue/Group:	El-Barta Baragoi Childrens Fund Hall
Facilitator/Documenter:	Parison/Philip Juma
Number Present:	**M:** 13 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders are the decision-makers and eyes of the community.
- They heads all the group ranches.
- They also control all the community rituals i.e. circumcision.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the community, and healing is their livelihood.
- They use traditional herbs such as *Lekeek siet* and *sagaram,* and natural resources like *siteti* for healing the diseased[1].
- *Ltepes* (umbrella thorn) is a food for animals and used when women give birth.



[1] *Lekeek siet*- a combination of 8 herbs; *Sagaram* - Acacia tortilis pods; *Siteti* - Grewia Mollis tree; *Ltepes* - Acacia tortilis.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are no sacred sites along the pipeline corridor.
- *Ltepes* (umbrella thorn) is the only sacred tree in the area and is specially taken care of. The cutting of *Ltepes* is illegal as ordered by the council leadership.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- There are no sacred or special areas near the pipeline that should not be visited.

5. Important rites of passage (what are they and how are they observed?)

- Circumcision marks the transition of a boy and girl child from childhood to adulthood (*Morans* - boys and *Surmelei* – girls).
- The ceremony is marked by traditions and rituals at different times.
- Animals such as cows, goats and sheep are sacrificed during these events.
- Plant material from specific trees is also used in these rituals.

6. What should the proponent know about entering a village? How is respect shown?

- Proponents should respect the Samburu people and their traditions.
- Girls are expected to dress appropriately as a sign of respect.
- No community women or girls may be enticed into any relationships.
- The community is to be consulted on all matters relating to them before final decisions are made.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	***How often***	***How much for an average family***	***Other comments***
Fish	Never	Rarely	Not wanted in the area
Goat	Frequently	Frequently	Mostly considered food
Chicken	Frequently	Frequently	Mostly considered food
Beef	Frequently	Frequently	Mostly considered food
Milk/yogurt	Frequently	Frequently	Mostly considered food
Rice	Frequently	Frequently	Mostly considered food
Bush meat	No information provided	No information provided	No information provided
Wild plants	No information provided	No information provided	No information provided

FACILITATOR OBSERVATIONS

Comment
▪ It was an interesting focus group discussion. ▪ The elders are well-informed and positive about the pipeline project and hope that it will start soon. ▪ They participated actively in the community meetings; overall, the community participate actively in all decisions.

Comment
▪ There is no food security and little water. ▪ The community buy and consume food daily.

Visitors should observe the following customs/rules when visiting Baragoi Village:

- Proponents should respect the Samburu people and their traditions.
- Girls are expected to dress appropriately as a sign of respect.
- No community women or girls may be enticed into any relationships.
- The community is to be consulted on all matters relating to them before final decisions are made.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Samburu, Baragoi
Meeting Date and Time:	23 October 2018
Meeting Venue/Group:	El-Barta Children Fund Hall
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 13 **F:**

1. Herding activities (Use seasonal calendar).

- Herding activities are found throughout the entire area.
- During *Lorikine* (winter) most of the livestock graze in the Sikira area.
- For three quarters of the year, the animals graze in Siap area.
- During the autumn months they graze around Sinkwa.

2. Requirements for water, when, from where, in what quantities per animal.

- The community need water for human and animal consumption.
- They also need water for washing clothes, irrigating plants and spraying and recreational use.

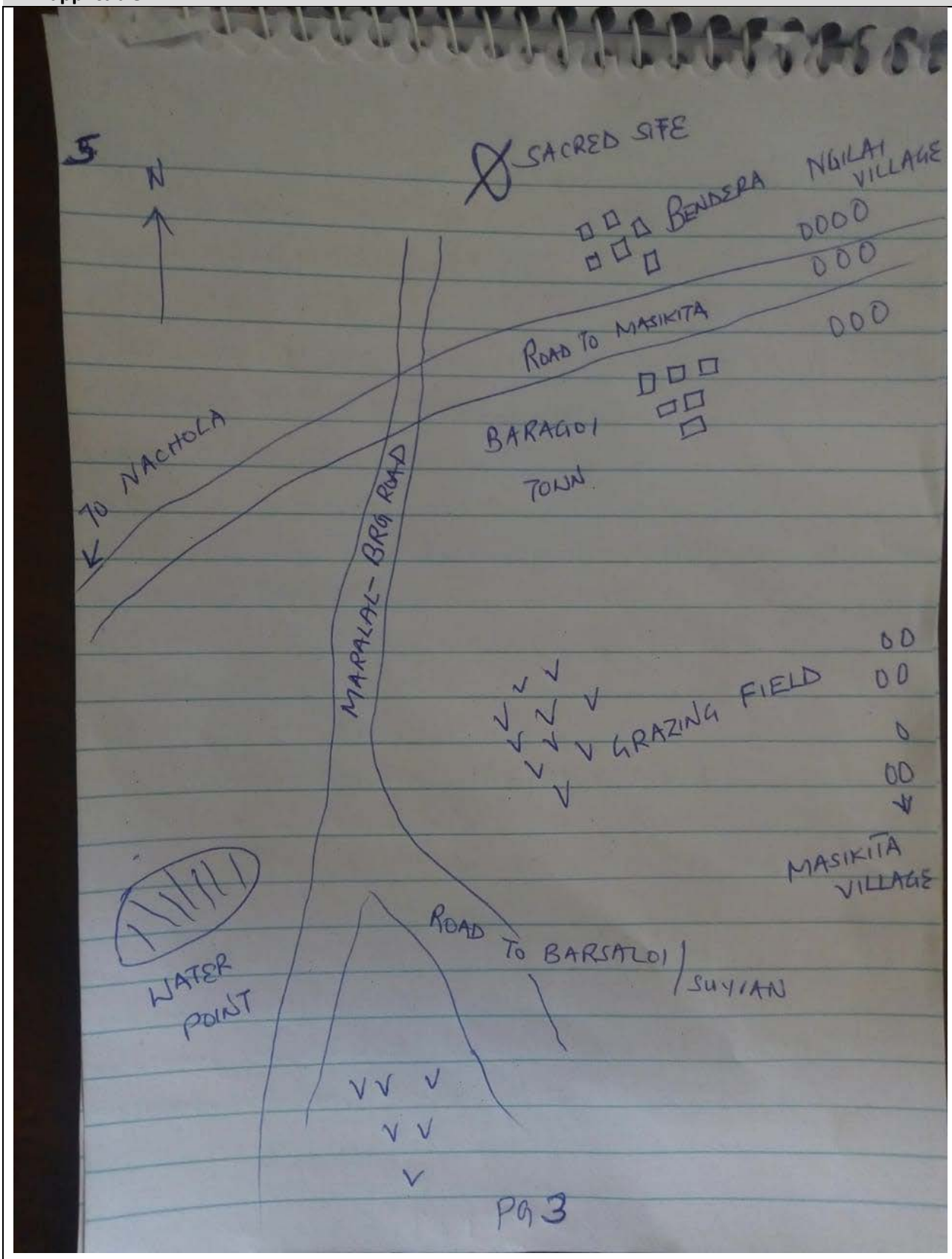
3. Economics: average herd size.

- The average herd size changes according to the season.
- A herder will have approximately 30 cattle.
- There are around 25 to 30 herders in the community.

4. Extension services; veterinary services.

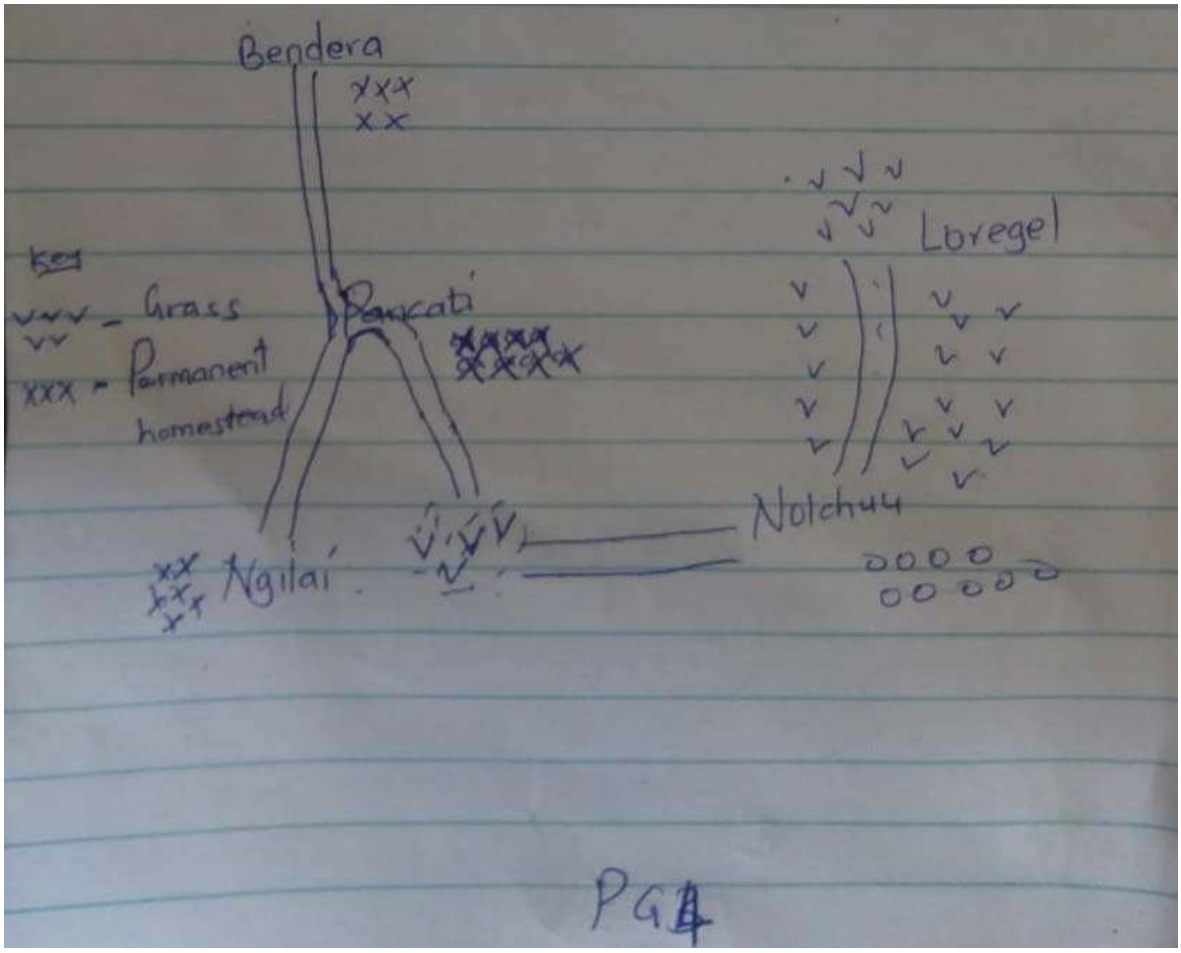
- Extension services provided on occasion but often at short notice.
- Pasture is brought in during dry periods but in small quantities.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.



6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- Permanent homesteads are located at Bendera, Ngilai and Parkati (no movement, only for animals).
- Animals are moved to Nolchuu (Suyian) and Loregel where they search for pasture & water.



7. Travelling in what size of group? Are these family or lineage groups?

- The herders and their families move the animals in groups to search for green pasture.
- They move in groups because of security concerns in the area.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Plants that are gathered include:
  - *Sagaram* (seed pods from the umbrella thorn tree)
  - *Sukuroi* (aloe) - to treat disease
  - *Nkuuk* - for charcoal
  - Herbs - used as medicine.
- The cultural sites are at:
  - Sikinte (circumcision for mud spearing)
  - Loonyeyok (gum). The 'gum' is often mixed with honey and hay, which is then fed to dairy cows to enhance milk production. The gum comes from Acacia Senegal tree.

9. Groups representing pastoral groups. Mandate, range management, etc.
▪ Elders are the head of the pastoral groups, and the herders follow their advice. ▪ They bless the animals in the morning. ▪ The elders manage grazing lands and during periods of insecurity instruct the herders to return home with their livestock.
10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
▪ The elders fear injuries or destruction as a result of the project because young children look after animals. ▪ The project may also result in the deaths of animals along the project corridor. ▪ The project may affect milk production due to the land lost during the length of the project. ▪ Elders must find a solution to remove animals away from areas around the pipeline corridor. ▪ Noise pollution from heavy construction vehicles may also occur. ▪ The elders would like immediate compensation and this should be paid annually.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Baragoi
Meeting Date:	23 October 2018
Meeting Venue/Group:	El-Barta Children Fund Hall
Facilitators:	Parison Loongonyo/Philip Juma
Number Present:	8 Women

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- There are few agricultural activities in the area because of low rainfall thus insufficient water for irrigation.
- Women and youth typically work the agricultural activities.
- Animals destroy the agricultural products because of poor security.
- The youths usually look after the animals until the evening.
- The agricultural departments are behind in issuing seeds.
- Household duties are performed by women early in the day.
- Since formal employment for women is scare, approximately 95% are self-employed.
- Sources of income include selling milk, firewood and charcoal, operating canteens and washing clothes and fetching water for wealthier community members.
- Many women in the community are widowers or single mothers, thus self-sufficiency is important.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Men make the decisions in the family.
- Women are responsible for paying school fees and hospital bills.
- Men frequent the village bars.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Men own the land.
- Women are manage agricultural products.
- The elders of the community generally own the livestock.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are several women's groups but they are unskilled and capital is a constraint.
- Women are politically active and have a say in leader election.
- They organise fundraising and other events, but receive no support from the government.
- The women are aware of their changing role over time.
- They are united and work hard to provide a good and comfortable life for their children.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single mothers are not supported by the community; they are frequently suppressed and isolated and survival is difficult.

- Single mothers work hard to support their children to go to school and to provide a better life.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Family planning is accessible and used mostly by the young people in the community.
- Women are aware of HIV and acquired immunodeficiency syndrome, what causes it and what to do to prevent the disease.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	***How often***	***How much for an average family***	***Other comments***
Fish	Never	Rarely	Not wanted in the area
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Chicken	Frequently	Frequently	Most considered food
Beef	Frequently	Frequently	Most considered food
Milk/yogurt	Frequently	Frequently	Most considered food
Rice	Frequently	Frequently	Most considered
Bush meat	No	No	No
Wild plants	No	No	No

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school between the age of three and four years old.
- A large number of children drop out of school at adolescence due to a lack of school fees, early teen pregnancies, peer pressure (drug use), poverty and no parents.
- Uneducated children face a bleak future.
- The community and the government is intervening with training and public rallies.
- Children from rich families are more likely to get the available jobs; the poor children are discriminated against.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Baragoi
Meeting Date/Time:	23 October 2018
Meeting Venue/Group:	El-Barta Children Fund Hall
Facilitators/Documenter:	Alex Nadome/Job Lelekong
Number Present:	**M:** 2 **F:** 4

1. Contributions/responsibilities to households.

- The youth assist their parents in daily chores such as herding activities and fetching water and firewood.
- They are the income earners in child-headed households.
- They also offer security to their parents, siblings and the community.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Employment in the community is currently low because of constraints from political differences, clannism, corruption and nepotism.
- The unemployment levels are exacerbated by incompetency, since many youths do not have the opportunity to attend school and are thus disadvantaged.
- The population increase in the urban centres of Baragoi also contribute to unemployment.
- Traditionally the community restrict marriage to after the rite of passage; typically, a male is not allowed to marry a female until he has reached this stage.
- The access to resources to pay a dowry can influence a marriage date.
- Education also affects a marriage. This specifically applies to the ladies. When women are educated, they become powerful, acquire property and independence to a point where they do not want to get married but rather have a "child/baby daddy" instead of a husband.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth's perception of education is deteriorating because of a lack of employment after school.
- Job distribution within the community is poor. Prospective employers are corrupt.
- Nepotism fosters unemployment among young adults and also ruins their view of education.
- The youth are forced to seek employment outside of their county.

4. General labour force characteristics and job readiness.

- The youths are ready for jobs when the pipeline project starts.
- Manual work such as field clearance is typically the work of the young men in the community and girls are tasked with office and hospitality work.

5. Human immunodeficiency virus (HIV) awareness.

- The community health officers run a HIV/AIDS (acquired immunodeficiency syndrome) awareness campaign and they also distribute condoms to the youth.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youths are actively involved in politics, and put themselves up for election.
- They are discouraged, however, by the community's perception that unmarried men or women should not be leaders.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Suyian
Meeting Date and Time:	24 October 2018
Meeting Venue/Group:	Suyian Community Baraza
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	**M:** 4 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- The name Suyian means 'wild dogs'. These were found here in the 1960s. Some members from Samburu migrated to the area. After several years, they requested that the area be declared a location which lead to the development of the village of Suyian.
- In the 1990s there were security issues such as cattle rustling, which forced community members to leave Suyian to other neighbouring locations. They returned after the cattle rustling abated and set themselves up closer together to respond to new security threats from neighbouring communities e.g. Turkana.
- Other migrants from the nearby locations also came to live in Suyian prior to the security issue of the 1990s.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Only thirty per cent of land is available because the bulk is used for grazing and homesteads.
- There are two main villages. The land is found around these villages.
- Those community members who returned after migrating because of security issues are allocated temporary areas to live in until their land is deemed safe for occupation.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)?

- The communal land is mainly used for grazing. Other parts are used for beehives, sand harvesting and aloe vera farming. There are also salt licks.
- Community laws and seasonal calendars safeguard grazing patterns.
- The land is managed by the grazing committee who are charged with the responsibility of controlling grazing water points and solving disputes.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Land has been allocated in in the town for the building of hospitals and health centres.
- The priorities are healthcare centres, schools, water (dams and water collection system), temporary campsites in case of security issues, a market place for selling livestock and access roads to Suyian villages.
- Constraints include a lack of funds to implement the new developments, poor network coverage and a constant security threat. Poor leadership also affects the development plans negatively.

5. Current ongoing village initiatives, what is the progress?

- Social services include the registration of groups- women, youth and self-help groups.
- There is poultry keeping (rearing).
- The grazing committee breed animals and are empowered through *barazas* (public meeting places).

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

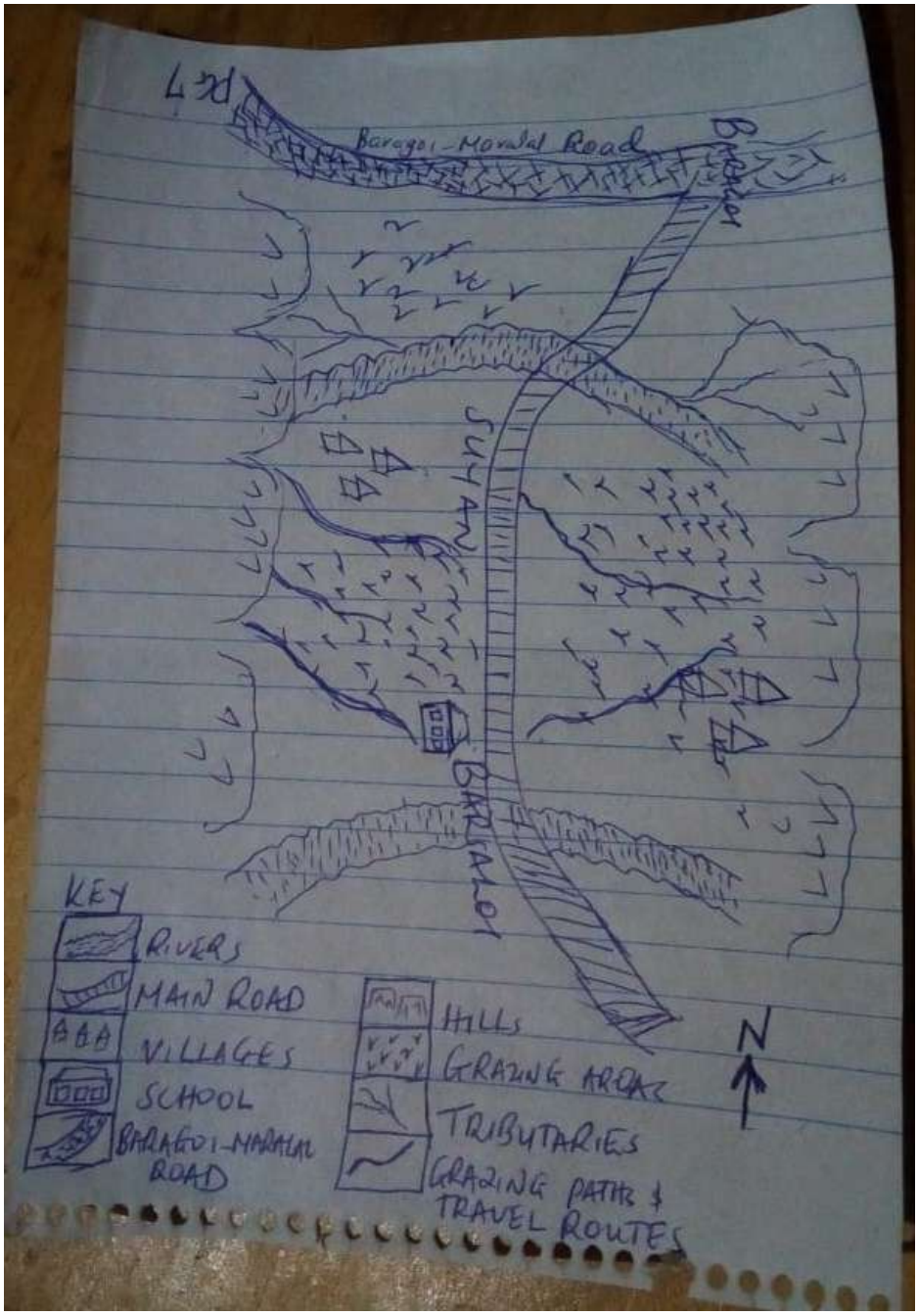
- The community receive revenue from other organisations e.g. The Boma Project.
- Capital expenditure in the form of capital given to residents or individuals by the Boma Project which is an initiative that assists individuals to start up a business or a certain project.
- Women participate actively in village initiatives.
- The community works closely with the district administration, and local government work together with the district administration to achieve various objectives.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- The land in Suyian is communal and controlled by the group ranches, the grazing committee and the local village administration.
- There is no definite source of revenue and this makes it hard for this level of government to implement development plans.
- The village government is only supported by the county government regarding access to resources.
- The County Integrated Development Plan (CIDP) is run by village administrators for both villages of Suyian, but the funds are provided wholly by the county government.

8. Request for village statistics if available

Current population (m/f)	2 800
No. of households	400
Births 2017	114
Deaths 2017	15
Population <15 **Population 15 – 54**	1 100 1 700
Population 55+	**30**
No. of in migrants	**None**


Baragoi-Maralal Road
SUYAN
BARAGOI
KEY
RIVERS
MAIN ROAD
VILLAGES
SCHOOL
BARAGOI-MARALAL ROAD
HILLS
GRAZING AREAS
TRIBUTARIES
GRAZING PATHS & TRAVEL ROUTES
N

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Samburu, Suyian
Meeting Date and Time:	24 October 2018
Meeting Venue/Group:	Suyian Community Baraza
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 14 **F:**

1. Herding activities (Use seasonal calendar).

- Animals graze far from the community because of security concerns.
- During *Ltumuren* (the long rains that fall from October to December) the animals graze.
- During *Lorikine* (the rains that start in June and ends in August) the animals graze at Sikira and Marti.
- The Suyian River is the only source of water.

2. Requirements for water, when, from where, in what quantities per animal.

- Drinking water is needed for humans and animals.
- Water is drawn from the Suyian River.

3. Economics: average herd size.

- Livestock are kept in the area, with an average of 30 cows per individual.
- Good fertility ensures a cow typically produces eight litres of milk per day.
-

4. Extension services; veterinary services.

- Veterinary services only issue medicines.
- Animals are vaccinated and dewormed twice a year.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

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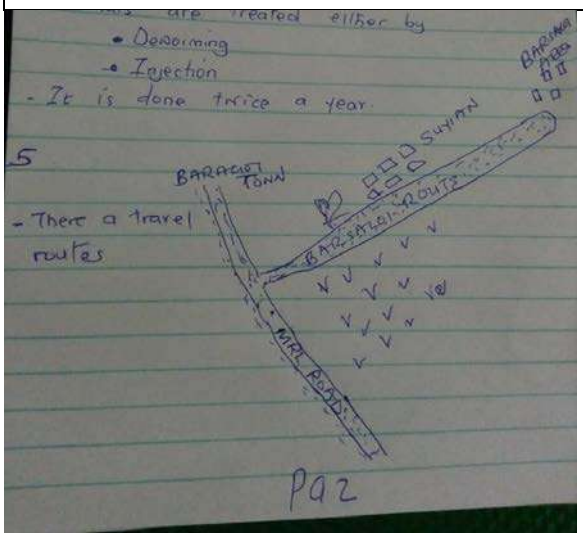


6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- Long-term homesteads are set up at Suyian and Lgotoi because of security concerns.
- Herders live together in large groups.
- Short-term homesteads are only found when the herders move from area to area in search of green pastures.
- Herders live in a large homestead as a security measure against threats from hostile communities like Turkana.

7. Travelling in what size of group? Are these family or lineage groups?

- Livestock herders look after their cattle in groups.
- While herding, they carry guns.
- Guns are used as security to deter thieves.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- There are no cultural sites along the pipeline corridor, they are located away from the paths.
- Hunting is mostly practiced in the forest away from homestead.
- There is no fishing.
- No farming occurs because the land is infertile.

9. Groups representing pastoral groups. Mandate, range management, etc.

- The elders are the head of the Suyian community.
- They regulate grazing patterns daily.
- Family groups graze and take care of their animals.

10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?

- Herders are concerned about the project.
- They fear the project may harm grazing animals.
- They are also concerned that a pipeline leakage could result in soil pollution, which in turn will reduce a cow's milk supply.
- They are, however, positive about the project.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Suyian
Meeting Date and Time:	24 October 2018
Meeting Venue/Group:	Suyian Community Baraza
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	8

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women of the community participate in the harvesting of aloe vera and sell it to Barsaloi (15 km away) to earn a living.
- They don't farm the aloe vera because it can be found everywhere.
- They keep livestock individually and sell the animals to willing buyers.
- They harvest *Acacia tortilis* (umbrella thorn) pods and also sell them to supplement their income. One 50 kg bag is KSh 400.
- Salt licks naturally found in the river banks are collected by the women and sold for between KSh 200 and KSh 400 depending on the quantity.
- Suyian is a dry area with little or no rainfall hence no agricultural activity occurs.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Most of the household decisions are made by the husband (in a typical two-parent family with children).
- In single-parent families, women are the decision-makers.
- Women are responsible for the majority of household chores.
- They oversee the finances and plan the household budget to prevent their husbands wasting money on alcohol.
- They also pay for their children's school fees, medical expenses and water.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- The land is owned by the community, and managed by a group of ranches and conservancies (Baragoi Conservation Area).
- The conservancy and the ranch group control and organise land allocation issues, manage wildlife and control grazing patterns.
- Livestock products are mainly for household use e.g. milk and mutton.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are no registered women's groups.
- Women are politically active and vote during elections.
- Shared work among the community women includes building houses (structures).
- The elderly women of the community fulfil the role of midwifes, fetch water and firewood and cook for their families. They also perform these duties during wedding ceremonies.

- Suyian is a very remote area and women cannot access social services in terms of registration of various groups.
- The community women are also undervalued by the men, and traditionally subservient, thus preventing their exposure to innovation.
- It is difficult to get support from elected officials in terms of women empowerment and the implementation of projects e.g. there are no dams, health care or health centres, network coverage, toilets etc. This has affected women's participation in politics negatively.
- In the past women were mainly supposed to perform household duties but now they study and become being employed as nurses, teachers and so on. They have embraced their new roles in the community.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?).

- Single women in the community are not stigmatised by other members of the community. They are treated as equals by the married women.
- Single women are the head of their families.
- During childbirth married women come to the aid of single women as they are considered vulnerable.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- The nearest hospital is in Barsaloi (15 km from Suyian) meaning the community women cannot access family planning services easily.
- They know about HIV and understand its cause mainly through prostitution. However, they need to be educated on the preventive and curative measures and child health care. They do not have sufficient information about these issues.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- There is insufficient food and the community cannot be sustained for any length of time.
- Goats are slaughtered for the blood and milk in in the event of no food. The community do not understand the meaning of a balanced diet.
- The constraints to having food security include money shortages, no shops or canteens nearby, and the distance from Suyian to Barsaloi.

Product	***How often***	***How much for an average family***	***Other comments***
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children enrol for school between the age of three and four years.
- Female children do not complete school (primary), they leave at the age of ten because of forced marriages.

▪ Children also drop out and start herding. ▪ The future of female children is dismal.
9. Map to the extent possible/relevant with the group.
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Suyian
Meeting Date and Time:	23 October 2018
Meeting Venue/Group:	Suyian Community Baraza
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 6 **F:** 2

1. Contributions/responsibilities to households.

- The youth are the warriors of the community.
- They are responsible for finding pasture.
- They also provide food for their families.
- Both males and females look after the animals.
- Females are responsible for domestic duties in the household and also for fetching water and firewood.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Constraints facing the community include security issues, drought and population influx.
- Currently there is an adequate supply of food due to government relief food.
- The youth usually get married at around 18 years old, but some get married at any age.
- Animals are slaughtered and women ululate when a child is born.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Education is important and has made a difference in the community.
- Those who did not attend school in the past have regrets as they see how important education is now.
- Educated people get jobs and can access technology.

4. General labour force characteristics and job readiness.

- There are jobs available in the both formal and informal sectors.
- The youth are eager to work.
- Fewer jobs are available for those that are illiterate which creates challenges.
- When jobs are advertised, the youth are ready to apply.

5. Human immunodeficiency virus (HIV) awareness.

- The youth are aware HIV but to date, no cases have been reported.
- HIV is caused with by unprotected sex with infected person and using one razor blade during circumcision procedures.
- HIV is prevented through abstaining, use of a *mpira* (condom) and faithfulness.
- It is also importance to seek advice and get counselling.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youth frequent *barazas* in Suyian (public meeting place) for social interaction.
- They are specially considered and participate in elections.

- The youth choose leaders who have successful community development records i.e. the Honourable Maison, a Samburu County women's representative who has built houses for Suyian families. She is highly regarded in the Suyian community.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Barsaloi
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Barsaloi Catholic Mission Hall
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	**M:** 1 **F:** 1

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- The village was registered in the 1960s.
- The first town to exist in Samburu County was started by a colonialist.
- Leaduma Mzee started Barsoloi town when he opened a shop in the area.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Barsaloi encompasses most of the land (90%).
- The land is spread away from homesteads and public resources.
- Applicants are issued with land permits once they pay the necessary charges.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- There is communal land which is mostly used for animal grazing.
- There are laws that govern communal land such as no cutting down of trees and grazing control.
- Those who break the law are charged accordingly
- Group ranches and elders manage the land.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- The community practice destocking (reducing large numbers of herds).
- They follow grazing patterns.
- Graving[1] are found where they educate children and issue the sponsorship programmes.
- A portion of land is used for green houses, beading and tree planting.
- Drought is a significant factor in Barsaloi.
- Cattle rustling occurs on occasion.
- Land availability of land is an immense opportunity in the area.

[1] Graving is a collective term/name given to refer to the Charity Organisation that helps to educate and give sponsorship programmes to the children of Samburu. For example, The Missionaries, “Maria Mfariji Home for Children”; “Spring of Hope for Children” just to mention but a few of the charity organisation.

5. Current ongoing village initiatives, what is the progress?

- Green house activities are ongoing.
- The community farm poultry, grow aloe vera and keep bees for additional income.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with district administration).

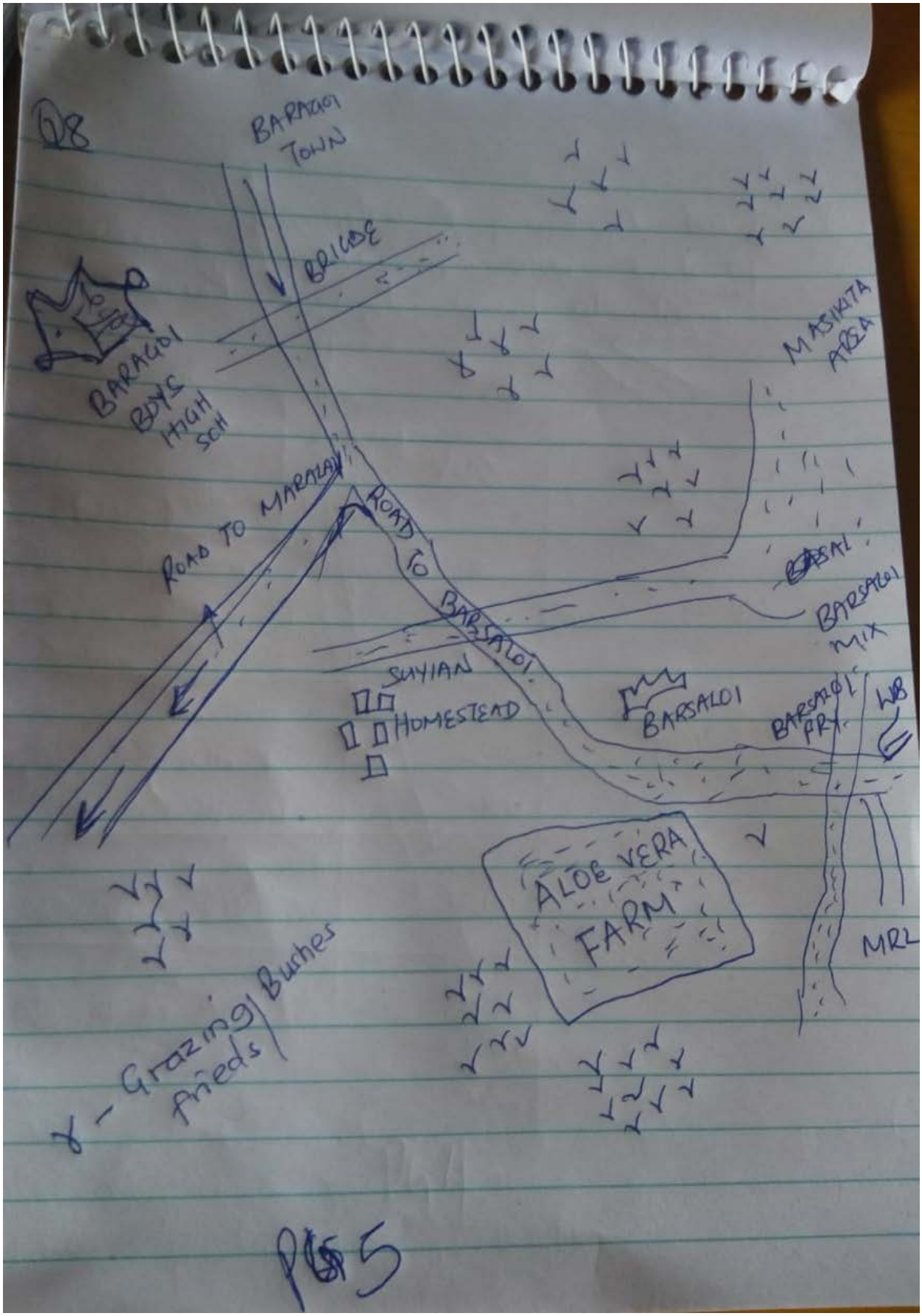
- There are community water projects.
- The village administration raise KSh 20,000 as annual revenue.
- Most of the revenue is used for repair and maintenances plus salaries and wages.
- Village administrators participate in village activities though the main challenges they face that limit effective participation are education, poverty and poor road networks.
- Both district and village administrators work together.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- The village capacity in terms of personnel is fair but poor in terms of resource mobilisation.
- Women participation is high.
- The government is facilitated the easier access to resources from other levels of government through an annual allocation of resources.

8. Request for village statistics if available

Current population (m/f)	800
No. of households	100
Births 2017	36
Deaths 2017	6
Population <15 **Population 15 – 54**	200 400
Population 55+	200
No. of in migrants	Nil


Q8
BARAGOI TOWN
BRIDGE
BARAGOI BOYS HIGH SCH
MASIKITA AREA
ROAD TO MARALAL
ROAD TO BARSALOI
BARSALOI MIX
SUYIAN HOMESTEAD
BARSALOI
BARSALOI FRY
WB
ALOE VERA FARM
MRL
γ - Grazing Bushes
Pg 5

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Samburu, Barsaloi
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Barsaloi Catholic Mission Hall
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	**M:** 11 **F:**

1. Herding activities (Use seasonal calendar).

- Rains fall during October and November and the community herds close to homes.
- January and February are dry months and the community migrate to the Mart area (west) and Wamba (east) and also to some parts of Marsabit and Isiolo in search of pasture.
- They return to Barsaloi during the rainy season which is between March and April and migrate back the same areas during the long dry season between May and September.

2. Requirements for water, when, from where, in what quantities per animal

- Water is sourced from the local river.
- Up to 40 litres are required per cow per day, and per donkey every two days.
- Camels require approximately 120 litres once a month.
- Sheep and goats need around 5 litres of water per week.

3. Economics: average herd size.

On average, an individual owns:

- 100 head of shoats[1]
- 50 head of cattle
- 40 camels
- 5 donkeys

LIVESTOCK	AVERAGE HERD/PERSON
Cattle	50
Shoats	100
Camel	40
Donkey	5

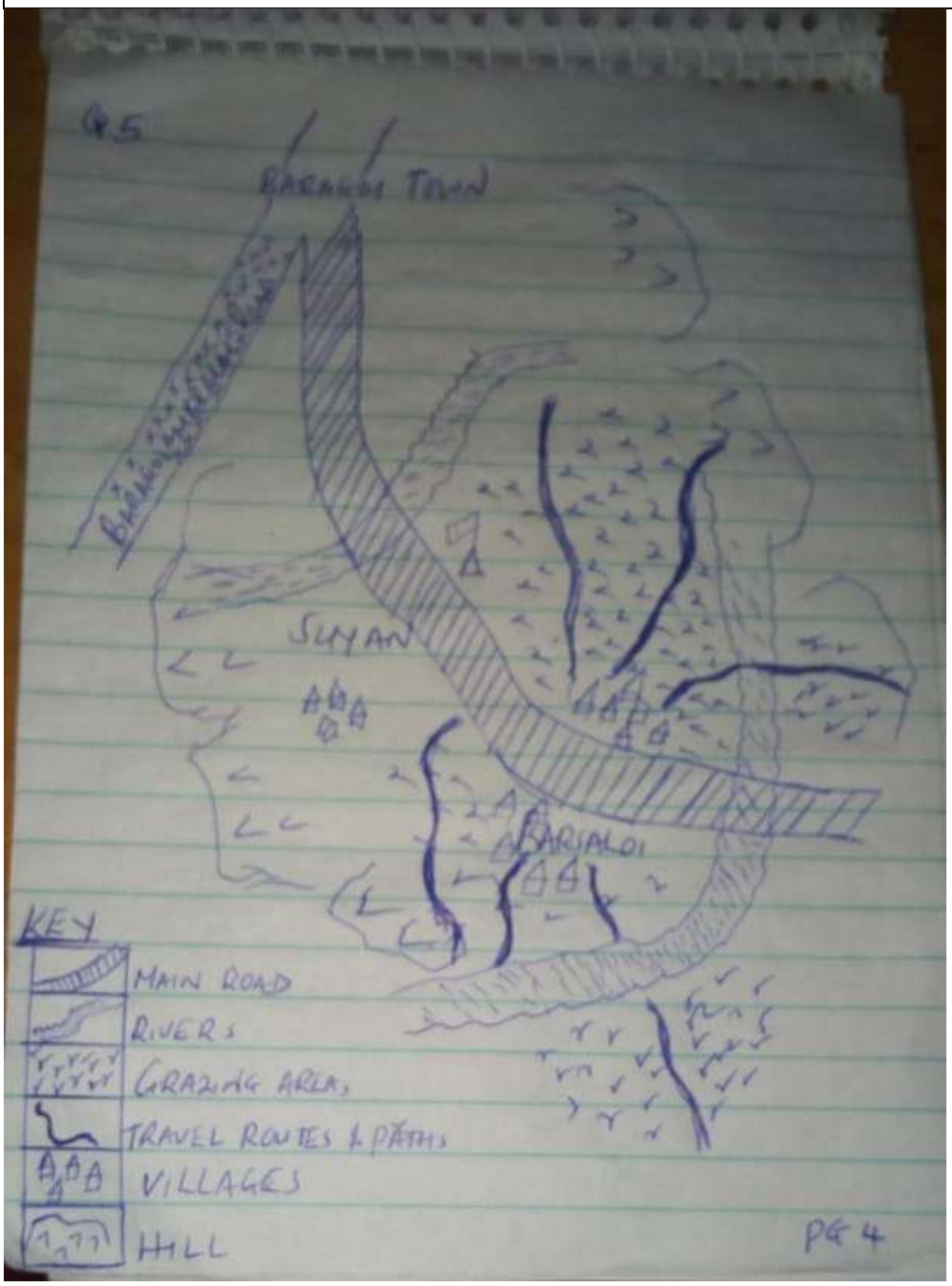
4. Extension services; veterinary services.

- In Barsaloi, livestock herding is typically a form of livelihood for individuals.
- Veterinary services are provided by the county government.
- Education and training concerning livestock is done mainly by the National Drought Management Authority (NDMA) and non-government organisations from the Agency for Technical Cooperation and Development (ACTED.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

[1] Shoats is a name given to mixture of sheep and goats. For example, one might have 50 goats and 50 sheep which he will name collectively as shoats or 40 goats and 60 sheep or vice versa which he will still refer to as shoats. Note the number may vary but in total it must amount to a hundred which is a mixture of both sheep and goat.

- See map below.



6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere)
▪ In Barsaloi, there are semi-permanent homesteads. The land is communal, and herders can live anywhere except on grazing areas. ▪ Herders are allowed to construct or build homesteads in the area.
7. Travelling in what size of group? Are these family or lineage groups?
▪ Herders migrate as groups because of the security concerns. They move as one group which consist of several families and lineages.
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
▪ There are no cultural sites. ▪ No hunting, fishing or plant gathering occurs in the area.
9. Groups representing pastoral groups. Mandate, range management, etc.
▪ Elders are manage the pastoral groups in terms of grazing and seasonal calendars. ▪ These elders control grazing patterns and manage the harvesting of *acacia tortilis* pods and leaves which are used as animal feed. ▪ They promote peace within the community and solve intra- and intercommunal conflict. ▪ They control and oversee natural resources and other valuables such as precious stones to avoid misuse and theft.
10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
▪ There has been an increase in deforestation especially those trees that area used for medicinal purposes or as food. ▪ The community are concerned the project may destroy graves. ▪ Livestock travel paths and routes as well as grazing area and patterns may also be affected thus reducing production.

FACILITATOR OBSERVATIONS

Comment
▪

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Barsaloi
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Barsaloi Catholic Mission Hall
Facilitator/Documenter:	Parison Loongonyo/Philip Juma
Number Present:	17

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The community women plant crops during the rainy season for food.
- They herd animals and the domesticated animals are sold to generate income.
- Women are responsible for domestic duties during early morning and evening hours.
- They enhance their business activities with table banking.
- Single businesses are typically a sole proprietorship.
- They sell beads.
- There are no employment opportunities for women.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- A woman is responsible for household decisions and money management.
- Both parents pay hospital bills and participate in the school search for their children.
- It is a women's responsibility to fetch water and firewood.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Men and women may both hold land rights, but men are considered more favourably.
- Agricultural production ownership is also shared between men and women, after clear consultation.
- Livestock may be owned by any community member.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women groups include:
  - Maria sacred heart (for beading, *Sukuma* and onion farming)
  - Noolturi (for poultry)
  - Naningo women group (wholesalers)
- As a group they fully participate in political events and decision-making.
- They also act as the political voice of the community.
- They practise 'harambee' for the less fortunate.
- They take part in charity work such as building of houses and sourcing clothes for the elderly.
- Men occasionally restrict women from participating in various events.
- The community women face issues with alcoholism which takes away time they could have spent more constructively in their development initiatives.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- There are single women in the community.
- They are considered as second-class citizens though.
- Their children are not stigmatised by the community.
- Single women get help through relief initiatives while others are issued goats.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Family planning is easily accessible in the area through training and medical services.
- Women are aware of HIV and acquired immunodeficiency syndrome (AIDS).
- They said 'We know HIV/AIDS is caused by sharing of razors, having unprotected sex with an infected person and poverty which leads to females prostituting themselves in order to get money.'
- HIV/AIDS can be prevented through the use of condoms, voluntary counselling and testing, abstaining from sex and faithfulness among married couples. Giving birth in a maternity ward and not breastfeeding during birth if a mother is infected by the virus are also preventative measures.
- HIV is treated with antiretroviral drugs and a balanced diet.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish	At times (they eat fish)	¼	Nice food though many don't eat
Goat	Frequently	At least ½ kg	Best food
Chicken	frequently	1 kg	Most preferred
Beef	frequently	2 kg	Nice food for many
Milk/yogurt	frequently	2 litres daily	Most preferred especially for children
Rice	frequently	1 kg for the one family	Nice food
Bush meat	Not used	-	-
Wild plants	Not used	-	-

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- Children are encouraged to go to school. From 8 months old to 2 years old they go to baby care. At four years old most children will join pre-school classes.
- There is a high rate of school dropout between the age of 12 and 15. This is due to adolescence, modern technology, poverty and orphanages.
- Other reasons include children having to work domestic chores during class hours, such as caring for the animals, and laundry and dish washing, especially for female children.
- In spite of these challenges parents have hope for the future of their children.

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Barsaloi
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Barsaloi Catholic Mission Hall
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	**M:** 8 **F:** 4

1. Contributions/responsibilities to households.

- Youth responsibilities in the household include:
  - herding and fencing
  - taking care of the family in absence of the parents
  - provide security
  - contribute in decision-making
  - take care of their siblings in case of s child-headed family
  - cleaning of utensils and cloths.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- In the past the youth skipped school and were directly hand-picked for jobs with colonial employers. The youth are now more educated and employed according to their skills.
- The county government employs a large percentage of the educated youths.
- Some youth are self-employed through joint business unit groups.
- The area is inhabited mostly by the Samburu community so they follow Samburu cultural practices such as the beading of young girls and warriors and circumcision is still practised traditionally for both men and female.
- A man in Samburu community is allowed to marry when he finishes celebrating the rite of passage (called *Lmuget)* with his age group.
- Most of them are married at 18 years of age.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Young adults have a low perception of education since they are selected on competence; the employers selections are typically marked by corruption and nepotism.
- The youth are also disillusioned concerning education because of a lack of legitimate employment opportunities in the area.
- Those that are educated view employment opportunities which involve manual labour such as the construction of toilets and house unfavourably.
- Inter-community clashes lead to poverty.

4. General labour force characteristics and job readiness.

- Manual labour is typically allocated to the young men in the community.
- Young women work tasks that do not require manual labour.

5. Human immunodeficiency virus (HIV) awareness.
▪ The community are served by community health volunteers from Amref Health Africa (and Afya Timiza), Uzazi Salama and the ministry of health. ▪ Videos also promote awareness. ▪ The health ministry also provides free condoms to the community.
6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ The youth participated in political campaigns during the last general election. ▪ They plan to seek political seats in the 2022 elections.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Swari
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Swari Catholic Church
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	**M:** 5 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- There was originally one location called Ngilai which later split into several communities.
- Swari was formerly known as Sere Elkerenket and started with two shops in 1965.
- The business centre started in 1992.
- The school in Swari opened in 1965 and a dispensary was opened in 1992 by Thimoty Lenarren, a nurse.
- People migrated into and out of the area.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- Twenty per cent of the land is occupied by the residents.
- There is no available land for new applicants since the land is owned by group ranch members.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- The land in Swari is communal and managed by the group ranch committee, grazing committee and conservancies.
- A seasonal calendar controls grazing patterns.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- The land is under planning for various uses such as plots and other social amenities.
- Priority plans include water drilling, electricity, early childhood development (ECD), restocking camel herds, building stadiums and playing grounds and empowering youth groups through farming.
- The constraints facing the community are incomplete projects, an insufficient supply of camels to restock herds, a lack of teachers for ECD centres since most of the youth don't extend their education to qualify for the position, which is as a result of poverty and a shortage of school fees.

5. Current ongoing village initiatives, what is the progress?

- Initiatives include community health units, community health extension workers (CHEWs) and community health volunteers (CHVs).
- Restocking of goats by the Caritas Project.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

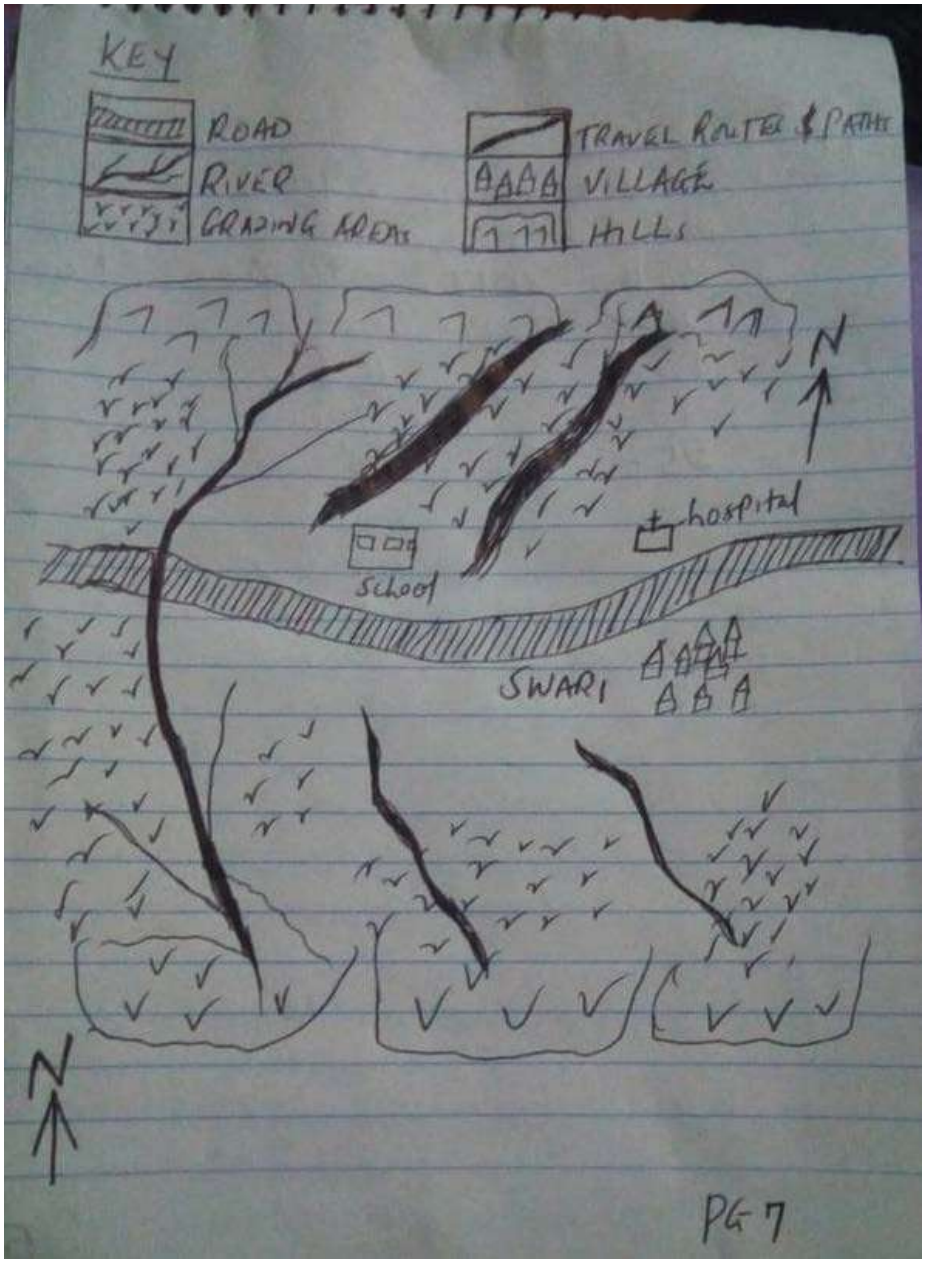
- There are no revenue sources in the area since no one is responsible for collection.
- Women participate in community activities but are constrained by male dominance. They do not engage in hard tasks which are typically done by men.
- The administrators office has a closer relationship with the district administration office since they work hand-in-hand at all times.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- Village government is reliant on the national government and the county government.
- Development plans and priorities are implemented once funds are received from other levels of the government; thus limiting the village government's capacity.
- There are no definite sources of revenues that can be used to implement village project or plans.
- Swari is a male-dominated community. Men, especially elders or husbands are the primary decision-makers, which limits women participation in village initiatives and other development activities.

8. Request for village statistics if available

Current population (m/f)	3,943
No. of households	780
Births 2017	3% of the population
Deaths 2017	
Population <15 **Population 15 – 54**	15%
Population 55+	70%
No. of in-migrants	55%


KEY
ROAD
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hospital
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SWARI
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PG 7

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Samburu, Swari
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Swari Catholic Church
Facilitator/Documenter:	Parison Loongonyo/Philip Jua
Number Present:	**M:** 9 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

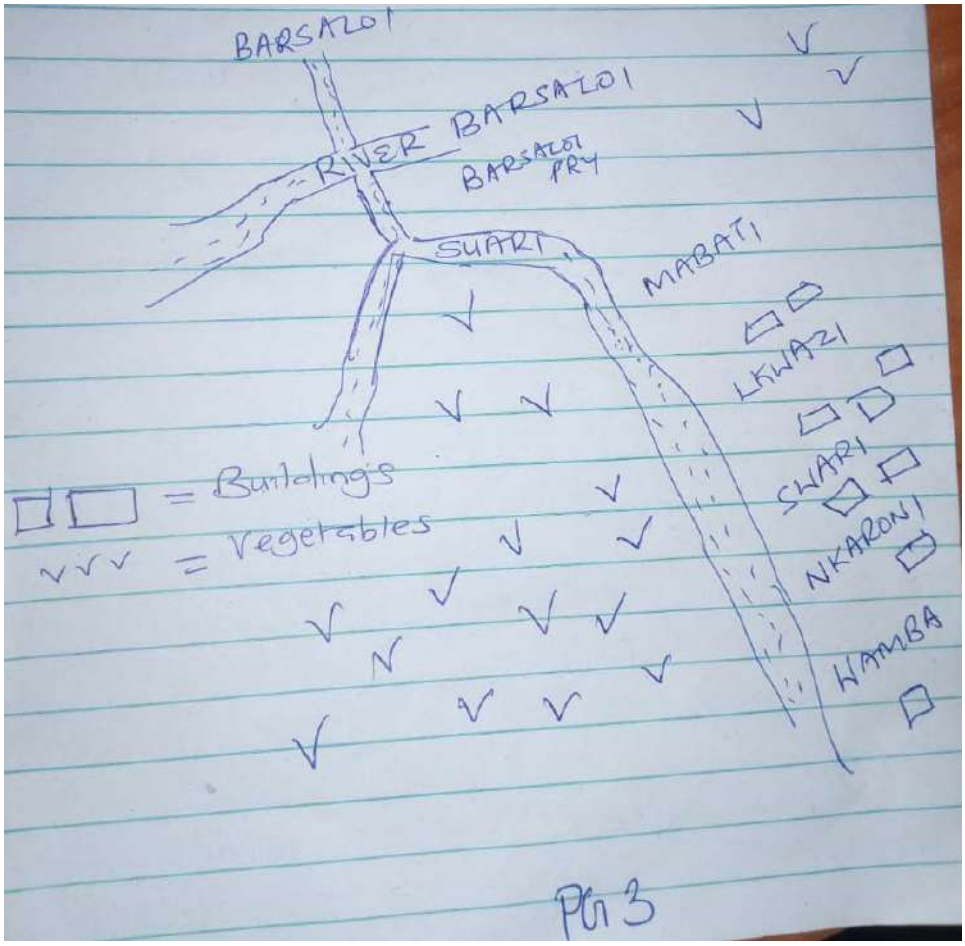
- Elders are the head of the community, and community resources such as land and other assets. They take their roles seriously.
- They bless the community. Before the animals go to the grazing land they are also blessed by the elders.
- The elders conduct traditional rituals of the community i.e. circumcision and marriage from generation to generation.
- The influences of the modern world have not changed the role of elders.
- The county and national government previously dominated the duties and responsibilities of the elders in the society but this not the case currently.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

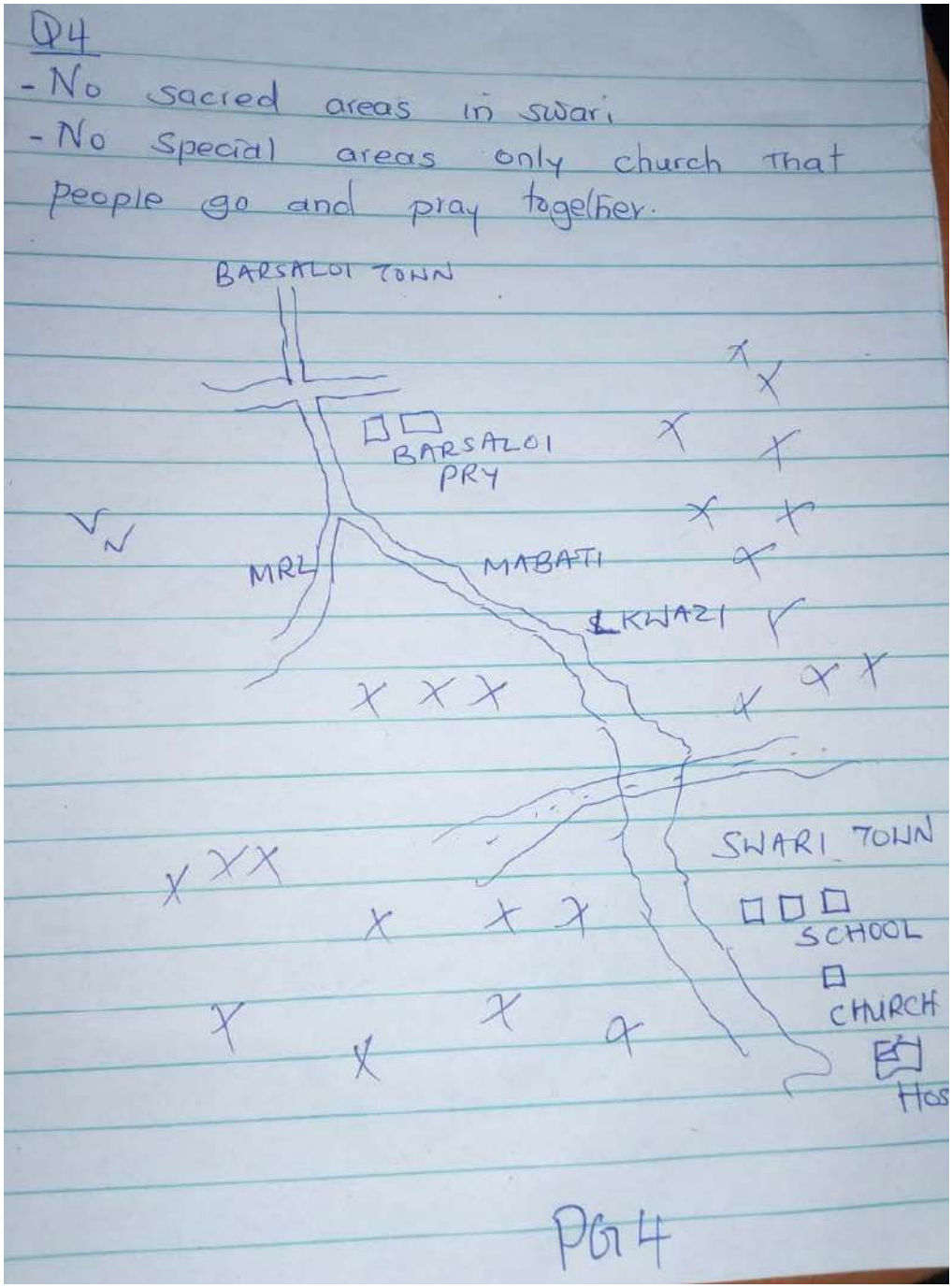
- There are traditional healers in the community. Laiboni predict the future.
- Laiboni use natural resources for healing such as animal blood (to cleanse a body from witchcraft) and herbs such as *Itepes* (umbrella thorn) to cure disease and blindness.
- The healers are paid with cows or goats and sometimes money as a sign of appreciation.
- Traditional healers are used by the community as natural doctors - alternatives in the absence of trained doctors in hospitals.
- They collect resources from the forests (herbs) and the community (animal blood).

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are no sacred sites or sacred physical features in the surrounding environment.
- The proposed pipeline passes through unaffected areas and will not impact on sacred sites.



4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.
▪ There are no sacred sites in Swari. ▪ There are no special areas. The community pray at the local church.



5. Important rites of passage (what are they and how are they observed?).
▪ Circumcision of both genders is still practiced. It is the most important rite of passage. ▪ The community come together to sing and slaughter animals during initiation, and the initiates drink the blood of the animal. ▪ Females are not permitted in the area where a male child is circumcised, and vice versa. ▪ The important rite of passage prepares one for each stage of life; either from childhood to adulthood or the transition from an adult to an elder.
6. What should the proponent know about entering a village? How is respect shown?
▪ The proponent should respect the culture and general way of life of the Samburu people. ▪ They should respect the people of the community.

▪ They should not steal any natural resources. ▪ The proponent must not take the community for granted, and observe and respect the local laws and policies.

FACILITATOR OBSERVATIONS

Comment
▪ It appears that the elders are fearful of the project. ▪ As this is the first major project in the area, their ability to understand possible effects (both positive and negative) is very limited. ▪ A special approach should be taken with this community during the engagement process.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Lamu, Swari
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Swari Catholic Church
Facilitator/Documenter:	Parison Longonyo/Philip Juma
Number Present:	**M:** 10 **F:**

1. Herding activities (Use seasonal calendar).

- Livestock covers the entire area of Swari at all times, both during the rainy and dry seasons.
- Animals drink water in Seyia River.
- Cows drink approximately 60 litres per day.

2. Requirements for water, when, from where, in what quantities per animal.

- Water is need for human use and the community animals.
- The only source of water is from the Seyia River, and it is available throughout the year.
- Approximately 30-40 litres per animal (cow) is required per two days.
- Camels consume around 120 litres per month.

3. Economics: average herd size

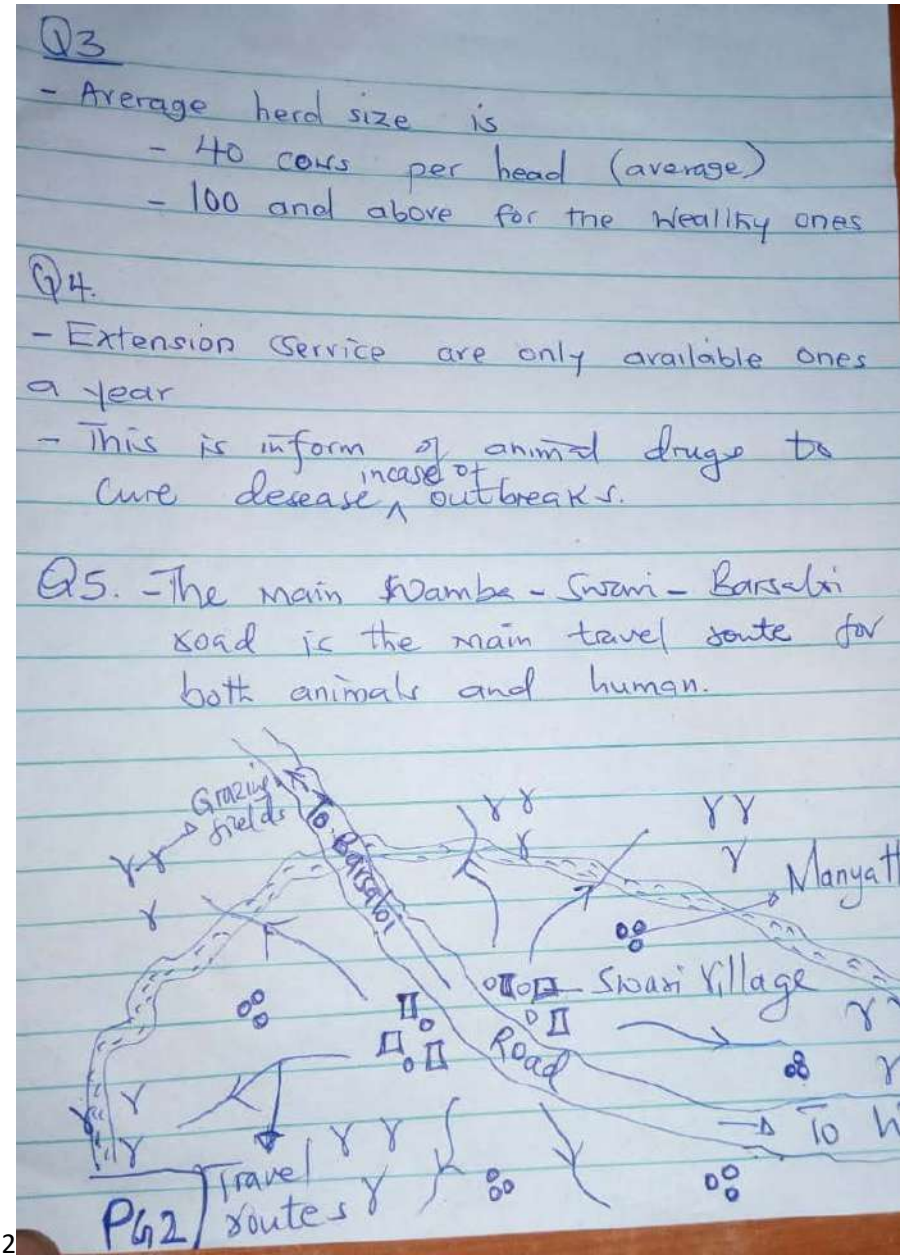
- The average herd size is 40 cows per herd.
- Wealthy livestock owners have herds of 100 and more.

4. Extension services; veterinary services.

- Extension services in the form of veterinary drugs to prevent disease outbreaks are only available once a year.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

- The main Wamba–Swari–Barsaloi road is the main route for both animals and people.

2 

Q3
- Average herd size is
  - 40 cows per head (average)
  - 100 and above for the wealthy ones

Q4.
- Extension service are only available ones a year
- This is inform of animal drugs to cure desease incase of outbreaks.

Q5. - The main Wamba - Swani - Barsalai road is the main travel route for both animals and human.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent household on Ere).
▪
7. Travelling in what size of group? Are these family or lineage groups?
▪ The groups travel as families. ▪ Animals (cows) travel in groups of approximately 30 to 40 head. ▪ Sheep and goats travel at in groups of around 100 to 200 while camels are in groups of 30 to 40.
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
▪ There is no fishing and hunting of wild animals in the area.

- Plants are gathered for animal consumption.
- The main vegetation in the Swari area (around 90%) is the *acacia tortilis* (umbrella thorn).

9. Groups representing pastoral groups. Mandate, range management, etc.

- The council of elders represent the pastoral groups in Swari.
- They have absolute authority in overseeing all pastoral activities and practices in the area.
- Elders have authority over land use rights.
- Depending on the season, elders have the authority to exclude outsiders from grazing within their land.

10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?

- Trenches could result in injuries.
- There is concern regarding the spread of diseases by outsiders such as the human immunodeficiency virus or acquired immunodeficiency syndrome (HIV/AIDS).
- Livestock and mineral theft, and taking girls for wives is a concern.
- The company should provide local employment opportunities.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Swari
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Swari Catholic Church
Facilitator/Documenter:	Alex Nadome/Job Lelekong
Number Present:	7

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women sell livestock.
- They belong to small women groups that are facilitate saving and giving out small loans to various individuals who would like to venture into small businesses. The beneficiary of such a loan is required to repay the loan with a little interest.
- Their household responsibilities are fetching water, cooking for other members of the household and take part in the decision-making.
- During the dry season, women sell livestock to markets in and outside Swari. During the rainy season, they engage in small-scale businesses such as general shops and canteens.
- Several women are employed as casual workers in the health centre especially as support to the maternity staff, and others are school matrons.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- The husband is the main decision-maker in a typical two parent family.
- Where there is no husband, the mother is the sole decision-maker. The same applies to child-headed families. However, child-headed families are discouraged.
- Money management is the responsibility of women in the household. This includes school fees and health costs.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Swari is a communal land and managed by the elders.
- There are no agricultural activities in these areas.
- Livestock products are consumed in all most households.
- Women have other assets such as plots, bee hives and quarries where precious stones are found.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- There are several women groups such as the Nkibaru, Lauraki, Nkiserian and Loikoka women groups, the Naabik self-help group, and the mother-to-mother women group.
- A higher percentage of women participate in political decision-making such as voting and influencing the populace (campaigning) compared to their male counterparts.
- There is shared work among women which includes raising money to enable them to develop business ventures as groups.
- Funds are also collected for vulnerable children.

- The women of the community fetch water, construct temporary structures and cook and fetch firewood together during occasions such as weddings. This is usually voluntary. They all help women who have given birth in the same way.
- They have strong challenges from domineering husbands who are against women activities outside of the household.
- Their businesses are affected negatively by a high family dependency. Business items are frequently consumed by family members.
- During the dry season, and when children are in school, women close down their businesses to attend to livestock (herding).
- Women are more educated and engage in matters concerning health (e.g. midwifery), compared to the past when they were not a part of anything outside of the important matters of the household.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women are treated like any other women in the community. They are not segregated or discriminated on any grounds.
- There are government programmes such as OVC (orphans and vulnerable children) which take care of single women.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Women can access family planning services from the healthcare centre in the area. Community health volunteers (CHVs) are trained to train the community on the use of family planning and general healthcare. The CHVs bring these medications to the women's homes.
- Women are aware about HIV, causes and effects. This has been enabled by workshops and seminars by several organisations that provide healthcare services.
- There are also immunisation programmes for children e.g. polio and measles.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- Swari is generally dry and there are no agricultural activities.
- Maize, flour and milk is available daily during the rainy season, which provides food security for households.
- There are no ready markets for livestock, hence no food. Government sometimes provide food relief.
- Food security is threatened by drought and the long distance from Swari to the market area.
- Food is mainly stored in buckets to avoid rodents and water is stored in jerry cans.

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).
▪ Schooling starts in nursery schools between the age of three and four for both girls and boys. ▪ Female children from the age of 14 usually drop out due to early pregnancies and early cultural marriages. ▪ Almost all male children complete high school between the age of 18 and 20 years. However, they fail to get admission to tertiary institutions due to a lack of funds. ▪ The future of female children is bleak because they do not get educated. They are destined to stay and perform household chores.
9. Map to the extent possible/relevant with the group
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Swari
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Swari Catholic Church
Facilitator/Documenter:	Parison Loongonyo/Juma Philip
Number Present:	**M:** 6 **F:** 2

1. Contributions/responsibilities to households.

- The youth have to be aware of what is going on in the house or with the family.
- They are the next of kin after their parents.
- They look after the animals.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- There is rise in unemployment which has not been experienced in recent years.
- The youth are exposed to modern and sport technologies.
- As a result, they marry at any age.
- Currently fewer rituals are followed are observed after childbirth.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth are more educated compared to their ancestors.
- There are, however, few employment opportunities for the youth.
- The road network is poor.
- Many youth hustle i.e. use illicit or unethical means to generate income, due to the lack of employment opportunities.
- The youth migrate to find employment opportunities.

4. General labour force characteristics and job readiness.

- The youth have good skills and are ready for work if they get an employment opportunity.
- They are keen and look out for employment opportunities.

5. Human immunodeficiency virus (HIV) awareness.

- The youth are aware of the human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS).
- They know it is spread by unprotected sexual intercourse, sharp infected objects and exposure to infected blood.
- Prevention is through the use of condoms, abstinence, faithfulness and counselling and education.
- Treatment is managed through antiretroviral drugs, a balanced diet and by avoiding sexual intercourse with infected persons to prevent reinfection.

6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ The youth take part in community politics. ▪ They are eligible to stand for any political seat such as members of the county assembly (MCAs), village administrators and parliament members. ▪ Money is a major factor in influencing politics. ▪ Rich politicians have power because they have money.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Nkaroni
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	Nkaroni
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	**M:** 3 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Nkaroni was once a local farm called Loding'okwe, and which later was subdivided into the Nkaroni location and the Loding'okwe location.
- Nkaroni Location was further subdivided into three locations in 1989.
- In 1990 there was an influx of migrants to the Nkaroni area to perform circumcision and they settled permanently.
- The area is owned by group ranch members, which was registered in 1975.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- The land is communal land owned by the group ranch.
- There is land available for new applicants but only after consulting the owners.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- There is a land committee made up of the grazing committee and the group ranch committee.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- The community practice land use planning have numerous proposals.
- Priorities are early childhood centres (ECD), hospitals, roads, conservation units, market areas and water points.
- They face constraints such as a lack funding and scarcity of water.

5. Current ongoing village initiatives, what is the progress.

- The community are currently involved in building toilets and facilitating cash transfers.
- Nutrition education and training as well as drought management is provided by non-government organisations (NGOs).
- Afya Bora facilitate health projects
- Security duties are managed by conservation rangers.
- Conservancies promote environmental conservation.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with district administration).

- Safaricom boosters provide annual revenue.
- Ballast cess – gravel/hardcore stone which is often mixed with sand and cement during construction works.
- Total annual revenue is KSh 200,000.
- Women are more involved in community initiatives than men.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- Local leaders always liaise with the community elders to improve leadership in the area.
- The community respects the leadership of the local elders.

8. Request for village statistics if available

Current population (m/f)	20,000
No. of households	5,000
Births 2017	300
Deaths 2017	120
Population <15 **Population 15 – 54**	6,000 10,000
Population 55+	4,000
No. of in-migrants	4,000

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Samburu, Nkaroni
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	Nkaroni
Facilitator/Documenter:	Alex Nadome / Job Lelekong
Number Present:	**M:** 7 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

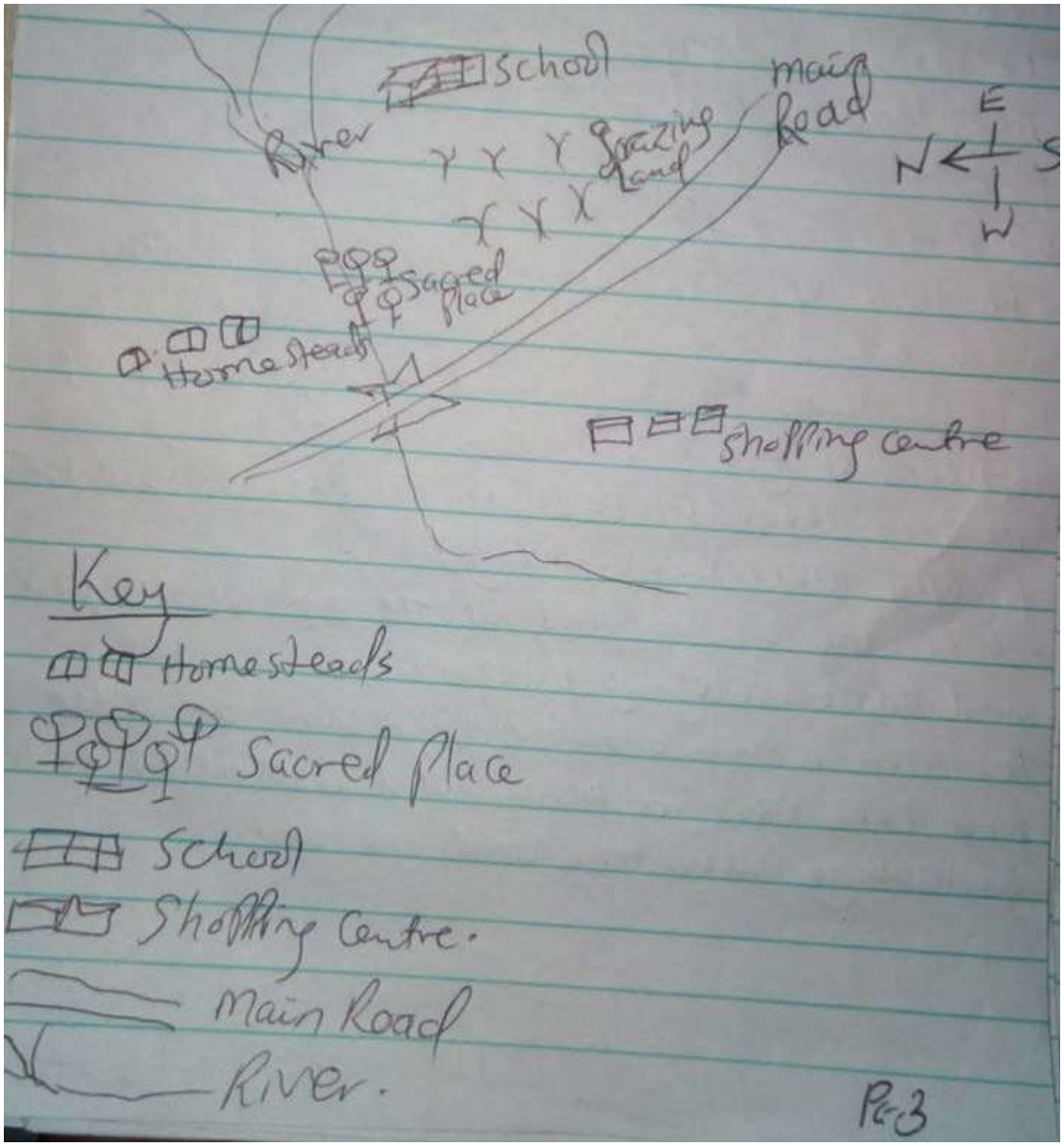
- Nkaroni is mainly inhabited by the Samburu community. The Samburu council of elders are responsible for conservation of the environment in terms of preserving trees and the river lines.
- They are the law makers in the community, and their decision is final.
- They settle disputes both internally and externally.
- They take the centre role in controlling seasonal calendars.
- Mostly they are bread winners of the family and offer advice to the rest of the community.
- They ensure peace prevails in the community and foster positive coexistence among all members of the community.
- The role of the elders has changed over time.
- The government contacts elders first before undertaking a business in their area unlike in the past.
- Both the local and national government invest in the elders because they are considered trustworthy.
- The elders work hand-in-hand with the local government to ensure that the village initiatives are successfully carried out.
- The elders have the power to embrace or reject projects in their areas.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- The traditional healers in the community are elderly, and understand which of the herbs found in the forest around Nkaroni can be used to treat various.
- The healers are there at the community's service and are not paid.
- Herbs are collected from the trees (forests), river lines, hills and on the plains.
- When treated by a healer, the patient is washed clean or the wounded part is cleaned with water.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Across the main road, there is a sacred site called "Nagoroworu" where the elders and other people go to pray for the rain. This sacred site is within the pipeline area.



4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.
▪ There are no taboo areas within the pipeline. ▪ There is no restriction in terms of visitation to any of the places around the pipeline area. However, there is only one sacred site where people go for prayers. ▪ There are graves in the area.

5. Important rites of passage (what are they and how are they observed?).
Typical rites of passage include: ▪ Circumcision, which is performed at the age of fifteen years. ▪ The circumcised young adult remains unmarried for the next fifteen years. ▪ He is then allowed to become an elder and take part in household activities such as making decisions and others. ▪ Girls are circumcised at the age of fourteen years and are married immediately thereafter.

6. What should the proponent know about entering a village? How is respect shown?
▪ When a visitor arrives in Nkaroni, they are first introduced to the chief of the area and will then accompany the chief to meet the village elders. ▪ Visitors must introduce themselves and greet the elders in the most respected manner. ▪ Visitors must adhere to the rules and regulations as advised by the elders and is required to show respect to the families in the area. ▪ They should also respect livestock, because this is the source of livelihood for the community. ▪ Elders are to be consulted in the event of project activities that would impact the community negatively or positively.

FACILITATOR OBSERVATIONS

Comment
Elders are the most respected section of the population, they control almost everything.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Nkaroni
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	Nkaroni
Facilitator/Documenter:	Parison Loongonyo/ Philip Juma
Number Present:	6

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The area is semi-arid therefore agricultural activities are not commonly practiced.
- Women devote most of their day to looking after their livestock.
- Domestic work is done early morning and early evening hours.
- Income-generating activities include bead work, livestock trade, small hotels and the selling of liquor.
- There are no significant employment opportunities for women in the Nkaroni area.
- Many are illiterate with no formal education.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- The husband is the primary decision-maker in the house.
- He is responsible for money management, school fees and the health costs of the family.
- Women are the sole water farmers.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Men are the sole owners of land
- They own land-use rights as well as other major assets in agriculture and livestock

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women are organised into numerous social groups that carry out various economic activities to generate income.
- Women participate in political decision-making, they compete to elect their leaders.
- The majority of shared work among women is charity work to help the vulnerable.
- They help each other in heavy duties such as house construction.
- The main barriers to women participating are their difficult husbands, distance, household chores and poor health.
- The Nkaroni women agree that changing roles over time is right, and work sharing between the two sexes is beneficial and welcomed.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?).

- There are many single women in Nkaroni.
- Single women and their children are not stigmatised in society.
- The receive help from the community, the same as any other person.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- There are preventative health care services for children and adults, visiting clinics.
- The Nkaroni women have limited access to family planning services.
- They do not use family planning services.
- They are aware of HIV and acquired immunodeficiency syndrome (AIDS)
- They also understand the causes of the disease are unprotected sex with infected persons and sharing needles.
- Treatment of the disease includes the use of antiretroviral drugs, eating a balanced diet and abstaining from unprotected sex.
- Prevention is through use of condoms, abstention and faithfulness.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- A good diet is one that provides the body with energy and increases the body's immunity.
- There are no storage facilities for food.
- Constraints facing the community are food security, drought, theft from neighbouring communities and disease.
- They cope with drought by migrating to search for pasture and water.

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school at four years old.
- The typically leave school between the ages of 16 and 20 years.
- Early school dropout is as a result of a shortage of school fees, poverty, a loss of parents and pregnancy and marriage.
- Children help parents to fulfil household duties.
- The future of the community children is positive.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

GOLDER

ESF Consultants
Environmental Management Consultants

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Nkaroni
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	Nkaroni
Facilitator/Documenter:	Parison Loongonyo/ Philip Juma
Number Present:	**M:** 6 **F:** 2

1. Contributions/responsibilities to households.

- The youth defend and act as the eyes of the community.
- They attend school, and look after animals.
- They are also bread winners of the family.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The young adults have a longer life expectancy as a result of technology.
- There is poverty.
- The population has increased.
- Both genders can marry at an early age.
- They marry at different times depending on the decisions made.
- The birth of a child belonging to a youth still follows the normal community rituals; animals are slaughtered and water is collected.
- Most girls do not undergo female genital mutilation (FGM).

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth have a positive attitude towards education, and most are educated.
- They are ready to work but there are no job opportunities, and move from area to area looking for work.
- They have little access to technology.

4. General labour force characteristics and job readiness.

- A fair number of young adults are educated as teachers, drivers and doctors and work in these jobs.
- They are ready to work but there are few job opportunities.

5. Human immunodeficiency virus (HIV) awareness.

- The youth are aware of HIV.
- There has been no cases of HIV or acquired immunodeficiency syndrome (AIDS) in the area.
- The disease is caused by unprotected sexual intercourse or blood donation among many others.
- HIV/AIDS is prevented through the use of protection, for example condoms, being faithful to a partner and abstaining from sexual intercourse.
- Treatment for the disease is the use of antiretroviral drugs, eating a balanced diet, and abstaining from sex.

6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ The youth are inclined to participate in politics in the area. ▪ Their views are considered in terms of politics decision-making. ▪ They are eligible to contest any sit. ▪ Money plays a big role in politics as it influences the youth to vote for the rich, but also they are able to make wise decisions.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Samburu, Wamba
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Wamba Catholic Consolata Hall
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	**M:** 11 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

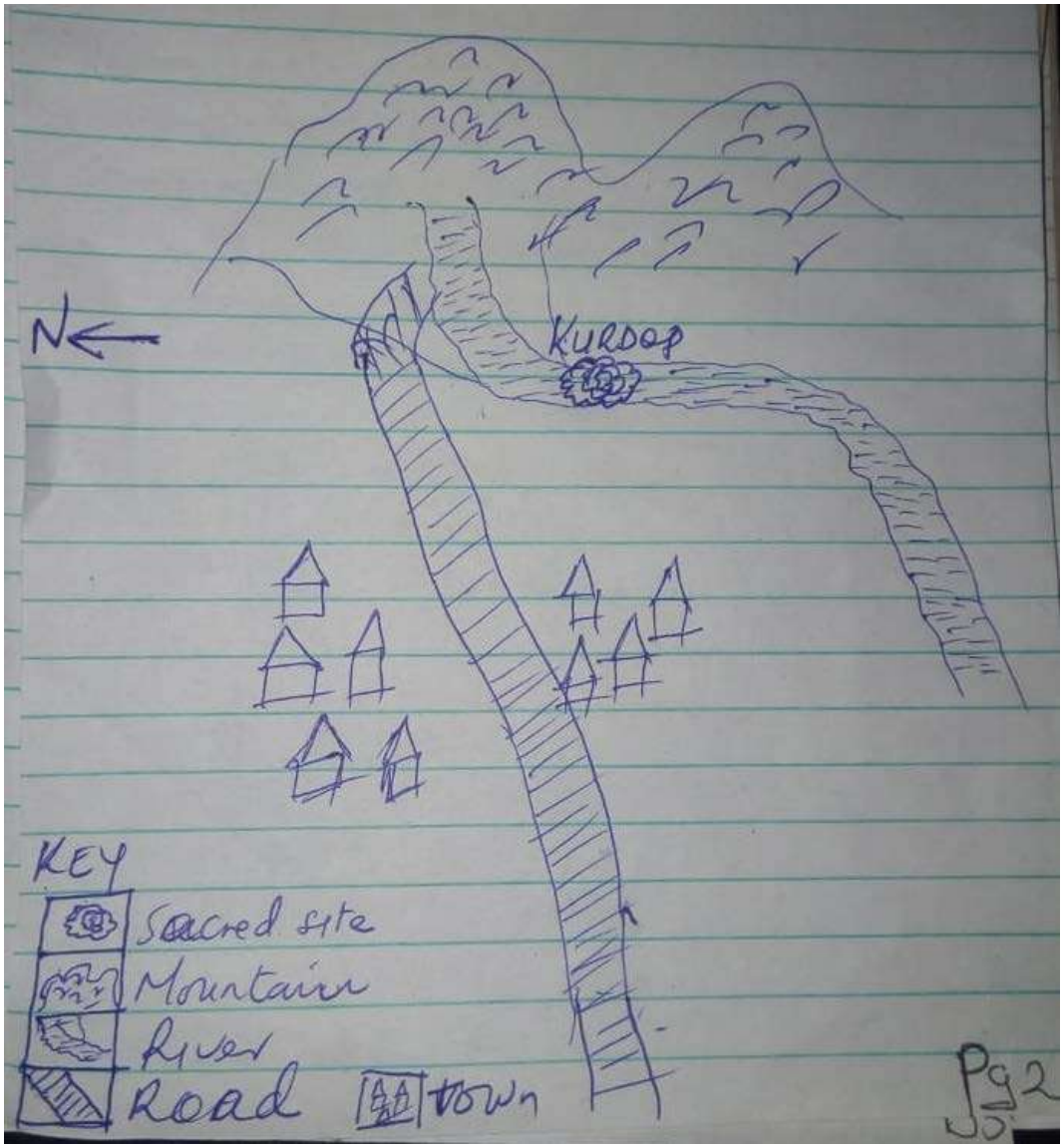
- The elders of opinion leaders and the link between the community and the government.
- They form committees that are responsible for land issues, and also plan settlements and grazing patterns.
- As respected elders they resolve disputes and promote peace.
- They herd livestock.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the community.
- They use local herbs found in the mountains, riverbanks and plains.
- They are paid for their services either in cash or in exchange of animals.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There is a sacred place in the area called Kurdop. It is situated in the river at the foot of the mountain.


N
KURDOP
KEY
Sacred site
Mountain
River
Road
Town
Pg 2

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.
▪ There are graves which sacred and taboo in the area. They are not just situated at specific places but must be observed and respected. ▪ Site where the warriors celebrate 'Lmuget'[1] are surrounded by trees that must not be cut down.
5. Important rites of passage (what are they and how are they observed?).
▪ The mass circumcision of boys is performed every 15 years. ▪ A boy marries at the age of 25 years old. ▪ Girl may marry from the age of 12 years old. ▪ 'Lminong'[2] is also practised by warriors as they graduate to the elder stage.
6. What should the proponent know about entering a village? How is respect shown?
▪ Visitors must introduce themselves to the elders of the community. ▪ Elders then introduce the visitor to the area chief. ▪ Visitors should always seek advice and directives from the elders with support from the chief's office to ensure they do not oppose the elders' principles governing the community members.

FACILITATOR OBSERVATIONS

Comment
▪ Elders are respected and play a big role in the governance of this community. ▪ The county government, together with the national government, recognise the governance of the local elders in the community.

[1] A traditional ceremony for the Samburu tribe initiates to upgrade from one age set to another after circumcision of boys to morans

[2] 'Lminong' bars morans from eating meat at home as a way to separate them from the young and the elderly.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Wamba
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Wamba Catholic Consolata Hall
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	8

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women in the community are involved in growing vegetables for commercial benefit. They spend part of their day on their farms and at the market, and the remaining part on other chores at home.
- They are involved in other businesses such as selling and buying livestock, which is usually a full days' work, on specific days of the week.
- Domestic livestock responsibility involves fetching water, cooking, collecting firewood, herding and small-scale businesses both at individual and group level.
- There are casual employment opportunities such as cooks, matrons, teachers, community health volunteers (CHVs) and midwifes.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Decision-making and the managing of finances is the responsibility of both parents, and it is important they reach agreement.
- Water carrying is a woman's duty.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Land is owned by the community and managed by the elders and a committee.
- Tomatoes, spinach and *pilipili hoho* (capsicum) are grown.
- Livestock products are primarily for the community only, and not for sale.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women participate in the following registered groups:
  - Tawakal women's group- livestock trade
  - Namaiyain & Samburu progressive women's group - agriculture
  - Matonyok women's group - savings and table banking
  - Naitutum women's group - savings and beading work
- They also have tents and public address systems for hire.
- There is a high percentage of women in politics.
- The role of the woman in the community is changing; women involve themselves more in decision-making.
- They make themselves available for employment in positions such as drivers, painters, plumbers and contractors.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women are not stigmatised. They are treated like any other woman.
- Help is given to vulnerable single mothers. This help is provided from benevolent funds and by compassionate members of the community.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Family planning services are easily available from CHVs, community health extension workers (CHEWs) and nearby health facilities.
- There is HIV awareness in the area.
- Children immunisation is available.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- Many in the community do not have access to regular food, particularly those that do not have small businesses to supplement their income.
- They cope by borrowing from friends.
- Water is stored in jerry cans and food in boxes.
- The community do not have a balanced diet.

Constraints:

- The high unemployment in the area leads to food insecurity.
- The area is suffering from a long drought.
- Lack of funds, poverty and illiteracy are common constraints.
- There is an absence of education and capacity building.

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school at the age of four years.
- Girls often leave school at fourteen years as a result of early marriages and early pregnancies and also a shortage of school fees.
- Boys leave school at no particular age, but when they do it is usually because drug abuse and a shortage of school fees.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Wamba
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Wamba Catholic Consolata Hall
Facilitator/Documenter:	Parison Longoonyo/Philip Juma
Number Present:	**M:** 9 **F:** 2

1. Contributions/responsibilities to households.

- Youth are the primary security personnel for the community and their families.
- They are the eyes of the community.
- They also look after the livestock.
- Girls and boys are both responsible for fetching water and cooking food.
- The youth are the breadwinners.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The young adults in the community are educated.
- Chemicals in food have contributed to the reduction in overall life expectancy; this was not the case in the past.
- Drugs have become one of the greatest factors contributing to the social changes.
- People marry on agreement and at any age because of the influences of the modern world.
- In the past, the community had enough resources but currently resources are scarce.
- When a child is born, the youth participate in the rituals such as slaughtering animals, ululating and fetching water in the river.
- Girls do not undergo female genital mutilation (FGM) since the influences of the modern world has led to a change in cultural practises.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth of the community understand that education is important.
- Boys and girls are given equal chances and rights to education.
- Employment is a challenge; young adults have qualifications but no jobs.
- There is easy access to the second generation (2G) network and there is a fourth generation (4G) network project underway in Wamba.
- The youth move to other areas in search of employment.

4. General labour force characteristics and job readiness.

- The youth are actively exposed to the job market.
- They work hard in industries such as constructions to earn a good income.
- They are eager to work, with skills and a good attitude, but there are few jobs in the area.

5. Human immunodeficiency virus (HIV) awareness.
▪ The youth are aware of HIV but no one has been identified ▪ HIV is caused by unprotected sexual intercourse, drugs, poverty and sharing razors. ▪ HIV is prevented by using condoms, abstaining from sexual intercourse, going for voluntary counselling and testing (VCT) and being faithful to one partner. ▪ HIV is treated by accepting your HIV status positively, and managing it well by taking antiretroviral drugs and following a balanced diet.

6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ The young adults participate in politics and are the voice of the community during campaign time. ▪ Political seats are open for any members of the community. ▪ Advice on political issues is given. ▪ Money brought in by politicians is substantial and influences the community. ▪ Youths around are the voice of the people when it comes to campaigns.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Samburu, Lerata
Meeting Date and Time:	29 October 2018
Meeting Venue/Group:	East Africa Pentecostal Church Lerata
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	**M:** 2 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Lerata was first inhabited by the pastoralists who are now herders and over time they built schools, hospitals and a church following the schooling of missionaries.
- People migrate in and out of Lerata in search of greener pastures.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- There is no available land for new applicants. This is because land has already been planned for various uses.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

- Land is communal and managed by the group ranches management.
- A portion of land has been given for military training.
- The other parts of land have been allocated for conservancies, and social amenities such as schools and hospitals.
- There are bylaws governing the use of land which is governed by the committees (grazing, group ranch).

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Land has been planned for numerous uses such as schools, playing grounds, an existing town and other projects such as a hospital and an airstrip which are still underway.
- Economic priorities and plans include water points, pumping and housing.
- Security issues need to be taken into account.
- There are plans to build of a livestock market and a secondary school

Constraints:

- Lack of funds to drill boreholes.
- Long dry spells experienced in the area.
- There is absence of security and stability.

5. Current ongoing village initiatives, what is the progress

- The youth and elders run human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) awareness programmes.
- Non-government organisations (NGOs) facilitate capacity building (education on health issues.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

Revenue:

- There are no sources of revenue at village level, only at county levels.

Women participation:

- There is high percentage of women participation in the village initiatives.

Constraints:

- There is no source of revenue at village level so it is difficult to undertake and complete development plans.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- The village government hast no capacity to undertake any project without it first being approved and funded by other levels of government.
- There is a high percentage of women participating in village initiatives. Mostly women perform household chores and some are also involved in small businesses and agriculture.
- The local government can access resources from the county government, for example money for development purposes.

8. Request for village statistics if available.

Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in migrants	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Samburu, Lerata
Meeting Date and Time:	29 October 2018
Meeting Venue/Group:	East Africa Pentecostal Church Lerata
Facilitator/Documenter:	Parison Longoonyo/ Philip Juma
Number Present:	**M:** 13 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elders are the head of the community.
- They spearhead the community activities, bless the community and own community resources such as land.
- The elders resolve conflict by holding barazas (public meeting places).

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- Traditional healers still exist in the community.
- They use herbs to treat disease and heal, such as:
  - *Lmakutukuti* (blue-flowered tinderwood)- clerodendrum myricoides/ rotheca myricoides(Butterfly bush) -
  - *Ltepes* (umbrella thorn)- Acacia tortilis -
  - *Ljirman* -
  - *Serichoi* - Boscia coriacea pax -
  - *Mpopongi* - Euphorbia virgata -
- Currently healers are paid which differs from the past; payment is usually in the form of cows.
- The herbs are found along areas of Lerata and Nkusoroni.
- Mostly the herbs are used to treat common stomach diseases.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Sacred places are found further afield, for example in Sapache.
- No sacred sites and places are found along the pipeline corridor.
- The only sacred tree found along the pipeline corridor is the Ltepes (umbrella thorn).

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- An important rite of passage is circumcision. It is observed by bringing the community together in a specific place. Animals are sacrificed to mark the occasion.
- Several plant resources are also used in the ceremonies. Many are found in the bushes around.

5. Important rites of passage (what are they and how are they observed?)

Circumcision:

- Circumcision marks the transition of a person from childhood into adulthood.
- It is performed when at approximately 18 years of age.
- Boys are usually circumcised.

▪ Female genital mutilation (FGM) is against the law.
6. What should the proponent know about entering a village? How is respect shown?
▪ Visitors are accepted but they need to observe the community rules: - Correct procedures and hierarchy must be observed. - No seducing of any husband, wife or daughter of any member of the community. - No killing of kill wild animals. - Project owners should settle in one area only, and not mix with the community.

FACILITATOR OBSERVATIONS

Comment
▪ The community has a positive attitude towards the project. ▪ Elders have the authority over various resources such as land use rights. ▪ Land compensation is a major issue.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Samburu, Lerata
Meeting Date and Time:	29 October 2018
Meeting Venue/Group:	East Africa Pentecostal Church Lerata
Facilitator/Documenter:	Alex Nadome/ Job Lelekong
Number Present:	8

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women groups under the BOMA Project have savings accounts for their small-scale business for example selling sugar and tobacco.
- They also do make beaded items and sell them.
- They clear the fields especially when contractors are in the area i.e. construction and digging of trenches.
- The women also fetch water and sell it to the construction contractors.
- Land is typically cleared during the month of April and planting is done a month later at the start of the rainy season.
- They plant spinach, kale, maize and beans which are then sold to the local residents at Archer's post.
- Women help with the herding especially when their children are at school. The livestock is sold at the market place, and the price depends on the size of the animal.
- Domestic responsibilities include building makeshift houses, cleaning utensils, cooking and fetching water.
- They sell manure to people from other counties.
- There are community health volunteers (midwives) who are paid cash for their services.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- The husband is usually the decision-maker. However, occasionally the husband and wife will work together on certain issues to reach agreement.
- Money management is primarily the husband's duty.
- School fees and healthcare costs are a joint responsibility.
- Women fetch and carry water. In some cases, a husband will fetch water if they possesses a motorbike or a tuktuk.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Land is communal and is managed by the group ranch (Losesia).
- Agricultural products include spinach, *sukuma wiki* (colewort), maize and beans and these are sold to nearby towns.
- Livestock products are consumed by the family and by-products such as milk are sold outside Lerata.
- Other community members own land (plots) individually.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- There are several women groups such as Nkiramat, Nasha, Umoja, Nelepo, Naltakoon.
- These groups engage in:

- Small-scale agriculture
- Subsistence businesses
- Livestock buying and selling.

- Women participate in political decision-making especially during the electioneering period. The majority of them vote.
- They also usually assist by building structures, cooking, fetching water and firewood during ceremonies such as weddings.
- They are involved in controlling resources and advising on how best these can be used, and construct clan manyattas (Lorora) that are purely managed by women.

Constraints:

- There is a shortage of existing markets for products.
- The current severe drought affects agriculture and livestock production.
- Women are usually strained in terms of flexibility regarding business and household chores.
- The decision-making power of men is misused, and this prevents the development of women. Men are in charge of the finances making it difficult to keep businesses running smoothly.
- More education and training concerning the drought and agriculture is needed.

Perception of changing roles of women:

- There is difference between a woman whose main work revolves around the household and the modern woman who has now been educated and can work in various disciplines.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women are stigmatised. They are typically not included in village initiatives and cannot benefit in any way. In every project married women are prioritised.
- There is no help for such women as they are neglected by other members of the community.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- There is a health centre and community health volunteers therefore women have access to family planning services either at the health centre or at home.
- HIV awareness campaigns have been conducted by various organisations and people understand the causes and preventative measures. They also access children immunisation services for measles, polio etc. at the health centre.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- There is insufficient food, but the shortage is supplemented with the income from the small businesses of the community. Most community members are unaware of what constitutes a good diet.

Constraints

- Small businesses do not entirely sustain the women and their families because their income is needed to settle other bills.
- Drought is a constraint that affects both agriculture and livestock keeping.

Coping strategies include involving/ engaging in sale of water, ballast and other local business for subsistence.

Product	How often	How much for an average family	Other comments
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children enrol for school at four years old as per the new curriculum.
- Female children frequently drop out of school at the age of 13 or 14 due to unplanned pregnancies.
- Males generally complete their high school education unless they do not have the funds to complete their schooling.
- There are early marriages for young girls resulting from a negative attitude towards education by their fathers.
- Young men become involved in drug abuse both at primary and secondary level leading to school dropout.
- Overall, however, there is a bright future for the community's children.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Samburu, Lerata
Meeting Date and Time:	29 October 2018
Meeting Venue/Group:	East Africa Pentecostal Church Lerata
Facilitator/Documenter:	Parison Longoonyo/ Philip Juma
Number Present:	**M:** 12 **F:** 3

1. Contributions/responsibilities to households.

- The young adults in the community are the primary income earners in their families.
- They offer protection to the family (security agents), and help with nurturing the younger children to full growth.
- The young adults are also tasked with looking after the animals
- Girls are required to fetch water and firewood, and assist their mothers in cleaning the house.
- In the case of orphans, the firstborn male is the next of kin.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- In the past blood and meat were the only forms of food. Currently the youth are exposed to synthetic drugs (as opposed to traditional medicines) and foods containing preservatives and chemicals which are a great challenge.
- Modern technology has also about brought changes in the way the young adults respect their elders and dress; girls, in particular, wear inappropriate clothes often exposing their bodies.
- There are many opportunities available to the youth currently.
- There has been an improvement in community infrastructure.
- The transport network has also improved.
- Youths frequently marry young (15 years and above currently as opposed to the average age of 35 in the past).
- Young girls marry early but it is against the rule of law.
- At birth when a child is born an animal is slaughtered, women fetch water for the men, and ululate.
- Education has changed the way in which the youth view society, and many do not follow the traditional rituals.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth have a positive attitude towards education.
- Most of the youth in Lerata are educated but are unemployed, as opportunities are minimal.
- The community have easy access to the internet road transport networks.
- In the area the youth move from area to area in search for jobs.

4. General labour force characteristics and job readiness.

- A general labour force is available. The youth have got varied skills in different fields, but most are unemployed.
- There is readiness to join the job market.

5. Human immunodeficiency virus (HIV) awareness.
▪ The community is aware of HIV. ▪ They understand that HIV is caused by unprotected sexual intercourse, blood contact and sharing razors etc. ▪ To date, no known cases have been identified in the area.
6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ They participate in politics and are eligible to contend any favourable seats. ▪ Politically, the youth in the area have a major role and act as the eye of the community. ▪ The youth back the project positively and are ready to provide support once the project commences.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Isiolo, Central
Meeting Date and Time:	9 November 2018
Meeting Venue/Group:	Rangelands Hotel
Facilitator/Documenter:	Halkano Boru Adan Omar, Halkano Dida
Number Present:	5

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women wake up and pray at 05h00.
- They prepare breakfast and their children for school by 06h00 in the morning.
- Household chores are done between 06h00 and 08h00.
- Farmers go to the farm from 08h00 to 16h00.
- Women shopkeepers and stall owners go to their premises by 08h00 and return around 18h00.
- The seasonal calendar for farming women comprises the following:
  - From January to March - prepare the land and plant
  - From April to May - weed
  - During the months of June and July - harvesting
  - From August to September - prepare the land and plant
  - October to November – weed and some planting
  - December – harvesting.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Husbands are sole decision-makers.
- Single mothers make their own decisions.
- Both husbands and wives who trade contribute to school fees.
- Women do all household chores including fetching water.
- Health costs are shared.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Typically, the head of the household (husband) owns the land and other assets.
- Commonly farming work is done by wives and single mothers.
- Livestock are kept on communal land.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women participate in political decision-making.
- There are numerous women groups that are actively involved in various activities.
- Roles are changing as women are taking higher positions in groups, county politics and employment.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of household?)

- Single women do not face stigmatisation neither do their children.
- Some single women are forced to resort to prostitution to support themselves and their families.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Family planning methods are easily accessed at healthcare centres and chemists.
- There is little awareness of HIV. Awareness would help in prevention of HIV cases in the area.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Once in a month	1 kg	
Goat	3 per week	0,5 kg	
Chicken	Once per month	0,5 kg	
Beef	3 days per week		
Milk/yogurt	Once in a month	1 litre	Shared among families
Rice	Daily	1 kg	Staple food
Bush meat	Nil	Nil	
Wild plants	Nil	Nil	

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- Children start school at four years old.
- Both boys and girls leave school between the age of 13 and 14 years after completion of school.
- Children frequently drop out of school when parents or guardians die.
- Children help in household chores; girls clean the house, fetch water, help in farms and sell milk. Boys help with herding livestock.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Isiolo, Central
Meeting Date and Time:	9 November 2018
Meeting Venue/Group:	Rangelands Hotel
Facilitator/Documenter:	Halkano Boru/Adan Omar, Halkano Dida
Number Present:	**M:** 6 **F:** 2

1. Contributions/responsibilities to households.

- The youth are a source of labour to the household.
- They are involved in decision-making, and responsible for the safety of their families and the community.
- Girls assist with cooking chores.
- The youth provide knowledge and information to the household.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The rite of passage in the past was through circumcision but presently it is not considered.
- The youth married early in the past but in present times they study, get jobs and only then marry.
- Children are now born in hospitals as opposed to at home in the past.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The young adults study for white collar and technical jobs.
- Education is not considered as the only way to get wealthy or earn money.
- More opportunities enable some young adults to work in other counties.
- There is easier access to information and technology.
- However, the technological advancement has led to a decline in morals.

4. General labour force characteristics and job readiness.

- Jobs are frequently gained by corrupt methods.
- There is a great need for jobs because the unemployment rate is high.
- In Isiolo county there is a lot of nepotism which has affected the less affluent youths in the county.

5. Human immunodeficiency virus (HIV) awareness.

- There is little awareness about HIV in Isiolo County.
- The HIV rate is high in Isiolo.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youth are actively involved in politics, but are easily manipulated by politicians.
- They are not concerned with quality of leadership, and more interested in the wealthy individuals.
- The youth do view the elders' opinions as much as they did in the past.
- The youths do not follow the traditional authorities or their problem-solving methods.
- Culture has been enhanced through non-governmental organisations and youth forums.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Isiolo, Ngare Mara Ward
Meeting Date and Time:	10 November 2018
Meeting Venue/Group:	Ngare Mara Catholic Mission Hall
Facilitator/Documenter:	Halkano Boru/ Adan Omar, Halkano Dida
Number Present:	**M:** 19 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elders protect, guide and lead the community, and resolve conflict.
- They formulate laws and negotiate dowry payments.
- They conduct sacrifice and cleansing ceremonies and pray for the community.
- There have been changes in education and the role of women.
- Women are more frequently involved in the making of major decisions.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers. They use natural resources (herbs for healing).
- Examples of herbs used by the Turkana traditional healers include *egong* (used for removing worms in the body) and *esokon* (roots used for treating chicken pox).

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Sacred sites exist within the proposed pipeline route.
- Some specific acacia trees are regarded as sacred according to the Turkana community.
- Acacia trees are used during the rite of passage from childhood to adulthood.
- The acacia tree is a no-go zone for all community members until the date of the ceremony.
- Charcoal burners are instructed not to cut the sacred acacia tree.
- The scared site is shown on the map.
- Community elders are responsible for protecting sacred land and historical sites.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- There are shrines, cleansing sites and traditional initiation sites near the pipeline route.

5. Important rites of passage (what are they and how are they observed?).

- *Atha Pan* is the initiation from childhood to adulthood. During the ceremony animals such as bulls, camels and rams are slaughtered.

6. What should the proponent know about entering a village? How is respect shown?

- The proponent should first meet the elders.
- The traditional greeting is *mata* and reply is mata.
- A sprinkling of blessed water mixed with milk is a sign of blessing and welcome.

FACILITATOR OBSERVATIONS

Comment
▪ The community are very welcoming. ▪ They share their beautiful culture openly.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Isiolo, Ngare Mara village
Meeting Date and Time:	10 November 2018
Meeting Venue/Group:	Ngare Mara Social Hall
Facilitator/Documenter:	Joseph Kalapata/Adan Omar
Number Present:	**M:** 10 **F:**

1. Herding activities (Use seasonal calendar).

- Pastoralists herd cows, goats and sheep.
- During the months of January and February animals are herded close to home since there is plenty of water and pasture.
- From March to April there is a decrease in pasture.
- In May and June, following the late April rains, pasture is abundant.
- From July to December, because of a decrease in pasture herders move away to places like Kaichuru, Chumbi yare and Magado.

2. Requirements for water, when, from where, in what quantities per animal.

- There is shortage of water during the dry season from July to December.
- A cow requires an average of 30 to 40 litres of water per day. Goats need around 10 to 15 litres a day.

3. Economics: average herd size.

- Due to drought and a recurrence of dry seasons livestock numbers have reduced. Prior to the drought in 2017, an individual had, on average, 100 to 150 cows and some even more.
- The average now is around 30 to 50 cows per individual.
- Cows average 75 to 100 kilograms of weight while goats average 10 to 15 kilograms.

4. Extension services; veterinary services.

- There are no extension officers in the area thus no extension services.
- Animal drugs are purchased in Isiolo.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

- Herders follow routes to places such as Daaba and Hillout which are approximately 20 kilometres from the community. Areas such as Kinna, Kulamawe, Magado and Rapsu are more than 100 kilometres away.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- Permission is needed and mostly involves discussions with elders and pasture management committees. This is essential especially when herders travel with their animals to the neighbouring communities.

7. Travelling in what size of group? Are these family or lineage groups?

- Herders move in lineage groups. On average a group of between five to ten herders travel together with approximately 600 to 1 000 cows.

- There are two types of movement. Migration for pasture during peace time and migration due to conflict and fear.
- Before the herders move from one grazing set up to another, small groups travel to research and inspect the proposed areas.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Farmers and herders use the area.
- There are also places of cultural significance, and areas for fruit and plant gathering.

9. Groups representing pastoral groups. Mandate, range management, etc.

- Pasture management committee.
- Council of elders.
- Youth leaders.
- Traditional decision-makers

10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?

- The community were not aware of the project prior to these focus group meetings. They do not know if it will benefit or destroy their livelihood.
- It is their hope that their lives will be uplifted by the project.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Isiolo, Ngare Mara
Meeting Date and Time:	10 November 2018
Meeting Venue/Group:	Ngare Mara Church Hall
Facilitator/Documenter:	Joseph Kalapata/Adan Omar
Number Present:	25

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women are mostly involved in pastoralism.
- Some farm (small-scale) at their homestead.
- They also trade in livestock.
- They cut posts and collect hardcore and pebbles to sell for household construction. The posts are also sold for fencing.
- Some women collect and sell gum Arabica (acacia gum), as well as *Acacia tortilis* (umbrella thorn) pods to generate income.
- They sell manure, firewood and wild fruits.
- The women's day typically starts at 06h00 when they milk the livestock, prepare breakfast and get their children ready for school.
- All household chores are done after the children go to school at 07h00.
- The livestock are released for grazing at 08h00.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Men (husbands) are the decision-makers
- Single women must care for their own families.
- School fees payments are the responsibility of both parents.
- Health care costs are taken care of women.
- Women and children fetch water.
- Women collect firewood.
- Women purchase all the food for the household.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Elders decide the use of land with the help of warriors (*morans*).
- Grazing lands are situated near homesteads.
- Land is distributed by the household head.
- Household residence is held and owned by the head (fathers), and single mothers.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women actively participate in group discussions.
- According to tradition, women are typically not allowed to join political groups however education has changed the role of women and they are more frequently allowed to participate.

- Women feel that they are politically besieged and do not have voice in the community.
- There is little empowerment of women in the community so few end up in leadership positions.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women are lonely and neglected, and denied rights by their family and the community.
- They are voiceless politically, are unable to educate and empower their children.
- Single mothers are passed over by political leaders for school fee and bursary support.
- Widows, single mothers and orphans are often neglected. They have to work harder than married women to survive.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- There has been increased awareness of HIV over the past three years, but currently there are no awareness campaigns or programmes in the area.
- Family planning is prohibited in the Ngare Mara culture.
- Healthcare is available for children and adults.
- There has been an increase in HIV cases in the region.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- Women face many challenges such as inadequate water, few water storage facilities, climate change and a lack of extension officers in livestock and agriculture.

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Never		
Goat	Once a week	0,25 kg	
Chicken	N/A		
Beef	Once a month	0,5/0,25 kg	Due to lack of a slaughter house
Milk/yogurt	Daily	1 litre a day	
Rice	Daily	1 kg	
Bush meat	N/A		
Wild plants	variety	Depends on seasons	

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start nursery school at four years old.
- They leave school between 12 and 18 years old because they are orphans, or adolescence, peer pressure, early marriage and drug use.
- Traditional customs also have children herding at a young age.
- Food is short at household levels and there are no school feeding programmes.
- Hopes for the community children include education and job opportunities.
- There is a need for parent support such as counselling, rehabilitation and advice for single mothers and widows. Clothing and food support is also needed.
- Parents also have a desire for their children to take better care of resources.

9. Map to the extent possible/relevant with the group.

Map attached.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Isiolo, Ngare Mara Ward
Meeting Date and Time:	10 November 2018
Meeting Venue/Group:	Ngare Mara Catholic Mission Hall
Facilitator/Documenter:	Halkano Boru/Adan Omar, Halkano Dida
Number Present:	**M:** 15 **F:** 5

1. Contributions/responsibilities to households.

- The young adults of the village have many responsibilities, some of which include looking after animals, carpentry, sand harvesting, bee keeping and charcoal burning.
- They are also involved in farming.
- The run small businesses such as kiosks and *boda boda* (bicycle or motorbike taxis) riding.
- They also organise youth self-help groups.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The youth face many challenges such as insecurity, unemployment and poverty.
- They are educated more than their parent's generation but are held back by the lack of opportunity to put their knowledge and skills into practice.
- They marry well into adulthood since they spend more time studying.
- Children are born in hospital.
- They follow the same traditions as the Turkana community.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth have a positive attitude towards education and employment, but there is no access to technology.
- They are ready to work wherever the opportunities may take them, even far from their home community.
- There are few employment opportunities.

4. General labour force characteristics and job readiness.

- The youths have skills and knowledge as carpenters, plant operators, drivers, electricians, mechanical engineers, hairdressers and caterers.
- They are eager to find jobs and work.

5. Human immunodeficiency virus (HIV) awareness.

- The youths have information about HIV awareness.
- Awareness is conducted through mass media, seminars and maternal health care programmes, and taught at school.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youth respect the decision of traditional elders.
- The elders and traditional authorities solve disputes, and provide guidance and counselling.

- They also give blessings and conduct cleansing and sacrifice ceremonies.
- The elders are the decision-makers in matters concerning marriage, grazing areas and land.
- Elders can be influenced by money in the decision-making process, and values are changing because of money.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Isiolo, Yaq Barsadi
Meeting Date and Time:	11 November 2018
Meeting Venue/Group:	Under a tree
Facilitator/Documenter:	Halkano Boru/Adan Omar, Halkano Dida
Number Present:	**M:** 12 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The roles of the elders has changed over time.
- They are custodians of traditions and customs, and fix dates for community rituals and ceremonies.
- They give instructions and guidelines on various issues.
- They advise the member of the community on what steps to take during difficult times.
- They make major decisions affecting families and the community, and settle any disputes.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are a number of traditional healers in the village.
- Herbs found at Mado Dhula and around Yaqarbarsadhi are used for healing and treating stomach ulcers.
- Traditional healers are valuable partners in the delivery of health services.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are sacred sites and these places are visited during the dry season.
- Elders are custodians of the sacred places.
- There are a number of cemeteries in the project area.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- We have a cemetery and Mado.

5. Important rites of passage (what are they and how are they observed?)

- Circumcision and marriage and naming ceremonies are observed.

6. What should the proponent know about entering a village? How is respect shown?

- The community is an Islamic society.
- The elders will take charge in welcoming foreigners.
- Visitors should respect women and girls.
- Visitors must first consult elders before any engagement.

FACILITATOR OBSERVATIONS

Comment
▪ The community complains about neglect by their chosen leader. ▪ They were receptive to the facilitator and documenter.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Isiolo, Yaq Barsadi
Meeting Date and Time:	11 November 2018
Meeting Venue/Group:	Under a tree
Facilitator/Documenter:	Halkano Boru/Adan Omar, Halkano Dida
Number Present:	21

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women in the community are regarded as housewives, and because there are no employment opportunities, they run their own business.
- They sell goats, cattle and sheep and firewood and charcoal.
- They also sell khat/*miraa* (*miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulant effect).
- From March to April, with some rain there is an increase in animal production.
- During November and December there is little rain which leads to a decrease in animal production.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- The husband is the sole decision-maker in the family
- Money is managed by both husband and wife.
- School fees are paid for by both parents.
- There are no hospitals in Yaq Barsadi. Community members have to walk to Kula Mawe for treatment.
- Women fetch water.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Men own all the land.
- Widows are able to own family land.
- There are no agricultural products in Yaq Barsadi.
- Women and men are both are permitted to own livestock, but men typically manage the animals.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are several women's groups in the area.
- Work is shared among women.
- The culture of the community is a barrier to women participation in some decision-making.
- There has been a perception change in the roles of women over time; women participate freely in politics and are also able to contribute to make their own decisions.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of household?).

- Single women are expected to care for their families with little assistance from the community.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Women have access to family planning.
- Women are educated on maternal issues by the government and other non-governmental organisations (NGOs).
- HIV awareness campaigns are conducted by NGOs, mass media and government health departments.
- However, women do not understand the causes of HIV, nor how to prevent or treat HIV.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- A good diet is food that contains protein, carbohydrates and vitamins.
- Food is stored in granaries.
- Water is stored in drums and tanks.
- The cost of buying food is high, some people can afford only one meal a day.

Product	***How often***	***How much for an average family***	***Other comments***
Fish	Nil		
Goat	After one month	0.5 kg	
Chicken	After one year	1 kg	
Beef	Nil		
Milk/yogurt	Daily	1 litre	
Rice	Daily	1 kg	
Bush meat	Nil		
Wild plants	nil		

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school at four years old.
- Boys and girls frequently leave school around the age of 12 as a result of indiscipline, pregnancy, poverty or with consent of their parents who need them to look after the animals.
- Children look after animals and sell eggs.
- Hopes for the future of the community children:
  - Girl child protection is on the increase.
  - The Kenyan constitution protects children
  - Free education is provided by the government
  - Modern parents' value both boys and girls equally.

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Isiolo, Yaq Barsadi
Meeting Date and Time:	11 November 2018
Meeting Venue/Group:	Under a tree
Facilitator/Documenter:	Joseph Kalapata/Adan Omar
Number Present:	**M:** 6 **F:** 2

1. Contributions/responsibilities to households.

- The youth are responsible for livestock keeping, and the sale of livestock skins, milk and fat.
- Salt lick is harvested from the Magado crater and sold to local markets.
- They also sell local building materials. (wood poles) for local house construction.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Most of the young men in the community have few opportunities due to unchanging traditional customs. This has resulted in the young adults being dependent and having to follow the guidance of their parents.
- Early marriages and pregnancies have decreased.
- All possessions belong to the parents.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth in Yaq Barsadi have moved north to seek employment even though they do not have enough education since they are limited education institutions in the area. Some schools only teach up to Form 4.
- The youth would like to have jobs but there are no opportunities even for casual work.
- There is also segregation by employers during interviews and recruitment.

4. General labour force characteristics and job readiness.

- The youth are ready to be employed but there are no opportunities. Many young adults have migrated to Isiolo, Meru or Nairobi for opportunities.

5. Human immunodeficiency virus (HIV) awareness.

- HIV awareness level are high because the ministry of health has informed communities and created awareness.
- The Boran culture also is strong; Islam discourages young adults to renounce drug abuse and promiscuity.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The young men of Yaq Barsadi participate actively in politics.
- During elections they join different political parties.
- Traditional decision-makers are strongly involved.
- The youth are paid to campaign for their chosen party and party leader.
- Elders are hired to declare election results.
- The traditional authority is usually split between the clan and community selections.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Isiolo, Boji
Meeting Date and Time:	13 November 2018
Meeting Venue/Group:	Boji Primary School
Facilitator/Documenter:	Halkano Boru/Adan Omar, Halkano Dida
Number Present:	20

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women buy and sell livestock.
- Women are self-employed and run shops selling groceries and *khat/miraa* (*miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulant effect).
- They also sell milk, firewood, gum Arabica and charcoal.
- From March to April during the rainy season, there is enough milk, a decrease in animal disease, and the livestock are grazed close to Boji, increasing their market value.
- During November and December, there is little rain, inadequate milk and an increase in animal disease. Livestock are grazed far from Boji, decreasing their market value.
- There are no employment opportunities for women.
- Girls are married at a young age. They are not educated.
- Women are typically regarded as housewives and are responsible for the grocery shopping.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- The husband is the sole decision-maker in the family.
- Family members make decisions after consulting the head of the household, the husband.
- Money is managed by both husband and wife.
- School fees are paid for by both parents.
- There are no hospitals in the area for maternal care.
- Mothers with complicated pregnancies are referred to hospitals in outlying area which leads to high health cost.
- Women and girls fetch water.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Men own all the land.
- There are no farms or agriculture produce in Boji.
- Livestock is owned by both husband and wife.
- The husband has a management role.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Different women groups exist in Boji.
- Women participate in political decision-making.

- Work is shared among the community women; they help in social gatherings by cooking, and fetching firewood and water.
- Perceptions of a woman's role is changing over time as many more girls attend school. Women are also now actively involved in politics and decision making. They can manage family resources after the death of their husband.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?).

- The clan takes care of single women.
- Single women are given first priority for donations and support.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Women have access to family planning.
- They do understand the causes, prevention and treatment of HIV but more education is needed. HIV awareness programmes are less frequent.
- Health care for children and adult is needed.
- Infant and maternal mortality is high due to a lack of proper healthcare.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- There is inadequate food for pregnant mothers.
- Pregnant mothers cannot afford a balanced diet.
- A good diet is food that contains protein, carbohydrates and vitamins.
- Boji women do not have enough food for storage.
- Water is scarce in Boji, and there are no storage facilities.

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Nil		
Goat	3 days a week	0.25 kg	
Chicken	A month	1 kg	
Beef	Yearly	0.5 kg	
Milk/yogurt	Daily	2 litres	
Rice	Daily	1 kg	
Bush meat	Nil		
Wild plants	seasonal		During the rainy season

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school at 4 years.
- Boys and girls leave school at 12 years.
- Boys drop out of school because of drugs especially *miraa (khat)* and *bhang* (an edible preparation of cannabis).
- Girls drop out of school because of forced marriages and early pregnancies .
- Children are responsible for fetching water and firewood, herding and poultry keeping.
- Parents hope for their children include a quality education and employment.

9. Map to the extent possible/relevant with the group.
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Isiolo, Garba Tula
Meeting Date and Time:	14 November 2018
Meeting Venue/Group:	Garba Tulla Social Hall
Facilitator/Documenter:	Halkano Boru/Halkano Dida, Adan Omar
Number Present:	**M:** 7 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The roles of the elders has not changed.
- They are responsible for conflict mediation and resolution, and solve land disputes and community disagreements.
- They control grazing patterns of the community.
- They are gateway into the community.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the community, they use natural resources.
- Honey, roots and leaves are used to treat malaria, diarrhoea and vomiting.
- They are paid for their services.
- They collect these resources from nearby places in areas along the pipeline route.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Yes, the site is frequently visited by elders during drought to offer sacrifices.
- Elders are responsible for the site.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- Yes. Harr Buyo.

5. Important rites of passage (what are they and how are they observed?).

- Elders take charge during the rite of passage. During the rainy season, young boys are taken to Harr Buyo for circumcision.
- Naming ceremonies are carried out within the homesteads.

6. What should the proponent know about entering a village? How is respect shown?

- Garba Tulla is an Islamic society.
- The proponent should consult with the elders first. They are the gateway to the community.
- They should respect local culture and norms.
- Men should respect women and girls in the community.

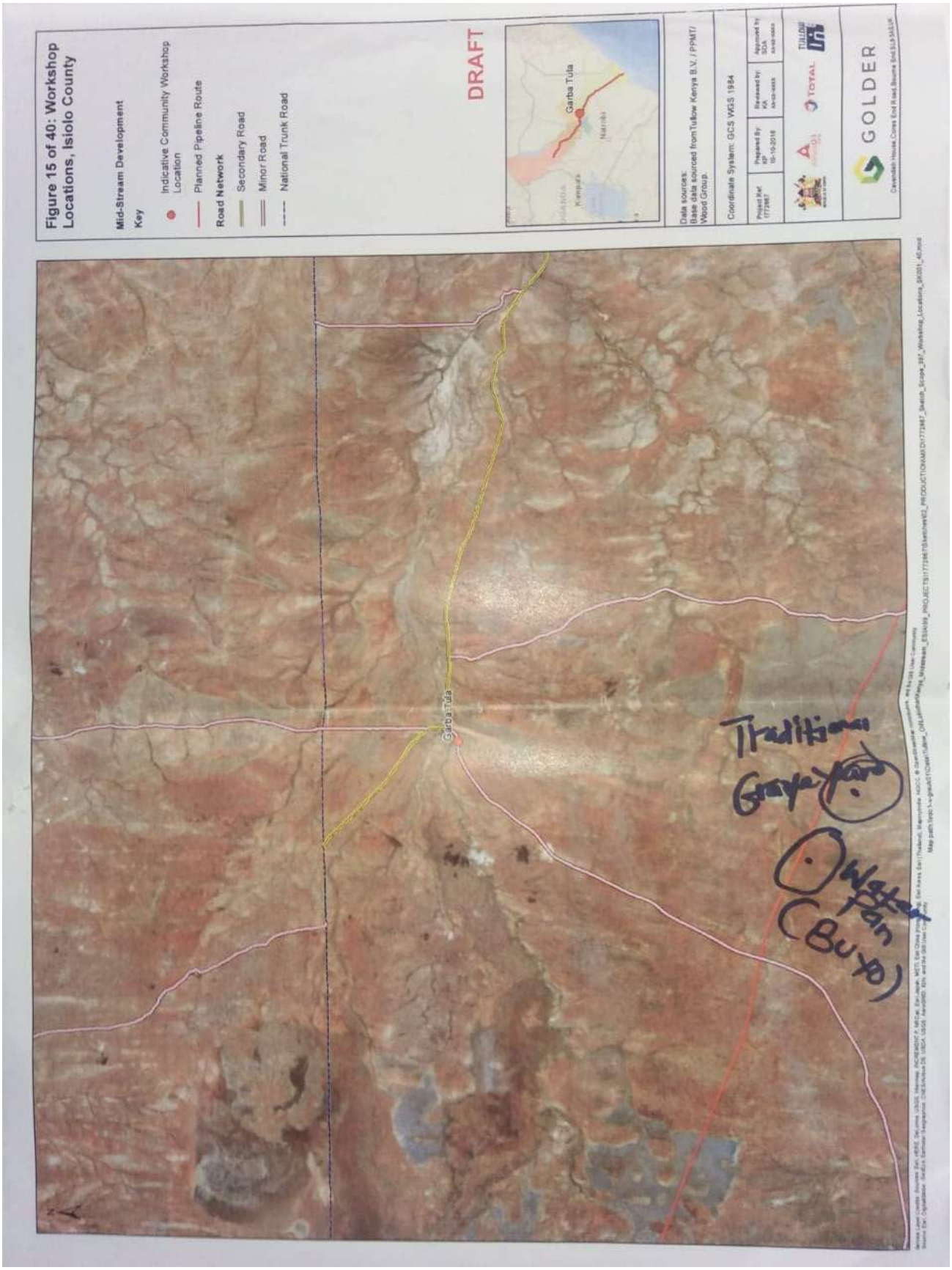


Figure 15 of 40: Workshop Locations, Isiolo County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
Road Network
Secondary Road
Minor Road
National Trunk Road
DRAFT
Garba Tula
Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group.
Coordinate System: GCS WGS 1984
GOLDER
Garba Tula
Traditional Graveyard
Water Pan (Buyo)

FACILITATOR OBSERVATIONS

Comment
▪ The community are hospitable and well-organised. ▪ They need more awareness on LAPSSET components.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Isiolo, Garba Tula
Meeting Date and Time:	14 November 2018
Meeting Venue/Group:	CDF Hall
Facilitator/Documenter:	Halkano Boru/Adan Omar, Halkano Dida
Number Present:	22

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Typical economic activities for the women in the community includes shop keeping and the selling of livestock, groceries, milk, kerosene and tobacco.
- They also provide tailoring services.
- They sell *khat/miraa* (*miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulant effect).
- From March to April, during the rainy season, the livestock graze around Garba Tulla, and their market value increases.
- During the months of November and December rains are few and the livestock graze far from Garba Tulla, decreasing their market value.
- There are no employment opportunities for women.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.),

- Husbands are responsible for making decisions.
- Both husband and wife manage the household money, and paying school fees and medical costs.
- Women fetch water.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Land is community owned.
- There is no agricultural produce in Garba Tulla.
- Livestock is family owned.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Cultural traditions are a barrier to women's participation.
- There have been changes in the perception of women's roles in the community.
- Women are more involved in decision-making, and are politically active.
- Females may go to school.
- They also cook food, and fetch water and firewood.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?).

- Single women provide for their family.
- They are cared for by their clan, and prioritised for support.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- The women of Garba Tulla understand the cause, prevention and treatment of HIV.
- Healthcare for children and adults is needed.
- There is a high rate of maternal deaths due to improper healthcare.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- A good diet is one that contains protein, carbohydrate and vitamins.
- Food is stored in houses.
- Water is stored in pots and jerry cans.

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Nil		
Goat	2 days per week	0.25 kg	
Chicken	Yearly	1 kg	
Beef	Once a week	0.5 kg	
Milk/yogurt	Daily	2 litres	
Rice	Daily	1 kg	
Bush meat	Nil		
Wild plants	Nil		

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school at four years.
- Boys and girls leave school at 12 years.
- Girl drop out of school because of poverty, early marriage and early pregnancies.
- Children are responsible for herding and keeping poultry.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Isiolo, Garba Tula
Meeting Date and Time:	14 November 2018
Meeting Venue/Group:	Garba Tulla Social Hall
Facilitator/Documenter:	Halkano Boru/Adan Omar
Number Present:	**M:** 7 **F:**

1. Contributions/responsibilities to households.

- The youth are income earners in the household, and support their weak parents and the aged.
- They are responsible for the safety of the community.
- They look after livestock.
- Females cook for the household and fetch water.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- In present times, the youths marry late unlike in the past when they married young or were betrothed at a very young age.
- The child mortality rate is lower than in previous years.
- Children are born in hospital,
- Girls are no longer circumcised as a traditional rite and parents are being discouraged to follow this practice.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The local education system is poor.
- Poverty has led to a large number of school dropouts.
- Poor and needy students are given very little support in Garba Tulla.
- The high rate of unemployment leads to increased conflict in households and crime within the community.
- The youth use drugs.
- There is a sense of hopelessness among the youth.
- They are moving to other towns in search of employment.

4. General labour force characteristics and job readiness.

- There is high rate of unemployment.
- Corruption and nepotism are common and youths are unable to secure jobs.
- Few vacancies in the area because of marginalisation.
- The youth are eager to work, but there is a feeling that unless corruption levels fall, they will not secure jobs easily.

5. Human immunodeficiency virus (HIV) awareness.

- The rate of HIV awareness is very low.

6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ The youth are not recognised by political leaders and or the council of elders. ▪ They are not represented well in political or social circles. ▪ Hopelessness and poverty lure them to easy money.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Meru, Meru Town
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Alba Hotel
Facilitator/Documenter:	Dominic Mwireri/Dennis Murega
Number Present:	**M:** 1 **F:**

1. Contributions/responsibilities to households.

- The youth have direct and indirect responsibilities to their households, for instance parenting, paying rent and school fees.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- They are more exposed to business opportunities.
- They face constraints such as a lack of capital and skills.
- The marrying age for girls differs according to location, e.g. in Tigania girls are married at a young age.
- The average age for giving birth is 22 years old.
- The community traditions and culture are observed, e.g. circumcision.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- There is a negative perception amongst the youth towards education and employment, because even though they are educated they remain unemployed.
- Technology is easily accessible.

4. General labour force characteristics and job readiness.

- The labour force are committed and find manual labour easily. They are well-rewarded.

5. Human immunodeficiency virus (HIV) awareness.

- Young adults are aware of HIV, but they do not act on the information provided.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youth are involved in politics, but their decisions are greatly influenced by politicians who ply them with money and gifts.
- They do not participate in social forums.
- Their values are frequently linked to money in the form of older men and women who lavish them with money or gifts in return for company or sexual favours).

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Meru, Kaichuru

Meeting Date and Time: 31 October 2018

Meeting Venue/Group: Mantile hall

Facilitator/Documenter: Lilian Kathure/Caroline Gatwiri

Number Present: **M:** 8 **F:**

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted).

- The community typically farm maize, beans and peas. Planting and harvesting is carried out twice a year. Land preparation begins in February, planting is done in March and in June harvesting for the first part of the year takes place.
- The next preparation begins in August to mid-October, planting is done in October and November and harvesting usually takes place in January and February.
- After harvesting, the products are sold or exchanged for children's school fees at the local schools. There are no processing facilities in the area to process agricultural products.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans	20,90 per kg bag	1 acre of land	Around 15 bags	February and August	KSh 8 000 per bag	KSh 10 000 per bag
Cassava						
Peas	6, 90 per kg bag	1 acre of land	100%	February and August	KSh 6 000 per kg	KSh 10 000 per bag
Maize	25,90 per kg bag	1 acre of land	About 75%	February and August	KSh 3 000 per bag	KSh 4 000 per bag
Yam						
Rice						
Leafy greens						
Cash crops						

3. Rotational system description, years in and out of cultivation, rotation of what crops?

- It is difficult to practice rotational cultivation as for some of the land products are the only source of income. The cultivation is all year round with harvesting twice a year.
- Only maize, beans and peas are rotated; and sometimes they are mixed up.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix).

- Manure from livestock is used as fertiliser for beans, maize and peas, and tractors are hired to till the land. The farmers buy the seed, but seed is also sometimes provided by the government.
- Labour is provided by family members and occasionally other people are hired to work on the land. Farmers buy pesticides in the neighbouring town.

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Children inherit land from their parents. Presently males and females may inherit land resulting in a shortage, thus community members wishing to own land are forced to buy plots.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- Most of the livestock is indigenous and herding takes place throughout the year in the same area. More pasture is available during the rainy seasons.
- There is no communal herding land and farmers herd on their own land.
- Sale of livestock is mostly in January to raise funds for school fees or to set aside funds for emergencies.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.).

- Farmers are unable to farm on a large scale because they do not own enough land. Some farmers rent land, but this is expensive rates. The poor rainfall is also a challenge and the soil quality can only accommodate certain types of crops.

8. Family labour distribution for agriculture and livestock activities – use matrix.

Activity (confirm activities with participants first)	Adult male	Adult female	Child male	Child female	Aged
Clearing					
Other land preparation	X	X			
Planting	X	X			
Weeding	X	X			
Harvesting	X	X			
Post harvesting processing	X	X			
Herding	X		X		

9. Available extension services (government, non-government organisation) for agriculture and livestock, quality.

- Farmers have received training and extension services from the ministry of agriculture and a non-governmental organisation known as Samaritan Purse.

10. Map to the extent possible/relevant with the group.

Map attached.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Meru, Kaichuru
Meeting Date and Time:	31 October 2018
Meeting Venue/Group:	Mantile Hall
Facilitator/Documenter:	Domnic Mwirigi/Dennis Murega
Number Present:	**M:** 5 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elders are responsible for maintaining peace, and settling family and clan disputes.
- They also settle business disputes.
- Their roles have changed since they are have more support from the formal authorities.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers and medicine men in the community.
- They use natural herbs from the surrounding area.
- They are compensated with cash or in the form of livestock such as goats.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- The only sacred site is *Igembe* which is surrounded by trees and large stones.
- Natural minerals are also found in *Igembe*.
- The place is protected by nature and occupied by human beings and animals.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- Igembe is near the pipeline as shown on the map but the distance cannot be accurately approximated.

5. Important rites of passage (what are they and how are they observed?)

- Boys are circumcised and the ceremonies conducted during different seasons.
- Traditional and modern marriage practices are observed. Camels and cows are given in exchange.
- To be part of the *Njuri Ncheeke* (the supreme governing council of elders for the Meru people) an elder must prepare a ceremony.

6. What should the proponent know about entering a village? How is respect shown?

- The proponent must build a relationship with an elder to get a clear insight of typical life within the community.
- Appreciation tokens can be given by offering a goat or cash and this is taken as a sign of respect.

FACILITATOR OBSERVATIONS

Comment
▪ Four clans co-exist, the Meru, Borana, Somali and the Kikuyu.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Meru, Kaichuru
Meeting Date and Time:	31 October 2018
Meeting Venue/Group:	Mantile Hall
Facilitator/Documenter:	Dominic Mwirigi/Dennis Murega
Number Present:	**M:** 19 **F:**

1. Herding activities (Use seasonal calendar).

- Herding takes place in the months of January, February, March, April and May at Ngutu, Lumbine, Kaichiuri, Saba, Ndumuru, Makinya and Katicha.
- In months of June, July, August, September and October herders move approximately 20 kilometres to the areas of Kirina, Lumbune, Mbitine, Magutu, Migombe, Ithata, Njerune, Linkurungu.
- The herders take their animals all year round to Mbijiri, Satija, Kajajabu, Kiliwe, Tabasiti, Kuhaya, Sitacho, Ladaro, Ntoricha, Garbatana, Buresukira and Hera.
- Herding activities also take place between June and December in the areas around Benjeere, Kubiaji, Kasabamba, Bada Bamba, Bogasanu, Kaboge, Albore, Baru, Uxure, Bariji, Bardera and Kabute.
- Grazing areas can be found at Galdima, Topesi, Mataba, Dakari, Dakarika, Njaro, Dera, Kumbini and Lakuriko.

2. Requirements for water, when, from where, in what quantities per animal.

- The main sources of water are Magado springs, the Barajadi and Gachuru boreholes and Waso and Chapa springs.
- One cow requires approximately 80 litres per day.
- A camel drinks 120 litres per day.
- One goat needs 15-20 litres per day.
- A donkey drinks around 60 litres per day.

3. Economics: average herd size.

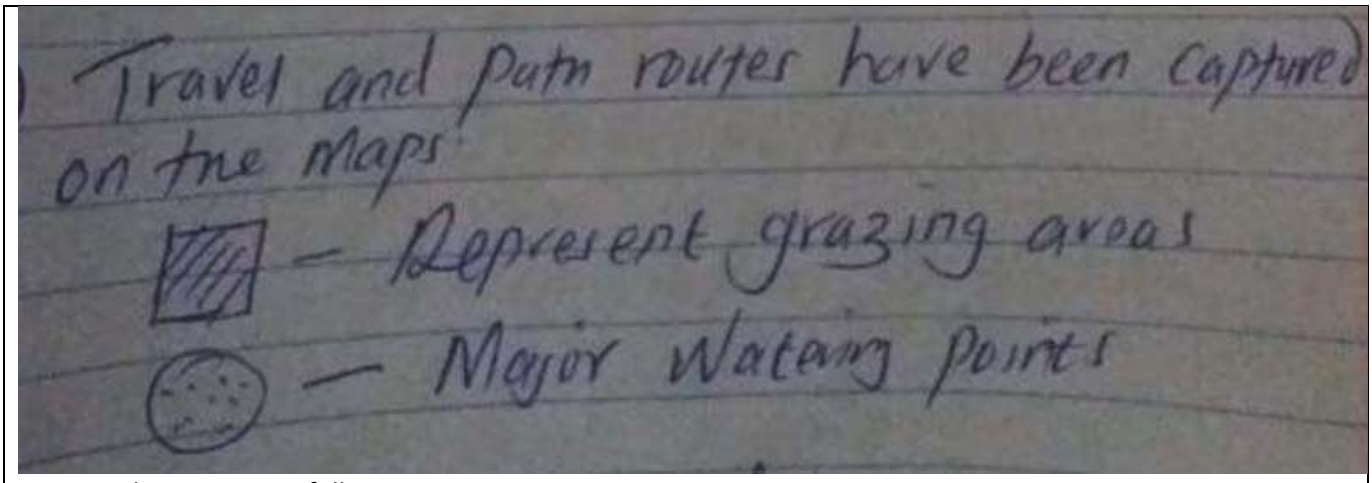
- The average herd comprises 500 goats and sheep, 200 cows, 700 camels and between 10 to 20 donkeys.

4. Extension services; veterinary services.

- Minor extension services like deworming are carried out by herders.
- In serious cases veterinary government veterinary offices are called.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

- Travel and population routes have been captured on the map.



- Travel routes are as follows;
  - Kaichiuru – Magajo
  - Biriki – Magajo
  - Goto – Magajo
  - Laharangilna- Magaji
  - Bruno – Magajo
  - Garderra – Njeruene – Magajo.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- Temporary homesteads are located in Magajo, Liabure, Garderra, Burechawitu, Birigidera, Njerune, Ruungo rwa Mburia and Kangatune.

7. Travelling in what size of group? Are these family or lineage groups?

- An average of 70 people will travel together.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Tilapia fishing takes place at Ewaso.

9. Groups representing pastoral groups. Mandate, range management, etc.

- There are no groups representing pastoral groups.

10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)

- The herders are concerned about noise pollution and animal injuries during construction.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Meru, Kaichuru
Meeting Date and Time:	31 October 2018
Meeting Venue/Group:	Mantile Hall
Facilitator/Documenter:	Lilian Wathure/Caroline Gatwiri
Number Present:	10

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The dominant economic activity for women in Kaichiuru is the running of small businesses like such as buying and selling of *miraa* (*khat*), which is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulant effect.
- They sell firewood and charcoal (from dried trees as freshly cut trees cannot be used due to government ban), and perfume from the Dakar tree.
- The also run small-scale shops and hotels.
- The women wake up early and spend the morning cooking and doing house chores. They are open for business in the afternoon and they can close up as late as midnight especially in the case of *miraa* sellers.
- Their pattern of activities is similar throughout the year although sales and prices of some items can be affected by rains. Employment opportunities are limited as women can only engage in small businesses.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Men are the decision-makers and determine how money is spent.
- Women can only manage money with the consent of their husbands.
- The women carry out household chores like carrying water and cooking.
- Single mothers make their own decisions.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Land owners are predominantly male; women do not possess land. Livestock is also owned by men as are most assets including household items. This is in the case of married women.
- Women in business own their products e.g. *miraa*.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women groups exist to empowering fellow women.
- They are allowed to participate in political activities e.g. voting and also campaigning for their preferred candidate.
- They are not involved in the making of decisions that the community as the elders are predominantly male.
- Culture is still a challenge to women involvement although the women are encouraged by changes since they are now consulted on community issues (however, they cannot still make final decisions).

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- There is no stigmatisation towards single mothers.
- But they receive no help and are self-reliant when it comes to providing for their families.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- A dispensary is located in the area where women access information and services for family planning.
- Mobile clinics e.g. the 'zero campaign' visit once a month and offer counselling and awareness on HIV.
- They also provide nutrition supplements
- The challenge to healthcare is during emergencies and serious cases; there are no nearby facilities to handle serious health issues.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- There is no access for fresh farm products as the markets are far (Isiolo and Mutuati).
- Vegetables or fruits are rarely eaten as they can only be purchased when an opportunity presents itself.
- Common food is rice and potatoes.

Product	***How often***	***How much for an average family***	***Other comments***
Fish	Never		No access to such
Goat	Once a week	1 kg at 400 shillings	It is expensive
Chicken			
Beef	Rarely		Can only be accessed in neighbouring towns
Milk/yogurt	Seasonal (when it rains)	1 litre at 60 shillings	
Rice	Almost daily	1 kg at 120 shilling	Easy storage
Bush meat			Prohibited by gout
Wild plants			None in the area

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school is at the average age of five years old.
- Completion of primary school is at usually at 12 or 13 years old.
- Most children do not complete school and leave due to a lack of school fees; there is also no secondary school in the area.
- When girls leave school, they often marry; boys get jobs such as fetching firewood for sale.

9. Map to the extent possible/relevant with the group.

Map attached.

FACILITATOR OBSERVATIONS

Comment
Arising matters or concerns: ▪ Poor communication network in the area. ▪ There is no electricity. ▪ Safety and security are serious concerns. ▪ Access to the nearest town is limited due to poor roads. ▪ Water is scarce. ▪ There is no secondary school in the area.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Meru, Kaichuru
Meeting Date and Time:	31 October 2018
Meeting Venue/Group:	Mantile Hall
Facilitator/Documenter:	Lilian Kathure/Caroline Gatwiri
Number Present:	**M:** 9 **F:**

1. Contributions/responsibilities to households.

- The young men are involved in herding and farming.
- They are employed to harvest and transport harvests to market.
- They make up and sell hardcore and ballast for building.
- Some are engaged in selling of *miraa* which is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Life is more challenging for the modern youth as rainfall patterns have changed thus affecting earnings from economic activities like farming and herding.
- Previous sales of *miraa* was a viable economic activity but the ban in international markets has deprived the modern youth of the benefits their parents had.
- Traditional rites are conducted earlier since the education system makes children more mature.
- Young men marry much later as the payment of dowry is a challenge for the unemployed youth.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- There is little emphasis on education and most young people drop out of school to pursue business.
- Some have moved to towns to look for jobs, but choices are limited as there is little access to information concerning employment.

4. General labour force characteristics and job readiness.

- Most of the youth can only provide unskilled labour and are available when such opportunities are presented.

5. Human immunodeficiency virus (HIV) awareness.

- They are informed on HIV prevention, causes and management.
- Non-governmental organisations such as the 'Samaritan Pass' have carried out awareness campaigns.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- Youths are involved in political activities such as campaigns but seldom get elected as they have little funds to run a costly campaign.
- The older men are recognised as the elders and decision-makers.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Meru, Mutuati
Meeting Date and Time:	1 November 2018
Meeting Venue/Group:	Mutuati Catholic Social Hall
Facilitator/Documenter:	Lilian Kathure/Caroline Gatwiri
Number Present:	**M:** 6 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

- Between the 17th and 19th centuries, people stayed at Awathi.
- In 1974, the first chief, chief Mtuati, was elected.
- There was a severe famine around 1984, and many animals died.
- In 1992 the community had their first district officer.
- In 1997 they were affected by the long El Niño rains.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- The land is owned individually by residents through title deeds.
- They own from an average of one acre to large chunks of lands.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed?).

- There is no communal land.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Economic activities include farming and herding.
- Plans are in place for public institutions and a hospital.
- The community face safety issues because the town is bordered by hostile communities.
- Other challenges include a poor road infrastructures and few social amenities.

5. Current ongoing village initiatives, what is the progress.

- Currently initiatives include the drilling of new boreholes and the construction of a new road infrastructure, a dispensary, schools and police stations at Kachiuru and Maatati.

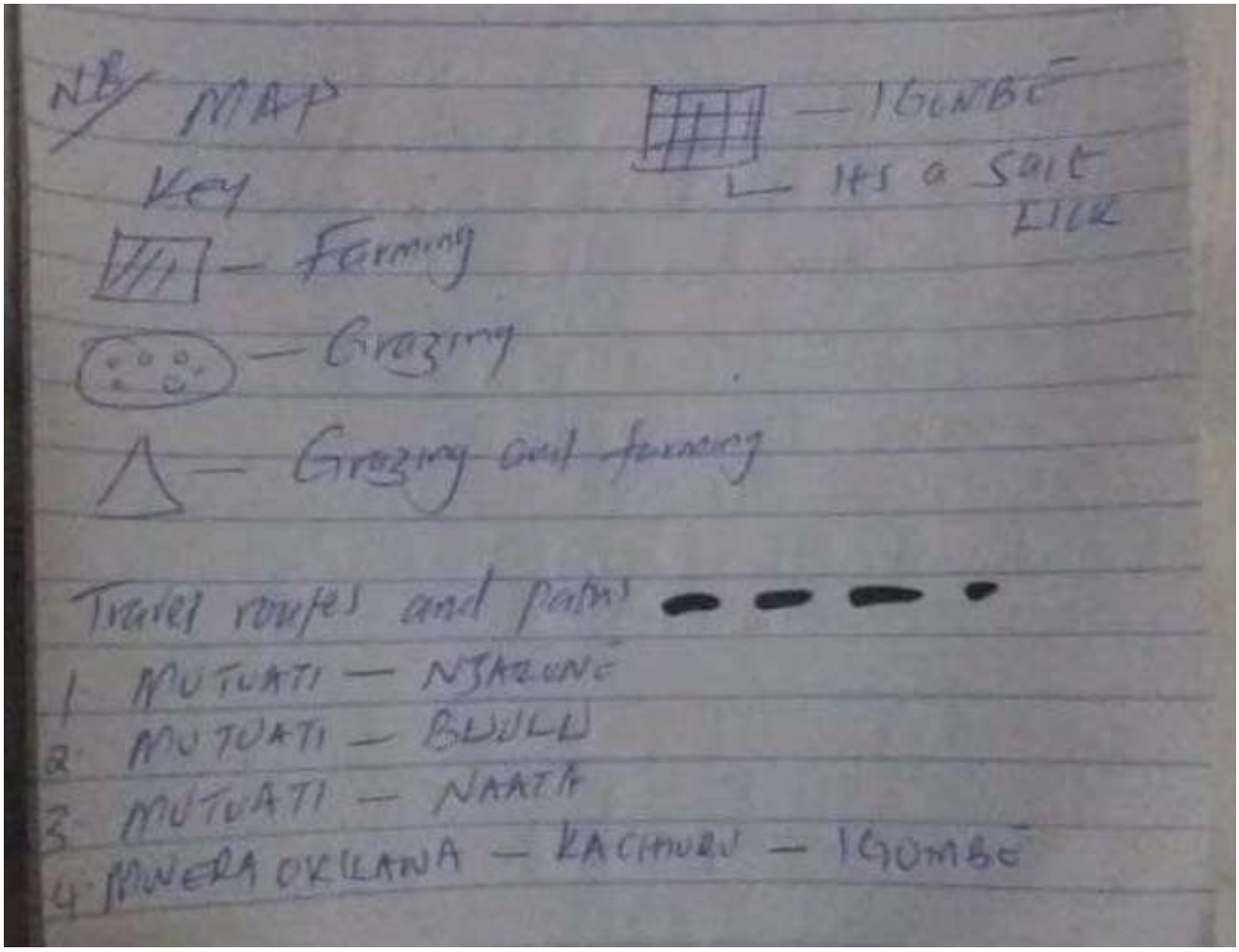
6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

- Village revenue includes sand harvesting at Ndunguru and Mzalendo, and *Miraa* sales (*miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect).
- The village administrators also issue business licenses for shop ownership.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).
▪ The community men participate more in public forums than women. The women typically participate in social groups. ▪ Women face time constraints as they are frequently busy with domestic chores.
8. Request for village statistics if available

Statistics available at the county level

Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in migrants	


NB/ MAP
Key
— IGUMBE
— its a salt lick
— Farming
— Grazing
— Grazing and farming
Travel routes and paths
1. MUTUATI — NJAKUNE
2. MUTUATI — BULLU
3. MUTUATI — NAATA
4. MWERA OKILANA — KACHURU — IGUMBE

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Meru, Mutuati
Meeting Date and Time:	1 November 2018
Meeting Venue/Group:	Mutuati Catholic Social Hall
Facilitator/Documenter:	Dominic Mwirigi/Caroline Gatwiri
Number Present:	**M:** 11 **F:** 2

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The main role of the elders is to maintain law and order, solve disputes, and counsel and advise community members on community issues.
- They maintain traditions of the community such as guarding shrines and ritual sites.
- The role of elders has not been affected by time, there has been little change.
- Elders make decisions on behalf of the community and also settle land disputes.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- The traditional healers in the community heal using medicines from herbs, shrubs and trees. They are compensated with money or livestock.
- The herbs are harvested from the forests in the area.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Scared sites are present such as Buru shrines and Ndumulu sacred sites. This is where elders meet and carry out rituals on behalf of the community.
- The sites are surrounded by natural salts (*mwonyo*) and herbs. Pregnant women and animals feed on these natural salts. There are also large rocks for praying.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- There are sacred shrines at Igembe. At Ndumuru and Buru sacred sites used for rituals and prayers are present. These sites are taboo and should not be visited by individuals that are not among the elders of Mutuati.

5. Important rites of passage (what are they and how are they observed?)

- Circumcision, marriage and becoming an elder are part of rites of passage for the people in these communities. One cannot be accepted as a community member without passing through these rites.
- Some of the rites such as circumcision are now carried out in hospitals using modern equipment.
- Marriage rites have not so much changed, dowry is still paid in the form of honey, *miraa* and goats.
- For one to join the council of elders i.e. Njuri Ncheke, the person must be responsible, hold high values of the community, be disciplined and of high integrity.

6. What should the proponent know about entering a village? How is respect shown?
▪ A visitor needs to be introduced to the community by a known community member. A visitor needs to make his or her intentions known to the community. They should offer greetings and, on their stay, respect the value of the village. ▪ Clans present include: I. Muchi Mutene II. Muchi Umwiru III. Antu a mwari ▪ The clans require houses to hold their historic artefacts and records concerning their clans. ▪ The three clans use the shrines sites that are taboo for people to visit. The shrines are historic sites which hold the cultural practices of the community.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Meru, Mutuati
Meeting Date and Time:	1 November 2018
Meeting Venue/Group:	Mutuati Catholic Church Hall
Facilitator/Documenter:	Lilian Kathure/Dennis Murega
Number Present:	10

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women typically prepare breakfast and prepare their children for school between 05h00 and 07h00.
- Around 07h00 they fetch water and firewood and collect animal feed.
- Daily economic activities include fetching firewood for use and selling, gathering animal feed, agricultural farming and businesses.
- From 17h00 to 21h00 they prepare and eat the evening meal.

Seasonal calendar:

- January to February – harvesting of beans and potatoes
- February to March - harvesting of millet, maize and sorghum
- March – tilling and land preparation
- April – planting season
- May – weeding season
- June to July – weeding and harvesting season
- August – harvest of black beans
- September to October – land preparation and planting season
- November to December – weeding season

2. Characterisation of household roles (who is responsible for decision-making, money management, school fees and health costs, water carrying, etc.).

- The men make family decisions.
- Both women and men make decisions on money depending on who has the money.
- School fees are paid for by women and men.
- Hospital bills are paid for by both.
- Fetching water is done by women.

3. Ownership of land use rights, agricultural product, livestock, other assets

- Both women and men have equal rights to land ownership.
- Men own most of the livestock, but agricultural produce is owned by both men and women.
- *Miraa* (a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect) is managed and owned by men.
- Banana trees are owned by women

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women are organised in groups, and they participate freely in political decisions.
- The practice table banking where they buy water tanks for one another.
- Discrimination of women bans them from participating in leadership roles.
- Equality and gender roles are not observed. Men are deemed as superior to women.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- There are a few single women in the community.
- They are typically discriminated against especially when competing for leadership roles.
- The property of a widowed woman is sometime taken over by the family of the late husband leaving the woman with nothing.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- The women in the community have knowledge of family planning which is always done by the community health volunteers. This was started in 2012.
- There is accessibility to health services in the following dispensary and hospitals:
  - Mutuati public hospital
  - Nakuriu dispensary
  - Mwera Omutuwa dispensary
  - Kuirumu dispensary
  - Leeta dispensary.
- People are affected mainly by tuberculosis.
- Poverty in the area is the main contributor to a poor diet.
- The community is aware of HIV. They shared that the major cause of the infection is not using condoms, unfaithfulness in marriage and having multiple partners.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Once in a while	½ kg	Eat occasionally
Goat	1 a week	1 kg	Cost them KSh 200
Chicken	1 a week	1 kg	Eat occasionally
Beef	Daily	1 kg	Cost them KSh 200
Milk/yogurt	Daily	1 litre	Cost them KSh 60
Rice	3 a week	1 kg	Cost them KSh 90
Bush meat	Once in a while	-	Free
Wild plants	Once in a while	-	Free

Documenter's observation:

- A good diet comprises of protein, carbohydrates, lipids and vitamins.
- The community do not have sufficient water boreholes.
- The have insufficient water tanks due to the high cost of water tanks.
- The poverty level of the area is high.

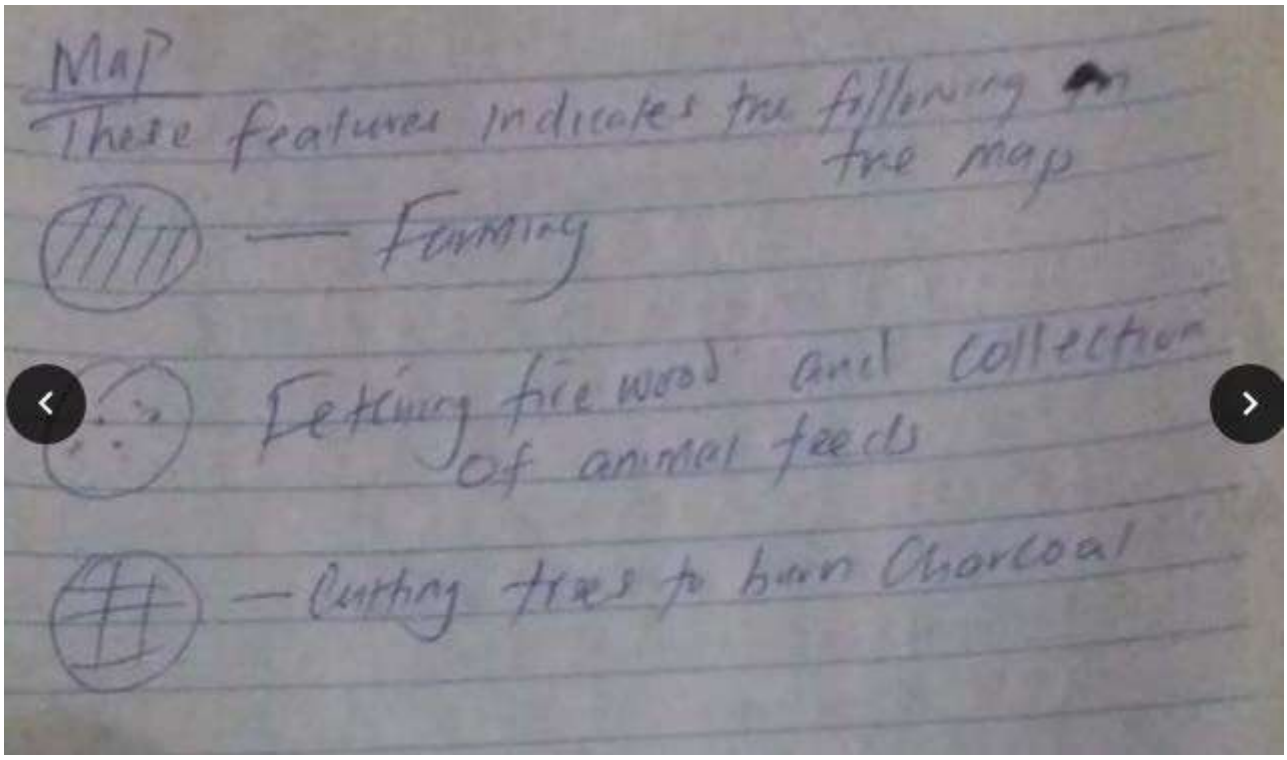
- Cattle rustling by a neighbouring hostile community is common.
- The community also face issues brought as a result of drought such as lack of food and animal deaths.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- Children start school between four to five years old. They finish primary school around 13 years old to join secondary school and finish there between the age of 17 and 20 years old.
- Most of those that go to university join at the age of twenty and older.
- There is high number of school drop outs. This could be due to a lack of food, no electricity for studying, poor living conditions, early pregnancies and drug abuse (especially the chewing of *miraa*).
- Boys from poor homes leave school to seek employment opportunities such as herding.

9. Map to the extent possible/relevant with the group

KEY



PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Meru, Mutuati
Meeting Date and Time:	1 November 2018
Meeting Venue/Group:	Mutuati Catholic Church Hall
Facilitator/Documenter:	Dominic Mwirigi/Caroline Gatwiri
Number Present:	**M:** 20 **F:**

1. Contributions/responsibilities to households.

- The youth provide food for the family, work and earn on behalf of the family. They also provide security for the family by saving.
- They farm and sell the products for profit.
- Due to the barrenness of the area, some engage in small business and casual jobs to provide for the family.
- Some are herders and others provide security to the herders.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- In the past, there was no value for education but that has since changed as people strive to educate their children.
- Rites of passage such as circumcision were done on an open fire using traditional instruments but presently it is conducted in hospitals.
- When it comes to marriage, partners were selected by the parents, but currently young people choose who and when to marry.
- Marriage before was meant for those who had matured i.e. 18 years and older, but under-age marriages have since increased.
- People eat more processed foods.
- Communication and transport have improved. People no longer walk for long distances.
- The community no longer practises female circumcision.
- The youths in the Igembe were considered violent people but this has since changed.
- They now have access to modern health care hence they no longer have to depend on traditional medicines.
- The population has increased significantly over the years. This has led to land scarcity hence inheritance of land from parents is slowly disappearing.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Education is the only way to access knowledge and facilitate employment. The majority of the youth own smart phones and are well-versed with knowledge on information and technology.
- Most of youth migrate to other parts of the town in search of job opportunities.

4. General labour force characteristics and job readiness.

- Most employed community members are females. The youth have skills in plumbing and driving and some are skilled in information technology, education, community health and clinical professions.
- Almost 98% of the youth are jobless. They would like to start their own business but lack capital.

5. Human immunodeficiency virus (HIV) awareness.
▪ The majority of young adults are aware of HIV causes and prevention. However, drug abuse is common and said to lead to irrational decisions that may lead to HIV infection in many youths. ▪ Publicity on HIV from the government agencies has decreased so the younger members of the community are uninformed about HIV.

6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ Youths are active in politics. Some are members of political parties, some are even at executive levels. ▪ They are involved in campaigns, and also participate in social events like weddings and fundraising for community members that are in need of medical help. ▪ They belong to musical bands and football clubs such as Kangwira FC, Nathu United Spurs, Kandone Green Eagles and Mutuati United, Amburu FC, Lecta FC, and Kathanga FC among others. These clubs lack uniforms and equipment such as balls and nets.

FACILITATOR OBSERVATIONS

Comment
Arising issues: ▪ Unemployment of youths even though they are qualified. ▪ Lack of talented academics. ▪ Lack of technical institutions to train the youth. ▪ Lack of psychosocial support from the government. ▪ Lack of equality in projects sharing with adults and elders. ▪ Scarcity of water.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Meru, Laare

Meeting Date and Time: 2 November 2018

Meeting Venue/Group: Victoria Ridge Hotel

Facilitator/Documenter: Dominic Mwirigi/Dennis Murega

Number Present: **M:** 3 **F:** 6

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted)

- January – harvesting beans and potatoes
- February – harvesting of maize
- February to March – land preparation
- April – planting and weeding
- May – second round of weeding
- June to July – harvesting of potatoes, maize, peas and green grams
- August – land preparations
- September – planting season
- October/ November – weeding
- December – January - harvesting

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans	10-14 bags	Per acre	80	February, March	50 per kg	60 per kg
Cassava						
Peas	10 bags	Per acre	80		80 per kg	
Maize	25 bags	Per acre	80	March, February, September, August	25 per kg	30 per kg
Yam						
Rice						
Leafy greens						
Cash crops						
Cow peas	7-8 bags	Per acre	90		80 per kg	100 per kg

*Miraa**	100 kg per month	Per acre	100	All months	3 000	5 000

* *miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect).

3. Rotational system description, years in and out of cultivation, rotation of what crops.

- During March and April, maize, black beans and sorghum are grown.
- In September and October, beans, cow peas and potatoes are grown.
- Lands are left idle for a period of time (a season) to increase soil fertility.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertiliser, water, labour from outside the family, pesticides – may need a matrix)

Crop	Inputs	Pesticides	Labor	Seed Type
Maize	DP fertiliser Manure CAN fertiliser	Used	Hired labour	Certified 614, 513 Duma
Beans	Manure	Not used	Hired labour	Not certified
Miraa	Manure	Not used	Hired/family labour	
Millet	Manure	Not used	Hired labor	Traditional
Sorghum	Manure	Not used	Hired labor	Traditional
Green grams	Manure	Used	Hired labor	Traditional

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Land is inherited from family members.
- Land can also be bought.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- The community keep Friesians, Hessian, Jersey and Guernsey cattle as well as indigenous livestock, and follow a zero-grazing system.
- Livestock for slaughter are kept and cost between KSh 60 000 and KSh 80 000. They are kept for approximately two years.
- Pasture types include normal grass, Napier grass, maize and commercial feed.
- The community does not process livestock products.
- The price of 1 litre of milk ranges from KSh 50 to KSh 60.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.)

Some of the challenges that face farmers and livestock keepers are:

- insufficient rainfall
- inadequate finances to purchase farm inputs
- insufficient funds for weeding
- pest invasions
- shortage of water
- lack of water storage facilities
- fluctuating market prices of farm products.

8. Family labour distribution for agriculture and livestock activities – use matrix					
Activity (confirm activities with participants first)	Adult male	Adult female	Child male	Child female	Aged
Clearing	X	X	X	X	
Other land preparation	X	X	X	X	
Planting	X	X	X	X	
Weeding	X	X			
Harvesting	X	X			
Post harvesting processing	X				
Herding	X				

9. Available extension services (government, non-government organisations,) for agriculture and livestock, quality.

- Government extension are available.

10. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

BEE KEEPER FOCUS GROUP

Village Name:	Meru, Laare
Meeting Date and Time:	2 November 2018
Meeting Venue/Group:	Victoria Ridge Hotel
Facilitator/Documenter:	Dominic Mwirigi/Dennis Murega
Number Present:	**M:** 4 **F:** 6

1. Describe activity with typical seasonal calendar include frequency and duration of specific activity.

- Bees are kept throughout the year.
- Honey is harvested twice a year, in February and March and in July and June.
- At this time plants and trees have blossomed.

2. Where are hives located? Do you have access to good hive locations?

- Beehives are located in Ndumuru. A number of community members keep bees at their homesteads.

3. How many hives do you have? What is the average no. of hives? (please estimate).

- Beehives are owned either individually or by groups.
- Typical ownership is around two to ten hives per group or individual.

4. What is the average production per season per hive? Yield per season.

- The average harvest is 10 kg per hive.

5. Use of product (honey, alcohol, etc.) Market? % sold? Pricing (if relevant).

- Honey is sold and used domestically.
- One kilogram costs KSh 1 000.
- Honey used to brew alcohol.

6. Family labour required for bee keeping (men, women, children, doing what exactly for bee keeping, production and marketing?

- Bee keeping and harvesting is typically the responsibility of the men in the community.
- The whole community is involved in selling honey.

7. Other inputs and costs (hives, places to put hives, casual labour, etc.) and sources.

- Bees can be kept by the individual at their home.
- Protective gear is needed for harvesting.
- Sugar is an input cost.

8. Hive building –what materials do you need, life of hive, skills required?

- Timber, iron sheets and nails are needed to build bee hives. These are made by other people who charge for their services.
- Hives can last up to ten years depending on the materials used to make them.

9. Are there extension services?
▪ There are no extension services in the area, these are needed.
10. Are there bee keepers associations to access services, funding for projects?
▪ There are no bee keeper associations or funding for projects.
11. Hopes and aspirations—plans for the future? Plans being implemented? How?
▪ To learn more about bee keeping.
12. Constraints and opportunities—quality, technology, marketing.
▪ There are several challenges in bee keeping: - insufficient water - lack of protective clothing for harvesting - no training opportunities for beekeepers.
13. Map to the extent possible/relevant with the group.
Map attached.

Key:
III and II is where they keep the beehives

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Meru, Laare
Meeting Date and Time:	2 November 2018
Meeting Venue/Group:	Victoria Ridge Hotel
Facilitator/Documenter:	Dominic Mwirigi/ Dennis Murega
Number Present:	**M:** 10 **F:** 1

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elders solve community issues, for instance, farming disputes and matters around cases of school dropouts.
- They settling land disputes and boundary issues, and individual disputes such as money lending issues in case of defaulters.
- The elders oversee the safety of the community.
- They work try to prevent illegal brewing.
- The elders are responsible for the dissemination of information to the community.
- Elders would guide community rituals, and bless or curse people, but their roles are changing over time.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the community.
- They use natural resources for healing, and are paid for their services.
- They collect herbs at Migombe, Luma and Mea hills.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are sacred places at Igombe (salt lick) and Kimeru (white ash used for rituals and blessings).
- The places are visited by the community.
- There is no particular person who is responsible for these sites.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- The sacred places are:
  - Places where traditional healers go to collect their herbs
  - Sacred hill places
  - Igombe (water sources, salt lick); Kimeru (white ash, clear white soil).

5. Important rites of passage (what are they and how are they observed?).

- Boys are circumcised.
- Newborn children are given gifts such as cows, goats and sheep at their naming ceremonies. Children are named according to their parents' characters.
- There are groups such as the Lunge, Murerwa, Muriira and Gitile. The members of these groups resolve disputes.
- These are the ceremonies in all age groups. They are observed in the month of August:

- Circumcision of boys and their joining of different age groups. They are named as Ndingusi, Kobia and Kaberia
- Marriage practices are observed
- Young men were taught to be obedient to elders, women and young children.

6. What should the proponent know about entering a village? How is respect shown?

- The proponent should observe the cultural values of the community.
- Elders should be involved and consulted before new entrants come into a village.
- Village people should be respected.

FACILITATOR OBSERVATIONS

Comment
▪ Suggestion by elders: - People from the community should get job opportunities. - Elders are supporting the project, but they need to be involved at all stages.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WATER AND SANITATION FOCUS GROUP

Village Name:	Meru, Laare
Meeting Date and Time:	2 November 2018
Meeting Venue/Group:	Victoria Ridge Hotel
Facilitator/Documenter:	Lilian Kathure/Caroline Gatwiri
Number Present:	**M:** 2 **F:** 13

1. Types of services provided, costs (water committee and sanitation).

- The main water supply is from the diocese of Meru, springs at Laare, Kitawaa, Atununu and Kithingangu, and boreholes in Laare, Ntunene and Kiridora.
- Spring water is free. Residents pay between KSh 5 to KSh10 for water from the boreholes. Diocese water is paid for monthly and estimated to be KSh 800.
- Water committees manage all the water sources; they collect money paid for the water and follow up on bad debt.
- The bulk of the area's sanitation facilities are pit latrines, and many are poorly built. There is no sewage infrastructure in the area.

2. Collaboration with formal health workers.

- The ministry depends on community health workers to implement government projects.
- The information flows from the formal agencies through the community health workers to community members.

3. How are water and sanitation services organised? Workers or volunteers?

- The services are offered voluntarily, and there is very little support from the county or national government.
- They are not empowered to offer help to those who need it and have to depend on government services for trivial issues.

4. Dominant water sources: traditional wells, improved, piped water.

- The main water source is from the diocese of Meru (Turo Water Project) and water trucks.

5. Water (public water supply facilities, what are the bylaws and fees on use, how are facilities maintained, adequacy of supply, adequacy of quality, how is water supply managed.

- Public water supply facilities are managed through by-laws that set charges and limit the usage time and quantity.
- Public water kiosks exist, where water is free.
- The supply of water is limited in May, June, July and August. During this time the community depend solely on water truckers.

6. Sanitation including disposal of human waste, landfills, etc.

- Sanitation facilities are in the form of pit latrines. Open defecation has reduced significantly as most people have latrines in their compounds.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Meru, Laare
Meeting Date and Time:	2 November 2018
Meeting Venue/Group:	Victoria Ridge Hotel
Facilitator/Documenter:	Lilian Kathure/Caroline Gatwiri
Number Present:	11

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women typically wake up at 06h00.
- Activities differ from 08h00 to noon. The majority of the women spend the early morning preparing breakfast for the children as they leave for school.
- Some women will go to their farms and return at around 17h00.
- Common economic activities for the women include farming and small businesses while others are employed as teachers.
- The majority of women do not own farms and can only work on their husbands' *miraa* farms (*miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect).
- Seasonal calendar runs as follows:
  - January to February – harvesting
  - March – preparing the land and clearing
  - April – planting and weeding
  - June to July – harvesting
  - August – preparation for the second season
  - September – planting
  - October to November – weeding
  - December – harvesting the crops that are ready.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Husbands make all household decisions, such as those related to money. They pay school fees and health costs.
- Women are not involved in the harvest or sale of the predominant cash crop (*miraa*). This is the men's responsibility. Women can only assist in weeding and harvesting.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Land is owned by the men. The cash crop (*miraa*) is also owned by men.
- Food products like maize, beans and other cereals and chickens can be owned by women
- Livestock is predominantly owned by men.
- Where families own cars or '*boda boda's* (bicycle or motorbike taxis), they belong to the men.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Most women belong to women groups.
- They may make their own political decisions like voting for a preferred candidate.
- Few women stand for elective positions.
- Barriers to participation include:
  - Patriarchy prevents the women from pursuing elective positions. Husbands will not allow their wives to run for fear of being dominated.
  - They are over-burdened and unable to balance between caring for the family and running a campaign.
  - They are limited by resources (funds) and most women are also illiterate and cannot pursue politics with limited education.
- Women participation has improved with the different government and non-government organisation initiatives to empower women.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women are discriminated against and regards as failures.
- They are picked on and their assets seized as they are considered weak. Assets inherited from their former husbands are seized from them.
- Other women mistreat them with accusations that they will steal their husbands from them.
- No help is offered to the single women as society has little value for them.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Some women use family planning and can access these services from health facilities.
- Women are aware of preventive, causes and treatment of HIV.
- Training or public campaigns against acquired immunodeficiency syndrome (AIDS) have decreased over recent months with the assumption that everyone is aware of HIV/AIDS and how it affects the younger generation.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

- The women consider a mix of kale, beans and maize a good diet. Common fruits include avocado, oranges, pawpaw, banana, mangoes, tomatoes and pumpkin.
- Food is stored in bags and water in tanks.
- Constraints to food security are insufficient rainfall and pests and worms.
- They cope by buying food.

Product	***How often***	***How much for an average family***	***Other comments***
Fish	Never	None	Not a fish-eating culture
Goat	Once in a month	½ kg	Not common for all families
Chicken	Once in a month	One per family	-
Beef	Once in a week	½ kg	-
Milk/yogurt	Daily	2 litres per family	-
Rice	Daily	2 kg per day	-

Bush meat	Never	-	-
Wild plants	Never	-	Not available

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school at the age of 5 years and complete primary school education at 14 years (both boys and girls).
- Reasons for leaving school include:
  - A shortage of food
  - Family breakups causing a hostile environment for studies
  - Poverty
  - In search of money especially since the *miraa* business is very attractive.
- Parents don't allow their children to work on behalf of the household unless the family is child-headed. Parents hope their children will have lucrative careers like teachers, lawyers, engineers and become independent.

9. Map to the extent possible/relevant with the group

Map attached.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Meru, Laare
Meeting Date and Time:	2 November 2018
Meeting Venue/Group:	Victoria Ridge Hotel
Facilitator/Documenter:	Lilian Kathure/Caroline Gatwiri
Number Present:	**M:** 2 **F:** 14

1. Contributions/responsibilities to households.

- The young adults in the community work to earn a living and help the family.
- Those that are married pay school fees.
- When parents are irresponsible, the youth take charge and provide for the family by paying for siblings' school fees, healthcare and other basic needs.
- The young men are responsible for the safety of the community.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The age of giving birth has changed. Currently girls are get pregnant at an early age.
- In the past both boys and girls were circumcised, but presently only boys are circumcised since the government banned circumcision of girls.
- Circumcisions are also now only carried out in individual families and not collectively in open fields as they were in the past.
- Women are far more informed about how to establish groups for self-empowerment. They also now know how to save and run businesses.
- Technology has made communication easier. People can send and receive goods through delivery services.
- Children are usually born in hospital.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Education increases chances of employment.
- Corruption has affected the chances of deserving youth getting employment.
- Most youth have access to technology and use social platforms such as Facebook and Whatsapp.
- Unemployment rates are high as many young adults do not have jobs.
- They frequently migrate to other towns to look for employment.

4. General labour force characteristics and job readiness.

- Teaching and secretarial skills are common among the educated youth.
- Other skills include hairdressing, tailoring, mechanics and driving. Most of those who have these skills are unemployed.
- Those that are unskilled hawk eggs, engage in casual jobs such as harvesting *miraa* and washing clothes, and run small businesses such as buying and selling of *miraa* (a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect).

5. Human immunodeficiency virus (HIV) awareness.
▪ The youth are aware of the causes of HIV including promiscuity, sharing of sharp objects, exchange of blood with infected persons, and mother to child infection when the HIV is not prevented early enough.
6. Political and social participation (ask about traditional authorities, changing values due to money).
▪ They are members of political parties and also stand for elective positions. ▪ Some belong to self-help groups that offer help and support to other members during emergencies. ▪ They invite each other to celebrations such as birthdays, rites of passage ceremonies, weddings and funerals. ▪ Money doesn't necessarily affect their political decisions.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Meru, Kandebene

Meeting Date and Time: 3 November 2018

Meeting Venue/Group: Kandebene Catholic Church Hall

Facilitator/Documenter: Lilian Kathure/ Dennis Murega

Number Present: **M:** 5 **F:** 3

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted)

- The typical seasonal calendar is:
  - January – February: harvesting
  - March: land preparation
  - April: planting
  - May and June: weeding
  - July and August: harvesting
  - September: land preparation
  - October: planting
  - November and December: weeding.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans	10 bags	1 acre	70%	March/April	3 000	4 000
Sorghum	25-30 bags	1 acre	90%	February	3 300	4 000
Green grams	7 bags	1 acre	95%	March/April	8 000	12 000
Tomatoes	6 000 tonnes	1 acre	95%	December to March	262 500	600 000
Onions	14 000 tonnes	1 acre	98%	December to March		1 050 000
Sunflower	20 bags	1 acre	95%	June to March	4 000	6 000
Cassava						
Peas						
Maize						
Yam						
Rice						

Leafy greens						
Cash crops						

3. Rotational system description, years in and out of cultivation, rotation of what crops.

- Rotation is done seasonally between:
  - onions, tomatoes and kales
  - beans, maize and sorghum
  - sorghum and cow peas.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix).

CROP	INPUTS	PESTICIDES	LABOUR	SEEDS
Maize	Fertilisers Manure	Applied	Hired	Certified
Tomatoes	Fertiliser Manure	Applied	Hired	Certified
Onions	Fertiliser Manure	Applied	Hired	Certified
Sorghum	Fertiliser Manure	Applied	Hired	Certified
Beans	Fertiliser Manure	Applied	Hired	Certified

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Land is inherited from family members.
- Community members may also purchase land.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- Together the community keep cows and bulls for slaughter.
- They herd, and livestock are fed on grass.
- They keep a mixture of cattle – Friesian, Jersey and indigenous.
- A bull can be sold for between KSh 50000 and 70 000.
- An average of 15-20 litres of milk can be produced from cows.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.).

The community face several constraints:

- Drought due to unreliable rainfall
- Lack of finance
- Destruction of crops by wild animals
- Cattle rustling
- Few markets
- Lack of transport infrastructure.

Isiolo, Meru and Nairobi serve as the main markets.

8. Family labour distribution for agriculture and livestock activities – use matrix.

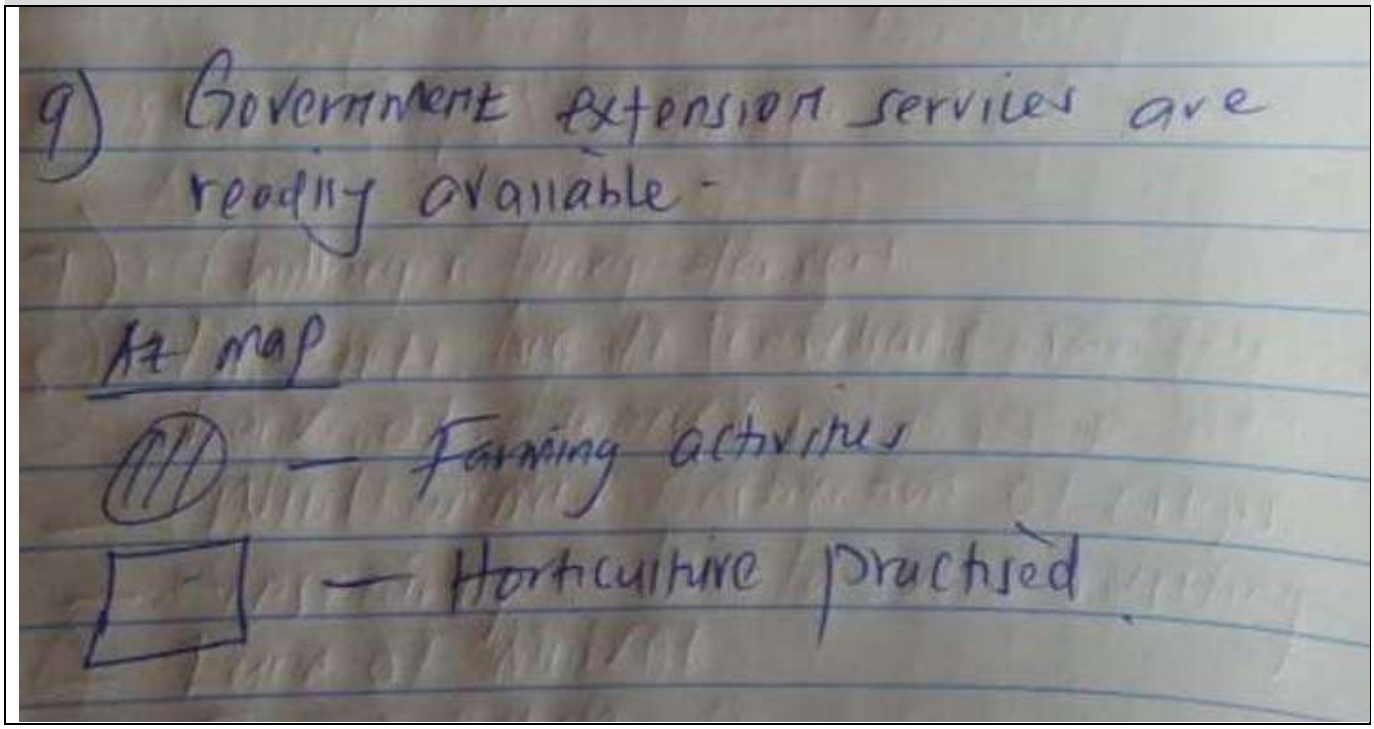
Activity (confirm activities with participants first)	Adult male	Adult female	Child male	Child female	Aged
Clearing	X	X	X	X	

Other land preparation					
Planting	X	X	X	X	
Weeding	X	X	X	X	
Harvesting	X	X	X	X	
Post harvesting processing					
Herding	X		X	X	

9. Available extension services (government, non-government organisations) for agriculture and livestock, quality.

- Government extension services are readily available.

10. Map to the extent possible/relevant with the group.



PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Meru, Kandebene
Meeting Date and Time:	3 November 2018
Meeting Venue/Group:	Kandebene Catholic church hall
Facilitator/Documenter:	Dominic Mwirigi/Caroline Gatwiri
Number Present:	**M:** 21 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders have the duty to supervise development in the community.
- They manage resources and maintain peace by solving common disputes, and work negotiations between conflicting parties.
- They seek help on behalf of the community.
- They facilitate marriage rites and dowry negotiations, and assist in maintaining cultural values.
- Elders inform the community about upcoming developments and inform them on the importance of such issues.
- They represent the community in meetings involving other communities.
- The role of the elders has not significantly changed with time but it is not as intense in the past.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- Herbalist exist and use trees within the area for treating illness.
- Very few community members use herbs to treat illness.
- The healers sell the herbs for money but only around 20% of the community depend on these herbs.
- The herbs are collected from the area.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Plants in special areas in Lobua swamp and Chokaa are used to feed livestock and the water is used for both human and animal consumption.
- Animals drink *mwonyo* (water from natural salt water springs) from these swamps, which is full of nutritional supplements.
- Some of the resources were protected in the past but presently the swamps are not protected.
- *Laaria* salt lick is also within the area but does not sit along the pipeline route.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- There three existing areas that hold the house of the elder (*njuri*):
  - Muteri, Mutethia and Mukaria shrines are taboo for visitors.

5. Important rites of passage (what are they and how are they observed?)

- Boys are circumcised and given a new name to signify the transition.
- They move on to marriage and later they are named elders.

- For the girl's circumcision is no longer a rite of passage, and after marriage they have completed all rites of passage.

6. What should the proponent know about entering a village? How is respect shown?

- A visitor should introduce themselves to the elders and understand the culture and know the mode of dressing and greetings among others.
- To show respect, an elder is not allowed to be playful with the young ones, use abusive words and dress inappropriately.
- Decency in dressing is imported to the community members especially when one is approaching elders.

FACILITATOR OBSERVATIONS

Comment
▪ The area has a cosmopolitan nature made up of Turkana, Borana, Meru and Somali. ▪ Women are not recognised as elders.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Meru, Kandebene
Meeting Date and Time:	3 November 2018
Meeting Venue/Group:	Kandebene Catholic Church Hall
Facilitator/Documenter:	Dominic Mwirigi/Caroline Gatwiri
Number Present:	**M:** 6 **F:** 2

1. Herding activities (Use seasonal calendar).

- The herders move frequently in search of pasture (the Nganomara – Meru route and the Nganomara – Isiolo route).
- From January to December they remain in the area.

2. Requirements for water, when, from where, in what quantities per animal.

- A single cow and a single donkey will each consume 40 litres of water per day. A goat consumes 5 litres a day.
- The community depends on the Kandebene borehole and in the rainy seasons they also draw water from the Matabithi borehole and the Batalo, Kungu, Karuya and Kandebene dams.
- Lanyiru is a stream which flows throughout the year.
- The Rikindu River also flows through the community. The Wasonara River is nearby. Both these rivers are seasonal.
- Lanyiru, Liliaba, Vikindu and Wasonara are commonly used by herders.

3. Economics: average herd size.

- The average herd size comprises approximately 300 to 400 cattle, 600 to 800 goats and around 5 to 8 donkeys.

4. Extension services; veterinary services.

- Veterinary services are available in Kianjai, Isiolo Mutuara and Karama.
- The government provides extension services.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

- The routes exist as illustrated on the map are Kandebene to Isiolo to Ngenemora to Mutuati to Laare to Kandebene.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- From Kandebene where they have permanent homes, the herders travel to Ngarui for approximately one month. The next settlement could be at Letui Ebabu for two weeks followed by Mwithorenywa for between two weeks to one month. From there they travel to Mbataro and stay for two months. They then move on to Karuya, Kiingene, Mbee and Lotethui, each for a stay of around one month, and make final stops at Laboria and Kerua.
- The herders are on the move throughout the year.

7. **Travelling in what size of group? Are these family or lineage groups?**
▪ They travel in groups of 50 families because of security issues.
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
▪ None of these activities take place in the area.
9. Groups representing pastoral groups. Mandate, range management, etc.
▪ Pastoral groups are supported by the county government. ▪ The Christian Children's Fund (CCF) dug a borehole in Kibiru for the herders. ▪ The herders are not represented by any group.
10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
▪ There are concerns that if there is a pipeline leak it will affect the water sources and livestock. ▪ Noise from the machines during construction of the pipeline could also disturb the cattle.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Meru, Kandebene
Meeting Date and Time:	3 November 2018
Meeting Venue/Group:	Kandebene Catholic church hall
Facilitator/Documenter:	Lilian Kathure/Dennis Murega
Number Present:	20

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

The daily timetable of a typical woman in the community is:

- Wake up at 05h00.
- From 05h00 to 06h00, organised breakfast and take children to school
- From 06h50 to 08h00, do house chores, and milk and take care of animals
- From 08h00 to 17h00, attend to various duties:
  - Those that farm return at 17h00
  - Those attending groups do so between 08h00 and 09h00
  - Others go to their business premises and other income generating activities starting 07h00.
  - Farming and businesses.

Seasonal Calendar:

- January to February: harvesting when there is rainfall
- March: land preparation and planting
- April to May: weeding
- June: harvesting
- July: harvesting
- August to September: land preparation
- October: planting
- November to December: weeding

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Men make the major decisions in the household.
- Money management decisions are made by both men and women.
- School fees and health care are paid for by both men and women.
- Mainly women fetch water.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Land use rights are given to both men and women.
- Livestock rights are held by men but through consultations.
- Agricultural products are owned by both men and women.
- All asset decisions are mainly made by both men and women.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women participate in self-help groups.
- Political decisions are made independently.
- Women share work among themselves, e.g. ceremonies.
- Women contribute freely in the participation of groups and leadership roles.
- Women are recognised and allowed to take leadership roles, for instance, in churches, schools and other establishments.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Widows and single women are not stigmatised by the community. However, that can depend largely on the woman's character.
- No special help is given to single women.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- There is accessibility to health facilities at the Kandebene and Kiburu dispensaries.
- Family planning services are available and used.
- People are aware of HIV. Seminars are conducted by hospitals and community health volunteers.
- Children are mainly affected by malaria and typhoid because of unclean water.
- HIV prevention is done at the hospital.
- Preventive health care is given.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish	-	-	Not available
Goat	2	-	-
Chicken	Rarely	1	Used for sale
Beef	3	½ kg	Low income
Milk/yogurt	daily	½ litre to 1 litre a day	Available
Rice	3	1 kg daily	-
Bush meat	-	-	Not available
Wild plants	-	-	Not available

- A good diet comprises of proteins, carbohydrates and vegetables.
- There is a lack of unity among the families.
- There is no shortage of facilities, but they get water from a borehole.
- Drought due to lack of rainfall is the only constraint to food security.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children attend school at the age of 4 years. They leave primary school between 11 and 13 years old.
- They join secondary school between 13 and 14 years and complete these studies at 19 years.
- Children are responsible for herding cattle, farming, and fetching water and firewood.

- Women's hope for their children is that they complete their studies in the future and get skills and jobs.

9. Map to the extent possible/relevant with the group

Key:

- H indicates the hospital
- W indicates the boreholes
- S indicates the schools
- Xxx indicates the church
- Dotted area indicates grazing areas
- Shaded area indicates farming

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Galbert Township
Meeting Date and Time:	12 October 2018
Meeting Venue/Group:	Lantern Resort, Senior Chief, Salat Aden
Facilitator/Documenter:	Nadhir Mohamed Gabow
Number Present:	**M:** 1 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

Galbert is part of Garissa Town. It is located in central Garissa. Residents come from "reservoirs" due to rural-urban migration. Galbert was established in the 1960s. Early settlers were Somali.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

In Galbert town, land is fully occupied. Outside the town, land is available. Land outside the town can be acquired through "the offices".

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

- The whole of Garissa County land is communal land.
- It is used for grazing. Farmers occupy the areas along the riverside.
- If one wants to use the land, one should give back to the community.
- It must be beneficial to the community, such as building hospitals, schools or water pans.
- The land falls under the County Government, Land Ministry.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

The land is mostly used for grazing. The land along the river is used for farming. Some part is for settlements and forest cover.

5. Current ongoing village initiatives, what is the progress

- Tarmacking of the road
- Environmental conservation.
- WARMA (Water Resource Management Authority) is doing some work to protect water catchments.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

- No sources of revenue for the local administrations. Money goes to the County Government.
- No total revenue.
- No expenditure.
- Women are part of policy making. They are active in the villages.

- Some women are involved in conflict resolution.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

- Galbert is in Garissa so the settlers access to government services.
- Women are very active in administration and in community activities.
- Women can access all government resources.

8. Request for village statistics if available

Current population (m/f)	46 000
No. of households	4 600
Births 2017	Average of 300 children
Deaths 2017	Average of 60 people
Population <15 **Population 15 – 54**	Around 16 000 Around 20 000
Population 55+	Around 10 000
No. of in migrants	35 people per month

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Galbet Township			
Meeting Date and Time:	12 October 2018			
Meeting Venue/Group:	Lantern Resort, Garissa			
Facilitator/Documenter:	Nadhir Mohamed Gabow			
Number Present:	**M:**	1 (Salat Aden, senior chief, Galbet)	**F:**	-

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now).

- Galbet originated in the 1960s; initial settlers were Somali's.
- Galbert is part of Garissa town. It is Garissa Central.
- Residents came from rural areas due to rural-urban migration.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land).

- In Galbet there is no open land; outside the town land is available.
- People can obtain land from outside the town through the land offices in the county government.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed).

- All land in Garissa County belongs to the community, i.e. communal land.
- It is used for grazing, and there are areas occupied by farmers along the riverside.
- People that want to use the land are expected to give back to the community in ways that are beneficial to the community such as building hospitals, schools, water pans.
- Land is managed by the Ministry of Lands under the county government.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Land is used for mostly for grazing.
- The land along the river is used for farming; with forest covered parts used for settlement.

5. Current ongoing village initiatives, what is the progress.

- Tarring of the road.
- Environmental conservation.
- The Water Resources Management Authority (WRMA) is currently working at protecting water catchment areas.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

- There are no sources of revenue for the local administration; money goes to the county government, and thus no expenditure.

- Women are active in the villages and assist in decision making.
- Some work in conflict resolution.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- Galbet is in Garissa town and settlers have access to all government services.
- Women participate actively in community activities. They can also access all government resources.

8. Request for village statistics if available.

Current population (m/f)	41,000
No. of households	46 x 100 = 46,000
Births 2017	Average of 300 children
Deaths 2017	Average of 60 people
Population <15 **Population 15 – 54**	Around 16,000 Around 20,000
Population 55+	Around 10.000
No. of in migrants	**35 people monthly**

FACILITATOR OBSERVATIONS

Comment
▪ Maps are not available.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

EDUCATION FOCUS GROUP

Village Name:	Garissa, Province Area
Meeting Date and Time:	12 October 2018
Meeting Venue/Group:	Lanterna Resort
Facilitator/Documenter:	Nathir Mahomed Gabow
Informant Name:	Abdi Hassan – Organization (Womankind)
Number Present:	**M:** 1 **F:** -

1. What age do children start school (is there kindergarten?)

Children start school at age of 7 – 8 years.

2. What age do children leave school? Males and females? Does it coincide with important exams?

Reasons for early school leaving: Adolescence, peer pressure, not enough teachers and looking after the animals. Children leave school between the ages of 15 – 18 years.

3. Is there adult education?

Yes, Mohamed Dalir Education Centre, Masalani in Ijara Sub-county offers adult education.

4. Budgets/partners/private donors?

They work with partners like the Aga Khan Foundation (AKF), ERIKS Development Partner, Action Aid and UNICEF.

5. Priority areas and plans

Children to have basic primary and secondary education. To also have more facilities like building more classes.

6. HH costs associated with education (i.e. tuition, supplies, uniforms, etc.)

Households supply learning materials, books and uniforms.

7. Parental involvement (parent committees?)

They train the parents on SDP.

8. Teachers housing? Teacher education? Ongoing support?

They construct teacher's quarters in Hulusho, Ijara. They do capacity building, monitoring and they also undertake assessment of teachers.

9. Constraints and challenges?

Limited funds, they want more skills, insecurity in areas they work with, poor roads, they work in vast areas and their resources are limited.

10. Available statistics on

Enrolment	

Attendance and absenteeism	
Early school leavers	
Graduating	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WATER AND SANITATION FOCUS GROUP

Village Name:	Garissa, Garissa Town
Meeting Date and Time:	12 October 2018
Meeting Venue/Group:	Lantern Resort
Facilitator/Documenter:	Mahommed Khalif / Dayib Ali
Number Present:	**M:** 1 **F:**

1. Types of services provided, costs (water committee and sanitation).

- Link between water consumer and supplier of water services.
- Registration of consumer complains.
- Follow up unresolved consumer complaints.

2. Collaboration with formal health workers.

Collaboration of public health services on sanitation and water supply.

3. How are water and sanitation services organized? Workers or volunteers?

Water and sanitation services personnel are volunteer worker.

4. Dominant water sources: traditional wells, improved, piped water.

Dominant water sources are divided into traditional wells and piped water. Piped water is supplied by Garissa water and sewerage company.

5. Water (public water supply facilities, what are the bylaws and fees on use, how are facilities maintained, adequacy of supply, adequacy of quality, how is water supply managed.

- Public water supply facility is GAWASCO (Garissa Water and Sewerage Company)
- The facility is maintained poorly.
- The pipeline project will affect the water supplying as water infrastructure and pipes may be disconnecting and damaging.GAWASCO has a set of bylaws that guide the organization. A fees of approximately 3,000Ksh per month per household is charged for water supply.

6. Sanitation including disposal of human waste, landfills, etc.

There currently is no proper disposal of human waste, but there is an ongoing project about to be completed which should address this issue.

STAKEHOLDER COMMENTS AND RESPONSES

Comment	Person raising comment	Response provided
The pipeline project will affect the water supplying as water infrastructure and pipes may be disconnecting and damaging.		

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Garissa Town
Meeting Date and Time:	12 October 2018
Meeting Venue/Group:	Lantern Resort, Inua Girls and Pastoralist Organization
Facilitator/Documenter:	Mahomed Khalif / Dayib Ali
Number Present:	Maryam Amin from Bohai

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- Business women.
- Government Employees.
- Domestic responsibilities (women):
  - Taking care of children.
  - Doing household chores.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Money management – the husband.
- Decision making – the husband.
- Fees payment – the husband.
- Health care – the husband.
- Water carrying – the wife.

3. Ownership of land use rights, agricultural product, livestock, other assets

- Land is owned through ancestral heritage.
- Land is mainly used for grazing.
- Small scale farming (for subsistence).

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- Women groups include milk vendors; cultural entertainers or dancers; bee keepers.
- Barrier to woman participation in social organization include:
  - Religion.
  - Gender bias (lack of inclusivity).
  - Lack of funds.
  - Lack of awareness (low levels of empowerment).
- Perception of changing roles:
  - A woman can do more than a man can do (multitasking).
  - An empowered woman is an informed woman.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

- They are stigmatized.
- They are vulnerable.
- They have no support.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

- Health and reproductive health:
  - There is no access to family planning.
  - Their religious beliefs do not allow them to use family planning.
- HIV/AIDS awareness:
  - No awareness on the cause and prevention of HIV and AIDS in children and adults.
- Preventive Health care
  - The most common form of prevention is abstinence.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

- Primary components of household food in the region include milk, meat, rice, maize and beans.
- There is no food security. Weather can affect food security, for example during the rainy season food security is affected.
- Furthermore, the security situation in the area also has an effect on food security.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Garissa Town
Meeting Date and Time:	12 October 2018
Meeting Venue/Group:	Lantern Resort, Fatuma Ahmed Bathi - Youth & Gender Focus Group
Facilitator/Documenter:	Abdirahim Muktar / Ismail Mohamed
Number Present:	**M:** _____ **F:** 1

1. Contributions/responsibilities to households.

- Taking part in decision making process.
- Being a youth, you can still have your say.
- Due to the high rate to unemployment, many youth join militia groups or turn to drug abuse.
- If jobs are created through the project, the youth could have opportunities to be employed.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Adhere to the traditional rites and culture has been subjected to significant change.
- The age of marriage is between 12 and 18 years.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Every child has a right to education and yet they are not demanding it.
- There is no access to technology.
- There is no electricity connection.
- Youth can walk a long distance for work. However, there is a low rate of employment. There is an expectation that this project could provide job opportunities for the youth.

4. General labour force characteristics and job readiness.

General labour force in the youth and gender fraternity is important for socio-economic change. An empowered youth is half an empowered community.

5. HIV awareness.

There is no awareness amongst the youth. Abstaining of sexual activity will minimize the HIV infection rate amongst youth.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- Youth are not given political space, due to a lack of resources.
- The community does not have room for youth in the political arena.
- Youth are not included in decision-making processes.
- Most of the youth are not empowered especially those from pastoralist community .

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name:	Garissa, Bouralgy
Meeting Date and Time:	13 October 2018
Meeting Venue/Group:	Boralgy Primary School
Facilitator/Documenter:	Nathir Mohamed Gabow/Yussuf Abdi
Number Present:	**M:** 1 **F:** 1

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted)

- Cash crop farming.
- They have two seasons of planting bananas, mangoes and tomatoes.
  Land clearing is done in March and August in preparation for the rains which come in April and December respectively.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (Confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain	-	-	-	-	-	-
Beans	-	-	-	-	-	-
Cassava	-	-	-	-	-	-
Peas	-	-	-	-	-	-
Maize	20 (50kg sacks)	1 acre	100%	August	50 KSh per KG	
Yam	-	-	-	-	-	-
Rice	-	-	-	-	-	-
Leafy Greens	-	-	-	-	-	-
Cash crops	Tomato – 20kg per day	1 acre	95%	January - August	80 to 20kg	2 at 20 KSh

3. Rotational system description, years in and out of cultivation, rotation of what crops

They rotate between tomatoes and watermelon.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix)

- They use manure from animals as fertilizer.
- Pesticides are purchased and at times obtained free from government.

5. Inheritance systems for land, alternative means to acquire land for adult children

- There is land inheritance.
- You can either buy or ask the community to be given land for free.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year

- They have livestock.
- They can move up to 40km.
- They move depending on the season.
- At times, the herd is kept at the farm and at other times it is taken to the bush for grazing.
- They milk their animals.
- Cows' milk is sold at 50 KSh per liter.
- Livestock includes cows, camels and goats.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.)

- Constraints include floods during the rainy seasons which leads to them being displaced.
- There is no good training programme on how to use their land/ farming.
- Both farming and livestock suffers from seasonal fluctuations in market conditions.

8. Family labour distribution for agriculture and livestock activities – use matrix

Activity (Confirm activities with participants first)	Adult Male	Adult Female	Child Male	Child Female	Aged
Clearing	5	-	10	-	-
Other land preparation	7	5	2	3	5
Planting	2	-	-	-	3
Weeding	2	3	4	4	3
Harvesting	3	4	2	2	2
Post harvesting processing	8	9	5	3	3
Herding	1	2	2	1	2

9. Available extension services (government, NGO,) for agriculture and livestock, quality

10. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WATER AND SANITATION FOCUS GROUP

Village Name:	Garissa, Bouralgy
Meeting Date and Time:	13 October 2018
Meeting Venue/Group:	Boralgy Primary School, Water Action Group
Facilitator/Documenter:	Mohamed Khalif Aden/Dayib Ali Gedi
Number Present:	**M:** 1 **F:**

1. Types of services provided, costs (water committee and sanitation).

- Provide information to water consumers on clean water and sanitation.
- Convey complaints of consumers to relevant authorities.
- Hold discussions on use of water and conservation.
- Shortage of water is a major concern.
- People buy water at 20 KSh per 20litres .

Perceived advantages of the pipeline:

- It will create job opportunities.
- It will open up business along the areas it passes.

Perceived disadvantages of the pipeline:

- It may pass through a person's land and this can cause displacement.
- Mode of compensation is not known if any actually exist.
- Grazing land could be affected.
- There is uncertainty on the exact location where the pipeline passes. This may lead to destruction of the water pipes and water pans.

2. Collaboration with formal health workers.

- Collaboration between the community and public health workers is poor.
- The Bouralgy, the biggest sewerage system is situated in Bouralgy.
- The outlet of the sewerage system did not reach its required destination. This can lead to a disease outbreak.

3. How are water and sanitation services organized? Workers or volunteers?

- There are some people from GAWASCO (Garissa Water and Sewerage Company) who help.
- There are no sanitation workers in Bouralgy.
- Volunteers have so far tried to do some planting of trees.
- There is no supervision from the concerned ministry on matters of sanitation.

4. Dominant water sources: traditional wells, improved, piped water.

- Water pipes are very scarce.
- Water pans are located at Bukurey.

5. Water (public water supply facilities, what are the bylaws and fees on use, how are facilities maintained, adequacy of supply, adequacy of quality, how is water supply managed.

- Water boozers from the nearby Tana river bring raw water to the community.
- The cost for the water boozer carrying water is 6,000 KSh.

- Bylaws related to the management and use of water are required. In particular, bylaws are required provide a framework for matters such as:
  - Paying for the water.
  - Ensuring the supply of water whenever it is needed.
  - Appropriate use of water.
- Maintenance is done by owners through cleaning of the water storage facilities.
- In case of a breakdown of water boozers the owner bears the cost of maintenance.
- There is no adequate supply of water.
- Quality is improved since it is being brought to the community.
- No government water, pumping of water to Bouralgy is a problem.
- Water tanks are used for storage.

6. Sanitation including disposal of human waste, landfills, etc.

- Disposal of human waste is managed at Bouralgy.
- Bouralgy has the biggest sewerage system in Northern Kenya.
- There have been complaints from the community that the sewerage system is posing serious health risks.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Modika
Meeting Date and Time:	13 October 2018, 10:30am - 11:30am
Meeting Venue/Group:	Modikare Village
Facilitator/Documenter:	Abdirahim Muktar/Ismail Mohamed
Number Present:	**M:** 2 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Solution to family dispute, simple unity.
- They are role models to the community and if they want development towards the community they will be the front line.
- They are changed if the elder becomes partisan.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers who are approached when required.
- Healers use cultural plants for medical purpose.
- They do not charge a fee. They accept whatever is offered to them.
- They are sometimes taken as far as other counties.
- They collect resources from the forest. This is considered an “inheritance” or entitlement.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- Yes, there are sacred sites such as graveyard located at the left side of the map.
- Yes, they are visited during the burial occasions.
- The local community assumes responsibility for the site. The responsibility has not been assigned to.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

There are no taboo places at Modika specifically.

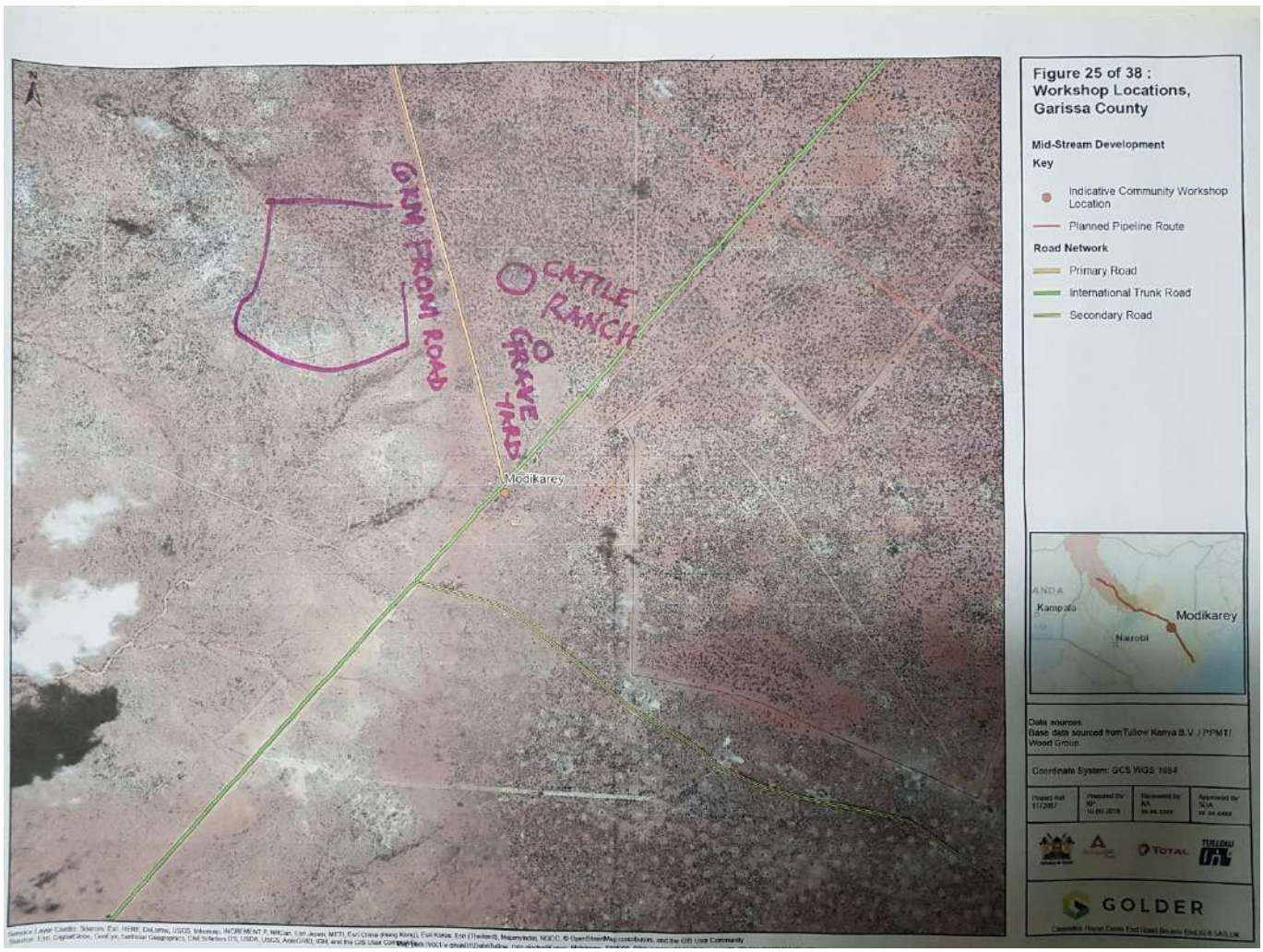
5. Important rites of passage (what are they and how are they observed?)

- Rites of passages such as circumcision exist. Circumcision is done by community members for themselves.
- The procedure is done by specific people.
- It is observed during the cold season and not during sunny and rainy seasons.

6. What should the proponent know about entering a village? How is respect shown?

- It is customary to greet the chiefs and enders when entering Modika.
- Respect is shown through welcoming and if they do not know the way they are directed in humble way.

See the attached map answering Q3



PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Modika
Meeting Date:	13 October 2018
Meeting Time:	10:30am-11.30am
Meeting Venue:	Modikare Village
Facilitators/Documenter:	Abdi Rahim Muktar/Ismail Mohamed
Number Present:	**M:** 1 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

- Year of registration is 1989.
- Some migrated from the bush and some from the neighbouring villages.
- Migration in and no migration out.
- Reason for migration: space for land, access roads and free communication network.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

- Availability of land is very big within the village.
- The cost of land depends on the amount and location of the land. For example, 50/100? along the road is about 1,500,000Khs while the same size property in the village is 1,000,000Khs.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

- The land is used for grazing.
- Nobody resides on grazing land.
- Decisions regarding land are made by the elders as well as the broader local community.
- Land is managed by the community.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

- Economic activities include petrol stations; shops; schools and Madrasas.
- Constraints include a lack of capital to expand local business.
- Opportunities include the empowerment of youth and women should capital be made available.

5. Current ongoing village initiatives, what is the progress

- Cattle ranching provides a source of income through the sale of meat and animal hides.
- Depots for the storage of diesel and petrol are available.
- Transportation services for diesel and petrol to neighboring towns are available.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

- Taxes are collected from the shops.

- Taxes are imposed on the sale of gypsum.
- Taxes are imposed on construction materials, i.e. “hard cores”.
- Expenditure is incurred on retaining county staff.
- There are no perceived constraints on participation by locals in village initiatives.
- The relationship between locals and the district administration is good.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

- Modika is a village with a capacity of 170 households which has an administration barrier. The level of participation in all the projects is well represented by elders (men) and women.
- They do not get great resources from other levels of the government and when they do, it is very minimal.

8. Request for village statistics if available

Current population (m/f)	Not available
No. of households	170
Births 2017	15
Deaths 2017	5
Population <15 **Population 15 – 54**	3000
Population 55+	150
No. of in migrants	200

FACILITATOR OBSERVATIONS

Comment
▪ There are no agricultural areas in Modika. ▪ Cattle ranch its kept towards the right part of the village at the Modika location. ▪ There are charcoal burners. ▪ Main travel destinations for locals include: – Wajir – Dadaab – Garissa – Mandera ▪ Travel routes include: KismayuRoad. ▪ Income is derived from charcoal burning and firewood collecting. ▪ Land is used for grazing. ▪ During the rainy season, land is used for farming. ▪ Unallocated land is available. ▪ Water is harvested during the rainy season from the sites listed below: – Shaiya – Bilif – Rukuub – Aragadud – Lamey Karis – Well Athey

Comment
– Hasna ▪ There are community cultural sites in the area, but no action has been taken to safeguard these sites. ▪ Kenya museum owns land in the area, but the land is not being used.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Modika
Meeting Date and Time:	13 October 2018
Meeting Venue/Group:	Modikare Village
Facilitator/Documenter:	Aden Abdi
Number Present:	9

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women are involved in varied businesses, for example selling milk, vegetables, *miraa* (*miraa* is a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect), vegetables and water to pastoralists during the dry season.
- They also run small hotels (customers comprise pastoralists and other travellers between Wajir and Mandera) and trade in livestock.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Women are involved in family responsibilities such as taking children to hospital and paying for school fees.
- They fetch water during the dry season.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- It is uncommon for women in Modika to own land. There are very few of them who have land in their name, and those that do have livestock and agriculture.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are several women groups including a special needs group.
- Women mobilise voters during election phases. Several women would like to be elected to positions of authority.
- Single women in the community manage and support their family singlehandedly. Some are helped by close family members who assist with taking care of their children.

5. If single, what is the status of single women (stigma for woman and/or children, is there help for single heads of households)?

- Women are aware of family planning and the human immunodeficiency virus (HIV) i.e. causes, prevention and treatment – non-governmental organisations have helped to educate them about these issues.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults).

- There is no food security in Modika, with few residents eating three meals a day. There is also a shortage of water. The most common food is *ugali* (maize porridge), milk, rice and beans.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish			No
Goat			Rare (one in a month)
Chicken			No
Beef			Rare
Milk/yoghurt			Thirty per cent are able to get
Rice			Their daily meal
Bush meat			None
Wild plants			None

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children in Modika start school at the age of five and leave schools at 18 or 19 years old. Many children drop out of school because they cannot afford the fees. Girls help with household chores and boys are pastoralists or run small kiosks.
- School leavers often cannot find work.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

FACILITATOR OBSERVATIONS

Comment
▪ They don't see any importance in how the pipeline will affect their daily lives. ▪ They fear their land will taken. ▪ They hope for employment for their unemployed children. ▪ The pipeline will interfere with their animals' grazing land.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Korakora
Meeting Date and Time:	14 October 2018
Meeting Venue/Group:	Korakora
Facilitator/Documenter:	Mohamed Khalif Aden/Dayib Ali Gedi
Number Present:	**M:** 1 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Reconciling the community in case of conflict.
- Works with government on matters concerning the affairs of the community.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the community. They treat back pain, snake bites, etc.
- They treat people for a fee.
- They collect medicinal plants from the forest. Not everyone has knowledge on the types of herbs that should be used.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

There are mosques around the area.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

No taboo areas.

5. Important rites of passage (what are they and how are they observed?)

- Circumcision ceremony for boys.
- Ceremonies for weddings.

6. What should the proponent know about entering a village? How is respect shown?

- Proponents who enter the village are directed to the village elder for orientation on the village norms.
- Community members observe a high level of respect for elders. Elders command a high status in the village.

FACILITATOR OBSERVATIONS

Comment
▪ The observation I made is that the community is not empowered on the matters of great concern to them in all aspects. ▪ There is a mentality that every group or the organization which comes to them has monetary benefits. Development agendas are not emphasized as much. ▪ There is also no compact organisation and coordination in the community making it difficult to convey messages and information. ▪ One positive and encouraging gesture however is the tremendous respect the elders command in the community. If this is utilised optimally, programmes could be implemented successfully.

for Q3, there was no map provided, therefore the informant was concern about the mosques that may be fond along the route of the pipeline.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Korakora
Meeting Date and Time:	14 October 2018, 09:00am to 10:00am
Meeting Venue/Group:	Korakora
Facilitator/Documenter:	Nathir Mohamed Gabow/Yussuf Abdi
Number Present:	**M:** 1 **F:** 2

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Old men do take care of the family. They are protectors of the family.
- They make key decision.
- They sometimes identify women to marry for their sons.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- They are old men who do herbal medicine.
- They do get paid sometimes.
- They get the herbs from the bushes.
- They collect herbs from the east side of the town.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

No map was provided.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

There are no taboo areas, but some areas are used for religious activities.

5. Important rites of passage (what are they and how are they observed?)

There are special areas for religious puposes

6. What should the proponent know about entering a village? How is respect shown?

- These are things to do before coming to Korakora.
- They should be welcomed by the community.
- They get food from there …..

FACILITATOR OBSERVATIONS

Comment
▪ The facilitator observed that in Korakora there were more women present during the stakeholders meeting. ▪ When it comes to decision making it is done by men (older men). ▪ People of the area were really concerned about the effects of the pipeline project.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Garissa, Korakora
Meeting Date and Time:	14 October 2018
Meeting Venue/Group:	Sarirah
Facilitator/Documenter:	Nathir/Yussuf Abdi
Number Present:	**M:** 3 **F:**

1. Herding activities (use seasonal calendar).

- Pastoralists herd animals throughout the year, and move from one area to another during periods of drought.

2. Requirements for water, when, from where, in what quantities per animal.

- Water is constantly needed.
- The rainy season lasts for several months.
- Water is sourced from water pans and boreholes. The information below is an approximation as the exact figure are not available. Totals are dependent on the weather and availability of pasture. If enough pasture is available, herders stay for long periods before they need water. However, a camel can take up to 10 days before they need water; a cow 2 to 3 days and a goat only one day.
  - Camels need up to 100 litres of water
  - Cows need 50 litres
  - Goats need approximately 20 litres

3. Economics: average herd size.

- Camel herds range in size from 80 to 100.
- The average cattle herd is between 30 and 60 cows.
- Goat herds vary greatly (20, 50, 200, 300, 500 & 700 animals).
- People have different herd sizes; no pattern.

4. Extension services; veterinary services.

- There are no extension services, government support is needed.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

- No map available.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent households on Ere).

- They migrate from Sarirah to Sheikh Hassan, Hailey Cambidera, Laantagsoye, Affore, Shilmi, Ceel Dear, Ceel Gab, Hira, Kulan, Liwaxle, Bukurey, Nagey, Deela Qalad, Majab Dumaal, Karobini, Kernel, Abow, Daad Bulle, Daad Cabas.

7. Travelling in what size of group? Are these family or lineage groups?

- They migrate in family groups comprising two to three families, sometimes up to 10 families.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
▪ They are people who use these areas for business activities like charcoal burning, cultural activity, animal herding.
9. Groups representing pastoral groups. Mandate, range management, etc.
▪ There are environmentalists in the community. They advise people not to cut down trees. ▪ Some trees are used for medicine. ▪ They go far in search of pasture and water ▪ They also take care of the wild animals; mainly giraffe.
10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
▪ People will be forced to move. ▪ The project may cause noise pollution due to the roads. ▪ An oil spill could pollute the land. Grazing will be affected as a result, and lead to a reduction in milk production and loss of income for the people.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa , Korakora
Meeting Date and Time:	14 October 2018
Meeting Venue/Group:	Korakora, Hidig Milk Project Group
Facilitator/Documenter:	Mahomed Khalif Aden/Dayib Ali Gedi
Number Present:	Treasurer: Ebla Ali Nuno

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- There was funding from the government. The money was used to build a milk storage system. The system is currently not functional.
- The challenge is a lack of training for personnel to manage the storage system.
- The milk is sold to Garissa residents.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Livestock rearing and herding is the husband's responsibility.
- Wives generally manage household chores.

3. Ownership of land use rights, agricultural product, livestock, other assets

- Everyone owns their plot. Grazing land is communal to all.
- There are certain farms which operate in Korakora. The farms were recently destroyed by heavy floods after the Tana river burst its banks.
- Vegetables and fruits grown in the farms include tomatoes, potatoes and bananas.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- Social groups in the area include:
  - Women groups
  - Youth groups
  - Elders groups
  - Cultural groups
- Women are not given a chance to participate in decision making about politics.
- There is a lack of inclusivity. During social gathering, women are sidelined. There is a likelihood that this trend (of sidelining women) will be reversed in the near future.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

- There is neglect of single women.
- Normally they are left on their own.
- Sometimes they may receive some support from some organization from orphan children.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

- Family planning is used to some extent.
- There is no HIV awareness.
- There is immunization and vaccination for children. This is very common.
- Malnourished children are given some support in terms of diet.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

- **There was relief food before, now it has reduced greatly**
- **Small scale farming is also common**

Product	*How often*	*How much for an average family*	*Other comments*
Fish	No	10	
Goat meat	Once in a week	10	
Cow meat	No	10	
Maziwa/ Mtindi (milk)	Daily	10	
Rice	Daily	10	
Wild plants	No	10	

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- At the age of six, children are taken to school.
- Drop-out of girls from school is now very rare compared to sometime back.
- In some cases, they will drop out due to lack of fees or early marriage.
- After school, children help with economic activities of the family.
- Others look after the animals. Livestock is the major source of income.

9. Map to the extent possible/relevant with the group

No mapping information provided.

IMPACTS OF THE PIPELING

Disadvantages	Advantages
Land issue: it may pass through plots of residents and may lead to displacement.	Create job opportunities.
Grazing land may be affected.	Open up business.
There is a concern on matters of health e.g. if there is an oil spill.	
Compensation uncertainty.	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Korakora
Meeting Date and Time:	14 October 2018
Meeting Venue/Group:	Korakora
Facilitator/Documenter:	Nathir Mohamed/Yussuf Abdi
Number Present:	**M:** 6 **F:**

1. Contributions/responsibilities to households.

- The youth help the parents to achieve their economic activities.
- They protect the household.
- They look after the animals.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Education opportunities are limited for the youth.
- Unemployment is a major constraint.
- The educated youth have few employment opportunities.
- The youth do not inherit the wealth of their parents.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth are ready to be employed and educated if opportunities are made available.

4. General labour force characteristics and job readiness.

- Farming, animal herding and burning and selling of charcoal
- They are ready to be employed and available to work at any time.

5. Human immunodeficiency virus (HIV) awareness.

- People are aware of their HIV status in Korakora.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- There is active participation in election processes.
- Community traditions have changed due to the influences of modern life.
- There are some traditional activities that area performed through payment. These activities include plays which are performed by the men and ladies known as "Diisow" for the men and "Heela" for the ladies to praise the politicians. These plays are also performed during weddings not only in the village but also in town.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Garissa, Sankuri

Meeting Date and Time: 14 October 2018

Meeting Venue/Group: Sankuri Boarding Primary School

Facilitator/Documenter: Aden Abdi

Number Present: **M:** 2 **F:**

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted).

- Farming system
- Crops include banana, pawpaw, tomato, watermelon, lentils (*ndengu*), black-eyed peas (*kunde*) and onion.
- Vegetables are grown before the rainy season to avoid flooding; the remainder of crops can be planted at any time.
- Crops are harvested at any time, followed by a post-harvesting process.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done.

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans						
Cassava						
Peas						
Maize						
Yam						
Rice						
Leafy greens						
Cash crops						

3. Rotational system description, years in and out of cultivation, rotation of what crops.

- Crops are rotated, with the exception of mangoes, pawpaw and similar crops.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix).

- The farmers of Sankuri harvest by hand or use a manual system.
- No animal tractors.
- They buy seedlings and they do not get any assistance from government or non-governmental organisations (NGOs).
- Animal waste is used as a fertiliser.

- Their main source of water is the River Tana.
- Labourers from outside the family are hired.

Challenges: -

1. Floods
2. Pest invasions
3. Lack of market

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Group of people come together and start the farm as a group or as community. They identify the land and inform the government and after approval from government divide and distribute the land between the members of the group.
- Most farmers have insufficient land to sub-divide between their children.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- Farmers typically have cows and goats. There is sufficient pasture and they harvest the grass.
- Livestock product is for family sustenance.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.)

- The land quality is good unless affected by flood, which typically results in a three-month hiatus before farming can recommence.
- Diesel for the generators. Some generators do not work efficiently.
- There are no inputs from county or national government.
- There is no market for their livestock or produce, and no available credit facilities.
- Education and training is non-existent.

8. Family labour distribution for agriculture and livestock activities – use matrix

Activity (confirm activities with participants first)	Adult male	Adult female	Child male	Child female	Aged
Clearing					
Other land preparation					
Planting					
Weeding					
Harvesting					
Post harvesting processing					
Herding					

9. Available extension services (government, NGO,) for agriculture and livestock, quality

- There are no available extension services either from government or non-governmental organisations (NGOs.

10. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Sankuri
Meeting Date and Time:	14 October 2018
Meeting Venue/Group:	Sankuri Boarding Primary School
Facilitator/Documenter:	Abdirahim Muktar/Ismail Mahomed
Number Present:	**M:** 1 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

- Established in 1970 as a sub-location. In 1987 Sankuri became a full location.
- Many refugees settled in the area due to drought in other regions.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

- Land is available in the village and surrounding areas.
- Land is distributed fairly. Few people are able to buy land.
- The village is not located in a strategic place i.e. town.
- In the event that land is "acquired", the maximum prices is around 300,000 KSh.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

- There is communal land. The land is used for grazing, farming and wildlife.
- There are not bylaws in place.
- According to the Chief, they do not permit private ownership of large pieces of land.
- A fee of up to 300,000 Khs can be charged for use of land.
- As the land is communal land, there is no private ownership of land.
- The land is managed by the Chief through the elders.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

Economic activities include:

- Grazing.
- Farming.
- Wildlife.

Economic development priorities include:

- Electricity.
- Roads.
- Construction of building.

Development plans:

- Nunow Madogashe Road (ongoing).
- Solar plant.

Constraints:

- No compensation for the land used.
- Grazing land is destroyed.
- Low employment levels linked to violence.
- Few employments opportunities, e.g. like casual labour.

5. Current ongoing village initiatives, what is the progress

- Ongoing Nunow Madogashe Roads.
- Solar plant ongoing.

Progress:

- It makes transport easy.
- Employment.
- Business opportunities.
-

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

- Sources of revenue include livestock, farming and charcoal but it is collected in Garissa.
- Expenditure includes maintaining security, helping-hand among the local women and the public at large participate.
- Constraints include a lack of target groups and different opinions.
- The relationship with District Administration is perfect.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

The people of Sankuri are welcoming and they put more focus on how the project will have a negative impact on the people, animals and the land which are essential to them.

8. Request for village statistics if available

Current population (m/f)	2,000
No. of households	500
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	1,000
Population 55+	200
No. of in migrants	300

FACILITATOR OBSERVATIONS

Comment
Agriculture areas: along the road Grazing area for cow: at Shambas depending on seasons Watering areas for cows: River Fuel wood cutting: Yes Medicine Gathering: No Other plants gathering: No Fishing: Yes Hunting big game: No Hunting small mammal: No Housing material gathering: Yes Main travel routes and means of transport: they go to Garissa mostly using public transport Resources: for farming and for grazing Unallocated village land is there. Water resource: River No community cultural sites Communal water resource is there Boundaries: Sankuri – Nonow boundary Sankuri – Raya boundary Sankuri – Garissa boundary Sankuri – Balambala boundary

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Garissa, Sankuri Division
Meeting Date and Time:	14 October 2018
Meeting Venue/Group:	Sankuri Boarding Primary School
Facilitator/Documenter:	Abdiharim Muktar/Ismail Mohamed
Number Present:	**M:** 3 **F:**

1. Herding activities (Use seasonal calendar).

- During cold season the livestock are in good condition.
- There is no green pasture but there is sufficient water available to cultivate herbs.
- There is less disease during the cold season.
- The pastoralists consider summer to be the worst season.
- The movements of livestock in and out of the area can bring diseases.

2. Requirements for water, when, from where, in what quantities per animal

- Tap water needs to be purchased while water from the river is free.
- Camel: each camel drinks about 10Ksh of water per day.

3. Economics: average herd size

Herds are comprised mostly of goats and cattle. Few camels are kept.

4. Extension services; veterinary services.

No veterinary assistance is obtained from the County or National Government. All veterinary expenses are covered by the pastoralists themselves.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

When they are looking for water, they transit in between the main roads and minor roads.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent hh on Ere)

Both short term and long term homesteads are established. At the village people are permanent, in the short term people are looking for greener pastures.

7. Travelling in what size of group? Are these family or lineage groups?

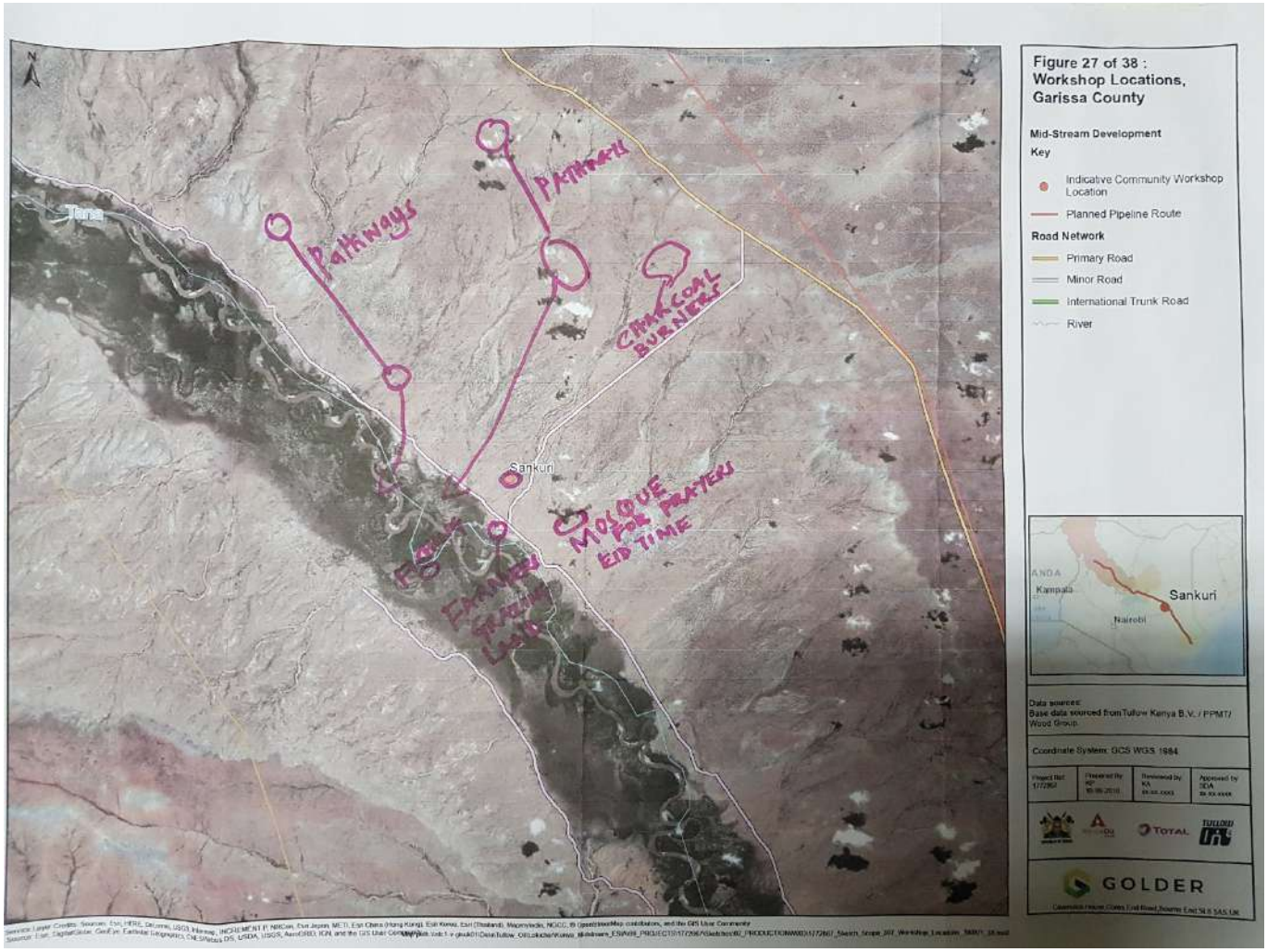
The pastoralists belong to different types and sizes of groups. Both family and lineage groups are prevalent. When migrating, they tend to move in these groups.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- No hunting in the area by this group.
- Fishing activities take place.
- No plant gathering.
- No cultural places are visited.

9. Groups representing pastoral groups. Mandate, range management, etc.
▪ They are aware of the movement of animals in and out of Sankuri. ▪ They move and look for greener pastures. During an outbreak of disease, they look for medicine for their animals. ▪ No range management.
10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)
▪ They are concerned that a leak in the pipeline may destroy vegetation and cause deforestation. ▪ Pastoralists primarily use fire as a means of illumination. They are concerned that a leak in the pipeline could cause an explosion or other damage and destruction.

See attached map



STAKEHOLDER COMMENTS AND RESPONSES

Comment	Person raising comment	Response provided

FACILITATOR OBSERVATIONS

Comment

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Garissa, Kamuthe

Meeting Date and Time: 15 October 2018

Meeting Venue/Group: Kumuthe Village, Hormud Women Farm (Chairlady: Kheira Issack)

Facilitator/Documenter: Mohamed Khalif Aden/Dayib Ali Gedi

Number Present: **M:** _____ **F:** 5

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted)

- The main crops include bananas, tomatoes, chilies and watermelon.
- Cultivation is ongoing now from October to December.
- Growing crops begin in January.
- Weeding is done after the crops have grown and not yet ready for harvest.
- Harvesting is done in March.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (Confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain	n/a	n/a	n/a	n/a	n/a	
Beans	3 sacks	1 acre	100	June	1 sack 3,500 KSh	
Cassava	n/a	n/a	n/a	n/a	n/a	
Peas	n/a	n/a	n/a	n/a	n/a	
Maize	High amount	5 acres	80	March	1 sack 2,000 KSh	
Yam	n/a	n/a	n/a	n/a	n/a	
Leafy Greens	High amount	5 acres	90	March		
Cash crops	n/a	n/a	n/a	n/a	n/a	

3. Rotational system description, years in and out of cultivation, rotation of what crops

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix)

- Labor is done by a tractor. They have a tractor for cultivation and ploughing.
- Fertilizers are used, and they are bought from the market.
- Seeds are bought from the market. Sometimes the Red Cross help them with some seeds like that of a watermelon.

Input Matrix

Item	Cost
Fertilizer	5kg-5,000 KSh
Labour (Tractor)	This depends on the land cultivated. It is expensive.
Seeds	50g size tin of tomatoes seed cost 600 KSh Watermelon ¼ kg cost 600KSh Chilli cost 600KSh

5. Inheritance systems for land, alternative means to acquire land for adult children

- Land was inherited from generation to generation.
- Alternative means of acquiring land is through buying.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year

- Main animal reared are cattle, goat, sheep and camels.
- Animals are herded mainly by the children of the owner. Where the owner does not have children of his own, they seek a service from others at a fee.
- The camels consume a variety of trees. The sheep, goats and cattle consume grass.
- The quality of pasture is greatly reduced, and this is attributed to the climate change.
- Livestock products include meat, milk, hides and skin. The milk is sold. The meat is consumed and also sold in the butchery.
-

Animal	Price
Goat (4 years)	7,000 KSh
Cattle (2 years)	16,000 KSh
Sheep (4 years)	6,000 KSh
Camel (4 years)	35,000 KSh

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.)

Livestock

- Drought: Due to climate change, the quality of pasture has reduced, this is because of lack of rain.
- Diseases: Sometimes the animals suffer from various diseases, there are no vet services available, this reduces the quality of the product of the animal and even it causes death of the animals.

Farming

- Flooding: Flooding has been caused by the excessive release of water by Kengen. The water bursts the banks of the river and causes destruction and a great loss of crops.
- The cost of seeds: The cost of seed is expensive for the locals.
- Lack of infrastructure: Transport is a huge problem, particularly during the rainy seasons.
- Market: They have a big problem as there is no readily available market. Their target market is Garissa which get its crops and vegetable from Thika. This makes them lack markets from their produce.
- Labour: Labour cost is expensive. No support from donors and well-wishers.
- Education and Training: No workshop or training provided to the community.

8. Family labour distribution for agriculture and livestock activities – use matrix

Activity (Confirm activities with participants first)	Adult Male	Adult Female	Child Male	Child Female	Aged

Clearing	√				
Other land preparation					
Planting	√	√			
Weeding	√	√			
Harvesting		√			
Post harvesting processing					
Herding			√	√	

9. Available extension services (government, NGO,) for agriculture and livestock, quality

- No aid for livestock mostly.
- The farmers sometimes receive some support and aid.
- Generally, support and aid is very rare.

10. Map to the extent possible/relevant with the group

See attached map

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Kamuthe Town
Meeting Date and Time:	15 October 2018
Meeting Venue/Group:	Kumuthe
Facilitator/Documenter:	Nathir Mohamed Gadow
Number Present:	**M:** 3 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- They are responsible for the family.
- They take children to school.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- They are traditional healer's. They use natural resources for healing.
- They also recorrect bone fractures in case it happens.
- They are both paid with money and animals.
- They collect their resources from Daad Abas, Hinta and Tana river.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

As indicated on the map, there are sacred trees that are meant for traditional rites. No unauthorized persons may visit these areas.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

It is not a taboo to visit the area where the proposed pipeline is to be installed.

5. Important rites of passage (what are they and how are they observed?)

- Perfoming religious responsibilities.
- Perfoming prayers.
- Gathering council of elder for family and political discussion.

6. What should the proponent know about entering a village? How is respect shown?

Before entering the village, the proponent must greet the people courteously. The proponent will then be welcomed, introduced and asked to state the aim of his/her visit.

FACILITATOR OBSERVATIONS

Comment
▪ This is a very happy, welcoming and cooperative community. ▪ They are eager to know more about the pipeline. ▪ They are very entertaining.

See attached map

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Garissa, Kamuthe
Meeting Date and Time:	15 October 2018
Meeting Venue/Group:	Hussein Ahmed Ali (Livestock Herder)
Facilitator/Documenter:	Mohamed Khalif Aden/ Dayib Ali Gedi
Number Present:	**M:** 1 **F:**

1. Herding activities (Use seasonal calendar).

- During the dry season, the herders are more with their animal and travel as far as 30 km from their permanent dwellings.
- During the rainy season, animals are moved back to the homes.

2. Requirements for water, when, from where, in what quantities per animal

- Requirements for water are for animals and people.
- During the dry season, water becomes absolutely necessary.
- The main water source is water pans.

3. Economics: average herd size

- Camels – herd size is 100.
- Cattle – herd size is 100.
- Goat – herd size is 100.
- Sheep – herd size is 100.

4. Extension services; veterinary services.

Pastoralists received some veterinary services from the local county government.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

Refer to the map for some clarifications. In the map we indicated routes and water pans the community uses.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent hh on Ere)

There are a number of seasonal settlements. These settlements are indicated (#1) on the map.

7. Travelling in what size of group? Are these family or lineage groups?

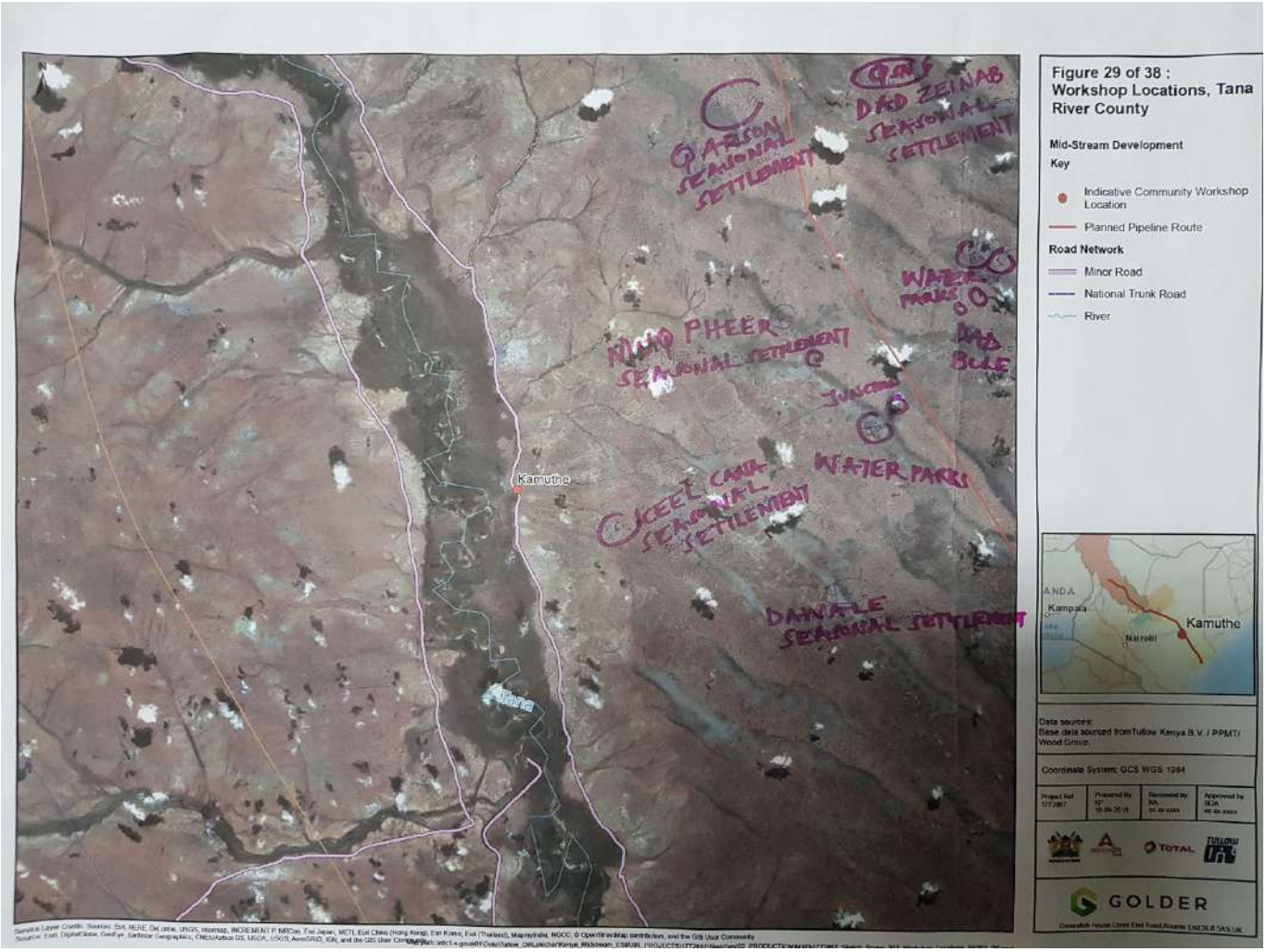
- People settle at a place 25km from Kamuthe, normally in large family groups.
- Normally different family lineage move together.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- Gathering of plants is carried out in some areas like Kala Goys (Junction) which is indicated on the map.
- In Dad Bulle, people visit the area for cultural reasons. This area is indicated on the map.

9. Groups representing pastoral groups. Mandate, range management, etc.
▪ There are pastoral youth groups in Kamuthe. They ensure the security of their pasture land from invasion by the neighboring communities. ▪ They also discourage the cutting of trees.
10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)
▪ The pipeline may affect the natural resources for example the soil, trees, water, etc. People are concerned about these impacts. ▪ Fear for the safety of their children. For example, children may drown in the areas where digging and excavation of the project is taking place. ▪ Disturbance of sacred sites is a concern. People have great respect for the graves and worshipping places. If the project passes through these places, it will affect them.

See attached maps



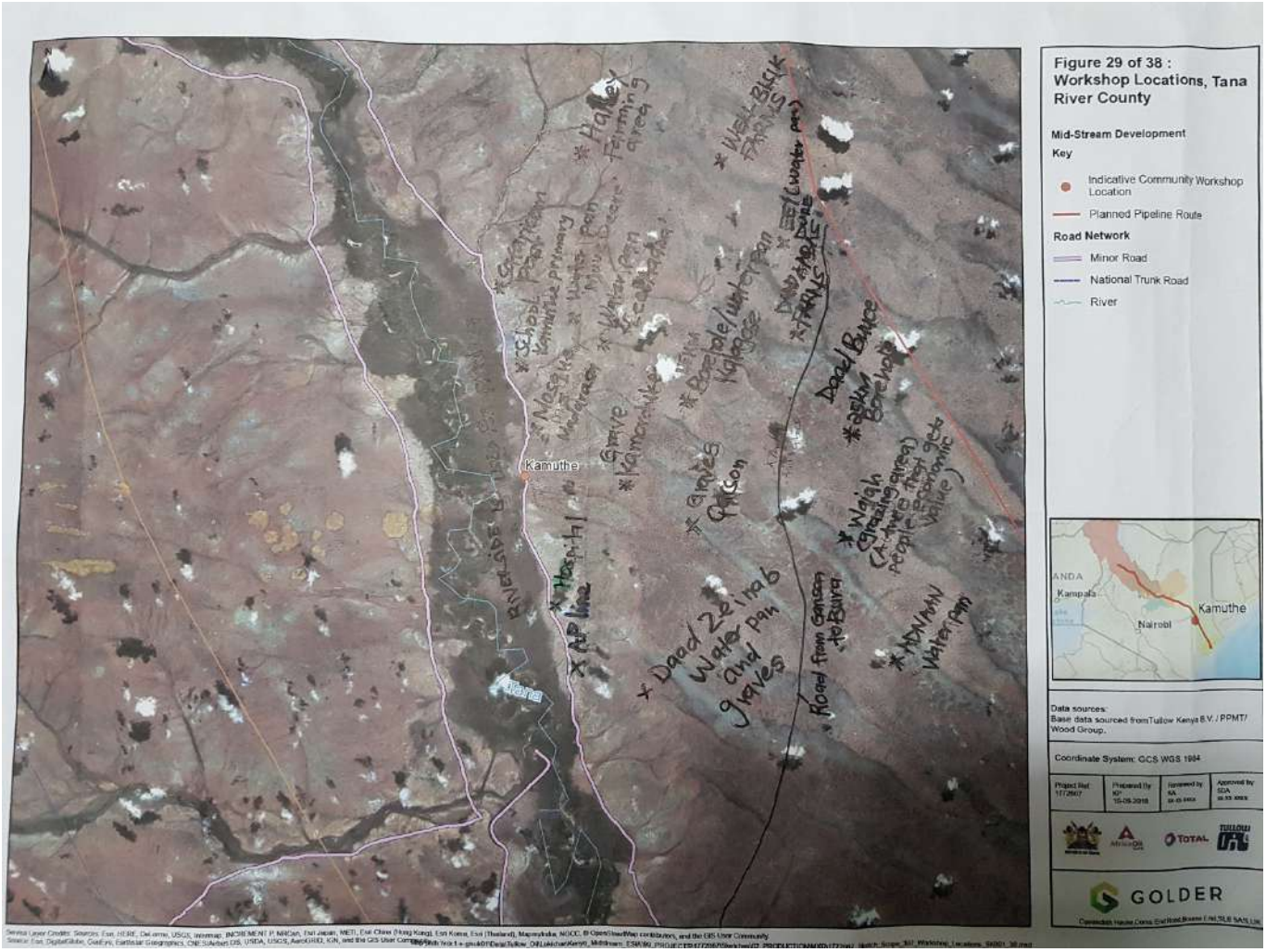


Figure 29 of 38 :
Workshop Locations, Tana River County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
Road Network
Minor Road
National Trunk Road
River
Kamuthe
Kampala
Nairobi
Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group.
Coordinate System: GCS WGS 1984
GOLDER

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WATER AND SANITATION FOCUS GROUP

Village Name:	Garissa, Kalagosk, Kamuthe
Meeting Date and Time:	15 October 2018
Meeting Venue/Group:	Kalagosk Kamuthe Water Users
Facilitator/Documenter:	Nathir Mohamed Omar
Number Present*: *attendance register attached	**M:** 1 **F:**

1. Types of services provided, costs (water committee and sanitation).

- Water is provided to residents at a cost of, for example, 500 Khs per month per household.
- There are water committees comprised of 18 persons.

2. Collaboration with formal health workers.

They work with Kamuthe Health Works in terms of Sanitation and Hygiene. For example, if the water at the water pans get polluted, they collaborate with health workers to undertake inspections on the use of water.

3. How are water and sanitation services organized? Workers or volunteers?

Meeting are held through the community and few people are selected to actively work on water provision. They work voluntarily.

4. Dominant water sources: traditional wells, improved, piped water.

- Piped water from the river.
- Water pans.
- Boreholes.

5. Water (public water supply facilities, what are the bylaws and fees on use, how are facilities maintained, adequacy of supply, adequacy of quality, how is water supply managed.

- Bylaws stipulate that water should not be polluted or wasted. Water should be used wisely. In case someone breaks the laws he/she will be required to pay for the damage caused.
- Each family pays 500 Ksh per month for household use. Fees for provision of water for animals, hospitals, schools etc. are charged.
- Water facilities are maintained through a chairman and an operator. An observed machine breakdown may lead to inadequate supply of water.

6. Sanitation including disposal of human waste, landfills, etc.

No sewerage system or formal human waste disposal facilities are available. The people only use normal latrines and when it gets filled, they try to rebuild latrines.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Bola Town, Kamuthe
Meeting Date and Time:	15 October 2018
Meeting Venue/Group:	Bola Town
Facilitator/Documenter:	Nathir Mohamed
Number Present*:	**M:** 2 **F:**

1. Contributions/responsibilities to households.

- Work for the family.
- Looking after the animals.
- Weeding the farm.
- Going to market and buying vegetables.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Since the older generation did not go to school they still adhere to a traditional way of life.
- The younger generation on the other hand, see education as a way to a better life.
- The older generation are well conversed in politics while the young support the politics but strive for a more modern way of life.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- They believe that education is the key to success.
- Kamuthe does not have technical colleges. The youth go to nearby towns in Garissa Country in search of an education.
- Sometimes the teachers are funded by the community and the community fails to support them. When this happens, the teacher moves out of the area in search of work.
-

4. General labour force characteristics and job readiness.

- Looking after animals.
- Cleaning the town.
- Small-scale business.
- Environmental supporters.
- Farming.
- The youth are mostly jobless. They are ready and able to work.

5. HIV awareness.

Youth are aware about HIV/ AIDs and they mostly visit VCT Centres.

6. Political and social participation (ask about traditional authorities, changing values due to money).

Traditionally the youth entertain the politicians by performing traditional dances Such as "Sar" and "Disow" Sometimes the value of these traditional dances are influenced by modernization.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Shimbiri
Meeting Date and Time:	15 October 2018
Meeting Venue/Group:	Shimbiri
Facilitator/Documenter:	Aden Abdi
Number Present:	3

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- Shimbiri women economic activities include Kiosks, small hotels, butcheries, vegetable vendors and selling milk.
- Half of the women in Shimbiri are engaged in economic activities.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Shimbiri women are knowledgeable in the role they need to play in the running of the house.
- Most of the time, when it comes to decisions in the house, it is mutually agreed between husbands and wives.
- Those with small businesses help in paying school fees and health costs for their children.
- Water carrying is the responsibility of the women.

3. Ownership of land use rights, agricultural product, livestock, other assets

- Land in Shimbiri is communal land. It is not registered to individuals.
- They settle as a family (comprised of husband, wife and children) in any part of Shimbiri they want as long as no other family is settled there before them.
- Very few women own livestock. Most of the livestock belongs to men.
- They do not practice farming.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- There are around 10 women groups which are active and doing the best they can to support themselves as the women of Shimbiri village.
- Women here rarely take part in political decision making. Most of the time, they follow the decision of the village elders, all of whom are men.
- They are hopeful that there will be change in traditional roles over time since many of their daughters go to school now.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

Single women are well taken care of, usually by the husband's relatives and sometimes by her family.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

- Women here are fully aware about HIV/AIDS, its causes, prevention, treatment.
- They do not believe in family planning.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

- The Shimbiri women informed us that the people here do not care about good diet.
- They eat whatever they can afford.
- Half of the families here get 3 meals a day.
- Their daily diets consist of rice, milk, ugali and goat meat.

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- Children of Shimbiri start school at the age of 5 years. They finish primary school at the age of 14 or 15. They finish secondary school at the age of 18, 19 or 20.
- Only 30% are able to get to secondary school. The rest are primarily drop-outs.
- Reasons for school drop-outs include:
  - Lack of teachers.
  - Lack of proper guidance.
  - Pastoralism.

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Shimbiri
Meeting Date and Time:	15 October 2018
Meeting Venue/Group:	Wadajir Midnimo Youth Group
Facilitator/Documenter:	Abdirahim Muktar/Ismail Mohamed
Number Present:	**M:** 3 **F:**

1. Contributions/responsibilities to households.

- They follow and protect the animals and they are the backbone of the family.
- If there are attacks towards the community, they are the frontline to defend.
- They also produce for those who are married and increase the population.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The perception difference can bring the different interest they have.
- Constraints: no creation of employment, there is high racism and they are not considered at all.
- Opportunities:
  - Can bring job creation.
  - Can learn, get skills since they are pastoralists.
  - Can participate and cooperate.
  - It can also change their livelihood.
  - Overcome some obstacles towards their parents for not taking part depending the number of the youth, they have in that households.
  - They can get married at the age of 20.
  - Take part in the circumcision as early as 6 years.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Some are in the school and studying while other are pastoralists and not attending school.
- Most are pastoralists and few get the opportunity to go to school.
- If the youth get the opportunity to get employed at towns the can do it.
- No access to technology due to lack of electricity.
- No migration out for work since there is no work.

4. General labour force characteristics and job readiness.

- They can do mechanic work, casual jobs such as watchmen, drivers, cooks and someone who can read and write.
- Job readiness: they are eagerly waiting for the youth to work on projects. However, on some projects, people are brought from somewhere else to take their opportunities.

5. HIV awareness.

It is a killer virus. They understand what it is but they need more sensitization and awareness.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- They participated in voting process and they also campaign.
- They understand politics more.

FACILITATOR OBSERVATIONS

Comment
▪ The youth at Shimbiri are suspecting that they will not get employment or business opportunities from the pipeline project. ▪ They feel the project will come with a lot of negative issues that will affect their animals and the forest. ▪ They also think that they can contribute to a good workforce if the proponent considers them before employing people from elsewhere.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Mansabubu
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Mansabubu
Facilitator/Documenter:	Nathir Mahomed Gabow
Number Present:	**M:** 2 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

Mansabubu was registered in 1964. Its early inhabitants came from the Coast. Inhabitants included Arabs and Somalis. Trade was an important factor. The Somalis chased away the Arabs and they remain in the area until this day.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

The chief is the Land Administrator. He monitors all the sale of land. The Chief can be approached to purchase land at the going rate of about 200,000Ksh per acre.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

No local by-laws guiding land occupation, management and ownership.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

Major economic activities are farming and livestock farming.

5. Current ongoing village initiatives, what is the progress

Road construction, WASH programs.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

Main source of revenue is from selling of livestock and crops.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

There is very low capacity building for women in this area.

8. Request for village statistics if available	
Current population (m/f)	15,000
No. of households	2,400
Births 2017	20 Population
Deaths 2017	10 Population
Population <15 **Population 15 – 54**	1,000 13,500
Population 55+	1,200
No. of in migrants	20

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

EDUCATION FOCUS GROUP

Village Name:	Garissa, Mansabubu
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Mansabubu Primary School, Abdirizak Bille, Headmaster
Facilitator/Documenter:	Mohamed Khalif Aden / Dayib Ali Gedi
Number Present:	**M:** 1 **F:**

1. What age do children start school (is there kindergarten?)

Children attend school at the age of 6.

2. What age do children leave school? Males and females? Does it coincide with important exams?

- By the age of 14 they are done with primary level.
- In cases where they do not complete primary level, they are influenced by:
  - Early marriage.
  - Nomadism.
  - Female genital mutilation.
  - Poverty.

3. Is there adult education?

There is no adult education.

4. Budgets/partners/private donors?

- There is budget for free Primary Education. Funding is provided by the government.
- There are no education partners in the area.
- Private donors are UNICEF, CARE and FAIDA.
  - FAIDA – They help in hygiene and sanitation.
  - UNICEF – Provide teaching and learning materials.
  - CARE – Hygiene and Sanitation.
  - CDF – They help in repair and construction of class rooms.

5. Priority areas and plans

- The school is in an open area. It needs fencing. This is the highest priority.
- Additional staff (teachers). There is shortage of teachers.
- There is a School Development Plan (SDP). The SDP highlights the needs and priorities for the school's development.

6. HH costs associated with education (i.e. tuition, supplies, uniforms, etc.)

- The children mostly buy their uniforms. Sometimes certain organization may help in buying the uniform.
- The government is providing teaching and learning materials. There is cost involved.

7. Parental involvement (parent committees?)

Parents are involved in the day to day activities and plans of the school. This is through the Board of Management

(BOM) and Parents Teachers Association (PTA).

8. Teachers housing? Teacher education? Ongoing support?

- Teachers housing: Teachers are not housed at school. There is no accommodation provided for the teachers.
- Teachers education: Teachers attend seminars and workshops organised by some organizations like TUSOME programme and Early Grade Mathematics (EGMA).
- Teachers also attend ICT trainings for the laptop project in primary schools.
- Ongoing support: UNICEF is providing support through a programme dubbed "Out of school children". UNICEF identifies the challenge which made some children leave school. They then buy uniforms, books and other learning materials to enable them to enroll back to school.
- FAIDA is now having a programme of providing hygiene and sanitation awareness. They are providing toothbrushes, sanitary pads. etc.

9. Constraints and challenges?

- Shortage of staff: There are not enough teachers.
- Security issue: Sometimes there can be conflict between the two main communities (Somali and Pokomo). In such cases, the children will not come to school.
- There are parallel schools operating near the main school. This feeds into the decline of the number of children in the main school.
- Nomadism: The community is largely a pastoralized one. During the dry season they move with the children in other areas.
- Water: There is a water crisis in the school.
- Floods: The area is prone to flooding from the nearby Tana River.

10. Available statistics on

Enrolment	
Attendance and absenteeism	
Early school leavers	
Graduating	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Mansabubu
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Mansabubu, Elder, Bare Mohamed Abdi
Facilitator/Documenter:	Mohamed Khalif Aden / Dayib Ali Gedi
Number Present:	**M:** 1 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Reconciliation: Whenever there is conflict the elders intervene and mediate between the conflicting parties.
- Support: The elders sometimes provide support to special groups like sick people. They highlight the problem and organize fund-raising.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers. They use natural resources like plants for healing.
- They do not ask for payment.
- They get the resources from the forest, especially during the rainy season.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

There are graves which is indicated on the map.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

No information provided.

5. Important rites of passage (what are they and how are they observed?)

- Circumcision is organization by the village elders. The age groups are taken to a special place and circumcision rites are performed.
- There are wedding ceremonies which are usually a very colourful ceremony.

6. What should the proponent know about entering a village? How is respect shown?

The proponent should show the “Wazee wa amani” which is “Elders of Peace” respect and humility.

FACILITATOR OBSERVATIONS

Comment
▪ The elders were well organised and welcoming. ▪ They are highly respected figure in the society. ▪ They resolve dispute among the community.

see attached map

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Mansabubu
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Mansabubu Women Group
Facilitator/Documenter:	Nathir Mohamed Gabow / Yussuf Abdi
Number Present:	4

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- They do business, for example selling at Mirra and retail shops.
- They are farmers.
- They keep animals, thus pastoral life.
- They train youth and elders.
- They work issues related to female genital mutilation.
- They work on issue about early marriage.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Mostly fathers are responsible in decision making. With single mothers the decision making lies with the mother.
- Mostly mothers do the management of money in houses but still there are some families where father do the management of capital.
- Responsibility for payment of school fees, health cost and water carrying varies. Sometimes fathers provide but in some cases mothers do work.

3. Ownership of land use rights, agricultural product, livestock, other assets

- Only people within community have the right to do farming along the communal land.
- Pastoralist from different part of county cannot come or cannot bring their animal without the consent of the community.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- They take part in political decision making. They also share leadership responsibilities, especially as it relates to women.
- Role of woman changes over time. For example, if a man fails to look after the animals, women do so.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

- Mostly single or divorced women are sometimes stigmatized when they cannot raise their children. In these circumstances, some families will offer some assistance.
- There is no household support they get from any place.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

- No family planning is done. People have an awareness about HIV/AIDS and its causes. Morality in this community is better than surrounding communities.
- No treatment, prevention is done through religious gathering.
- Adults and children are taken care of by regularly going for check-ups.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish	**No information provided**	**No information provided**	**No information provided**
Goat	Always	100	Varies
Chicken	Partially	20	Not ownership varies
Beef	Always	100	No information provided
Milk/yogurt	Abundant/ Partially	800 liter	No information provided
Rice	No information provided	No information provided	No information provided
Bush meat	No information provided	No information provided	No information provided
Wild plants	Seasonally	No information provided	No information provided

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- They help the family by looking after the animals and fetching water.
- They also help by selling in the retail shops.
- The hope for children is to be good person in the society hereafter.

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name: Garissa, Saka

Meeting Date and Time: 16 October 2018

Meeting Venue/Group: Saka

Facilitator/Documenter: Abdirahm Muktar / Ismail Mohamed

Number Present: **M:** 2 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

- Established in 1969.
- Early migrants were pastoralist and residents from the neighboring village.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

- There is available land.
- Cost - 400,0000Ksh.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

- Communal land is available and used for farming, settlement, hospital and schools. All are given land to construct.
- No one can take land without a permit from the local administrative.
- People are discouraged from living next to the river due to a fear of floods.
- You cannot just come and settle.
- No condition.
- Land is managed by the chief and elders.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

- Most people are pastoralist. A few are farming but they do not have a market for their products.
- Quarries.
- Soil for construction.
- Local people also collect firewood.
- Constraints:
  - No market for the farmers.
  - Floods.
  - High cost at the market
- Opportunities: Small opportunities.

5. Current ongoing village initiatives, what is the progress

Some run local business such as:

- Shops.

- Hotels.
- Butcheries.
- Groceries.
- Progress: They get some small income.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

- No source of revenue.
- No expenditure.
- Both men and women participate in all activities.
- Constraints:
  - Lack of knowledge.
  - No support to funding.
- Good relationship with the district Administration.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

Inputs from the Saka local community at large must be considered since they have a lot of fear about the impacts of the proposed project.

8. Request for village statistics if available

Current population (m/f)	750
No. of households	350
Births 2017	No information provided.
Deaths 2017	20
Population <15 **Population 15 – 54**	No information provided. 400
Population 55+	200
No. of in migrants	200
Current population (m/f)	No information provided
No. of households	No information provided
Agriculture areas	Yes
Grazing areas	Yes
Watering areas	Yes i.e. river, taps
Natural Sources	
Fuel wood cutting	Yes
Hunting	No
Fishing	**Yes**
Main travel routes	**Garissa**
Queries	
Fuel wood	

Sand	
Forest Conservation	
There's unallocated land	
Water resources yes, there is committee which runs the management and each house will pay 300 – per month	
No cultural sites	
Boundaries	
Saka	Sankuri
Saka	Mbalambala

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Garissa, Saka

Meeting Date and Time: 16 October 2018

Meeting Venue/Group: Saka

Facilitator/Documenter: Aden Abdi

Number Present: **M:** 3 **F:**

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted)

- Saka farmers do farming or plant crops just before the rainy seasons.
- Crops include maize, tomato and mangos.
- They do not do farming for economic reasons but just to feed their families.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done

Crop (Confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans						
Cassava						
Peas						
Maize						
Yam						
Rice						
Leafy Greens						
Cash crops						

3. Rotational system description, years in and out of cultivation, rotation of what crops

They do rotate the cultivation of most of their crops. Except for mangoes and pawpaw.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix)

- The farmer of Saka use a hands-on/manual system for harvesting.
- No animal tractors.
- They buy the seeds and they do not get any assistance from government or NGO.
- They use animal waste as fertilizer.
- Their main water source is River Tana.
- They employ labour from outside their family.
- Challenges include:
  - Floods.
  - Pest invade the farms.

– Lack of market.

5. Inheritance systems for land, alternative means to acquire land for adult children

- Group of people come together and start the farm as a group or as community.
- They identify the land and inform the government and after approval from government they divide and distribute the land among the group.
- Most of the farmers farm/land is too small to subdivide among their children.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year

- The farmers keep animals (mainly cows and goats).
- Their pastures are plenty, so much so that they harvest the grass.
- The livestock product is for family maintenance.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.)

Challenges include:

- The land quality is good unless affected by flood. When floods occur, the farmers must wait for about three months before they start farming again.
- Diesel for the generator. Some of the generators are not fully operational.
- No availability of inputs.
- No credit.
- No market.

8. Family labour distribution for agriculture and livestock activities – use matrix

Activity (Confirm activities with participants first)	Adult Male	Adult Female	Child Male	Child Female	Aged
Clearing					
Other land preparation					
Planting					
Weeding					
Harvesting					
Post harvesting processing					
Herding					

9. Available extension services (government, NGO,) for agriculture and livestock, quality

No information provided.

10. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

FISHERS FOCUS GROUP

Village Name:	Garissa, Saka
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Saka
Facilitator/Documenter:	Aden Abdi
Number Present:	**M:** 12 **F:**

1. Describe fishing industry structure and organization. Use seasonal calendar and map areas of use (i.e. are there areas of the bay that are 'leased'?) Associations and roles.

Only one man by the name of Husein Siyet Gure does fishing in Saka village. River Tana is his fishing area and it is the only water source in the village. He usually sets up his net during the afternoon and comes back in a day or two, depending the catch.

2. Typical catch (volume) by species; pricing. Use matrix.

The fisherman does not know the types of fishes or the species by name. He makes a weekly amount of 3,500 – 6,000 Ksh depending the size of the fish.

3. Access to markets; extension services.

There are two markets available to him, the first one is the people of Saka village and the other one is the Chinese Contractors, who are constructing the Nairobi – Garissa road. He recently extended his services to the market of Garissa Township.

4. Incomes and earnings per job—i.e. do net makers get % of catch or cash?

He pays the net makers on a daily basis, that is whenever the work is done, he pays them there.

5. Inputs and costs of inputs (i.e. nets, etc.)

He uses net to catch the fish and twigs or sticks from nearby forest trees. He pays the laborer about 2,000 KSh.

6. Tourism related activities?

The Saka village is a remote area, therefore no tourism activities.

7. Is fish/ crab, etc. an important food source in this community?

The community here prefer goat, cow or camel meat to that of fish. Very few people consume or like fish as an important food source. However, oil from the fish is used for medicinal purposes.

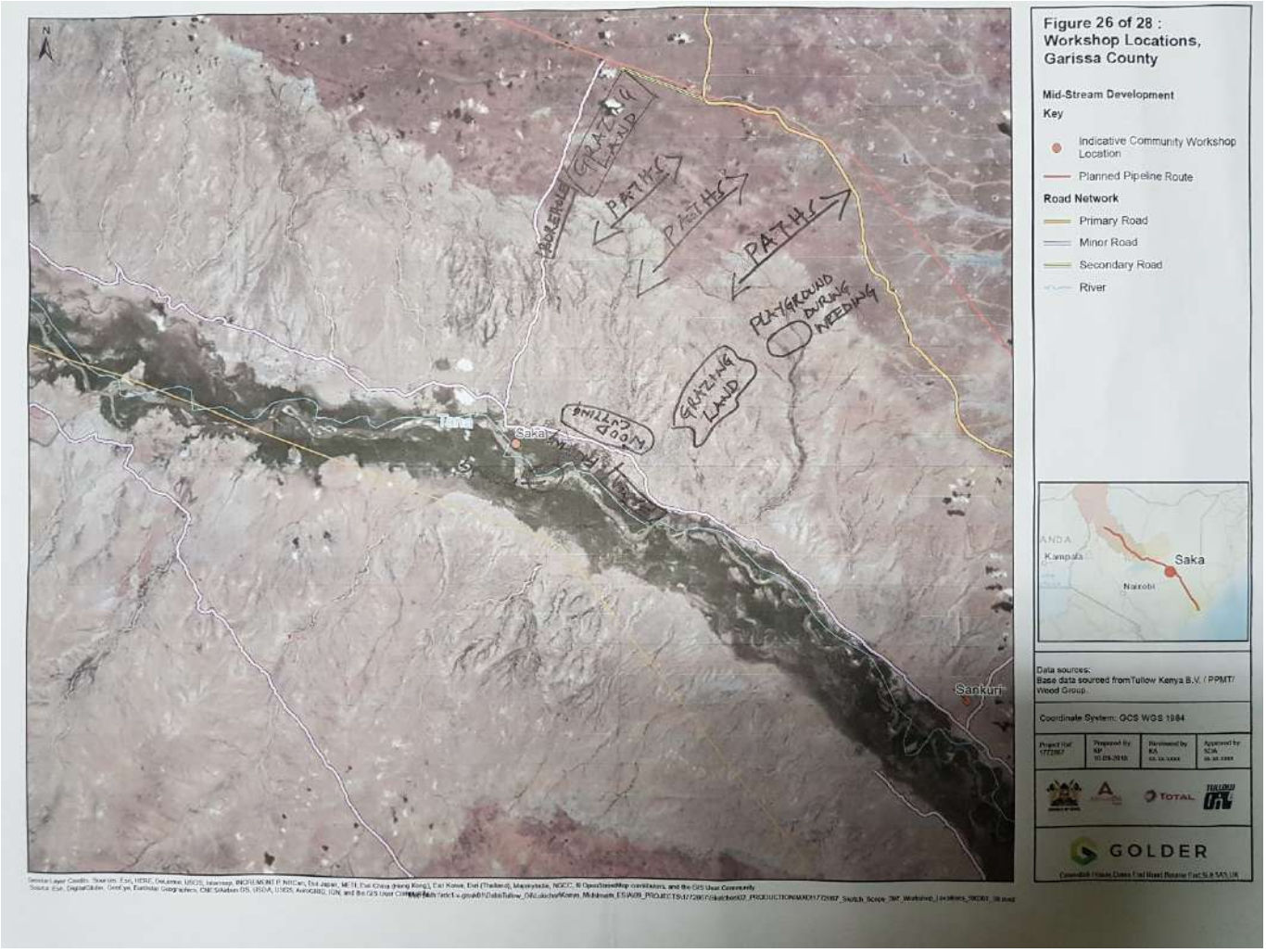
8. Constraints and opportunities.

Constraint include lack of market, poor transport system and lack of boats.

9. Do you have concerns about the Project on marine resources?

He has no concern about the project on marine resources. He believes it will provide a market for him during construction.

See attached map



PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Garissa, Saka
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Saka
Facilitator/Documenter:	Abdirahim Muktar / Ismail Mohamed
Number Present:	**M:** 3 **F:**

1. Herding activities (Use seasonal calendar).

Herding activities include:
- Camel – Followed.
- Cattles – Protected.
- Goats – Treated.
- Donkeys.

2. Requirements for water, when, from where, in what quantities per animal

- River.
- Taps and they pay depending the number of animal they have.

3. Economics: average herd size

Average size varies, some have more, some less.

4. Extension services; veterinary services.

Veterinary yes, but they are rare, may be once in a year.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

Pathways: In between the minor road and the primary road indicate in the map.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent hh on Ere)

They have short term and long term homesteads as they look for greener pasture for their animals.

7. Travelling in what size of group? Are these family or lineage groups?

Travelling in single and groups for both family and lineage groups.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- No hunting.
- Yes fishing.
- There is a cultural site i.e. Saar – local language.
- Indicates in the map.

9. Groups representing pastoral groups. Mandate, range management, etc.

- They follow their animals.

- Treatment of their animal.
- Protect their animal.
- Watering activities.
- No range management.
-

10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)

The concern about the project:

- They are afraid that harm may come to their animals, for example, their animals might fall into holes/excavations created during construction.
- They are also afraid that the project might cause deforestation.
- They want proper management of the project and proper consideration of stakeholder concerns of the Saka community given that this community will be hosting the pipeline infrastructure.
- They fear that leaks or damage to the pipeline might cause them loss or damage. Since they are pastoralist and can settle anywhere and the means of light they use is fire, a leak in the pipeline might have severe consequences.
- They are afraid that the pipeline project may cause disturbances to the production of their animals and also milk production.

See attached map

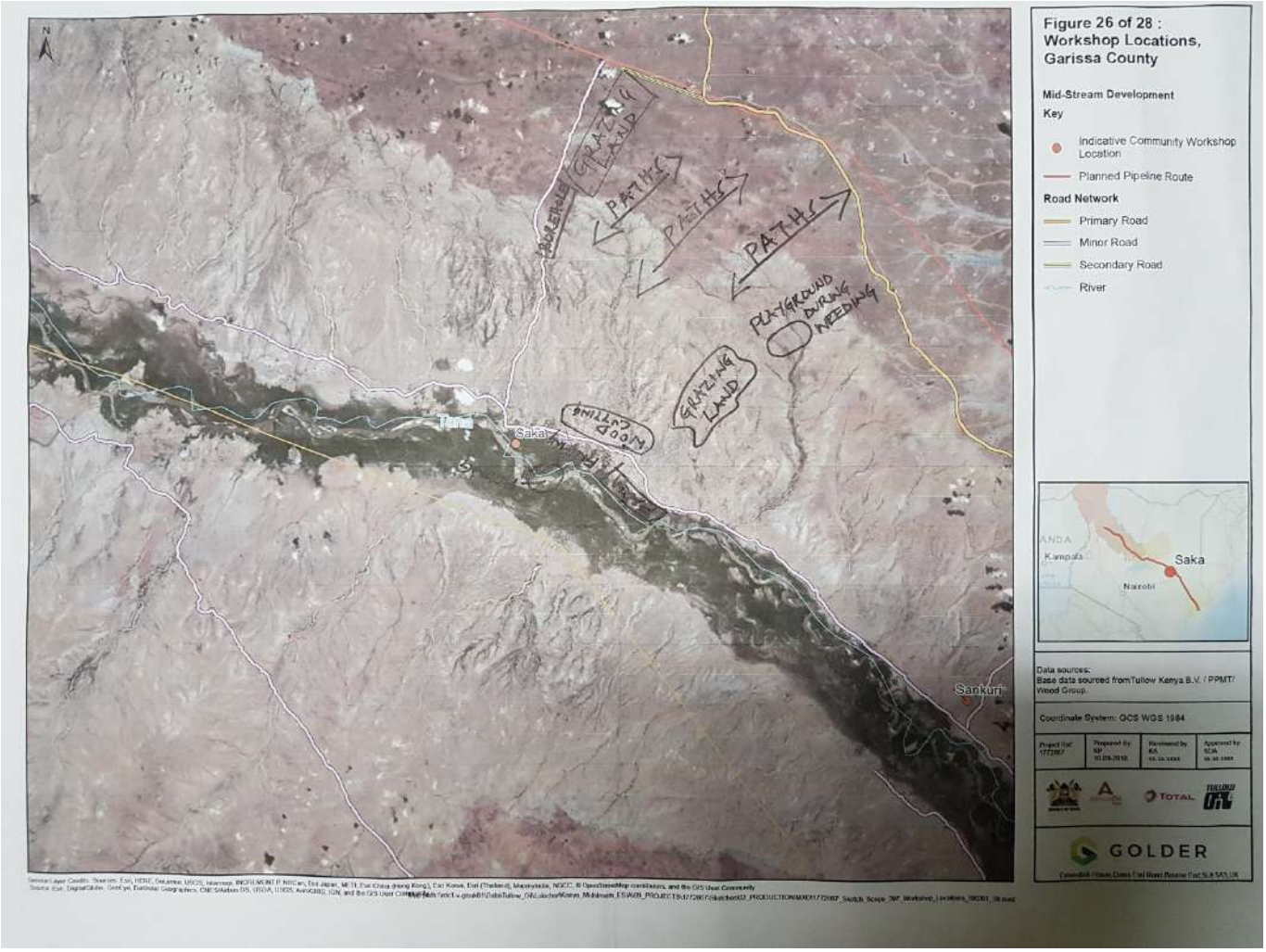


Figure 26 of 28 :
Workshop Locations,
Garissa County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
Road Network
Primary Road
Minor Road
Secondary Road
River
Saka
Sankuri
Kampala
Nairobi
Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group.
Coordinate System: GCS WGS 1984
GOLDER

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Saka
Meeting Date and Time:	16 October 2018
Meeting Venue/Group:	Saka
Facilitator/Documenter:	Abdirahim Muktar / Ismail Mohamed
Number Present:	**M:** 5 **F:** 1

1. Contributions/responsibilities to households.

- Small scale farming.
- They follow animals.
- Business.
- Some are drivers.
- Some are teachers for both secular and religious.
- Some idlers (unemployed people).

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

Difference of the youth, constraints: their interests differs

- Negligence.
- Lack of proper family management.
- Lack of fees.
- Family dispute i.e. school dropout.

Opportunities:

- Empowerment.
- Job creation.
- Some assistance as a group i.e. funds.
- Capacity building.

Age of marriage:

- 18 and above.
- Circumcision.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Education: They value education since without it you will be in the dark.
- Lack of jobs will lead them to be discouraged.
- Access to technology they used Facebook, WhatsApp.

4. General labour force characteristics and job readiness.

Labour force:

- Fishing.
- Farming.
- Driver.
- Barber.

- Local business.

Job readiness. They are eagerly waiting.

5. HIV awareness.

HIV awareness: They know HIV as it is a killer disease but they need more sensitization.

6. Political and social participation (ask about traditional authorities, changing values due to money).

They take part in politics but participation is seasonal since it comes during campaign period.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Balambala
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Balambala Village
Facilitator/Documenter:	Abdirahim Muktar / Ismail Mohamed
Number Present:	**M:** 1 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

- Balambala village was established in 1963 by pastoralists who were the early settlers in the area.
- The first people who attempted to settle after this date visit were the Munya's. Conflict arose between this group and the early settles and the result was that the Munya's were displaced.
- There is in-migration to the village.
- Reason for migration is when people lose their livestock they, migrate to the village to live.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

- Yes, there is land availability.
- Plots of 50/100 worth 200, 000 Ksh depending the center of the plot.
- The same size plot is worth 500,000 Ksh if located in town.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

Yes, there is communal land. It is used for:

- Farming.
- Grazing.
- Bee keeping.
- Settlement.

Regarding by laws, no outsider can settle without consent from and prior consultation with the community. This is to protect scarce resources. The following general rules apply:

- No one can come and allocate for himself a big amount of plots within Balambala.
- No fees are charged but there is arbitration through the "Wazees"(Elders). Under condition that you must come and convince the community.
- Disputes are resolved through "Wazees" and Chief, managed through traditional ways.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

Economic activities include:

- Livestock.
- Bee Keeping.
- Small business.
- Farming.

Economic development includes:
- Education.
- Livestock rearing.
- Employment.

Constraint include:
- Drought which leads to poverty.
- Education development is limited.
- Hospital facilities are scarce.
- No infrastructure.
- No market for livestock.
- No transport.

Opportunities include:
- The river in the area is not fully utilized.
- They have animals but no market at all.
- Sand for construction.
- Quarries are available for construction.

5. Current ongoing village initiatives, what is the progress

Initiatives include:
- Construction of polytechnics is ongoing.
- Another project of expanding water.
- A big market for the village.

Progress with these initiatives is unfortunately very slow.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

Sources of revenue:
- No source of revenue.
- No expenditure.
- No public participation.
- No female participation.

Constraints:
- No evolvement.
- Bad leadership.
- Unskilled labour.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

- Balambala community are welcoming people, good listeners and very cooperative.
- They have different opinions and they have good perception toward the project.

8. Request for village statistics if available

Current population (m/f)	No information provided.
No. of households	1200

Births 2017	No information provided.
Deaths 2017	No information provided.
Population <15 **Population 15 – 54**	No information provided. No information provided.
Population 55+	No information provided.
No. of in migrants	100

FACILITATOR OBSERVATIONS

Comment
Information indicated on the map
Agriculture areas: Yes Grazing areas: Yes Watering areas: Yes Fuel wood cutting: Yes No hunting There is limited medicine gathering. They do plant gathering at the forest. No fishing
Main travel and public transportation routes include: To Garissa ▪ Pickups ▪ Lorries ▪ Buses To Escort ▪ Pickups ▪ lorries
Communal land resources: Yes, there is Unallocated village land: No Communal water resources: from the river. Community cultural sites: No cultural site.
Village Boundaries: Balambala- Kuno Balambala – Jarjara Balabala – Oltio Balambala – Tana River

See attached map

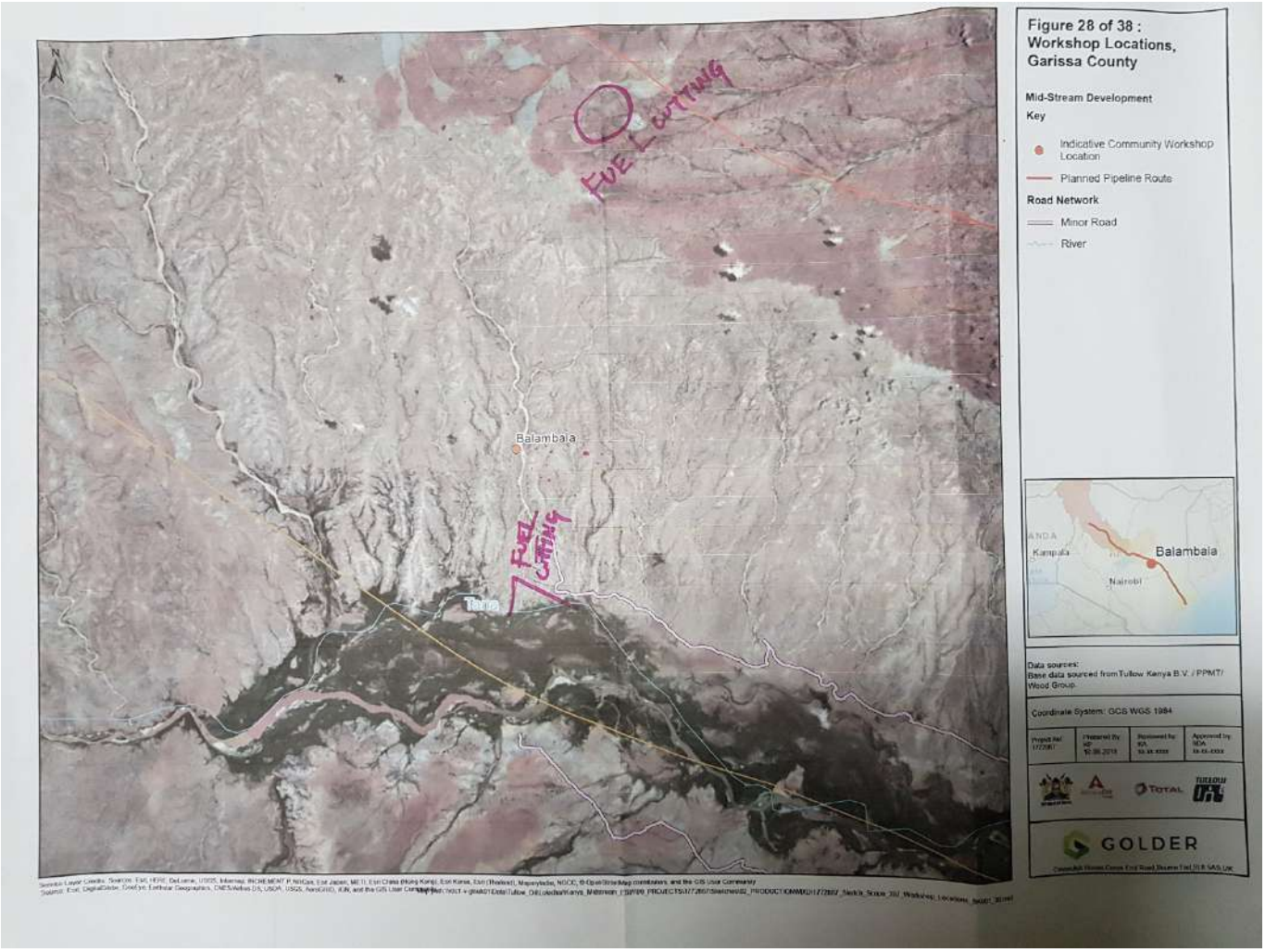


Figure 28 of 38 :
Workshop Locations,
Garissa County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
Road Network
Minor Road
River
Balambala
Tana
FUEL CUTTING
FUEL CUTTING
Kampala
Nairobi
Balambala
Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group.
Coordinate System: GCS WGS 1984
GOLDER

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Balambala
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Balambala Village
Facilitator/Documenter:	Aden Abdi
Number Present:	**M:** 2 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

The role of Balambala elders includes making decision on politics, general welfare of people, security, educating the youth, upholding morals and peaceful dispute resolution.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

There are a lot of traditional healers. The healers here use natural resources for healing. Trees from which materials are sources include the "Anariki", "Darkern" and "Hagar". These materials are harvested from the nearby bush. The healers are paid depending on the kind of medicine you need.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

Graveyards are the only sacred sites in this village.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

There are no special areas that are taboo.

5. Important rites of passage (what are they and how are they observed?)

No information provided.

6. What should the proponent know about entering a village? How is respect shown?

- The Proponent must arrange to meet the Chief, Assistant Chief and elected leaders.
- The workers on the pipeline should respect the culture of the community.
- As Muslim, the community adheres to strict Islam teachings.
- The community must officially know people entering the village.
- The pipeline workers must not come with foodstuff and other items from outside Balambala. They should buy from the local community.
- The community demands to be given employment from the pipeline and people should not be brought from other places.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Balambala Village
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Balambala Sigale Youth Group
Facilitator/Documenter:	Abdirahim Muktar / Ismail Mohamed
Number Present:	**M:** 2 **F:**

1. Contributions/responsibilities to households.

- New ideology.
- Some are entrepreneurs.
- Self-employed.
- Unite youths.
- They also fight for the right of the youths.
- Protection in the family.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

Constraints include:

- Unemployment.
- Lack of capital.
- Idleness.
- Disobedience.
- Drug abuse
- family disputes.
- Having different interest.

Opportunities include:

- Youth empowerment.
- To educate them.
- Job opportunities.
- Skills.

Age to get married:

- Boys: 18
- Girls: 15

Rites of passage include circumcision.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- They have a negative perception towards education because when they complete their schooling they have no hope to find employment because of the high rate of unemployment.
- Education does not provide them with hope for the future.
- They have access to technology and social media platforms such as Facebook and WhatsApp.

- They migrate to look for work.
- They have no emails.

4. General labour force characteristics and job readiness.

- Some are carpenters.
- Tailoring.
- Shop keeping.
- Butcheries.
- Hotels.
- They are ready for employment but there are no opportunities for the youth.

5. HIV awareness.

Those who are educated know, understand have a general awareness of HIV. Those who are illiterate do not know, understand or have any awareness of the disease.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- They participate in politics during campaign periods.
- They consider elections to merely be a “rubber stamp”.
- They feel that that the youth are “used and dumped” before and after elections.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Balambala
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Balambala Village
Facilitator/Documenter:	Aden Abdi
Number Present:	2

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- The main economic activities of Balambala women include miraa(Khat)selling, kiosks, milkselling, mitumba(Second-hand clothes), vegetable vendors etc.
- Most of the people are pastoralists and sometimes the market moves.
- There are plenty of employment opportunities but because of poverty only 15% of women are employed.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Women assume responsibility for household tasks and are predominantly responsible for taking care of their families.
- Some women pay school fee and health cost of their children.

3. Ownership of land use rights, agricultural product, livestock, other assets

50% of the women in Balambala own land. They also own farm land livestock.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

Women have engaged in social organization. There are about 20 women groups. Women also participate in political decision making. Women have no problem with the change of roles.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

Single women are not stigmatized. However, they do not get help from the community. They take care of themselves.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

Women are aware of HIV/AIDS. However, there is need for more awareness.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

50% of households can afford 3 meals a day. These meals are however comprised mostly of vegetables. There are shops in the area that can provide food for those who can afford it. Goat, chicken and rice is readily available in the village.

Product	***How often***	***How much for an average family***	***Other comments***
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- Children start school at 5 years. They leave primary school at 14 years and secondary school at 19 years.
- Most of the children drop out of school. Reasons for dropping out of school include:
  - Pastoral lifestyle.
  - Early marriage.
  - Lack of fees.
  - High poverty level.
  - Lack of teachers.

9. Map to the extent possible/relevant with the group

No mapping information provided.

FACILITATOR OBSERVATIONS

Comment
General opinion in pipe line: They do not see any employment opportunities for women. They also do not believe that there will be any compensation for women related to the pipeline activities.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

BEE KEEPER FOCUS GROUP

Village Name:	Garissa, Masalani
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Masalani Social Hall
Facilitator/Documenter:	Mohamed Khalif / Dayib Ali Gedi
Number Present:	**M:** 2 **F:**

1. Describe activity with typical seasonal calendar include frequency and duration of specific activity

- Bee keeping season is usually between October and December which falls in the rainy season.
- Dry season availability of honey is very rare.

2. Where are hives located? Do you have access to good hive locations?

- Bee hives are kept near the homes.
- There are no constraints to accessing the bee hive locations.

3. How many hives do you have? What is the average no. of hives? (please estimate)

On average, a person may own two bee hives. One bee hive can approximately produce 8 x 3 litres containers of honey, i.e. 24 liters of honey in total.

4. What is the average production per season per hive? Yield per season.

The honey harvested has various uses:

- Used at home as food.
- Used as medicine, traditional medicine men highly recommend honey for some ailments.
- It is also sold at a cost of about 3,000 KSh per 3 liters of honey.

5. Use of product (honey, alcohol, etc.) Market? % sold? Pricing (if relevant)

- Men are the main source of labour both in the honey hunting mission and harvesting.
- The honey is taken to the market by the person who harvested it.

6. Family labour required for bee keeping (men, women, children, doing what exactly for bee keeping, production and marketing?

The cost involved is mainly for the labour effort of the person who must look for honey bees and construct the bee hives.

7. Other inputs and costs (hives, places to put hives, casual labour, etc.) and sources.

- The beehives are constructed from a famous traditional “Gares” tree. The trunk of the “Gares” tree open on both ends.
- Of late, people are adopting timber to construct bee hives.

8. Hive building –what materials do you need, life of hive, skills required?

There is no support or aid at all in the bee keeping industry.

9. Are there Extension services?
No information provided.
10. Are there bee keepers associations to access services, funding for projects?
No groups or associations which advocate for the wellbeing of the bee keepers.
11. Hopes and aspirations—plans for the future? Plans being implemented? How?
The bee keepers would highly welcome any support or aid afforded to them, for example they would like to have modern bee hives.
12. Constraints and Opportunities—Quality, technology, marketing.
No information provided.
13. Map to the extent possible/relevant with the group
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Bothai
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Masalani Social Hall, Ijara Village Elders
Facilitator/Documenter:	Nathir Mohamed Gabo / Yussuf Abdi
Number Present:	**M:** 4 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders resolve family disputes.
- Provide for the family needs.
- They look after the animals.
- They prepare medication for both animals and humans.
- Their role changes from elder to security personnel.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- Yes, there are traditional healers. They use natural resource to heal their clients. The use aloe Vera, tira (Somali names). Also, dinsa (madax bubuq) (Tuqa) (gras). Most of these trees are used for treating ulcers, blood pressure and for women who are giving birth. Some of these tree names are written in the local Somali language.
- Traditional healers are given money and animals. They collected from the forestry of Bothai and surrounding bush in the Ijara community.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are places not to be visited or touched such as graves.
- Some of these trees are a source of fruit for the community.
- There are also trees used for prayer, especially women prayers.
- A committee of elders and other responsible individuals must be consulted about the location of these sites.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

It is not a taboo to visit the areas and around the proposed pipeline.

5. Important rites of passage (what are they and how are they observed?)

Important rites are performed by the community:

- Once every eight years.
- Once in a year.
- Once a month.
- During a drought, prayers for rain.

6. What should the proponent know about entering a village? How is respect shown?
▪ You should know the culture and taboos of the family. For example, it is polite to greet only the older men. It is considered taboo to greet the women. ▪ Guests are welcome and will be accommodated. The Proponent representative will be asked about the aim of his aim of visit.

FACILITATOR OBSERVATIONS

Comment
▪ Since the respondents were not in their hometown of Ijara, the facilitator cannot respond to the questions of some residents who are not present at the current meeting. ▪ The general view of the meeting attendees is that stakeholder engagement should have taken place in the town/village of Ijara. ▪ Ijara is said to be insecure due to Al-Shabab militia group.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Garissa, Masalani
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Masalani Social Hall
Facilitator/Documenter:	Mohamed Khalif Aden/Dayib Ali Gedi
Number Present:	**M:** 1 -Dadle Shurie Muhamed **F:**

1. Herding activities (Use seasonal calendar).

- During the rainy season the animals are kept at home or at the permanent structures.
- During the dry season the animals move to other areas where the community settle temporarily.

2. Requirements for water, when, from where, in what quantities per animal

- Water is mainly obtained from water pans.
- Water is readily available during the rainy season.
- During the dry season the community moves to where there is water.

3. Economics: average herd size

- Average herd size for goats and sheep is = 100
- Average herd size for cattle is = 100

4. Extension services; veterinary services.

- There is no support from either the national government or the county government.
- No veterinary services are provided in the area. In some cases, people have gone a step ahead by buying veterinary services.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

Routes and paths are indicated on the map.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent hh on Ere)

Temporary settlements during the dry season have been identified and are indicated on the map.

7. Travelling in what size of group? Are these family or lineage groups?

Normally the people move together in groups, not necessarily from the same family lineage.

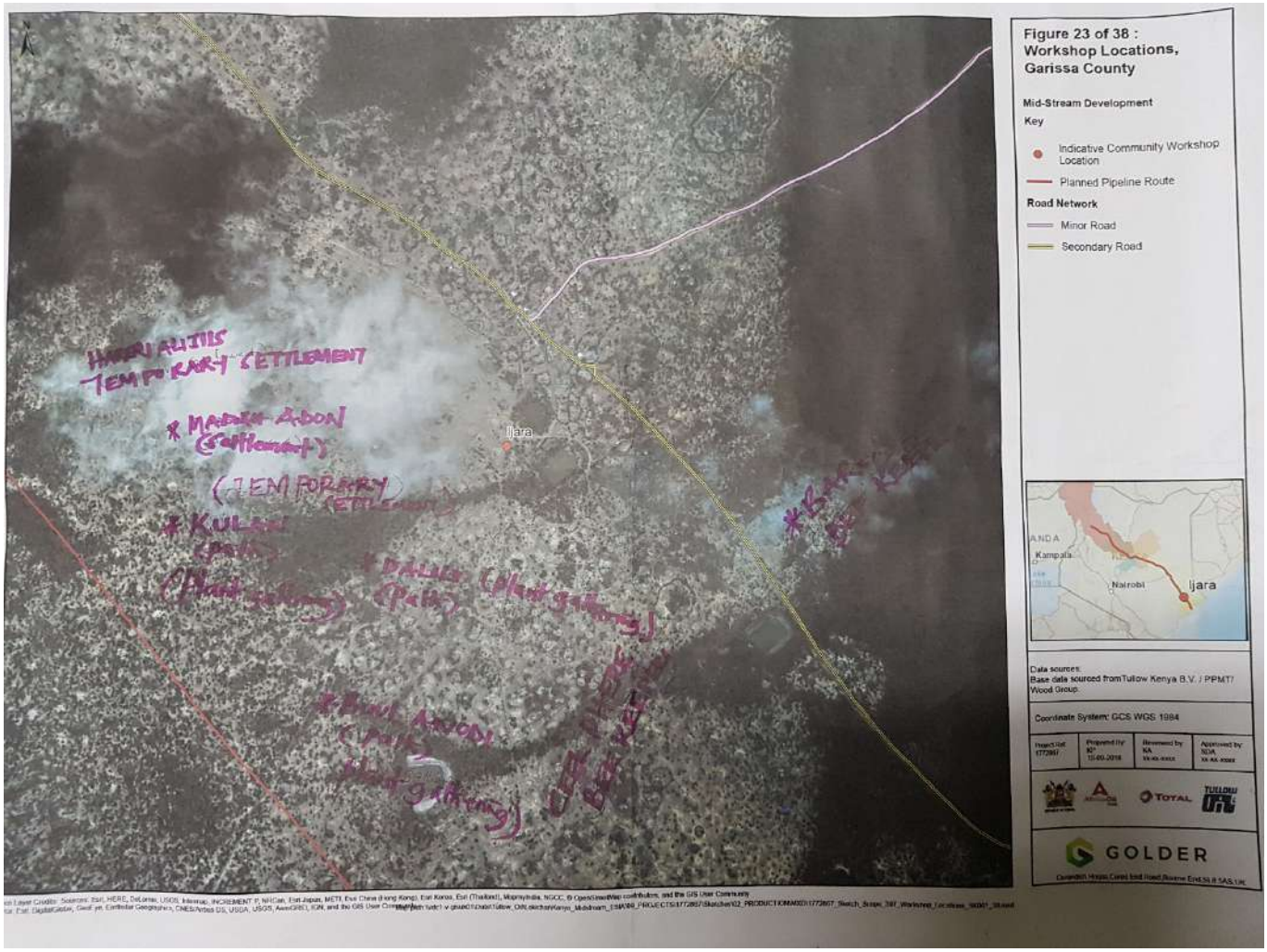
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

Plant gathering is very common. The plants gathered are used for treating illnesses. The plants are also used for constructing traditional houses.

9. Groups representing pastoral groups. Mandate, range management, etc.
There are informal groups that normally decide when and where the animals can be moved to for greener pastures.

10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)
Concerns include: ▪ Bee keeping business will be risked if the pipeline passes through the forest. ▪ Plant gathering for construction of houses and making traditional mats will be affected. ▪ Grazing land for animals will also be affected. ▪ Farmers will also be affected. ▪ Traditional herbs used to treat people may also be cleared.

See attached map



PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Masalani
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Masalani Social Hall
Facilitator/Documenter:	Mohamed Khalif Aden / Dayib Ali Gedi
Number Present:	1

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

Women economic activities are groceries, livestock keepers.

Groceries:

- Women in this area sell groceries such tomatoes, potatoes, mangoes, etc.

Livestock:

- Women in these areas keep goats, cattle, and sheep for the domestic use.
- They sell milk, meat and hides.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Leadership roles are reserved for respected elders. Men are responsible in decision making and money management. Women are rarely responsible for payment of school fees and health cost.
- Income generating activities is reserved for men.
- Water carrying is a role reserved for women.

3. Ownership of land use rights, agricultural product, livestock, other assets

Ownership of land:

- Women in Ijara area are not entitled to ownership of land right. Land was inherited from "the great grandfather" and has been passed from one generation to another.

Agricultural product:

- Women in Ijara rarely participate in farming and any agricultural produce.

Livestock:

- Livestock rearing is the primary economic activity for the greater population in Ijara Town.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- Many women groups have been formed by the indigenous Ijara women in an attempt to improve living standard for the county.
- Women in Ijara Town rarely participate in political decision making as the men are perceived to be "mighty and responsible" for the family political decisions.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

9. Map to the extent possible/relevant with the group
Map attached/No mapping information provided.

FACILITATOR OBSERVATIONS

Comment
NOTE: FOCUS GROUP MEETING WAS INTERRUPTED BY HEAVY DOWNPOUR WHICH MADE COMPLETING THE MEETING IMPOSSIBLE.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Garissa, Masalani, Bulagolol Village
Meeting Date and Time:	17 October 2018
Meeting Venue/Group:	Masalani Social Hall
Facilitator/Documenter:	Nathir Mohamed Gabow / Yussuf Abdi
Number Present:	**M:** 1 **F:**

1. Contributions/responsibilities to households.

- They look after the animals.
- They help their parents to construct bee hives.
- They work for the family.
- They do business.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Sometimes an educated youth abandons his/her culture and is later deemed to be unable to differentiate between good and bad by elders in the community. In these circumstances, the prescribed corrective action is early marriage. This, it is believed, is the best ways to keep the dignity of the family and social life of the community.
- The youth are well conversed in all rites of the community.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The youth sees education as the light and the only hope for them.
- They are also hopeful to get employed.

4. General labour force characteristics and job readiness.

- Youth provide the highest labour to the family.
- The unemployment rate is very high.
- Regarding job readiness, the youth are "highly available".

5. HIV awareness.

They are aware of HIV, however nobody is currently doing any awareness campaigns.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- They participate socially through a traditional way of life.
- The youth form the largest number of voters.
- They contest for political posts.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Garissa, Dagoob
Meeting Date and Time:	18 October 2018
Meeting Venue/Group:	Dagoob
Facilitator/Documenter:	Abdirahim Muktar / Ismail Mohamed
Number Present: *attendance register attached	**M:** 1 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)

- Dagoob Village was established in 1998.
- Local people originated from Libahlow.
- In-migration due to developments such as schools.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)

- Yes, there is a lot open plots. However, during the rainy season the locals farm on the vacant land.
- 50/100 is worth about 50,000 KSh.
- The same size plot could be worth up to 100,000 KSh if located close to the road.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)

Communal land is used for:

- Farming (10km).
- Grazing.
- Settlement.
- Road i.e. pathway.

By laws:

- If you need a plot, you can get permission to buy land from the chief.
- For those who wish to farm, an agreement is concluded and permission is granted.
- No one is permitted to simply arrive and occupy a large portion of land for themselves.
- Before anyone can settle or farm on the land, a permit must be obtained from the chief and the locals.
- The sub-chief is responsible for land management.

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities)

Economic activities include:

- Infrastructure (i.e. the mumram of the county is part of it).
- They need water.
- Education facilities is very limited.
- They also need health facilities.

Migration is very high.
Constraints include:
- Some small conflicts occur because of scarcity of water.
- Poor roads.
- Lack of health facilities.

Opportunities include:
- No opportunities for the last 3 years.

5. Current ongoing village initiatives, what is the progress

No developments, no village initiatives going on here, no progress.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration)

- No source of revenue.
- No participation in village initiatives.
- They take care of their animals.
- They do farming.

Constraint to participation include:
- No development projects involving the locals at all.
- No new development.

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government)

- Dagoobis a developing village which is experiencing an influx of new migrants. There is thus a need for an HIV/AIDS awareness campaign since they have no knowledge about the virus.
- They also have seasonal farms which covers about 10km from the town.

8. Request for village statistics if available

Current population (m/f)	10,000 population
No. of households	380 households
Births 2017	50
Deaths 2017	6
Population <15 **Population 15 – 54**	No information provided. 9,000+
Population 55+	35
No. of in migrants	For the last 2 months 120

FACILITATOR OBSERVATIONS

Comment
- Agriculture areas: Yes - Grazing areas for cows: Yes - Watering areas for cows: Yes

Comment
▪ Fuel wood cutting: No ▪ Medicine gathering: No ▪ Other plant gathering ▪ Fishing: No ▪ Housing materials: the chief and the locals will agree and reach consensus to go and fetch some materials from the forest.
Travel routes ▪ GSA ▪ Balambala ▪ Libahlow ▪ Public means transport
Communal land resources: Seasonal farms Unallocated land: No Water resource: Earth dams. Cultural sites: Yes ▪ i.e. Ropes. ▪ Traditional house materials for sale.
Boundaries: ▪ LagderaIsiolo ▪ Tana River.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Garissa, Dagoob
Meeting Date and Time:	18 October 2018
Meeting Venue/Group:	Dagoob
Facilitator/Documenter:	Aden Abdi
Number Present:	**M:** 2 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elder's role is security, conflict resolution.
- Contribute to household like looking after animals, discuss the benefits of the village.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

10% of the village men are traditional healers. They use natural resources like twigs, roots, leaves of specific trees from the bushes nearby. They are paid and charge depend on the sickness.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

No sacred sites.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

There are no sacred or special places that are taboo. However, they want the areas that they do farming and grazing to be respected.

5. Important rites of passage (what are they and how are they observed?)

No rites of passage.

6. What should the proponent know about entering a village? How is respect shown?

- They want the visitor first to inform the chief who will then inform the village elders. They want their tradition and beliefs to be respected.
- The visitors should respect the community culture.

FACILITATOR OBSERVATIONS

Comment
▪ The community are concerned about their farming and pastoral land. ▪ The community requires more civic education on the importance of the pipeline project.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Garissa, Dagoob
Meeting Date and Time:	18 October 2018
Meeting Venue/Group:	Dagoob
Facilitator/Documenter:	Abdirahm Muktar / Ismail Mohamed
Number Present:	**M:** 2 **F:**

1. Herding activities (Use seasonal calendar).

Herding activities:
- Camels.
- Cattle.
- Goats.
- Donkeys.

They protect.
They treat.
They follow at morning and bring back at the evening.
They do watering.
They do migration when lack for pasture.

2. Requirements for water, when, from where, in what quantities per animal

- Earth dam.
- River but depend on the season.
- Seasonal dams.
- Quantities of water is very low.

3. Economics: average herd size

Animals at Dagoob varies.
- Some have more.
- Some less.

4. Extension services; veterinary services.

- They get once in a year for veterinary treatment.
- They mostly come when they hear that there is a big outbreak of disease.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable

- No map for Dagoob.
- Pathways of the animals is everywhere.

6. Are there places where you establish short term or longer term homesteads? Use map. Do you need permissions to stay in some places? (i.e. permanent hh on Ere)

- They have short term homesteads.
- Long term homesteads also available.
- Depending on the season they are in.

- You must have a permission when you want to settle in Dagoob.

7. Travelling in what size of group? Are these family or lineage groups?

- They travel in singles.
- They also travel in groups.
- For both family and lineage groups.

8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?

- They have cultural sites for events such as weddings and entertainment.
- No maps.
- No hunting at all at Dagoob.
- Their activity is to herd.
- Their siblings also follow the animals.
- They protect the animals.
- When they are sick, they treat the animals.
- They look for greener pasture.

9. Groups representing pastoral groups. Mandate, range management, etc.

No range management

10. Do you have any concerns about the Project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)

According to them the project has both negative and positive impacts.
Negative impacts include:

- It can destroy the pasture areas.
- Those “pathholes” can be damaged to their animals since its open space.
- It can affect the production of their animals.
- Also, they are saying it can affect the milk production.
- They are saying it will minimize the movement of the community.

Positive impacts include:
It can create jobs for the locals.
The government can assist them to with the following:

- Infrastructure i.e. roads.
- To dig boreholes and dams.
- Schools.
- Madrasas.
- Hospitals.

They plea the government to consider their request in one way or the other since they are citizens.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Garissa, Dagoob
Meeting Date and Time:	18 October 2018
Meeting Venue/Group:	Dagoob
Facilitator/Documenter:	Abdi Aden
Number Present:	2

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- Dagoob is a small village of about 50 households.
- Women here have no economic activities.

2. Characterization of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

All the household roles are done by men. Women stay at home do cooking, cleaning and look after children.

3. Ownership of land use rights, agricultural product, livestock, other assets

No women who own land.

4. Social organization (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

No social organization.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of hhs?)

Single women are taken care of by their families. There is only one single women in this village.

6. Health and reproductive health (access and use of family planning, HIV awareness—causes, prevention, treatment, preventative health care for children and adults)

Women here have no idea what family planning. There never got educated on HIV/AIDS, its causes and prevention.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			

Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)

- The village does not have a complete school. It goes up to class 4. About 10% of children here attend school.
- They are pastoralist and look after animal.

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

FISHERS FOCUS GROUP

Village Name:	Lamu, Mokowe
Meeting Date and Time:	24 October 2018
Meeting Venue/Group:	Bandari Salam Fisheries group
Facilitator/Documenter:	Peter Kiiti/Patricia Syombua
Number Present:	**M:** 7 **F:**

1. Describe fishing industry structure and organisation. Use seasonal calendar and map areas of use (i.e. are there areas of the bay that are 'leased'?) Associations and roles.

- The members reside in the Mokowe area.
- The group comprises more than 30 members.
- Fishing grounds are located at Dununi, Kiunga, Kipungani, Kililana and Manda Bruno.

2. Typical catch (volume) by species; pricing. Use matrix.

TYPE	VOLUME	PRICING (KSh)
Crab and lobster	2 – 5 kg	1 000/kg
Tuku, Tafi (rabbit fish), Mbawa, Mkizi (bluespot mullet), Tewa(redmouth grouper)	Up to 200 kg	200/kg

- Collectively the group can catch up to 3 tonnes of fish per day.
- Each person can make up to KSh 2 000 per day.
- The types of fish caught depend on the season, for example in November, Tamamba is caught.

3. Access to markets; extension services.

- The fishers sell locally to individuals and hotels on Lamu Island.
- They also sell their fish in the towns of Malindi and Mombasa.

4. Incomes and earnings per job—i.e. do net makers get % of catch or cash?

- Shares differ percentage-wise per individual, and according to net makers, outboard motor and boat providers.

5. Inputs and costs of inputs (i.e. nets, etc.)

6. Tourism related activities?

- The fishers sell crab and lobster to tourists at a fair price.
- They also receive an income from hiring boats to take tourists to deep sea fishing.

7. Is fish/ crab, etc. an important food source in this community?

- Fish and crab are important sources of food but these products are frequently sold to provide an income for other household expenses.

8. Constraints and opportunities.
Constraints: ▪ There are numerous challenges in the rainy seasons such as a lack of umbrellas or cover to shield themselves during rain; heavy waves and winds during rainy period that makes it difficult to fish and they don't have the boats to sustain such big waves and strong winds. ▪ There is a shortage of machines, nets and fuel. **Opportunities:** ▪ Create income for net makers and machine providers. Fishers anticipate that the project will create market opportunities which will result in an increase in income. ▪ The fishers are in a tourist catchment area.
9. Do you have concerns about the project on marine resources?
▪ Oil spills will kill the fish. ▪ Oil spillage will also cause the mangroves to dry up, and this will in turn reduce the numbers of fish since they use mangroves as hatching sites. ▪ There is a fear of the transmission of disease and infections to the community. They fear that oil spillage may result to biomagnification and bioaccumulation.

See attached map

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Lamu, Mokowe
Meeting Date and Time:	24 October 2018
Meeting Venue/Group:	Hapa Hapa guest house
Facilitator/Documenter:	Mohammed Kitete/Esther Wairimu
Number Present:	**M:** 4 **F:**

1. Herding activities (use seasonal calendar).

- The herders keep cattle who fare well during the rainy season.
- They also keep goats.

2. Requirements for water, when, from where, in what quantities per animal.

- Herders source water from boreholes, seasonal dams and ponds for their cattle.
- Each cow consumes at least 40 litres of water per day.

3. Economics: average herd size.

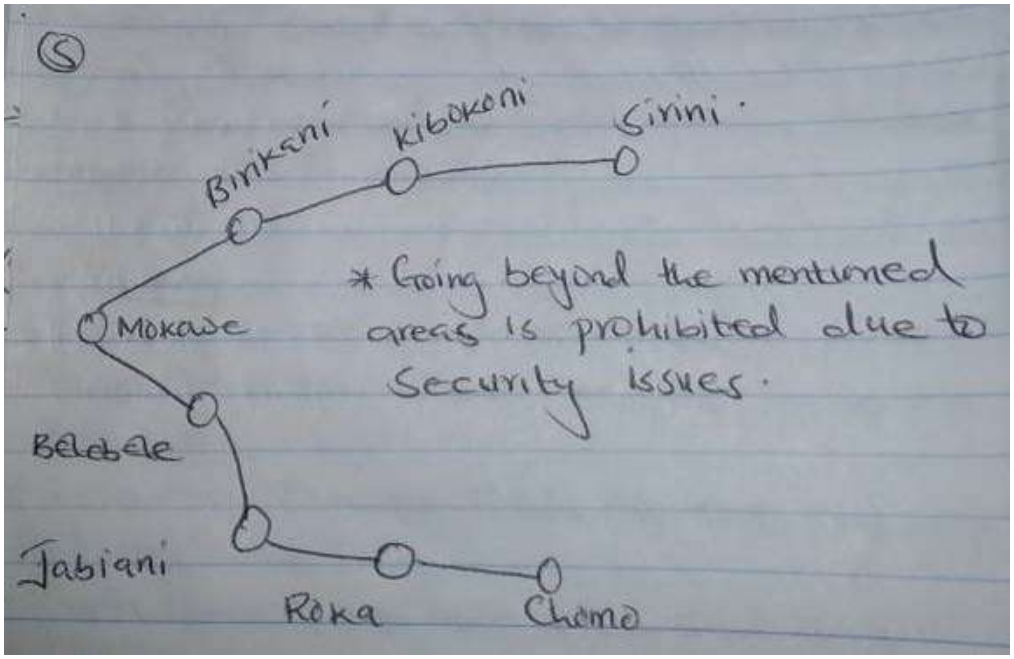
- During the rainy season, cattle have enough water and the grass is green enabling herders to harvest enough milk to sale.
- They also sell cattle to butchers at a fair price.

4. Extension services; veterinary services.

- Herders experience a shortage of land.
- They need to extend their herding areas to reduce the conflict between them and the local farmers. Veterinary services in the area are poor and herders are forced to treat their own cattle.
- There is great need for an extension of veterinary services.

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

-


5
Binkani
Kibokoni
Sirini.
Mokawe
* Going beyond the mentioned areas is prohibited due to security issues.
Belebele
Jabiani
Roka
Chema

6. Are there places where you establish short-term or longer-term homesteads? Use map. Do you need permission to stay in some places? (i.e. permanent households on Ere)?
▪ Herders stay at Belebele, Jabiani, Kibokoni, Roka, Chomo and Sirini. (non-permanent). ▪ Their movement from one area to another depends on the availability of green pasture and water.
7. Travelling in what size of group? Are these family or lineage groups?
▪ The herders travelling from one area to another as a family. ▪ This has resulted in most of their children dropping out of school.
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
Kibokoni ▪ Fishing and bee keeping occur in this area. **Belebele** ▪ There are cash crop and food crop farmers in the area. ▪ Forest farmers also found in the area. **Roka** ▪ Cash crop farmers, bee keepers, food crop farmers and poultry farmers are found in this area. **Jabiani** ▪ Fishing takes place in a dam called Jabia.
9. Groups representing pastoral groups. Mandate, range management, etc.
▪ There are a number of pastoralist groups in the area such as the Mokowe Kibokoni Ufugaji group and Kilimani Livestock. ▪ The groups assist the herders to air their grievances to the county government.
10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
▪ The project will bring investors from different parts of the country to buy cattle at satisfactory prices hence locals expect to see an increase in income (buying milk, meat, skin etc). ▪ The project will ease the transportation of cattle from the villages to the nearby markets.

FACILITATOR OBSERVATIONS

Comment
▪

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Lamu, Mokowe
Meeting Date and Time:	24 October 2018
Meeting Venue/Group:	Hapa Hapa guest house
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	1

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women of the community keep poultry during the dry season, and buy and sell fish during the rainy season.
- They farm kitchen gardens - sukuma wiki (colewort), pili pili (chillies) and spinach.
- They also keep goats.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- As a single mother, the person in attendance is responsible for decision making.
- She is also responsible for all family expenditure including food and school fees etc.

3. Ownership of land use rights, agricultural product, livestock, other assets.

-

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are approximately ten social organisations in the community.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?).

- The attendant is single by divorce.
- She has not experienced stigma as a single woman since she is hard working.

Ongoing initiatives include:

- Development plans from county government offices and national government offices for a new road infrastructure.
- Employment creation.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Health & reproductive health.

HIV:

- The community is aware of the HIV pandemic.
- Anti-retroviral drugs are supplied by a nearby dispensary although the supply is not reliable.
- Prevention methods are offered to expectant mothers.

Causes:

- Drug injections, sex (prostitution) and poverty.

Family planning:

- There is no use of contraceptives (Swahili culture), a woman is expected to conceive to until the end of her child-bearing years.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Frequently	2 kg	
Goat	Occasionally	1 kg	
Chicken			
Beef			
Milk/yogurt	Daily	At least 1,5 litres	
Rice	Daily	2 kg	
Bush meat	When available	2 kg	
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

Children activities:

- Children start pre-school between the age of seven and eight years.

Home chores (duties):

- Girls help with the laundry (washing clothes) and washing utensils.
- Boys are expected to fetch water and look after the cattle and poultry.

Water and storage:

- Water is collected from the boreholes.
- Water is occasionally brought by non-government organisations (NGOs).
- Piped water, although expensive, is KSh 30 per jerry can.
- It is often necessary to collect water at night due to the congestion at the boreholes.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Lamu, Kililana

Meeting Date and Time: 25 October 2018

Meeting Venue/Group: Zipporah' s restaurant

Facilitator/Documenter: Peter Kiiti/ Patricia Syombua

Number Present: **M:** 6 **F:**

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted).

- The community are traditional, small-scale farmers.
- There are two seasons a year, the rainy season and the dry season.
- Rainy season crops include cashew nuts and mangoes.
- Other seasonal crops include maize, sunflowers, cowpeas and simsim (sesame seeds).
- Clearing of lands is done from early February to March, and planting occurs in April.
- July and August is the harvesting period.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done.

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans						
Cassava						
Peas						
Maize	20,90 kg bags	1 acre	80	August and September	2 500 per bag	3 500 per bag
Simsim (sesame seeds)	6-12 bags; 50 kg	1 acre	90	September	6 000 per bag	8 000 per bag
Yam						
Rice						
Leafy greens						
Cash crops						

3. Rotational system description, years in and out of cultivation, rotation of what crops?

- The seasonal crops are rotated consecutively with one season left fallow for the land to regenerate nutrients.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix).

- New breeds of cattle, pesticides and injections are among the animal inputs.
- Crop inputs include the use of fertilisers and manure. Pesticides are used for pest and disease control.
- Casual labourers clear, plant, weed and harvest.

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Most members of the community follow Islam Sharia Law which defines boy and girl children – 2:1 (AL-QURAN- Chapter 4- Al-Nissa- Verses 11,12 & 176).
- Parents purchase land for the adult children.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- The pasture is dependent on natural vegetation (grass).
- There are two market days a week and cattle are sold to local business men (butchers).
- The price of cattle depends on the size and product (meat) variables at the local market.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.).

Major farming and livestock constraints

Land ownership:

- Title deeds are needed for legal ownership of land.
- Available land is not adequate.

Extension workers:

- There are no facilities for farming education and training, and little information on pesticide use and animal health is provide by extension workers.
- Extension workers and non-government organisations (NGOs) do not provide farm inputs such as fertiliser, seeds, machines and animal breeds.

8. Family labour distribution for agriculture and livestock activities – use matrix.

Activity (confirm activities with participants first)	Adult male	Adult female	Child male	Child female	Aged
Clearing	√				
Other land preparation	√	√			
Planting	√	√			
Weeding	√	√	√	√	
Harvesting	√	√			
Post harvesting processing	√	√	√	√	
Herding	√		√		

9. Available extension services (government, NGOs,) for agriculture and livestock, quality.

- No extension services are provided.

10. Map to the extent possible/relevant with the group.

Figure 33 of 40: Workshop Locations, Lamu County
Mid-Stream Development
Key
Indicative Community Workshop Location
Planned Pipeline Route
X - Farmer Area
DRAFT
Coordinate System: GCS WGS 1984
GOLDER

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

FISHERS FOCUS GROUP

Village Name:	Lamu, Kililana
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Zipporah's restaurant/fisheries
Facilitator/Documenter:	Mohammed Kitete/Esther Ndegwa
Number Present:	**M:** 3 **F:**

1. Describe fishing industry structure and organisation. Use seasonal calendar and map areas of use (i.e. are there areas of the bay that are 'leased'?) Associations and roles.

- The group has 430 registered members.
- They formed in 2015.
- Fishers are under the auspices of the beach management unit (BMU).

2. Typical catch (volume) by species; pricing. Use matrix.

Type	Grades	Volume (kg)	Prices (KSh)
Changu(snapper)	1,2,3	500	120, 150
Tewa(redmouth grouper)	1,2,3	400	130, 120
Tazanda	1,2,3	300	120, 130
Tafi (rabbitfish)	1,2,3	400	120, 140
Mkizi (bluespot mullet)	1,2,3	300	130, 120

- During the rainy season harvest increases.

3. Access to markets; extension services.

- During rainy season there is no market due to large fish harvest.
- During the dry season the market flourishes since the fishing catch drops. Demand for the fish is high.

4. Incomes and earnings per job—i.e. do net makers get percentage of catch or cash?

- Using a fishing line one can get 200 kgs of fish.
- Using a fishing net can bring in approximately 300 kgs of fish.

5. Inputs and costs of inputs (i.e. nets, etc.)

- Nets cost KSh 8,000.
- Fishing lines cost KSh 1,000.

6. Tourism-related activities?

- Tourist activities include snorkelling, sunset viewing and fishing.

7. Is fish/ crab, etc. an important food source in this community?

- Fish and crab are the staple foods in the area. Locals are keen on fishing activities since it's the main source of income.

8. Constraints and opportunities.
▪ The marine authorities are the main challenge to the fishers because they enforce the carrying of life jackets and personal identification. ▪ The fishers are restricted to conduct their fishing activities during night hours. **Opportunities:** ▪ When marine laws are followed, fishers are free to conduct their fishing activities without interference.
9. Do you have concerns about the project on marine resources?
▪ The project will have a negative impact on the fishers because the oil spills can kill fish and pollute the sea. ▪ Noise pollution is also a concern. ▪ Fishers will be restricted in their paths to the water.

FACILITATOR OBSERVATIONS

Comment
▪

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Lamu, Kililana
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Zipporah's restaurant/Women
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	2

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women in the community buy and sell fish locally in the streets.
- They also do the grocery shopping.
- Some have moved to Lamu Island because of a lack of social amenities such as schools and dispensaries at the village.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- Women are responsible for decision making since they are sole providers. This occurs mainly in cases where the husband is unemployed, or the woman is widowed.
- Household chores take around five hours; only then can the women get to their economic activities.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Women own land as per the Islam law 2:1 (AL- QURAN- Chapter 4- Al-Nissa- Verses 11,12 & 176).
- Livestock and agriculture is family owned. This also applies to other assets.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

Social organisations:

- There are several women organisations (village) and micro-finance groups.
- The women of these groups are involved fully in politics.
- As a result of financial constraints, they are unable to develop or merge into larger economic groups.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

Single (widow):

- Single women or widows have several challenges concerning family as they are the sole income earner.
- There is no stigma to single parents and their children.
- Single-headed households do not receive assistance.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Family planning is available only to those who know are financially able to travel far to such facilities and also pay for the consultation. There are no dispensaries in the area.

- HIV transmission occurs mainly through drug injections, miraa, sexual immorality brought about by poverty and during baby deliveries (unprotected midwives). Miraa/khat impairs judgement and is a natural aphrodisiac.
- There are no HIV awareness or educational campaigns of the pandemic, and the area is far from the nearest dispensary.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Daily	0,5 kg	
Goat	Occasionally	0,5 kg	
Chicken			
Beef			
Milk/yogurt			
Rice	Daily	1 kg	
Bush meat			
Wild plants			Mvumbani for medicinal purposes and Msavari for toothache.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school between four to six years.
- They leave school between the age of ten to fifteen years because of poverty and the fact that the schools (primary school) are far-removed from their community.

9. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Lamu, Kililana
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Zipporah's restaurant
Facilitator/Documenter:	Mohammed Kitete/Esther Ndegwa
Number Present:	**M:** 2 **F:**

1. Contributions/responsibilities to households.

- Kikozi Lamu court assisted the youth group to buy beehives and start tree nurseries.
- The group contributes KSh 200 per month which enables them to pay school fees for themselves and their children.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- The community adults do not support youth empowerment in the area.
- There are early marriages in the area due to poverty and this forces young girls to drop out of school.
- There are no facilities such as schools and health centres in the area and infrastructure is poor overall.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- Education is not taken seriously in the area because people left the area immediately after being compensated.

4. General labour force characteristics and job readiness.

- Youths are currently self-employed.
- They sell trees from nurseries to the forest people.
- Some are involved in a boda boda (motorbike) business.

5. Human immunodeficiency virus (HIV) awareness.

- Youths are conducting door-to-door awareness campaigns.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The young adults of the community participate in social activities
- They have self-help groups in which they participate actively.
- They show a keen interest in politics because they want to know their rights and the issues affecting their community.
- They want to know the agenda of the politicians.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

AGRICULTURE FOCUS GROUP

Village Name: Lamu, Jipe

Meeting Date and Time: 26 October 2018

Meeting Venue/Group: Mkondoni

Facilitator/Documenter: Peter Kiiti/Patricia Syombua

Number Present: **M:** 2 **F:**

1. Farming systems, with typical seasonal calendar (pick two main crops, with months of land clearing, other preparation, planting, weeding, harvesting, post harvesting processing, etc. – including brewing – noted).

- Use traditional methods.
- Main cash crops are *Bixa orellana* and cotton.
- Main food crops are maize, cowpeas and green grams.
- There is insufficient land. Bush clearing is done, and compensation administered by headmen.
- There is no communal land available.

2. Yields and marketing – use matrix, yield variability over years, how is marketing done?

Crop (confirm list of major crops with participants first)	Yield (amount and unit)	On how much land (amount and unit)	% sold	Months of sale	Price at harvest (amount and unit)	Price not at harvest (amount and unit)
Plantain						
Beans						
Cassava						
Peas						
Maize	8-10 kg	1 acre	80	August and September	KSH 1,800	KSh 3,500
Cotton	350 kg	1 acre	100	November and December	KSh 60 per kg	KSh 100 per kg
Yam						
Rice						
Leafy greens						
Cash crops						

3. Rotational system description, years in and out of cultivation, rotation of what crops?

- Crops rotate depending on season i.e. dry season or wet season.

4. Use of inputs, what inputs for what crops (animal traction, seeds, fertilizer, water, labour from outside the family, pesticides – may need a matrix).

- Manure, fertilisers and pesticides are used for livestock and poultry.

5. Inheritance systems for land, alternative means to acquire land for adult children.

- Squatters are allocated land by the government.
- Only share what they have to their adult children.

6. Livestock, herding activities, types/quality of pasture, livestock product processing, frequency of sale/slaughter of livestock, prices at different times of year.

- Poultry (both hybrid and locally bred) are kept.
- Eggs are sold by the crate to local markets.
- Chickens are sold to the local market.

7. Major farming and livestock constraints (land quantity, quality, water, cost/availability of inputs, credit, markets, prices, labour, education and training etc.).

- Poor prices of maize, cotton and cowpeas sold to intermediaries.
- There are no credit facilities available.
- There is a high cost of labour during land preparation, planting and harvesting.
- Wild animals destroy crops and kill poultry and livestock.

8. Family labour distribution for agriculture and livestock activities – use matrix.

Activity (Confirm activities with participants first)	Adult male	Adult female	Child male	Child female	Aged
Clearing	X	X			
Other land preparation	X	X	X	X	
Planting	X	X			
Weeding	X	X	X	X	
Harvesting	X	X	X	X	
Post harvesting processing	X	X			
Herding	X		X		X

9. Available extension services (government, non-government organisation) for agriculture and livestock, quality.

- Occasionally seedlings are provided by the government.

10. Map to the extent possible/relevant with the group

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

BEE KEEPER FOCUS GROUP

Village Name:	Lamu, Jipe
Meeting Date and Time:	25 October 2018
Meeting Venue/Group:	Mkondoni
Facilitator/Documenter:	Mohammed Kitete/ Esther Ndegwa
Number Present:	**M:** 2 **F:**

1. Describe activity with typical seasonal calendar include frequency and duration of specific activity

- During the rainy season honey harvesting is high because water and flowers are available.
- During the dry season harvesting drops due to lack of water and flowers.

2. Where are hives located? Do you have access to good hive locations?

- Beehives are located in special areas. Each member has beehives on their own farm.

3. How many hives do you have? What is the average no. of hives? (please estimate)

- On the group farm there are 15 beehives. On their own farms members have an average of five to six beehives.

4. What is the average production per season per hive? Yield per season.

- During rainy season 10 litres per beehive are harvested.
- During the dry season the harvest drops 6 litres per beehive.

5. Use of product (honey, alcohol, etc.) Market? % sold? Pricing (if relevant)

- Honey is used as food, to make alcohol and as a herbal medicine.
- There is a good market for honey. One litre costs KSh 450.

6. Family labour required for bee keeping (men, women, children, doing what exactly for bee keeping, production and marketing?

- Adults are involved in bee keeping.
- Both men and women have the responsibility.

7. Other inputs and costs (hives, places to put hives, casual labour, etc.) and sources.

- One bee hive costs KSh 2,500.
- Bee hives are fenced off to prevent bees from interfering with other animals.

8. Hive building –what materials do you need, life of hive, skills required?

- Materials such as wood and nylon ropes are used.
- Bee hives can last for more than 10 years if they are well constructed.

9. Are there extension services?

-

10. Are there bee keepers associations to access services, funding for projects?
▪ There are no bee keeper associations to access services
11. Hopes and aspirations—plans for the future? Plans being implemented? How?
▪ There are plans to educate and recruit more members on the importance of bee keeping.
12. Constraints and opportunities—quality, technology, marketing.
Constraints ▪ There are many financial challenges because of insufficient capital to buy bee hives. **Opportunities** ▪ The smaller beehives have provided small amounts of cash to pay school fees for their children and other essential needs.
13. Map to the extent possible/relevant with the group
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

EDUCATION FOCUS GROUP

Village Name:	Lamu, Jipe
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Mkondoni
Facilitator/Documenter:	Mohammed Kitete/Esther Ndegwa
Number Present:	**M:** 2 **F:**

1. What age do children start school (is there kindergarten?)

- Children start kindergarten at three years of age.

2. What age do children leave school? Males and females? Does it coincide with important exams?

Reasons for early school leaving?

- At 12-13 years children should be finishing primary education but there is a high number of school dropouts due to divorce cases and poverty, and concerns around security.

3. Is there adult education?

- Adult education is yet to be introduced in the area.

4. Budgets/partners/private donors?

- They get help from a non-government organisation (NGO) called World Vision. This includes donations of chairs and uniforms. Each parent pays KSh 500 school fees per child per month.

5. Priority areas and plans.

- Education is given first priority.
- There are plans for expansion of the school project.

6. Household costs associated with education (i.e. tuition, supplies, uniforms, etc.).

- All schooling costs funded by the parents.

7. Parental involvement (parent committees?)

- Parents involve themselves in day-to-day activities.

8. Teachers housing? Teacher education? Ongoing support?

- There is no housing for teachers. They get support from World Vision, for example, in training of early childhood development (ECD) teachers.

9. Constraints and challenges?

- Schools lack equipment and trained teachers.
- Children suffer from wild animal attacks resulting in them arriving late at school.
- Parents are not well-educated leading to them not taking the education of their children seriously.

10. Available statistics on	
Enrolment	
Attendance and absenteeism	
Early school leavers	
Graduating	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Lamu, Jipe
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Mkondoni
Facilitator/Documenter:	Peter Kiiti/Patricia Syombua
Number Present:	**M:** 4 **F:** 1

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The elders advise the community on government development projects and benefits to the community.
- They act as a link between the people and the government.
- They also provide security information to relevant authorities and the government.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- Traditional healers exist and are recognised.
- They have knowledge on the type and location of specific herbs, and use herbs for healing.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There's a known ancient mosque where a sheikh is believed to be buried. Community members attend worship there.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

-

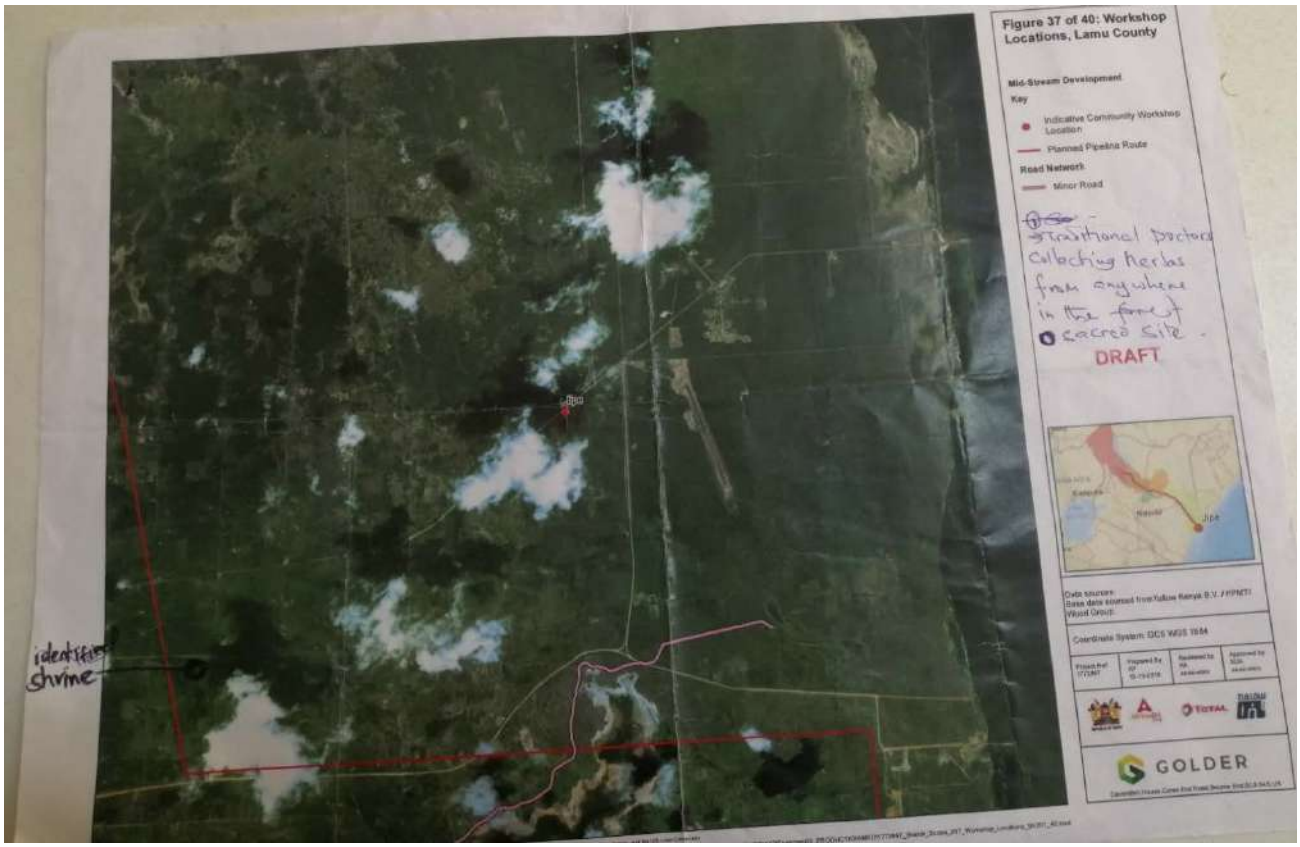
5. Important rites of passage (what are they and how are they observed?)

-

6. What should the proponent know about entering a village? How is respect shown?

-

See map below:



Elders View on the LLCOP Project
▪ Request for awareness to be created for those who will be compensated concerning land, and be trained on how to invest in permanent investments. ▪ Request the relevant developers to consider locals when employment opportunities arise. ▪ Request for title deeds to be provided for the lands allocated to them.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WATER AND SANITATION FOCUS GROUP

Village Name:	Lamu, Jipe
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Mkondoni
Facilitator/Documenter:	Mohammed Kitete/ Esther Ndegewa
Number Present:	**M:** 1 **F:** 1

1. Types of services provided, costs (water committee and sanitation).

- Water is supplied for household consumption in the areas of Hindi and Magogoni.

2. Collaboration with formal health workers.

- Water samples are sent to the government chemists for monthly analysis.

3. How are water and sanitation services organised? Workers or volunteers?

- The workers operate on their own with a board, and technical staff, a technical manager and management staff. There are no volunteers.

4. Dominant water sources: traditional wells, improved, piped water.

- Ground water is the primary source of water. There are boreholes and elevated tanks, and pipelines rising from wells to elevated tanks. The distribution line runs for about 10 km from the main tanks to consumers.

5. Water (public water supply facilities, what are the bylaws and fees on use, how are facilities maintained, adequacy of supply, adequacy of quality, how is water supply managed?)

There are three types of water supply:

- private connection
- communal water points
- water tracking.

Areas such as Mkondoni, Sina Mbio, Bora Imani, Mokowe and Barigoni use water tracking system. Drawing water at HIMWA in Hindi station, the water boozers are provided by county government and National Government. The tariffs are 4 KSh per 20 litre jerry-can.

6. Sanitation including disposal of human waste, landfills, etc.

-

FACILITATOR OBSERVATIONS

Comment
Challenges It is a non-profit making organisation so there are constraints in transporting water to all consumers. There is no funding, and there is need for people to be assisted with pipe extensions for easy water distribution.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Lamu, Jipe
Meeting Date and Time:	26 October 2018
Meeting Venue/Group:	Mkondoni
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	3

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women in the community spend most of their time doing household duties.
- They keep poultry, goats and do garden farming.
- March to May is harvest time. No economic activity occurs during this period.
- A more fruitful economic season is between September and December, when vegetables, cashews and cotton are sold.
- There is no formal employment for women. Despite their own sense of self-worth, they are not viewed as potential employees.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Men make decisions for the married households. Women make decisions in single families.
- Husband and wife contribute to the combined family expenditure. In single parent families are single income households.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- There is no restriction on land ownership.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- There are social organisations such as merry-go-round groups.
- Women participate fully in politics.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women have many challenges in running family expenditure, farming and their overall livelihood.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Family planning is available.
- HIV awareness and counselling are provided.
- Prevention of expectant mother to unborn child HIV transmission is given.
- Treatment and anti-retroviral drugs are available at the nearest facility.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Occasionally	0,5 kg	Expensive
Goat	Occasionally	0,5 kg	Expensive
Chicken	Occasionally	1 chicken	Expensive
Beef	Occasionally	0,5 kg	Expensive
Milk/yogurt	Daily	1 litre	Goat milk
Rice	Occasionally	1 kg	Expensive
Bush meat	When available	1 kg	Not available
Wild plants			Mabuyu- food (business product) Mpepera- food Mringa- vegetable, herb

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children start school between three to four years. Girls leave school between 13-15 years old while boys leave between 11-16 years.
- Boys watch over farms to prevent wild animals from destroying plants. They also look after cattle and poultry.
- Girls help in looking after siblings and also help their mothers to sell vegetables.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

BUSINESS FOCUS GROUP

Village Name:	Lamu, Hindi
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	GTZ camp
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	**M:** _____ **F:** 1

1. Activities.

- The group advises business people on good business strategies.
- They encourage and support small-scale businesses and advise them on how to grow their business.

2. Environmental activities.

- Trees around the Hindi town business area have been planted.
- Cleaning services in the town are provided by the group.

3. Challenges in the business sector.

- Security concerns scare away investors, and businesses fail as a consequence.
- Marginalisation, and insufficient sharing of information on new developments to enable locals to obtain access to tenders and employment.

4. Expectations on new developments in the area.

- The creation of new job opportunities
- Employment opportunities for the youth
- Improved security to attract investors into the area
- The growth of the town and introduction of social amenities such as good schools and colleges.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Lamu, Hindi
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	GTZ camp
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	**M:** 2 **F:**

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders settle disputes in the community.
- They report security matters to relevant authorities, and serve as the link between the community and government.
- They also advise the community of new developments in the area.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- Traditional healers exist and use natural resources (herbs).
- They are used by individuals and not communities.
- They are paid for their services.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are none to show.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- There are no sacred or special areas in Hindi.

5. Important rites of passage (what are they and how are they observed?)

- No rites observed. There is a mix of several tribes in the area.

6. What should the proponent know about entering a village? How is respect shown?

- There are many different cultures in the area. No special arrangements need to be made before entering a village.

FACILITATOR OBSERVATIONS

Comment
▪ Aware of traditional doctors and sacred sites but cannot trace the exact locations due to developments.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LIVESTOCK HERDERS (PASTORAL LIVELIHOODS) FOCUS GROUP

Village Name:	Lamu, Hindi
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	GZT Camp
Facilitator/Documenter:	Mohammed Kitete/Esther Ndegwa
Number Present:	**M:** 2 **F:**

1. Herding activities (Use seasonal calendar).

- During the long rainy season livestock farmers have sufficient grazing area because grass and water are readily available.
- During the dry season the herders travel from one area to another looking for pasture and water.

2. Requirements for water, when, from where, in what quantities per animal.

- Livestock keepers get water from seasonal dams that are full during the rainy season. The dams evaporate during the dry season.
- The livestock keepers buy water for livestock from Hindi Magogoni Water Association (HIMWA) during the dry season.
- There are no boreholes.
- Each cow consumes 40 litres of water per day.

3. Economics: average herd size.

- The herd size is affected during both dry and rainy seasons. In the rainy season, livestock perish due to disease and in the dry season they die because of inadequate water and pasture supply.

4. Extension services; veterinary services.

- The livestock keepers are forced to buy drugs for their livestock themselves.
- There are no veterinary services in the area.
- There are no dipping sites in the area.
- They have plans to extend the livestock sector, but they lack funds (financial assistance is needed from the county government and donors).

5. Use mapping tool. Are there particular paths and travel routes? Use map to show travel routes, if applicable.

-

6. Are there places where you establish short-term or longer-term homesteads? Use map. Do you need permission to stay in some places? (i.e. permanent household on Ere).
▪ The livestock keepers only stay at Jabiani and Chomo. They live with their families.
7. Travelling in what size of group? Are these family or lineage groups?
▪ In any case of movement from one place to another the keepers travel with their families.
8. Do you or are you aware of people that use this area (point to map) for hunting, fishing, plant gathering, visiting cultural sites? If yes, where and describe—i.e. what species are hunted?
▪
9. Groups representing pastoral groups. Mandate, range management, etc.
Wadajir Hindi Livestock Community ▪ Assists in raising funds that help buy livestock, drugs, water etc. ▪ Raise funds to pay farmers for damages caused by livestock.
10. Do you have any concerns about the project and how it may affect your livelihood activity (i.e. noise and camel milk production, effects on reproductive health of animals)?
▪ The project might affect livestock activities because it will affect the regular movement of livestock.

FACILITATOR OBSERVATIONS

Comment
▪

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WATER AND SANITATION FOCUS GROUP

Village Name:	Lamu, Hindi
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	GTZ camp
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	**M:** 1 **F:**

1. Types of services provided, costs (water committee and sanitation).

- Planting trees for water catchment.
- Providing water tanks to the community and schools.

The water and sanitation group have planted trees in schools and on community land.

Costs

Jambian (a place/location in Hindi town) – KSh 1,5 million
Tanks – KSh 16,000 per tank

The group has a management committee that oversees the funds received from donors. It consists of around 70 registered members.

2. Collaboration with formal health workers.

- Health workers help in ensuring compliance.

3. How are water and sanitation services organised? Workers or volunteers?

- These are done by the supplier (Hindi Magogoni Water Association, HIMWA).

4. Dominant water sources: traditional wells, improved, piped water.

- Traditional wells do not exist, and there are no improved water sources.
- Piped water is available and distributed to the whole of Hindi town and its environs.

5. Water (public water supply facilities, what are the bylaws and fees on use, how are facilities maintained, adequacy of supply, adequacy of quality, how is water supply managed?

- There are kiosks to supply water to the public at a fee of 4 shillings per 20 litres.
- They maintain the facilities such as meters, broken pipes etc.
- Water is adequate and is also available for farming.

6. Sanitation including disposal of human waste, landfills, etc.

- The disposal of human waste is the responsibility of the ministry of health in collaboration with the county council.
- Landfills are managed by the ministry of health and the county government.

See attached map

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Lamu, Hindi
Meeting Date and Time:	27 October 2018
Meeting Venue/Group:	GTZ camp
Facilitator/Documenter:	Mohammed Kitete/Esther Ndegwa
Number Present:	2

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- Women in the community involve themselves in business and agricultural activities to earn a living.
- They depend on loans and savings from their respective groups.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Domestic activities such as fetching firewood, water and other household chores are the responsibility of the women of the village.
- They also make decisions on their own.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Typically, women do not own land, however, some single women do own land.
- Men have the responsibilities of ownership of land.
- Women are tasked with keeping livestock.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- The women in the community participate in social groups that they form.
- They collect funds and start projects such as goat keeping, poultry keeping and other activities.
- Women are not allowed to participate in politics because there is a perception that women do not have power to lead the community.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single women do not get any help from the government or supporters.
- They must work hard to get funds for school fees and other domestic uses.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- Women are knowledgeable concerning the use of family planning.
- There is HIV awareness in the area and women receive preventive measures.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies).

Product	*How often*	*How much for an average family*	*Other comments*
Fish			
Goat	Not often available	10kgs per family	There is a need for goats per family.
Chicken	Always available in family	2 chickens per meal	
Beef	Not available		
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

There is a lack of a good diet for families since some lands are affected by security concerns and no farming occurs in these areas.

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children assist in some home activities such as fetching water, firewood, cooking and cleaning the compound.
- The age of first school attendance is three years of age.
- The dropout rate is high due to rape incidents and early marriages, and as a result of migration from village to village because of security fears.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

BEE KEEPER FOCUS GROUP

Village Name:	Lamu, Barigoni
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Barigoni Primary School
Facilitator/Documenter:	Peter Kiiti/ Patricia Syombua
Number Present:	**M:** 2 **F:**

1. Describe activity with typical seasonal calendar include frequency and duration of specific activity.

- Bee harvest is conducted twice a year.

2. Where are hives located? Do you have access to good hive locations?

- There are man-made hives and natural hives that are holes in big trees.
- Hives are located in:
  Braden
  Magumba
  Duduni
  Marma
  Ndodeni
  Locho
  Munyuni
  Baghala
  Reseni
  Ginda

- There is good access to the area despite the security issues. Sometimes, however, the bee keepers are unable to reach the hives due to security issues (al-Shabaab).

3. How many hives do you have? What is the average no. of hives? (please estimate).

- Each bee keeper has, on average, approximately 10 hives. Many depend on the hives in the trees.

4. What is the average production per season per hive? Yield per season.

- Harvest is carried out twice a year, per hive. In 2018 the harvest was done once because of the rains.
- A typical harvest is around 20 litres per hive.

5. Use of product (honey, alcohol, etc.) Market? % sold? Pricing (if relevant).

- Honey is used as food, medicine and also in brewing.
- The bee keepers sell 100% of their harvest since it is the only economic activity sustaining them.
- The market price is currently very high since the hives cannot be accessed due to ongoing security issues (al-Shabaab).

6. Family labour required for bee keeping (men, women, children, doing what exactly for bee keeping, production and marketing?

- Family labour is required.
- Men are tasked with the bee keeping, production and marketing.

7. Other inputs and costs (hives, places to put hives, casual labour, etc.) and sources.

- Other inputs used are axes for breaking the trees where hives are located, buckets, matchsticks, and spears for protection from enemies and wild animals.

8. Hive building –what materials do you need, life of hive, skills required?

- Traditional hives cost around 500 shillings.
- The hive can last for two years.
- Skills are required to produce the honey and maintain the hives.
- Wood hives are made from trees that grow locally.

9. Are there Extension services?

- No extension services are provided.

10. Are there bee keepers associations to access services, funding for projects?

- There are no bee keepers associations and no funding.

11. Hopes and aspirations—plans for the future? Plans being implemented? How?

- There are plans to expand the economic activities as well as plans to buy modern and artificial hives.

12. Constraints and opportunities—quality, technology, marketing.

- There is no security when accessing the hive locations.
- There is need for extension services to acquire the modern technologies of bee keeping.

13. Map to the extent possible/relevant with the group.

FACILITATOR OBSERVATIONS

Comment
▪ The community wish to be compensated by government when the new project is initiated as their resources will be affected.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Lamu, Barigoni
Meeting Date and Time:	23 October 2018
Meeting Venue/Group:	Barigoni Primary School
Facilitator/Documenter:	Mohammed Kitete/ Esther Ndegwa
Number Present:	**M:** 1 **F:** 1

1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- The village elders solve conflicts within the community, and work to ensure that there is peace in the area.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources, they need?

- There are traditional healers in the village that assist the community.
- Traditional healers work as volunteers.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?

- There are sacred places that are visited every day.

4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.

- There are special areas such as Kwa Mwalimu, Nduni and Majengo.
- Visitors are not allowed to visit these areas because the village ancestors are buried at these sites.

5. Important rites of passage (what are they and how are they observed?)
▪ Members of the community visit the sacred sites to pray for the sick and for God's intervention. They also pray for God's protection against their enemies. ▪ There are two types of sacred places: sacred places where only women are permitted, and sacred places where only men are allowed access.
6. What should the proponent know about entering a village? How is respect shown?
▪ The community welcomes visitors and like to hear what they have to say. ▪ Visitors are provided with guidelines in terms of the local laws and instructions to follow in the area. If the visitors do not adhere to these, they are asked to leave.

FACILITATOR OBSERVATIONS

Comment
▪ The village elders pray in and around the ancestral lands, so it is important to respect the sacred sites.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

FISHERS FOCUS GROUP

Village Name:	Lamu, Barigoni
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Barigoni Primary School
Facilitator/Documenter:	Peter Kiiti/Patricia Syombua
Number Present:	**M:** 2 **F:** 1

1. Describe fishing industry structure and organisation. Use seasonal calendar and map areas of use (i.e. are there areas of the bay that are 'leased'?) Associations and roles.

- There are different fishing structures that is fishers of crabs and lobsters, and fishers of snail fish.
- Some fishers have boats and machines, others use dhows etc.
- Those with boats and outboard motors fish in the deep sea while others fish at the sea front. (Dununi and Kibaoni).

2. Typical catch (volume) by species; pricing. Use matrix.

Type	Volume	Price
Tamamba	10 kg	170 KSh/kg
Red snapper	9 kg	170 KSh/kg
Mkizi(bluespot mullet)	7 kg	150 KSh/kg
Tewa (redmouth grouper)	6 kg	150 KSh/kg
Kaa (crab)	6 kg	450 KSh/kg
Lobster and crab	6 kg	400 KSh/kg
Prawns	6 kg	400 KSh/kg

3. Access to markets; extension services.

- There is no local market, only the option to travel to markets further away which is expensive.
- The transport costs to market areas are high.
- Extension services such as boats, outboard motors, education/capacity building on the fishing grounds, fishing nets, marketing etc. services are provided.

4. Incomes and earnings per job—i.e. do net makers get % of catch or cash?

The earnings are shared among themselves i.e.:

- Net- KSh 500
- Boat- KSh 500
- Catch individual- KSh500

5. Inputs and costs of inputs (i.e. nets, etc.)?

- Nets – around KSh 20,000 for 5 nets
- Long lines for big fish, crabs and lobsters
- Net bundles – KSh 5,000
- Hooks for prawns – 100 per hook
- Cooler boxes – KSh 15,000

6. Tourism-related activities?

- There are no tourists as the area faces security issues.

7. Is fish/ crab, etc. an important food source in this community?
▪

8. Constraints and opportunities.
▪ Security is a concern; there is no fishing at night. ▪ Security officers harass local residents. ▪ A local market is not readily available.

9. Do you have concerns about the project on marine resources?
▪ Fear of a decreasing catch as the projects are initiated.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Lamu, Barigoni
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Barigoni Primary School
Facilitator/Documenter:	Mohammed Kitete/Esther
Number Present:	2

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.).

- The women of the community started a merry-go-round programme that assists them to start businesses and other projects.
- As a group, they also carry out farming activities.

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.).

- Women are responsible for the household chores such as fetching water, cooking and fetching firewood.
- They also help their husbands by working to pay school fees.

3. Ownership of land use rights, agricultural product, livestock, other assets.

- Men are the land owners. Women have the use of land for their farming activities.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time).

- Women are not allowed to actively participate in politics.
- They do, however, participate in social organisations and are committed to serve the community.
- Several women conduct business activities.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

- Single mothers are responsible for themselves in terms of earning a living.
- They also depend on their relatives.
- Non-government organisations such as World Vision provide assistance.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults).

- There is HIV awareness in the area.
- A door-to-door campaign on how to use family planning and prevention of HIV is ongoing.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)

Product	*How often*	*How much for an average family*	*Other comments*
Fish	Rare	1 kg per meal	Lack of money.
Goat	Rare	0,5 kg per meal	
Chicken	Rare	2 kg per meal	The community would like financial assistance to help them start a project.
Beef	Once per month	1 kg per meal	
Milk/yogurt		2 litres per meal	
Rice	Rare	2 kg per meal	Unable to afford rice.
Bush meat	N/A	N/A	N/A
Wild plants	N/A	N/A	N/A

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future).

- Children assist parents in fetching water, firewood, cleaning compounds and other activities.
- Children drop out of school early due to a lack of school fees, a poor environment and insecurity issues.
- The community women have hopes for their children's futures and believe that education is the key to their children's successful future.

9. Map to the extent possible/relevant with the group.

No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Lamu, Barigoni
Meeting Date and Time:	28 October 2018
Meeting Venue/Group:	Barigoni Primary School
Facilitator/Documenter:	Mohammed Kitete/ Esther Ndegwa
Number Present:	**M:** 3 **F:** 1

1. Contributions/responsibilities to households.

- Young adults play a key role in the community.
- They conduct door-to-door awareness on the effects of drug abuse.
- They also assist their parents in activities that enable them to earn a living.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition like rites of passage).

- Inhabitants of the area get married at an early age because they do not take education seriously.
- The youth are working to create awareness on the importance of education.
- In the area they encounter many challenges that need to be addressed.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- The young adults in the community have a positive attitude towards education but the older people in the area are discouraging.

4. General labour force characteristics and job readiness.

- There are no ready-made jobs in the area.
- The youth rely on farming, bee keeping and fishing for an income.

5. Human immunodeficiency virus (HIV) awareness.

- HIV awareness is presented through tournaments.
- The young adults of the community also conduct door-to door-awareness drives.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The youth participate in politics because they are progressive.
- They vote for the leaders who advocate development.

FACILITATOR OBSERVATIONS

Comment
▪ The Barigoni youth group has the intention to help others, but lack the financial means to do so.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

LOCAL GOVERNMENT (ADMINISTRATIVE OFFICERS/PLANNERS) FOCUS GROUP

Village Name:	Lamu, Pate
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Pate Social Hall
Facilitator/Documenter:	Peter Kiiti/Patricia Syombua
Number Present:	**M:** 1 **F:**

1. Short village history (year of registration, who came to live, from where, in and out migration now, reasons for migration now)?

- Pate village was formed in the seventh century. People living in Pate are Bajun and Swahili.

2. Land availability (how much land is available, where in village, how much is given to new applicants for land)?

- There is no land available. Land can only be bought.

3. Communal land (is there any, what is it used for, what are the bylaws and fees on use, what is the condition of communal land, how is the land managed)?

- The village has communal land for a cemetery.
- There are two of these, one in Pnoato and a public one (6,5 hectares)

4. Economic activities (land use planning progress, economic development priorities, development plans, constraints and opportunities).

- Economically, the community of Pate depend on different types of mangroves, which located in different areas.
- They also rely on fishing activities.

5. Current ongoing village initiatives, what is the progress?

- Pate Girls Secondary School will open in November 2018.

6. Village administration (sources of revenue, total annual revenues, types of expenditures, public and female participation in village initiatives, constraints to participation, relationship with District administration).

- The population is estimated at 3 720 people (village approximation).

7. Observations of facilitator (village government capacity, level of participation including by women, capacity to access resources from other levels of government).

- The village is governed by the chief and a council of elders.
- Women are involved in politics.
- The village's access to resources from government is limited.

8. Request for village statistics if available	
Current population (m/f)	
No. of households	
Births 2017	
Deaths 2017	
Population <15 **Population 15 – 54**	
Population 55+	
No. of in migrants	

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

FISHERS FOCUS GROUP

Village Name:	Lamu, Pate
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Pate social hall
Facilitator/Documenter:	Peter KIiti/Patricia Syombua
Number Present:	**M:** 6 **F:**

1. Describe fishing industry structure and organisation. Use seasonal calendar and map areas of use (i.e. are there areas of the bay that are 'leased'?). Associations and roles.

- Fishing areas are Bruno, Dunune, Wange, Kiunga and Dodori.
- There are no formal organisations.
- The members of the community that fish work individually.
- Some are employed.
- They move to different areas due to fish catchment quantity and quality.
- They base the type of fish they catch on the season and vary their fishing areas to allow fish to hatch and mature.

2. Typical catch (volume) by species; pricing. Use matrix.

Type	Volume	Pricing
Tasi		
Jodari (tuna)		
Tewa (redmouth grouper)		
Tamamba		
Fumi (lemur)		
Lobster and crabs	5 kg	4 000 per kg
Prawns		
Tachawa		

3. Access to markets; extension services.

- They have no access to markets.
- They sell their catch to the locals and hotels.
- Extension services such as nets and outboard motors are provided by fisheries.

4. Incomes and earnings per job—i.e. do net makers get % of catch or cash?

-

5. Inputs and costs of inputs (i.e. nets, etc.)

- Fishing line – KSh 2,000
- Glass (diving) – KSh 2,000
- Nets – KSh 5,000
- Hooks – KSh 500 a pack of 100 pieces
- Outboard motor or boat – KSh 500,000

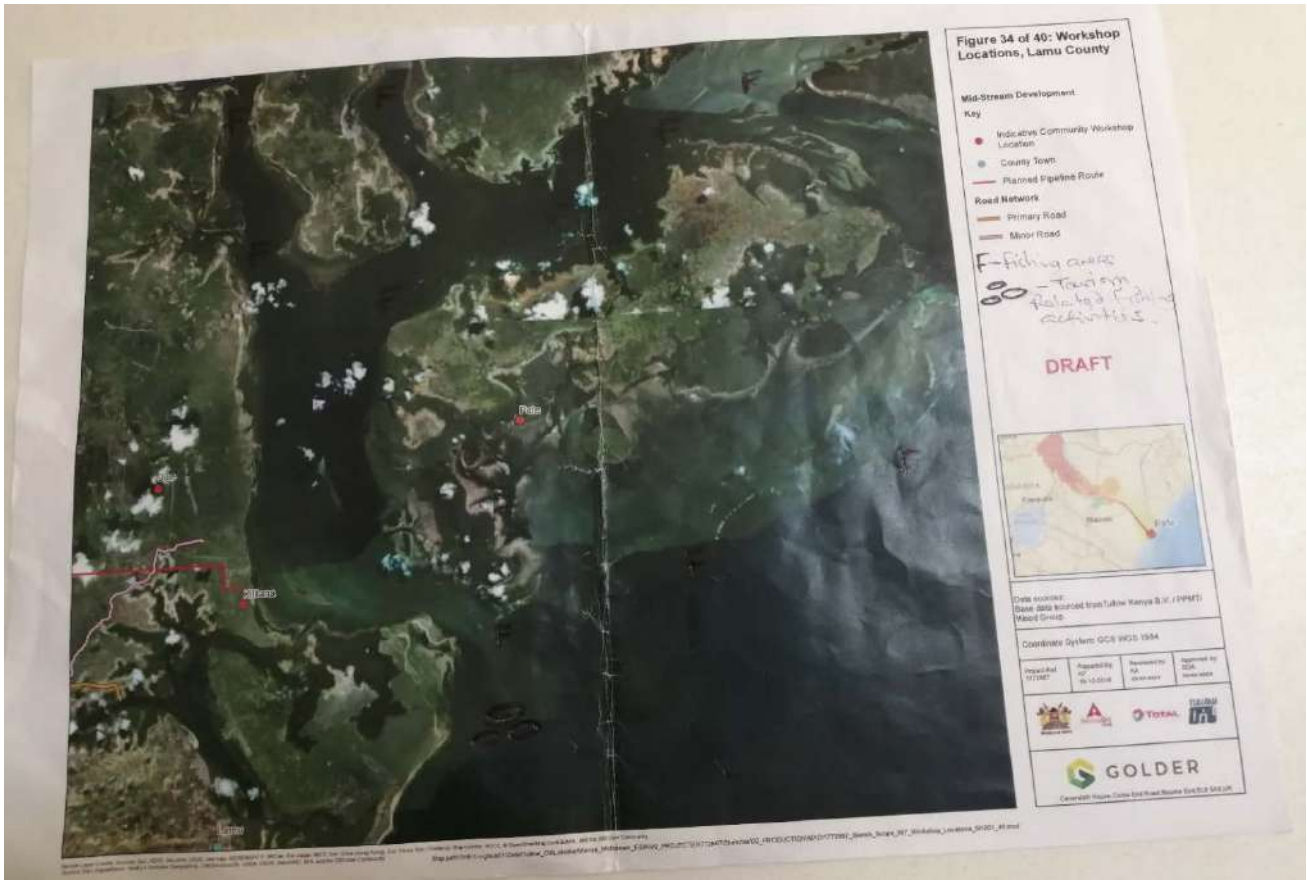
6. Tourism-related activities?

- There are coral sites, which have a catchment area where they have reared different types of fish.
- Hire boats are available for deep sea touring and fishing.

7. Is fish/ crab, etc. an important food source in this community?
▪ Fish is the staple food in the area.

8. Constraints and opportunities.
▪ There is a shortage of good outboard motor for deep sea fishing. ▪ There is inadequate input into the industry.

9. Do you have concerns about the project on marine resources?
▪ Fish may migrate as a result of the project, depleting fish stocks in the area. ▪ The current development in the area may limit access to fishing, and it will be more difficult to use boats to fish at current levels in those areas. ▪ The project may cause oil spills and odours which kills the fish.



PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

WOMEN FOCUS GROUP

Village Name:	Lamu, Pate
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Pate social hall
Facilitator/Documenter:	Peter Kiiti/Patricia Syombua
Number Present:	5

1. Women's economic activities (proportion of day devoted to agriculture and livestock, domestic responsibilities, income generating activities, seasonal calendar, employment opportunities for women, etc.)

- Woman have no economic activities, and receive no income from the fishing industry and mangrove.
- They depend on the earnings from their husbands (fishermen).

2. Characterisation of household roles (who is responsible for decision making, money management, school fees and health costs, water carrying, etc.)

- The husbands are the decision makers and provide for the family needs and health costs.

3. Ownership of land use rights, agricultural product, livestock, other assets

- Men and women can both own land.

4. Social organisation (women's groups, participation in political decision making, shared work among women, barriers to women's participation, perception of changing roles over time)

- The women are part of an organisation but it is currently not operating due to lack of finance and resources.
- Women participate in political decision-making.
- The women in the community do not share work.

5. If single, what is the status of single women? (stigma for woman and/or children, is there help for single heads of households?)

Status

- It is very challenging as a single woman in the community, with moderate stigmatisation very little assistance.

6. Health and reproductive health (access and use of family planning, human immunodeficiency virus (HIV) awareness—causes, prevention, treatment, preventative health care for children and adults)

- Family planning is offered to all community members.
- HIV awareness is also provided.
- HIV prevention methods are provided to expectant mothers and unborn child.
- HIV treatment and antiretroviral drugs are available at the nearest medical facility.

7. Household food security (use matrix--frequency and amount of various product consumption—use matrix, what is a good diet, food and water storage facilities, constraints to food security, coping strategies)			
Product	***How often***	***How much for an average family***	***Other comments***
Fish			
Goat			
Chicken			
Beef			
Milk/yogurt			
Rice			
Bush meat			
Wild plants			

8. Children's activities (age of first school attendance, typical age to leave school for girls and boys, reasons for leaving school, children's role in household economy, hopes for children's future)
▪

9. Map to the extent possible/relevant with the group
No mapping information provided.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

DISABLED SELF-HELP FOCUS GROUP

Village Name:	Lamu, Pate
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Pate social hall
Facilitator/Documenter:	Mohammed Kitete/ Esther Ndegwa
Number Present:	**M:** 1 **F:** 1

1. History and composition of group.

- The group consists of over 15 people, both children and adults.
- The group was formed in 2016.
- The group depends on well-wishers and money set aside for the disabled by the county government.

2. Aim of group.

- The aim of the group is to empower, create awareness and help each other economically due to neglect by the community.

3. Management and funding of group.

- The group receives some financial assistance for self-empowerment from the community.
- The group meet and decide together on the projects they would like to start.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

ELDERS FOCUS GROUP

Village Name:	Lamu, Pate
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Pate social hall
Facilitator/Documenter:	Mohammed Kitete/Esther Ndegwa
Number Present:	**M:** 2 **F:**

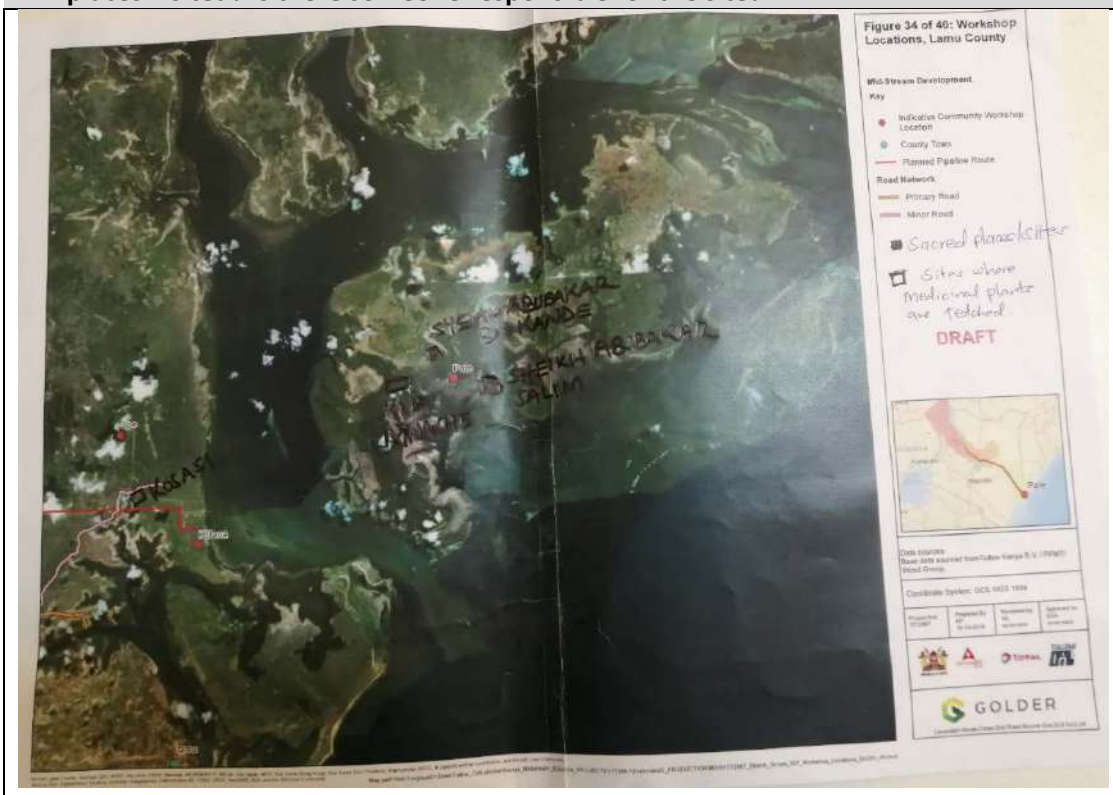
1. Describe the role of the elder (is it changed and if so, how and what influences the role?).

- Elders have a role in ensuring there is peace in the area.
- Elders assist in resolving conflict in the area.
- Elders fight against drug abuse, for example the use of *bhang* (cannabis) and cocaine.

2. Are there traditional healers? Do they use natural resources for healing? If so, can you inform us on that? Are they paid? Are they used? Where do they collect the resources they need?

- There are traditional healers in the area.
- Traditional healers are not paid for their services
- They collect medicine from the forest.

3. Using the map, are there sacred sites and physical features of the environment that are sacred, and/or of spiritual or historical importance in the location of the proposed pipeline? Draw these on map. Are these places visited? Is there someone responsible for the site?



4. Are there sacred or special areas that are taboo, should not be visited near the area of the pipeline? Draw on map.
▪ There are no sacred areas that should not be visited near the area of the pipeline.
5. Important rites of passage (what are they and how are they observed?)
▪ Most of their rites of passage are done within each homesteads. Circumcision is performed immediately after the child is born.
6. What should the proponent know about entering a village? How is respect shown?
▪ A visitor is not allowed to visit the village if not fully dressed. ▪ Visitors are welcome and treated accordingly.

FACILITATOR OBSERVATIONS

Comment
▪ As an observer, I have noticed that the community has changed several spiritual rites as a result of a shift to religion.

PROPOSED LOKICHAR TO LAMU CRUDE OIL PIPELINE (LLCOP) PROJECT

YOUTH (YOUNG ADULTS) FOCUS GROUP

Village Name:	Lamu, Pate
Meeting Date and Time:	30 October 2018
Meeting Venue/Group:	Pate social hall
Facilitator/Documenter:	Mohammed Kitete/ Esther Ndegwa
Number Present:	**M:** 2 **F:**

1. Contributions/responsibilities to households.

- They contribute cash to start up small businesses such as selling bread, fish and other items.
- They share the profits from each business.

2. Perceptions of differences, including constraints and opportunities, between young adults and their parents' generation. Important social changes such as age at marriage, at child birth, adherence to tradition-like rites of passage).

- The youth in the community are affected by several challenges, such as early marriage and dropping out of school.
- School dropout is caused by a lack of school fees and support from the parents.
- The young adults work hard to create job opportunities, for example by painting boats and fishing.
- The inhabitants of Pate are enlightened; they go to hospitals. Women give birth in the hospital unlike in the past when they were assisted by a midwife.

3. Attitudes towards education and employment (aspirations, access to technology, migrating out for work, employment).

- As a group, the young adults campaigns to inform the other villagers on the importance of education.
- They also work hard to obtain employment opportunities from the county government.
- Self-employment is high in the village.

4. General labour force characteristics and job readiness.

- Sources of employment are available in the area but due to corruption, the youth do not benefit from the opportunities.

5. HIV awareness.

- The youth create awareness in the community against the human immunodeficiency virus (HIV). They conduct door-to-door campaigns to educate on the need to go for tests, prevention and the control of HIV.

6. Political and social participation (ask about traditional authorities, changing values due to money).

- The young adults in the village participate fully in politics. They are ambassadors of peace in the area.

APPENDIX C

Minimum Wages in Kenya by Occupation and Region (2018)

Table 1: Minimum Wages in Kenya by Occupation and Region (2018) in Kenyan Shillings

Occupation / Grade	Region	Minimum Wage per Hour	Minimum Wage per Day	Minimum Wage per Month
Cleaners, Gardeners, General Workers, House servants, Children's ayah, Sweepers, Day watchmen, Messengers	Cities (Nairobi, Mombasa and Kisumu)	115.5	622	12,926.55
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	105.6	571.45	11,926.40
	All other areas (neither cities nor municipalities nor town councils)	64.55	349.5	6,896.15
Cooks, Waiters, Miners, Stone cutters, Turn boys, Logger line cutters	Cities (Nairobi, Mombasa and Kisumu)	125.8	671.05	13,960.80
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	107.05	593.4	12,386.35
	All other areas (neither cities nor municipalities nor town councils)	72	393.9	7,967.95
Night watchmen	Cities (Nairobi, Mombasa and Kisumu)	130.05	691.95	14,420.90
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	118.35	644.85	13,369.50
	All other areas (neither cities nor municipalities nor town councils)	75.85	396.85	8,225.05
Machine attendants, Sawmill sawyers, Machine assistants, Mass production machinists, Shoe cutters, Bakery workers, Bakery assistants, Tailor's assistants	Cities (Nairobi, Mombasa and Kisumu)	135	703.85	14,650.90
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	119.55	659.25	13,633.60
	All other areas (neither cities nor municipalities nor town councils)	99.35	533.7	11,050.35
Machinists (made-to-measure),	Cities	150.1	805.95	16,724.75

Table 1: Minimum Wages in Kenya by Occupation and Region (2018) in Kenyan Shillings

Occupation / Grade	Region	Minimum Wage per Hour	Minimum Wage per Day	Minimum Wage per Month
Shoe upper preparers, Chaplis makers, Vehicle service workers (petrol and service stations), Bakery plant hands, Laundry operators, Junior clerks, Wheeled tractor drivers (light)	(Nairobi, Mombasa and Kisumu)			
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	125.8	753.2	15,646.00
	All other areas (neither cities nor municipalities nor town councils)	155.5	618.65	12,791.70
Car driver, Printing machine operators, Bakery machine operators, Plywood machine operators, Sawmill dressers, Shop assistants, Machine tool operators, Dough makers, Table hand bakers, Table hand confectioners, Copy-typists, Light vans drivers	Cities (Nairobi, Mombasa and Kisumu)	157.05	838.4	17,447.15
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	143.25	773.85	16,102.75
	All other areas (neither cities nor municipalities nor town councils)	118.25	639.55	13,309.80
Clerks, Pattern designers (draughts-men), Garment and dress cutters, Single hand oven men, Charge-hand bakers, Telephone operators, Receptionists, Storekeepers	Cities (Nairobi, Mombasa and Kisumu)	179.35	957.2	19,909.45
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	144.2	875.45	18,201.95
	All other areas (neither cities nor municipalities nor town councils)	139.35	744	15,519.95
Tailors, Medium-sized vehicle drivers	Cities (Nairobi, Mombasa and Kisumu)	195.3	1,056.00	21,942.30
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	179.6	971.25	20,166.80
	All other areas (neither cities nor municipalities nor town councils)	161.2	878	17,982.10

Table 1: Minimum Wages in Kenya by Occupation and Region (2018) in Kenyan Shillings

Occupation / Grade	Region	Minimum Wage per Hour	Minimum Wage per Day	Minimum Wage per Month
Dyers, Crawler tractor drivers, Salesmen	Cities (Nairobi, Mombasa and Kisumu)	217.7	1,161.70	24,224.00
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	202.5	1,087.60	22,601.70
	All other areas (neither cities nor municipalities nor town councils)	179.85	979.55	20,398.55
Saw doctors, Caretakers (buildings)	Cities (Nairobi, Mombasa and Kisumu)	241.2	1,290.90	26,807.25
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	224.55	1,205.25	25,031.70
	All other areas (neither cities nor municipalities nor town councils)	208.5	1,120.90	23,319.15
Cashiers, Heavy commercial vehicle drivers, Salesmen-drivers	Cities (Nairobi, Mombasa and Kisumu)	262.8	1,404.30	29,169.00
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	248.15	1,321.35	27,449.65
	All other areas (neither cities nor municipalities nor town councils)	231.5	1,237.10	25,737.10
Artisans - Ungraded	Cities (Nairobi, Mombasa and Kisumu)	157.05	839	17,447.15
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	143.25	773.85	16,102.75
	All other areas (neither cities nor municipalities nor town councils)	118.35	639.55	13,309.80

Table 1: Minimum Wages in Kenya by Occupation and Region (2018) in Kenyan Shillings

Occupation / Grade	Region	Minimum Wage per Hour	Minimum Wage per Day	Minimum Wage per Month
Artisans - Grade III	Cities (Nairobi, Mombasa and Kisumu)	195.3	1,056.00	21,942.35
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	179.6	971.25	20,166.80
	All other areas (neither cities nor municipalities nor town councils)	161.3	878.05	17,948.15
Artisans - Grade II	Cities (Nairobi, Mombasa and Kisumu)	217.7	1,161.70	23,699.10
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	202.5	1,177.15	22,601.70
	All other areas (neither cities nor municipalities nor town councils)	180.05	979.15	20,398.55
Artisans - Grade I	Cities (Nairobi, Mombasa and Kisumu)	262.8	1,404.30	29,169.00
	Municipalities, Mavoko Town Council, Riuru Town Council, Limuru Town Council	248.15	1,231.35	27,449.65
	All other areas (neither cities nor municipalities nor town councils)	231.5	1,237.10	25,737.10

Source: Wage Indicator 2018

Note: Green highlighted cells are the top three highest minimum wages. Red highlighted cells are the three lowest minimum wages.

APPENDIX D

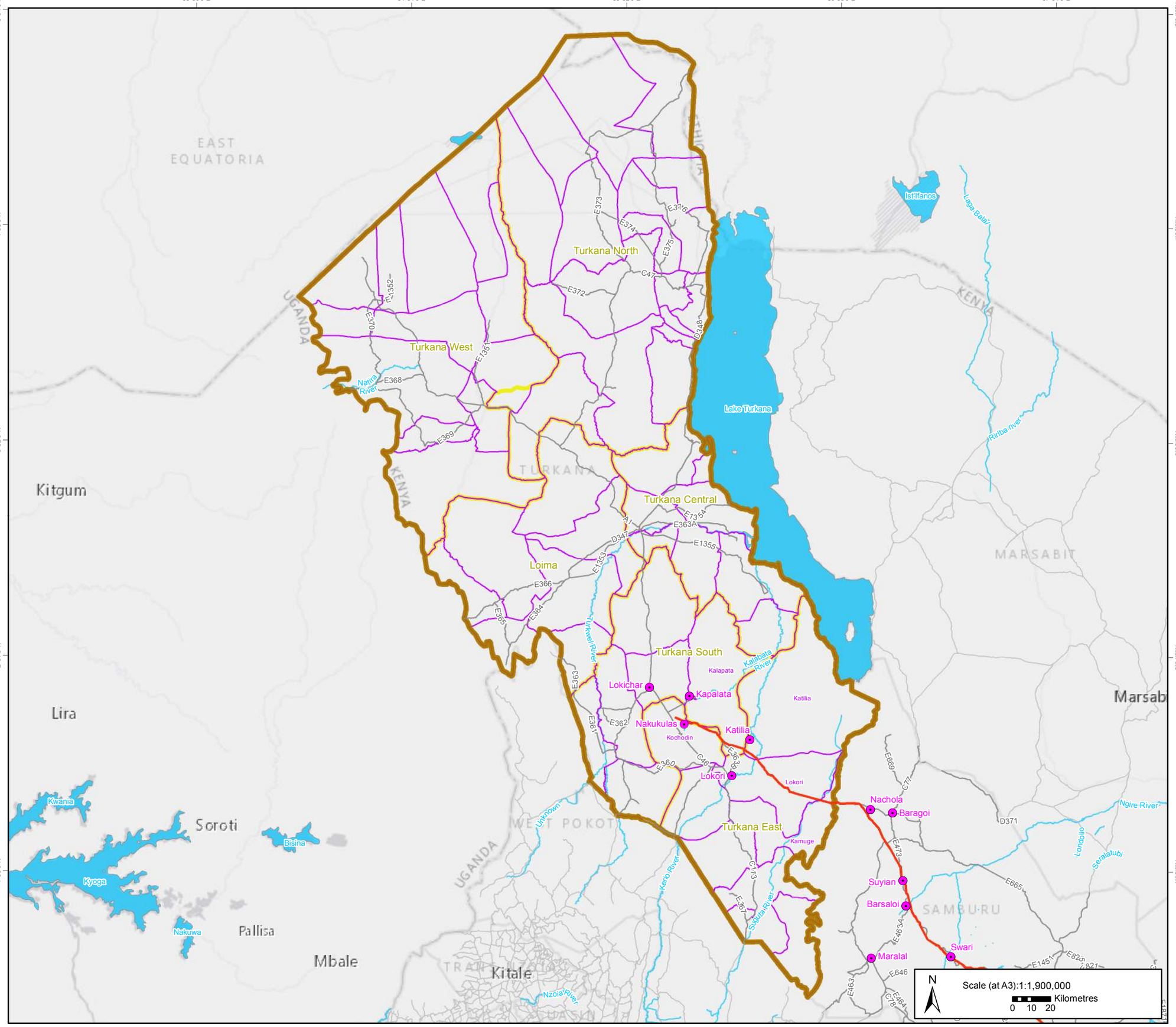
County Figures - Administrative Boundaries & Protective Areas

Drawing 1 of 6: Turkana County, Administrative Units

Mid-Stream Development

Key

- Area of Influence (AOI) Community
- Proposed Pipeline Route
- Major Road
- Location
- Subcounty (Constituency)
- County
- Waterbody
- Watercourse



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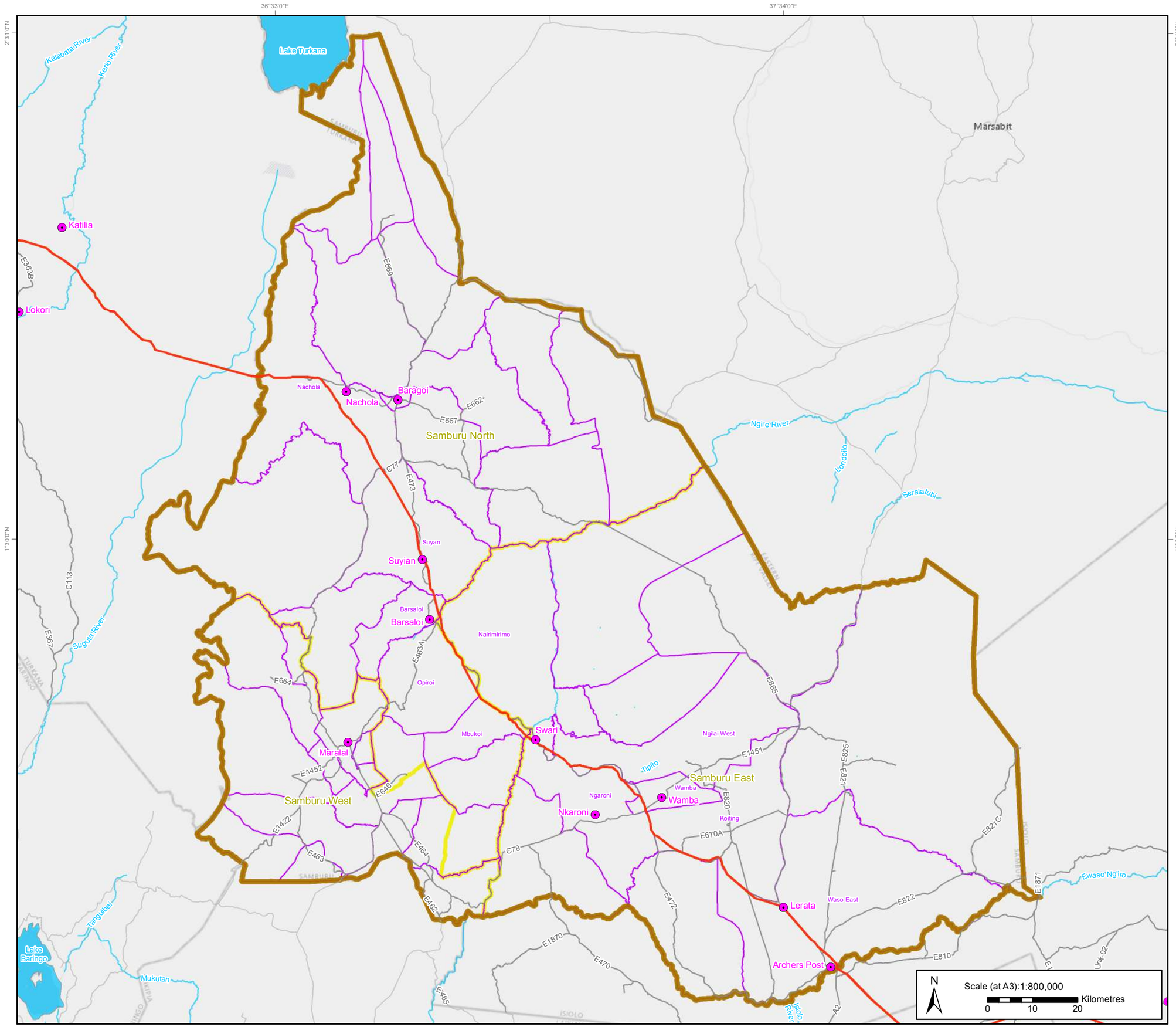
Drawing 2 of 6: Samburu County, Administrative Units

Mid-Stream Development



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- Waterbody
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Drawing 3 of 6: Isiolo County, Administrative Units

Mid-Stream Development

Key

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- Proposed Pipeline Route
- Major Road
- Location
- Subcounty (Constituency)
- County
- Watercourse

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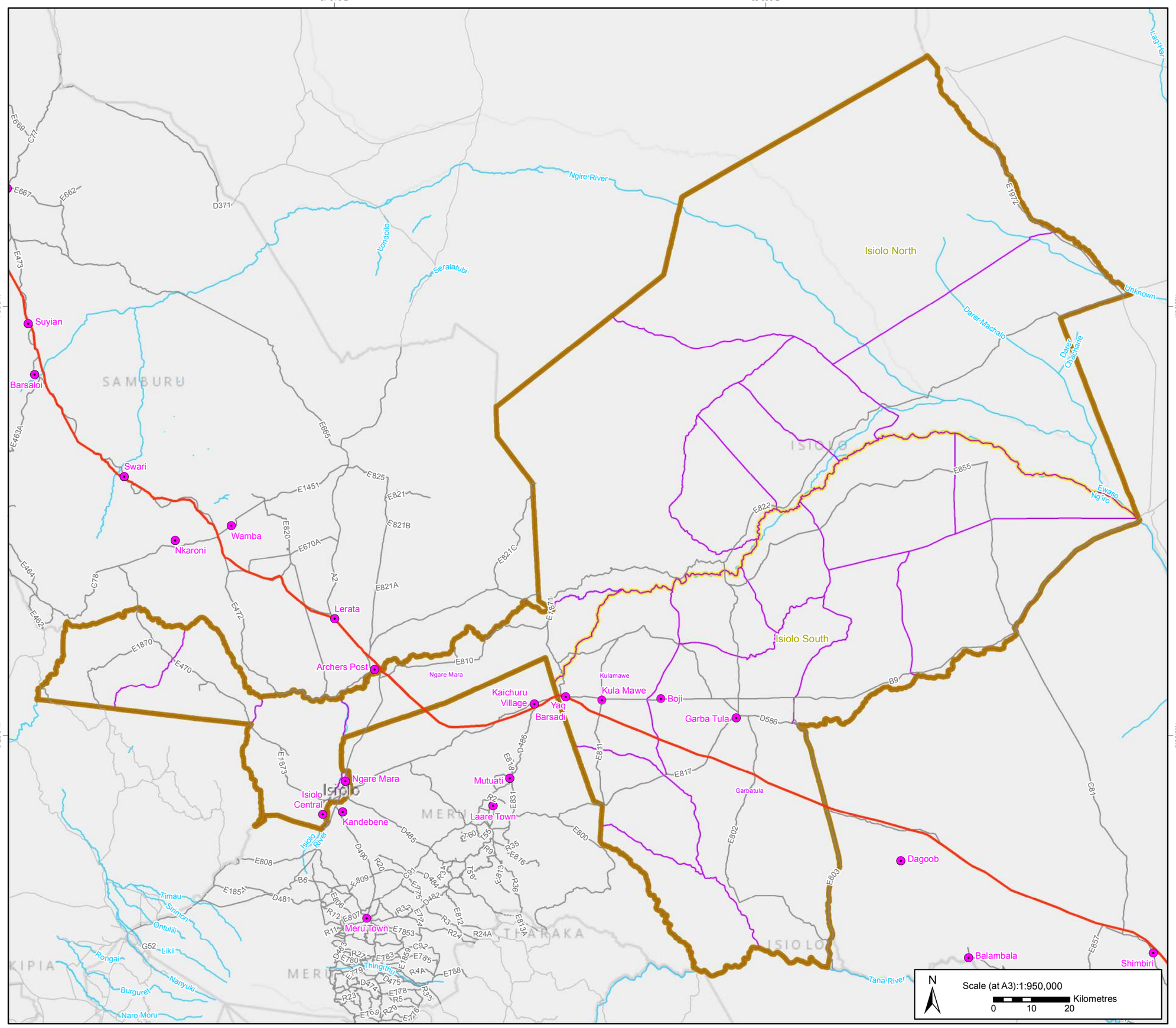

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Drawing 4 of 6: Meru County, Administrative Units

Mid-Stream Development

Key

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- Proposed Pipeline Route
- Major Road
- Location
- Subcounty (Constituency)
- County
- Watercourse

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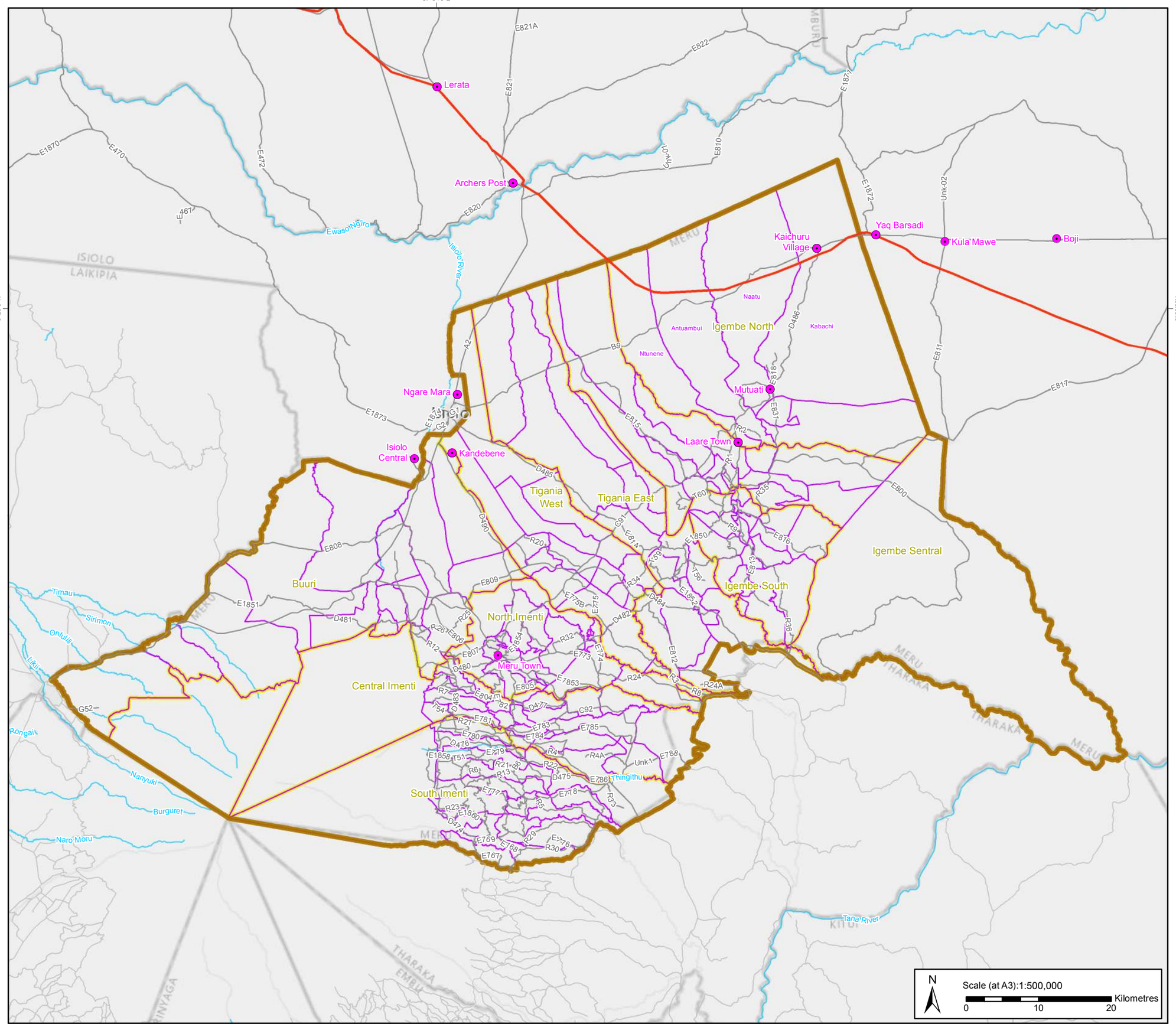

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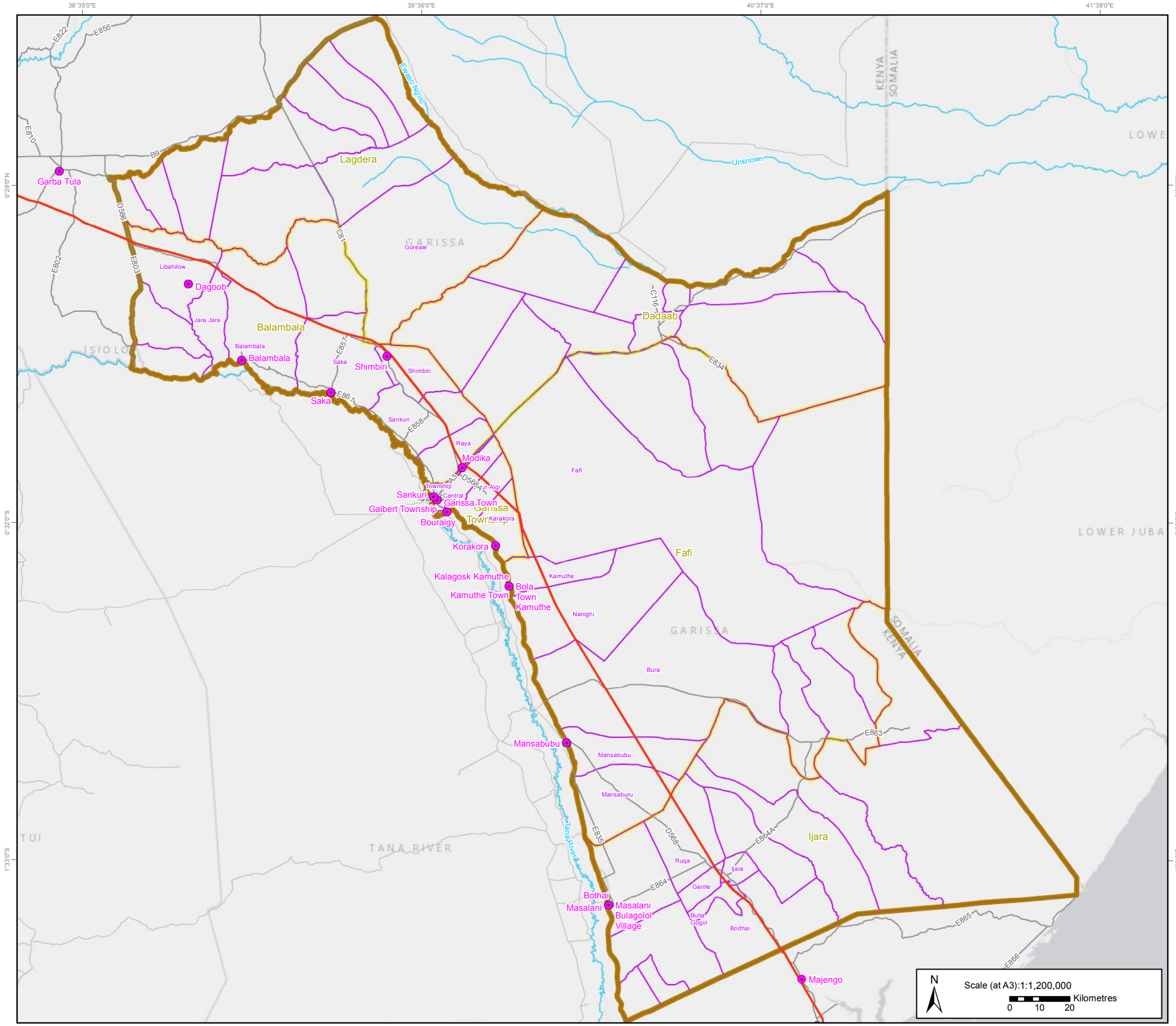
Drawing 5 of 6: Garissa County, Administrative Units

Mid-Stream Development



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Key

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- Major Road
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- Subcounty (Constituency)
- County
- Watercourse

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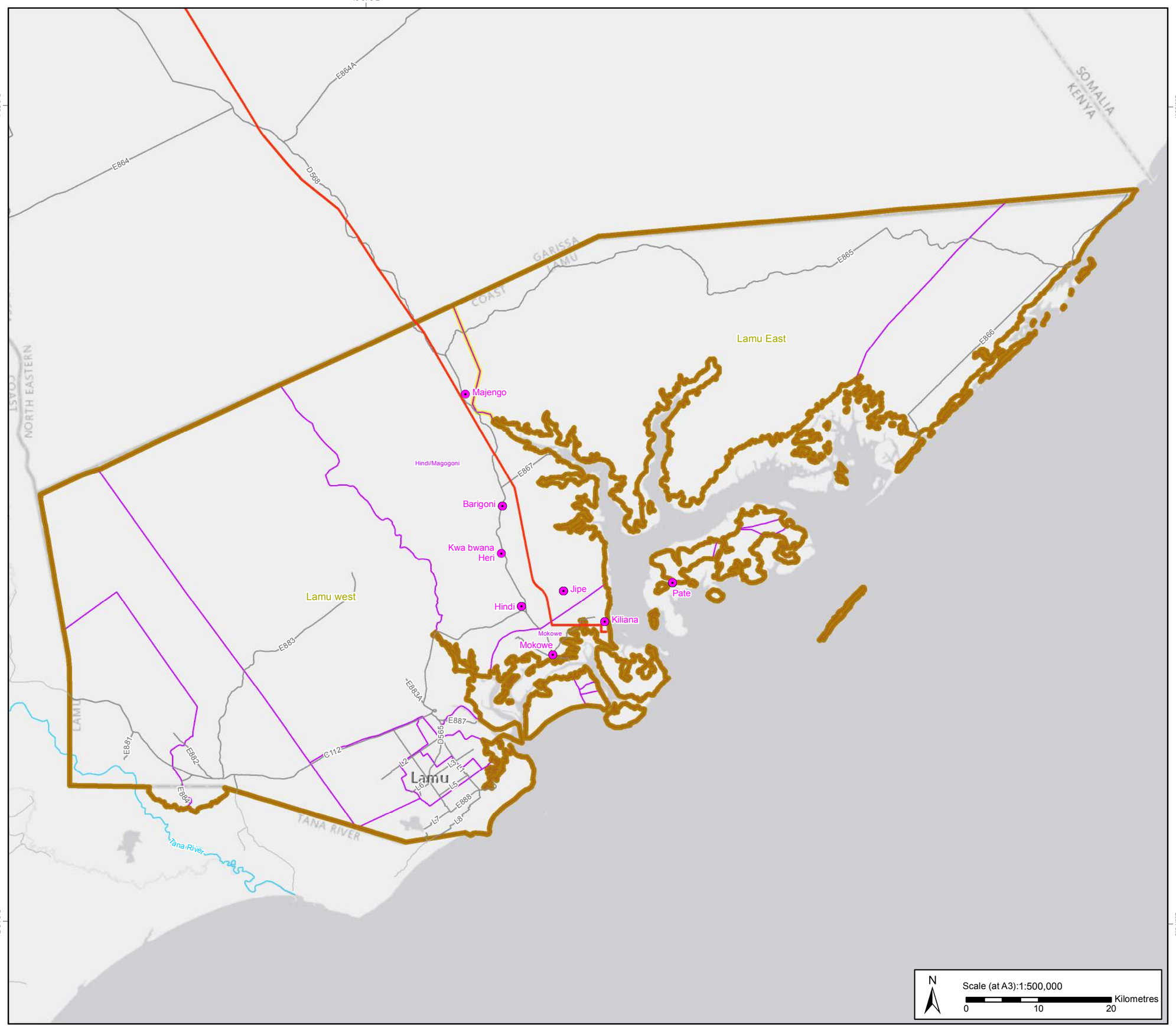

Drawing 6 of 6: Lamu County, Administrative Units

Mid-Stream Development

Key

- Area of Influence (AOI) Community
- Proposed Pipeline Route
- Major Road
- Location
- Subcounty (Constituency)
- County
- Watercourse

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Drawing 1 of 6 : Turkana County, Protected Areas

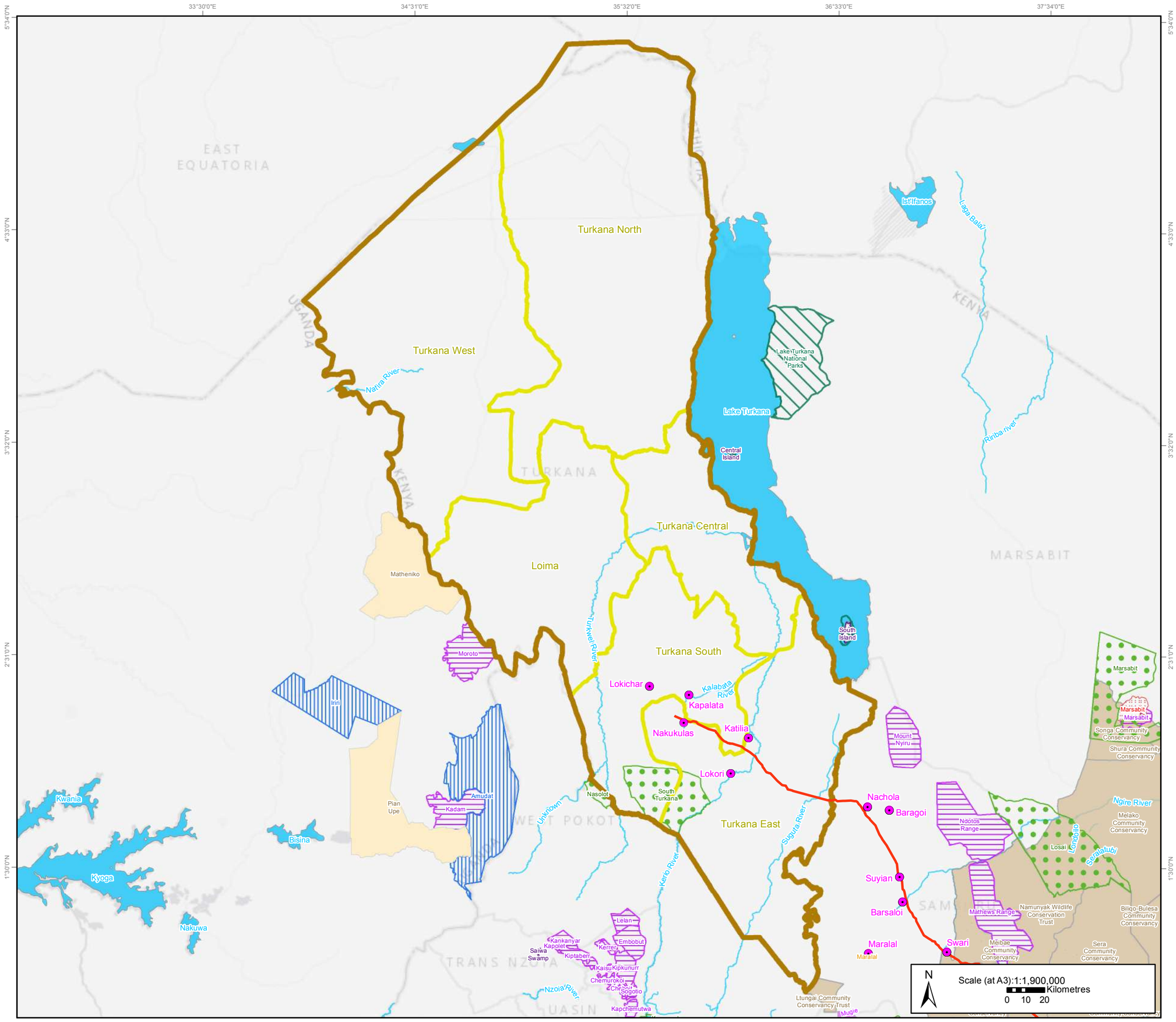
Mid-Stream Development

Key

- Area of Influence (AOI) Community
- Proposed Pipeline Route
- Subcounty (Constituency)
- County
- Watercourse

World Database of Protected Area (March 2018)

- Community Conservancy
- Community Nature Reserve
- Community Wildlife Management Area
- Forest Reserve
- National Park
- National Park (Proposed)
- National Reserve
- National Sanctuary
- Wildlife Reserve
- World Heritage Site



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Drawing 2 of 6 : Samburu County, Protected Areas

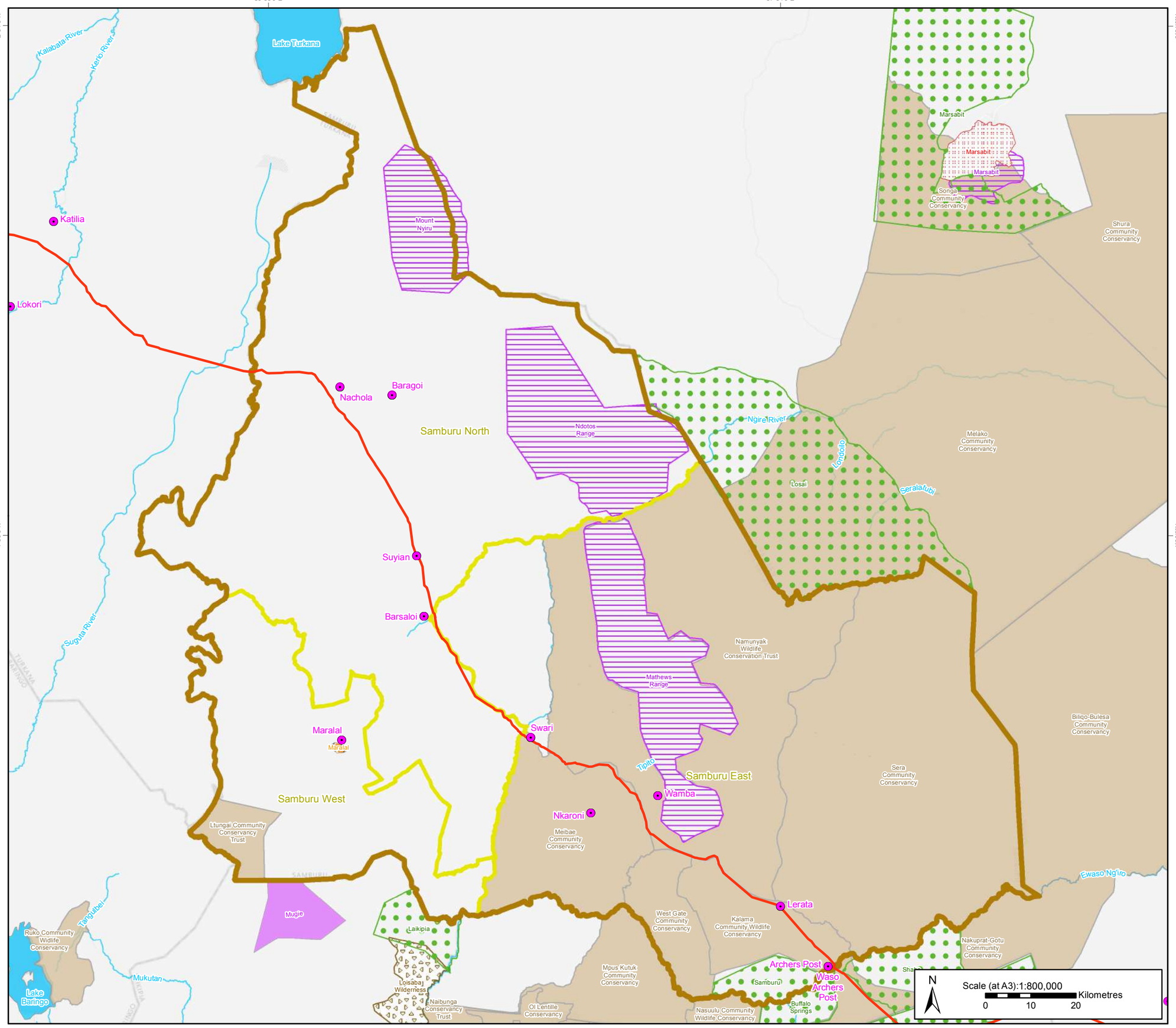
Mid-Stream Development

Key

- Area of Influence (AOI) Community
- Proposed Pipeline Route
- Subcounty (Constituency)
- County
- Watercourse

World Database of Protected Area (March 2018)

- Community Conservancy
- Community Nature Reserve
- Forest Reserve
- National Park (Proposed)
- National Reserve
- National Sanctuary
- Private Ranch



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Drawing 3 of 6 : Isiolo County, Protected Areas

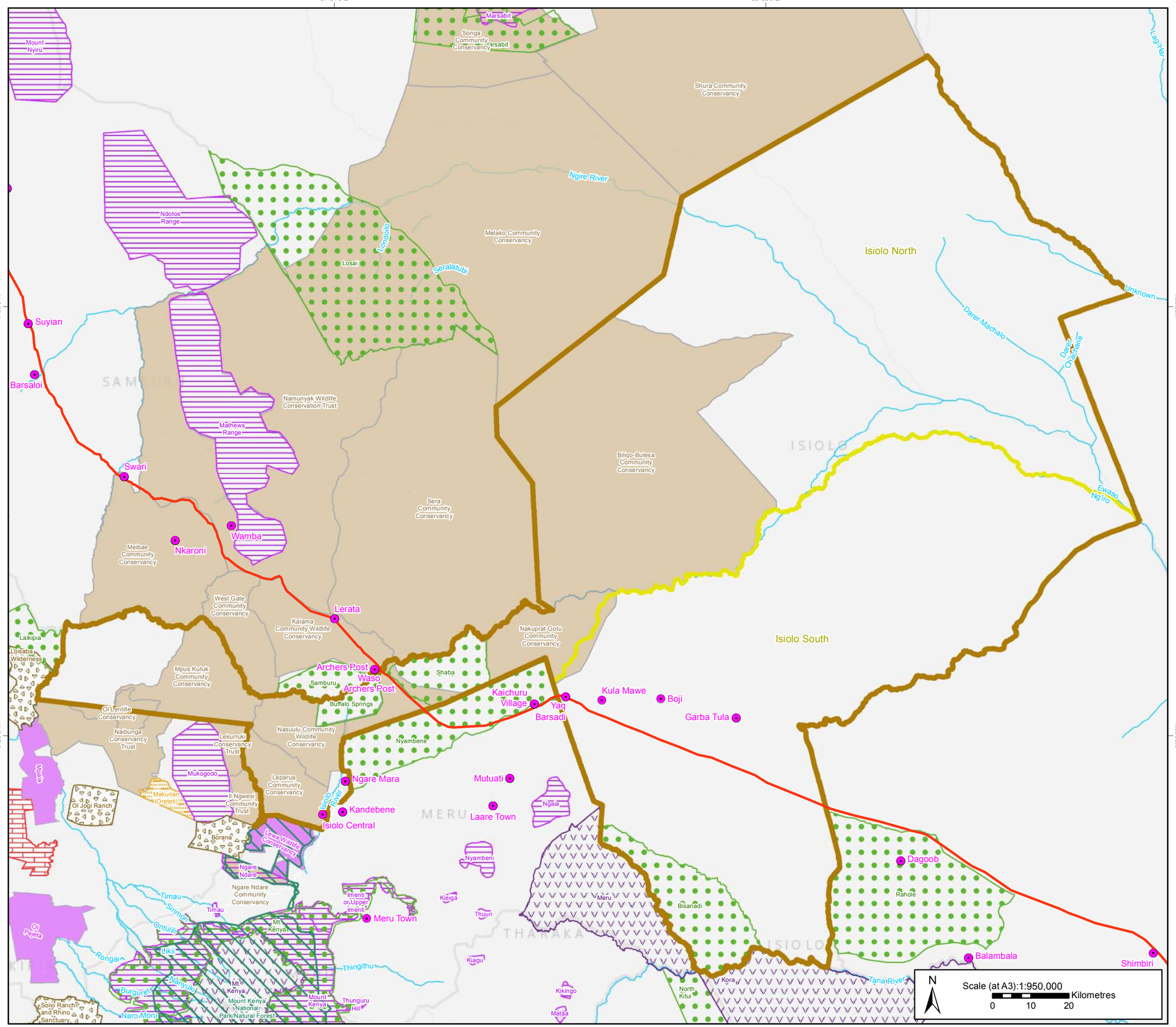
Mid-Stream Development

Key

- Area of Influence (AOI) Community
- Proposed Pipeline Route
- Subcounty (Constituency)
- County
- Watercourse

World Database of Protected Area (March 2018)

- Community Conservancy
- Community Nature Reserve
- Forest Reserve
- Group Ranch
- National Park
- National Reserve
- Private Nature Reserve
- Private Protected Area
- Private Ranch
- World Heritage Site



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Drawing 4 of 6 : Meru County, Protected Areas

Mid-Stream Development

Key

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World Database of Protected Area (March 2018)

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- Group Ranch
- National Park
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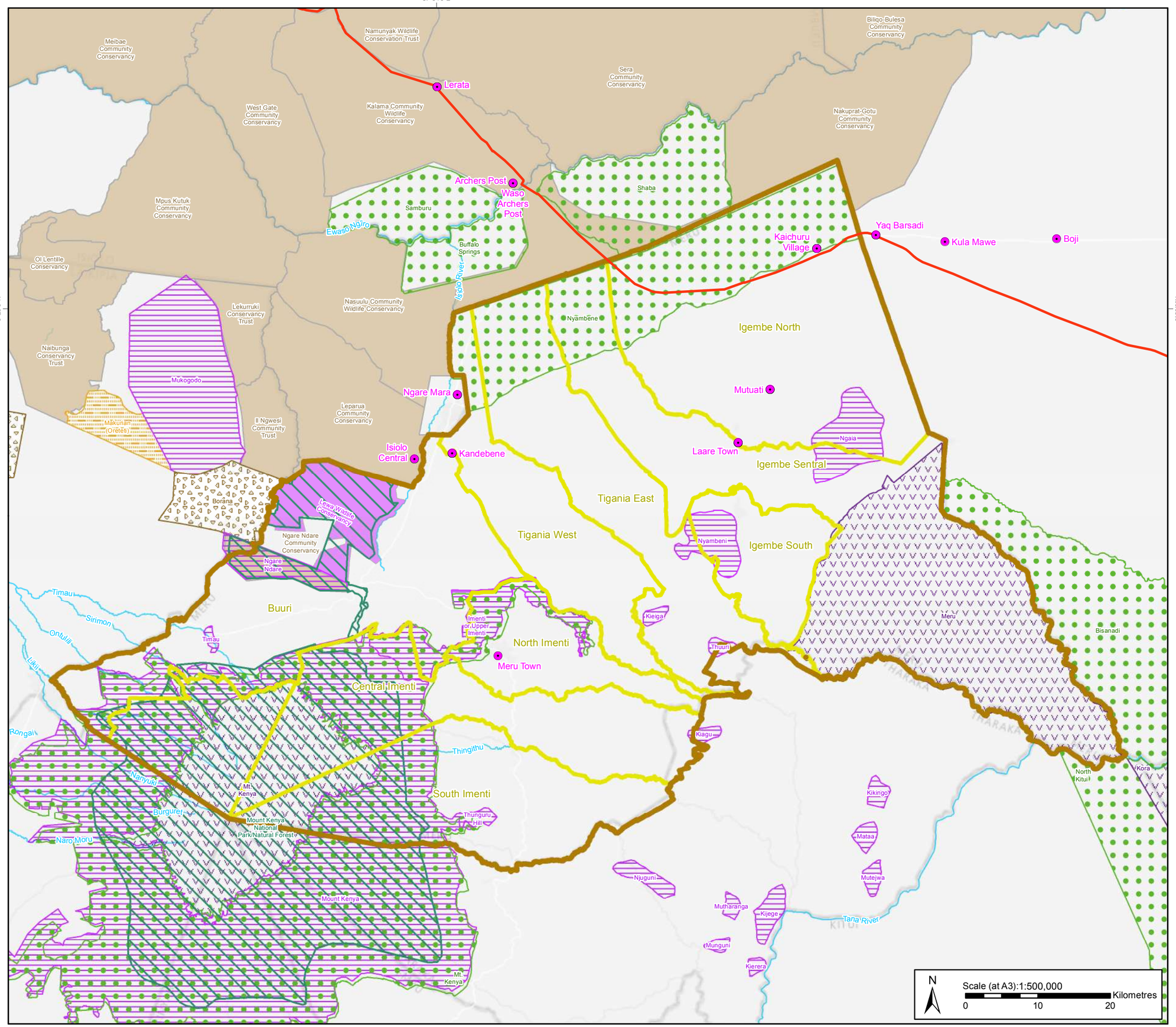

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Drawing 5 of 6 : Garissa County, Protected Areas

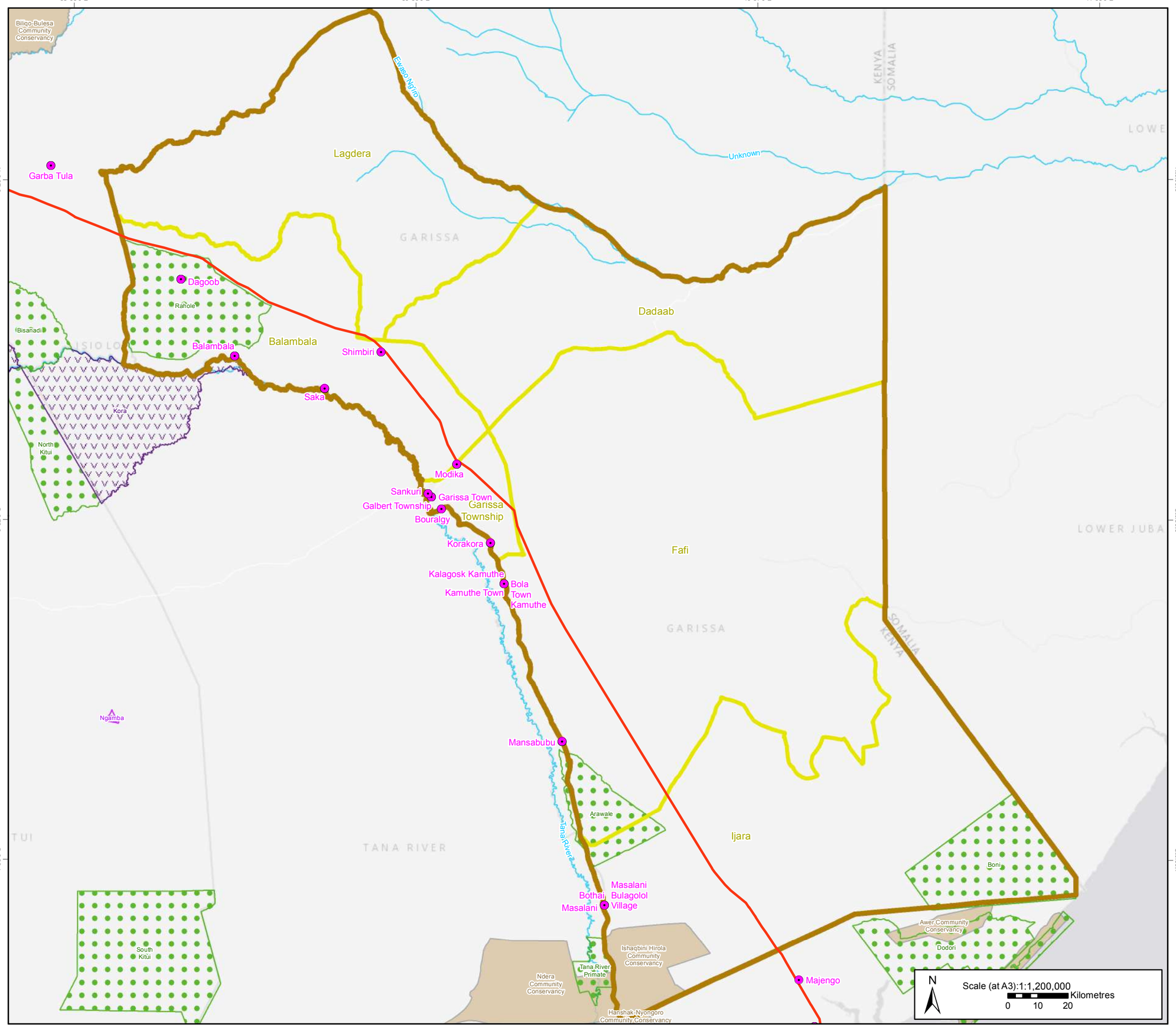
Mid-Stream Development

Key

- Area of Influence (AOI) Community
- Proposed Pipeline Route
- Subcounty (Constituency)
- County
- Watercourse

World Database of Protected Area (March 2018)

- Community Nature Reserve
- Forest Reserve
- National Park
- National Reserve



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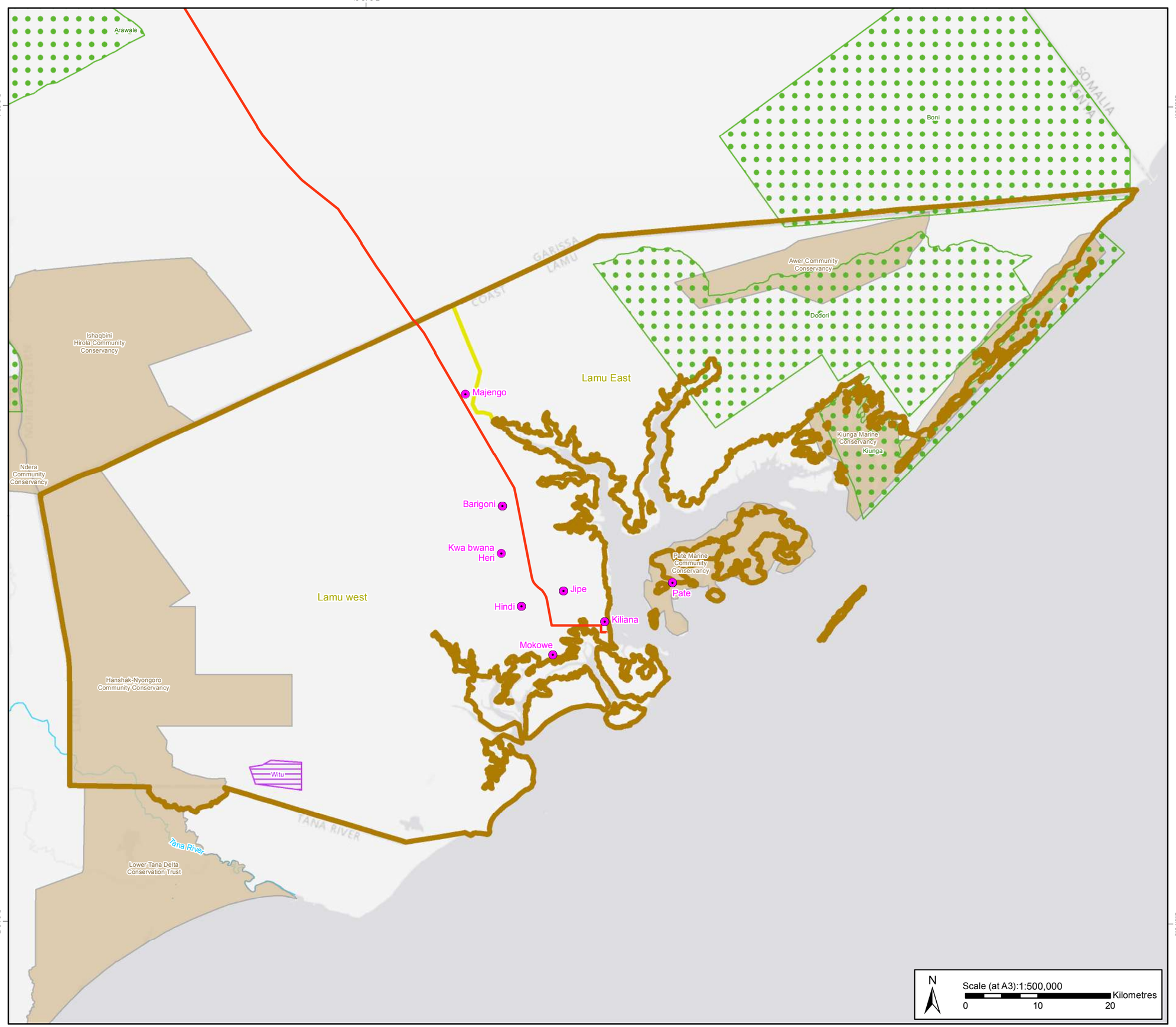

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Drawing 6 of 6 : Lamu County, Protected Areas

Mid-Stream Development

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REPORT

Cultural Heritage Baseline Report

Lokichar to Lamu Crude Oil Pipeline Project

Submitted to:

Pipeline Project Management Team (PPMT)

Submitted by:

Golder Associates (UK) Ltd

Cavendish House, Bourne End Business Park, Cores End Road,
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August 2019

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Cultural Heritage Sites

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Minutes of Lamu meeting

1.0 CULTURAL HERITAGE

1.1 Introduction

The purpose of this study was to collect objective and scientifically defendable data of sufficient breadth and quality to characterise baseline cultural heritage conditions within the LLCOP project footprint (Project Area).

Cultural heritage can be both tangible and intangible. Tangible heritage includes moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), palaeontological, historical, cultural, artistic, and religious values; or unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls (IFC 2012).

Intangible heritage, also known as "*living heritage*" or *"living culture*", includes practices, representations, expressions, knowledge and skills handed down from generation to generation. The importance of intangible cultural heritage is not the cultural manifestation itself, but the knowledge and skills that are transmitted. The term "*intangible*" is used because its existence and recognition depend mainly on the "*will of individuals*", which is immaterial.

The UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO 2003) outlines five broad "*domains*" in which, among others, intangible cultural heritage is manifested:

- Oral traditions and expressions, including language;
- Performing arts;
- Social practices, rituals and festive events;
- Knowledge and practices concerning nature and the universe; and
- Traditional craftsmanship.

This baseline report documents both tangible and intangible cultural heritage within the Project Area.

1.2 Area of Influence

The AoI for the cultural heritage baseline within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a buffer area of 5 km along the entire pipeline, where cultural heritage sites (both tangible and intangible) may be present.

The buffer was included for two reasons. First, to accommodate minor adjustments to the proposed Project alignment which may be considered in future. Second, to characterise and learn from the nature, setting and density of previously recorded cultural heritage sites from similar environments. These more distant sites provide a regional context and insight into the range of cultural heritage sites in the general area and serve as proxies where logistics or security considerations precluded field investigation of certain areas.

1.3 Methods

A combination of desk-based study (Secondary Data gathering), field survey and key informant interviews (Primary Data gathering) are used to characterise baseline conditions for cultural heritage in the Project Area. Field investigations focused on a 1 km wide corridor (500 m on either side of the Project centreline) whereas the desktop review of existing data and key informant interviews (KIIs) included the 5 km wide corridor noted above.

1.3.1 Secondary Data

Published and unpublished reference material was reviewed to identify cultural heritage sites located in the Project Area, to identify areas of potential for the presence of such sites and to provide regional context in which to interpret the established baseline conditions. The results were also used to identify areas to target with field work.

The Lake Turkana basin, owing to its internationally recognised archaeological and palaeontological significance, has attracted a wealth of academic research, which is used to inform the National Museum of Kenya (NMK) cultural heritage dataset. These records are the primary source of information for previously recorded sites in the Project Area, including statutory protections afforded to them. While valuable, it is important to recognize that NMK records are biased toward sites of higher assessed significance. More modest cultural heritage sites, such as local churches are unlikely to be found in NMK records.

In addition to the NMK cultural heritage dataset, the following information sources were consulted:

- UNESCO World Heritage List;
- Accession reports and field notes from different research missions;
- LLCOP Stage 2 Baseline Survey Field Survey Reports for Cultural Heritage Survey in Lamu, Samburu/Isiolo Section, Turkana and Garissa / Sankuri Area (Golder 2019a-d);
- W.P. and K.E. Ndiema. 2014. Report on Prehistory Heritage Monitoring and Conservation During Tullow Oil Seismic Data Acquisition Block 10BA, Kenya. Unpublished report on file with Tullow Oil plc.;
- Aerial photographs; and
- High resolution satellite imagery of the Project Area.

1.3.2 Primary Data

Primary data gathering included key informant interviews and field investigations (survey) in accordance with Kenyan legislation and guidance pertaining to cultural heritage protection, in particular the Environmental Management and Co-ordination Act (EMCA) 1999 and the National Museums and Heritage Act (2006).

1.3.2.1 Key Informant Interviews

Key Informant Interviews were undertaken at settlements in proximity to the Project Area. Initial contact with community members was made through Environnementalistes Sans Frontiers (ESF) Consultants and local government leadership, followed by Golder. During these introductory meetings, arrangements were made to conduct the KIIs.

The KIIs were completed in partnership with NMK specialist (Dr. Christine Ogola) with a local community member assisting. Interviews were largely conducted in Swahili and were digitally recorded with the consent of the participants. Where interview participants did not speak Swahili, a member of the local community translated.

KKIs were completed with community leaders and Elders and sought to document the following:

- Sites of cultural significance to communities, including religious, sacred or ritual sites and cemeteries or burial areas. For each identified site, the following information was documented where possible: location, extent, current use and access;
- Settlement patterns and current land use in the Project Area; and
- Local traditions and practices (e.g., intangible, or living heritage) that are important to the communities.

1.3.2.2 Field Survey

The Project Area was divided into four sections (Figure 1).

- Lamu;
- Samburu/Isiolo;
- Garissa/Sankuri; and
- Turkana.

Field survey involved walking over the proposed project footprint looking for evidence of tangible and intangible heritage and recording the locations of identified sites. The survey corridor was 1 km wide; up to 500 m on either side of the Project centreline where topographically possible. Field investigations concentrated on accessible and safe areas with known cultural heritage sites based on the results of the KII's and the desktop study. Residents in the vicinity of the field survey areas were queried for information on both tangible and intangible cultural heritage sites.

A survey team comprised of three cultural heritage specialists completed a systematic walkover survey following transects spaced 20 m apart. The survey was limited to remains visible at the surface and unobscured by vegetation or loose surface material. In areas where erosion has cut deep gullies, these exposures were inspected for evidence of cultural materials such as stone tools and fossil bone.

Cultural heritage sites, features and objects were photographed using a Canon D700 18.1 M/P DSLR camera and mapped with a recreational grade GPS (Garmin GPSMAP 62S) using the WGS 84 datum. Field notes include a brief site description and salient details such as dimensions, setting and associated finds.

1.3.2.3 Spatial Analysis

Secondary (archival) and Primary (field) cultural heritage data were compiled into one dataset, which was then georeferenced using geographical information system (GIS) software to establish their locations in relation to the proposed project footprint.

1.4 Results

The sections that follow present the results of the cultural heritage baseline study for LLCOP. This includes the review and analysis of Secondary Data (archival) and Primary Data (KII's and field work).

1.4.1.1 Secondary Data

Consistent with the methods outlined in Section 1.3, Secondary Data were assembled and summarized in preparation for ground-truthing and to serve as indicators of the types and density of cultural heritage sites in areas inaccessible to field work due to logistical or security-related considerations. While a small number of these sites fall outside the 10 km buffer zone, they are included in the baseline summary given their ability to provide information on the types and density of sites expected in the Project footprint.

1.4.1.2 Primary Data

The sections below summarise information collected through Key Informant Interviews and field investigations by the cultural heritage team.

1.4.1.2.1 Key Informant Interviews

Prior to the commencement of the cultural heritage baseline study, cultural heritage data of a non-archaeological nature had been collected by the social assessment team. Subsequently, in the Turkana, Samburu and Garissa regions, cultural heritage baseline meetings were held which focused on archaeology and living heritage sites, including burials.

Several meetings were held in Hindi Sub-County with community leaders, religious leaders, and Elders from communities which overlap the pipeline alignment, including the Sub-Locations of Hindi, Bargoni and Bodhei. The objectives of the meetings were to inform local community leaders about the Project and to gather information on local cultural heritage types and locations, which may overlap the Project area. Meetings were mobilized by the Hindi Sub-County Commissioner in consultation with the Chief for the Hindi Location. Data was gathered without structured questionnaires through informal interviews. Prior to each interview, the attendees were briefed about the objectives for the visit and each representative was provided with an opportunity to share information about their knowledge of local cultural heritage.

Four meetings were held in Lamu to discuss cultural heritage as it relates to the Project. This location was chosen as there was only limited information on cultural heritage available and this setting was considered the best location to obtain cultural heritage information for the region. Due to issues concerning land ownership, cultivation and security, only limited physical access to the land in this region was possible at the time of the cultural heritage baseline study. The local Chief was able to mobilise groups of Elders and other leaders for Golder to speak with at specific locations (in townships) and to show the location of some of the sites/features along the pipeline where conditions allowed.

Meeting notes are provided in Appendix C with salient aspects detailed below.

Meeting 1

Meeting: Lamu County Commissioner

Date: 11 December 2018

Synopsis: this meeting mostly focused on security issues

- The objective of the meeting was to officially submit the letter of introduction and explain the goals and scope of Golder's work in Lamu.
- The Project team was informed of security concerns in the proposed survey areas.
- Suggested meeting with Elders and local leaders to gather information on existing sites located in areas not accessible due to safety concerns.

Meeting 2

Meeting: Hindi Sub-County Commissioner and Hindi Location Chief

Date: 15 December 2018

Synopsis: this meeting mostly focused on security issues and scheduling forums

- Purpose of the meeting was to explain the cultural heritage study, request assistance with arranging heritage interview forums with local area Elders and religious leaders and to discuss security concerns in the proposed survey areas.
- Forum scheduled for 17 December 2018.
- Heritage surveys scheduled for 18 December 2018

Meeting 3

Meeting: Hindi Forum Meeting

Date: 17 December 2018

- Purpose of the meeting was to explain the cultural heritage study and consult with community religious leaders and Elders.
- An important natural source for honey production and wildlife habitat is associated with a grove of trees near Bargoni.
- Gravesites from previous inhabitants and shrines for special occasions may be present in the Hindi / Bargoni area.

Meeting 4

Meeting: Bargoni Forum Meeting

Date: 17 December 2018

- The Project team met with 11 Elders and leaders from Bargoni and Bodhei Sub-Locations to discuss the cultural heritage study.
- The Bargoni Sub-Location contains shrines, sacred trees, and plants used for traditional medicine.
- Inhabitants move around the landscape, but also establish semi-permanent and permanent settlements.
- Bee harvesting is a significant part of the community subsistence and culture.
- Other species [in addition to bees] of significance to community members include insects [*chori* (Boni) and *tungu* (Swahili)] and a bird named *merris* (Boni) which guide community members to sources of honey.
- Trees named *wahare* in the local Boni language and *Mongo* in Swahili are very sacred to them and are markers of burial sites in the area.
- Names for sacred trees and plants and their uses were recorded by the Project team.

In sum, the Turkana region is well covered by KIIs, but coverage for the Samburu/Isiolo and Garissa regions is less comprehensive. The team was unable to conduct KIIs in the Kula Mawe region and it remains a gap in our information.

1.4.1.2.2 Field Work

Four field work campaigns took place as follows:

- 26 October to 3 November 2018: Turkana County, focusing on the sub counties of Turkana South and Turkana East;
- 12 to 23 November 2018: Counties of Samburu (Samburu North and Samburu East), Isiolo (Isiolo Central Sub-County);
- 3 to 9 December 2018 Garissa County (Garissa central and Mbalambala Sub Counties); and
- 11 to 20 December 2018, Lamu County (Hindi Sub County).

Survey coverage within the four Project segments is illustrated in Drawings 2 to 6. Gaps in coverage are due to logistics/access constraints and security concerns. For example, field work did take place in the Kula Mawe region.

1.4.1.2.3 Discussion

There are seven sites designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as World Heritage Sites (WHS) in Kenya, comprising four cultural sites and three natural sites. None of these sites lie within the Project Area. However, Lamu Old Town WHS is situated approximately 8 km southwest of Lamu Port where the pipeline terminates. Drawing 19 illustrates the Project footprint in relation to Lamu Old Town WHS and its buffer zone. Lake Turkana National Parks WHS and its buffer zone is located more than 50 km from the Project Area and will therefore not be impacted in any way by the project. Tullow Oil plc (2017) has pledged not to explore or exploit reserves in World Heritage Sites.

In total, 129 cultural heritage sites were identified in the Project Area (Drawing 7 to 18). As shown in Table 1, there are three major site categories: archaeological (n=70), living heritage (n=48) and palaeontological (n=4). In addition, there are two hybrid categories where more than one site type is present in a given locality, namely archaeological/living heritage (n=5) and palaeontological/living heritage (n=2). These archaeological, living heritage and palaeontological sites are summarised in the sections that follow and are described in greater detail in Appendix B.

Table 1: Site Type Counts and Percentages.

Site Type	Counts	Percentage (%)
Archaeological	70	54.3
Archaeological/Living Heritage	5	3.9
Living Heritage	48	37.2
Palaeontological	4	3.1
Palaeontological/Living Heritage	2	1.6
Total	**129**	**100**

Archaeological Sites

Archaeological sites are summarised in Table 2 and Table 3 with single burial sites the most common type at 60% overall. When combined with the other sites containing archaeological burials, the overall percentage rises to 65% of all archaeological sites and 50% of all site types combined. Archaeological grave sites are characterised by large stone cairn markers and are a common feature in the northern Kenya region (Appendix A, Plate 2). Upright stone marked graves in Samburu (e.g., LLCOPP-24) are not recognised by the local inhabitants as Samburu burials and are thus deemed archaeological (Appendix A, Plate 3).

Table 2: Archaeological Sites Types[1], Counts and Percentages.

Archaeological Site Types	Count	Percent (%)
Burial Site, multiple (LLCOP-11, 40, 41 and 123)	4	5.7
Burial Site, multiple; Lithic Artefact, scatter (LLCOP-33)	1	1.4
Burial Site, single (LLCOP-46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 95, 96, 97, 98, 99, 100, 101, 125, 127, 128 and 129)	42	60.0
Lithic Artefact, isolated find (LLCOP-13 and 14)	2	2.9
Lithic Artefact, scatter (LLCOP-4, 12, 32, 34, 35, 36, 37 and 39)	8	11.4
Monument (LLCOP-102)	1	1.4
Ostrich Egg Shell Bead (LLCOP-10, 15, 16, 17, 23 and 24)	6	8.6
Pot Sherds (LLCOP-26, 27, 28, 29, 30, 31)	6	8.6
Total	**70**	**100**

Table 3: Archaeological/Living Heritage Site Types, Counts and Percentages.

Archaeological / Living Heritage Site Types	Count	Percentage (%)
Burial Site, multiple (LLCOP-18)	1	20
Burial Site, multiple (recent and archaeological); Potsherds and Beads (LLCOP-25)	1	20
Lithic Artefact Scatter/Burial (LLCOP-2)	1	20
Settlement (LLCOP-93 and 94)	2	40
Total	**5**	**100**

Other archaeological finds in this region include low density scatters of lithic artefacts including Early Stone Age-like cores and flakes (2.5 million to 280,000 years ago) (LLCOPP-36), Pastoral Neolithic (pre-4,000 to circa 1,300 BP) ostrich eggshell beads, pot sherds and stone artefacts (Bower 1991). Stone artefacts are made from quartz, obsidian, chert and phonolite/rhyolite.

Two lithic artefact sites (LLCOPP-12 and -38), separated by 300 m in the western plains between the Central Processing Facility and Lokicheda Village (Turkana Region), are more substantive and date to the Middle Stone Age (MSA) which spans the period roughly from about 280,000 to 30,000 years ago (Jacobs et al. 2008).

[1] All Burial Sites are considered Archaeological unless available data indicates they are Living Heritage.

The first of these MSA sites (LLCOPP-12) is represented by approximately 200 phonolite/rhyolite artefacts scattered across a ~100 m² area. The assemblage includes *in situ* artefacts characteristic of this time period including blades, points, Levallois flakes and distinctive core types. Many of the artefacts were exposed by erosion from a small water channel that runs east-west through the site. While some artefacts have been displaced, *in situ* artefacts are visible along the edges of the channel and on stable, un-eroded surfaces adjacent to the channel. This site is significant as it the only *in situ* MSA site recorded west of the Lake Turkana region (Appendix A, Plates 4 and 5.

The second MSA site (LLCOPP-38) is a large scatter of about 500 weathered rhyolite artefacts in an area of about 50 m². Sandy sediments at this location have been deflated and winnowed out either by wind or slow-moving water action or both, leaving weathered/rolled lithic artefacts strewn on the surface. These tools are also of MSA disposition with distinct tool types identifiable (Appendix A, Plates 6 and 7).

Living Heritage Sites

Different cultural traditions are practiced in the different regions through which the proposed pipeline corridor runs, each with its own observations and beliefs. However, common to the inhabitants is a livelihood based upon pastoralism (and hunting and gathering for the Boni of the coast). These populations are highly reliant upon the local environment and depend on grazing, hunting and the collection of medicinal and food plants. Different tree species (such as Ewoi, Edome and Ekadeli, Wahare) are used for a variety of functional and spiritual purposes. Religious beliefs include Christianity, Islam and local polytheist/animist religions. The significance of 'seers' and herbalists to the communities was noted in the KIIs.

Tables 3 to 5 summarise the different types of living heritage sites documented in the AoI. Sacred/Ritual sites (n=16 / 29%) and Settlements (n=16 / 29%) are the most common, followed by sites with Burials (n=11 / 20%) (Appendix A, Plates 8 to 11).

Among the living heritage feature types that were recorded are Akiriket and Ngasenon. Akiriket refers to a Turkana community Elders' ritual meat feasting practice and associated site by the same name (LLCOPP-76). The site consists of a large (depending on number of Elders), semi-circular stone formation (sitting area) and front-centre stone pile (meat preparation and serving area). During Akiriket, the group of Elders sit in an arc, with the most senior age sets sitting at the centre, with younger age sets following in ascending sequence to either side of the most senior (Appendix A, Plate 12).

Ngasenon (LLCOPP-82) refers to a wayside sacred site where passers-by/travellers make prayers/wishes for safe passage through the respective territory by throwing pebbles into a pile at a particular location, creating a cairn-like roadside feature (usually along a regularly used footpath) (Appendix A, Plate 13). This feature is distinguished from graves by its lack of arranged foundation stone and general lack of form/shape.

Other examples of ceremonial sites include a traditional meeting place near the river at Barsaloi and another site that consists of two tall Acacia trees next to a women's bead-making shed at Archers Post (LLCOPP-105).

Table 4: Living Heritage Site Types, Counts and Percentages.

Living Heritage Site Types	Count	Percentage (%)
Beads, modern (LLCOP-45)	1	2.1
Burial Items, Ostrich Egg Shell Fragments (LLCOP-19, 20 and 21)	3	6.3
Burial Site, multiple (LLCOP-108, 111, 112 and 113)	4	8.3
Burial Site, multiple; Sacred/Ritual Site (LLCOP-110)	1	2.1
Burial Site, single (LLCOP-109)	1	2.1
Sacred/Ritual (Feasting) (LLCOP-77 and 78)	2	4.2
Gathering Location (LLCOP-106)	1	2.1
Sacred/Ritual Site (LLCOP-81, 82, 83, 105, 107, 115,116, 117, 118, 119, 120, 121, 122, 124 and 130)	15	31.3
Settlement (LLCOP-9, 42, 43, 44, 84, 85, 86, 87, 88, 89, 90, 91, 92, 114)	14	29.2
Subsistence Extraction Area (LLCOP-79, 80, and 103)	3	6.3
Subsistence, Pastoral (stock pens) (LLCOP-104 and 126)	2	4.2
Well (LLCOP-1)	1	2.1
Total	**48**	**100**

Table 5: Palaeontological/Living Heritage Site Types, Counts and Percentages.

Palaeontological / Living Heritage Site Types	Count	Percentage (%)
Burial Site, multiple; Fossil Bone – unspecified (LLCOP-5)	1	50
Burial Site, single; Fossil Bone – unspecified (LLCOP-6)	1	50
Total	**2**	**100**

In Lamu region, the Boni community has a large inventory of intangible heritage sites gleaned from interviews with Elders and local leaders, some of which were recorded along the pipeline corridor in this region. These include a sacred grove (miingani) (LLCOPP-106) and tree species used as sources of medicine, for food resource purposes and for spiritual and ceremonial/ritual purposes.

In Garissa region, a Maulac, a women's worship place, was recorded near Fatuma Golicha villages (LLCOPP-104) (Appendix A, Plate 14). At the same location, trees are planted to mark grave sites (LLCOPP-109) and are also used as traditional worship locations among the Boni of coastal Kenya.

Throughout the AoI, graves occur singularly or as multiple graves near non-urbanised settlements or as cemeteries in some urban centres. Graves are marked with stone cairns, upright stones, head/tomb stones and crosses, but there are also reports of unmarked graves in some regions like Garissa.

Graves in the northern regions are marked with small stone cairns, similar to the much larger archaeological stone cairns, but a few are marked with crosses. Often times, modern burial cairns vary in size of marker with social standing of the interred. Among the Turkana, graves of Elders, leaders and other prominent individuals in society are marked with large memorials. Such individuals' graves are also revisited over time for feasts, during which the grave markers are reinforced or enhanced with additional material.

Similar grave types are recorded for the Turkana and Samburu/Isiolo regions. In Isiolo, numerous burials are identified including single and multiple inhumations. In both regions, burials were recorded near abandoned settlements where traces of settlements are still visible, but some burials occur in isolated areas and could imply an abandoned settlement in the distant past. It is common for the dead to be buried near settlements, after which the living members abandon the homestead and establish homes elsewhere.

Three public cemeteries were recorded in the Samburu/Isiolo region; one at Barsaloi near the Catholic Mission, and two at Archer's Post; one Muslim and the other for the general public, both located right next to the Ewaso Ng'iro River (Appendix A, Plates 10 and 11). It is important to note that even in urban centres where there are public cemeteries, isolated burials outside of these cemeteries can be found (e.g., at Archer's Post).

There were no grave sites recorded along the pipeline corridor in Garissa region. However, archaeological burials are previously recorded in Saka and Hardley Villages in Mbalambala Sub-County. The Somali community inhabitants of this region generally bury their dead according to Islamic faith – in cemeteries, while those that fall outside these cemeteries are unmarked, and not easily identifiable. Team members were prohibited from recording the locations of burials and cemeteries, and even in Hardley and Saka villages where there are previous reports of archaeological burials, access was denied. The Saka and Hardley burials are however far removed from the pipeline route. Their existence thus only serves to indicate that similar could be found in areas not surveyed, especially areas along the River Tana.

Burials sites at the coast are historical and are marked with headstones. Another type of grave marking; the Muhongo (Swa)/Wahare (Boni) tree was recorded among the Boni community. The grave is marked by planting two trees of this species, one at the head and the other at the feet of the buried dead (LLCOPP-109). Thus, this tree species commonly occurs in pairs, indicating the location of burials and past settlements – where burials existed. It is noted that this tree also occurs naturally, and in this case its distribution would be random. None of these tree-marked graves were recorded along the pipeline corridor, but Elders intimate that they are common, and one such tree-marked grave was recorded close to the pipeline corridor near Bargoni village (Appendix A, Plate 15).

In regard to pastoralists' settlements, they are typically ephemeral with little material remains left behind when occupants depart, and thus traces of settlements are completely destroyed after some time of non-return (Appendix A, Plates 16 to 18).

Palaeontology

Several fossil-bearing sites with large mammal fossils, and fossil wood were recorded in the Nachola area (Appendix A, Plates 19 and 20). Fossil teeth fragments (LLCOPP-37) were found near "*Monkey Hill*" (Appendix A, Plate 21). No fossil hominid remains were identified.

Table 6: Palaeontological Site Types, Counts and Percentages.

Palaeontological Site Types	Count	Percentage (%)
Bovid (LLCOP-3)	1	25
Fossil Bone – unspecified (LLCOP-7 and 8)	2	50
Mammal Teeth (LLCOP-38)	1	25
Total	**4**	**100**

1.5 Conclusions

The present baseline study covering the proposed Lokichar to Lamu Crude Oil Pipeline corridor has established that the project area is sensitive cultural landscape with a diverse range of cultural heritage sites including a large number of burial sites and archaeological sites of considerable antiquity. A total of 129 sites were documented in the AoI. However, due to time and security constraints and the sampling methods employed, not all areas have been subject to field survey and likely that additional sites may exist in those areas that were not reached. It is therefore crucial that these areas are visited and investigated during subsequent field campaigns as Project Area access improves and security constraints are addressed.

Overall the cultural heritage baseline assessment succeeded in its key objective of documenting important cultural heritage resources present along the project footprint area. The assessment has also created a detailed inventory to support the proponent with decision-making as the Project proceeds to the next stage, which would include the development of project infrastructure in the project footprint area.

1.6 References

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DRAWINGS

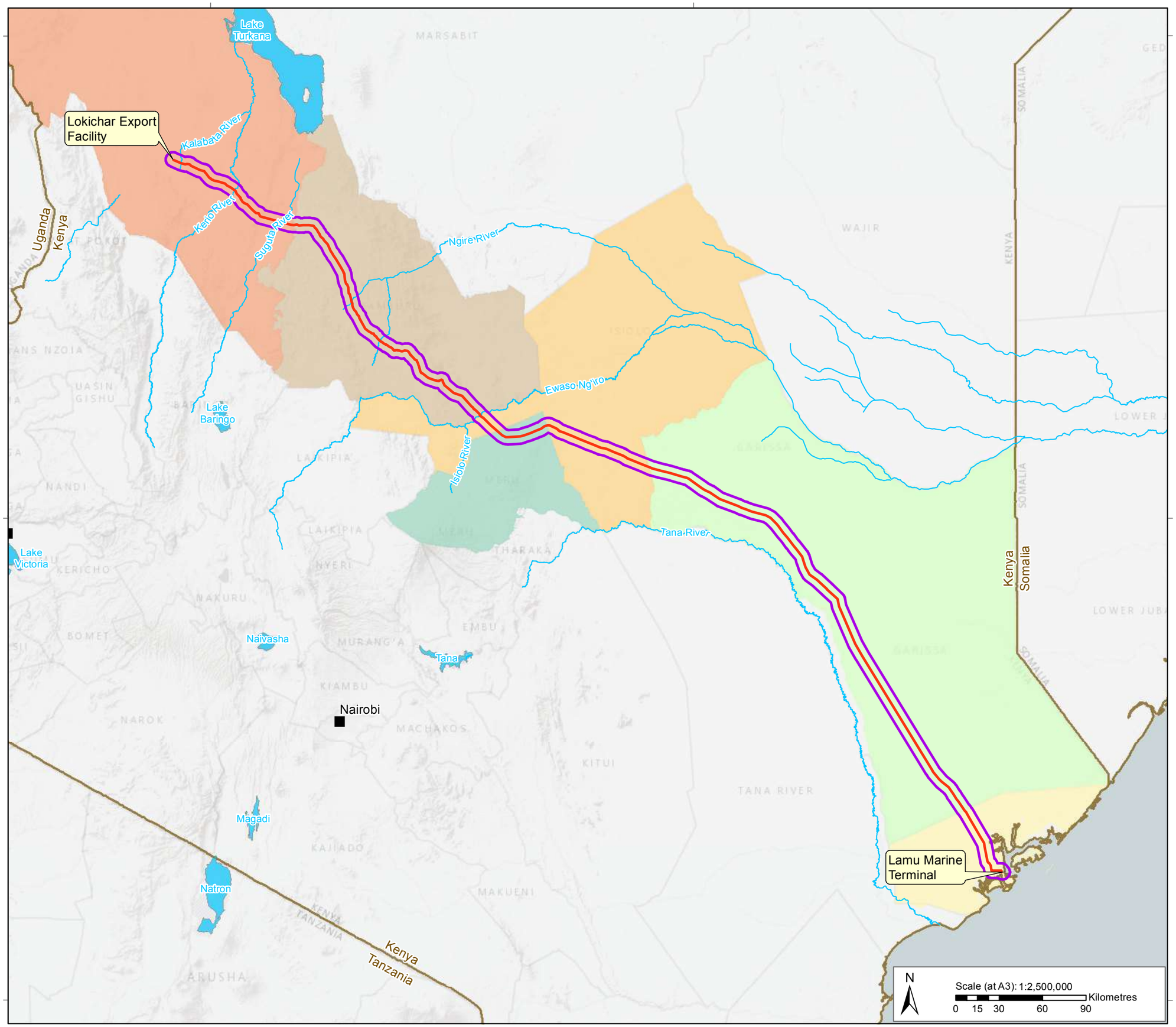
Drawing 1: Project Area

Drawings 2 to 6: Survey Coverage

Drawings 7 to 18: Cultural Heritage Sites

Drawing 19: Lamu Old Town

Drawing 1: Project Area



Key

- City
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Country Boundary
- Waterbody
- Watercourse

Counties

- Turkana
- Samburu
- Isiolo
- Meru
- Garissa
- Lamu

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	HR 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

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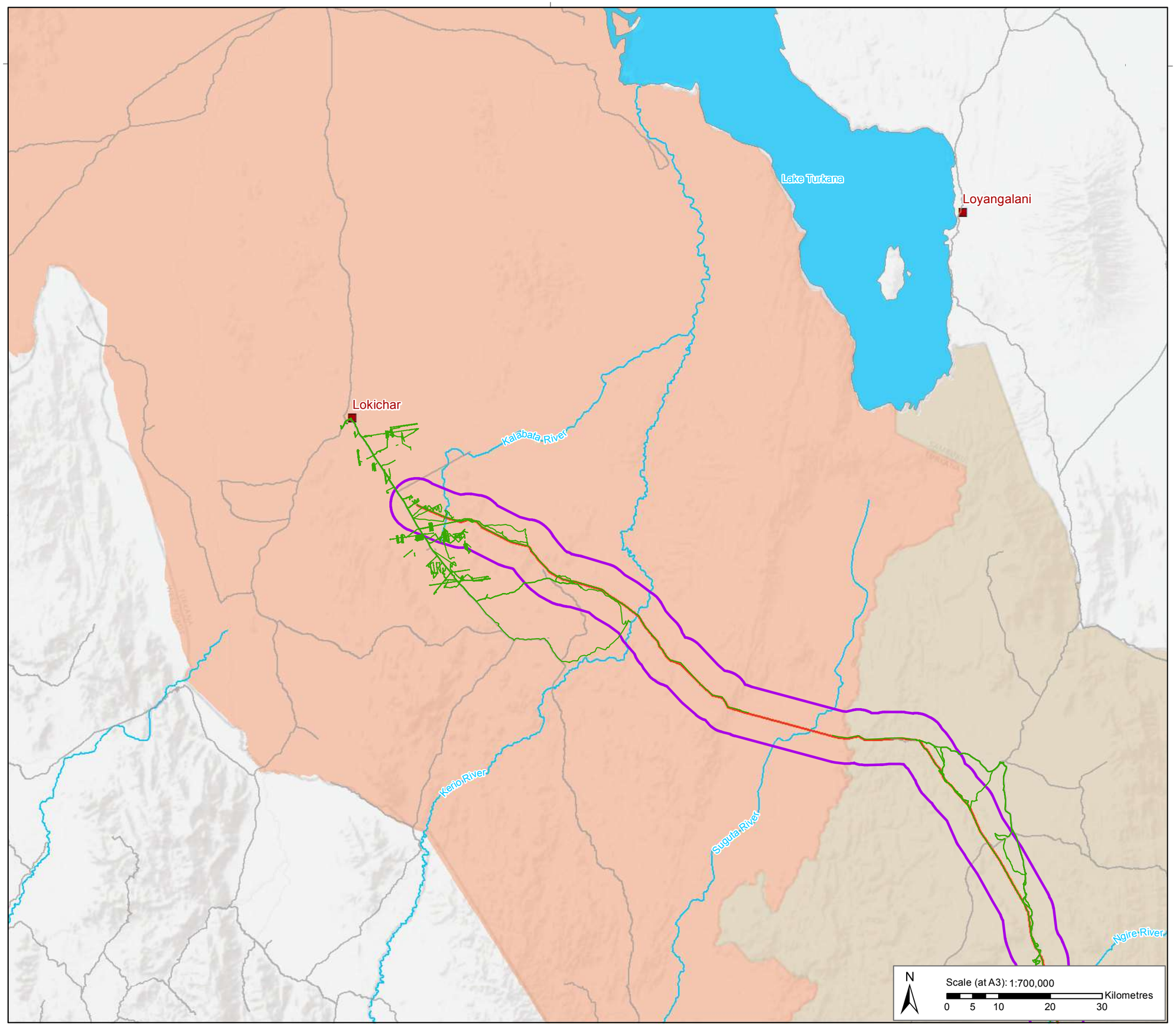
Drawing 2 of 6: Survey Coverage

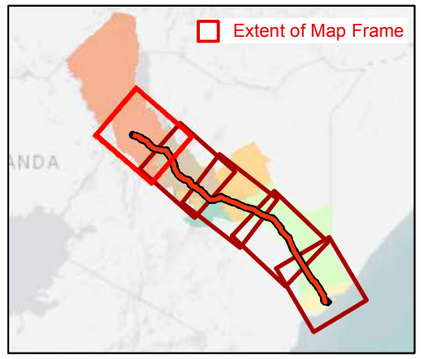


Key

- Town
- Survey Coverage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Waterbody
- Watercourse

Counties

- Turkana
- Samburu



Data sources:
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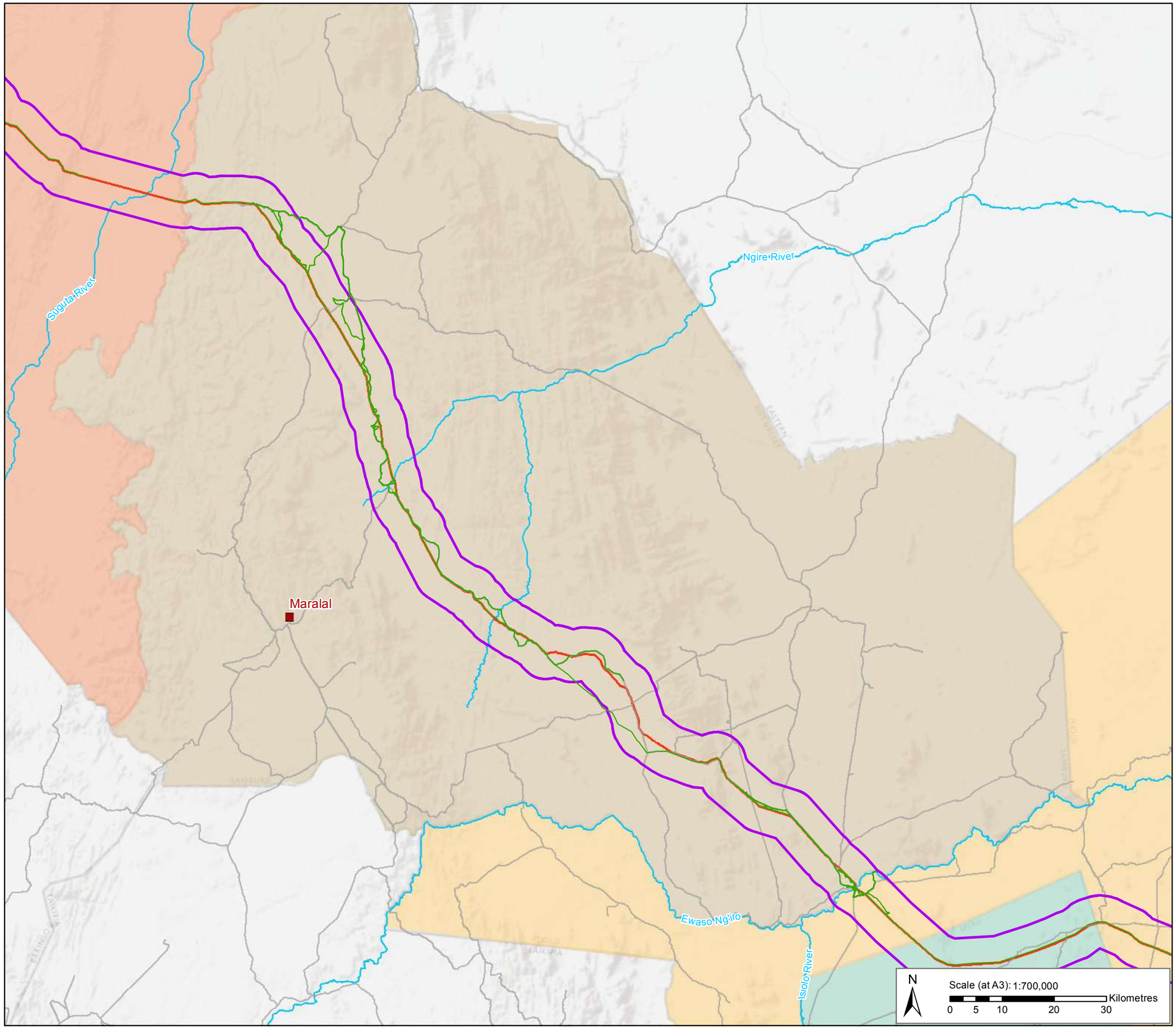
Drawing 3 of 6: Survey Coverage

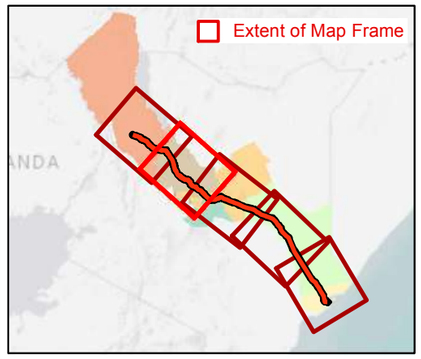


Key

- Town
- Survey Coverage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Turkana
- Samburu
- Isiolo
- Meru



Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	HR 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, USGS, NOAA

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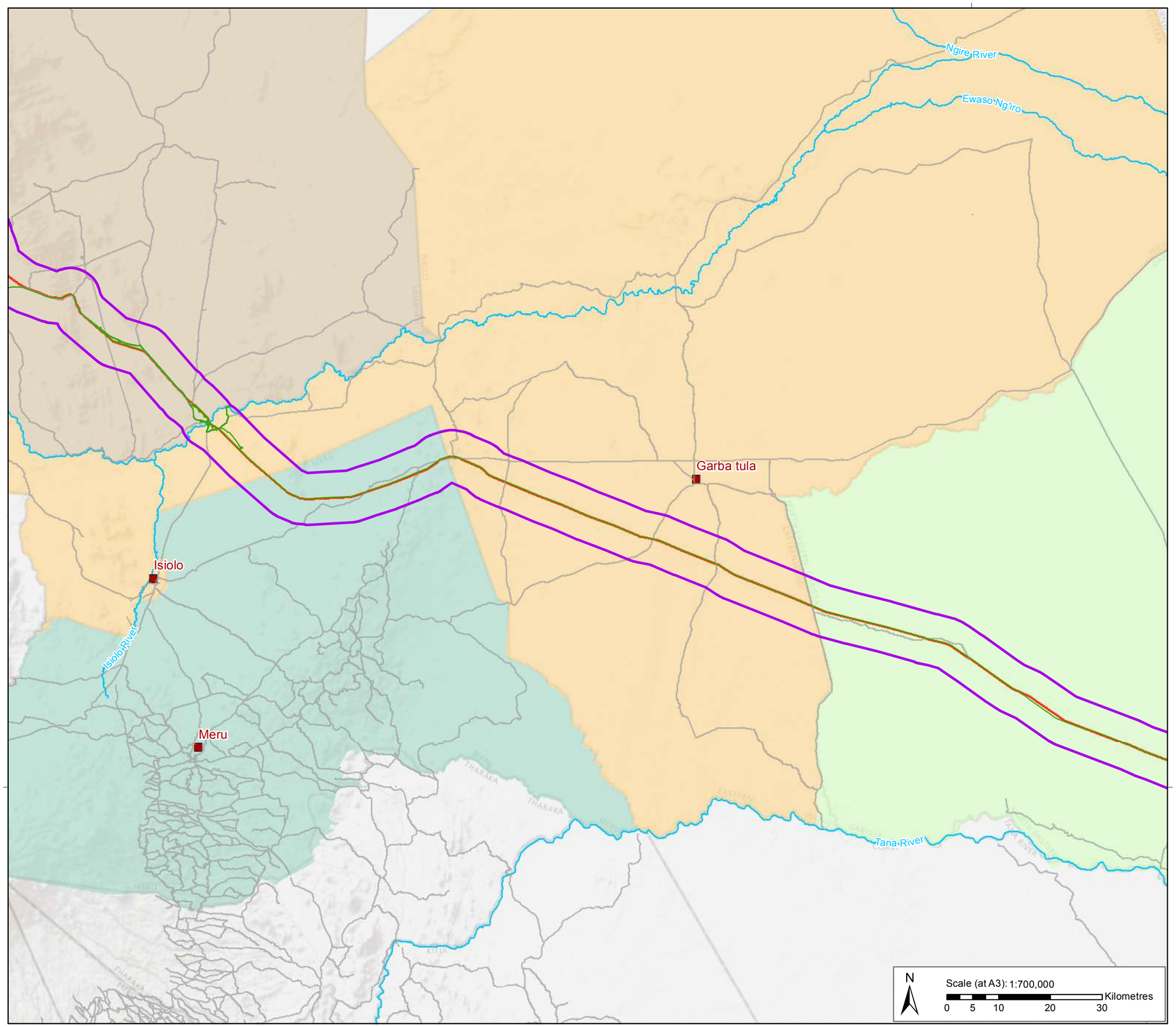
Drawing 4 of 6: Survey Coverage

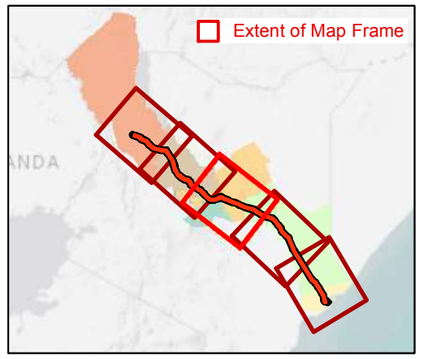


Key

- Town
- Survey Coverage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru
- Garissa



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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

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GOLDER

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Sources: Esri, USGS, NOAA

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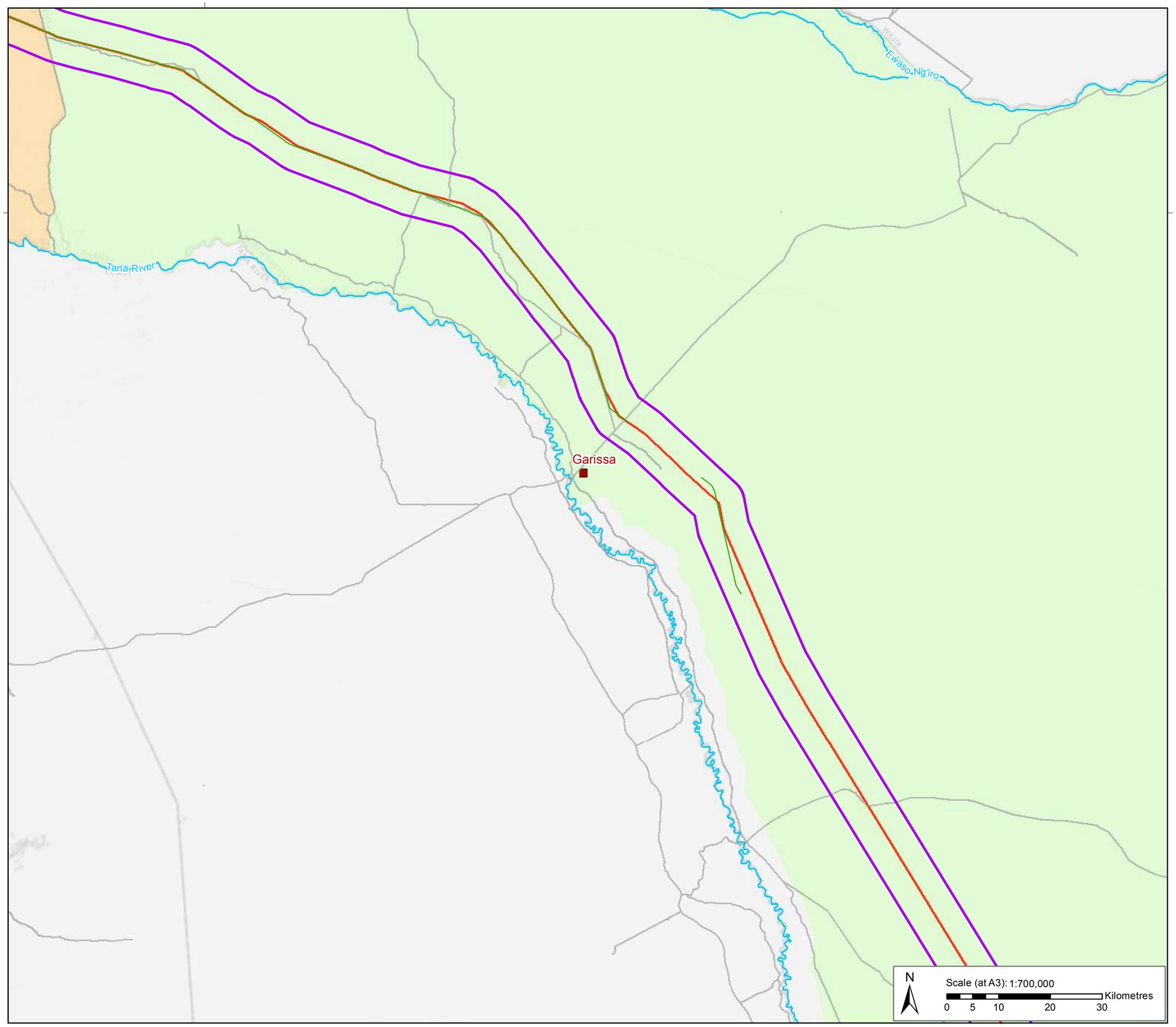
Drawing 5 of 6: Survey Coverage

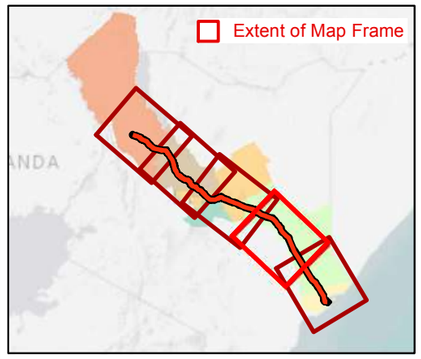


Key

- Town
- Survey Coverage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Isiolo
- Garissa



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GOLDER

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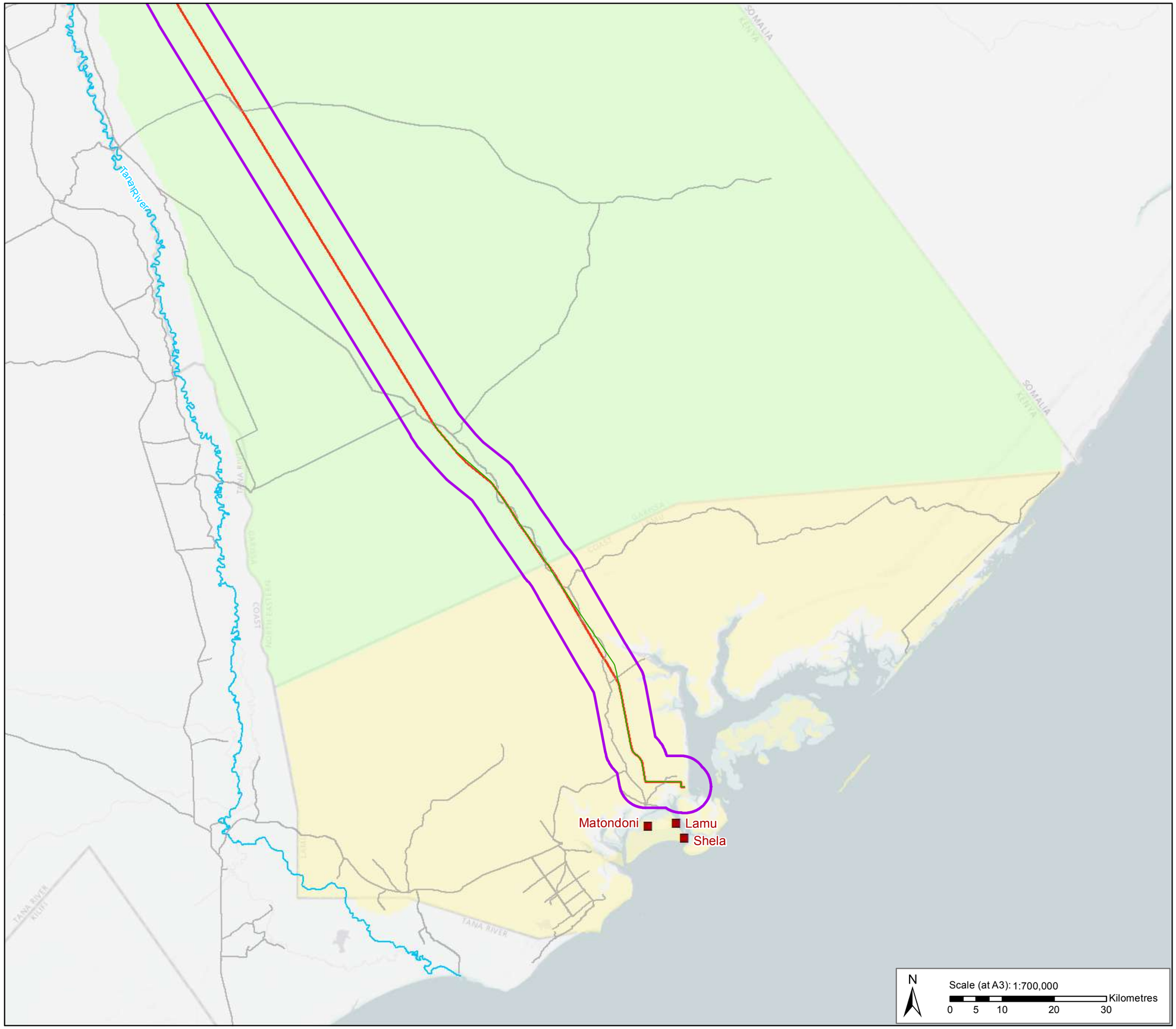
Sources: Esri, USGS, NOAA

Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Cultural_Heritage\1772867_554_OG_704_D002_06_Survey_Coverage.mxd

Drawing 6 of 6: Survey Coverage

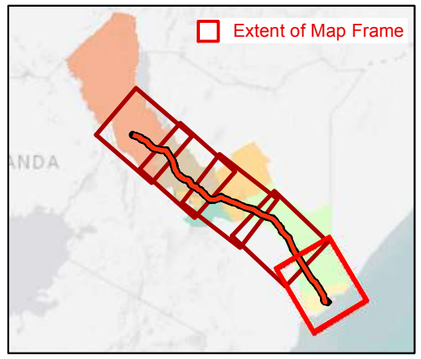


Key

- Town
- Survey Coverage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Garissa
- Lamu



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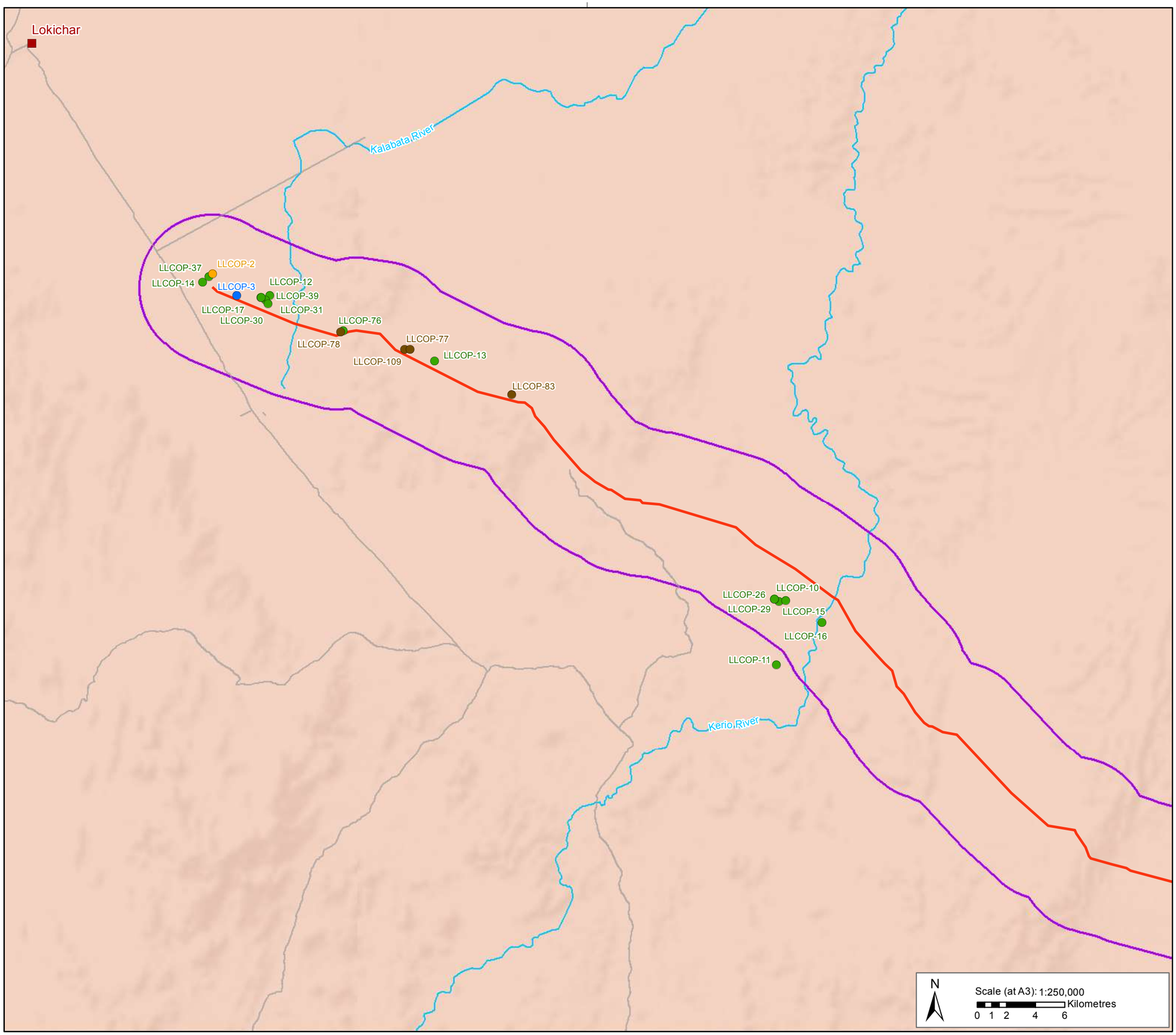
Drawing 7 of 18: Cultural Heritage Sites



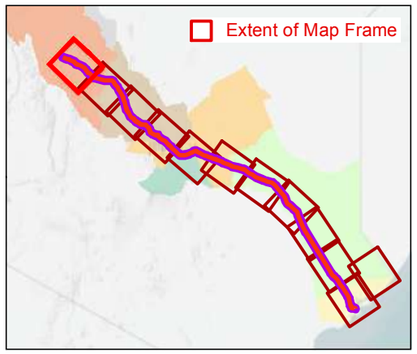
Key

Cultural Heritage Site

- Archaeological
- Archaeological / Living Heritage
- Living Heritage
- Palaeontological
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Town
- Road
- Watercourse

Counties

- Turkana



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1772867	KP 06-08-2019	AM 06-08-2019	TF 06-08-2019

GOLDER

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Sources: Esri, USGS, NOAA

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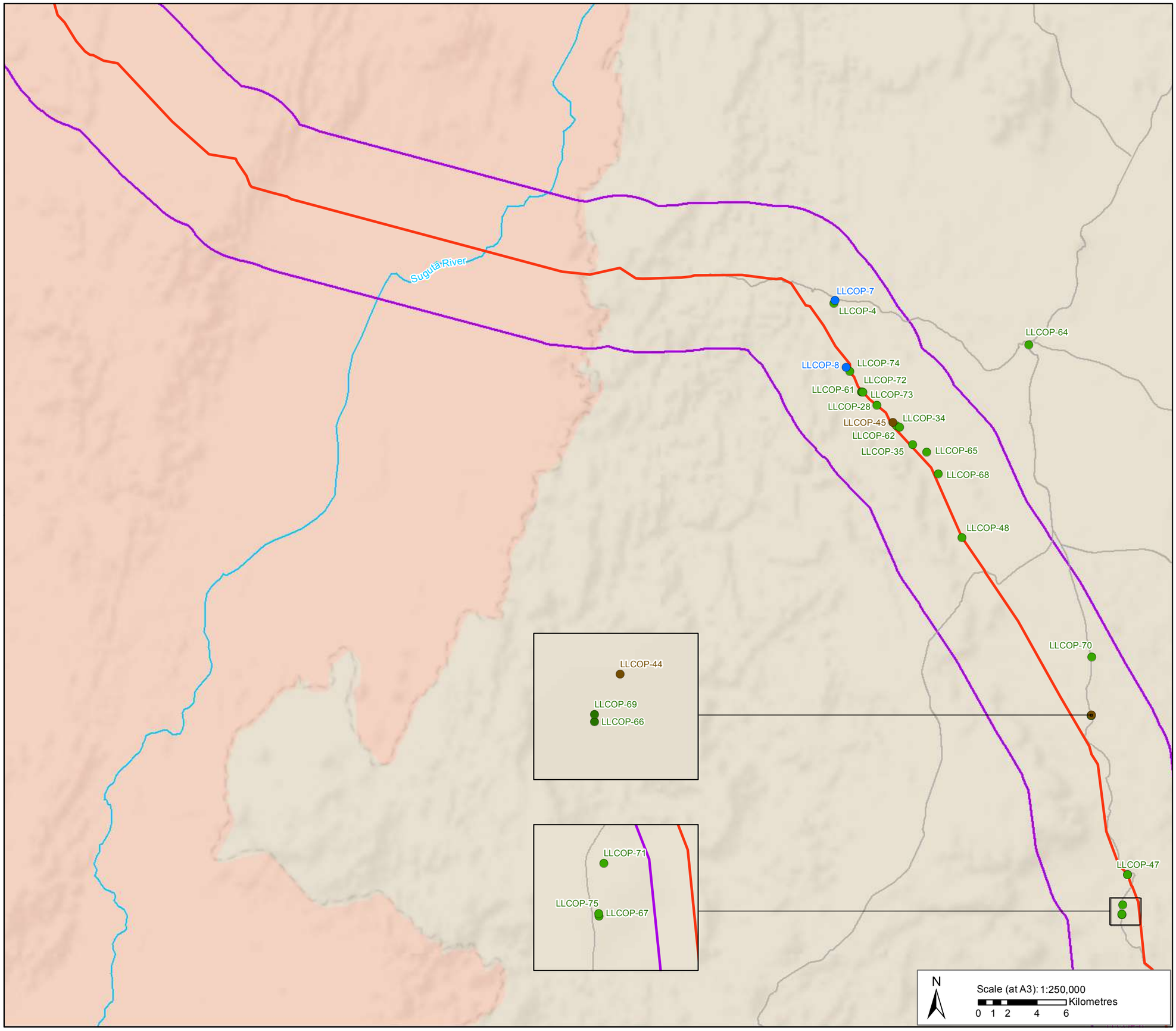
Drawing 8 of 18: Cultural Heritage Sites



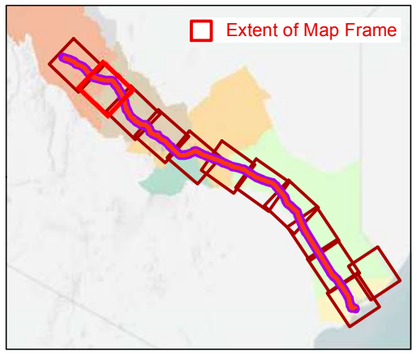
Key

Cultural Heritage Site

- Archaeological
- Living Heritage
- Palaeontological
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Turkana
- Samburu



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Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	AM 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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Sources: Esri, USGS, NOAA

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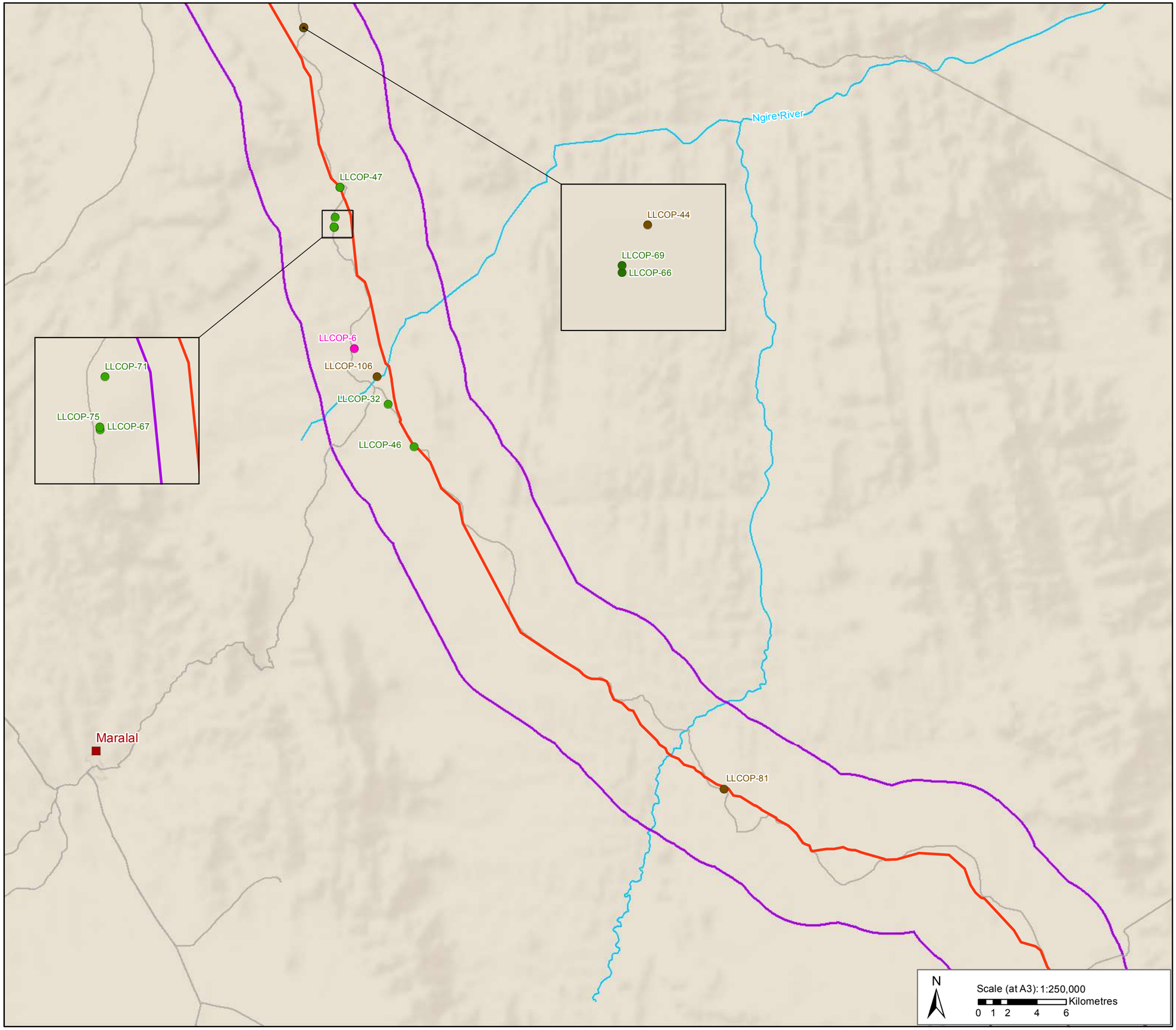
Drawing 9 of 18: Cultural Heritage Sites



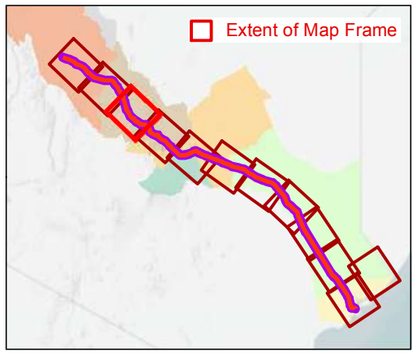
Key

Cultural Heritage Site

- Archaeological
- Living Heritage
- Palaeontological / Living Heritage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Town
- Road
- Watercourse

Counties

- Samburu



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref: 1772867	Prepared By: KP 06-08-2019	Reviewed by: AM 06-08-2019	Approved by: TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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Sources: Esri, USGS, NOAA

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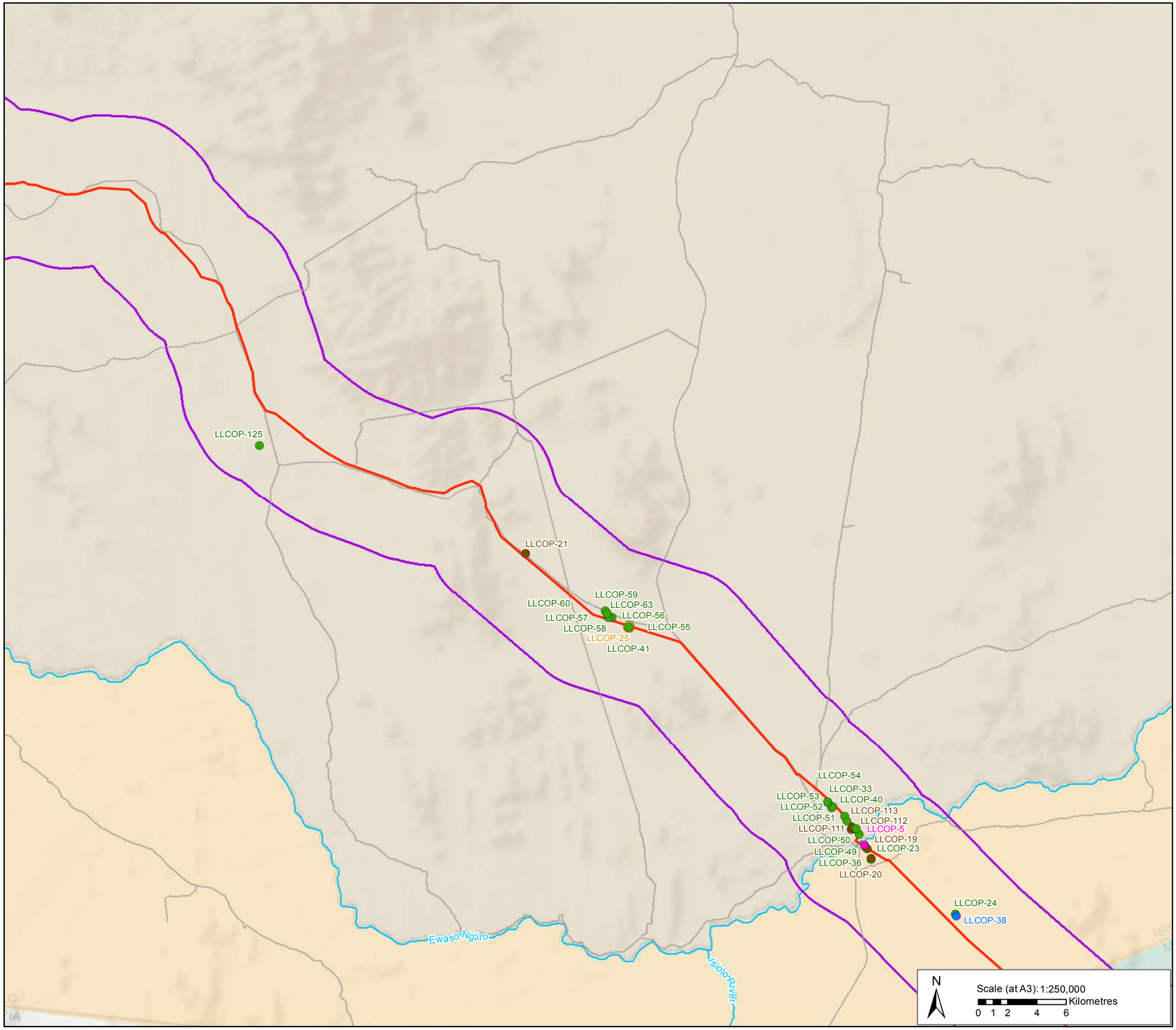
Drawing 10 of 18: Cultural Heritage Sites



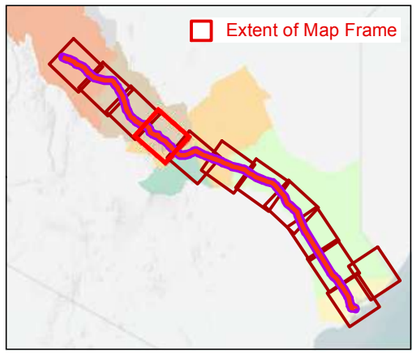
Key

Cultural Heritage Site

- Archaeological
- Archaeological / Living Heritage
- Living Heritage
- Palaeontological
- Palaeontological / Living Heritage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	AM 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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Sources: Esri, USGS, NOAA

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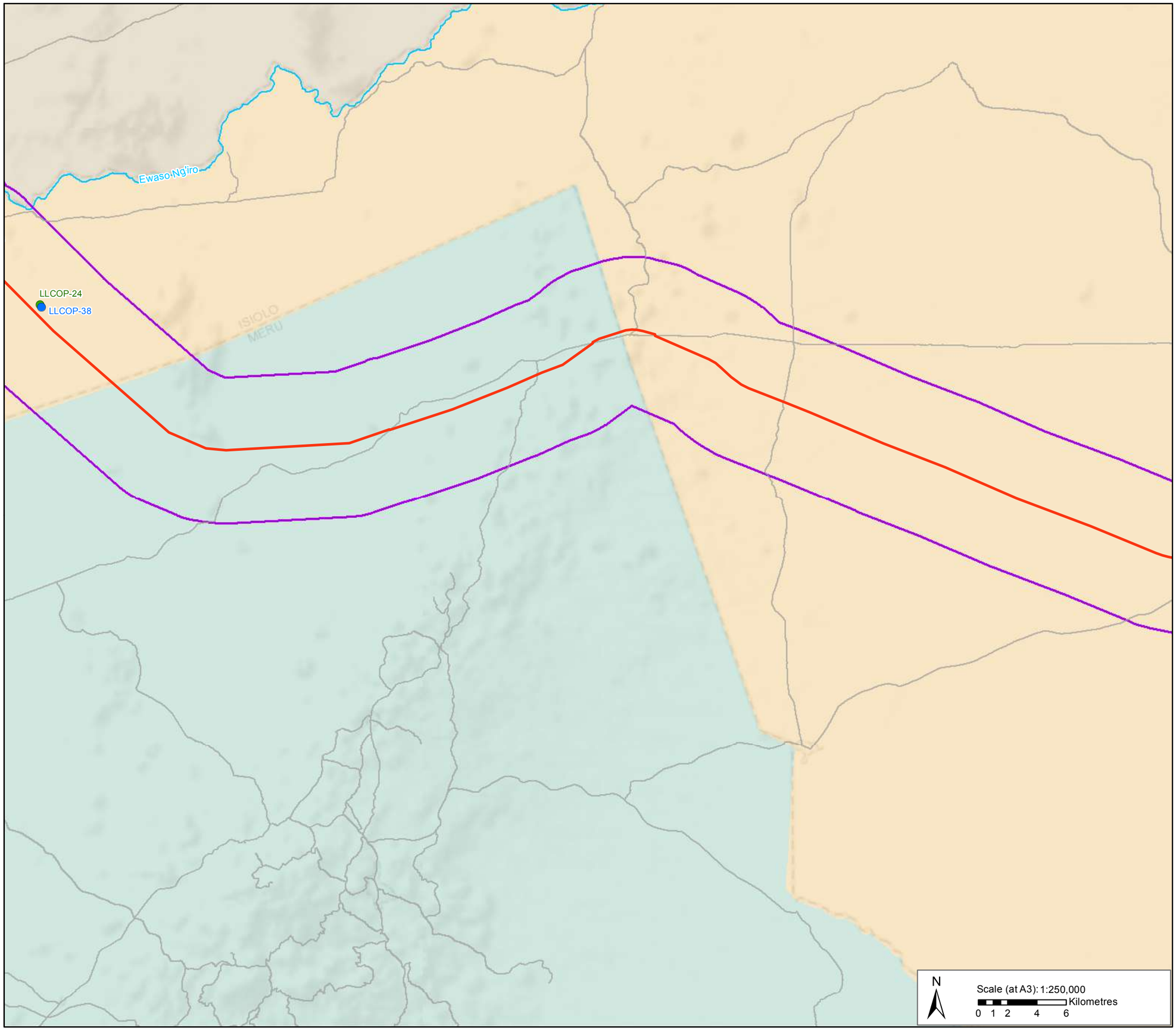
Drawing 11 of 18: Cultural Heritage Sites



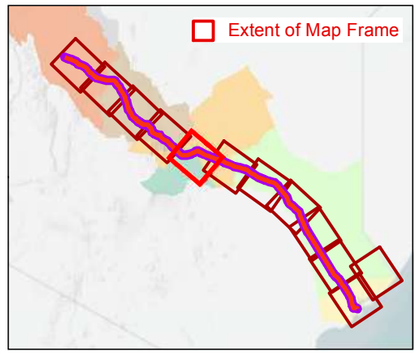
Key

Cultural Heritage Site

- Archaeological
- Palaeontological
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Samburu
- Isiolo
- Meru



Data sources:
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1772867	KP 06-08-2019	AM 06-08-2019	TF 06-08-2019

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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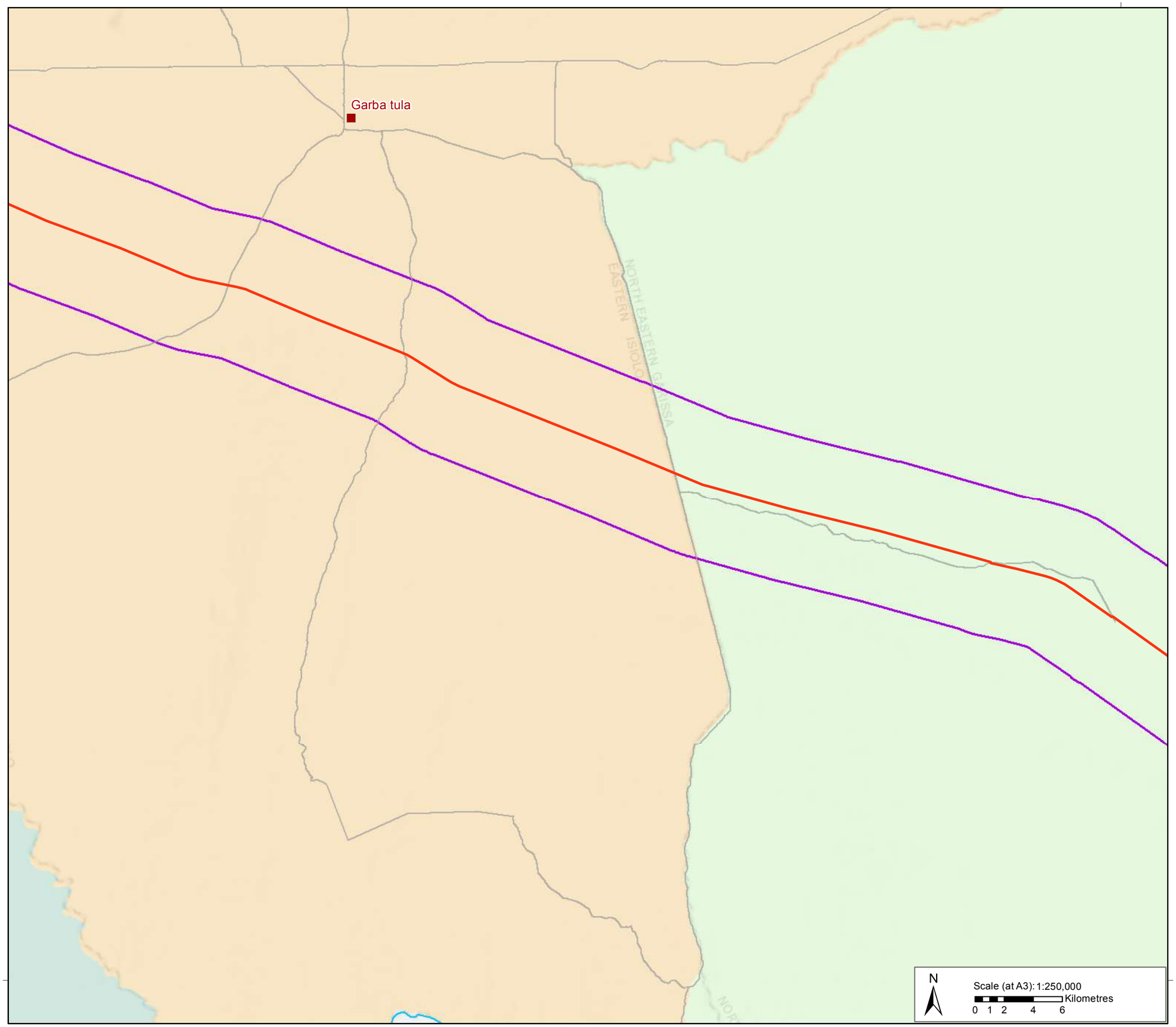
Drawing 12 of 18: Cultural Heritage Sites

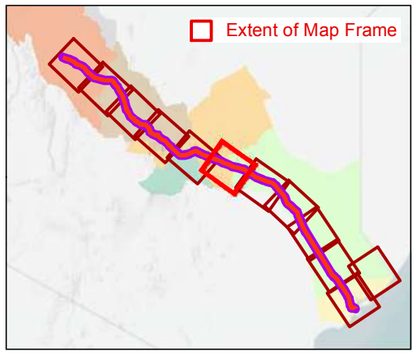


Key

- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Town
- Road
- Watercourse

Counties

- Isiolo
- Meru
- Garissa



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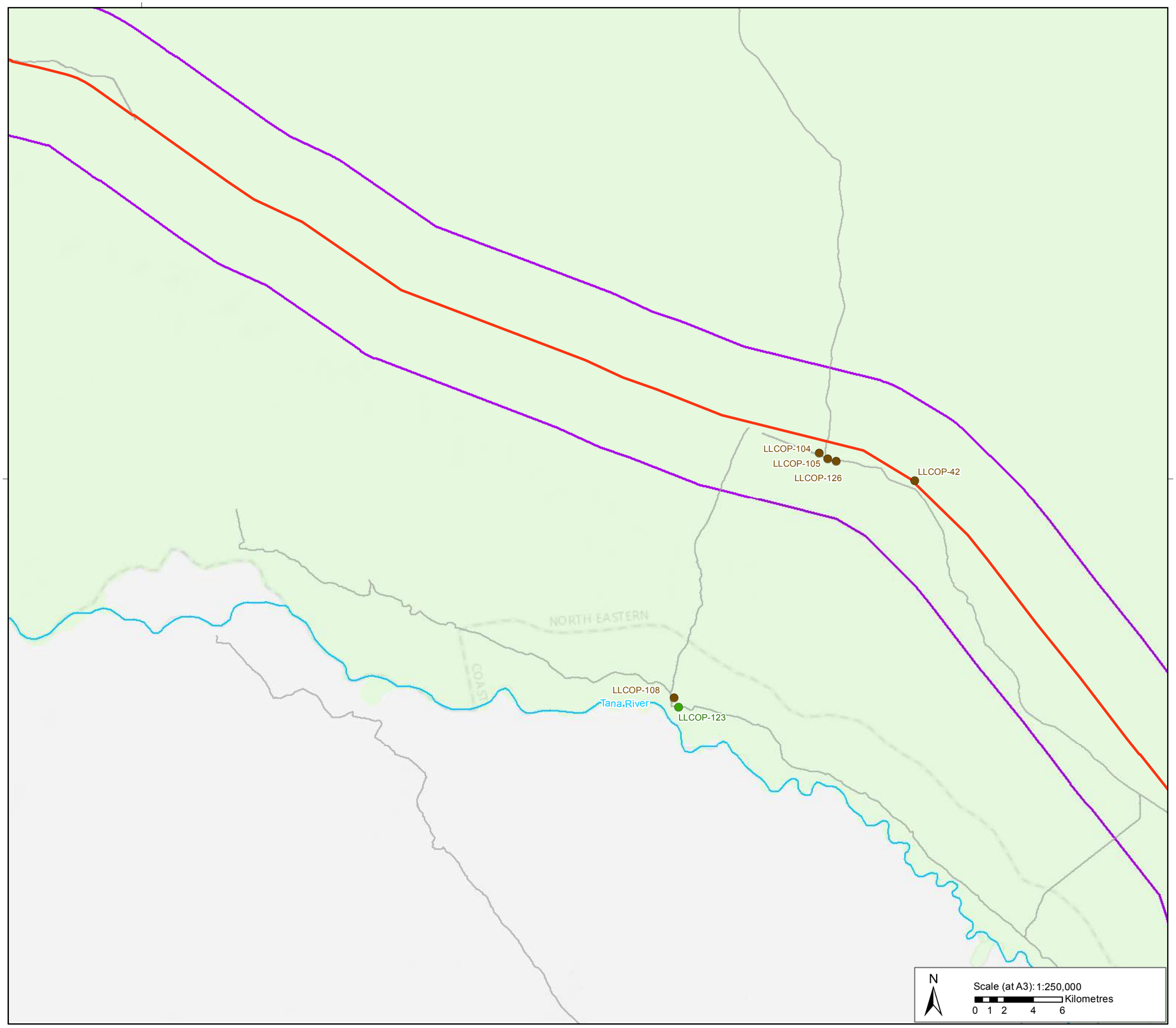
Drawing 13 of 18: Cultural Heritage Sites



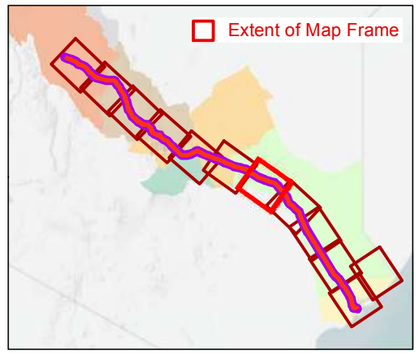
Key

Cultural Heritage Site

- Archaeological
- Living Heritage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Garissa



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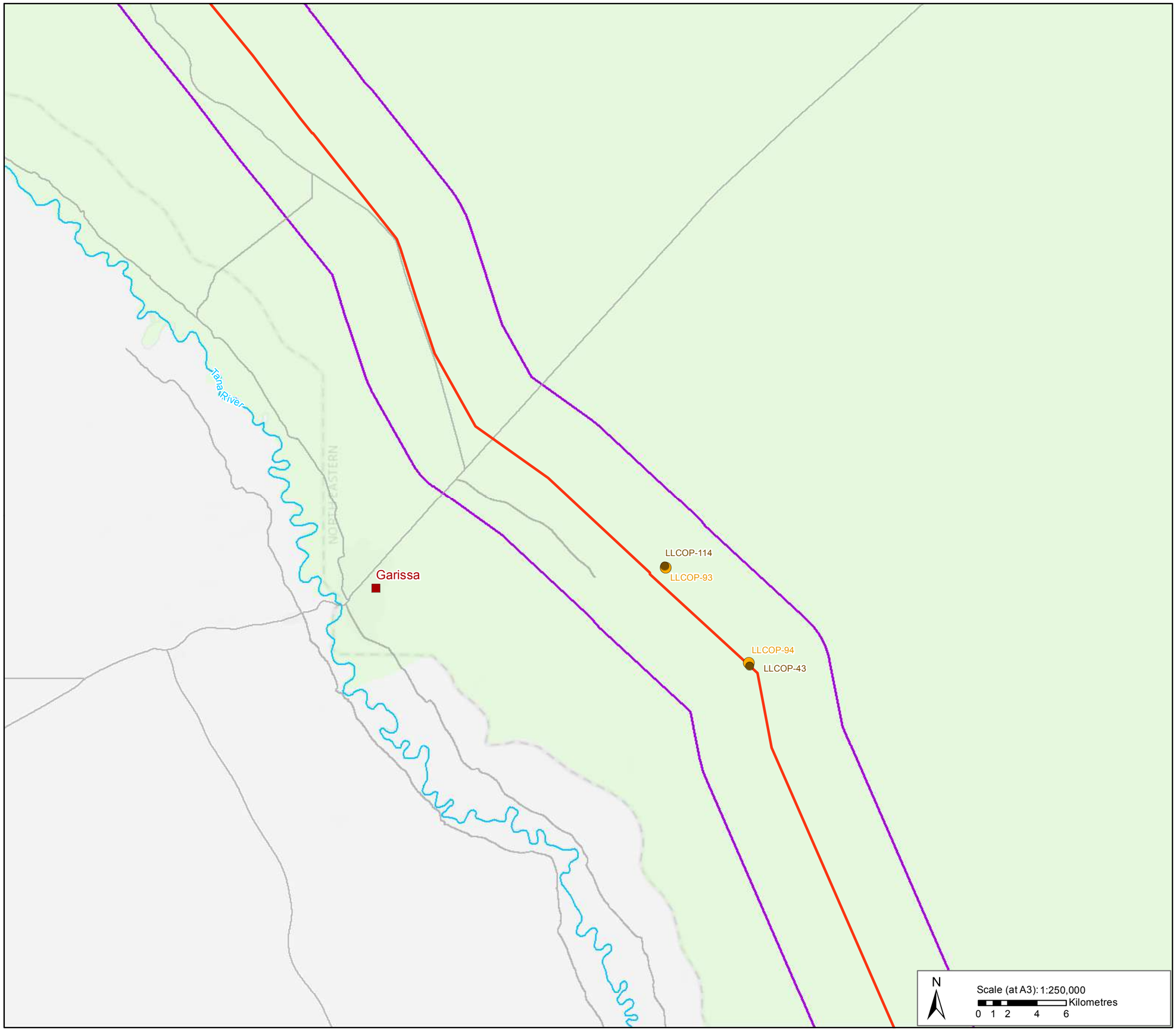
Drawing 14 of 18: Cultural Heritage Sites



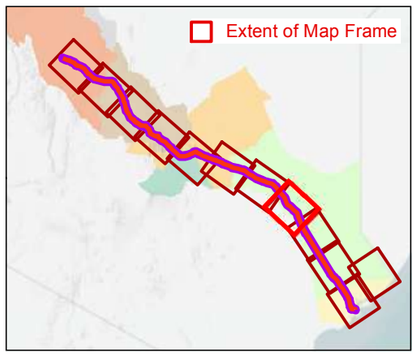
Key

Cultural Heritage Site

- Archaeological / Living Heritage
- Living Heritage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Town
- Road
- Watercourse

Counties

- Garissa



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Project Ref: 1772867	Prepared By: KP 06-08-2019	Reviewed by: AM 06-08-2019	Approved by: TF 06-08-2019

GOLDER

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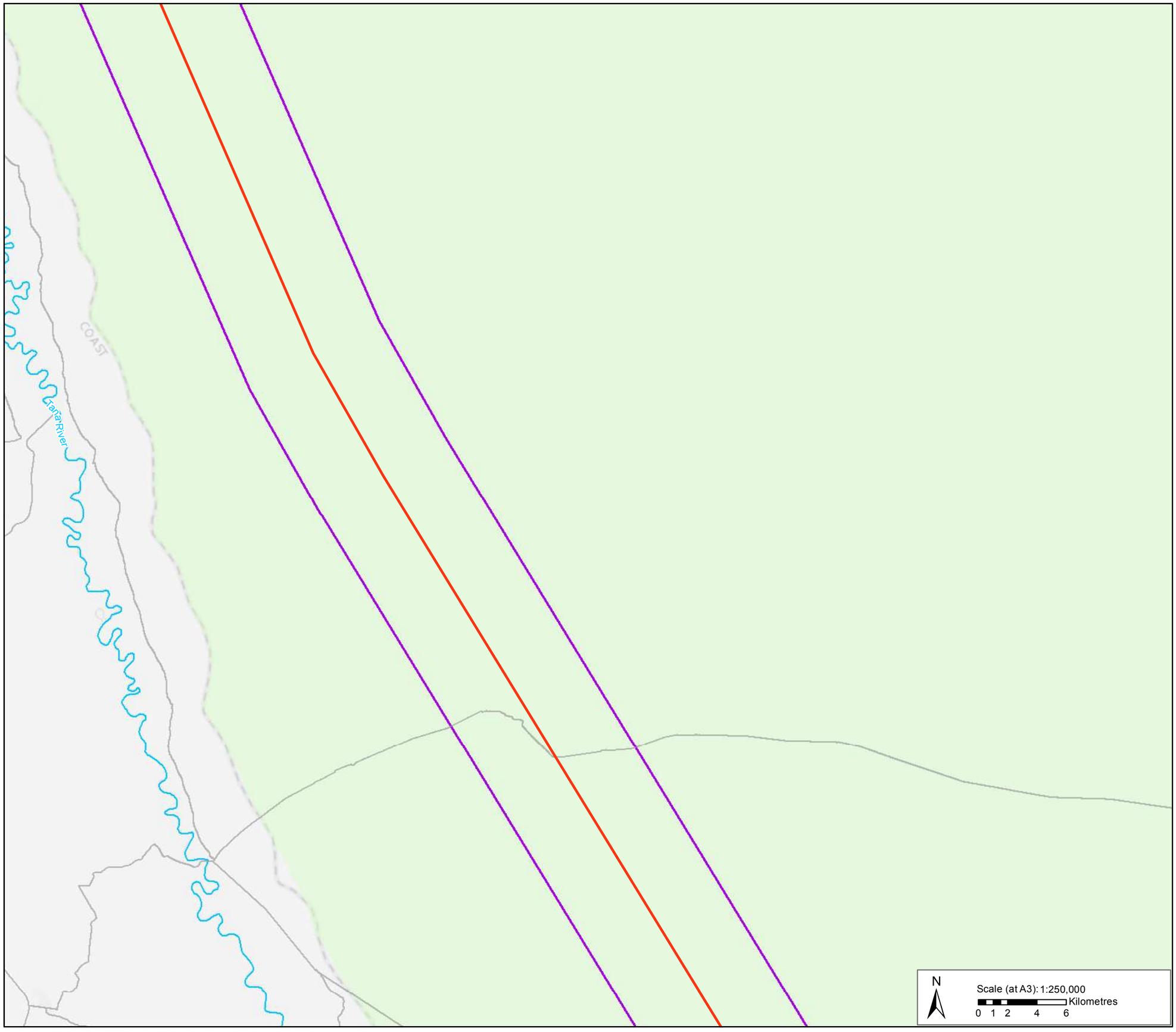
Drawing 15 of 18: Cultural Heritage Sites

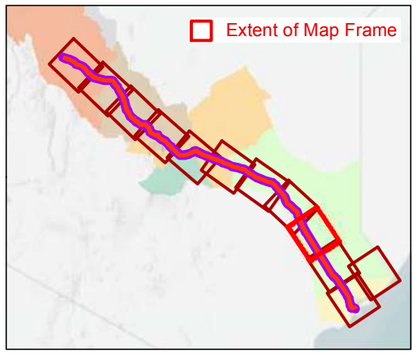


Key

- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road
- Watercourse

Counties

- Garissa



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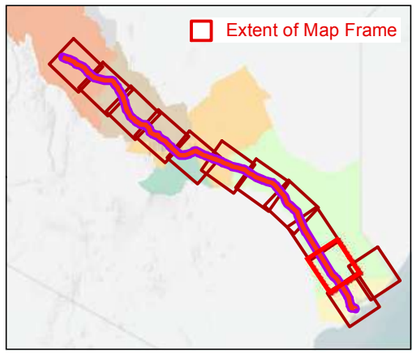
Drawing 16 of 18: Cultural Heritage Sites

Key

- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Road

Counties

- Garissa
- Lamu



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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	AM 06-08-2019	TF 06-08-2019

N

Scale (at A3): 1:250,000
Kilometres
0 1 2 4 6

GOLDER

Cavendish House,Cores End Road,Bourne End,SL8 5AS,UK

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Sources: Esri, USGS, NOAA

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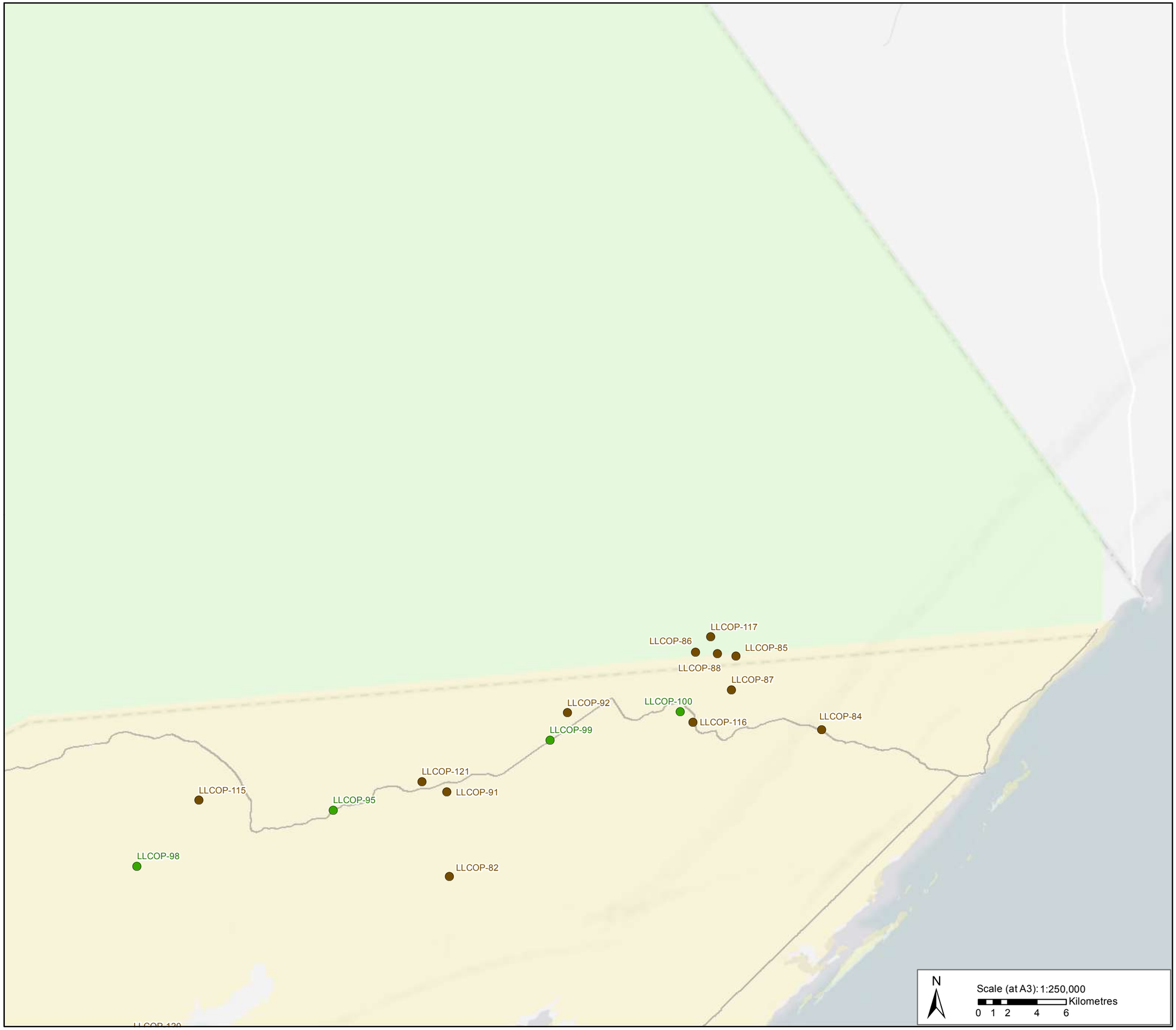
Drawing 17 of 18: Cultural Heritage Sites



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Sources: Esri, USGS, NOAA

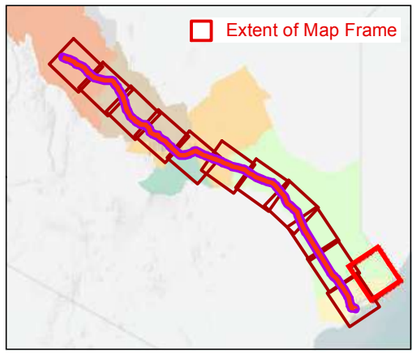
Key

Cultural Heritage Site

- Archaeological
- Living Heritage
- Road

Counties

- Garissa
- Lamu



Data sources:
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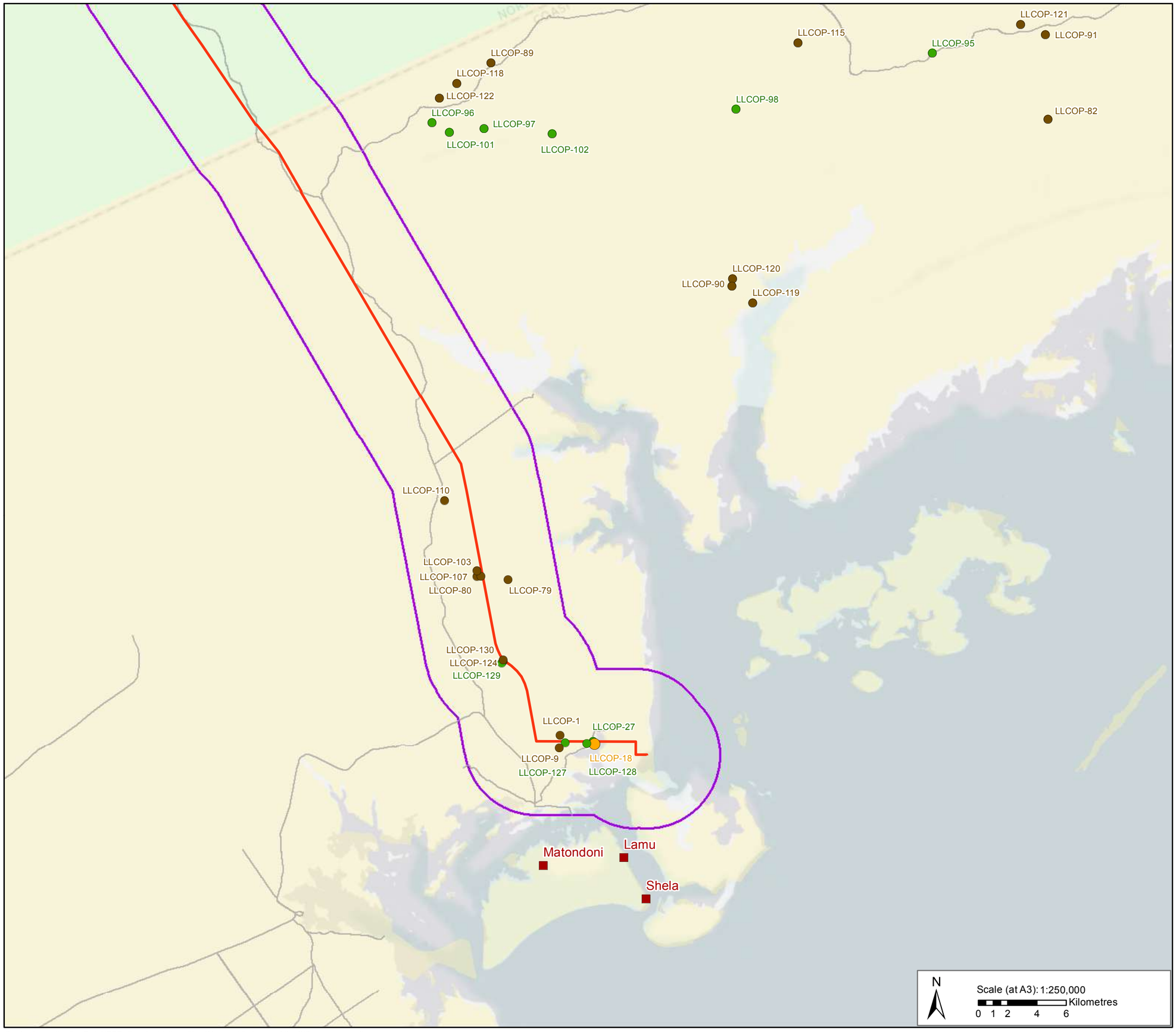
Drawing 18 of 18: Cultural Heritage Sites



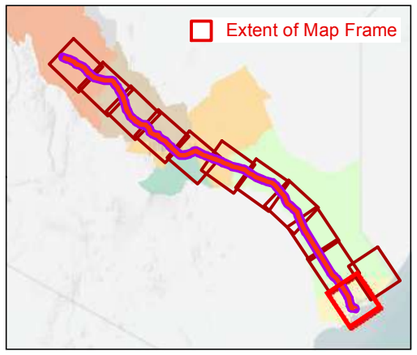
Key

Cultural Heritage Site

- Archaeological
- Archaeological / Living Heritage
- Living Heritage
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Town
- Road

Counties

- Garissa
- Lamu



Data sources:
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Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	AM 06-08-2019	TF 06-08-2019

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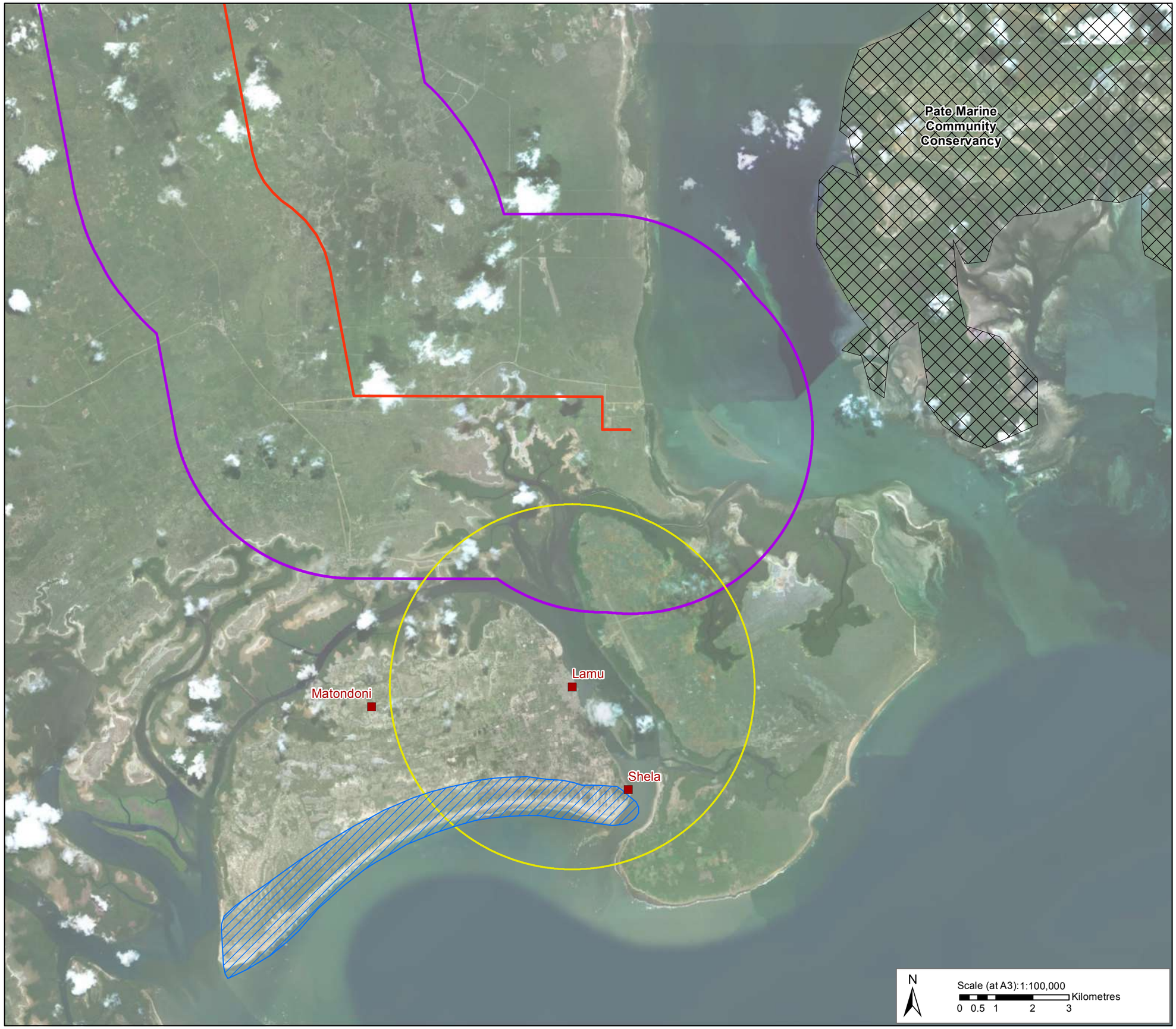
Map path:\\rdc1-v-gisuk01\Data\Tullow_Oil\Lokichar\Kenya_Midstream_ESIA\99_PROJECTS\1772867\554\02_PRODUCTION\MXD\Cultural_Heritage\1772867_554_OG_705_D007_CulturalHeritage_sites.mxd



Drawing 19: Lamu Old Town

Key

- Town
- Proposed Pipeline Route
- Cultural Heritage Area of Influence (AoI)
- Buffer Zone
- The Water Catchment Area of Lamu

World Database of Protected Areas (March 2018)

- Community Nature Reserve

Data sources:
Base data sourced from Tullow Kenya B.V. / PPMT/ Wood Group. Protected areas available from Protected Planet.Surface water data available from Openstreet map under the Open Data Commons Open Database License

Coordinate System: Kenyan Development Pipeline WGK (WGS 1984 Customised)

Project Ref:	Prepared By:	Reviewed by:	Approved by:
1772867	KP 06-08-2019	HR 06-08-2019	TF 06-08-2019

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APPENDIX A

Plates

Plate 1: Survey in the western plains of the Turkana segment

Plate 2: The thick grass/bush cover near Suyan Police Post

Plate 3: Burials in Suyian area, Samburu/Isiolo segment

Plate 4: Site LLCOPP-12 (in situ MSA site and finds from the western plains of the Turkana segment)

Plate 5: Site LLCOPP-12 (close-up of select finds from MSA site)

Plate 6: Site LLOCPP-38 (weathered MSA site from the western plains of the Turkana segment)

Plate 7: Site LLCOPP-38 (close-up of select finds from MSA site)

Plate 8: Graves at Archers Post

Plate 9: Graves at Archers Post

Plate 10: Public cemetery at Archers Post

Plate 11: Muslim cemetery at Archers Post

Plate 12: Akiriket site (LLCOPP-76)

Plate 13: Ngasenon site (LLCOPP-82)

Plate 14: Maulac, a worship area for women near Fatuma Golicha village, Garissa segment

Plate 15: Mhongo tree near the pipeline corridor close to Bargoni

Plate 16: Abandoned Settlement in the Garissa Segment

Plate 17: Abandoned Settlement in the Garissa Segment

Plate 18: Abandoned Settlement in the Garissa Segment

Plate 19: Fossil bone and teeth fragments from Nachola

Plate 20: Fossil bone and teeth fragments from Nachola (bone fragments eroding from sediments at a gully)

Plate 21: Fossil teeth fragments

APPENDIX B

Cultural Heritage Sites

Site ID	Site Type	Site Description (short)	Lithic Materials	Site Description
LLCOP-1	Living Heritage	Well	n/a	Historical well about 300 m from the coast. The well has a rim made of local coral stone and motar.
LLCOP-2	Archaeological / Living Heritage	Lithic Artefact Scatter / Burial	Phonolite/Rhyolite and Quartz	Lithic artefact scatter including phonolite/rhyolite and quartz pieces near a burial that consists of a small rock mound. It is not clear how old the burial is. Our local assistant informed us that the area had been occupied on and off over the las sixty years, and the burial may be attributed to those who have immigrated from the area recently.
LLCOP-3	Palaeontological	Bovid	n/a	Medium-to-large sized bovid bones half buried in an eroded area, with only a small profile of some of the bones visible on the surface. It appears that these could be bones of an individual bovid in articulation, but because only some profiles are visible, it is not possible to identify them further without exposing more of them. It is not clear if this was part of an intentional burial or skeleton buried naturally.
LLCOP-4	Archaeological	Lithic Artefact Scatter	Chert	Chert flakes, hammerstone.
LLCOP-5	Palaeontological / Living Heritage	Burial Site, multiple; Fossil Bone, unspecified	n/a	Fossil bone site and a modern burial stone cairn nearby in Nachola area, Samburu. The burial is reported to be a multiple inhumation.
LLCOP-6	Palaeontological / Living Heritage	Burial Site, single; Fossil Bone, unspecified	n/a	Fossil bone site with a modern burial cairn in the vicinity.
LLCOP-7	Palaeontological	Fossil Bone, unspecified	n/a	Fossil bone site.
LLCOP-8	Palaeontological	Fossil Bone, unspecified	n/a	Fossil bone site.
LLCOP-9	Living Heritage	Settlement	n/a	Abandoned settlement and farm on the mainland historically tilled by residents of Manda and Lamu according to a local informant.
LLCOP-10	Archaeological	Ostrich Egg Shell Bead	n/a	Large ostrich egg shell bead in an open eroded area.
LLCOP-11	Archaeological	Burial Site, multiple	n/a	Lokori Namortunga site - ancient burial ground with engraved upright stone markers in circular formations. This site has been studied and dated to about 2,500 years before present.
LLCOP-12	Archaeological	Lithic Artefact Scatter	Phonolite/Rhyolite	Middle Stone Age site with *in situ* formed tools by a small gully in the western plains of the Turkana segment.
LLCOP-13	Archaeological	Lithic Artefact, Isolated Find	Obsidian	Isolated occurrence of obsidian stone tool.
LLCOP-14	Archaeological	Lithic Artefact, Isolated Find	Obsidian	Isolated occurrence of obsidian stone tool.
LLCOP-15	Archaeological	Ostrich Egg Shell Bead	n/a	Ostrich egg shell bead in open eroded area.
LLCOP-16	Archaeological	Ostrich Egg Shell Bead	n/a	Ostrich egg shell bead in open eroded area.
LLCOP-17	Archaeological	Ostrich Egg Shell Bead	n/a	Ostrich egg shell bead in open eroded area.
LLCOP-18	Archaeological / Living Heritage	Burial Site, multiple	n/a	Site is recorded in the NMK database as the Tumbiri Tomb site and is associated with historic/late Swahili inhabitants of Lamu coastal region (about AD 1700 to 1950) recorded at the site reported as abandoned settlement (LLCOP-9). The grave shown to us in a graveyard consists of coral cobble remnants of the original tombstone. The other graves in this graveyard were not identifiable.
LLCOP-19	Living Heritage	Burial Items, Ostrich Egg Shell Fragments	n/a	Ostrich egg shell fragments at a burial.
LLCOP-20	Living Heritage	Burial Items, Ostrich Egg Shell Fragments	n/a	Ostrich egg shell fragments at a burial.
LLCOP-21	Living Heritage	Burial Items, Ostrich Egg Shell Fragments	n/a	Ostrich egg shell fragments at a burial.
LLCOP-23	Archaeological	Ostrich Egg Shell Bead	n/a	
LLCOP-24	Archaeological	Ostrich Egg Shell Bead	n/a	Ostrich egg shell fragments and bead preform.
LLCOP-25	Archaeological / Living Heritage	Burial Site, multiple (recent and archaeological); Potsherds and Beads	n/a	Potsherd and beads near a group of three graves. Because pots are not used by Samburu pastoralists, their occurrence is considered archaeological. The beads maybe associated with the modern burial.
LLCOP-26	Archaeological	Pot Sherds	n/a	Pot sherds.
LLCOP-27	Archaeological	Pot Sherds	n/a	Pot sherds.
LLCOP-28	Archaeological	Pot Sherds	n/a	Pot sherds.
LLCOP-29	Archaeological	Pot Sherds	n/a	Pot sherds.
LLCOP-30	Archaeological	Pot Sherds	n/a	Pot sherds.
LLCOP-31	Archaeological	Pot Sherds	n/a	Pot sherds.
LLCOP-32	Archaeological	Lithic Artefact Scatter	Quartz and Obsidian	
LLCOP-33	Archaeological	Burial Site, multiple; Lithic Artefact Scatter	Quartz	Quartz flakes near two graves.
LLCOP-34	Archaeological	Lithic Artefact Scatter	Quartz	Quartz flakes.
LLCOP-35	Archaeological	Lithic Artefact Scatter	Quartz	Quartz flakes.
LLCOP-36	Archaeological	Lithic Artefact Scatter	Quartz	Quartz flakes.
LLCOP-37	Archaeological	Lithic Artefact Scatter	Unrecorded	An archaeological site with scatter of stone tools of possible different time periods ranging from the Early to Late Stone Age.
LLCOP-38	Palaeontological	Mammal Teeth	n/a	
LLCOP-39	Archaeological	Lithic Artefact Scatter	Phonolite/Rhyolite	Large site with dense concentration of weathered Middle Stone Age tools.
LLCOP-40	Archaeological	Burial Site, multiple	n/a	Two graves.
LLCOP-41	Archaeological	Burial Site, multiple	n/a	Two graves.
LLCOP-42	Living Heritage	Settlement	n/a	Abandoned settlement with remains of livestock enclosures.
LLCOP-43	Living Heritage	Settlement	n/a	Abandoned modern settlement.
LLCOP-44	Living Heritage	Settlement	n/a	Abandoned modern settlement.
LLCOP-45	Living Heritage	Beads, modern	n/a	Modern plastic beads from Samburu.
LLCOP-46	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-47	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-48	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-49	Archaeological	Burial Site, single	n/a	Stone cairn burial.

Site ID	Site Type	Site Description (short)	Lithic Materials	Site Description
LLCOP-50	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-51	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-52	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-53	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-54	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-55	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-56	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-57	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-58	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-59	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-60	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-61	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-62	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-63	Archaeological	Burial Site, single	n/a	Burial (disturbed).
LLCOP-64	Archaeological	Burial Site, single	n/a	Burial with upright stone slabs. This burial predates the local community, the Samburu, who do not recognize who is buried, hence may be archaeological.
LLCOP-65	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-66	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-67	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-68	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-69	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-70	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-71	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-72	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-73	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-74	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-75	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-76	Archaeological	Burial Site, single	n/a	Stone cairn burial.
LLCOP-77	Living Heritage	Sacred / Ritual Site (Feasting)	n/a	Akiriket: Turkana traditional meat feasting/ritual site that consists of semi-circular stones sitting arrangement and a meet serving area (stone pile) in the forward centre.
LLCOP-78	Living Heritage	Sacred / Ritual Site (Feasting)	n/a	Burial mound cairn of recently dead individual (in the past year) with a nearby memorial meat feasting fire ash.
LLCOP-79	Living Heritage	Subsistence Extraction Area	n/a	Chomo kubwa - a swampy area that the community depend on for animal food resources.
LLCOP-80	Living Heritage	Subsistence Extraction Area	n/a	Chomo ndogo , the same as Chomo kubwa swamp, only smaller in size.
LLCOP-81	Living Heritage	Sacred / Ritual Site	n/a	Cross on the hill.
LLCOP-82	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-83	Living Heritage	Sacred / Ritual Site	n/a	Ngasenon: feature marking a wayside sacred site where passersby/travelers make prayers/wishes for safe passage through the territory by throwing pebbles into a pile, creating a cairn-like feature.
LLCOP-84	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-85	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-86	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-87	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-88	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-89	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-90	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-91	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-92	Living Heritage	Settlement	n/a	Former/historical settlement areas.
LLCOP-93	Archaeological / Living Heritage	Settlement	n/a	Glade area among tress that previously/historically or prehistorically had a pastoralist's settlement.
LLCOP-94	Archaeological / Living Heritage	Settlement	n/a	Glade area among trees that previously/historically or prehistorically had a pastoralist's settlement. They take the circular form, the predominant form of settlements in the area. There are adjacent abandoned settlements in various stages of disuse, ranging from recent (brush used fresh with dry leaves still standing in circular formation); to recent past (dried and collapsed enclosure making brush), distant past (dried scattered enclosure making brush) and open areas with animal dung remains) and nearby occupied settlements.
LLCOP-95	Archaeological	Burial Site, single	n/a	Grave.
LLCOP-96	Archaeological	Burial Site, single	n/a	Grave.
LLCOP-97	Archaeological	Burial Site, single	n/a	Grave.
LLCOP-98	Archaeological	Burial Site, single	n/a	Grave.
LLCOP-99	Archaeological	Burial Site, single	n/a	Grave.
LLCOP-100	Archaeological	Burial Site, single	n/a	Grave.

Site ID	Site Type	Site Description (short)	Lithic Materials	Site Description
LLCOP-101	Archaeological	Burial Site, single	n/a	Grave.
LLCOP-102	Archaeological	Monument	n/a	Historical sites/Monuments.
LLCOP-103	Living Heritage	Subsistence Extraction Area	n/a	Honey hive trees for the Boni at the edge of the forest located between Hindi and Bargoni.
LLCOP-104	Living Heritage	Subsistence, Pastoral	n/a	Livestock pen.
LLCOP-105	Living Heritage	Sacred / Ritual Site	n/a	Maulac, a Somali community prayer place for women.
LLCOP-106	Living Heritage	Gathering Location	n/a	Meeting place consisting of acacia trees in Archers Post, Samburu.
LLCOP-107	Living Heritage	Sacred / Ritual Site	n/a	Mingani, a sacred grove where elders meet.
LLCOP-108	Living Heritage	Burial Site, multiple	n/a	Modern cemetery with few graves (only one positively identified) in Saka town, Garissa.
LLCOP-109	Living Heritage	Burial Site, single	n/a	Modern grave.
LLCOP-110	Living Heritage	Burial Site, multiple; Sacred / Ritual Site	n/a	Burial/sacred site consisting of Mhongo trees, a Boni community burial marker tree. Its presence in pairs (head and foot of burial) mark burial sites, which are also sacred worship areas.
LLCOP-111	Living Heritage	Burial Site, multiple	n/a	Muslim public cemetery in Archers Post Town, Samburu.
LLCOP-112	Living Heritage	Burial Site, multiple	n/a	Public cemetery in Archers Post Town, Samburu.
LLCOP-113	Living Heritage	Burial Site, multiple	n/a	Public cemetery in Barsaloi, Samburu.
LLCOP-114	Living Heritage	Settlement	n/a	Recently abandoned settlement in Fatuma Golicha village, Garissa.
LLCOP-115	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for men.
LLCOP-116	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for men.
LLCOP-117	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-118	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-119	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-120	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-121	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-122	Living Heritage	Sacred / Ritual Site	n/a	Boni Sacred site for women.
LLCOP-123	Archaeological	Burial Site, multiple	n/a	Saka cairn burials sites(points taken as near as possible to the Saka burials), Saka town. These burials are previously reported to NMK as archaeological as they cannot be attributed to the local inhabitants.
LLCOP-124	Living Heritage	Sacred / Ritual Site	n/a	Shrine tree.
LLCOP-125	Archaeological	Burial Site, single	n/a	Single burial.
LLCOP-126	Living Heritage	Subsistence, Pastoral	n/a	Small stock pen.
LLCOP-127	Archaeological	Burial Site, single	n/a	Tomb site.
LLCOP-128	Archaeological	Burial Site, single	n/a	Tomb?
LLCOP-129	Archaeological	Burial Site, single	n/a	Tomb?
LLCOP-130	Living Heritage	Sacred / Ritual Site	n/a	Tumaini Christian Church, a modern semi-permanent worship facility currently in use.

APPENDIX C

Minutes of Lamu meeting

APPENDIX C - KEY INFORMANT INTERVIEW MEETING NOTES

Meeting: Lamu County Commissioner

Date: 11 December 2018

Time: 1530 hours

Location: Lamu County offices

Attendees:

- Dr. Christine Ogola - National Museum of Kenya
- Mr. Rono - Deputy County Commissioner
- Mr. Wanderi - Head of the DAPC
- Mr. Kanyiri - County Commissioner

The Project team, including Dr. Christine Ogola, met with Mr. Rono (the Deputy County Commissioner); Mr. Wanderi (the head of the DAPC), and Mr. Kanyiri (the County Commissioner), on Tuesday, 11 December 2018. The objective of the meeting was to officially submit the letter of introduction and explain the goals and scope of our work in Lamu. Dr. Ogola explained the selected survey locations for the LLCOP project and why the survey was required for the Project.

Mr. Rono informed the Project team of security concerns which included traveling by road to Bodhei, about 47 kilometres away from Lamu town; traveling in areas near the border of Lamu and Garissa; and the security situation past Bargone village, which was reaffirmed by Mr. Kanyiri. To mitigate the security concerns in the survey area, Mr. Rono recommended the Project team take a boat to Mokowe then drive to Hindi and Bargone by road as these areas were safe for travel. Mr. Wanderi suggested the Project team also include a security escort during the survey. Considering all of the security concerns in the proposed survey area, we also discussed the option of meeting with local leaders and Elders to gather information on existing sites in areas not accessible due to safety concerns.

Meeting: Hindi Sub-County Commissioner and Hindi Location Chief

Date: 15 December 2018

Time: 1100 hours

Location: Hindi Sub-County Offices, Hindi Town

Attendees

- Dr. Christine Ogola – National Museum of Kenya
- Mr. William Magiri - Assistant County Commissioner for Hindi Sub-County
- Chief Jamal Hamisi - Chief of Hindi Location
- Mr. Mugo - Hindi Ward Administration Police Ward Commander
- Mr. Jamal Hamisi - area Chief

The Project team, including Dr. Christine Ogola, met with Mr. William Magiri (Assistant County Commissioner for Hindi Sub-County), Chief Jamal Hamisi (Chief of Hindi Location[2]), Mr. Mugo (Hindi Ward Administration Police Ward Commander), Mr. Jamal Hamisi (area Chief), on Saturday the 15 of December 2018.

Dr. Christine Ogola introduced the Project team to the Assistant County Commissioner and explained the purpose of the meeting which were to explain why heritage impact assessments are necessary prior to development projects, such as the construction of the LLCOP pipeline project; and, to request Mr. Magiri's assistance with arranging forums with local area Elders and religious leaders to gain local insight on potential and existing heritage sites.

Mr. Magiri agreed to arrange forums with the Elders and religious leaders for both Hindi and Bargone. They agreed the forums would be conducted, Monday 17 December 2018, to avoid conducting them on Sunday which was too soon for scheduling and is also a day of worship.

Mr. Magiri also informed us that public participation meetings had previously been held in Kililana, Mokowe and other areas in Lamu by Mr. Mohamed Kitete. The results of these meetings suggested that the Hindi area is culturally diverse however Indigenous people such as the Boni are prominent in most areas.

Mr. Mugo and Mr. Hamisi discussed the required security escort when proceeding to Bargone for both surveys and forums. It was agreed that a police escort would be provided for the Project team for the forums held on Monday the 17th in Hindi and later on in Bargone.

Heritage surveys were confirmed for Tuesday the 18 December 2018 to survey the heritage sites, record any sacred shrines, ethnomedicine and taboo areas discussed in the forums held on Monday the 17th, which would also be accompanied by the security escort as well.

[2] The Hindi location encompasses Hindi Sub-Location, Bodhei Sub-Location and Bargone Sub-Location

Meeting: Hindi Forum Meeting

Date: 17 December 2018

Time: 0900 hours

Location: Hindi Sub-County Offices, Hindi Town

Attendees:

- Mr. Abshir Bwana Msaji – Hindi community religious leader
- Mr. John Njoroge Kibugu – Hindi community religious leader
- Mr. Peter Mwaura Warui – Hindi community elder
- Dr. Christine Ogola – National Museum of Kenya

Dr. Ogola met with community and religious leaders Mr. Abshir, Mr. Kibugu, and Mr. Warui to communicate information about the heritage impact assessment for the Project. As part of the heritage impact assessment, the meeting was held to consult local religious and community leaders about the Project heritage impact assessment; and, to establish and document any existing sacred, historical sites and shrines located within the proposed survey area. This would enable working hand in hand with the local communities as the major stakeholders in the protection and management of cultural heritage whilst bringing development.

Religious Leader Mr. Abshir communicated that close to Bargone, the community is dependent on a grove of trees within the forest which provides bee habitat for natural honey production and an environment for honey storage. He emphasised the importance of this as inhabitants of the area rely on the honey production for consumption as well as trading; as such a source of livelihood could be threatened by the pipeline construction. This area is located in the area between Chomo (Kubwa and Ndogo) and Bargone. He also stated that there are numerous species of wildlife in the area, which are important subsistence resources for the local community, and could also be impacted by pipeline construction.

Mr. Njoroge stated that there may be grave sites present in the Hindi / Bargone area left over from inhabitants who left the area when there were incidences of economic insecurity. Shrines used for special occasions may also be present in the area.

The meeting concluded with the Elders and religious leaders asked to get more information from the community on sites that they may not be aware of for a scheduled visit and recording the following day.

Meeting: Bargone Forum Meeting

Date: 17 December 2018

Attendees

- Christine Ogola – NMK, The Meeting Chair
- Muhamed Ali – Bodhei Sub-Location
- Abuli Ngaracho Tiro – Bargone Sub-Location
- Doza Diza Kururo - Bargone Sub-Location
- Ali Sani Hamisa – Bodhei Sub-Location
- Abdalla Mohamed Juma – Bodhei Sub-Location
- Omar Bashungi Muhmud - Bargone Sub-Location
- Hadija Salim Bin Subo - Bargone Sub-Location
- Abdul Muhumed Abuli– Bodhei Sub-Location
- Abdalla Ben Shevei – Assistant Chief Bodhei Sub-Location
- Hamisi Babeto Kololo - Bargone Sub-Location
- Salim A Salim – Assistant Chief Bargone Sub-Location
- William Magiri – Sub-County Commissioner
- Jamal Hamisi – Hindi Location
- Mohamed Kitete – Local Assistant
- Pamela Akuku – NMK, Taking Notes
- Dennis Milewa – NMK

The Project team met with 11 Elders and leaders from Bargone and Bodhei Sub-Locations to discuss the heritage impact assessment for the Project. Dr. Ogola and Mr. Magiri began the meeting by stating what our purpose was with regards to culture and heritage management. Areas of interest were expressed as including but not limited to shrines, historical sites, settlements, burial sites, ceremonial areas and meeting points.

Mr. Kitete stated previous meetings with the local elders discussed and documented different historical areas of worship and spiritual significance for both men and women.

Local elder, Mr. Doza Diza Kururo, discussed shrines in the forest, sometimes containing sacred trees, used for worship especially in times of hardship; and, plants and trees they use as food and medicine. He also discussed burial practices such as the practice of planting two trees one at the head and the other at the foot of the grave in lieu of headstones. Trees named *wahare* in the local boni language and *Mongo* in Swahili are very sacred to them and are major markers of burial sites in the area. He also noted that inhabitants of the area are mobile, however they established semi-permanent to permanent settlements.

Bee harvesting and keeping is a key part of their community subsistence and culture. They expressed fears of how upcoming development could affect honey production by bees in the forest.

Assistant Chief Salim discussed economically important wildlife in the forest such as buffaloes, lions and leopards which could be affected by the construction of the pipeline. Mr. Omar Bashungu reaffirmed that the

community depends on the wildlife for food and livelihood. Other species potentially threatened by the pipeline include insects named *chori* (Boni) and *tungu* (Swahili); and a bird named *merris* (Boni), which are animals which guide community members to honey locations.

Names for Sacred Trees and their uses by the community (provided by Mr. Banshungu)

- *Wahare* (Boni), *Mongo* (Swahili); used for burial markings, used by women to pray for help with matters such as fertility and barrenness.
- *Hurub* (Boni), *Mkupa* (Swahili), *tumur* (Boni), *mawacha* (Swahili), *Kuradh* (Boni), *Kuraki* (Swahili); used as food and their fruits are edible. The community depends on this tree during seasons of hardship and drought. It is also a sacred tree used in occasions such as weddings to signify consummation of the marriage.
- *Ichili* (boni), *Nkama* (Swahili); is a unique tree that has four (4) different uses. It is used to make flour (*nkarabaka*) for bread; has edible fruits; can be made into food; and also used to make arrows.
- *Doho* (boni); produces leaves and fruits that are as sweet as honey.
- *Weredh* (boni); also acts as a home to bees and contains edible fruits.
- *Dhana* (boni), *waziza* (boni); are also sacred trees used in burials.
- *Teng'ethe* (boni); tree used for wood and honey by acting as a home for the bees.

Ethnobotony

The Elders also provided examples of various plants and trees used to for many purposes including treating ailments; used in cultural practices; as food for special occasions; and as well as anti-venom for snakes such as puff adder. Ethnomedicine also ties into religious practices and concerns were expressed on the potential loss of these indigenous plants due to the pipeline development. Some examples of these plants include:

- *Dhigi* (boni); in the tuber family is used as food;
- *Ururo* (boni), *Mvumbani* (Swahili); plant used to treat high blood pressure among other ailments.
- *Kakaree/Kakari* (boni); used to treat flu and cough.
- *Hijabu* (boni) tree is used to make medicine to cure ailments such as tonsils.

The Elders and leaders expressed concerns of the impact assessments being ignored by the development project. Christine ended the meeting by explaining that the Project team consists of a reconnaissance survey and mapping team meant to record the various subjects of cultural importance. Upon completion of the survey, the team will compile the report documenting these sites and deliver it to the government and the project developer who are expected to use the information for project planning and to consider the preservation of identified sites.

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ANNEX II

Socio-economic (Cultural Heritage) Baseline Field Reports

F

F1	**Samburu & Isiolo**
F2	**Garissa**
F3	**Lamu**
F4	**Turkana**

REPORT

Lokichar to Lamu Crude Oil Pipeline (LLCOP) ESIA Project

Stage 2 Baseline Survey Field Survey Report Cultural Heritage Samburu/Isiolo Section

Submitted to:

Pipeline Project Management Team

Submitted by:

Golder Associates (UK) Ltd

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1.0 INTRODUCTION

The Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Social Impact Assessment (ESIA) project is scheduled to be conducted in four key sections. These sections correspond with different regions which were based on findings from the desk surveys in the Scoping Report to identify potential areas of interest and which offer a likely sample of expected cultural heritage features on each section, including, Turkana, Samburu/Isiolo, Sankuri/Garissa and Lamu respectively. This report details the results of the first phase of the Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Social Impact Assessment (ESIA) project.

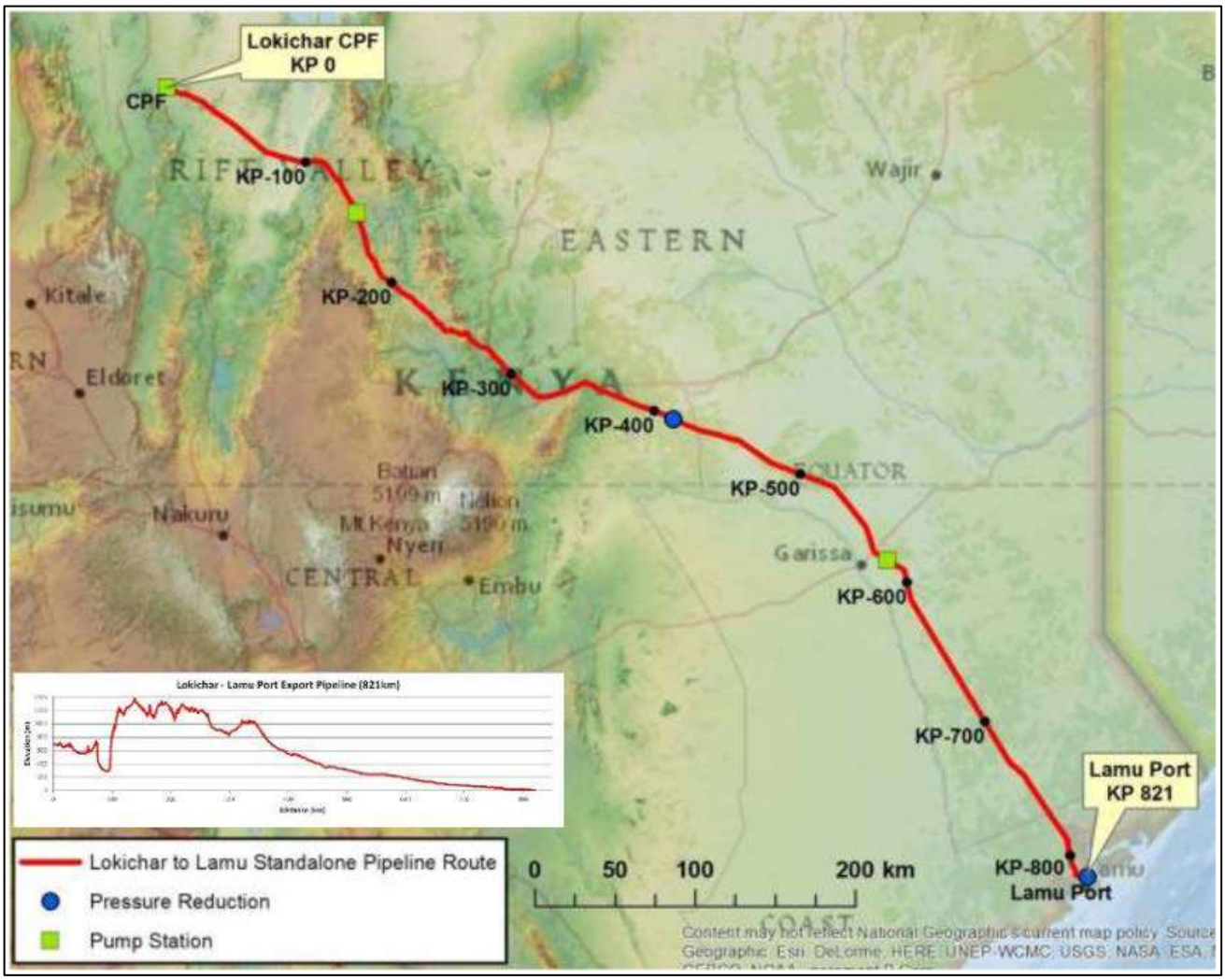

Figure 1: Map of pipeline route

This section of the baseline survey was mainly in Samburu County, but also in Isiolo and Meru Counties. This section has previously recorded fossil and archaeological sites in Nachola and around the Ewaso Nyiro plains (Samburu County). The survey was undertaken on the Samburu/Isiolo Section of the pipeline route at intervals along accessible sections that were also far away from existing roads and trading centers/towns where construction has disturbed sediments and integrity of any cultural materials found therein may not be certain. The survey therefore concentrated on pipeline sections farther from the roads and trading centers/towns.

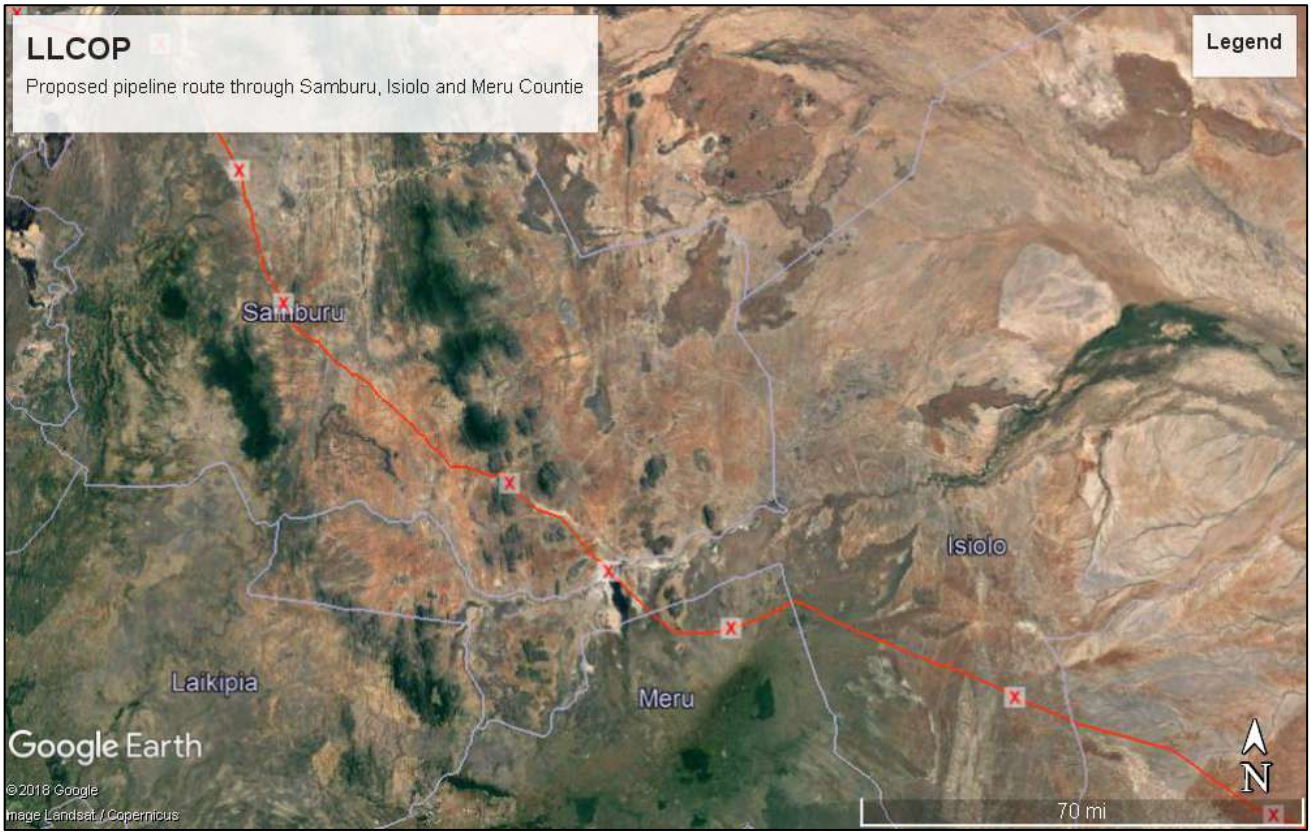

Figure 2: Map of pipeline corridor in this region

2.0 SURVEY METHODOLOGY

The survey involved ground walking of sampled areas in the different sections of the pipeline route. Surveyed areas were sampled based on location (further away from main roads, to minimise disturbance, sediment features identified on google earth and ease of access of areas to optimize time. Sampling was also done taking care to sample different landscape types. The region is mainly covered in plains where access should be relatively easy. However, the area is covered in thick bush cover where driving through along the pipeline route is virtually impossible and foot survey of multiple transects intervals at some locations was not possible.

3.0 SURVEY RESULTS

The team identified several fossil-bearing sites, mainly large mammals' fossils, and fossil wood in the Nachola area. The fossil sites can easily be identified by the yellowish-brown sediments they are preserved in and washing out of; there were isolated occurrences of stone tools but no significant concentrations that could be assigned archaeological site status were identified. Numerous burials were also identified; both single and multiple inhumations according to local informants. Vegetation in this area is mainly *Acacia sp. b*ush but the fossil sites appear in clearings within the bush, where there is no undergrowth.

Figure 3: Fossil bone and teeth fragments form Nachola. Left - antelope tooth and Right - bone fragments eroding from sediments at a gully

Figure 4: Burials at Nachola. Left – burial with upright slabs, Right – Multiple inhumation burial

The area south of Baragoi yielded no fossils or archaeological sites, and the thick grass cover makes it difficult to see anything on the ground surface. In some places, the grass is so thick it is difficult to walk through it. There are few trees in this area, most of which are along seasonal river channels (sand luggas) that make it very tricky to drive through. In the area close to Suyan Police Post, the grass thins out and the tree cover gets a little thicker, and the ground is mainly rocky.

Thick long grass cover south of Baragoi *The thick grass/bush cover near Suyan Police Post*

Figure 5: Landscape characteristics along the pipeline corridor in Samburu County

Figure 6: Burials in Suyian area

The area around Suyan Police Post has many clearings with remnants of abandoned settlements whose occupants have recently migrated to other areas. There are very little material remains left behind by the occupants, but there are several burials. According to the informant, when a person dies and is buried close to the manyatta, the living relatives abandon that homestead and establish a home elsewhere. Thus there are many burials but no sign of the owners. No fossil or archaeological sites were recorded here.

The burials recorded so far are of the stone cairn form but a few around here are marked with upright slabs. The Samburu do not recognize these as belonging to one of their own, and we can only assume these are non-Samburu buried here, thus may be archaeological burials. It was also suggested that anthills may be an indication of older graves. At the 'monkey hill' near Barsaloi there are fossil teeth that seem to have been washed down by rain water, but it was not possible to establish their point of origin. A few obsidian flakes lay next to the teeth.

Figure 7: Fossil teeth fragments at 'Monkey hill'

Three public cemeteries were recorded; one at Barsaloi near the Catholic Mission, and two at Archer's Post; one Muslim and the other a public, both located right next to the Ewaso Nyiro river. Isolated burials were also recorded outside these cemeteries in Archer's Post area.

Figure 8: Cemeteries at Archer's Post. Left is the Public cemetery while on the right is the Muslim cemetery

Figure 9: Graves at Archer's Post

There are two ceremonial places of interest, the traditional meeting place near the river at Barsaloi and one at Archer's Post. The latter one is identified by two tall Acacia trees next to the women's bead-making shed. Away from the settled area at Archer's Post, the main vegetation is acacia bush with little undergrowth. The Acacia is especially dense next to the wildlife conservancies, but gradually thins out as one heads towards Wamba. Here the ground is mainly rocky; existing settlements are mainly situated close to the road but the population is generally thin in between towns/shopping centres.

The southern side of Ewaso Nyiro river is covered by a thick layer of volcanic bombs for a long distance, and gradually gives way to mote Acacia thicket.

Quartz scatters are common near Archer's Post

Volcanic deposits south of Ewaso Nyiro river

Figure 10: Some natural sediment types along the pipeline corridor

There were several sites with glass/plastic beads, which seem to be from settlements deserted not too long ago, but in the absence of other material it was difficult to give an estimated date. Pottery fragments were only found at two locations, but they were all plain sherds.

Potsherds at Lerata (obsidian fragments)

Beads and obsidian fragments at Lerata

Figure 11: Other finds from the survey of the pipeline corridor along the Samburu section

4.0 SUMMARY

There are fossils at Nachola and Archer's Post; Possible fossil site at Barsaloi.

Archaeological occurrences are recorded in several locations of the Samburu survey of the pipeline corridor, but no substantive archaeological site was identified.

Most of the cultural remains identified are burials, both recent and probably prehistoric. Burials are mostly located close to current or past occupation sites. Public cemeteries at Barsaloi and Archer's Post.

Two sites of cultural significance were recorded that are associated with the Samburu at Archer's Post. No other ritual or ceremonial sites were recorded.

5.0 RECOMMENDATIONS:

The area around Nachola seems to have significant fossil sites, while Nachola and Archer's Post both have a significant number of burials. More detailed survey and monitoring prior to construction will be required to mitigate impacts to the fossil bearing sediment and burials in these areas.

A lot of care and community consultations will be required when working around recorded ceremonial sites and considerations made that other sites may yet be identified and recorded.

Signature Page

Golder Associates (UK) Ltd

Tim Flower
Project Manager

Gary Morris Iveson
Associate

Date: 5 April 2019

CO/TF/GMI

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APPENDIX A

Tracks and Sites Recorded During Survey

Table 1: Tracks and Sites Recorded During Survey

ID	Latitude	Longitude	Elev.(m)	Description
1	1.821739012	36.638605	1246	
2	1.810368961	36.66981401	1213	FOSSIL SITE
3	1.808691993	36.66910004	1219	CHERT FLAKES, HAMMERSTONE
4	1.76595401	36.68067201	1125	BURIAL
5	1.768862028	36.67676303	1171	FOSSIL SITE
6	0.533799995	38.19047003	767	
7	0.555079971	38.15233002	767	
8	0.577640031	38.10431002	767	
9	0.542399995	38.02034003	767	
10	0.504780002	37.83525	769	
11	0.636489959	37.67584004	769	
12	0.639929976	37.67378001	765	
13	0.642909994	37.67435996	767	
14	0.644029984	37.67431998	766	
15	0.657889964	37.66209003	766	
16	0.668470021	37.65101996	770	
17	0.666500023	37.64391999	766	
18	0.672380012	37.64036003	767	
19	0.675720032	37.63863998	766	
20	0.676870029	37.63800002	765	
21	0.690690028	37.62865998	771	
22	0.695329998	37.62234002	766	
23	0.761980042	37.56418001	764	
24	0.77887997	37.51052996	766	
25	0.827340027	37.45386997	765	

ID	Latitude	Longitude	Elev.(m)	Description
26	0.845430018	37.44453999	771	
27	0.861710021	37.43607997	768	
28	0.857289992	37.39293002	1265	
29	0.87306004	37.35187998	788	
30	0.873460025	37.33401001	788	
31	0.870779995	37.31573001	787	
32	0.889610024	37.30251996	787	
33	0.892270021	37.29949996	1265	
34	0.948700011	37.23976004	1262	
35	1.008180007	37.178	1265	
36	1.052450035	37.13336997	1264	
37	1.070700036	37.10869004	1264	
38	1.09842997	37.06091998	1265	
39	1.129309991	37.03039996	1268	
40	1.152719976	37.00235998	1266	
41	1.247230042	36.92574997	1267	
42	1.29440004	36.89594996	1265	
43	1.29440004	36.89594996	1123	BS
44	1.335640009	36.88192997	1182	
45	1.344309999	36.88021998	1183	
46	1.335640009	36.88192997	1257	
47	1.345940027	36.87824998	1149	BS
48	1.358009968	36.87460997	1184	
49	1.387289967	36.86836001	1182	
50	1.396420039	36.86541997	1180	

ID	Latitude	Longitude	Elev.(m)	Description
51	1.400409993	36.86051999	1182	
52	1.29440004	36.89594996	1268	
53	1.437969971	36.85671	1258	
54	1.437969971	36.85671	1181	
55	1.437969971	36.85671	1153	BS
56	1.455060001	36.85008997	1261	
57	1.460730024	36.84466001	1262	
58	1.476710038	36.83930003	1263	
59	1.523330016	36.83180996	1262	
60	1.529409997	36.82789997	1261	
61	1.534539973	36.82650003	1262	BURIAL WITH UPRIGHT SLABS
62	1.565189995	36.80865001	1261	
63	1.61199999	36.78259998	1259	
64	1.66379001	36.74809	1258	
65	1.706839968	36.72911002	1261	
66	1.749230018	36.69103003	1260	
67	1.807219964	36.65187003	1262	
68	1.782995006	36.78915102	1261	
69	1.823489992	36.63185002	1261	
70	1.783021996	36.78912001	1256	
71	1.74543201	36.69558702	1179	POTTERY
72	1.732940963	36.70771102	1231	QUARTZ SCATTER
73	1.721233036	36.71751802	1243	QUARTZ SCATTER
74	1.589362985	36.82882802	1293	OSTRICH EGG SHELL FRAGS
75	1.823710017	36.55150998	1263	

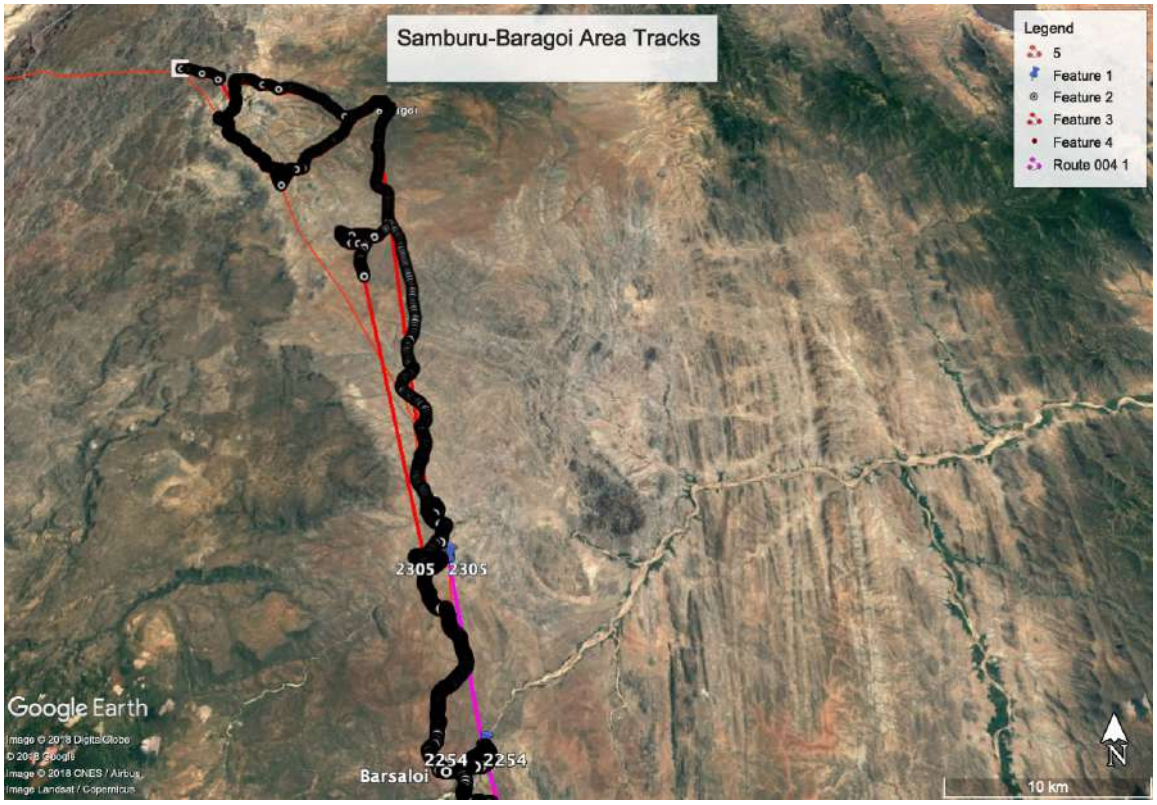
ID	Latitude	Longitude	Elev.(m)	Description
76	1.553981965	36.82780098	1275	ABANDONED SETTLEMENT
77	1.437532017	36.84502001	1182	BURIAL
78	1.335612014	36.85965196	1165	PUBLIC CEMETERY
79	1.337989038	36.87288498	1113	MEETING PLACE
80	1.321007973	36.87994396	1167	QUARTZ & OBSIDIAN SCATTER
81	1.082608961	37.08664203	1201	CROSS ON THE HILL
82	0.641299998	37.67427798	841	PUBLIC CEMETERY
83	0.641765026	37.67339503	843	MUSLIM PUBLIC CEMETERY
84	0.644306	37.67502003	845	BURIAL
85	0.644974038	37.67316001	848	2 GRAVES
86	0.646499963	37.67251099	847	2 GRAVES
87	0.646263007	37.672166	848	BURIAL
88	0.646744967	37.67191797	849	BURIAL
89	0.646747984	37.67117098	852	BURIAL
90	0.647262968	37.67036699	852	2 GRAVES
91	0.647439994	37.66997497	853	BURIAL
92	0.645966958	37.66953299	852	3 GRAVES
93	0.650930973	37.66678699	860	BURIAL
94	0.654209973	37.66541898	870	TREE
95	0.659365011	37.65743597	883	QUARTZ SCATTER
96	0.660020979	37.65796999	878	BURIAL
97	0.662579974	37.65501201	874	BURIAL
98	0.663135024	37.65483297	874	BURIAL DISTURBED
99	0.77147699	37.532698	923	BURIAL
100	0.771083962	37.53247102	925	BURIAL

ID	Latitude	Longitude	Elev.(m)	Description
101	0.771438014	37.53254796	927	POTSHERDS BEADS
102	0.777192023	37.52215097	935	BURIAL SINGLE
103	0.777181964	37.52214703	935	SINGLE BURIAL
104	0.777167967	37.52007896	932	SINGLE BURIAL
105	0.777164027	37.52009799	933	
106	0.777166039	37.52007804	933	
107	0.779672982	37.51914304	935	
108	0.779654039	37.51912803	937	SINGLE BURIAL
109	0.781381968	37.518073	939	SINGE BURIAL
110	0.63520099	37.67809602	844	QUARTZ SCATTER
111	0.636379989	37.67749999	842	FOSSIL SITE
112	0.634014029	37.67937804	843	OSTRICH EGG SHELL FRAGS
113	0.628162036	37.681514	846	OSTRICH EGG SHELL FRAGS
114	0.627503973	37.68163	851	OSTRICH EGG SHELL FRAGS
115	0.593650974	37.733358	908	OSTRICH EGG SHELL FRAGS & BEAD PREFORM
116	0.592191014	37.73414103	909	TEETH
117	0.816730969	37.46892203	1004	OSTRICH EGG SHELL FRAGS
118	0.883457959	37.30523796	1183	BURIAL
119	0.888235979	37.30380096	1191	BURIAL
121	1.828189977	36.51235996	573	AGI 06
139	1.734848013	36.70541899	1225	BEADS
140	1.589630032	36.828121	1283	BURIAL11
141	1.436859034	36.84849003	1167	BURIAL12
142	1.753649041	36.68616702	1174	BURIAL14
143	1.589634977	36.82858301	1288	BURIAL21

ID	Latitude	Longitude	Elev.(m)	Description
144	1.433958979	36.85149503	1180	BURIAL22
145	1.753854984	36.68596803	1176	BURIAL24
146	1.731960028	36.709548	1232	BURIAL3
147	1.589709995	36.82887202	1283	BURIAL31
148	1.432672022	36.849721	1199	BURIAL32
149	1.716526011	36.72638398	1244	BURIAL4
150	1.553658005	36.82762899	1270	BURIAL41
151	1.430284018	36.84656404	1210	BURIAL42
152	1.703101303	36.73337381	1257	BURIAL5
153	1.553707961	36.82762798	1270	BURIAL51
154	1.589748971	36.82807599	1281	BURIAL6
155	1.436416972	36.84712001	1170	BURIAL7
156	1.753847022	36.68649903	1177	BURIAL9
157	1.355236983	36.85903204	1135	FOSSIL SITE
158	1.753608976	36.68695701	1176	
159	1.766449967	36.67906998	1257	
160	1.430585012	36.84652104	1210	

APPENDIX B

Samburu Section Survey Tracks


Samburu-Baragoi Area Tracks
Legend
5
Feature 1
Feature 2
Feature 3
Feature 4
Route 004 1
2305
2305
2254
2254
Barsaloi
Google Earth
10 km
N

Isiolo -Archer's Post Area Tracks
Legend
5
Feature 1
Feature 2
Feature 3
Feature 4
Route 004 1
Post
Google Earth
6 km
N

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REPORT

Lokichar to Lamu Crude Oil Pipeline (LLCOP) ESIA Project

Stage 2 Baseline Survey Field Survey Report for Cultural Heritage Survey in Garissa/Sankuri Area

Submitted to:

Pipeline Project Management Team

Submitted by:

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List of Sites Recorded During Survey

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Garissa Section Survey Tracks

1.0 INTRODUCTION

The Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Social Impact Assessment (ESIA) project is scheduled to be conducted in four key sections. These sections correspond with different regions which were based on findings from the desk surveys in the Scoping Report to identify potential areas of interest and which offer a likely sample of expected cultural heritage features on each section, including, Turkana, Samburu/Isiolo, Sankuri/Garissa and Lamu respectively. This report details the results of the first phase of the Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Social Impact Assessment (ESIA) project.

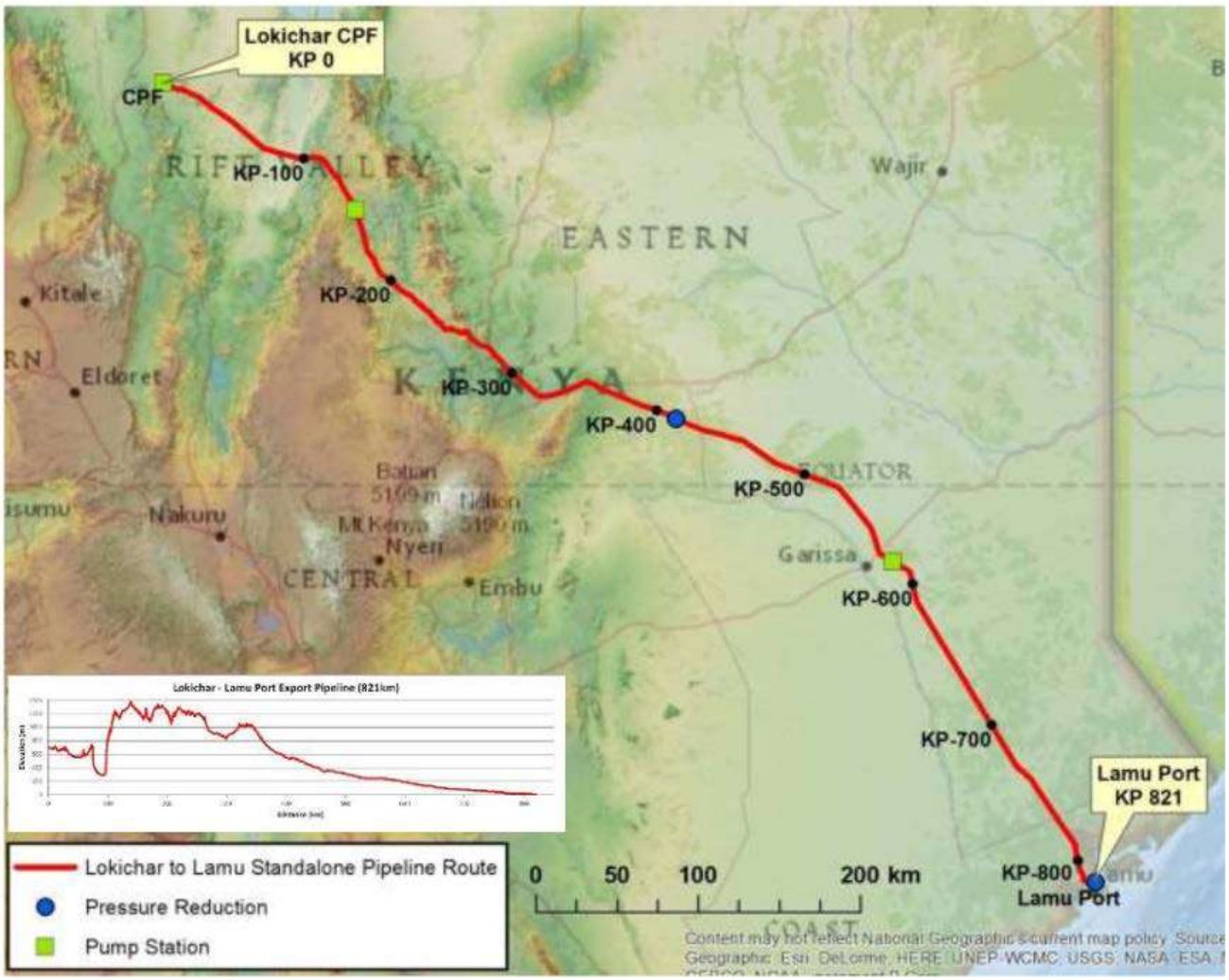

Figure 1: Map of pipeline route

This Field Report covers the survey work undertaken in Garissa County, around Garissa town and its environs between Fatuma Golicha and Sheikh Hassan Villages. Cultural heritage resources in the form of burial cairns have previously been reported in Garissa County specifically in Sankuri (Saka and Hardley villages) and Balambala areas. The area around Sankuri also has scatters of stone tools in quartz and other cryto-crystaline rocks that may be of Late Stone Age (LSA) or Neolithic period in disposition. The current survey was conducted to identify and record cultural materials that may lie along the proposed pipeline corridor that may be impacted by future construction of the proposed pipeline corridor in this region. We also intended to investigate the extent of, and the distribution of the previously reported burial cairns and their placement in relation to the upcoming development in the proposed pipeline route, as no GPS coordinates were previously available for their location. Survey was done in areas East and North East and South East of Garissa Town and various locations North

and South of the Garissa – Dadaab - Wajir road. Areas further north past Fatuma Golicha village were considered too far to cover in the available time frame, while areas further South of Sheikh Hassan village were flooded and was deemed too far south and unsafe to visit during this period.

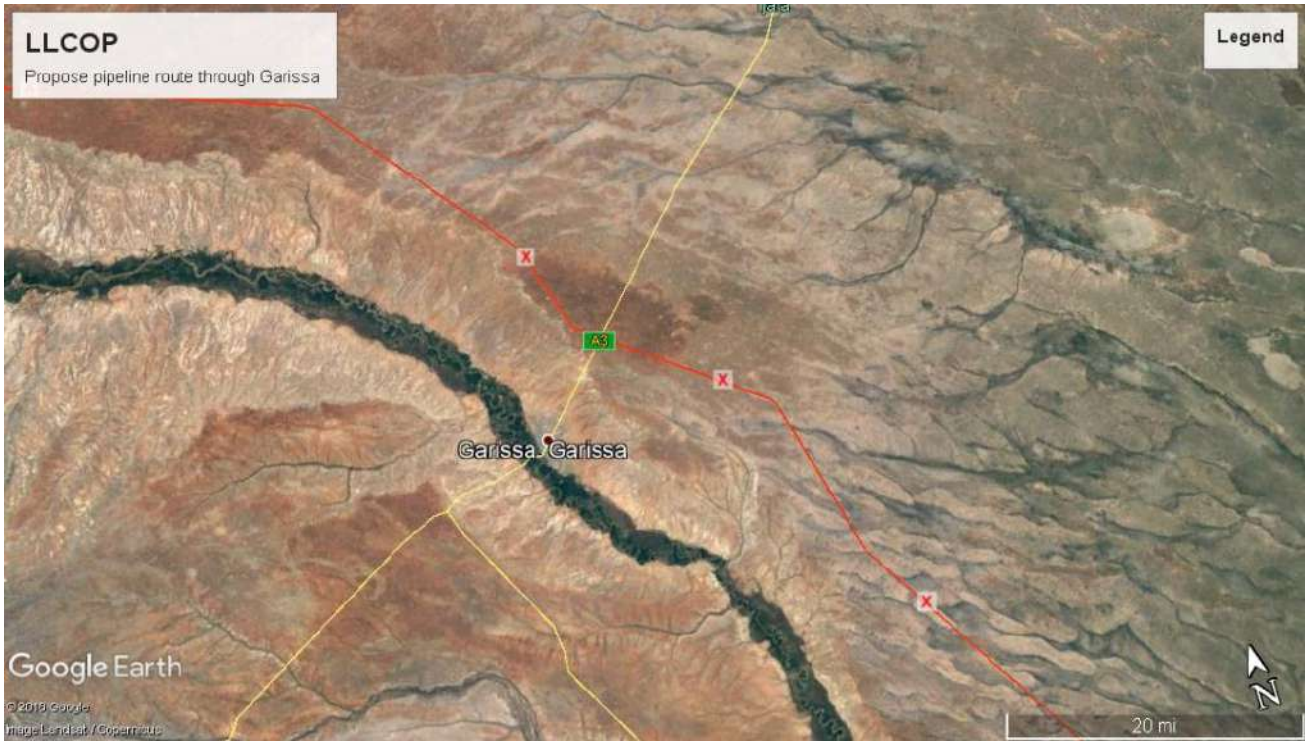

Figure 2: Map of pipeline corridor in this region

2.0 SURVEY METHODOLOGY

The survey involved pedestrian ground surveys of sampled areas in the different sections of the pipeline route. Surveyed areas were identified depending on location (from main roads, further means not disturbed, distance from Garissa for ease of access and security as well as features and sediment types identified on google earth. Sampling was also done considering different landscape facets. The landscape in this area is characterized by floodplains and rangelands. However, the area is covered in thick bushland where driving through along the pipeline route is virtually impossible and foot survey of multiple transect intervals at locations was difficult.

3.0 SURVEY RESULTS

Modikarey - Balambala area transect

The survey on this section began at Modikarey Township northeast of Garissa Town northwards towards Nunu, Shimbiray and Fatuma Golicha villages. Another transect was surveyed southwards towards Diiso 2 and Sheikh Hassan villages.

Figure 3: Vegetation and landscape characteristics along the proposed pipeline corridor

The pipeline route northwards in this area runs along the Garissa-Modogashe (C81) road towards Station10 from Modikarey to Nunu. The sediment types within Modikarey-Nunu area can be characterized as homogeneous sediments of coarse reddish-brown sand and appear. Vegetation is medium to dense *Acacia* bushland with a few open rangelands. No substantial concentrations that can be assigned to archaeological sites were identified except for isolated occurrences of what appear to be worked quartz pieces and well-rounded quartz cobbles - hammerstone. Abandoned settlements were also noted, and there is the possibility of cultural sites and modern burials at or near such locations, but none was recorded during the survey of this section. The local assistant confirmed that burial cairns have previously been reported in the area and along the proposed pipeline corridor, but none was observed during the current survey.

The survey of the transect between Nunu and Fatuma Golicha villages on the junction of Garissa –Modogashe and Garissa Balambala roads yielded several recently abandoned settlements near the Fatuma Golicha village. One possible sacred site, *Maulac,* a women's worship tree was recorded behind an abandoned homestead, long and separated by the *shel* (local road) that runs nearly parallel and about 1km west of the road in this area (Figure 4).

Figure 4: Maulac near Fatuma Golicha village

Further south near Nunu is a large area of abandoned settlements with possible repeated occupation at *Duduma kalankal*. The sediments in these areas are similar to those on the south at Modikarey and Nunu (course red brown sand). Along the same transect (Nunu – Fatuma Golicha) at *Welcathey* area, is distal flood plain like with greyish silty sand sediments (Figure 5). It is evident that the area is prone to flooding during heavy rains. The area has shrubby vegetation and dark/grey sediments visible on satellite maps as a feature and was thought to be an abandoned settlement. However, a visit to the site revealed no evidence of past human occupation at this location in *Welcathey*. Station 11, about 250m from the road in the same area has different sediments of the homogenous red sandy category.

Figure 5: Flood plain area near Welcathey village

Diiso 2 – Sheikh Hassan area

Surveying northwards from Station 12, was through flooded plains with fine silty sand and flooded erosional channels from the recent rains. Area vegetation is medium to thick acacia bushland. Glades – open areas within the bushes indicate historically abandoned settlements while some recently abandoned settlements still have brush used to make livestock enclosures, in various states of disrepair/disuse in place (Figure 6). Further survey south eastward along the corridor was restricted due to inaccessibility as a result of flooding from the recent rains, insufficient time and security concerns. No other cultural or historical sites were recorded.

Figure 6: Glades and abandoned settlements encountered during survey

Sankuri- Hardley – Balambala

Ancient burials have previously been reported in Sankuri near Saka and Hardley Villages. These burials consist of stone cairns of the variety reportedly common in northern and eastern Kenya. It was therefore important to include these for illustration and comparison of the burial cairn types likely to be found along the pipeline corridor in this region. However, these have no GPS records and are difficult to place in context in the region and in relation to the proposed pipeline corridor.

It was only possible to get coordinates of relative location of the burials (within the associated villages) as access to these sites was prohibited by local leaders and elders. We however note that these burial cairns are outside the pipeline corridor and survey was only intended to contextualize this kind of Cultural Heritage in the broader area. No such burial cairns were recorded or reported along the surveyed pipeline corridor section, but as these are said to be common in the north eastern region of Kenya, future work along the corridor should be conscious of their possible presence and put in place impact mitigation measures for them should they be encountered.

Modern burial sites were not easily visible and locations were not easily shared by the local community. It is modern practice for adherents of Islamic faith (which have historically been the majority of inhabitants in this region) to bury the dead at public Islamic cemeteries. It is not clear where those communities in the rural areas bury the dead as the locals were unwilling to share this information. In Saka Village, we were shown a modern cemetery with several graves.

Signature Page

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APPENDIX A

List of Sites Recorded During Survey

Table 1: List of Sites Recorded During Survey

No,	X_COORD	Y_COORD	ELEVATION (m asl)	NAME
1	39.328209000	-0.137935000	188	338
2	39.330004000	-0.136657000	189	MODERN CEMETERY
3	39.328876000	-0.140094000	184	SAKA VILLAGE
4	39.241257000	-0.108710000	207	HARDLEY VILLAGES
5	39.217973000	-0.021684000	279	339
6	39.217972000	-0.021685000	279	HARDLEY FALSE BURIAL
7	39.384863000	0.030652000	301	ROUTE INTERSECTION
8	39.703347000	-0.341258000	248	POINT40
9	39.694060000	-0.308330000	247	PN41
10	39.411658000	0.018113000	286	330
11	39.419988000	0.016123000	287	LIVESTOCK PEN
12	39.425374000	0.012355000	285	SMALL STOCK PEN
13	39.430590000	0.011067000	285	MAULAC
14	39.479176000	-0.001153000	278	ABANDONED SETTLEMENT
15	39.665154000	-0.230841000	262	DISTAL FLOOD PLAIN
16	39.675921000	-0.254656000	258	AGI11
17	39.674810000	-0.255090000	262	ENTRY TO AGI-11
18	39.829180000	-0.436780000	146	331
19	39.834470000	-0.440770000	152	332
20	39.837870000	-0.443230000	152	333
21	39.838990000	-0.444230000	152	334
22	39.852320000	-0.454330000	151	335
23	39.881340000	-0.477880000	151	336
24	39.889710000	-0.505430000	152	337
25	39.838932000	-0.444082000	221	START
26	39.835926000	-0.440623000	225	GLADE

No,	X_COORD	Y_COORD	ELEVATION (m asl)	NAME
27	39.835232000	-0.439539000	223	RECENTLY ABANDONED SETTLEMENT
28	39.834424000	-0.439491000	221	AGI-12
29	39.889906000	-0.505694000	213	START2
30	39.887688000	-0.501300000	214	ABANDONED SETTLEMENT
31	39.887095000	-0.499556000	210	GLADE
32	39.886844000	-0.496031000	211	END
33	39.375670000	-0.031900000	151	SAKA TURN OFF
34	39.332890000	-0.142410000	170	SAKA CAIRN
35	39.694060000	-0.308330000	244	0382
36	39.672960000	-0.244090000	140	0392
37	39.660580000	-0.224600000	141	0402
38	39.571720000	-0.150550000	139	0412
39	39.360920000	-0.392900000	137	0422
40	39.479110000	-0.000510000	140	0432
41	39.875970000	-0.472250000	243	3981
42	39.703380000	-0.341260000	234	4081
43	39.197560000	-0.101690000	146	AGI-10
44	39.676240000	-0.253780000	0	AGI-11
45	39.693942000	-0.307971000	245	AGI-20
4	39.703382000	-0.341267000	241	PONT 40
47	39.197560000	-0.101690000	139	STATION 10

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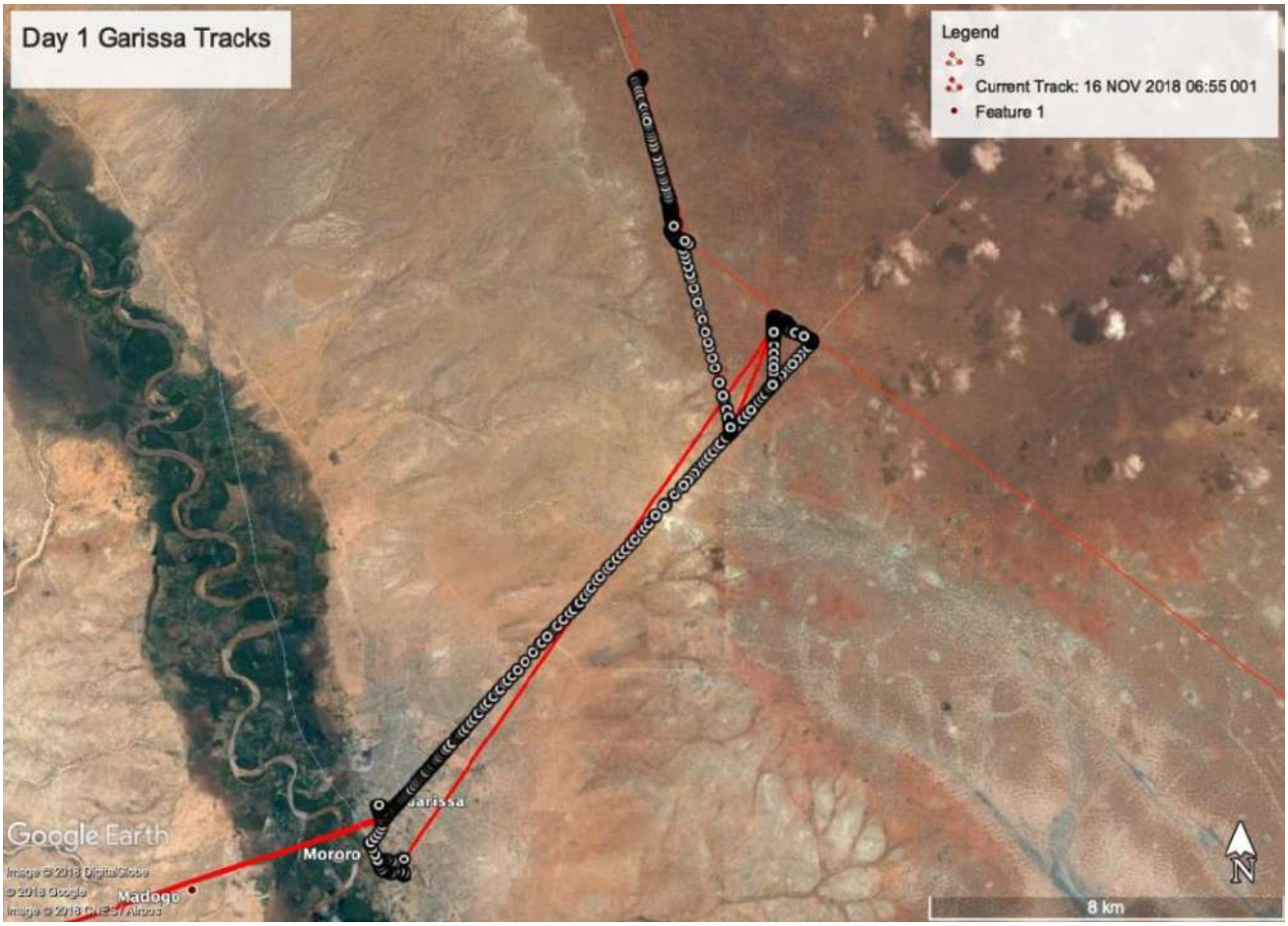
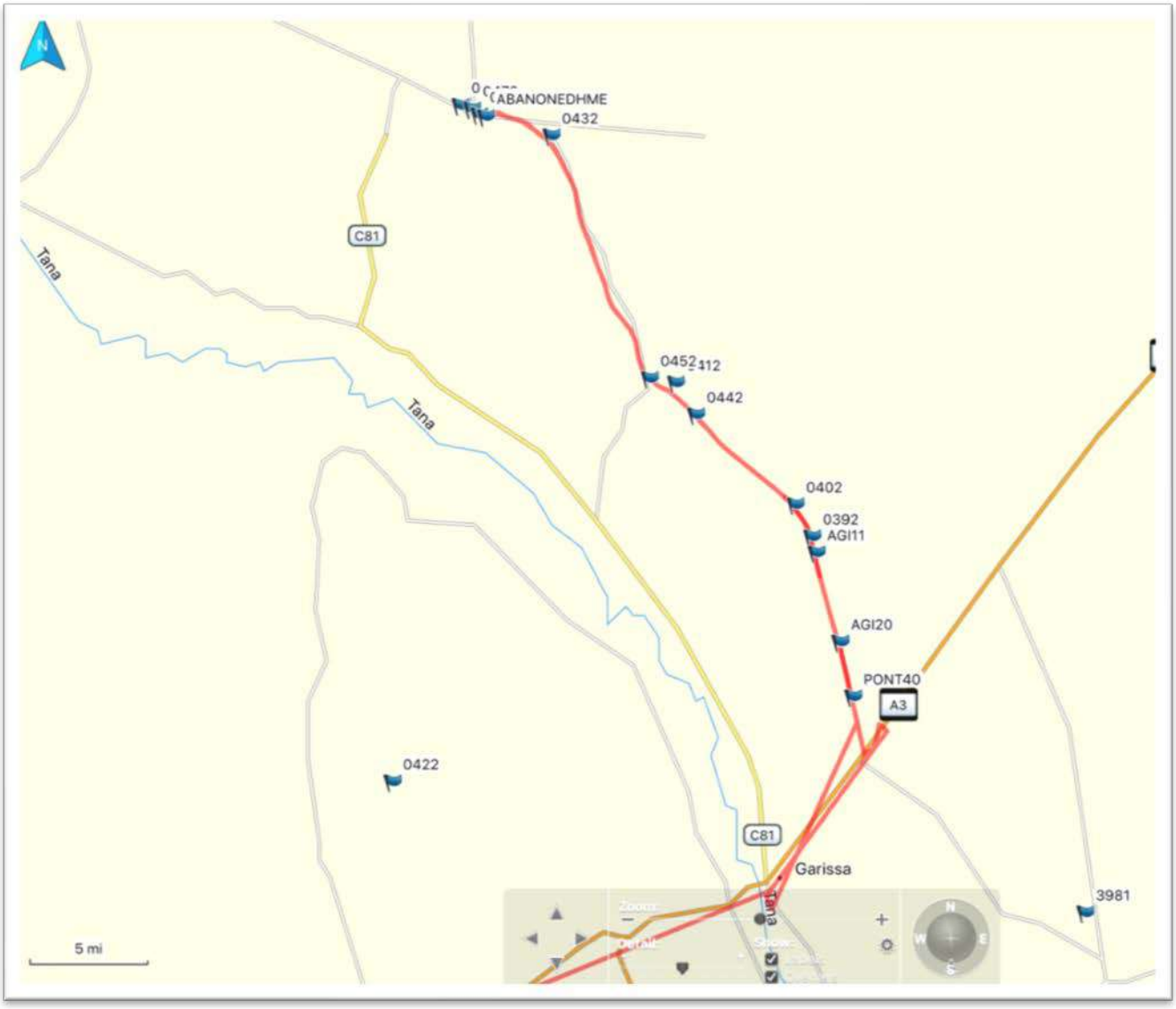
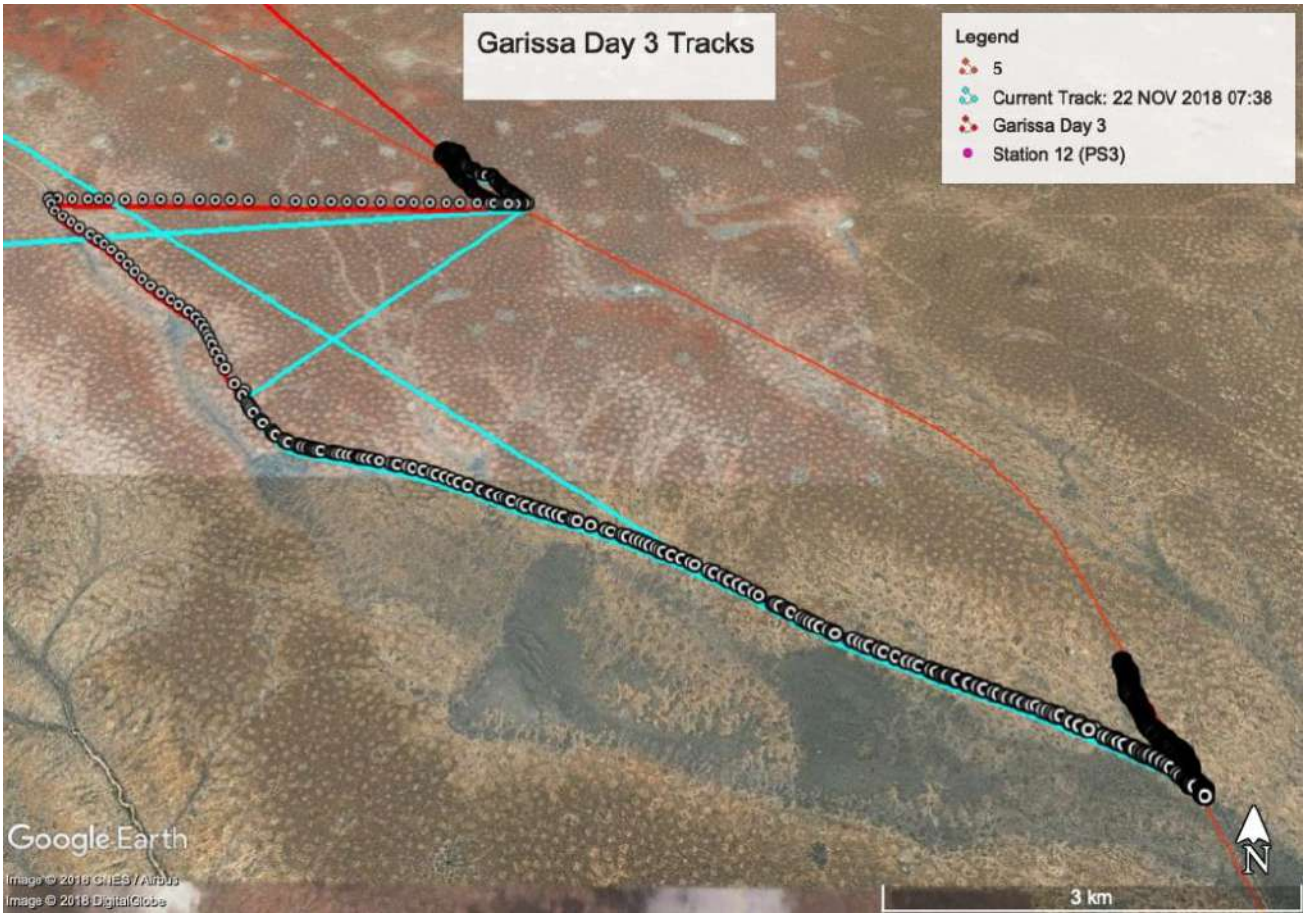
APPENDIX B

Garissa Section Survey Tracks


Day 1 Garissa Tracks
Legend
5
Current Track: 16 NOV 2018 06:55 001
Feature 1
Mororo
Madogo
Google Earth
8 km
N



Day 2: Fatuma Golicha – Nunu Transect



Day 3: Diiso 2 and Sheikh Hassan Transect

Day 4: Sankuri – Hardley – Balambala Transect

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REPORT

Lokichar to Lamu Crude Oil Pipeline (LLCOP) ESIA Project

Stage 2 Baseline Survey Field Survey Report for Cultural Heritage Survey in Lamu

Submitted to:

Pipeline Project Management Team

Submitted by:

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April 2019

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List of Sites Recorded During Survey

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Lamu Pipeline Section Survey Tracks

1.0 INTRODUCTION

The Cultural Heritage Baseline Survey for the Tullow Oil Kenya Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Strategic Impact Assessment (ESIA) project is scheduled to be conducted in four key sections. These sections correspond with different regions which were based on findings from the desk surveys in the Scoping Report to identify potential areas of interest and which offer a likely sample of expected cultural heritage features on each section, including, Turkana, Samburu/Isiolo, Sankuri/Garissa and Lamu respectively. This report details the results of the first phase of the Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Strategic Impact Assessment (ESIA) project.

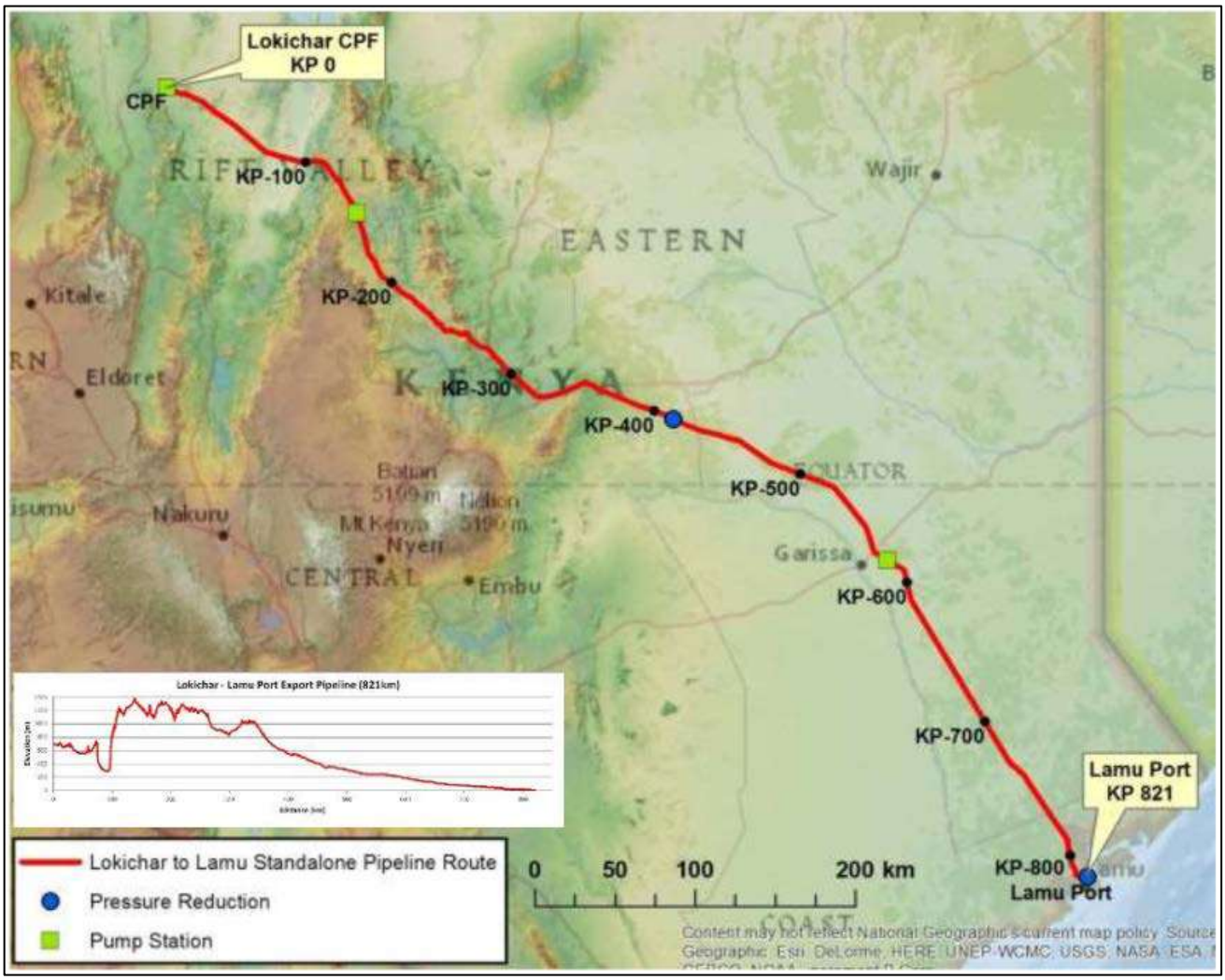

Figure 1: Map of pipeline route

This is the report for the section of the baseline survey conducted in Lamu County northwards between the new port of Lamu and Bargoni village.

The coastal region of Kenya and Lamu County in particular has many previously recorded early Swahili archaeological and historical sites and monuments. Lamu Town itself is a World Heritage list inscribed site. This area is inhabited by the Mijikenda communities, including the Bajun, Boni and Orma. Areas closer to the coast near Mokowe and Hindi townships are inhabited by the Bajun, while in the north are the Boni who inhabit the Bargoni and Bodhei villages and the nearby Boni forest.

This survey aimed to identify and record data on cultural heritage sites in relation to the proposed pipeline route. The team conducted surveys in areas just west, south and northwest of the new Lamu Port, following the proposed pipeline route west towards Hindi/Mokowe road and then north towards Bargoni. Areas further north of Bargoni were not surveyed due access issues as result of insecurity concerns in the area. There was however, opportunity to speak with leaders and elders from that region (from Bodhei village) and narratives about the types and nature of cultural heritage sites to be found in the area recorded.

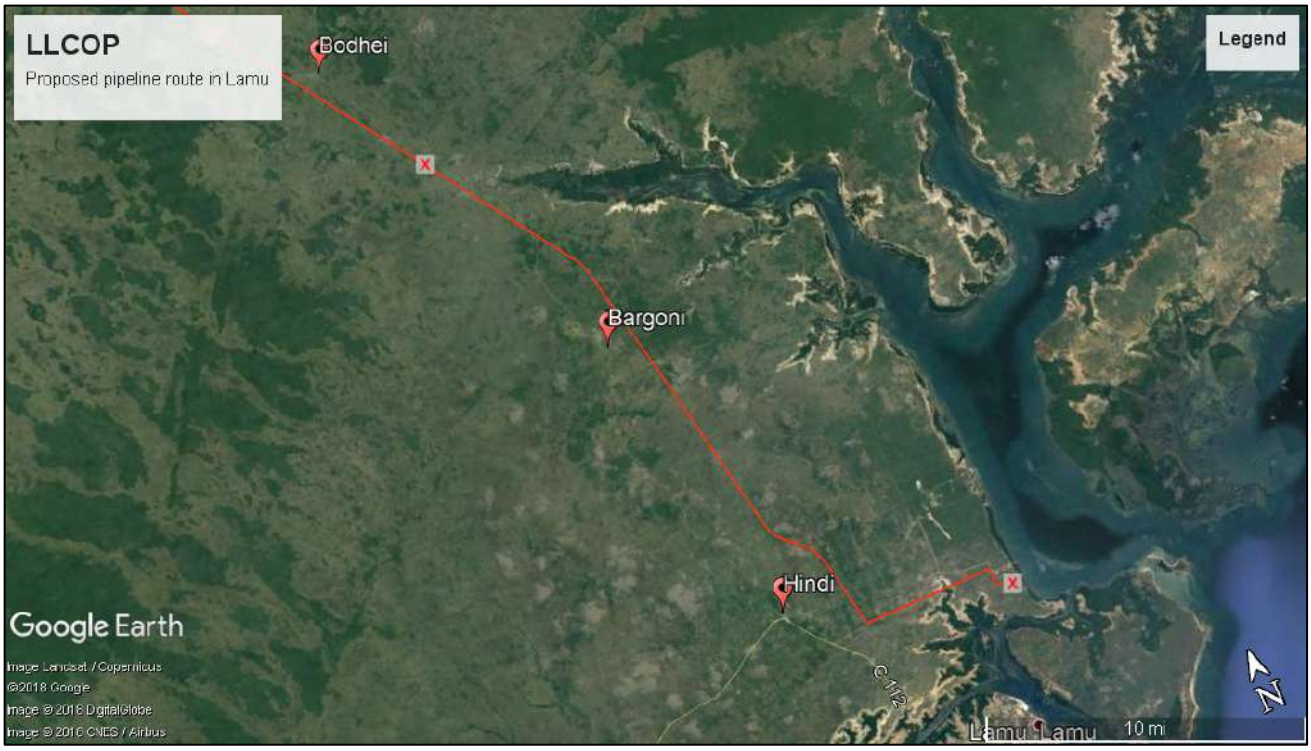

Figure 2: Map of pipeline corridor in this region

2.0 SURVEY METHODOLOGY

The Survey involved ground walking of sampled areas in the different sections of the pipeline route. Surveyed areas were identified depending on location (from main and local roads and security). The region is mainly in the coastal plains where access should be relatively easy. But the area is covered in farmland and thick bush in some places where driving through along the pipeline route is virtually impossible and foot survey of multiple transects intervals at locations was difficult. Local access routes were used to reach the pipeline corridor, while certain areas were visited with the guidance of local leaders and elders.

Figure 3: Landscape and vegetation Characteristics

3.0 SURVEY RESULTS

Surveys undertaken around the port area was in a controlled access area with a lot of ongoing construction development projects. Areas away from the construction sites that were accessible were also earmarked or recently developed (surface soils and bush clearing) or graded road. Areas in the south west where the pipeline enters the port is currently covered in thick bush of palms, grass and scrub and no ground surface is visible for identification of any cultural material. There are also no previously recorded heritage resources in this area.

South of the port at Kililana area is an old port area where locals living in Manda and Lamu Island used to access their farms on the mainland from. The area has a modern (semi-permanent) mosque, an ancient well and in the reported settlement in the surrounding bushes as far north as the area around the new Lamu Port traversing through the proposed pipeline route. However, apart from the ancient well, no ruins or associated features – burials and other monuments were seen in the area during the current survey. This area is joined to the new port area by foot paths through thick grass and bush vegetation where no cultural material is visible. Our local informant, Mr. Hassan (an environment activist and conservator in this area) reports that there are no modern or ancient burials or ruins of ancient settlements known to him in this area up to areas further northwest where farmlands of early inhabitants were located.

Figure 4: Kililana ancient Port area. An abandoned settlement area with a well. There is also a modern semi-permanent mosque nearby, by the beech.

The section of the pipeline that runs west-east from the Mokowe – Hindi road to the port area is bisected by local roads and access is relatively easy. However, away from the roads is thick impenetrable bushland or modern farmland (of cashew, coconut and mango trees) that was mostly not accessed. The eastern section closer to the port area has more clearings, both in the farmlands and in the bushes with medium to thick bush cover. The area around the nearby creek where the pipeline corridor runs about 1 km south of the port road has a previously reported site (Tumbiri tomb) within the pipeline corridor. This area has slightly more open vegetation including bushes and farmland, with vegetation including various palm species, cashews and eucalyptus. An ancient/historical settlement is identified along the corridor near the creek along a track that leads south towards Kililana with fragments of at least four (4) different ceramic types and glass shards and a concentration of sea shells *Mirindi* under a young eucalyptus tree. The area sediments are disturbed as would be expected of historically/recently tilled farmland, although it is not currently under cultivation. The area has a fig tree and other vegetation types indicative of human habitations and disturbance from farming such as *Solanum incanum (*sodom apple), *Anacardium occidentale* (cashew nut) *Euncalyptus* sp and other weed-like bush and scrub plants. Further south east is a scatter of coral stone reported as grave markers in an area that reportedly contain many historical graves but are not currently visible.

Figure 5: Finds from the proposed pipeline corridor including shells (left), ceramics (middle) and remains and a burial (right) from a historical settlement and farmland

Figure 6: Places of worship situated along the pipeline corridor, near Hindi Township. A modern Christian place of worship - Tumaini Church (left) and a cultural (sacred, worship) site –Miingani, near Chomo Ndogo (right).

The section of the pipeline corridor where it bends northward towards Hindi is covered in thickets and farm land. There were no reports and identifications of sites and monuments in the area. Two meetings with leaders and elders from Hindi, Bargoni and Bodhei indicated that there are various important cultural and socio-economic resources that require conservation during pipeline design and construction, including:

- Food plants and animals – the Boni ethnic community are mostly hunter gatherers/farmers;
- Sacred/medicinal trees;
- Burial sites - unmarked modern graves, and tree marked ancient and historical graves;
- Honey harvesting grounds and hive making wood;
- Hunting – arrow poison trees; and
- Worship/prayer sites;

Heritage resources in the above categories were identified during visits to the pipeline corridor with elders and including:

- Chomo Kubwa and Chomo ndogo – swamps with wildlife said to be consumed by the locals. Chomo ndogo is within the proposed pipeline corridor;
- Miingani sorio (miingani place of worship and sacrifice - a sacred groove in an area with Miinga (plu), Munga (sing.) tree;
- Mizingani – an area where the community harvests honey from natural hives in the many baobab trees in the area. They also put up man made hives on the trees here due to the availability of baobab tree flowers much loved by bees and other trees flowers that make good quality honey;
- Mhongo (swa), Wahare (Bon) tree marks grave sites which are regarded sacred are used as traditional worship places. This tree is planted usually in pairs, one at the head and the other at the foot of the interred to mark the grave. Location of Mhongo if in twos, indicate former settlements where people were usually buried;
- Other culturally and socio-economically important and livelihood used trees include:
  - Hurub- Food tree during famines, worship tree, also a sacred tree whose wood is used to symbolize marriage – for matrimonial beds and marriage/wedding ceremony thresholds.
  - engidhe – beehive timber tree
  - Hijabu – medicinal plants for mumps, tonsils (use roots)
  - Nkarabaka/Ichili – food tree – edible palm tick tree with thick succulent trunk. The trunk peeled and ground for baking floor, two edible parts of the fruit
  - Kashadhe – dawa ya nyoka mrefu a yellowish climber
  - Dhana – euphorbia- used as a burial marker and as a homestead hedge. Hedges occur in long rows, while grave marker occur as two bushes on either ends of the grave (head and feet)

Figure 7: Mzingani – an area near Chomo Ndogo (left picture) with numerous () baobab trees used by the community to hand beehives. The hollows in the baobab trees also act as natural beehives. This is located within the pipeline corridor

Figure 8: Grave marker plants. Mhongo tree (left) near the pipeline corridor close to Bargoni, and Dhana – euphobia bush. Other than being important cultural sites, grave sites marked by these plants can also be sacred community worship places

The area between Bargoni and Bodhei could not be surveyed due to insecurity concerns. However, local elders we spoke with informed us about heritage resources, mostly of similar medicinal and food plants as those listed above found in the surrounding forest and possibly along the proposed pipeline route. Consultations with the National Museums curatorial officers at the Lamu Fort Museum indicate that many scared and cultural sites were recorded in the Boni forest before the upheavals that have made it unsafe to visit currently and in the recent past. These records have been made available to the project team for plotting on the heritage resources map for the ESIA (Figure 10). Although these heritage sites are mostly away from the proposed pipeline corridor, it is considered however that similar sites may also lie along the pipeline corridor area where survey was not conducted in the past.

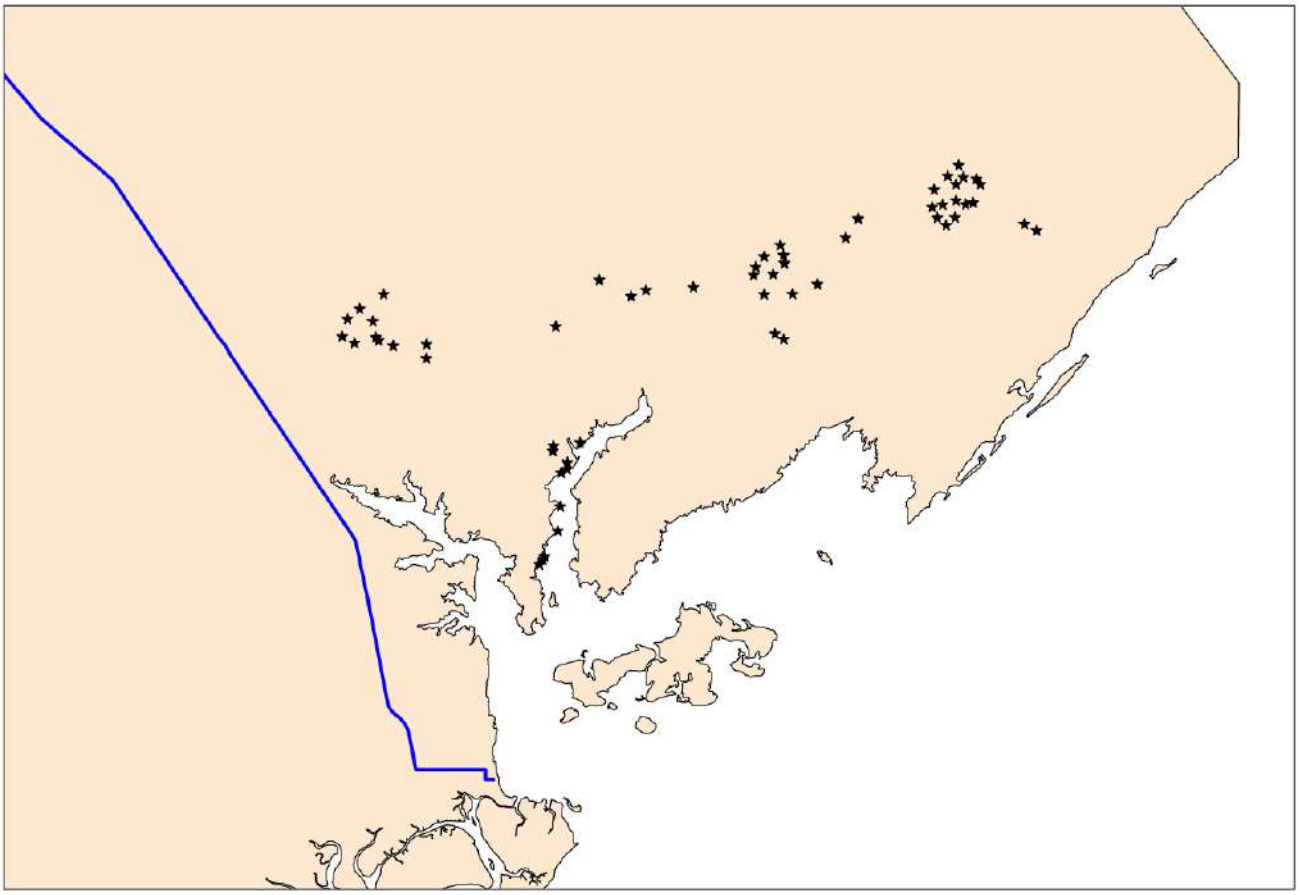

Figure 9: Map of previous recorded heritage sites in Boni forest (Source NMK, Lamu Fort Museum)

Signature Page

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Date: 5 April 2019

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APPENDIX A

List of Sites Recorded During Survey

Table 1: List of sites recorded during survey

No.	XCOORD	YCOORD	ELEVATION	CMT
081	40.878916000	-2.198073000	99.72	TOMB SITE?
082	40.883707000	-2.198511000	8.09	OLD GRAVESITE
073	40.830488000	-2.096970000	-101.11	CHOMO KUBWA
074	40.813840000	-2.094994000	9.37	CHOMO SMALL
075	40.811357000	-2.094843000	9.95	MINGANI
076	40.811172000	-2.091398000	15.10	HONEY HIVES
077	40.791204000	-2.048049000	18.75	MONGO
078	40.827480000	-2.146478000	13.90	TUMAINI
079	40.827509000	-2.147333000	17.85	SHRINE TREE
080	40.826726000	-2.148293000	16.63	TOMB2
PEP	40.916088000	-2.294725000	7.25	Flag, Blue
WELL	40.909802000	-2.218037000	5.11	Flag, Blue
059	40.910259000	-2.214864000	5.38	Flag, Blue
060	40.909536000	-2.218925000	5.17	Flag, Blue
069	40.845220000	-2.179764000	0.16	START PT 1
070	40.845176000	-2.181077000	10.49	INTERSECTION
071	40.845376000	-2.187288000	6.56	FARMLAND
072	40.844908000	-2.188180000	15.79	BAOBAB
061	40.856491000	-2.196316000	8.36	PIPELINE1
062	40.856357000	-2.198440000	14.40	
063	40.862446000	-2.193177000	-0.10	300M FROM C
064	40.862186000	-2.200972000	9.12	H SETTLE 2
065	40.865870000	-2.197628000	8.85	TOMB?
066	40.870303000	-2.197495000	8.93	CORAL BOULDER
067	40.882709000	-2.196106000	7.21	CORRIDOR

No.	XCOORD	YCOORD	ELEVATION	CMT
068	40.882807000	-2.196688000	5.59	POTTERY

APPENDIX B

List of Previously Recorded Sites in the Boni Forest

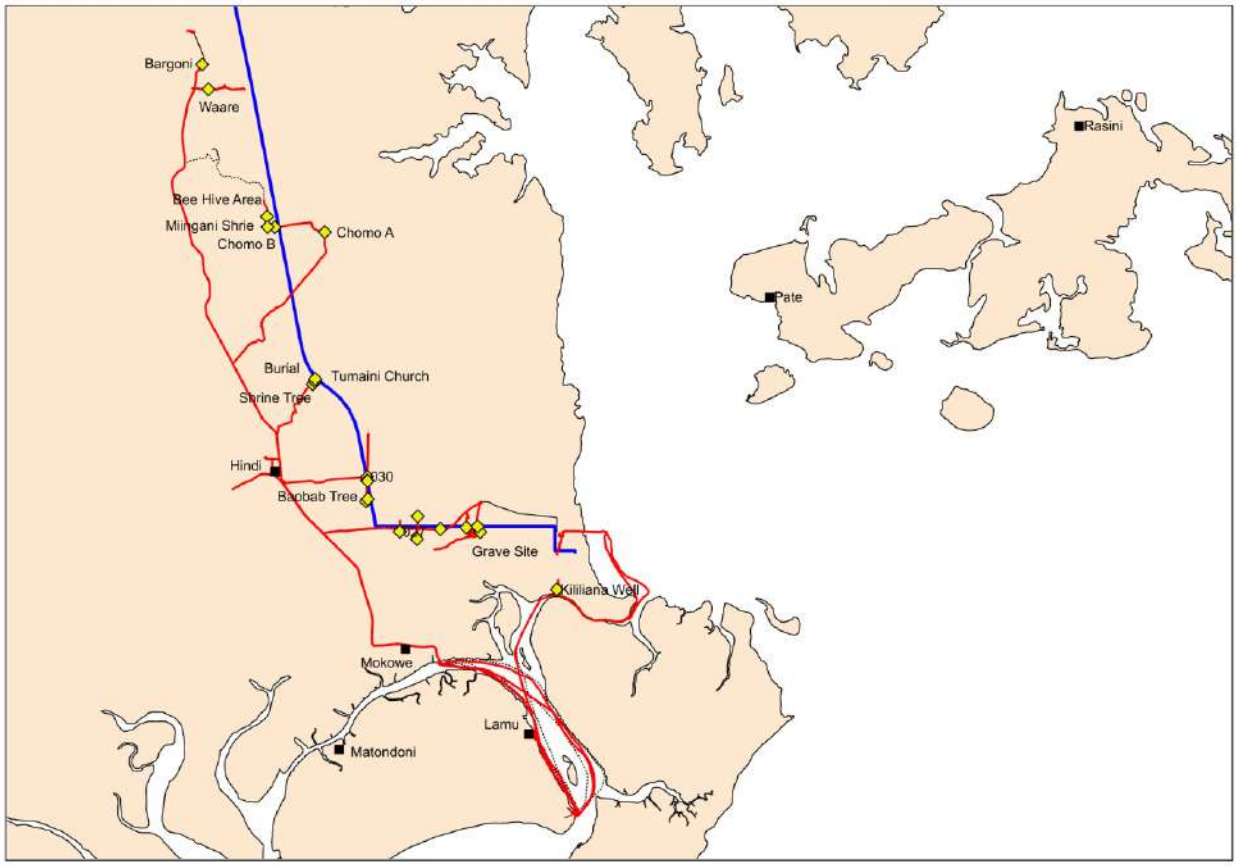
Table 1: List of previously recorded sites in the Boni forest

NO.	SITE TYPE	VILLAGE	COORDINATES	COORDINATES	ELEVATION
25	Sacred site	Basuba	41.008136000	-1.764777000	40.50
33	Grave	Basuba	41.090611000	-1.770995000	20.55
75	Cultural sites	Mangai	41.162043000	-1.811666000	4.45
77	Former Settlement areas	Mararani	41.390871000	-1.720686000	13.82
132	Former Settlement areas	Mararani	41.338049000	-1.675246000	18.63
133	Former Settlement areas	Mararani	41.313044000	-1.672796000	26.32
138	Sacred site	Mararani	41.311644000	-1.716081000	18.15
146	Former Settlement areas	Mararani	41.335244000	-1.696160000	18.15
147	Former Settlement areas	Mararani	41.326592000	-1.673775000	22.24
162	Sacred site	Mararani	41.322476000	-1.663186000	31.37
220	Former Settlement areas	Milimani	40.819455000	-1.777409000	28.48
291	Grave	Milimani	40.783128000	-1.814606000	28.24
326	Grave	Milimani	40.815053000	-1.818207000	23.68
337	Sacred site	Milimani	40.798484000	-1.790111000	52.28
353	Grave	Basuba	40.970105000	-1.805848000	31.61
403	Sacred site	Kiangwe	40.980449000	-1.925478000	13.34
404	Sacred site	Kiangwe	40.968190000	-1.910619000	22.48
443	Former Settlement areas	Kiangwe	40.967731000	-1.915285000	19.11
484	Grave	Mangai	41.223718000	-1.727254000	21.27
536	Former Settlement areas	Mangai	41.160334000	-1.759436000	20.31
549	Sacred site	Mangai	41.145064000	-1.753113000	23.44
551	Former Settlement areas	Mararani	41.234526000	-1.710426000	17.43
568	Grave	Mararani	41.303829000	-1.709556000	0.00
599	Historical sites/monuments	Milimani	40.857078000	-1.821297000	38.10
641	Grave	Milimani	40.793966000	-1.820413000	25.84

NO.	SITE TYPE	VILLAGE	COORDINATES	COORDINATES	ELEVATION
643	Sacred site	Milimani	40.787771000	-1.799311000	36.18

APPENDIX C

Lamu Pipeline Section Survey Tracks



Lamu Pipeline Section Survey tracks

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REPORT

Lokichar to Lamu Crude Oil Pipeline (LLCOP) ESIA Project

Stage 2 Baseline Survey Field Survey Report Cultural Heritage Turkana

Submitted to:

Pipeline Project Management Team

Submitted by:

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1.0 INTRODUCTION

The Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Social Impact Assessment (ESIA) project is scheduled to be conducted in four key sections. These sections correspond with different regions which were based on findings from the desk surveys in the Scoping Report to identify potential areas of interest and which offer a likely sample of expected cultural heritage features on each section, including, Turkana, Samburu/Isiolo, Sankuri/Garissa and Lamu respectively. This report details the results of the first phase of the Cultural Heritage Baseline Survey for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environment and Social Impact Assessment (ESIA) project.

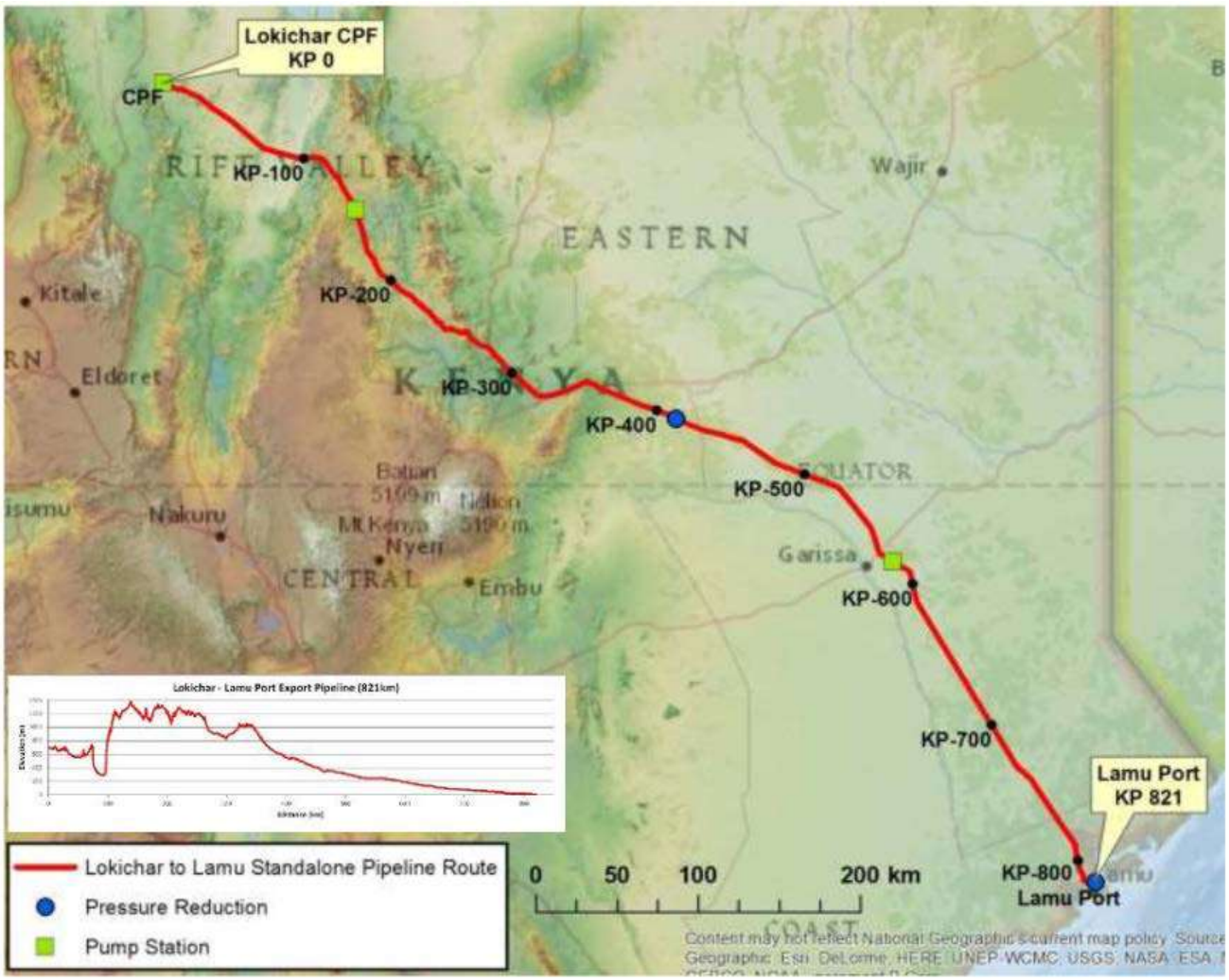

Figure 1: Map of pipeline route

The survey was conducted in proximal sections of the pipeline in Turkana region, starting from the Central Processing Facility and the first 100km of the pipeline, west of the Suguta valley. This section has previously recorded cultural heritage and archaeological sites recorded in different sedimentary basins and environments. These include open woodland plains with sparse to medium vegetation cover and small dry water channels/luggas, river flood plains with riverine forests or tree cover and rocky and hilly areas with underlying fine silty sediments of different textures and colours. Survey in this section of the pipeline therefore focused on establishing the cultural and archaeological potentials of these sedimentary profiles along the pipeline corridor while paying attention to the proposed pipeline route and the identified proposed Station locations.

This area has many previously recorded archaeological sites and isolated occurrence, recorded during previous research and seismic oil exploration respectively. Notable is the dense distribution of sites/occurrences of sites and features around the Lokichar area where the seismic oil exploration associated survey was based and in the Lokori/Lotubae area where previous research has recorded Namoratunga; an ancient cemetery with many engraved stone tomb markers encircling the graves. These sites belong to the Pastoral Neolithic period of early fishers, hunter gatherer and herder communities. The sites consist of Later Stone Age hunter gatherer and Pastoral Neolithic stone tool cultures consisting of microliths, burial cairns, stone pillar and stone circle burial sites with and/or without engravings both on the burial stone pillars and stand-alone boulders. Also present are Ostrich eggshell beads, pottery and wild as well as domestic animal bones.

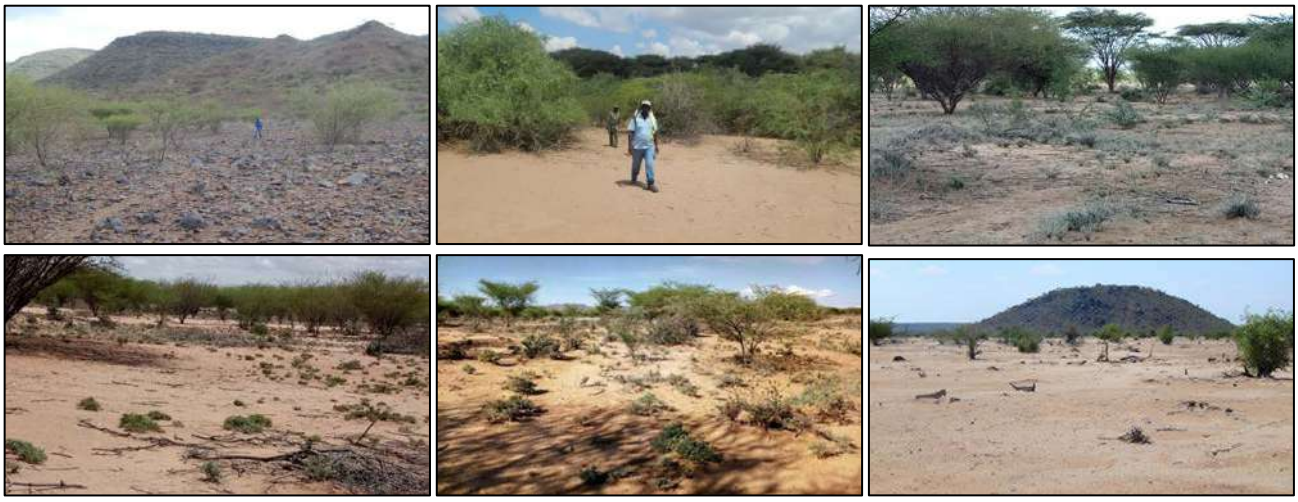

Figure 2: Landscape characteristics of the pipeline corridor surveyed

2.0 SURVEY METHODOLOGY

The surveys involved ground walking of sampled areas in the different sedimentary basin categories. The pipeline corridor survey area is 1km wide and was divided into 500m wide sections along the pipeline route for the purpose of this survey. Sampled areas and their sizes were determined by the approximate total area covered by the sedimentary basin, topography and ease of access. Sampling was also done taking care to sample different landscape types.

In the open plains where access was relatively easy, the team walked five sets of 100m wide by 500m long survey transects at 100m intervals and 2km between each set of transects. The transects were sampled on alternate sides of the pipeline route and ensuring that the centre of the corridor where the pipeline was likely to be laid was covered during the survey of each set of transect. The team therefore walked 4, 5 or 6 sets of transects in the plains between the CPF and the Nakukulas Village/River and on the flood plains on either banks of the River Kerio.

Most of the length of this pipeline corridor in this region is hilly and rocky with volcanic rock pebbles and boulders covering many hill slopes leaving very little in observable sediment deposits, especially where there has been no recent river cutting of erosion channels. This made the application of the five 100m by 50m long transects method described above difficult to apply in the hilly rocky areas. Survey here therefore followed the pipeline route ensuring that a 100m wide corridor or the pipeline route itself, whichever was wider was covered under survey.

Figure 3: Survey team along the pipeline corridor a) In the plains; b) Along river flood plains; c) In the rocky hills

3.0 SURVEY RESULTS

The western plains between the Central Processing Facility and Nakukulas Village/River

This area is covered in sparse to medium bush and scrub vegetation. The landscape is mostly plains with gentle slopes in parts and is traversed by many luggas of different sizes. Sediments in this area are mostly fine sand with isolated incidences of course and silty sand. Previous records of archaeological material in this area consists of Late Stone Age, Pastoral Neolithic and modern artifacts made in obsidian, chert and quarts stone raw material, microliths and blade cores. Other finds include potsherds, ostrich egg shell and plastic beads as well as burials and other cultural sites/features.

The team surveyed three (3) sets of five (5) 100m by 500m survey transects in this area, skipping 2km in between and alternating on either side of pipeline corridor (two on the northern, and one on the southern side of the corridor. Surveys in this area also included sampling of of the vicinity of the proposed Lokichar Export Facility. This area generally has isolated scatters of archaeological materials, including pot shards, stone tools in obsidian, rhyolite/basal. Quarts, chert and other stone raw materials, as well as ostrich egg shell beads and bone fragments (partially buried).

Figure 4: Survey in the westerns plains

Two large archaeological scatters were recorded, both of which are of Middle Stone Age (MSA) period disposition. The first site is *in situ* with formal MSA stone tool types like blades, points, *levallois* flakes and distinct core types in greyish brown silty sand sediments. The other site is a large scatter of very weathered rhyolite artefact in an area in which the sandy sediments have been winnowed out either by wind or slow water action or both. The tools are also of MSA disposition with distinct tool types.

Figure 5: Archaeological sites recorded during survey of the western plains transects. a) in situ MSA site at N 2.227743985, E 35.80494099 and b) weathered MSA at N 2.225233018, E 35.80224001

Western Hills between Nakukulas Village to Station 1

This area is a rocky hills section covered in sparse acacia vegetation in the hills and sparse to medium bushes and along the several large luggas that traverse this section. Access to this section of the pipeline corridor was difficult due to the hilly topography and long distance walks to and from the corridor limiting the length of sections that could be covered. There are no major deposits exposure in this section and the ground surface is covered in volcanic rock pebbles and boulders. Due to the hilly nature of this portion of the corridor, it was considered impractical to survey transect sets in this area as was done for the plains. Survey of this section was therefore done in three (3) 2km long and approximately 100m transects along the corridor. Apart from a large scatter of sparse archaeological materials in the Station 1 area, occurrence of archaeological artefacts was very rare in this section. The scatter of artefacts in the Station 1 area was characterized mostly by weathered Early Stone Age (ESA)-like cores and flakes in gravel bars near a large lugga at Station 1. Some of these tools are very weathered (Plate 3).

Figure 6: Archaeological materials recorded around Station 1

However, several cultural feature types were recorded including, burials (both modern and archaeological), *Airriket* and *Ngasenon*. *Airriket* is a Turkana community elders' ritual meat feasting cultural site. The site comprises a large (depending on number of elders) semi-circular stone arrangement (sitting area) and front-center stone pile(meat preparation and serving area). *Ngasenon* is a wayside sacred site where passersby/travelers make prayers/wishes for safe passage through the territory by throwing pebbles into a pile, creating a cairn-like feature next to a road (usually a regularly used footpath). This feature is distinguished from graves by its lack of arranged foundation stone and general lack of form//shape.

Figure 7: Recorded features (akiriket, modern burial and ngasenon respectively

Western plains of the Kerio River (between Lotubae and Station 1

This section consists of a large plain with a large number of dead (dry) trees in a windswept area of recent and modern flooding. The area also has sparse scatter of modern acacia bush vegetation on sandy silt sediments.

Isolated occurrences of archaeology were observed, consisting of ostrich egg shell beads, potshards and stone tools. An abandoned settlement with dense scuttles of potshards and a burial was recorded in an area further northeast of the pipeline corridor, indicating previous settlements on this area that is currently bare and unsettled.

Eastern plains of the Kerio River

This section of the pipeline corridor consists of a forested river bank and adjoining floodplains as well as open plains between hill areas further south away from the riverbank.

The forested riverbank area has settlements and recently tilled land that currently lies fallow, while flood plains consists of sparse vegetation covered area of sandy silt sediments with mostly bare ground. Even though no cultural site was observed, this area has potential for such sites, including burials sacred and medicinal trees

and plants. One sacred site intimated by Chief Lucas of Lotubae indicates this potential but could not be traced in his absence.

The flood plain and the plains further south have isolated scatters of archaeology, including ostrich egg shell beads, stone tools and potshards. An archaeological site with stone tools in quartz and chert stone raw material and decorated pottery was recorded. Areas further east towards Station 2 was not surveyed due to security concerns and time constraints. These areas consist of hilly landscapes with patches of possible archaeology-bearing deposits closer to the Suguta valley. This area could therefore be assessed during construction phase.

Figure 8: Landscape characteristics surveyed on the east of River Kerio

4.0 CONCLUSIONS AND RECOMMENDATIONS

The section of the proposed pipeline corridor between the CPF and Station 2 is rich in background scatters or archaeology meaning that it has potential for encounter of archaeological sites. This is especially true for the area in the bushy plains west of Nakukulas village, where substantial archaeological sites have been recorded. Two sites recorded along this section of the corridor are significant as they represent archaeological sequences hitherto un-recorded in the archaeology of the Turkana region, that would need careful assessment and preservation during future work in the area. One of these sites, the MSA period site near the Lokichar Export Facility is *in situ* and in under threat of erosion into the nearby channel should there be any disturbance to the deposits in this area. The ESA occurrences at Station 1 are new finds.

Signature Page

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Date: 5 April 2019

CO/TF/GMI

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APPENDIX A

List of Sites Recorded During Survey

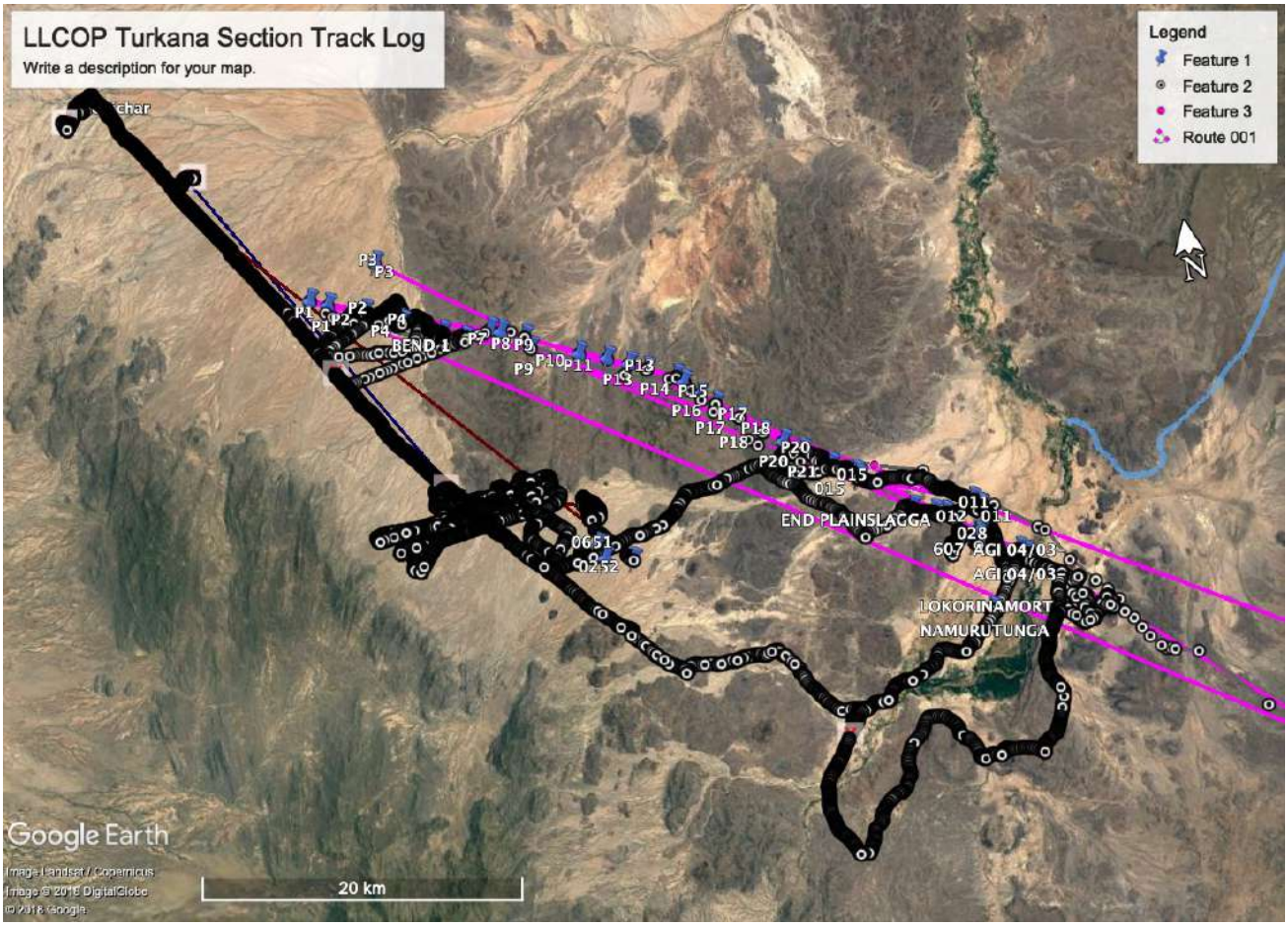
Table 1: List of Sites Recorded During Survey

ID	LAT	LON	ELEV	Description
1	2.20604701	35.85026999	710.012573	ABANDONED MANYATTA
2	2.194694979	35.89150703	658.926147	AKIRKET
3	2.241291991	35.76974999	701.118042	ARTEFACTS
4	2.227888992	35.78464002	703.537964	BONES HALF BURIED
5	2.205292974	35.84863502	708.880371	BURIAL
6	2.238524035	35.76200101	713.76593	END
7	2.058757022	36.10003	569.395935	END PLAINS LAGGA
8	2.065303959	36.08215299	574.667908	END SURVEY
9	2.228760961	35.80659097	686.018616	END TRANS1
10	2.191574983	35.89746899	656.833496	END LAGA
11	2.166769998	35.95411498	676.172791	FEATURE1
12	2.023943039	36.14294702	568.989868	FIRST STOP
13	2.060787035	36.09393703	575.266785	FOOTHILLS
14	2.039144961	36.11870103	565.003113	LARGE OES BEAD
15	1.999949003	36.11715004	578.782776	LOKORI NAMORTUNGA
16	2.194559025	35.88791798	659.709717	MODERN GRAVE
17	2.227743985	35.80494099	687.14856	MSA SITE
18	2.187509006	35.90649102	657.04126	OBS
19	2.23592598	35.76377101	709.123169	OBSI
20	2.025963999	36.14516697	563.806824	OES BEAD
21	2.039670004	36.12279098	564.255249	OES BEAD1
22	2.226547971	35.79956098	687.366638	OESBEAD
23	2.040543985	36.11590097	569.027771	POTSHERDS
24	2.040410964	36.11583701	562.553589	POTTERY11
25	2.226589965	35.79984999	693.091797	POTTERY2

ID	LAT	LON	ELEV	Description
26	2.222839985	35.80389401	689.007751	POTTERY3
27	2.203876013	35.87204701	685.524902	RED SOIL
28	2.239530031	35.76757698	701.652283	SITE1
29	2.220443012	35.80836399	686.798645	START29TH
30	2.225233018	35.80224001	690.176575	WEATHERED MSA

APPENDIX B

Turkana Section Survey Tracks


LLCOP Turkana Section Track Log
Write a description for your map.
Legend
Feature 1
Feature 2
Feature 3
Route 001
N
BEND 1
END PLAINSLAGGA
AGI 04/03
LOKORINAMORT
NAMURUTUNGA
Google Earth
20 km

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ANNEX II

Oil Spill Modelling Report

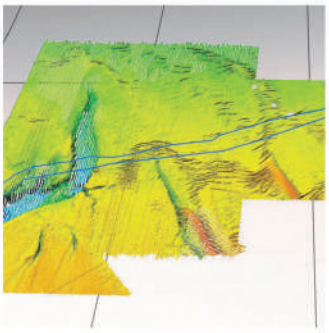
G

Golder Associates Ltd.

Oil Spill Modelling

Lamu Port

May 2019



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Oil Spill Modelling

Lamu Port

May 2019

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1 Introduction

1.1 Background

Golder Associates Ltd., requires oil spill modelling for use in an Environmental and Social Impact Assessment (ESIA) of the Lokichar to Lamu Crude Oil Pipeline export facility at Lamu Port, North-Eastern Kenya (Figure 1). The requirements of the study are to provide a preliminary assessment of the implications of various of spills from VLCC/SuezMax/AfraMax tankers (operating as an FSO moored alongside the quayside).

There are many environmental sensitivities near Lamu Port including; marine and coastal protected areas, key biodiversity sites, coral reefs, mangroves, mammal migration routes and turtle nesting areas. Assessment of the environmental sensitivities is found in the Marine Baseline report (Golder, 2018) and an example of such sensitivities is shown in Figure 2.

1.2 Oil spills in the marine environment

When oil is spilled in the marine environment it undergoes several physical and chemical changes, some of which lead to its removal from the sea surface, while others cause it to persist (ITOPF. Fate of Marine Oil Spills, 2002). Weathering processes such as spreading, evaporation, emulsification, vertical dispersion, dissolution, biodegradation and photo-oxidation take place once oil is spilled into the marine environment (Figure 3). The movement of oil on the surface and in the water column is heavily dependent on metocean processes such as currents and winds. Metocean conditions that affect Lamu Port and its surrounding areas are summarised in the next section.

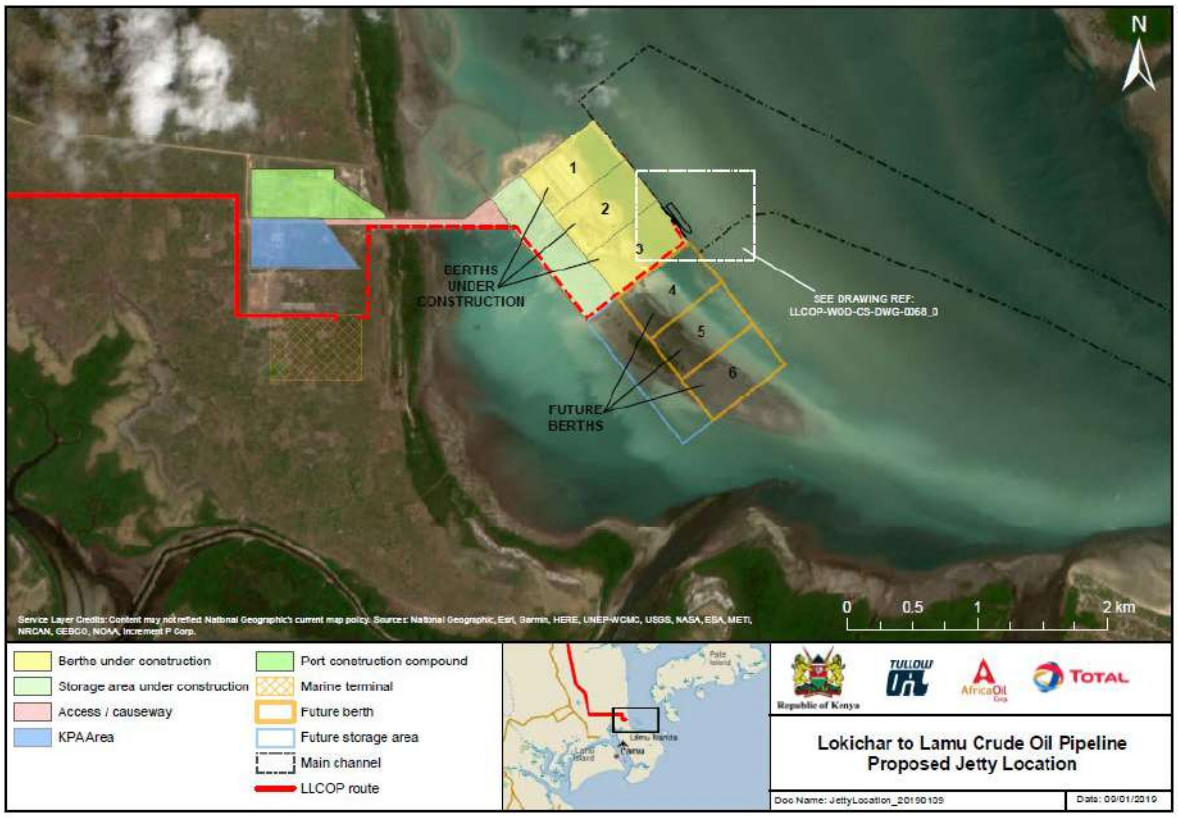
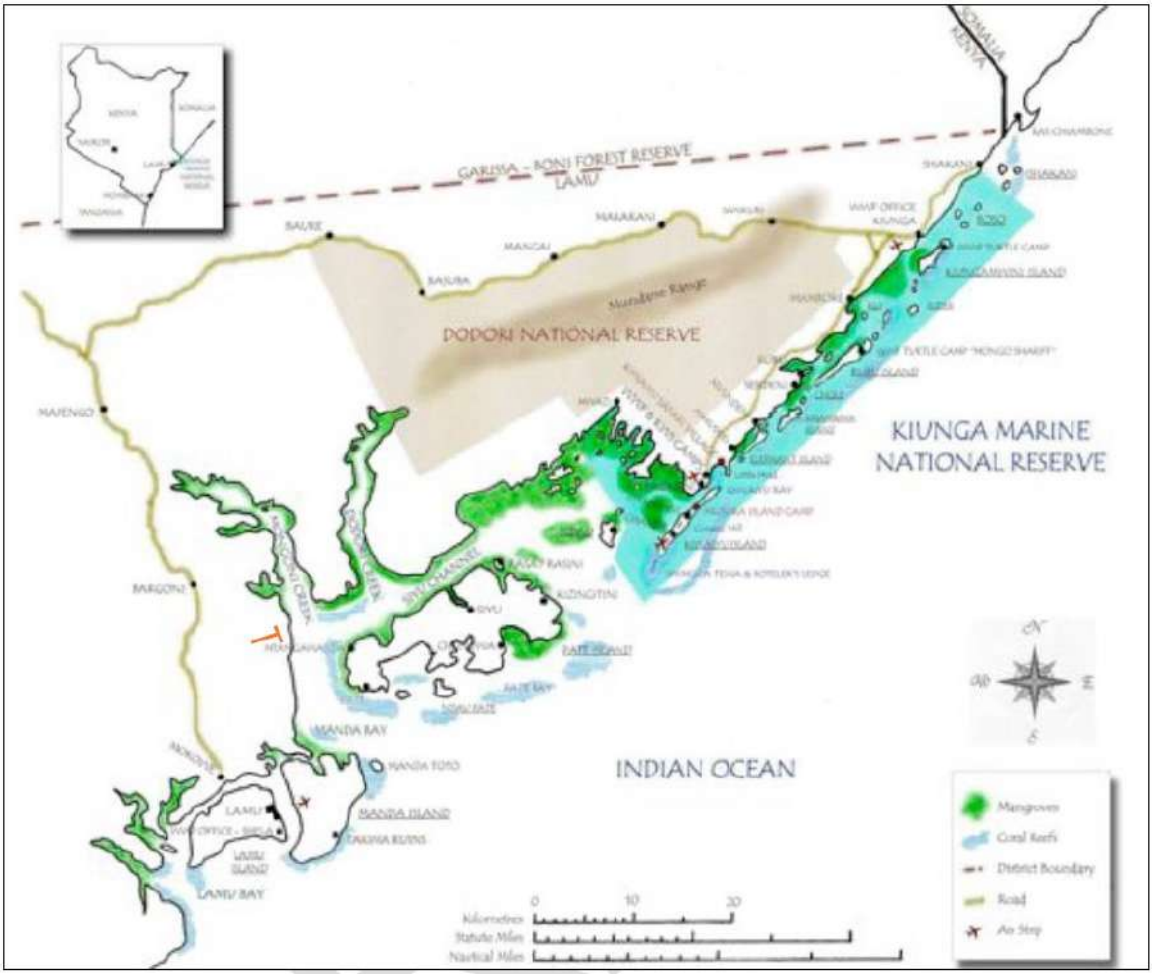


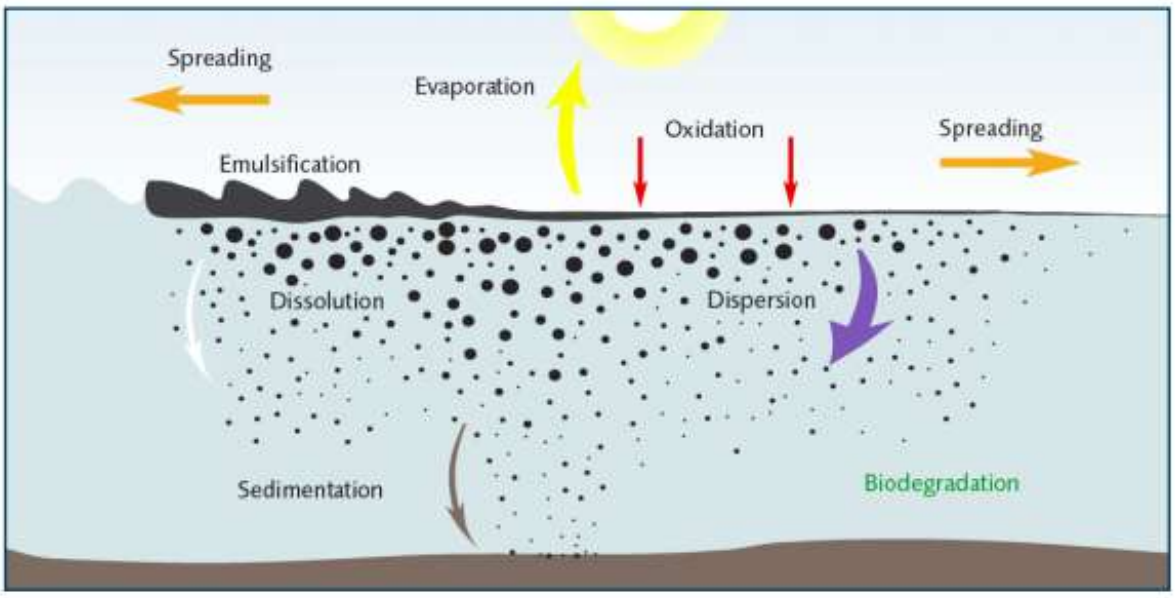
Figure 1. Location of jetty, Lamu Port



Source: Golder, 2018

The red line represents the berth location

Figure 2. Coral reefs and mangroves distribution in the Lamu-Kiunga region as separated by Samoilys and Kanyange (2008)



Source: ITOPF. Fate of Marine Oil Spills, 2002

Figure 3. Weathering processes

2 Metocean Conditions

The proposed export jetty is located within a relatively sheltered tidal inlet, approximately 8 km upstream of the open coastline. The tidal inlet extends approximately 40 km inland, and approximately 70 km along the coast, with extensive shallow channels behind the islands of Lamu and Pate (see Figure 4).

The channel that runs past the proposed jetty location extends southward, out to the open coast of the Indian Ocean. A regional location chart is shown in Figure 5.

The immediate fate of any oil discharged at the jetty location would be strongly influenced by the local tidal current flow within the inlet system together with surface winds. On the northerly flood flow, the discharge would advect northwards into the extensive tidal inlet system. On the southerly ebb flow, the discharge would advect southwards towards the open coastline. Thus, the near-field contaminant fate would be determined primarily by local tidal conditions.

However, upon entry into the open waters of the Indian Ocean during southerly ebb flow, the advection and dispersion would be strongly influenced by coastal and regional current circulation and by wave action. Thus, for the study it is important to consider both localised and regional scale oceanic, tidal and meteorological processes.

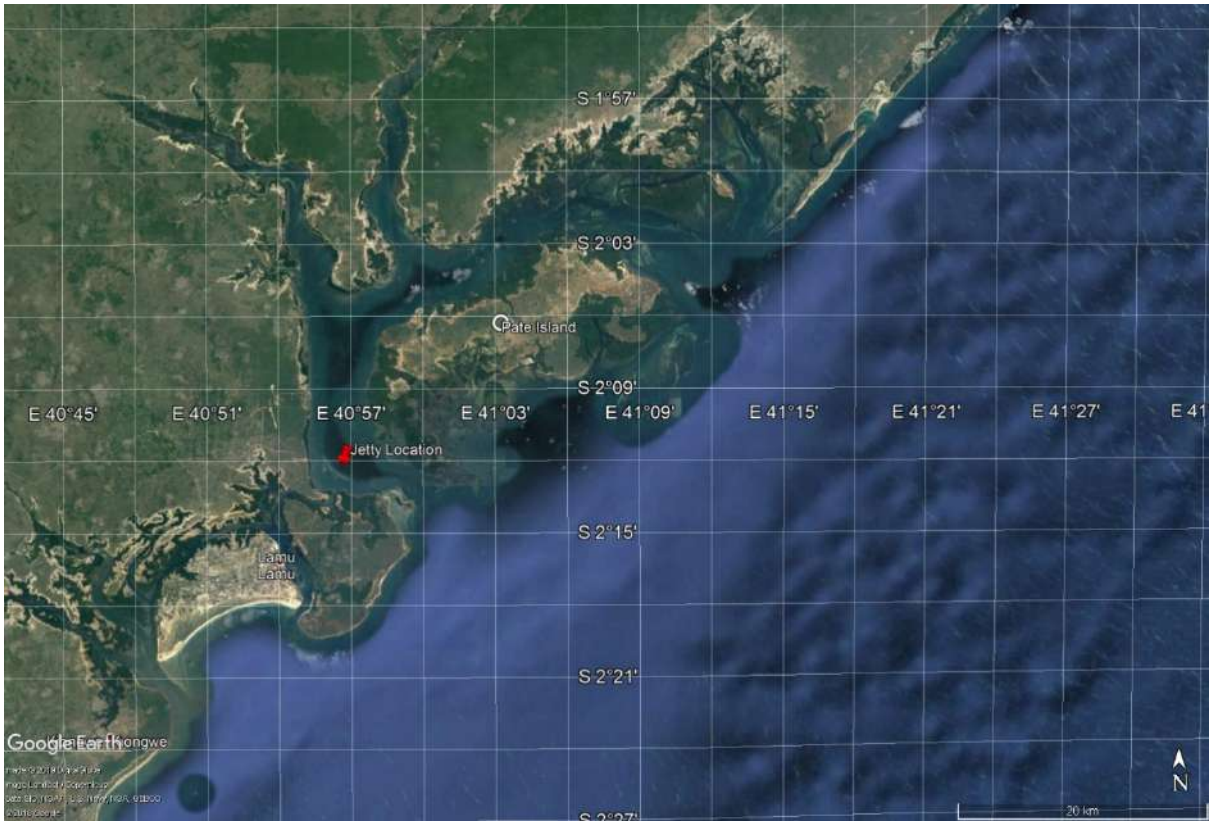


Figure 4. Location chart

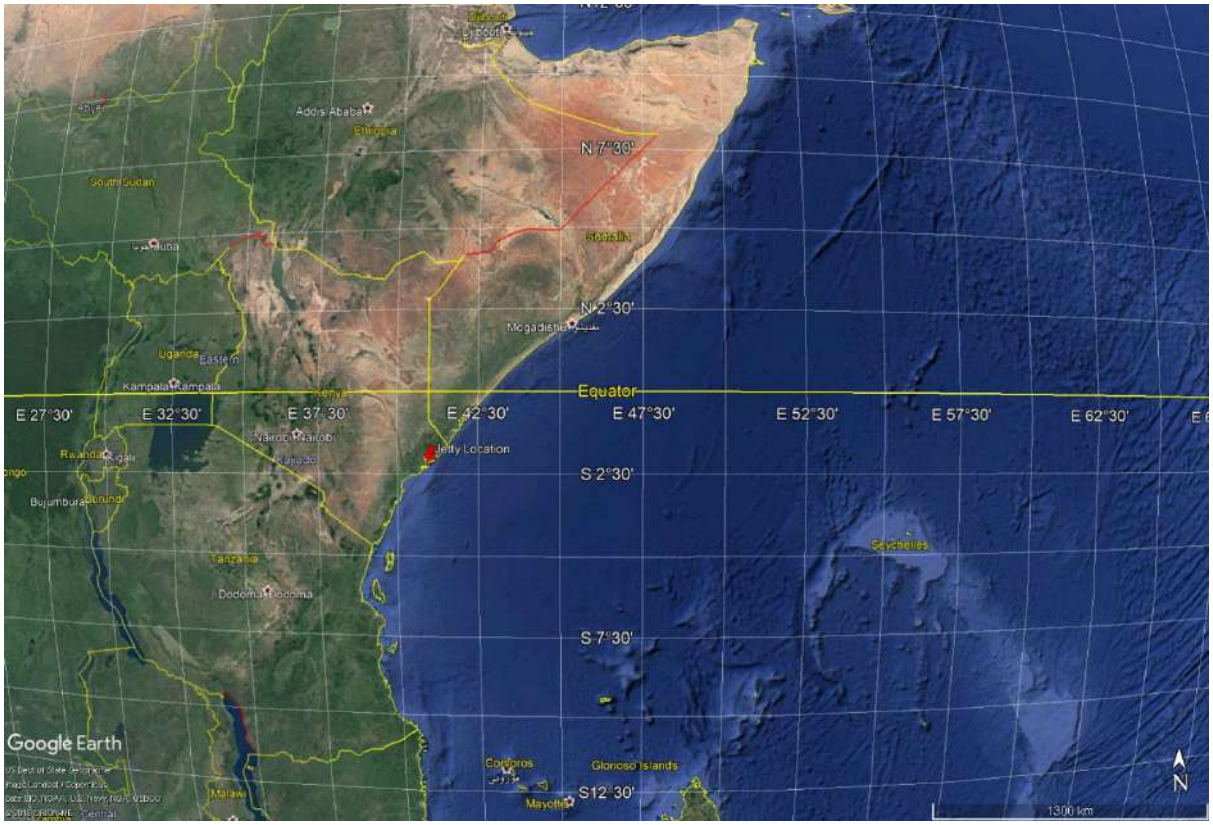


Figure 5. Regional chart

2.1 Tidal flows

The spring tidal range at Lamu is approximately 3.5 m, which will result in relatively strong tidal currents in the confined inlets. Example current flow fields from the local tidal hydrodynamic model are shown in Figure 6 and Figure 7.

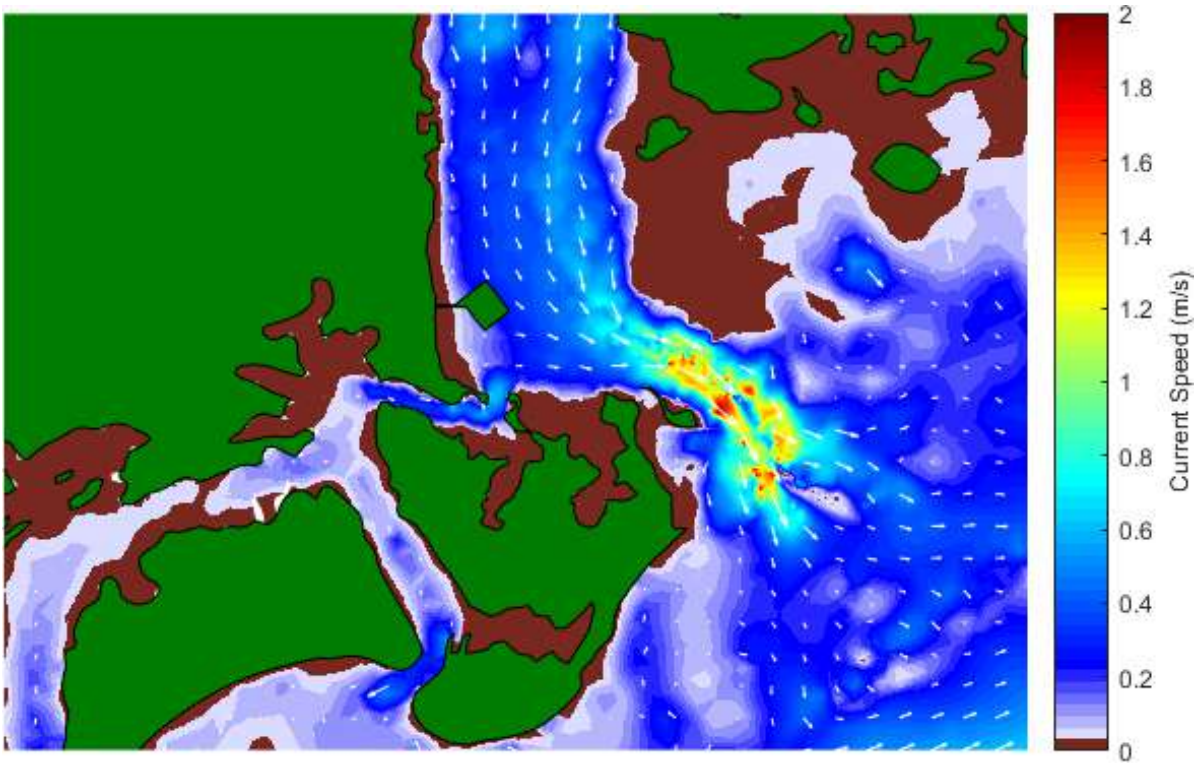


Figure 6. Local tidal model example current field - Ebb flow

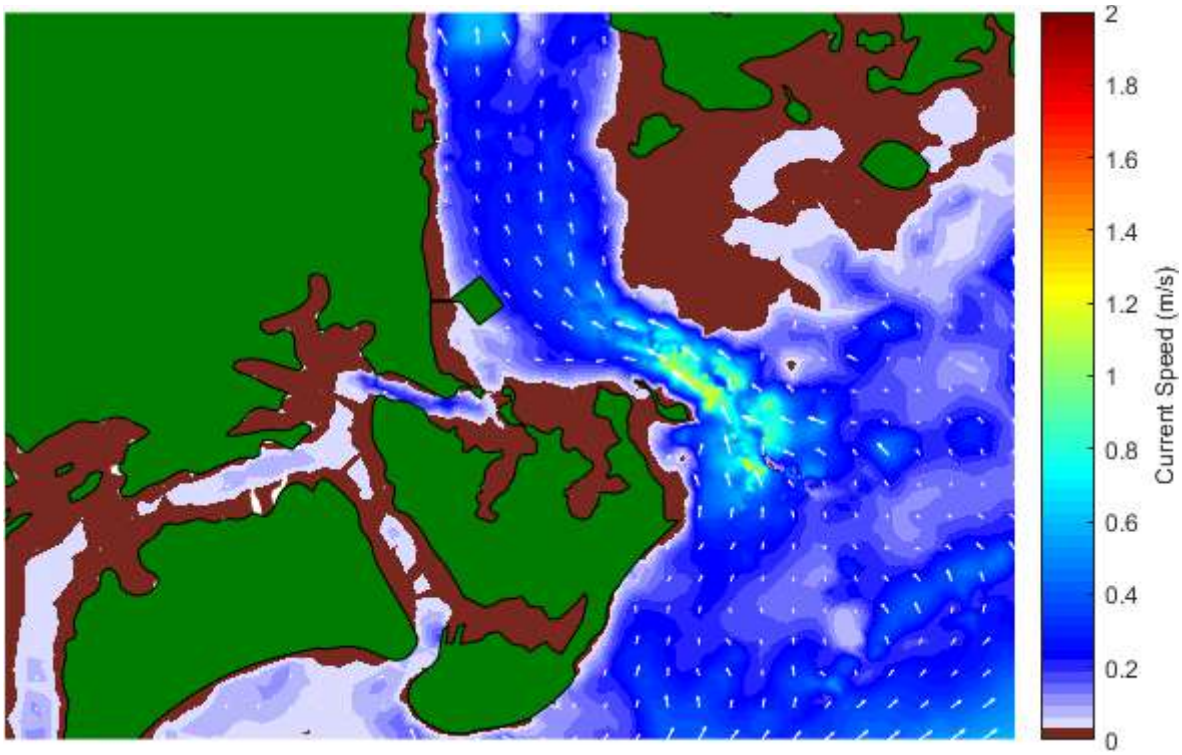


Figure 7. Local tidal model example current field - Flood flow

2.2 Oceanic flows

Meteorological and oceanographic conditions along the Kenyan coastline are strongly influenced by regional scale processes. The principal oceanic current systems in the Western Indian Ocean are shown schematically in Figure 8.

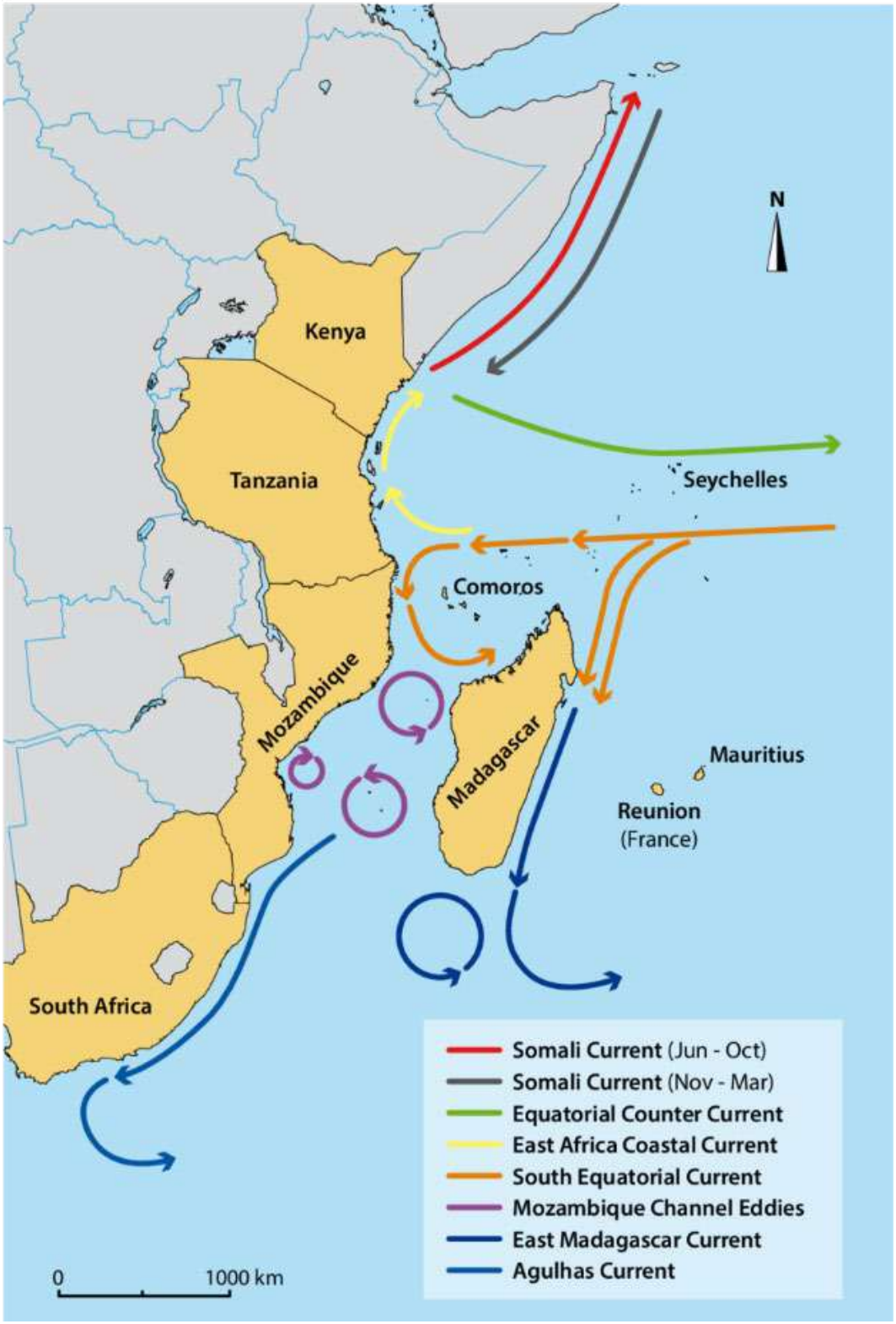
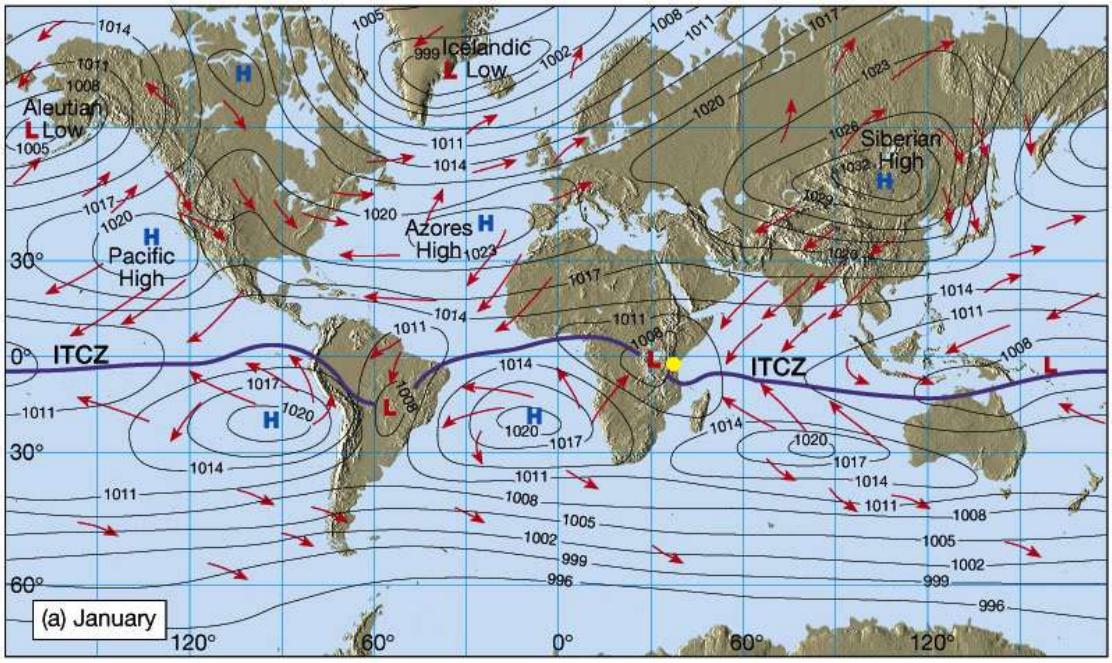


Figure 8. Major East Africa Ocean current systems

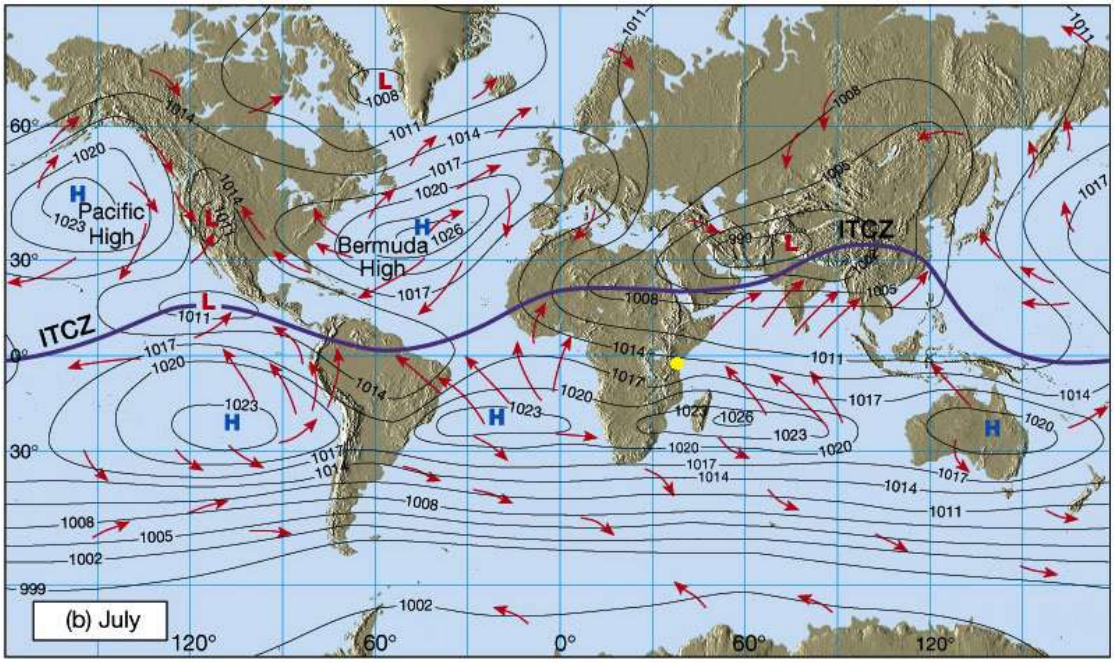
2.3 Monsoon seasons

Lamu is too close to the Equator to be influenced by tropical revolving storms. However, the seasonal monsoon is significant. Figure 9 and Figure 10 show mean sea level pressure and mean surface wind direction for the months of January and July respectively. During the period November to March, the Inter-Tropical Convergence Zone (ITCZ) is to the south of Lamu, and winds are predominantly from the north east. During the period May to September, the ITCZ is far to the north of Lamu, and winds are predominantly from the south west. Transition periods occur between the main monsoon seasons.



Lamu shown as yellow dot

Figure 9. Mean sea level pressure and mean wind direction – January



(Lamu shown as yellow dot)

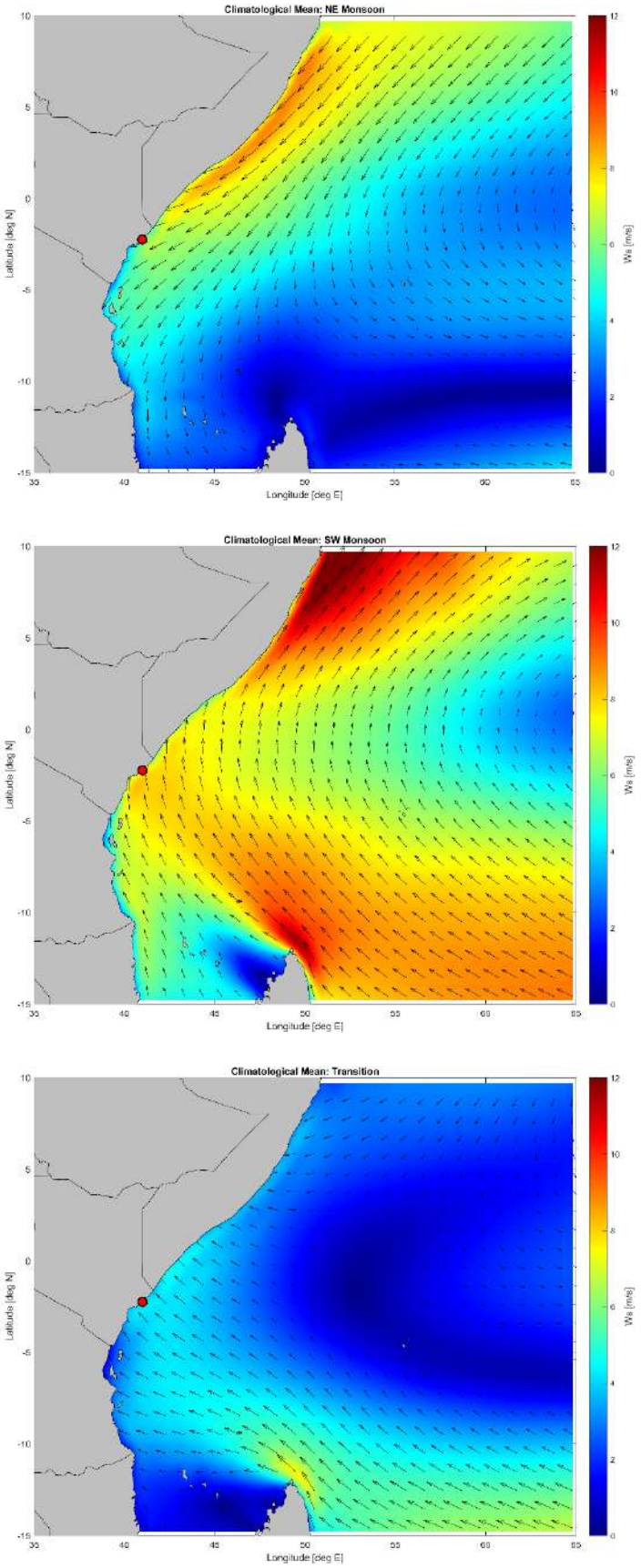
Figure 10. Mean sea level pressure and mean wind direction – July

Figure 11 and Figure 12 show seasonal and monthly wind velocity fields based on analysis of 10 years of NOAA CFSR hindcast data (https://rda.ucar.edu/pub/cfsr.html). These show the pattern of variation and regional monsoonal characteristics.

The monsoonal winds have an important effect on large-scale ocean currents and wave conditions. Ten years of residual currents and ten years of wave conditions have been extracted from HYCOM (https://www.hycom.org/) and WAVEWATCH III (https://polar.ncep.noaa.gov/waves/) respectively. Seasonal and monthly residual current and wave conditions are shown in Figure 13 to Figure 16. Both swell waves from across the Indian Ocean and those formed by local winds affect Lamu Port. Wave energy is highest during the SW Monsoon. The severity and timing of onset and cessation of the seasonal monsoons will vary from year to year as shown in Figure 17. A summary of the seasons affecting Lamu is shown in Table 1.

Table 1. Summary of monsoon seasons

Condition	Timing	General Coastal Metocean Characteristics
Northeast Monsoon	December - February	Persistent north easterly winds. Weak south westerly coastal current. Moderate wave conditions.
Transitional Period	March - April	Benign winds. Weak coastal circulation. Benign wave conditions.
Southwest Monsoon	May to September	Moderate to strong southerly winds. Strong north easterly coastal current. Energetic sea state from the south east.
Transitional Period	October - November	Benign winds. Weak coastal circulation. Benign wave conditions.



Lamu shown as red dot

Figure 11. Seasonal mean wind velocity at 10 m above sea level (based on 10-year analysis): NE Monsoon (upper), SW Monsoon (middle) and Transition (lower)

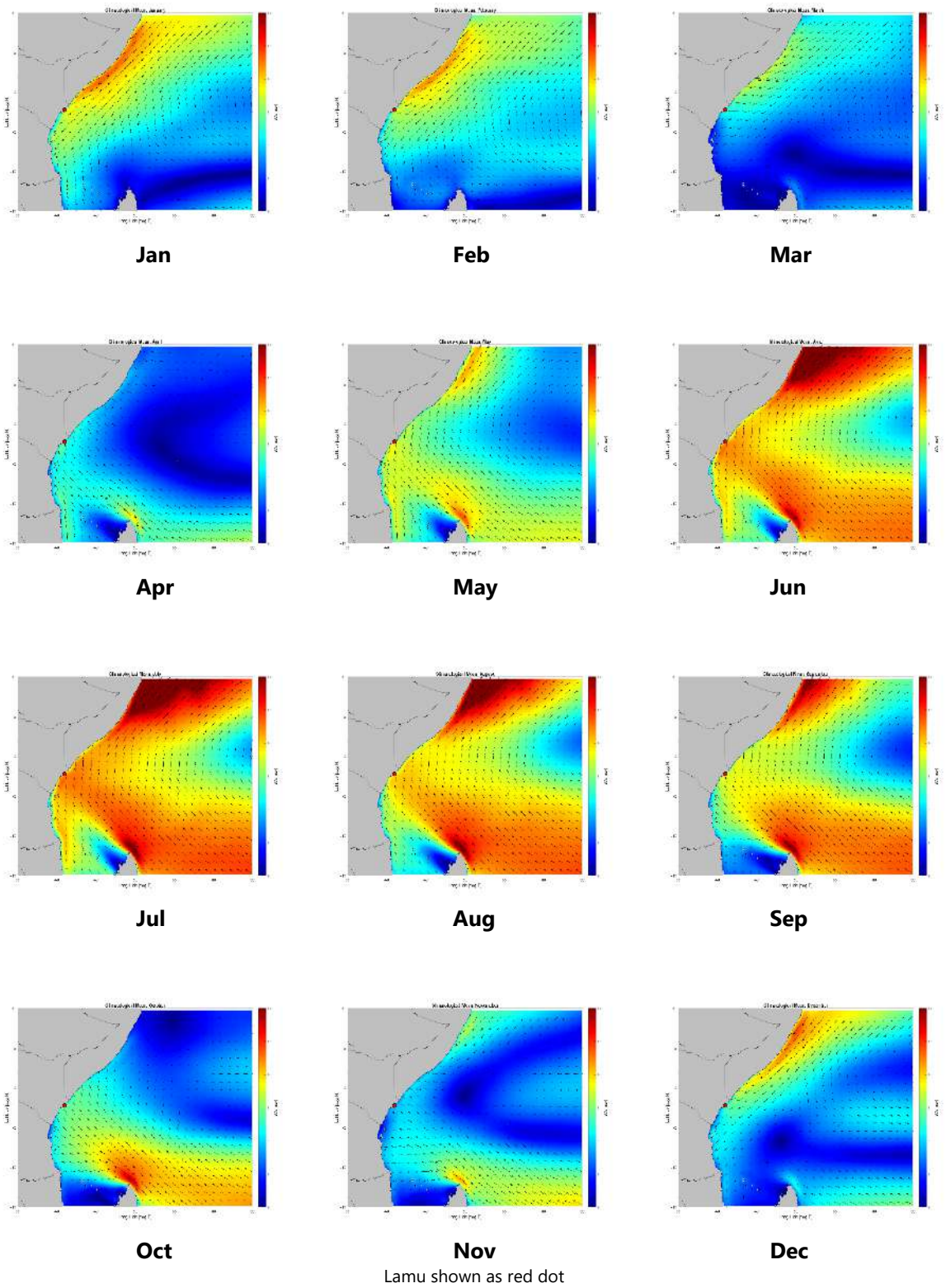
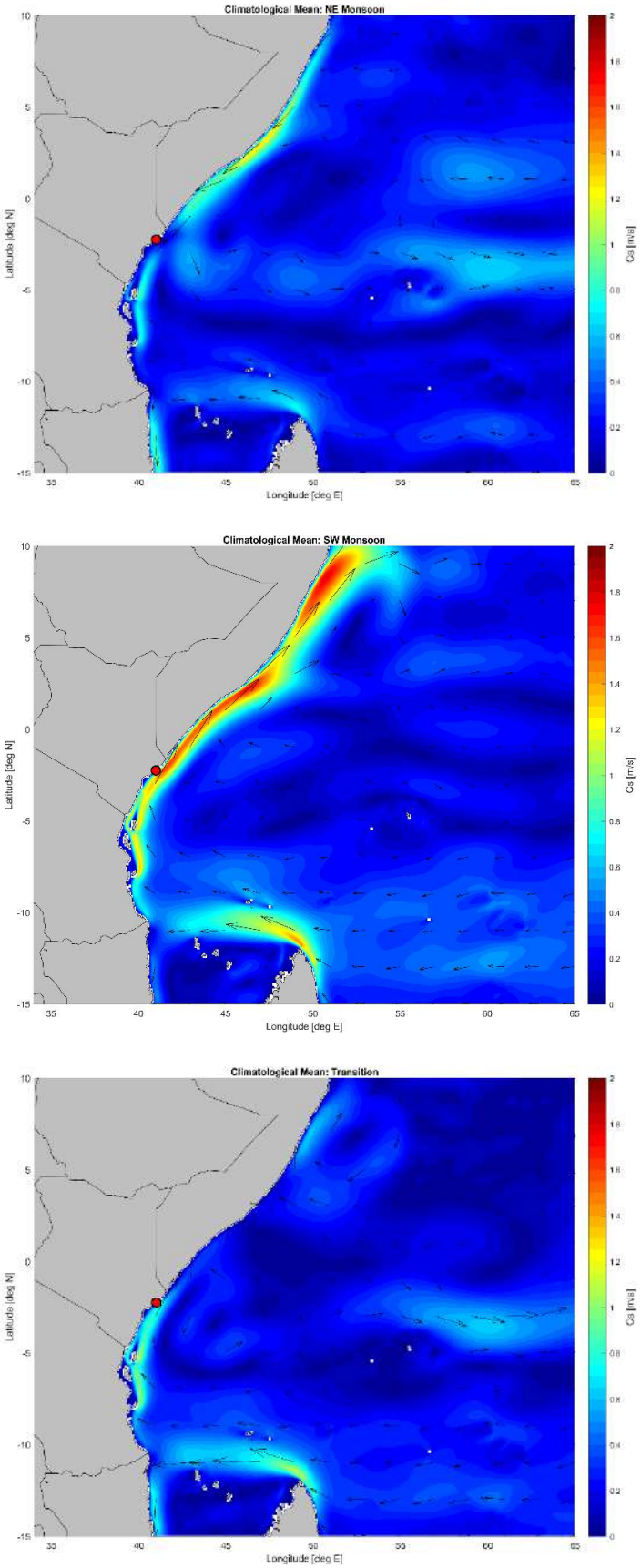


Figure 12. Monthly mean wind velocity at 10 m above sea level (based on 10-year analysis)



Lamu shown as red dot

Figure 13. Seasonal mean residual surface current velocity (based on 10-year analysis): NE Monsoon (upper), SW Monsoon (middle) and Transition (lower)

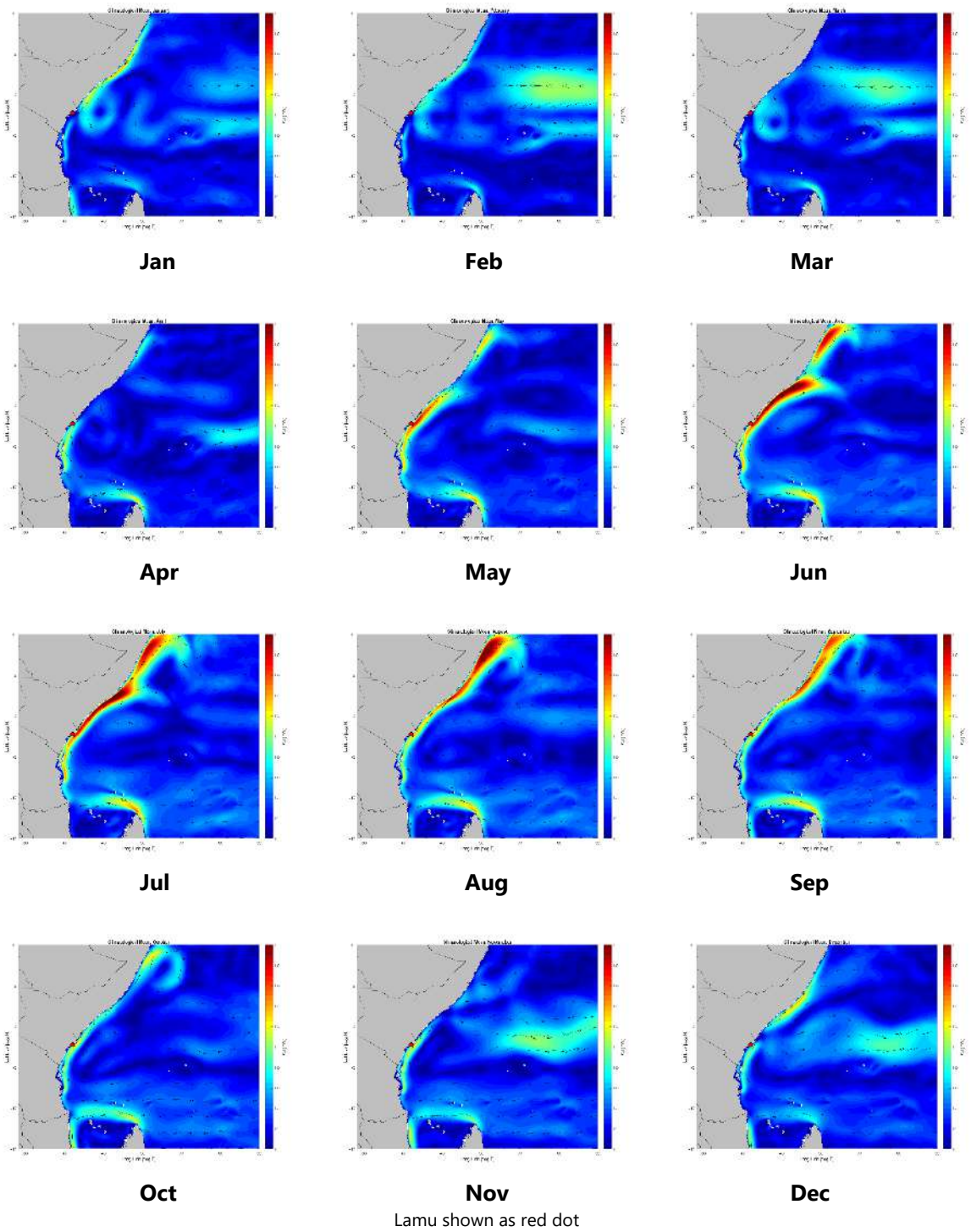
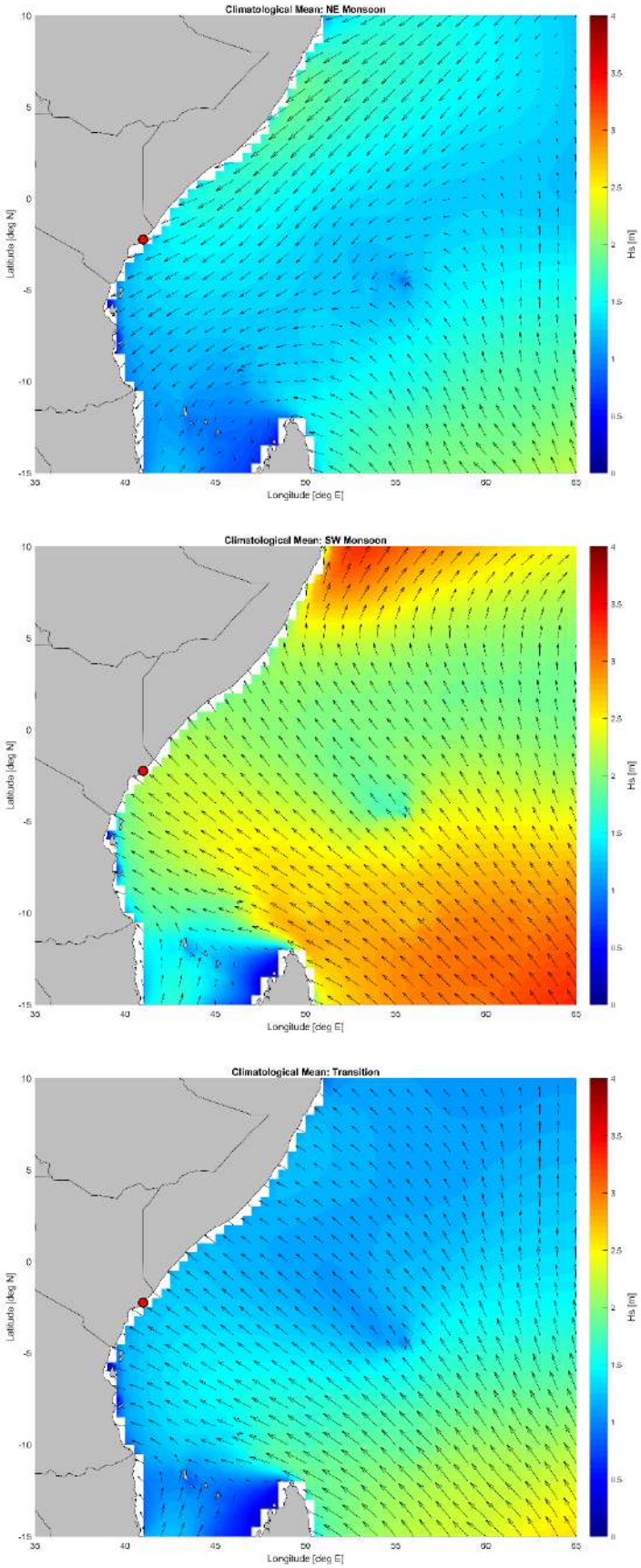


Figure 14. Monthly mean residual surface current velocity (based on 10-year analysis)



Lamu shown as red dot

Figure 15. Seasonal mean significant wave height and direction (based on 10-year analysis): NE Monsoon (upper), SW Monsoon (middle) and Transition (lower)

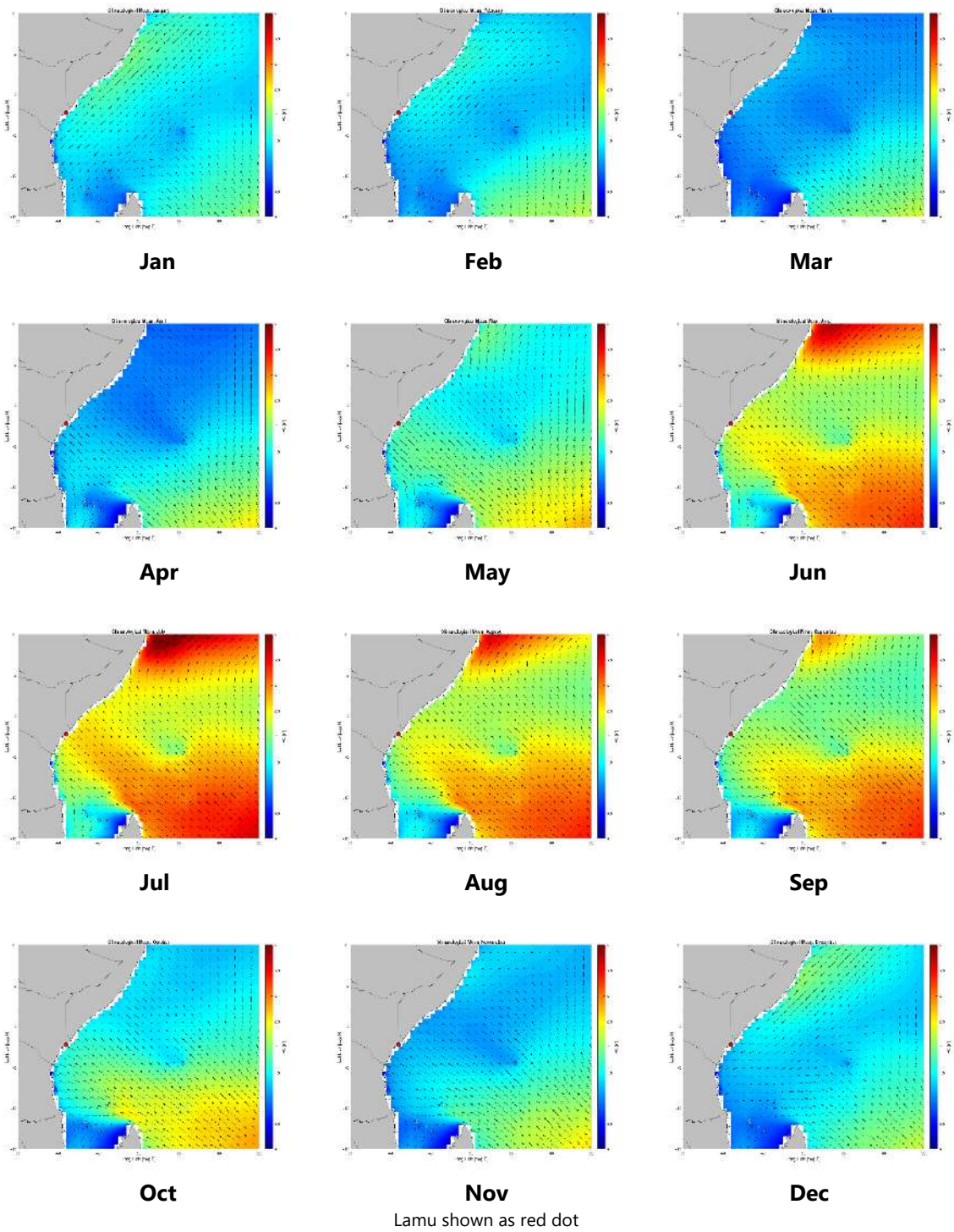


Figure 16. Monthly mean significant wave height and direction (based on 10-year analysis)

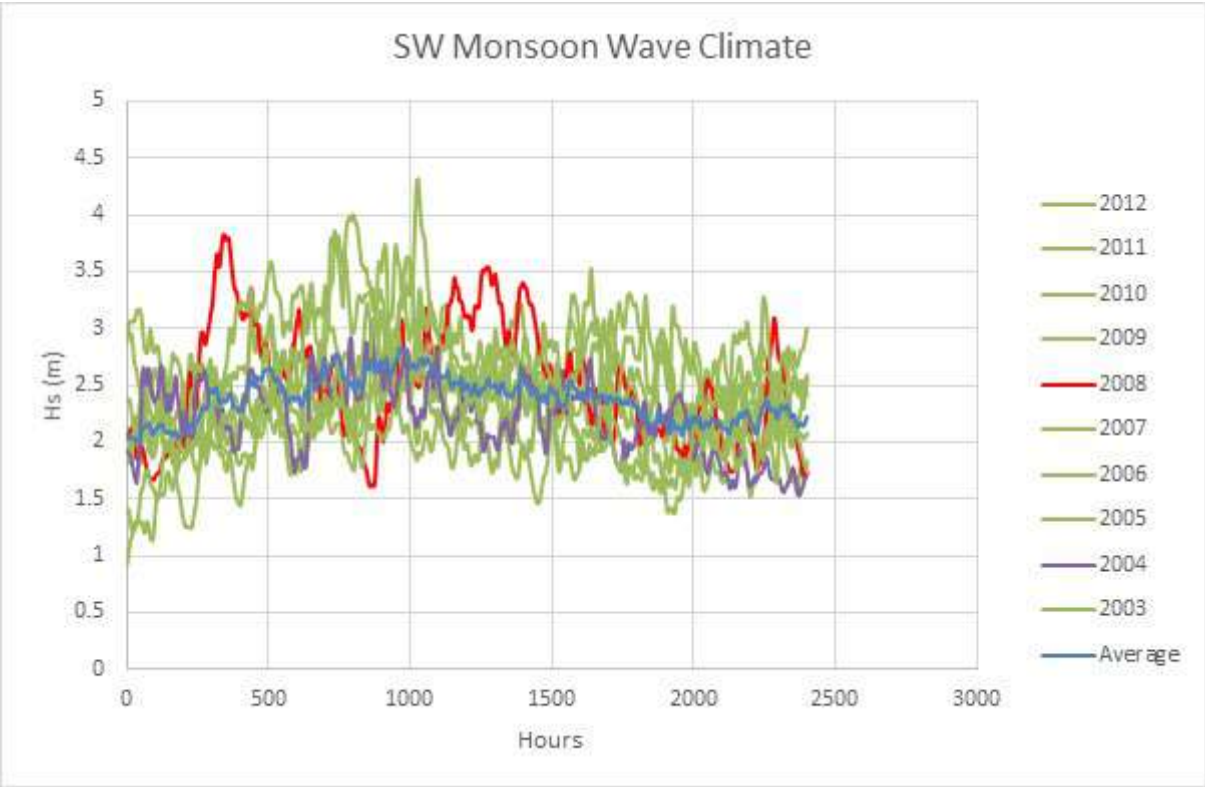


Figure 17. Significant wave height during SW Monsoon 2003 to 2012 showing inter-annual variation in conditions

2.4 Outcomes of metocean analysis

Based on the information reported above, oil spill modelling was undertaken for three separate seasons (SW Monsoon, NE Monsoon and one of the transitional periods). The averaged conditions from the 10 year datasets were used to represent each of these seasons.

3 Hydrodynamic and Wave Model

3.1 Setup

A hydrodynamic model has been created to capture oceanic and tidal flows to determine the transport of spilled oil. Waves break up and disperse spilled oil and therefore a wave model has been created to transform offshore waves across the model domain. The hydrodynamic and wave model have been developed on the same grid and coupled together meaning wave and currents feedback and affect to each other. Using a coupled model helps increase accuracy and reliability of the metocean conditions.

3.1.1 Mesh

The coupled hydrodynamic-wave model, has been created using a flexible mesh approach. This allows the size of the grid cells to be varied across the model domain, thereby maximising computational efficiency. The mesh resolution ranges from ~10 km at the outer sections, which is sufficient to accurately capture the large-scale currents around the model boundaries, to ~100 m at the jetty development where more complex tidal flows are of importance as discussed in Section 2. The model mesh is shown in Figure 18.

Figure 18. Model mesh

3.1.2 Bathymetry

The following bathymetric data have been applied in the Lamu Port model:

- Bathymetric survey data of jetty location.
- Digitised bathymetric survey data covering main channel.
- Digitised UKHO Chart 3362-0.
- The General Bathymetric Chart of Oceans (GEBCO).

All datasets have been corrected to MSL.

The model bathymetry is shown in Figure 19 and Figure 20 at regional and local scales respectively. To check that key features, such as channels, were represented the model bathymetry was overlaid on UKHO Chart 3362-0 in Figure 21.

The bathymetry has been deepened in accordance with *LLCOP-WOD-CS-DWG-0068_0 Berth 3 Crude Oil Export Option 1_v1_current.pdf* to represent the complete berth development. To allow comparisons between the model performance and data collected in 2009/10 to be undertaken, an additional bathymetry file was created without the berth development. The bathymetry for both cases are shown in Figure 22.

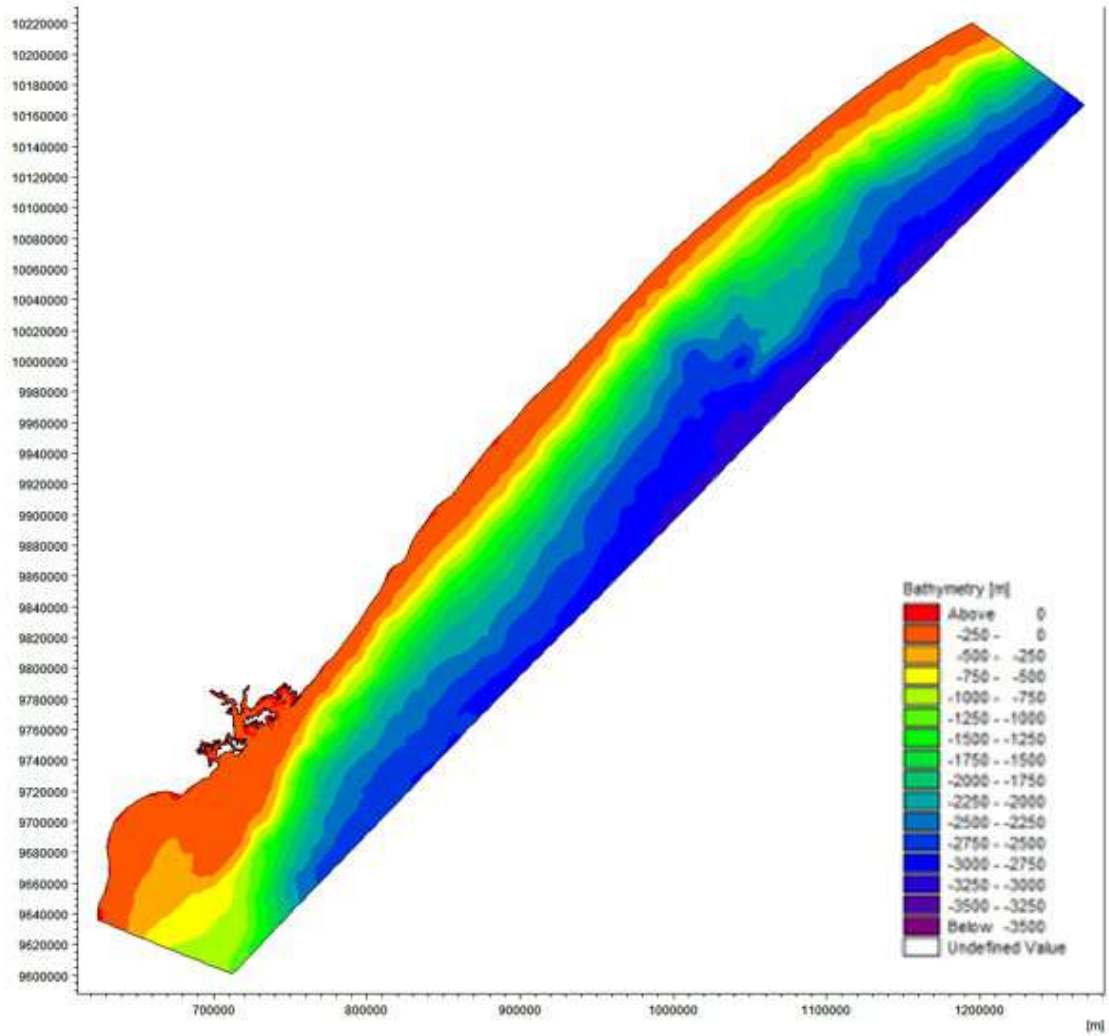


Figure 19. Regional bathymetry

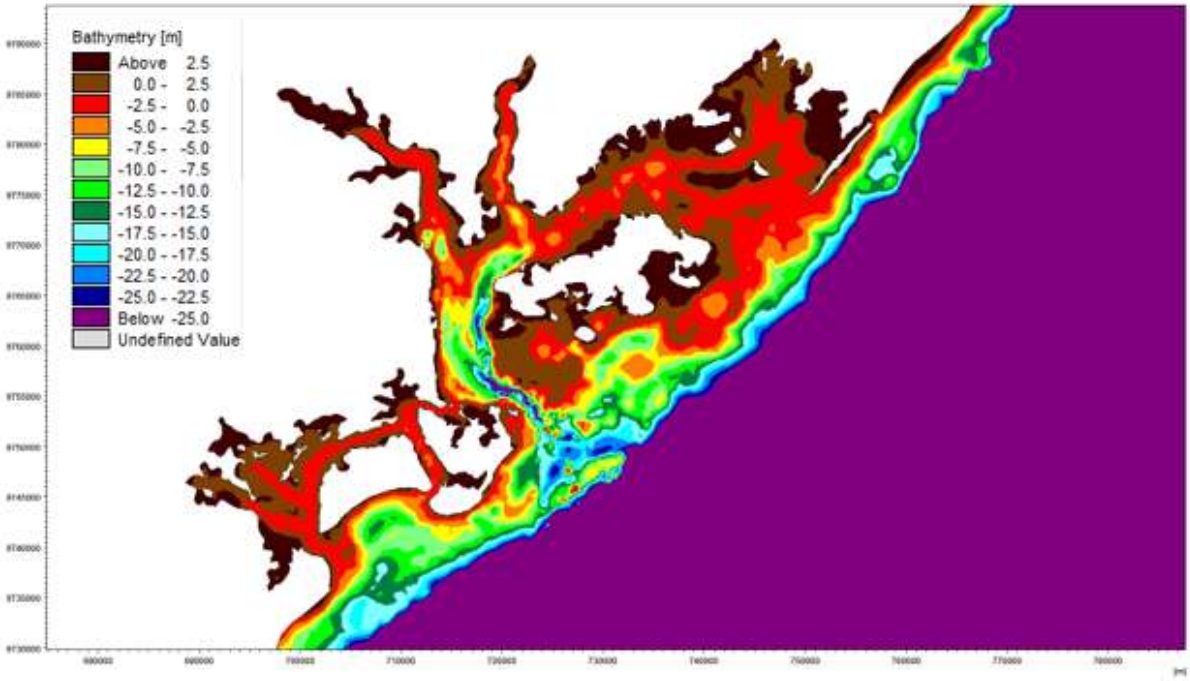


Figure 20. Localised bathymetry

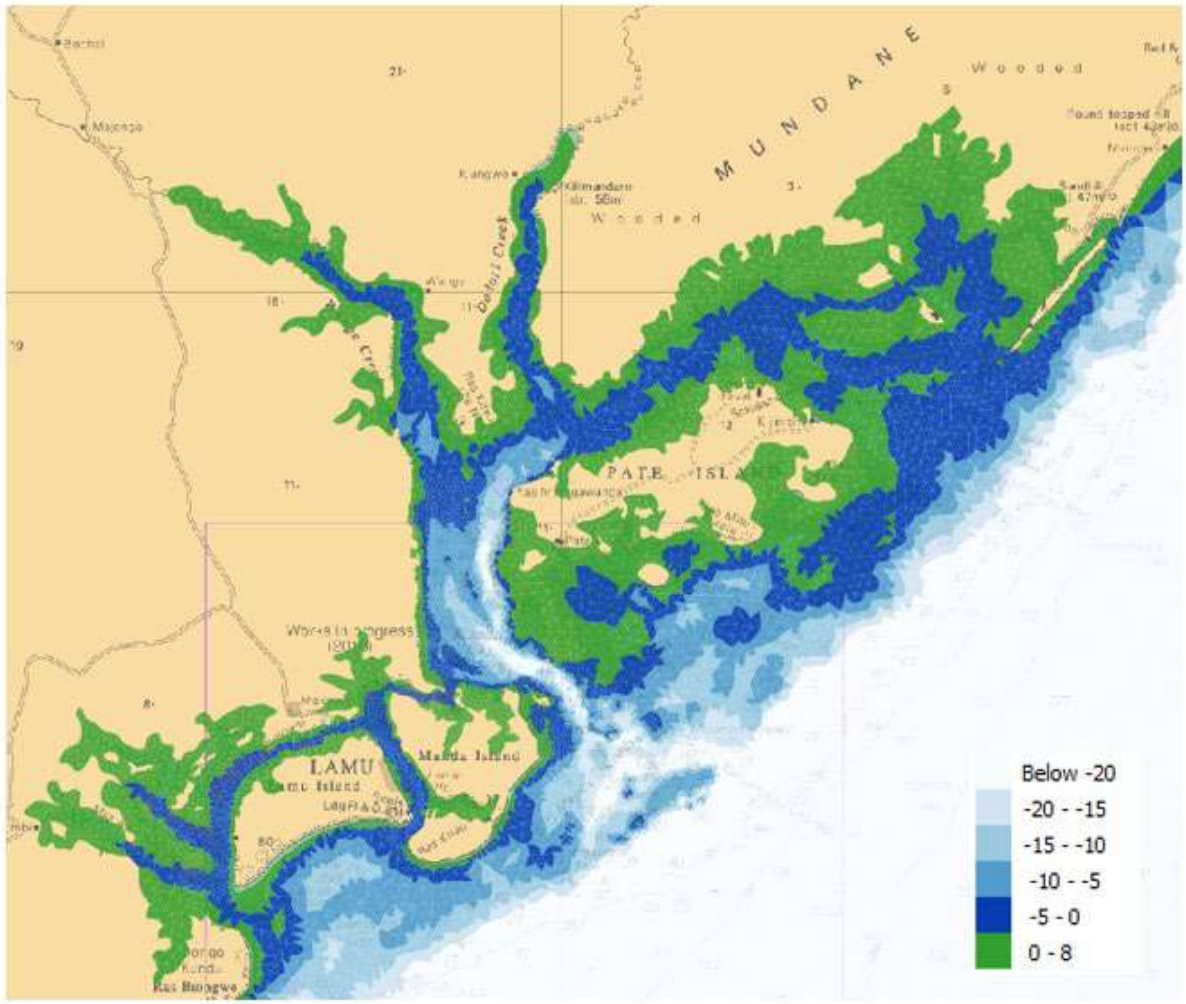


Figure 21. Bathymetry overlaid on UKHO Chart 3362-0 (Licence Number: EK001-FN800-02850)

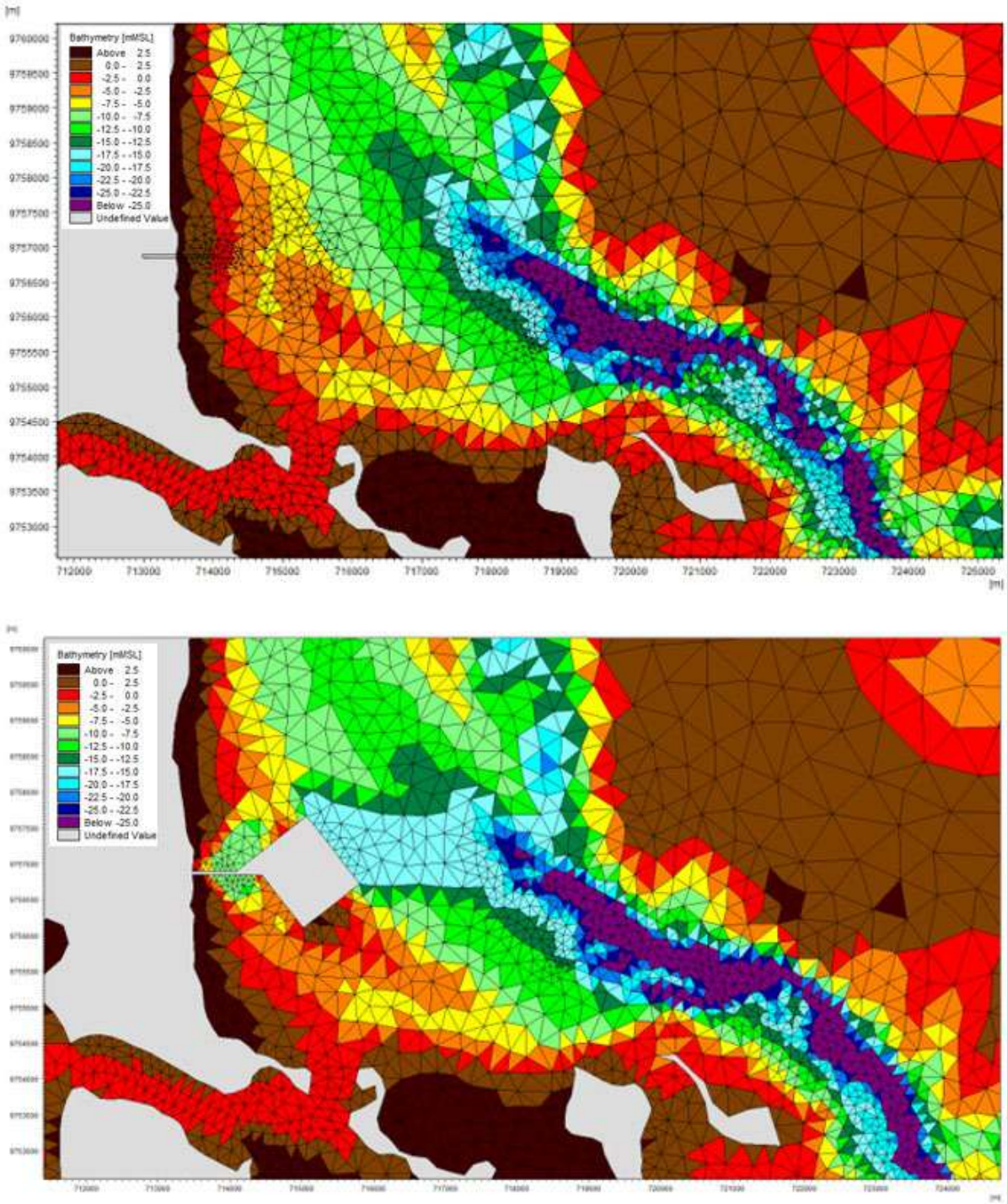


Figure 22. Bathymetry for baseline (upper) and scheme (lower)

3.1.3 Model boundaries and inputs

Climatological averages have been created by analysing ten years (2003–2012) of metocean data extracted from regional models (CFSR, HYCOM and WAVEWATCH III). The three seasons (SW Monsoon, NE Monsoon and transitional period) have been extracted from this single year synthetic dataset, that represents typical conditions, and used to drive the hydrodynamic-wave model. Details on these analyses are available in Section 2.

Currents

Tidal flows and fluctuations in water level along the offshore boundaries have been predicted using the well validated DTU10 Global Mean Sea Surface model (https://www.space.dtu.dk/english/research/scientific_data_and_models/global_mean_sea_surface). A single year of tidal flows has been added to the climatological averaged residual flow to create a complete dataset of current flows along the boundaries.

For the hydrodynamic model, velocities have been applied across the northern and southern boundaries and water levels have been applied across the eastern boundary (Figure 18). All boundaries vary both spatially and temporally.

Waves

The wave model has temporal and spatially varying boundaries, applied along the north, east and south boundaries, from the climatological averaged dataset allowing offshore waves to be transformed inshore.

Winds

A 2D wind-field is applied across the whole model domain for both the hydrodynamic and wave model.

3.2 Results/validation

To keep the study proportional, the model has been verified against measured data. A 13-day period (09 to 22 July 2010) during the SW Monsoon has been chosen for verification.

3.2.1 Water levels

As reported in Golder (2018), the tide at Lamu is semi-diurnal, with two unequal peaks during the day. The amplitudes of spring and neaps tides are 2.93 m and 0.99 m respectively.

This pattern is well replicated by the model as shown in Figure 23.

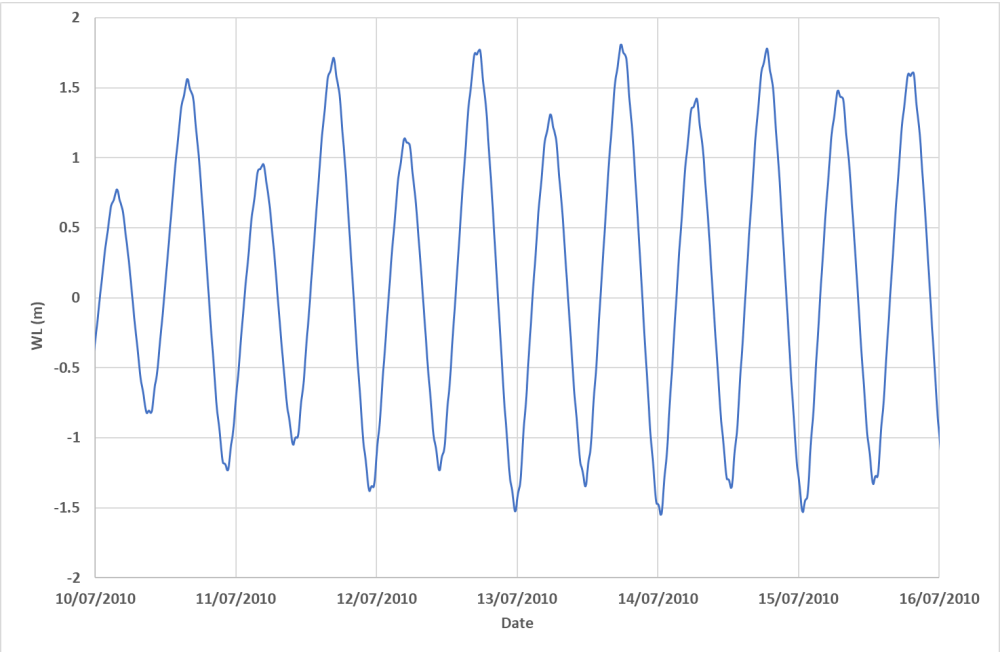
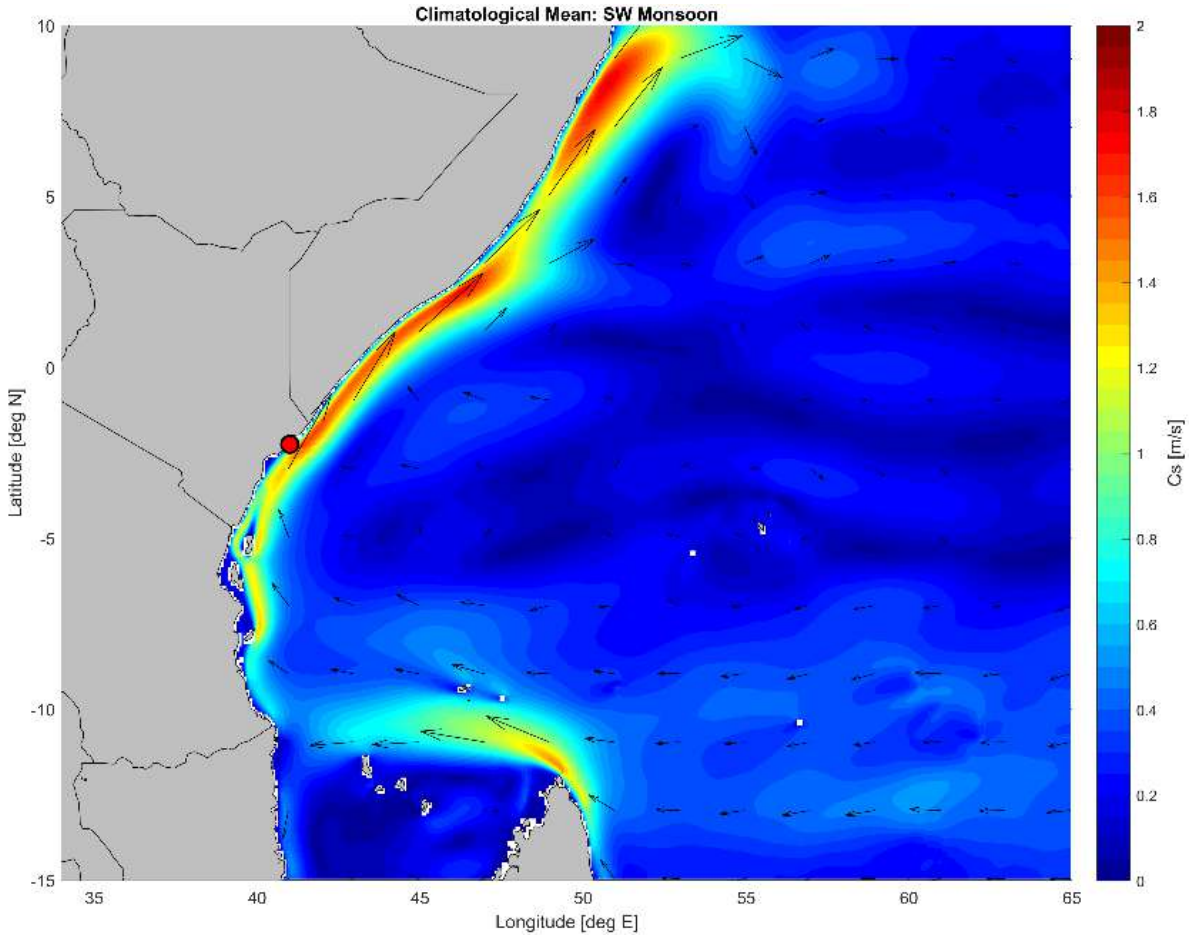


Figure 23. Modelled water level variation at Lamu Port

3.2.2 Flows

Regional flows

As discussed in Section 2, meteorological and oceanographic conditions along the Kenyan coastline are strongly influenced by regional scale processes. As the validation period lies within the SW monsoon, a strong northerly coastal current is expected as shown in Figure 24. This strong coastal current has been well replicated by the model as shown in Figure 25.



Source: HYCOM

Figure 24. SW Monsoon current speeds

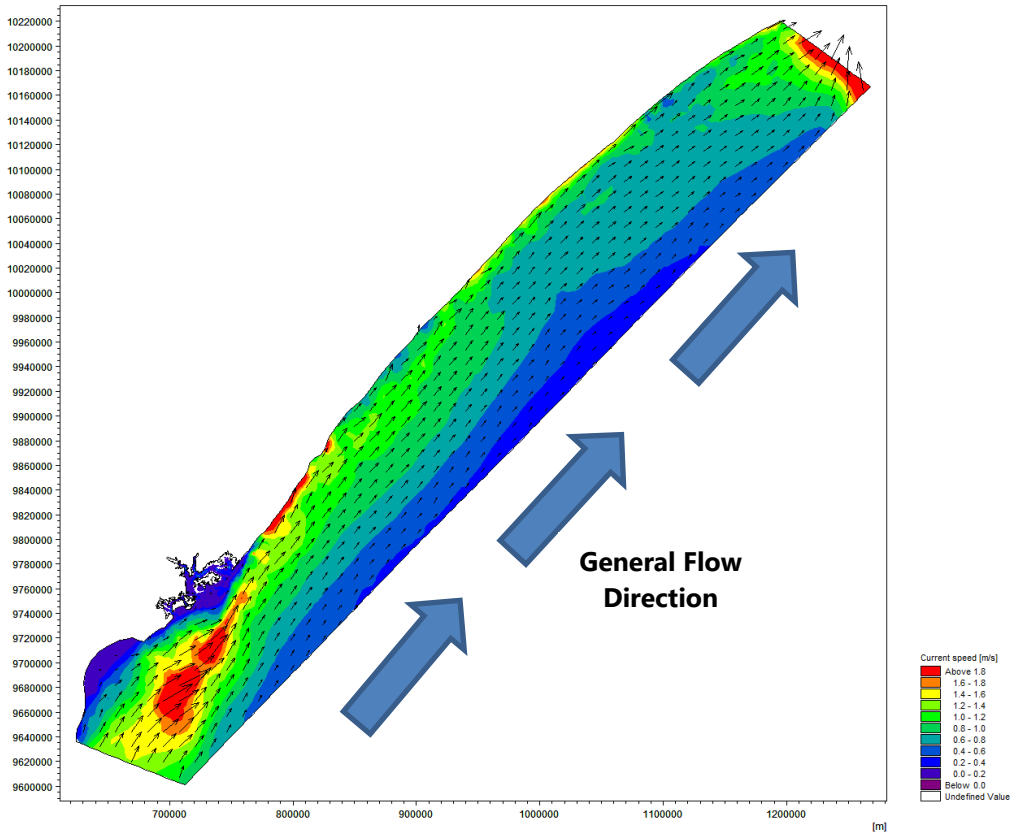


Figure 25. Modelled current speeds, SW Monsoon

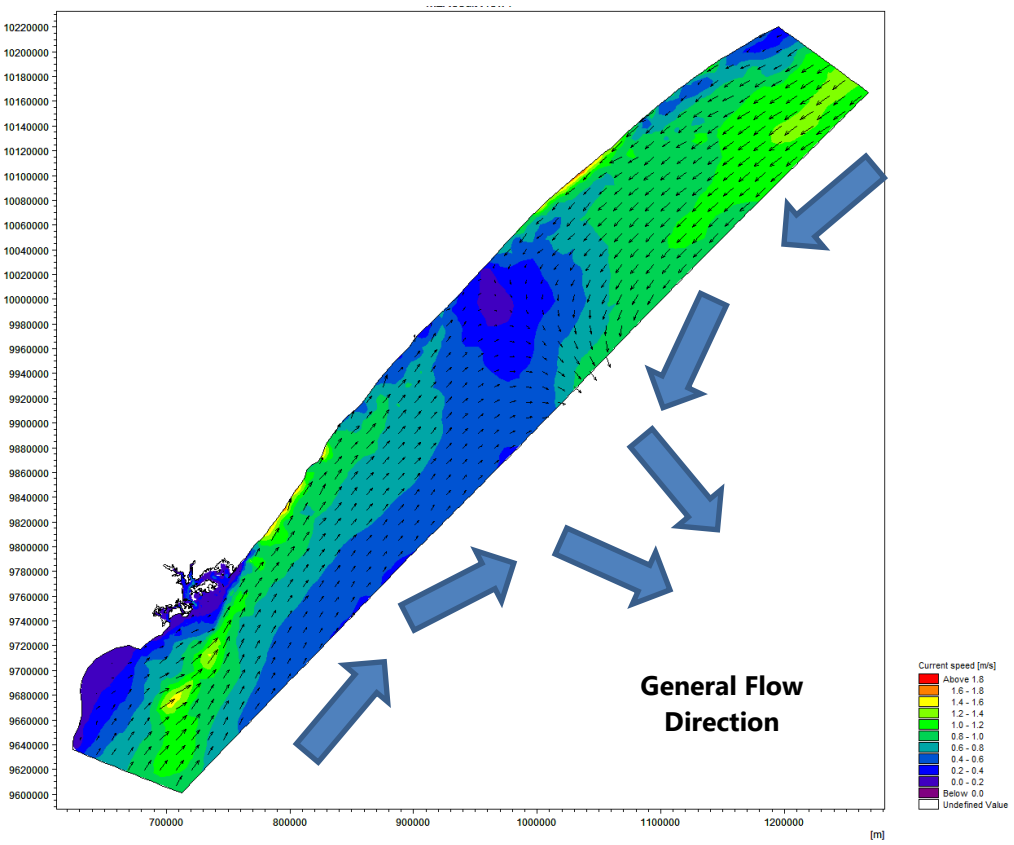


Figure 26. Modelled current speeds, NE Monsoon

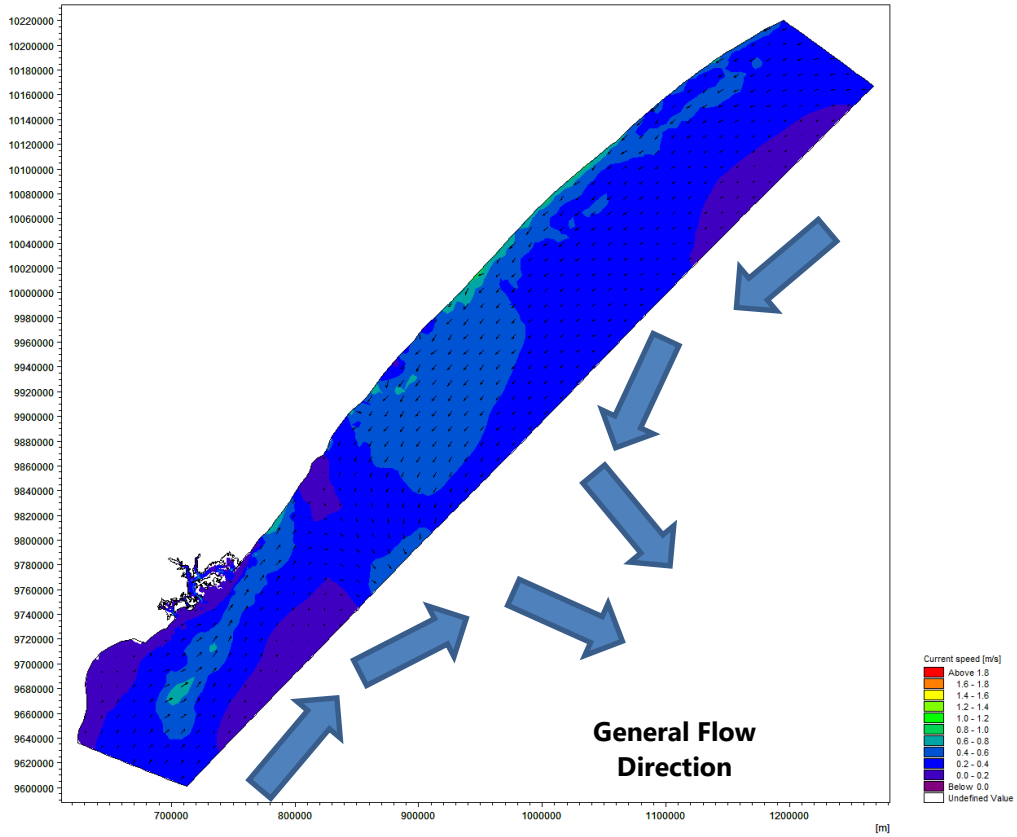


Figure 27. Modelled current speeds, Transition

Localised flows

As reported in Golder (2018), according to the Ministry of Transport (2013), the two main currents at the mouth of Manda Bay are the ebb and flood currents created by the tide. They are separated by around 180° (310° for the flood and 130° for the ebb), and the maximum spring velocity is 0.80 m/s during ebbs and 0.5 m/s during floods.

The model captures the flood and ebb flows through the Manda Channel and the 180° directional switch is clearly seen in Figure 29. As reported, the flows are strongest during the ebb and although the exact location of the Manda Bay Oceanic Station is not clear, the flow speeds through the channel are similar to those measured.

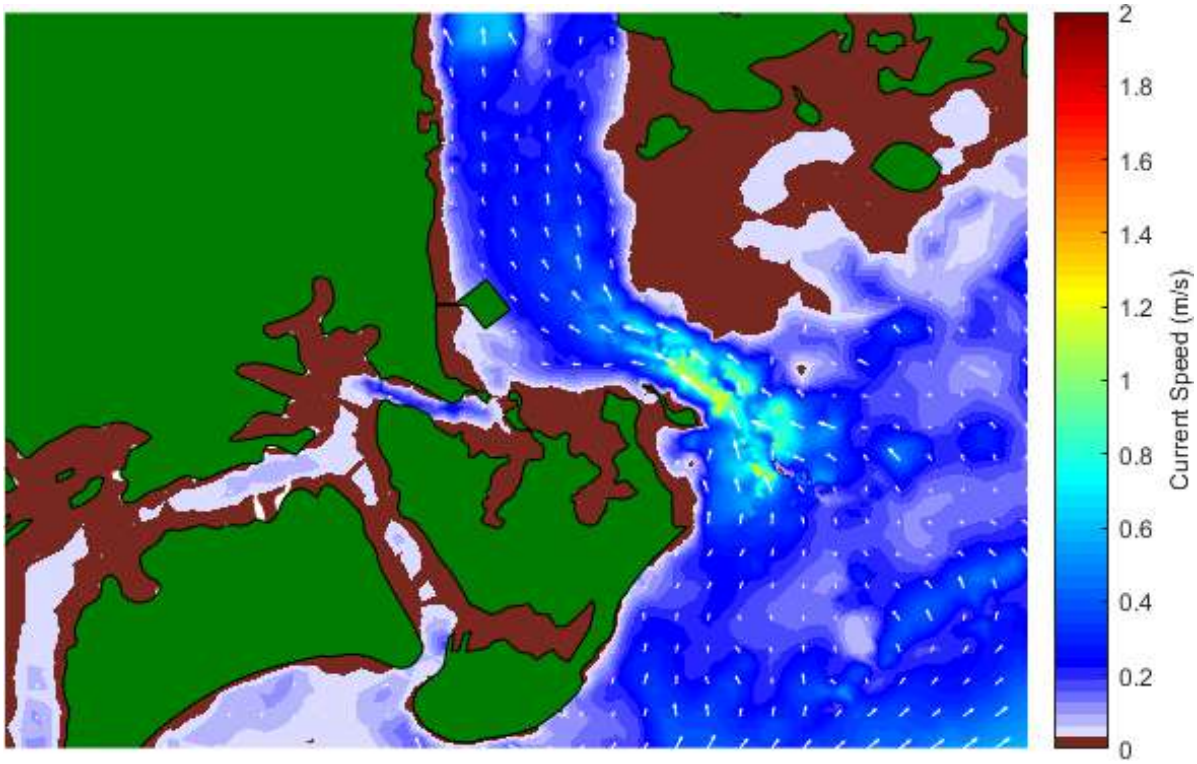


Figure 28. Modelled tidal flows during flood

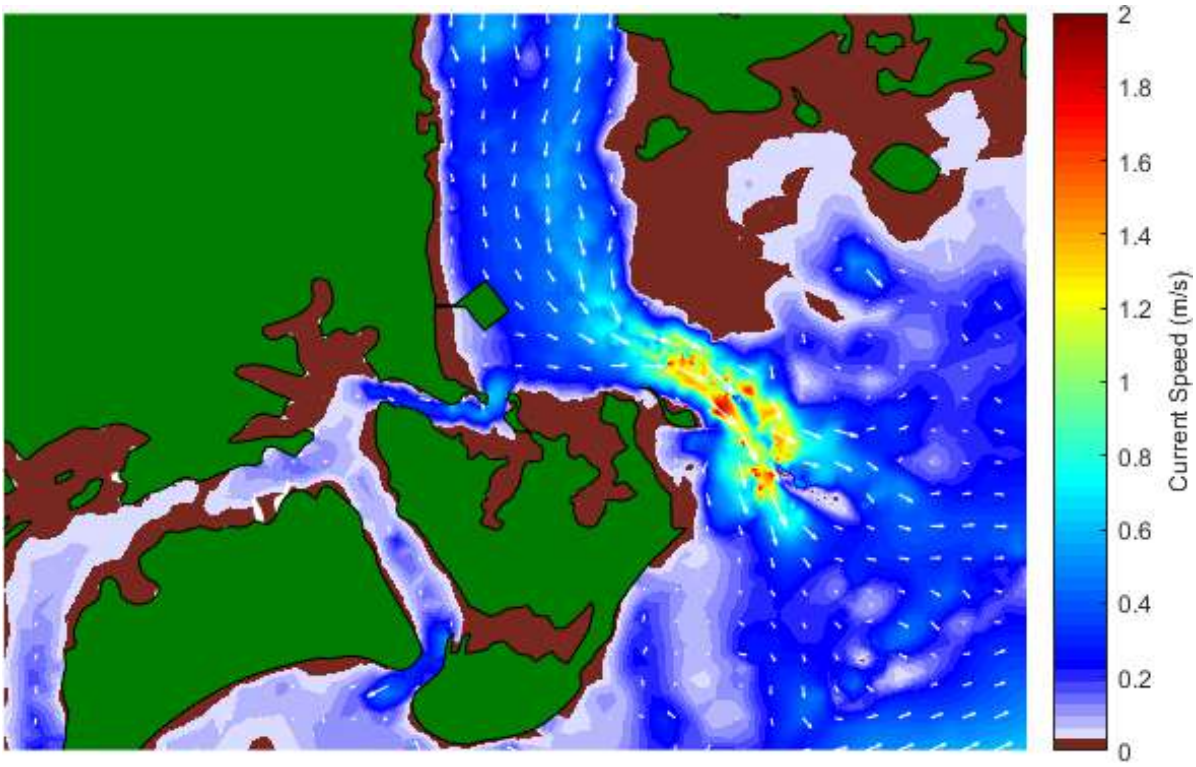


Figure 29. Modelled tidal flows during ebb

3.2.3 Waves

As discussed in Section 2, both swell waves from across the Indian Ocean and those formed by local winds affect Lamu Port. According to JPC & BAC/GKA JV (2011), the average wave height at the -30 m area in front of Lamu during July, based on 9 years of data, was 3.05 m with a period of 7.4 s. The wave model replicates these conditions well (Figure 30).

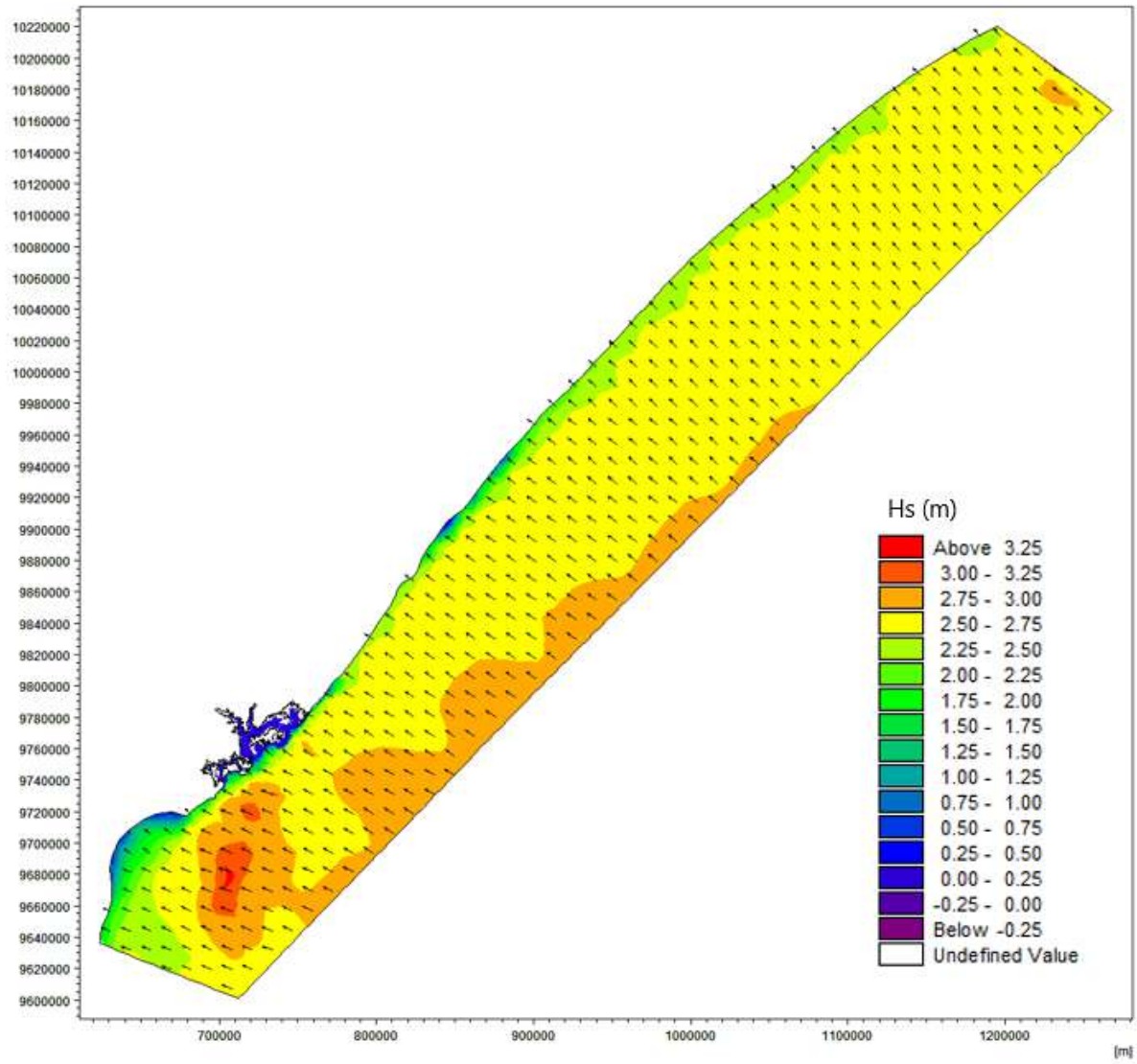


Figure 30. Modelled significant wave height, July 2010

4 Oil Spill Model

4.1 Spill scenarios

The spill scenarios modelled, shown in Table 2, have been selected by PPMT and Golder to cover a range of potential incidents ranging from large operational spills to catastrophic spills. Two additional scenarios that model the loss of a single compartment are presented in Appendix C.

All scenarios assume no response mitigation is undertaken and hence present a worse case situation. Each spill scenario has been modelled for 30 days; the extent of oiling is clear after this period.

Table 2. Oil spill scenarios

Scenario	Release Volume (bbl)	Oil Type	Seasons	Tidal State	Cases	Comment
Loss of two compartments	246,500	Waxy Crude	SW Monsoon NE Monsoon Transition	N/A	3	This scenario assumes that each tank is of equal volume, then the maximum VLCC compartment volume is 146,000 bbl (15 compartments in a total of 2.2 Mbbl capacity). Furthermore, it is assumed that the compartments are most likely to be filled to 85%. Therefore, the potential release volume is: 2 x 146,000 x 0.85 = 246,500 bbl
Partial loss of one compartment	36,000	Waxy Crude	SW Monsoon NE Monsoon Transition	N/A	3	This scenario assumes a potential release volume of 25% of one VLCC compartment. Therefore, the potential release volume is: 146,000 x 0.25 = 36,000 bbl
Offloading Spill	5,000	Waxy Crude	SW Monsoon NE Monsoon Transition	Spring Ebb Spring Flood	6	This scenario assumes that in the event of one of the loading arms (each 500,00 bbl/d) becoming disconnected, it is envisaged that a rapid response would be in place, as such intervention would be within 15 mins. Therefore, the potential release volume is: 500,000 bbl/d/24 hr x 15 min/60 min = 5,000 bbl

4.2 Model setup

4.2.1 Oil characterisation

The Lokichar export oil is extremely viscous at ambient temperature and is therefore likely to solidify quickly if a spill were to occur (Wood, 2018). This hypothesis is supported by videos from simple laboratory tests undertaken by Kernow Analytical Technology (2019).

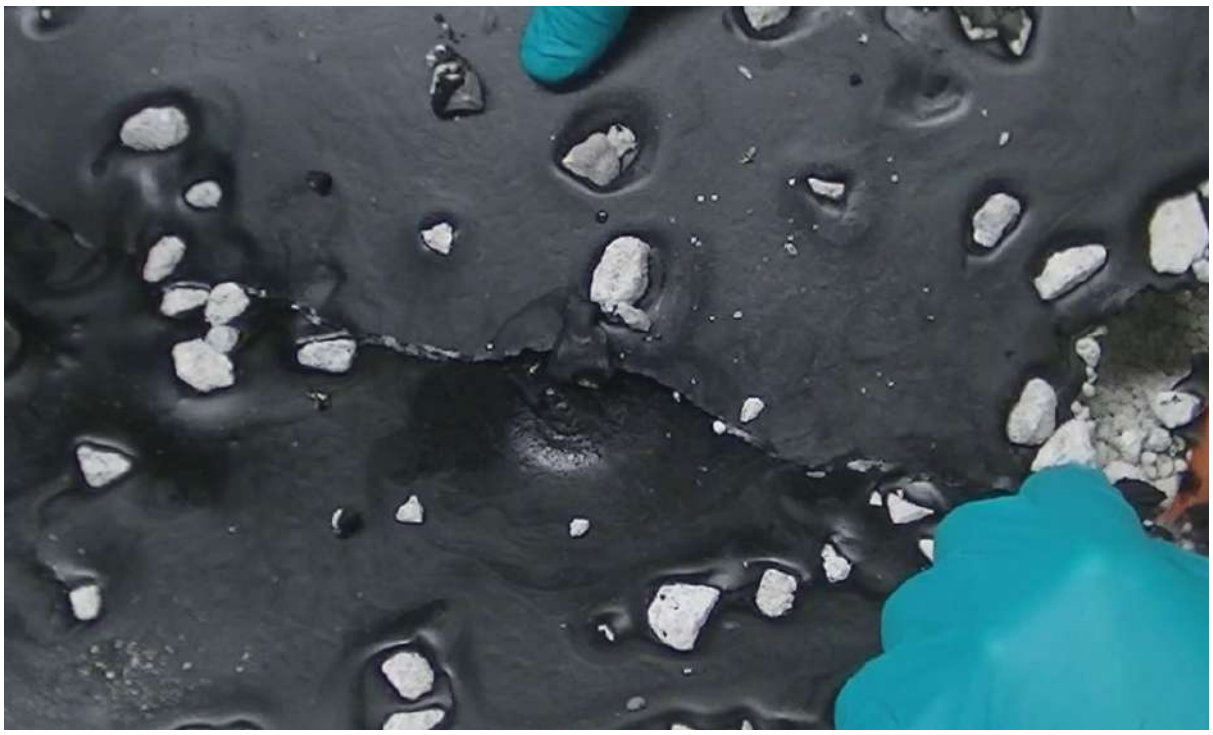


Figure 31. Still of video recording by Kernow Analytical Technology (2019) showing solidified oil

Oil has been characterised in the model by parameterising a detailed oil composition, shown in Figure 32 (Wood, 2018) into five key components: Volatile fractions, semi-volatile fractions, heavy fractions, waxes and asphaltenes.

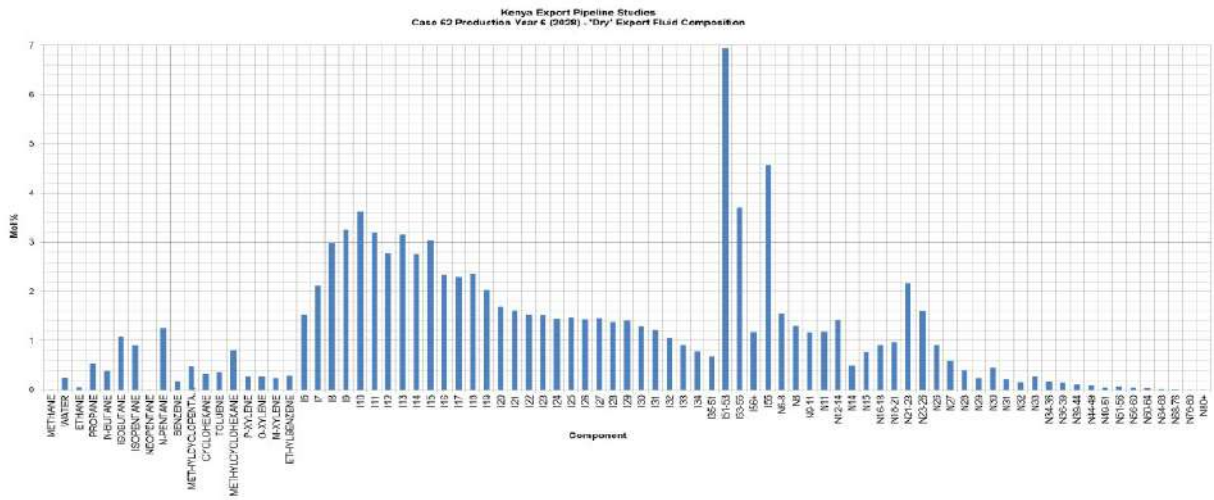


Figure 32. Lokichar export oil composition

For the purposes of the MIKE 21 OS model, volatile components are defined has having a molecular weight < 160 g/mol and a boiling point well below 300 °C i.e. fractions 19 to 24. Heavy fractions are defined by a molecular weight > 160 g/mol and boiling point above 300 °C i.e. fractions 31 to 83. Semi-volatile fractions are defined as the components in between the volatile and heavy, i.e. fractions 25-30. A breakdown of the five components is shown in Table 3.[1]

Table 3. Oil parameterisation, key components

Parameter	%	Average Density (kg/m^3)
Volatile Fraction	16.42	772.73
Semi-volatile Fraction	16.09	842.17
Heavy Fraction	58.29	880.74
Wax	1	-
Asphaltenes	0.01	-

Additional parameters such as viscosity and pour point have also been adjusted in the model as shown in Table 4. All other parameters have been left as default (see Appendix B for more details).

Table 4. Oil parameterisation, additional variables

Parameter	Adjusted Value
Emulsification: Maximum water fraction	0%
Dynamic oil viscosity at reference temperature	34 cP
Reference temperature for dynamic oil viscosity	57°C
Coefficient for exponential temperature dependency of viscosity	-0.039
Oil pour point	45°C

As mentioned in Section 1.2, weathering processes such as spreading, evaporation, emulsification, vertical dispersion, dissolution, biodegradation and photo-oxidation take place once oil is spilled into the marine environment. The MIKE21 OS module takes account of these processes for the parametrised oil. It is expected that the oil will solidify once it is spilled into the marine environment and this solidification is partly represented by the viscosity and pour point parameters.

[1] Fractions 19 and lower e.g. propane and benzene are not accounted for by the model but since they are very volatile components they are likely to evaporate/dissolve immediately during a spill.

4.3 Results

Spill modelling results for the following scenarios are presented in this section:

- Scenario 1a: spill of 246,500 bbls during SW Monsoon.
- Scenario 2a: spill of 36,000 bbls during SW Monsoon.
- Scenario 3a: spill of 5,000 bbls during SW Monsoon at ebbing spring tide.
- Scenario 4a: spill of 5,000 bbls during SW Monsoon at flooding spring tide.

- Scenario 1b: spill of 246,500 bbls during NE Monsoon.
- Scenario 2b: spill of 36,000 bbls during NE Monsoon.
- Scenario 3b: spill of 5,000 bbls during NE Monsoon at ebbing spring tide.
- Scenario 4b: spill of 5,000 bbls during NE Monsoon at flooding spring tide.

- Scenario 1c: spill of 246,500 bbls during Transition Period.
- Scenario 2c: spill of 36,000 bbls during Transition Period.
- Scenario 3c: spill of 5,000 bbls during Transition Period at ebbing spring tide.
- Scenario 4c: spill of 5,000 bbls during Transition Period at flooding spring tide.

4.3.1 SW Monsoon

Scenario 1a: Spill of 246,500 bbls during SW Monsoon

The loss of two compartments, consisting of 246,500 bbls, has been modelled for typical conditions during a SW Monsoon. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S01a.avi).

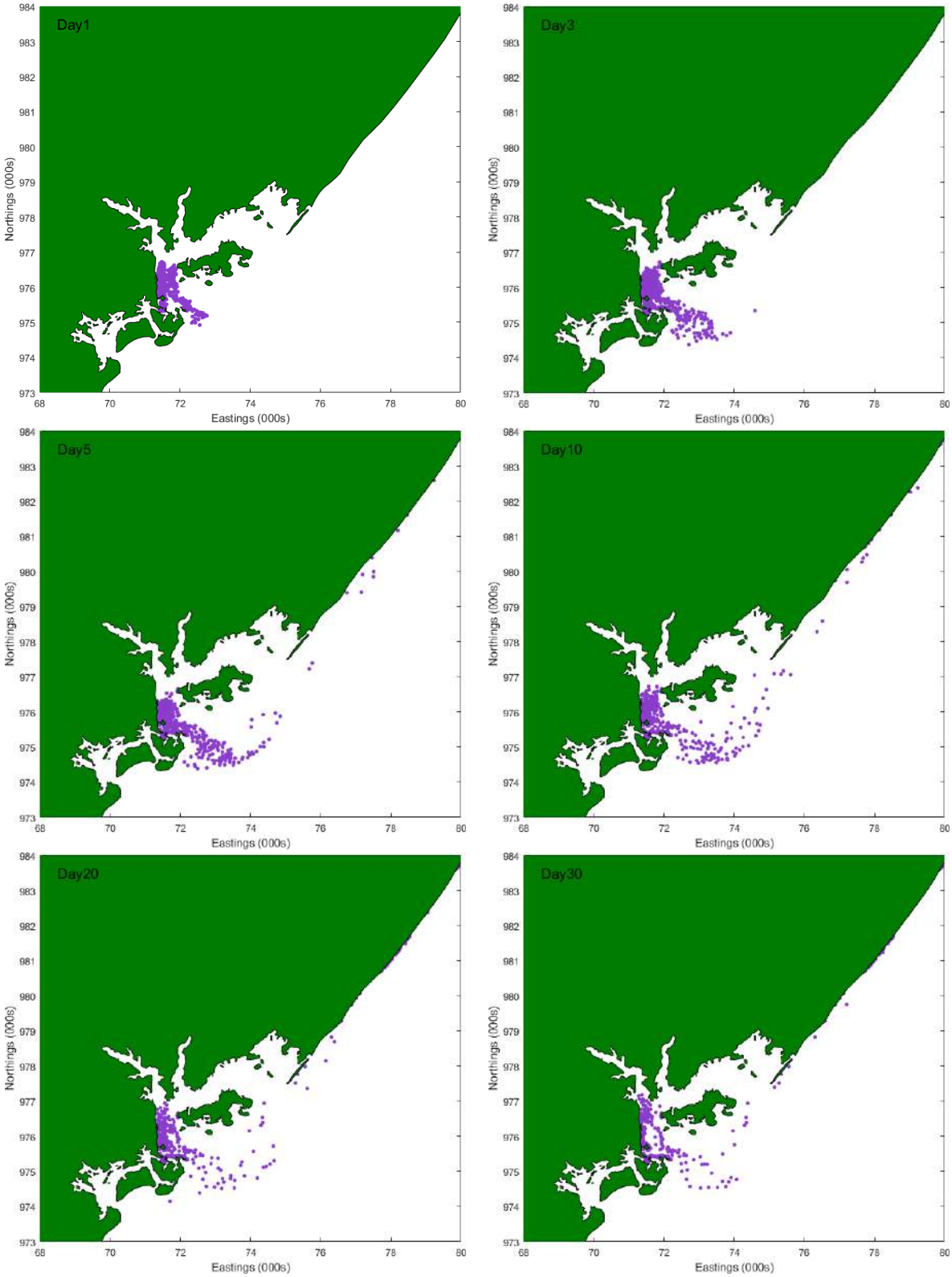


Figure 33. Scenario 1a: Spill impact during first 30 days of scenario, SW Monsoon

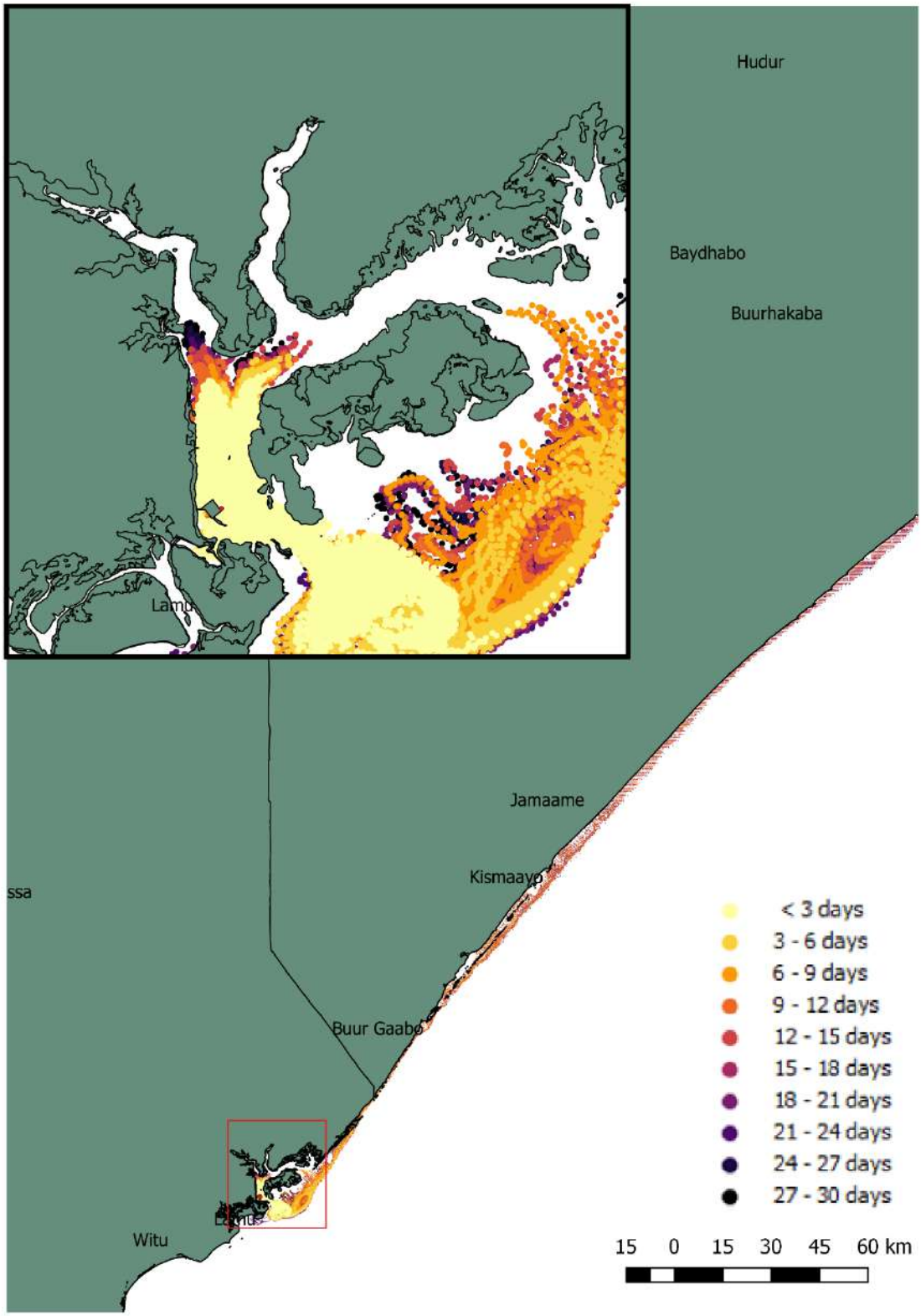


Figure 34. Scenario 1a: Total area impacted and minimum arrival time, SW Monsoon

Scenario 2a: Spill of 36,000 bbls during SW Monsoon

The partial loss of one compartment, consisting of 36,000 bbls, has been modelled for typical conditions during a SW Monsoon. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S02a.avi).

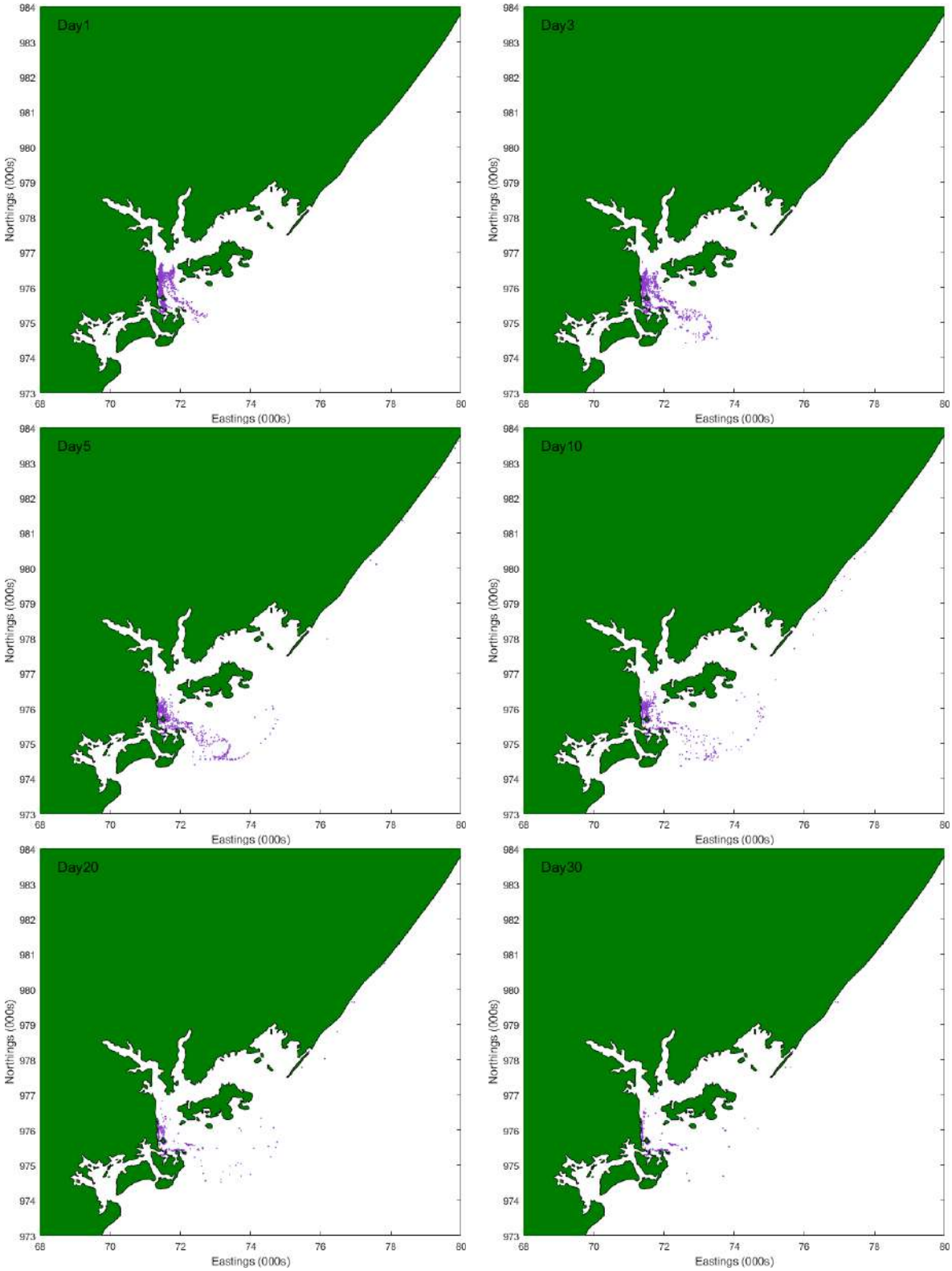


Figure 35. Scenario 2a: Spill impact during first 30 days of scenario, SW Monsoon

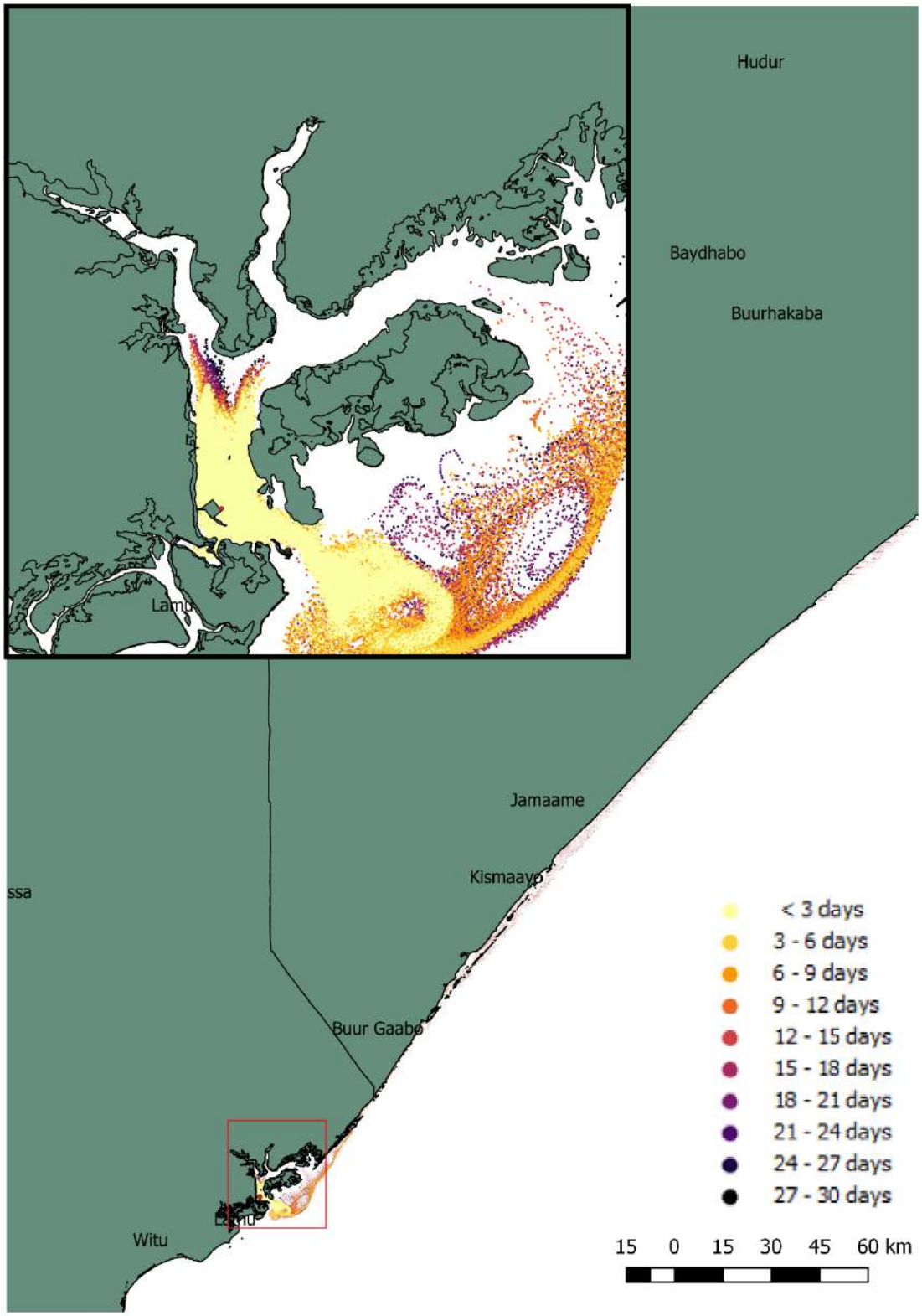


Figure 36. Scenario 2a: Total area impacted and minimum arrival time, SW Monsoon

Scenario 3a: Spill of 5,000 bbls during SW Monsoon, release during ebbing spring tide

An offloading spill, consisting of 5,000 bbls, has been modelled for typical conditions during a SW Monsoon. The release volume has been spread over a 6-hour period during an ebbing spring tide.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S03a.avi).

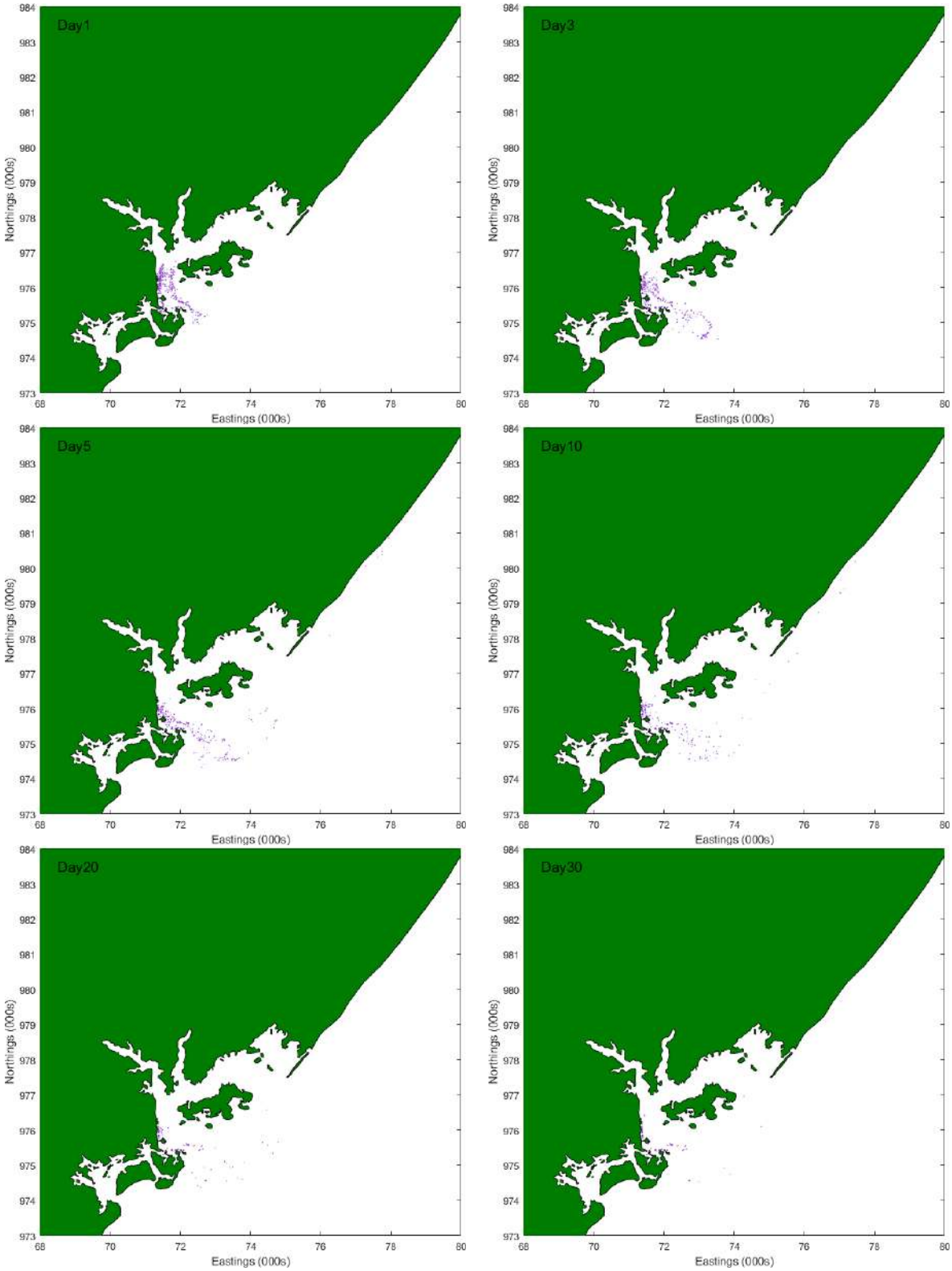


Figure 37. Scenario 3a: Spill impact during first 30 days of scenario, SW Monsoon

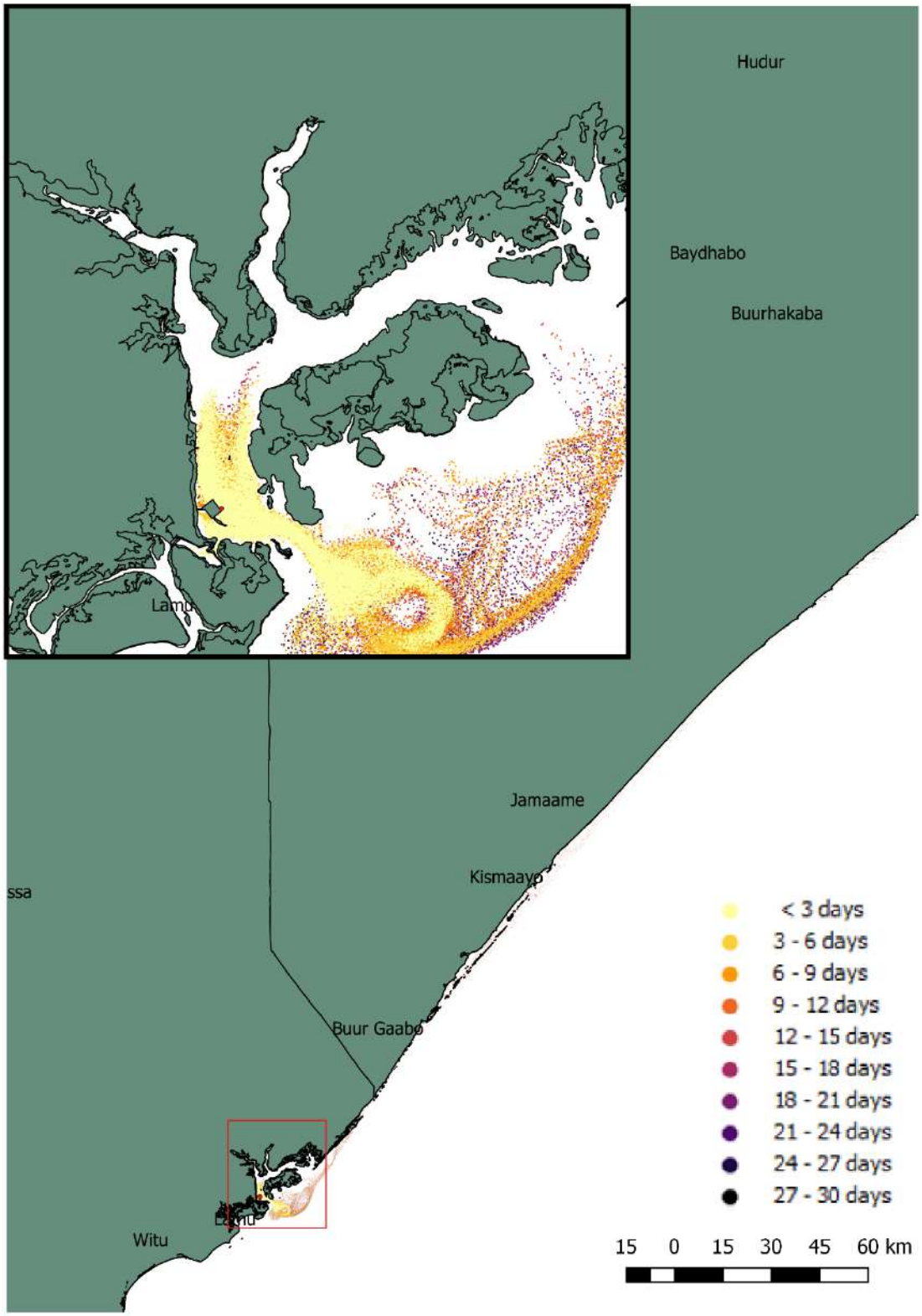


Figure 38. Scenario 3a: Total area impacted and minimum arrival time, SW Monsoon

Scenario 4a: Spill of 5,000 bbls during SW Monsoon, release during flooding spring tide

An offloading spill, consisting of 5,000 bbls, has been modelled for typical conditions during a SW Monsoon. The release volume has been spread over a 6-hour period during a flooding spring tide.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S04a.avi).

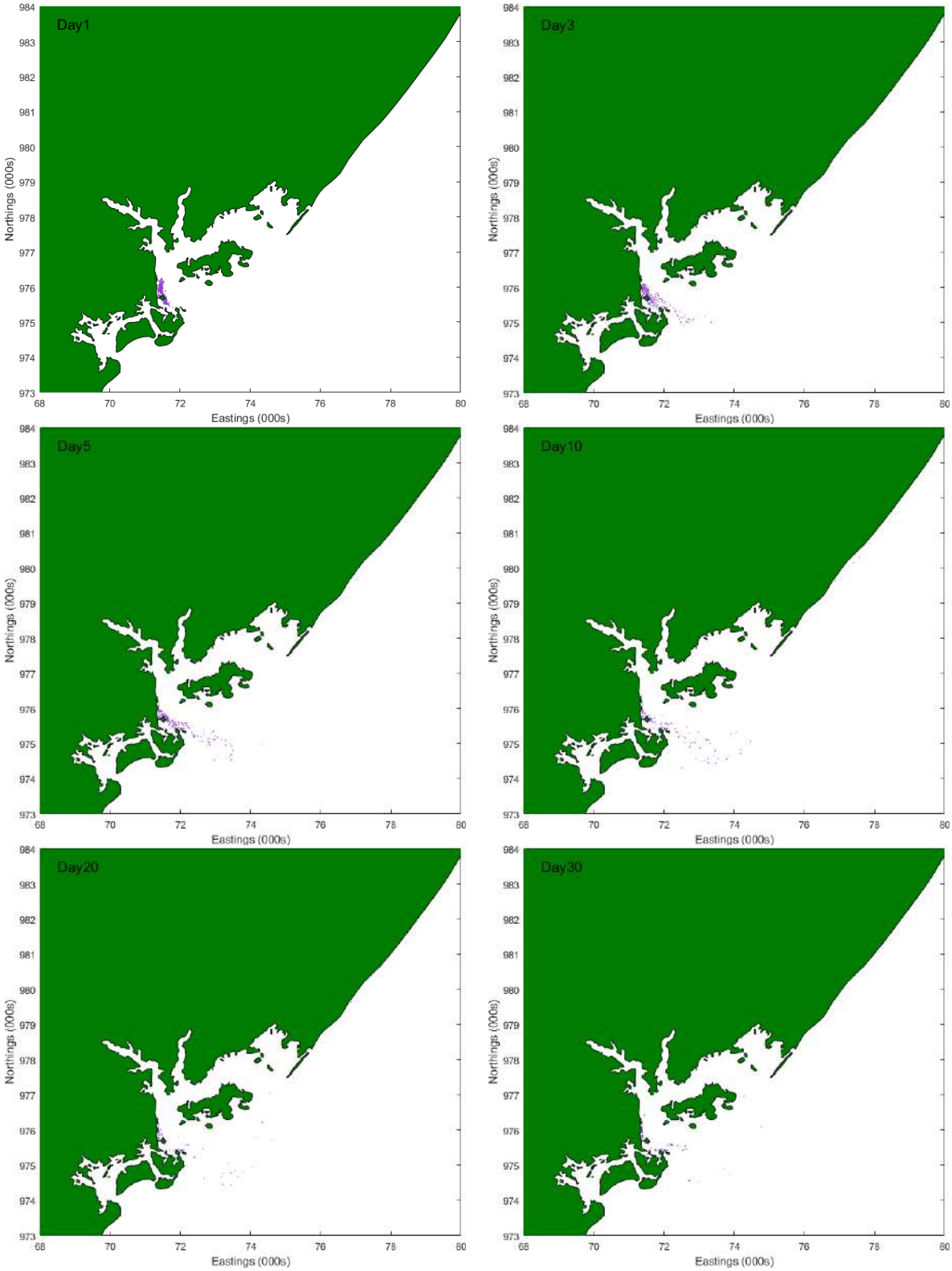


Figure 39. Scenario 4a: spill impact during first 30 days of scenario, SW Monsoon

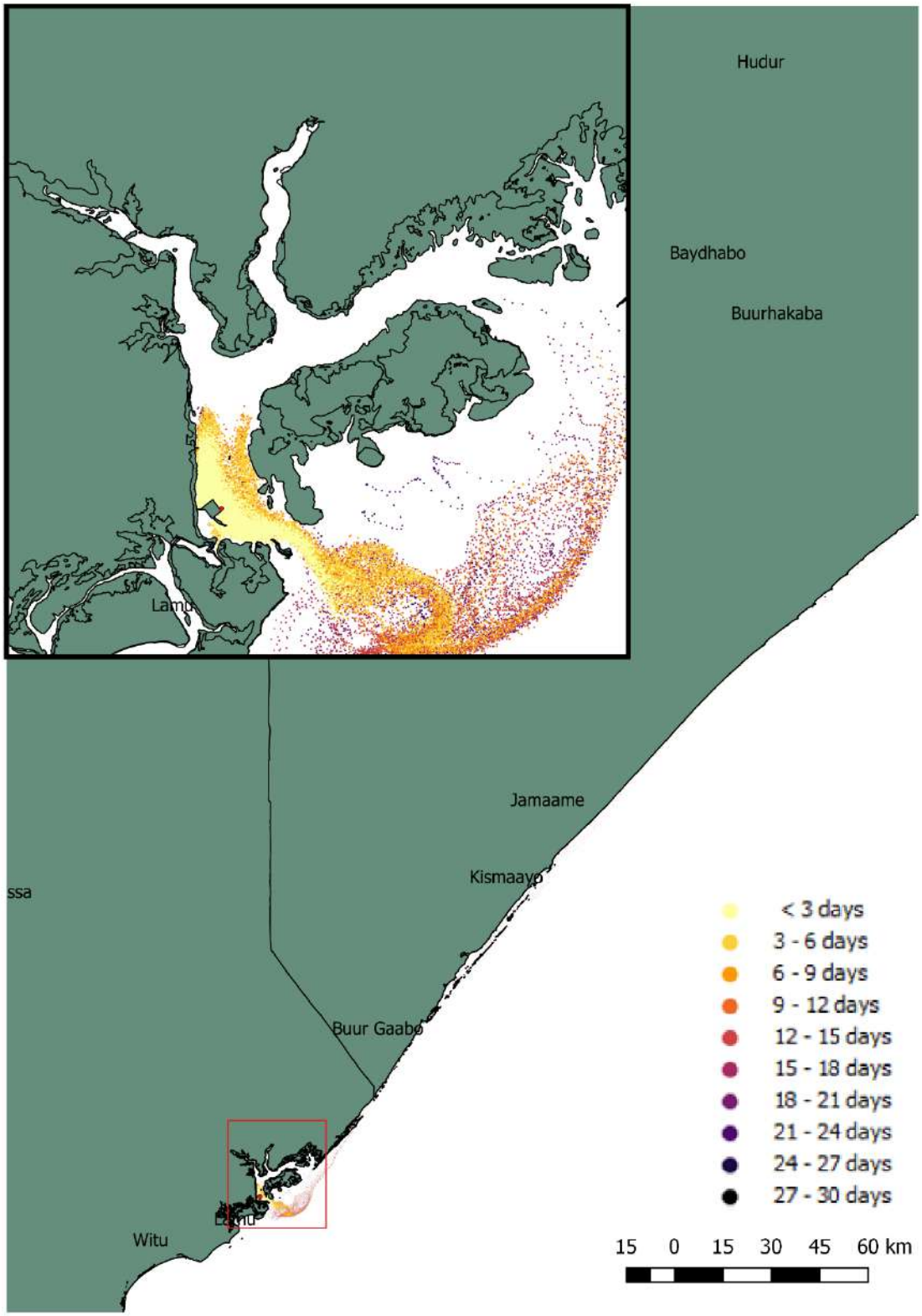


Figure 40. Scenario 4a: Total area impacted and minimum arrival time, SW Monsoon

4.3.2 NE Monsoon

Scenario 1b: Spill of 246,500 bbls during NE Monsoon

The loss of two compartments, consisting of 246,500 bbls, has been modelled for typical conditions during a NE Monsoon. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S01b.avi).

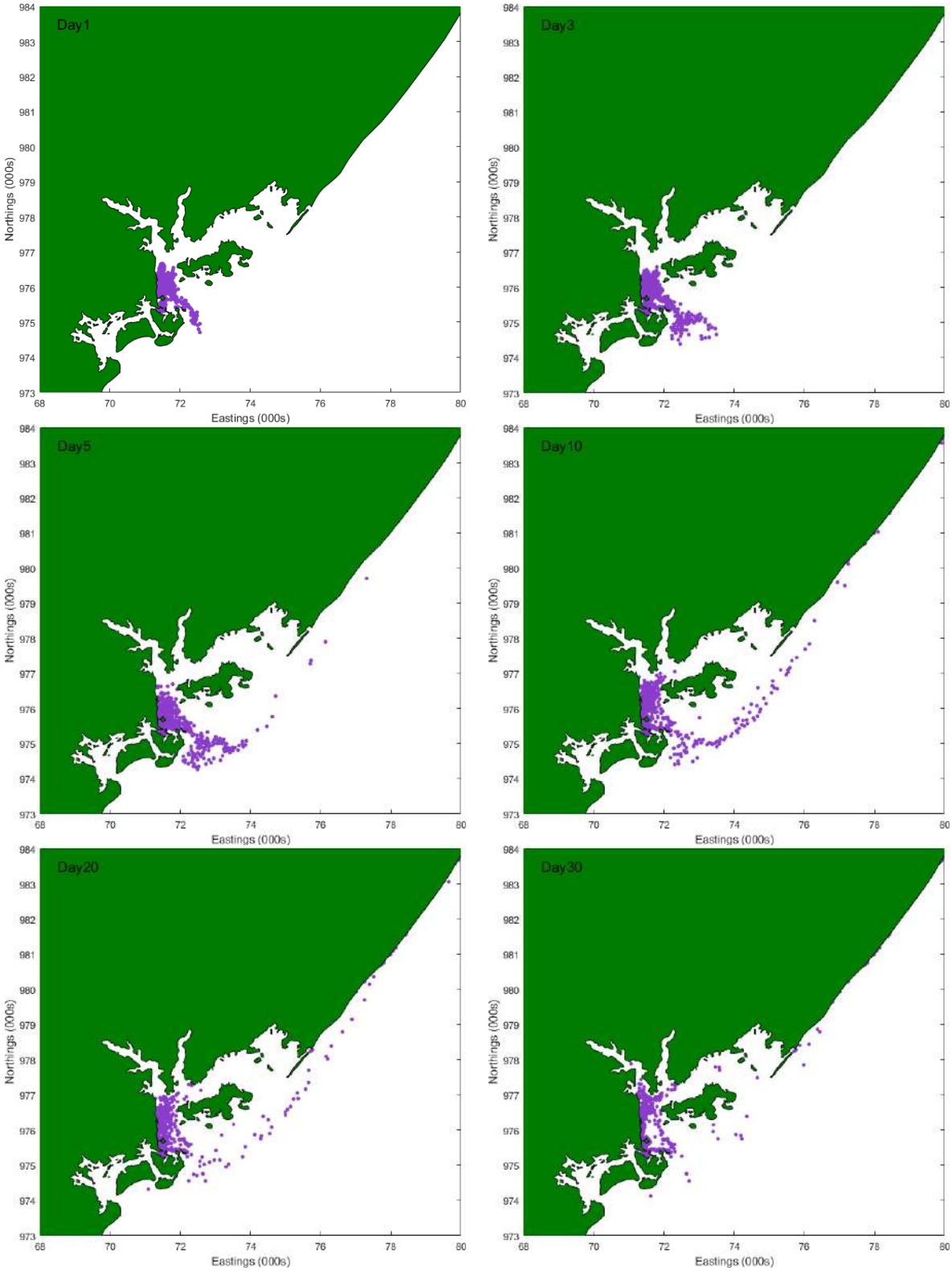


Figure 41. Scenario 1b: spill impact during first 30 days of scenario, NE Monsoon

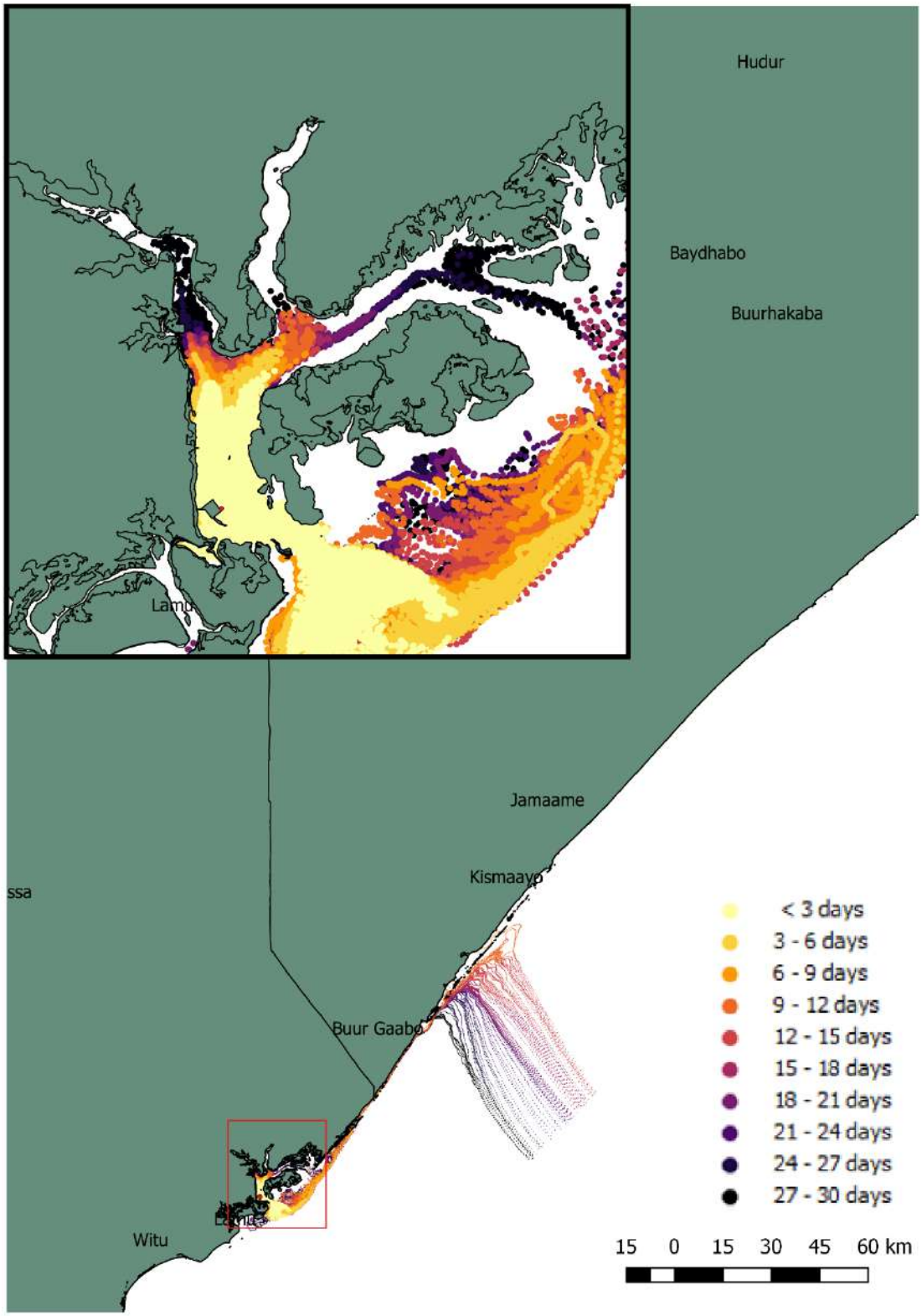


Figure 42. Scenario 1b: Total area impacted and minimum arrival time, NE Monsoon

Scenario 2b: Spill of 36,000 bbls during NE Monsoon

The partial loss of one compartment, consisting of 36,000 bbls, has been modelled for typical conditions during a NE Monsoon. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S02b.avi).

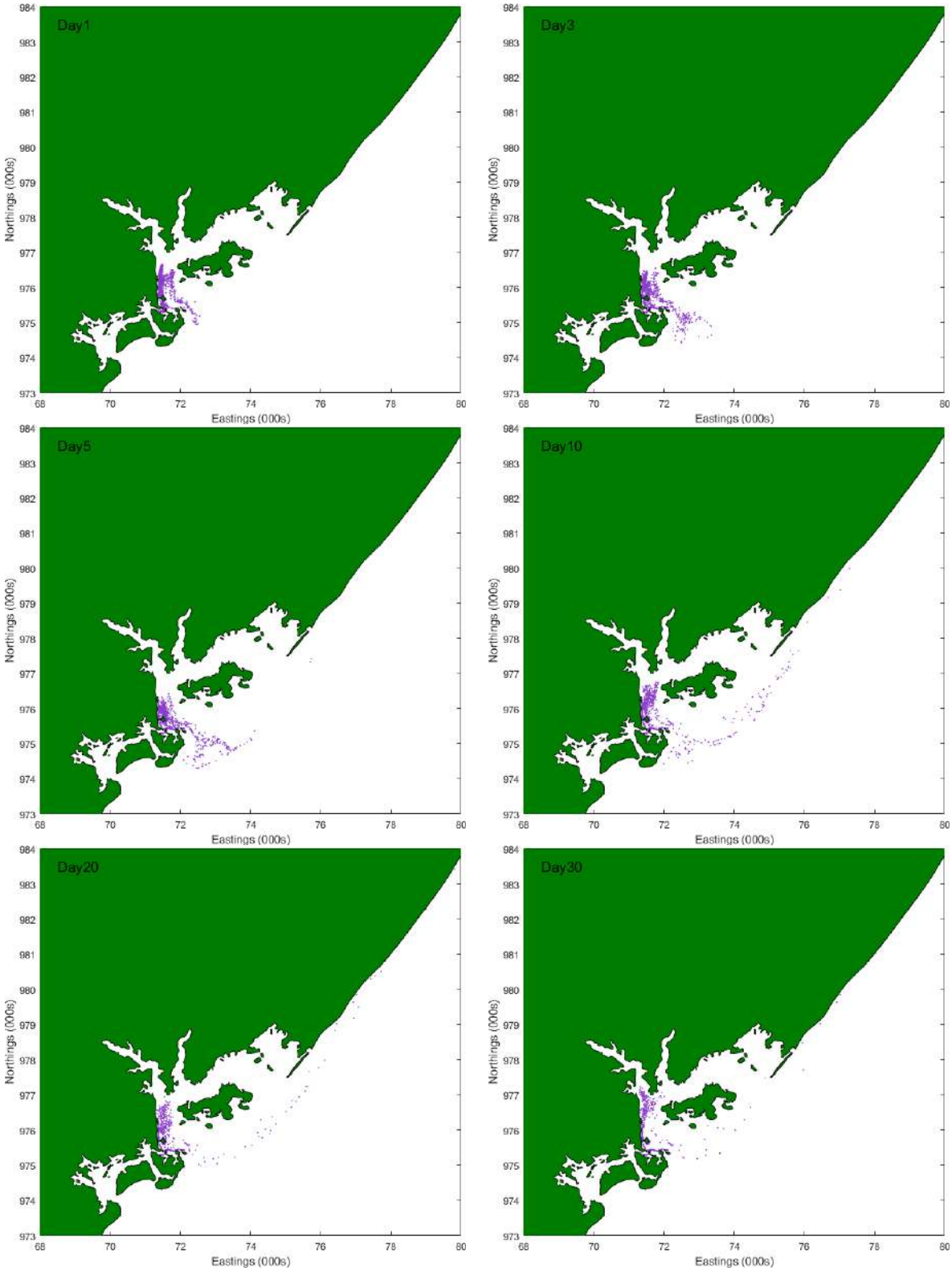


Figure 43. Scenario 2b: Spill impact during first 30 days of scenario, NE Monsoon

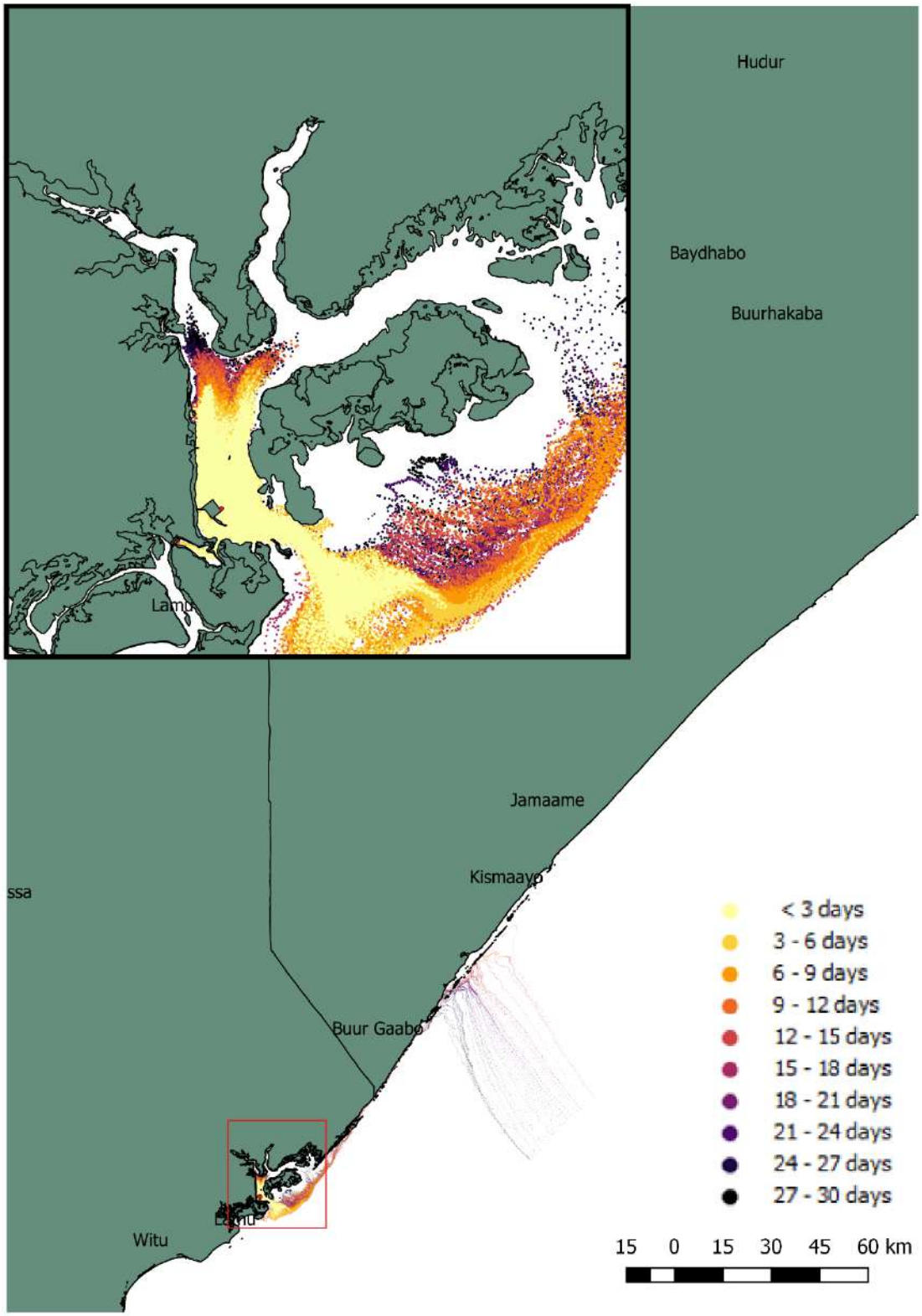


Figure 44. Scenario 2b: Total area impacted and minimum arrival time, NE Monsoon

Scenario 3b: Spill of 5,000 bbls during NE Monsoon, release during ebbing spring tide

An offloading spill, consisting of 5,000 bbls, has been modelled for typical conditions during a NE Monsoon. The release volume has been spread over a 6-hour period during an ebbing spring tide.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S03b.avi).

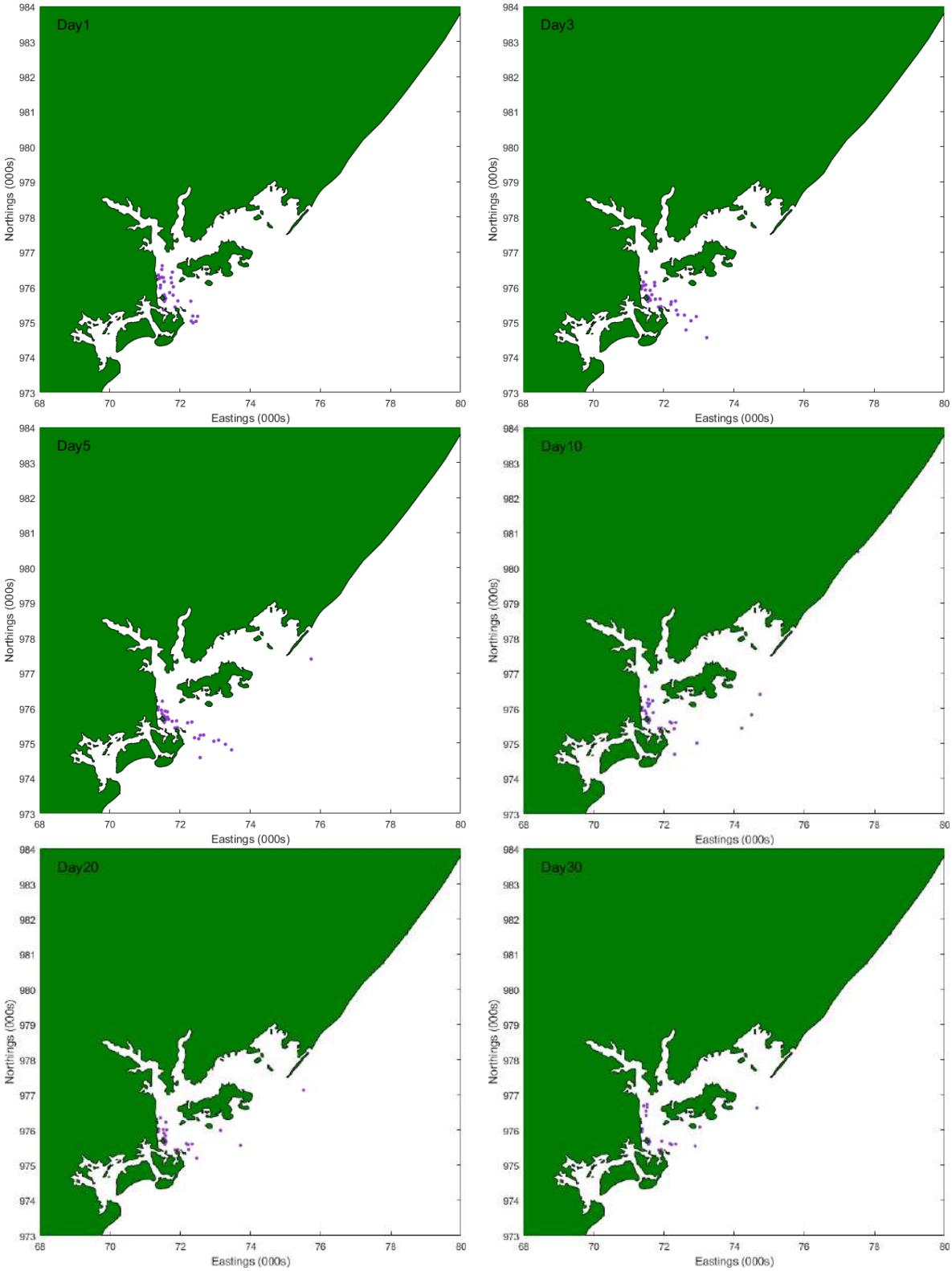


Figure 45. Scenario 3b: Spill impact during first 30 days of scenario, NE Monsoon

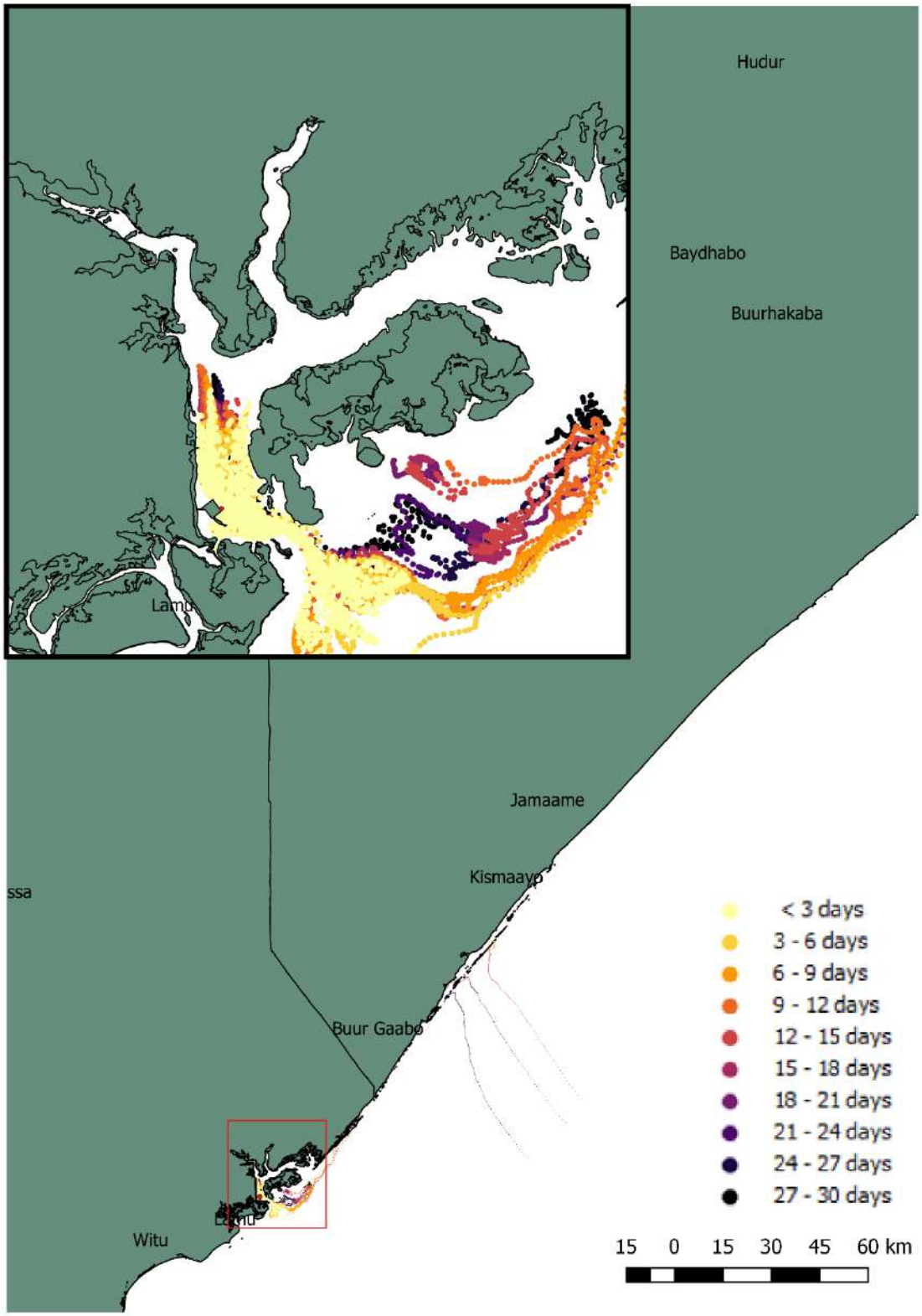


Figure 46. Scenario 3b: Total area impacted and minimum arrival time, NE Monsoon

Scenario 4b: Spill of 5,000 bbls during NE Monsoon, release during flooding spring tide

An offloading spill, consisting of 5,000 bbls, has been modelled for typical conditions during a NE Monsoon. The release volume has been spread over a 6-hour period during a flooding spring tide.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S04b.avi).

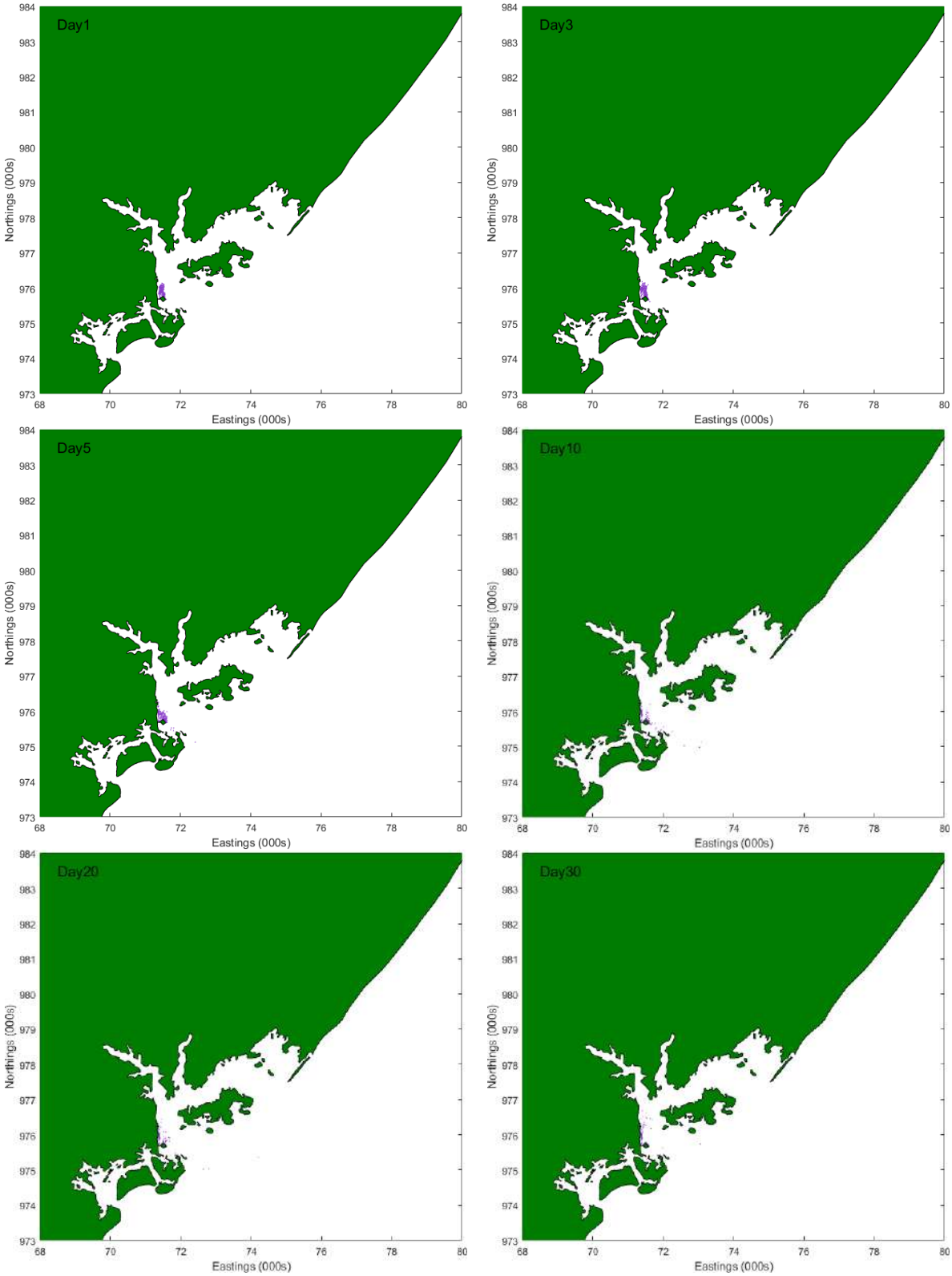


Figure 47. Scenario 4b: Spill impact during first 30 days of scenario, NE Monsoon

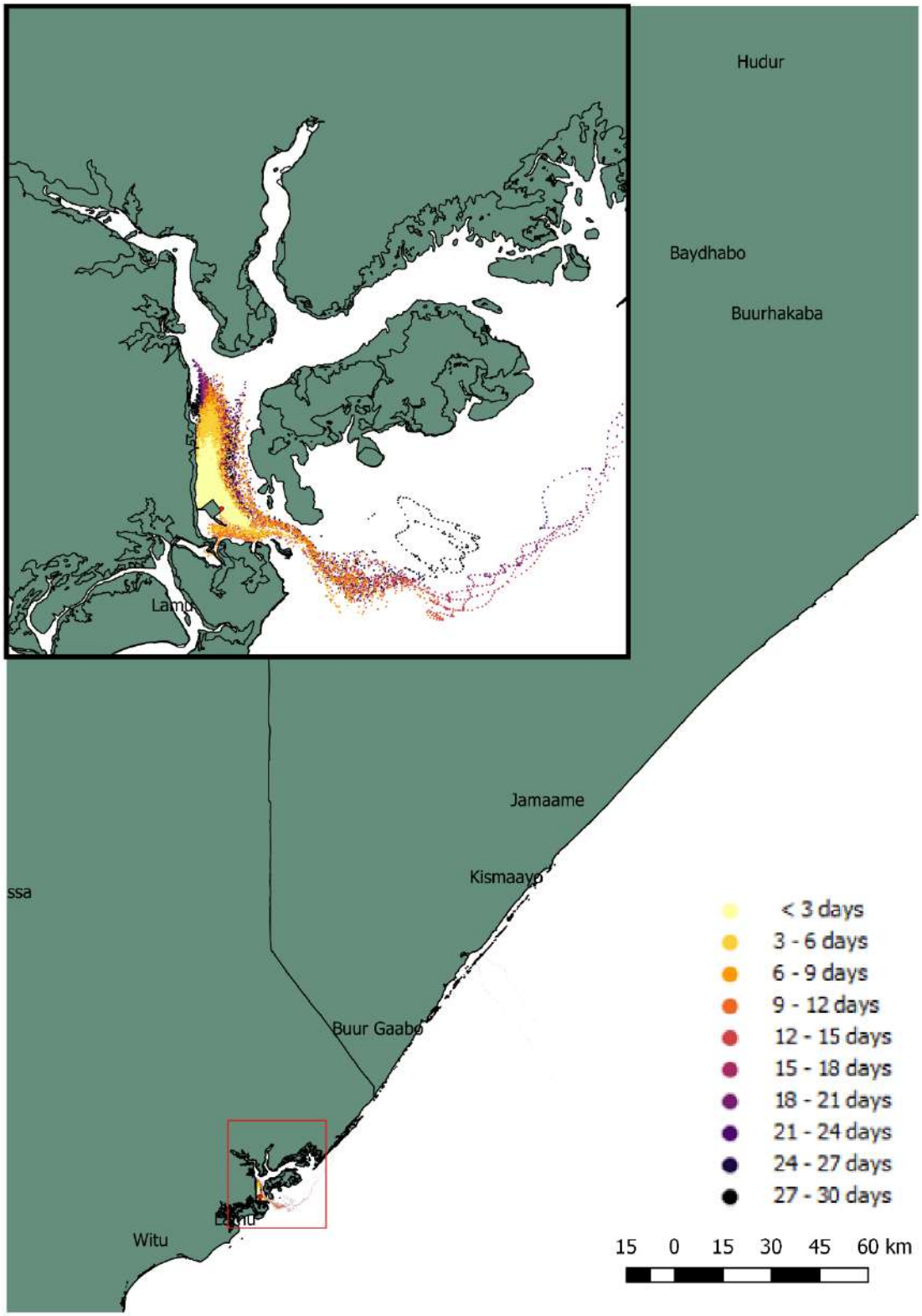


Figure 48. Scenario 4b: Total area impacted and minimum arrival time, NE Monsoon

4.3.3 Transition Period

Scenario 1c: Spill of 246,500 bbls during Transition Period

The loss of two compartments, consisting of 246,500 bbls, has been modelled for typical conditions during a Transition Period. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S01c.avi).

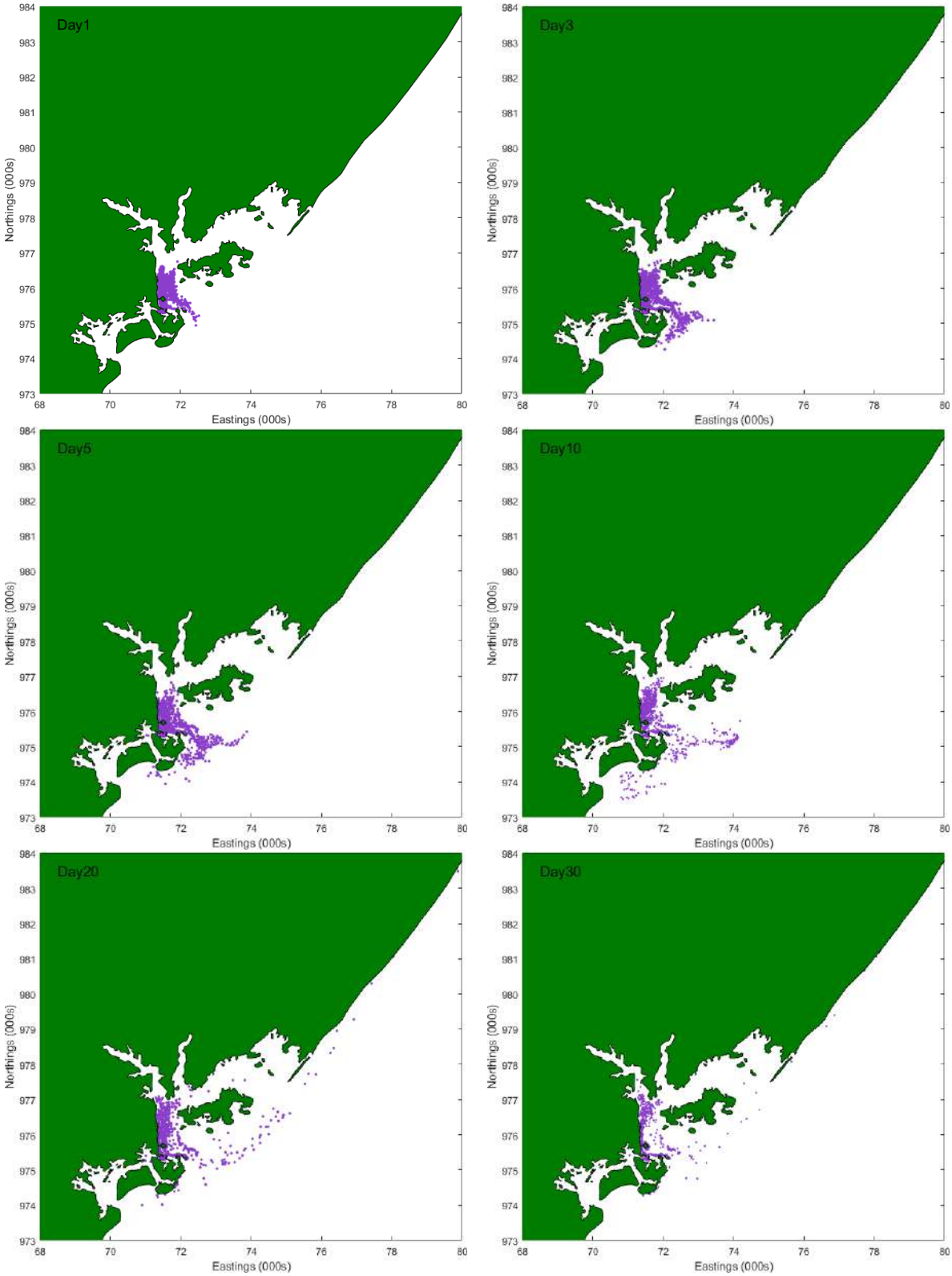


Figure 49. Scenario 1c: Spill impact during first 30 days of scenario, Transition Period

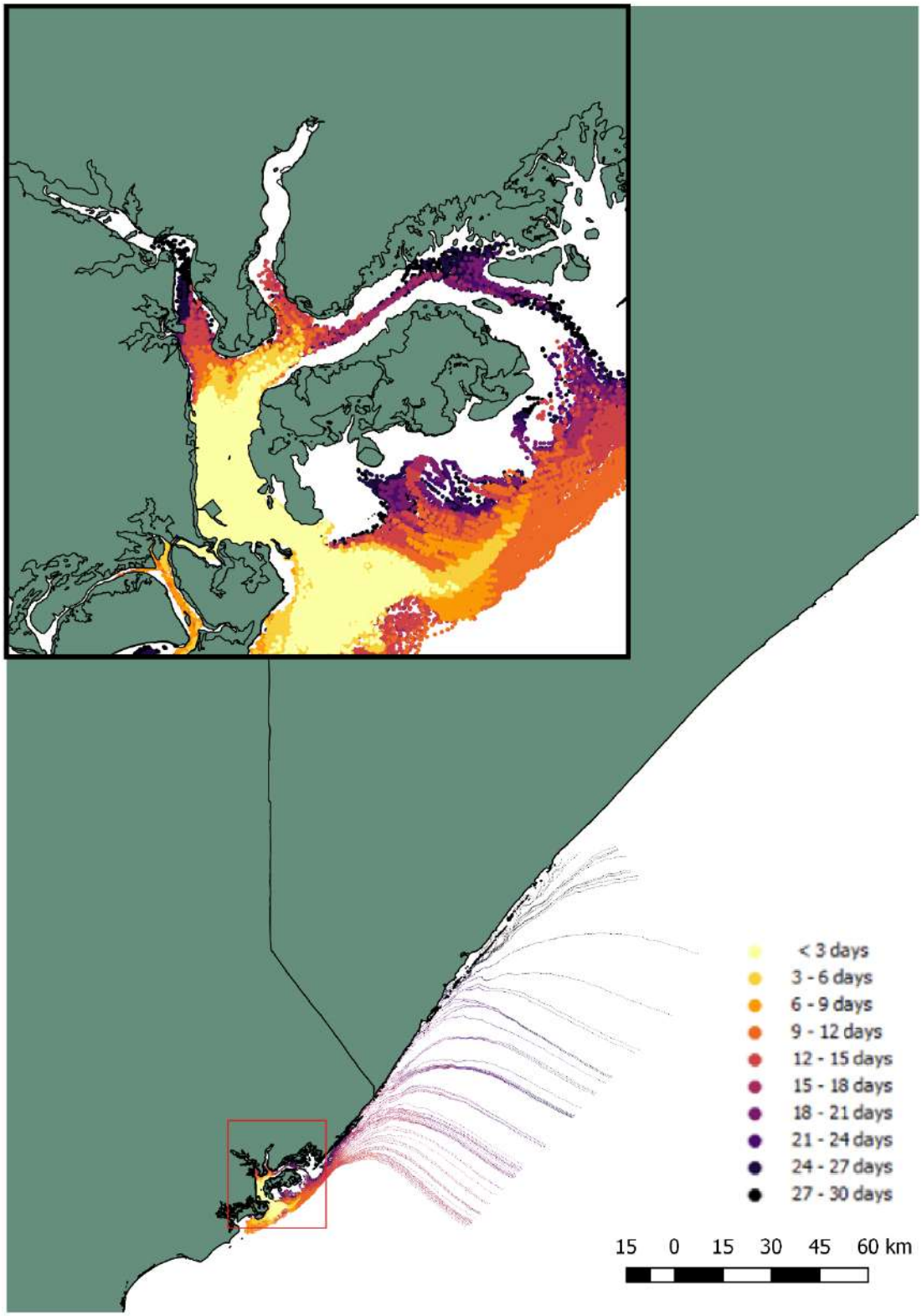


Figure 50. Scenario 1c: Total area impacted and minimum arrival time, Transition Period

Scenario 2c: Spill of 36,000 bbls during Transition Period

The partial loss of one compartment, consisting of 36,000 bbls, has been modelled for typical conditions during a Transition Period. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S02c.avi).

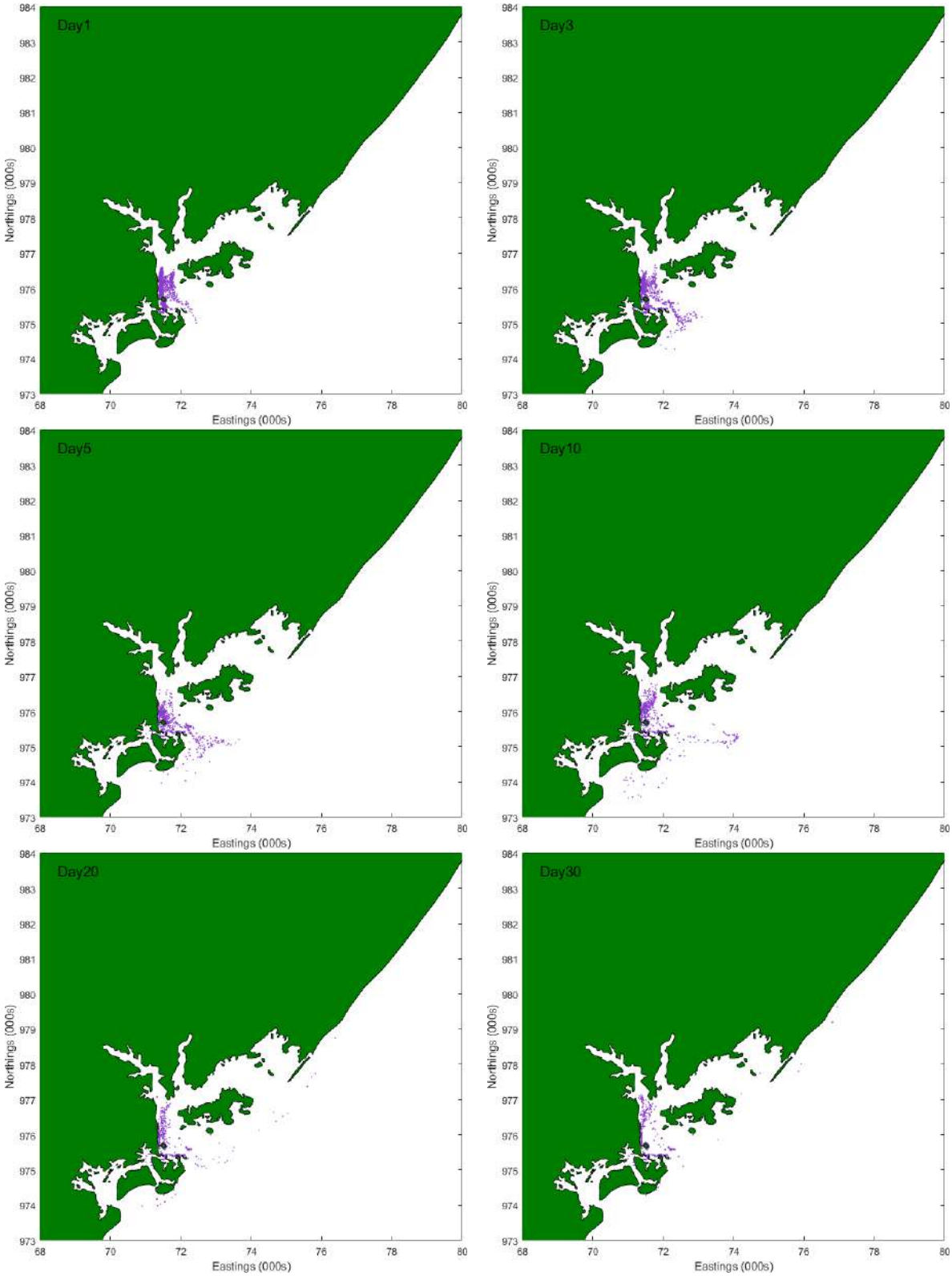


Figure 51. Scenario 2c: Spill impact during first 30 days of scenario, Transition Period

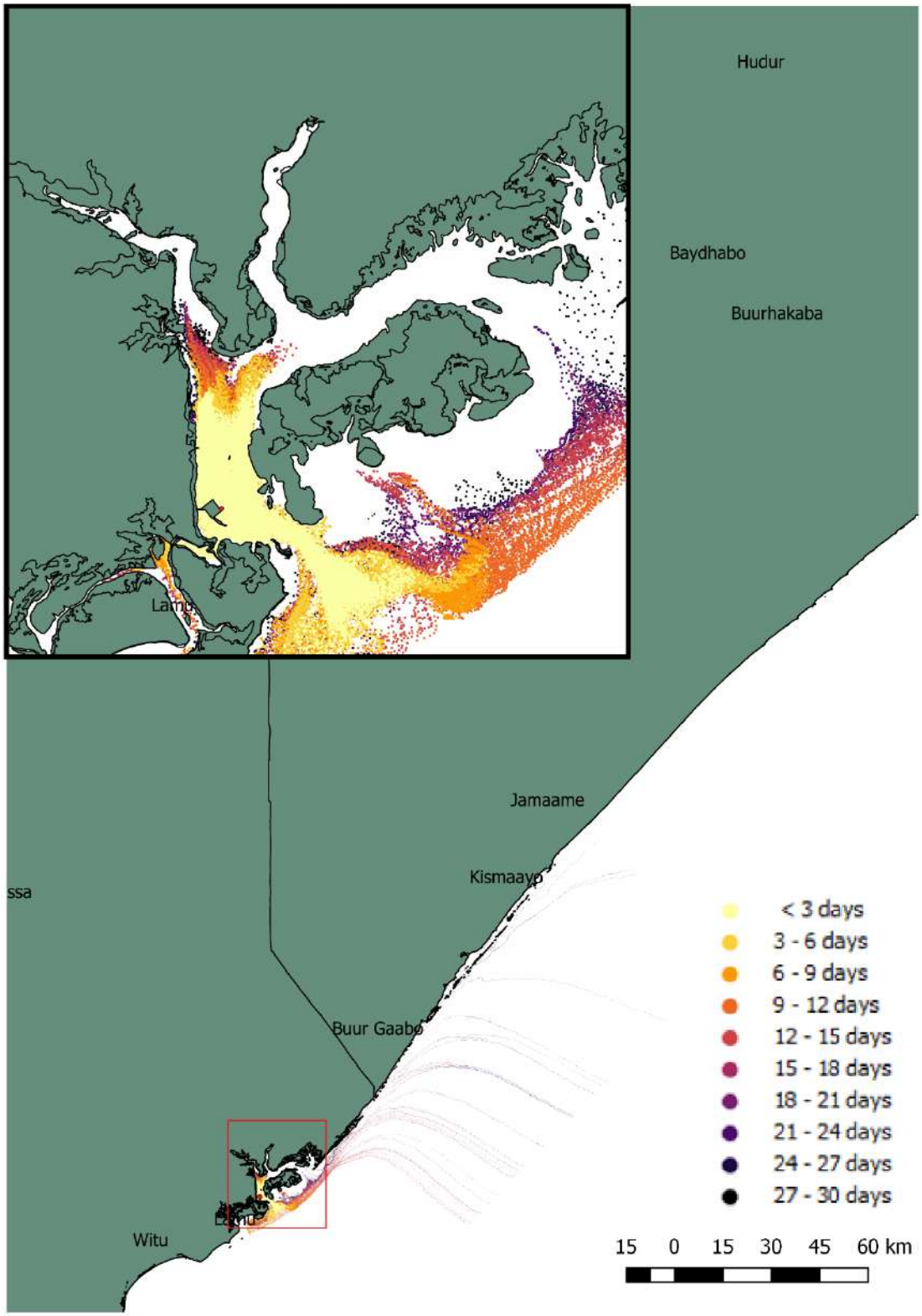


Figure 52. Scenario 2c: Total area impacted and minimum arrival time, Transition Period

Scenario 3c: Spill of 5,000 bbls during Transition Period, release during ebbing spring tide

An offloading spill, consisting of 5,000 bbls, has been modelled for typical conditions during a Transition Period. The release volume has been spread over a 6-hour period during an ebbing spring tide.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S03c.avi).

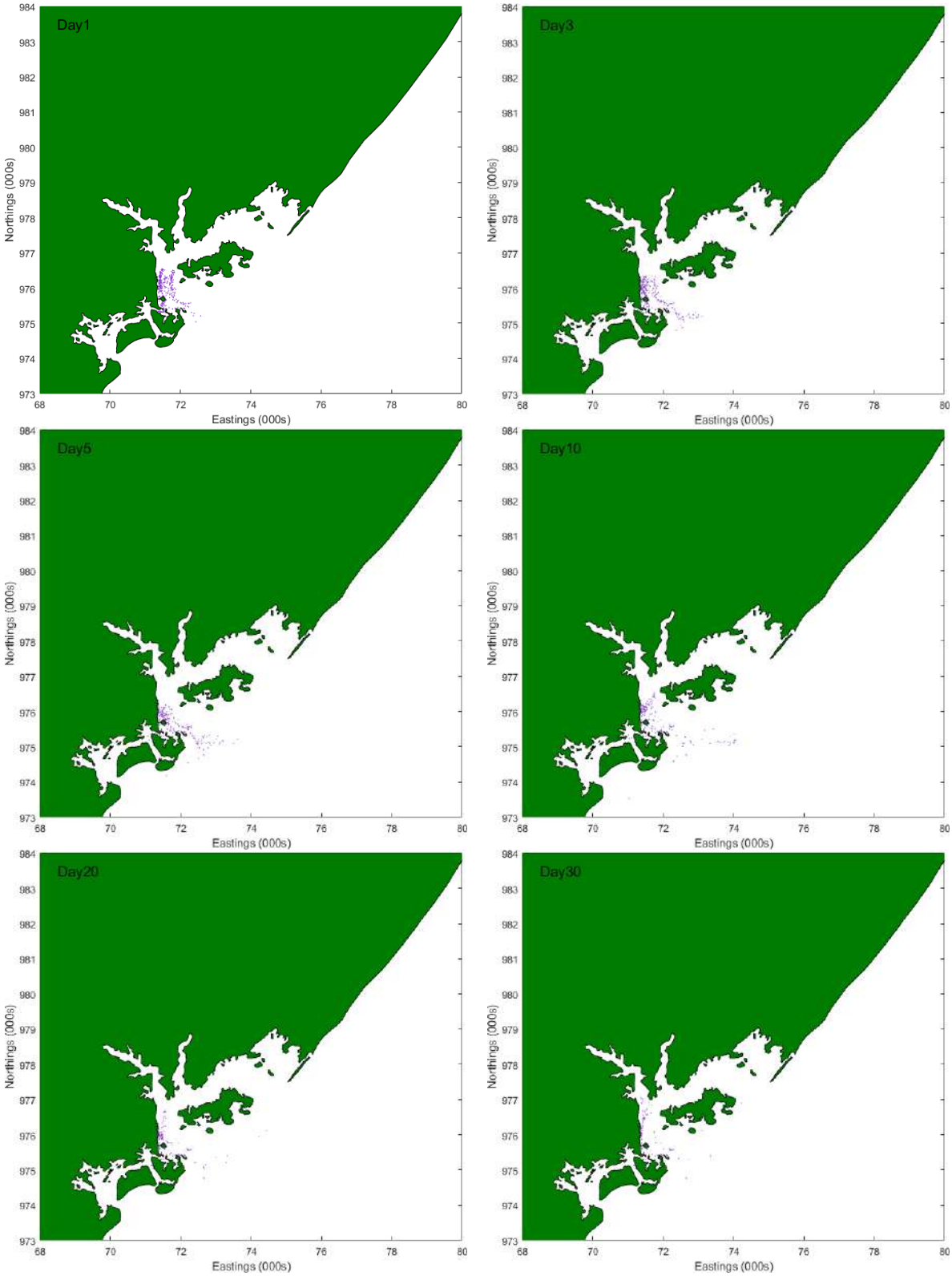


Figure 53. Scenario 3c: Spill impact during first 30 days of scenario, Transition Period

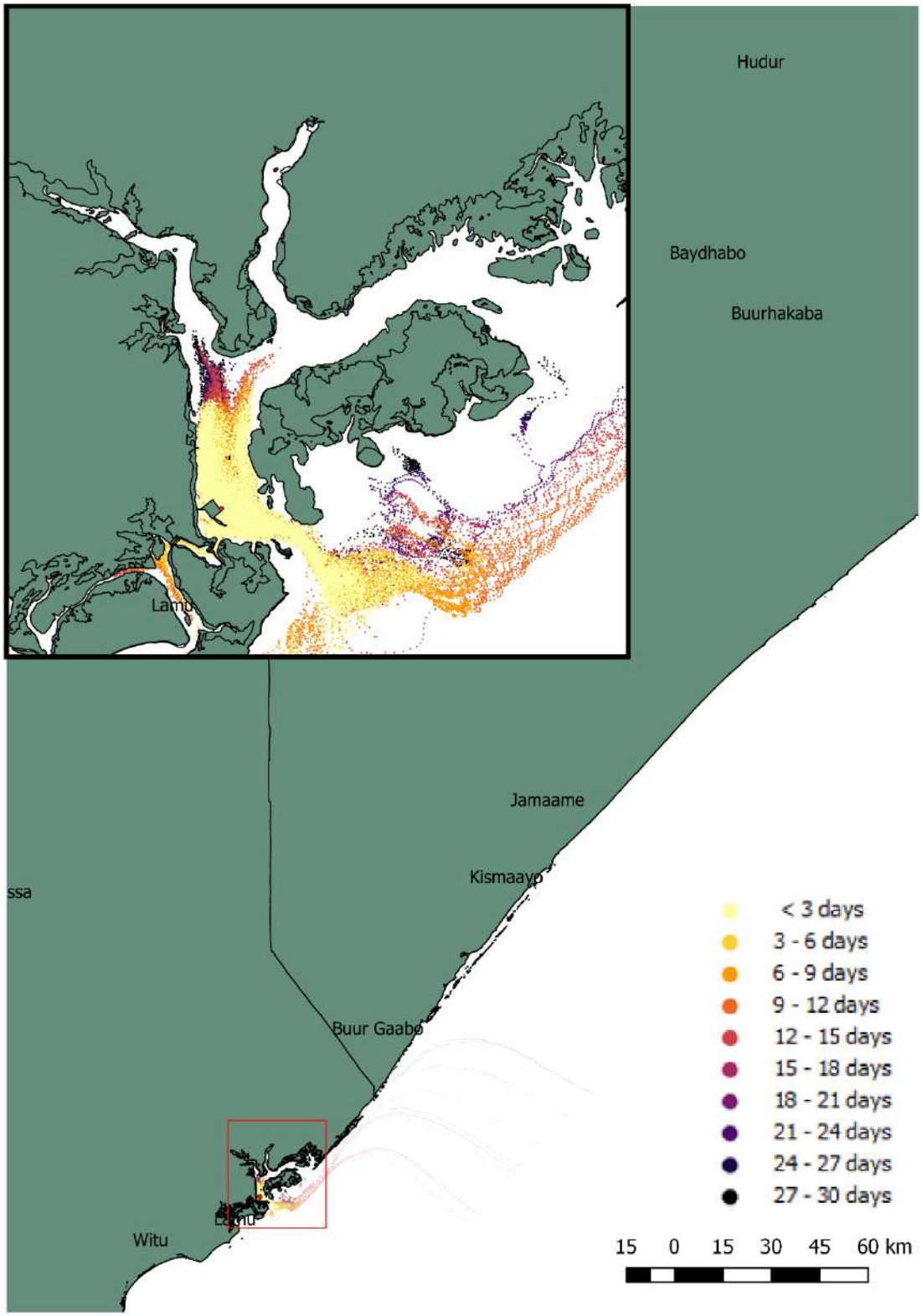


Figure 54. Scenario 3c: Total area impacted and minimum arrival time, Transition Period

Scenario 4c: Spill of 5,000 bbls during Transition Period, release during flooding spring tide

An offloading spill, consisting of 5,000 bbls, has been modelled for typical conditions during a Transition Period. The release volume has been spread over a 6-hour period during a flooding spring tide.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S04c.avi).

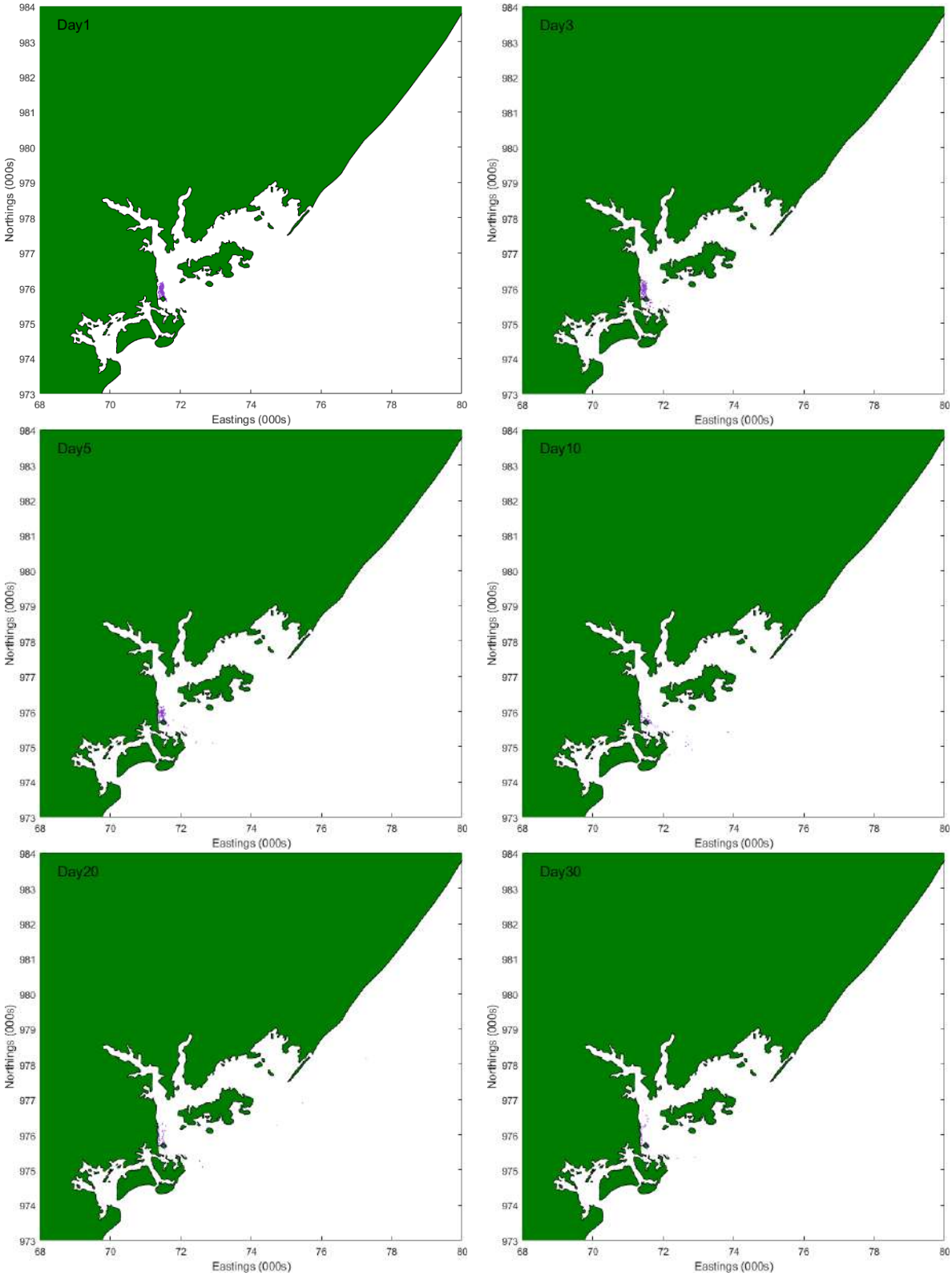


Figure 55. Scenario 4c: Spill impact during first 30 days of scenario, Transition Period

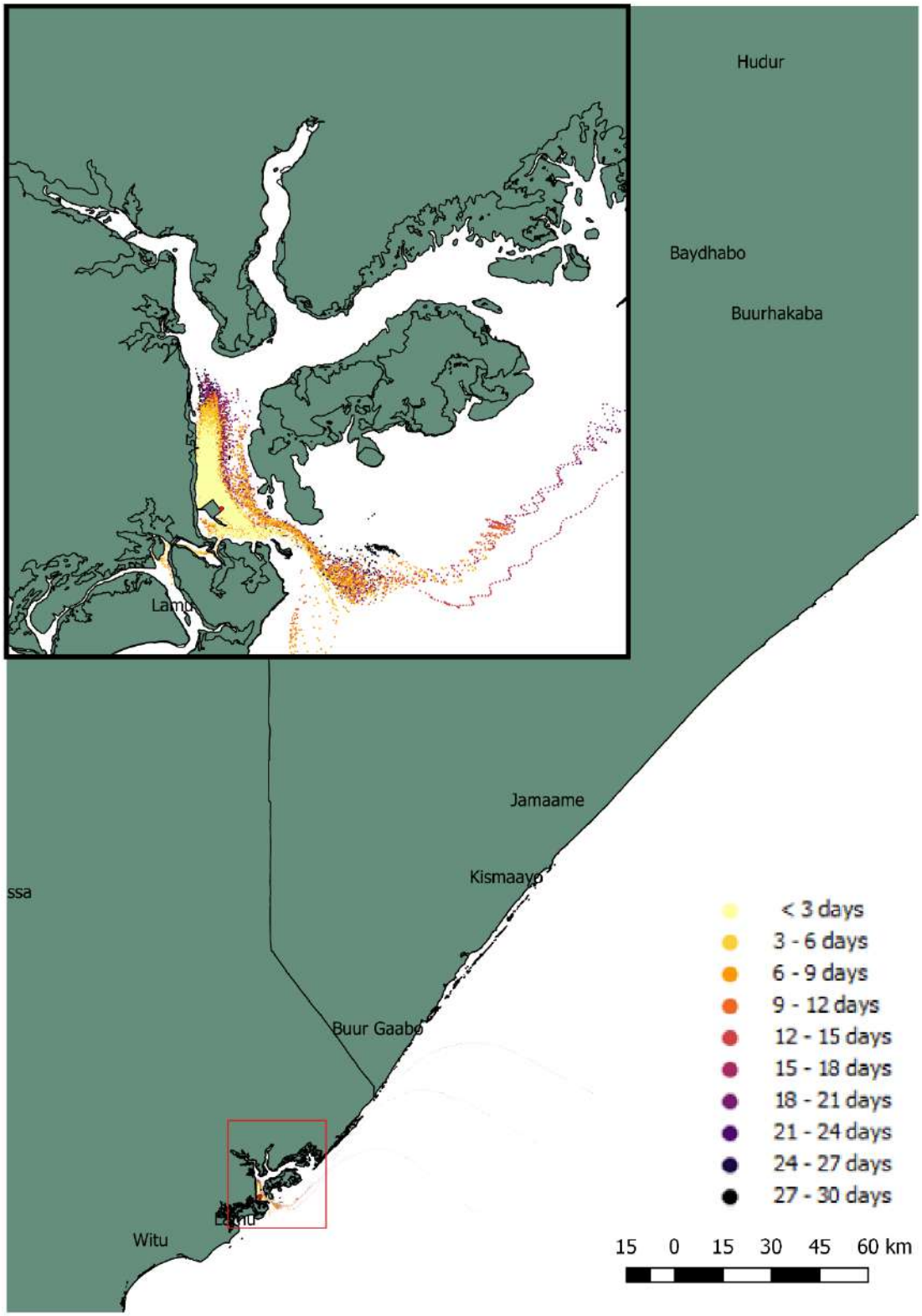


Figure 56. Scenario 4c: Total area impacted and minimum arrival time, Transition Period

5 Discussion

A selection of representative spill scenarios covering various release rates, seasons and tidal states have been modelled. The modelling supports the team's pre-assessment hypothesis that any spilled oil will emulsify quickly and will be largely unaffected by weathering processes such as evaporation and dispersion. Although the crude oil is not likely to spread in the same way as a conventional crude, it is likely to travel significant distance due to its persistence in the marine environment. All scenarios modelled are show oiling on both a local and regional scale, with all scenarios having some impact in Kenyan and Somalian waters.

In each of the three seasons simulated (SW Monsoon, NE Monsoon and Transition between SW and NE Monsoon) heavy oiling in the Manda Channel and local mangroves is expected. For the scenarios modelled, shoreline oiling is likely to occur in less than three days from release, regardless of the season.

The heaviest localised oiling is expected during the NE Monsoon and the transition period due to the onshore winds that help keep oil in the embayment. It should be noted that vegetation such as mangroves are not represented in the model. In reality, it is expected that oil would become entrained in vegetation at one tide and then 're-mobilised' into the flow during the next tide hence extending the area of oiling around the local inlets.

Upon entry into the open waters of the Indian Ocean, oil generally travels northwards in all three seasons. For Scenario's 1 and 2 (loss of two compartments, partial loss of one compartment) during the SW Monsoon, oil is transported northwards by a significant residual current and some oil components could reach as far north as Mogadishu within 30 days. However, it should be noted that once oil reaches the open ocean it will be subject to more intensive weathering, from factors such as an increased wave climate. It is known from the oil composition (Wood, 2018) and laboratory tests (Kernow Analytical Technology, 2018) that the oil is likely to solidify once it enters the marine environment and laboratory tests have also shown wave activity to break up the solidified oil into smaller particles. A high-resolution wave model has been developed to attempt to capture this process. However due to the unusual oil composition some far-field processes may be underrepresented.

The northern extent of oiling is predicted to be much smaller during the NE Monsoon and Transition period with oil being forced offshore between Buur Gaabo and Jamame where northerly and southerly currents meet forcing a lateral current to occur as shown in Figure 26 and Figure 27.

Scenario's 3 and 4 (offloading spill on ebb and flood flows respectively) are of interest, as they show a more likely spill occurrence and illustrate the impact of spilling oil at different states of tide. Scenario 4 occurs during a flood tide where water is flowing into the Manda Channel. This inward flow forces the oil to mainly stay within the localised area, whereas an ebb tide takes oil out of the estuary and hence has a larger northward coastal/offshore extent.

The scenarios modelled cover a range of significant spills from the catastrophic loss of two compartments to a worst-case offloading spill during the three key seasons. Mitigation such as containment and recovery, chemical dispersion and shoreline clean-up have not been modelled and therefore the scenarios can be considered as worst case. Whilst it is beyond the scope of this study to consider response options, it is clear that oil spill response equipment will need to be available in the local area to help minimise damage caused by any incident. As the spill is likely to be transboundary it may be necessary to co-operate with Somalia. For the larger spills, prioritisation of the most sensitive areas would need to be undertaken as it would be impossible to protect all receptors. Given the extremely high viscosity of the oil, containment and recovery is likely to be the most successful response option.

6 References

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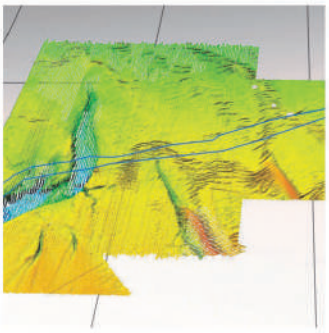
7 Abbreviations/Acronyms

2D	Two-Dimension(al)
AfraMax	Medium-sized crude tanker with a DWT ranging between 80,000 and 120,000 (Average Freight Rate Assessment)
bbl	Barrel of Oil
CAD	Computer Aided Drawing
CFSR	Climate Forecast System Reanalysis
cP	Centipoise
d	Day(s)
deg	Degree(s)
DTU	Technical University of Denmark (Denmark's National Space Institute)
DTU10	A global ocean tide model (DTU)
DWT	Dead Weight Tonnage
ESIA	Environmental and Social Impact Assessment
FSO	Floating Storage and Offloading
g	Gram(s)
GEBCO	General Bathymetric Chart of Oceans
GIS	Geographical Information System
hr	Hour(s)
HYCOM	Hybrid Coordinate Ocean Model
ITCZ	Inter-Tropical Convergence Zone
ITOPF	International Tanker Owners Pollution Federation Limited
kg	Kilogram(s)
LLCOP	Lokichar to Lamu Crude Oil Pipeline Project
m	Metre(s)
Mbbl	Million Barrels of Oil
min	Minute(s)
mol	Mole(s) *(the base unit of amount of substance)*
MSL	Mean Sea Level
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
OS	Oil Spill Model
PPMT	Pipeline Project Management Team
SuezMax	Medium to large-sized ships with a DWT between 120,000 to 200,000 (Suez Canal Maximum Laden Capacity)
UKHO	United Kingdom Hydrographic Office
VLCC	Very Large Crude Carrier
WAVEWATCH III	Third Generation Wave Model (NOAA/NCEP)

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices



Innovative Thinking - Sustainable Solutions

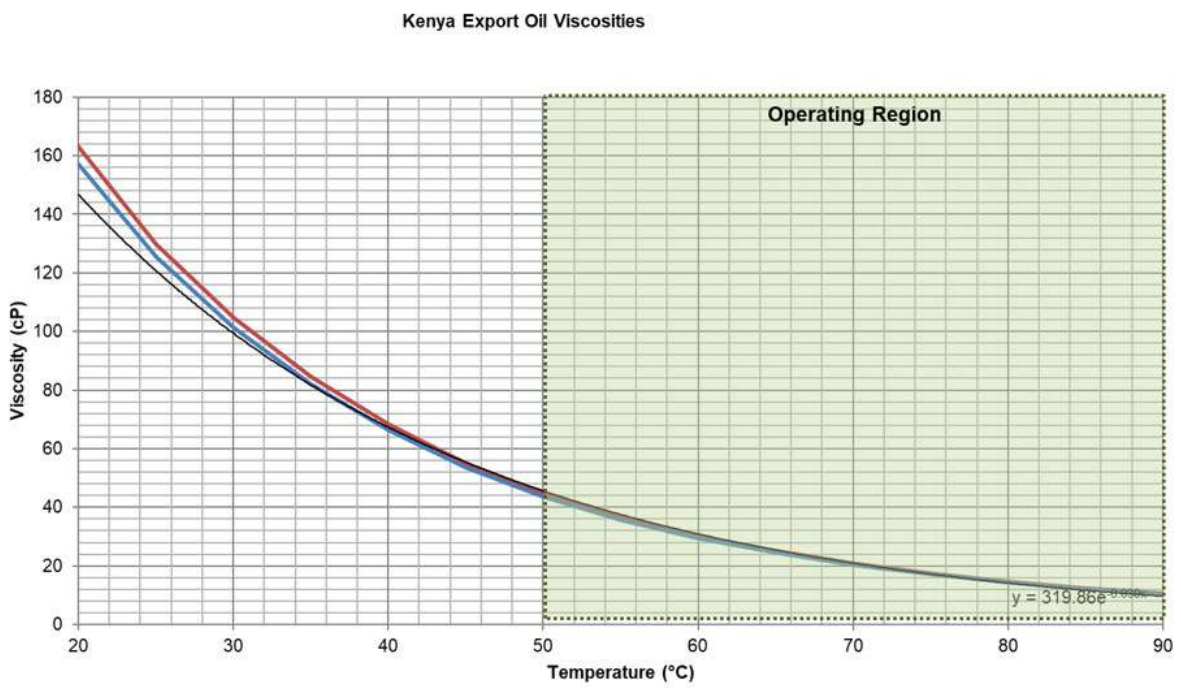
ABP mer

A Data Register

Data	Sender	Date Received (2019)	Used
Survey data of Lamu Port (hard copy) *04_A3-~F Lamu Port Area Survey Results.pdf*	Golder	11/02	Reference only
Survey data of Lamu Port (hard copy) *05_A3~13 Lamu Port Area Survey Results.pdf*	Golder	11/02	Reference only
Contour levels on top of weathered rock (hard copy) *06_A3~16 Contoured Level of Weathered Rock.pdf*	Golder	11/02	Reference only
GIS map of jetty location *JettyLocation_20190109.pdf*	Golder	11/02	Used in report
CAD drawings of berth *LLCOP-WOD-CS-DWG-0069_0.pdf*	Golder	11/02	Used to deepen bathymetry
Oil characterisation report *LLCOP-WOD-PR-REP-0001_0 Kenya Export Pipeline Fluid Characterisation (2).pdf*	Golder	11/02	Parametrization of oil
CAD drawing of bathymetric survey *1. Bathymetric Survey CAD file.dwg*	Africaoil	07/03	Used in model bathymetry
CAD drawings and raw data of bathymetric survey (phase 1-3) *Bathymetric survey raw (Phase 1~3).dwg* *Bathymetric survey contour (phase 1~ 3).dwg* Raw data(Phase ó±~phase ó¾).xls	Africaoil	07/03	Used in model bathymetry
CAD drawings and bathymetric survey (phase 4) of channel *BATHYMETRIC SURVEY OF CHANEL(4-4).dwg* *BATHYMETRIC SURVEY OF CHANEL RAW(4-2 4-3).dwg* *BATHYMETRIC SURVEY OF CHANEL CONTOUR(4-2 4-3).dwg* *2. Raw data(CHANEL).xls* *Tide Observation Sheet.pdf*	Africaoil	07/03	Used in model bathymetry
Marine Baseline Report *1772867.553.207.D0 - Marine_Baseline_Report (DRAFT)_v1_current.pdf*	Africaoil	07/03	Used to understand impact of oiling
Metocean report *1772867.562_LLCOP_Met_Baseline_B.0_Feb19_v1_current.pdf*	Africaoil	07/03	Used to verify hydrodynamic-wave model
Digitised bathymetry *Bathymetry.zip*	Golder	07/03	Used in model bathymetry
Lab study oil type *2133 Tullow Oil Spill Study - Kat Lab Sent to ABP Mer.pdf*	Tullow	08/03	Used to characterise oil
Chart *3362-0.tif*	Marine Find	12/03	Digitised in model bathymetry and included in report
Fluid compositions *LLCOP Fluid Compositions.xlsx*	Tullow	13/03	Used to characterise oil
Oil spill videos	Tullow	14/03	Used to verify results
V1-2-Present Conditions and Potential of LAPSSET Corridor Areas (tide and flow conditions available from page 39 onwards	Tullow	19/03	Used to verify coupled hydrodynamic- wave model
Oil_Parameterization_comments by PPMT.xlsx	Tullow	26/03	Included in report
Shapefile of berths	Ian Milligan	03/04	Used in model bathymetry

B Oil Parameterisation

Additional Oil Parameters (Non-Default Values Shown in **Bold**)	Values
Select between a simple, time dependent (=1, default) or detailed (=0) evaporation formula	1
Detailed Evaporation: Schmidt number	2.7
Detailed Evaporation: Average molecular weight of volatile fraction of oil	122
Detailed Evaporation: Vapor pressure of volatile fraction	0.00017
Simple Evaporation: select logarithmic or quadratic oil type (logarithmic=0, quadratic=1)	0
Simple evaporation formulation: distillation percentage (by weight) at 180 deg.C	0
Simple evaporation formulation, 1st oil specific constant	2.67
Simple evaporation formulation, 2nd oil specific constant for temperature dependency	0.06
Spreading: Terminal thickness	0.0001
Biodegradation volatile fraction: Decay rate	0.005
Biodegradation heavy fraction: Decay rate	0
Emulsification: Maximum water fraction	**0**
Emulsification: Constant Kao equal 3.3 at 293 K	3.3
Emulsification: Constant Kaw equal 200 at 293 K	200
Emulsification: emulsion rate	1.00E-06
Buoyancy: Density of original oil, volatile fraction (20 deg. C)	**860 kg/m^3**
Buoyancy: Density of original oil, heavy fraction (20 deg. C)	**860 kg/m^3**
Water solubility: volatile fraction	2.00E-05
Water solubility: heavy fraction	2.00E-07
Volumetric temperature expansion coefficient volatile oilfraction	0.0007
Volumetric temperature expansion coefficient heavy oilfraction	0.0007
Photooxidation volatile fraction: Decay rate at 100 watt/m^2	0
Photooxidation heavy fraction: Decay rate at 100 watt/m^2	0
Photooxidation: Light extinction coefficient	1
Dissolution: Rate, light fraction	0.4
Dissolution: Rate, heavy fraction	0.4
Vertical dispersion: Wind speed for initiation of wave breaking	5
Vertical dispersion: wave energy dissipation rate per unit volume	1000
Max distance below surface to belong to surface amount	0.05
Distance above bed to belong to bottom amount	0.05
Mooney constant in the viscosity-equation	0.7
Dynamic oil viscosity at reference temperature *	**34 cP**
Reference temperature for dynamic oil viscosity	**57°C**
Coefficient for exponential temperature dependency of viscosity	**-0.039**
Oil Area growth rate constant	150
Particles with a total oil mass below this threshold will be removed	0.001
Depth where extra output layer starts	0
Depth where extra output layer ends	10
Vertical dispersion: on-off switch (0=off, 1=on)	1
Evaporation: on-off switch (1=on, 0=off)	1
Biodegradation: on-off switch (1=on, 0=off)	1
Photo-oxidation: on-off switch (1=on, 0=off)	1
Surface dissolution: on-off switch (1=on, 0=off)	1
Water column dissolution: on-off switch (1=on, 0=off)	1
Water uptake: on-off switch (1=on, 0=off)	1
Water release: on-off switch (1=on, 0=off)	1
Droplet diameter change: on-off switch (1=on, 0=off)	1
Area change: on-off switch (1=on, 0=off)	1
Disc spreading speed factor	150
radius factor for search functions	3
Mackay:(0t) or Fay(1,default)	1
Oil pour point for volatile oil fraction	**45°C**
Oil pour point for heavy oil fraction	**45°C**
* Relationship between temperature and viscosity is shown in Figure B1	



Source: Wood, 2018

Figure B1. Relationship between viscosity and temperature

C Additional Scenarios

Two additional spill scenarios, shown in Table C1, have been selected by PPMT and Golder to understand the difference between spilling one or two VLCC compartments.

All scenarios assume no response mitigation is undertaken and hence present a worse case situation. Each spill scenario has been modelled for 30 days; the extent of oiling is clear after this period.

Table C1. Oil spill scenarios

Scenario	Release Volume (bbl)	Oil Type	Seasons	Tidal State	Cases	Comment
Loss of one compartment	146,000	Waxy Crude	NE Monsoon Transition	N/A	2	This scenario assumes that each tank is of equal volume, then the maximum VLCC compartment volume is 146,000 bbl (15 compartments in a total of 2.2 Mbbl capacity).

C.1 Results

C.1.1 NE Monsoon

Scenario 5b: Spill of 146,000 bbls during NE Monsoon

The loss of one compartment, consisting of 146,000 bbls, has been modelled for typical conditions during a NE Monsoon. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S05b.avi).

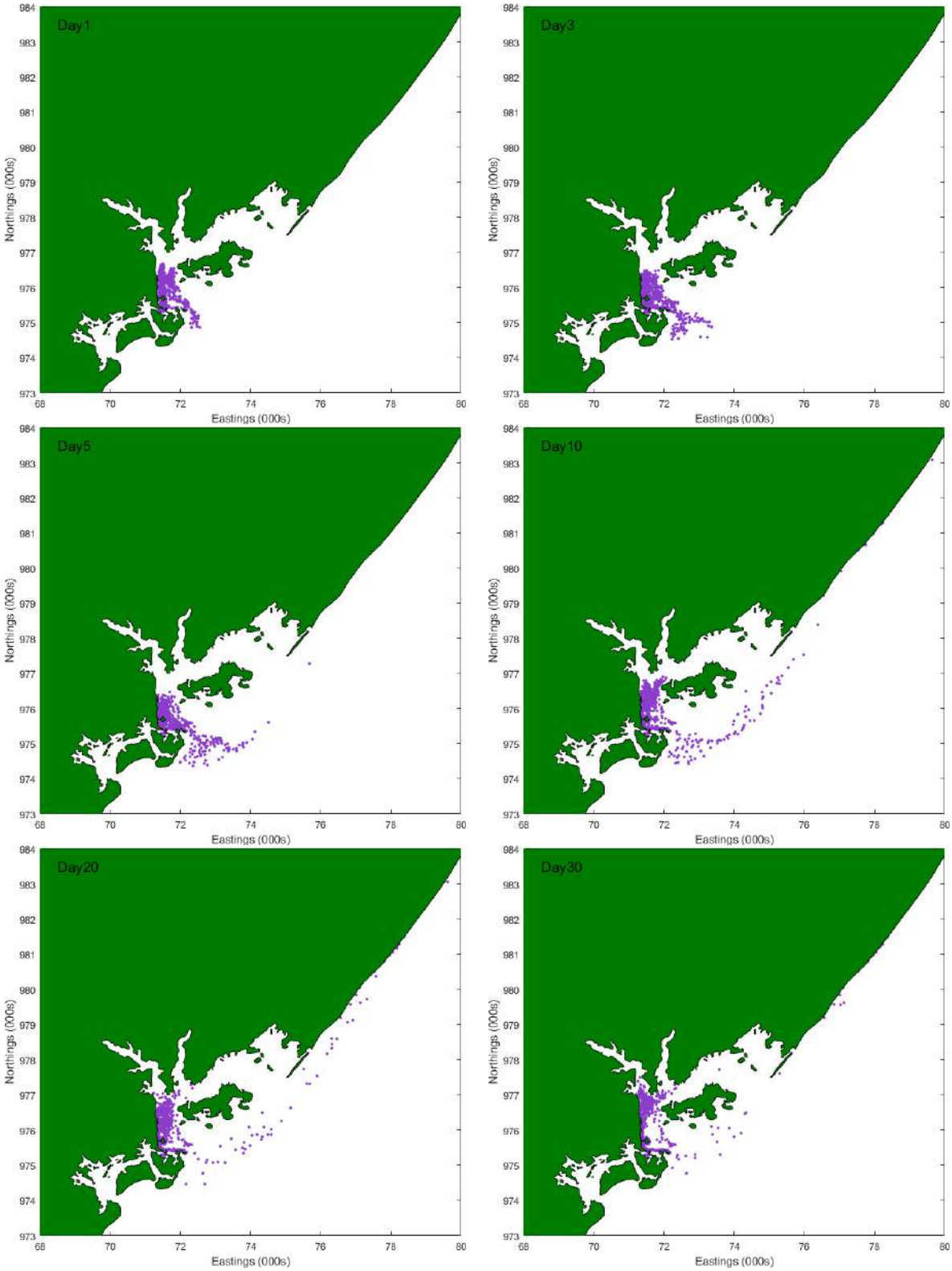


Figure C1. Scenario 5b: spill impact during first 30 days of scenario, NE Monsoon

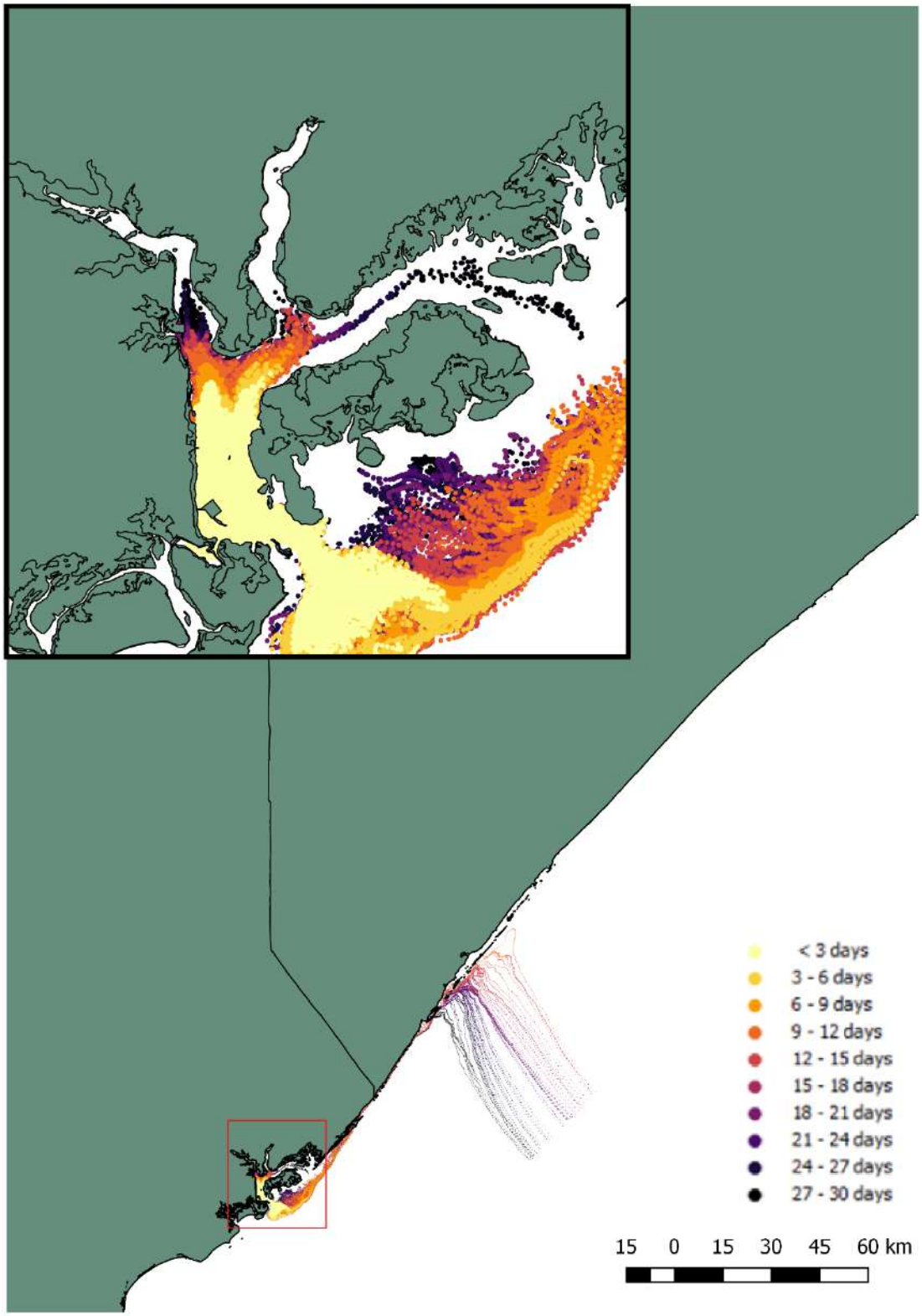


Figure C2. Scenario 5b: Total area impacted and minimum arrival time, NE Monsoon

C.1.2 Transition Period

Scenario 5c: Spill of 146,000 bbls during Transition Period

The loss of one compartment, consisting of 146,000 bbls, has been modelled for typical conditions during a Transition Period. Due to the size of the spill it has been necessary to release the volume over a 24-hour period and hence tidal state is not important.

The following results are presented:

- Maps of spill impact 1 day, 3 days, 5 days, 10 days, 20 days and 30 days following the release.
- Map of total area impacted and minimum arrival time during first 30 days.
- Video of spill model (S05c.avi).

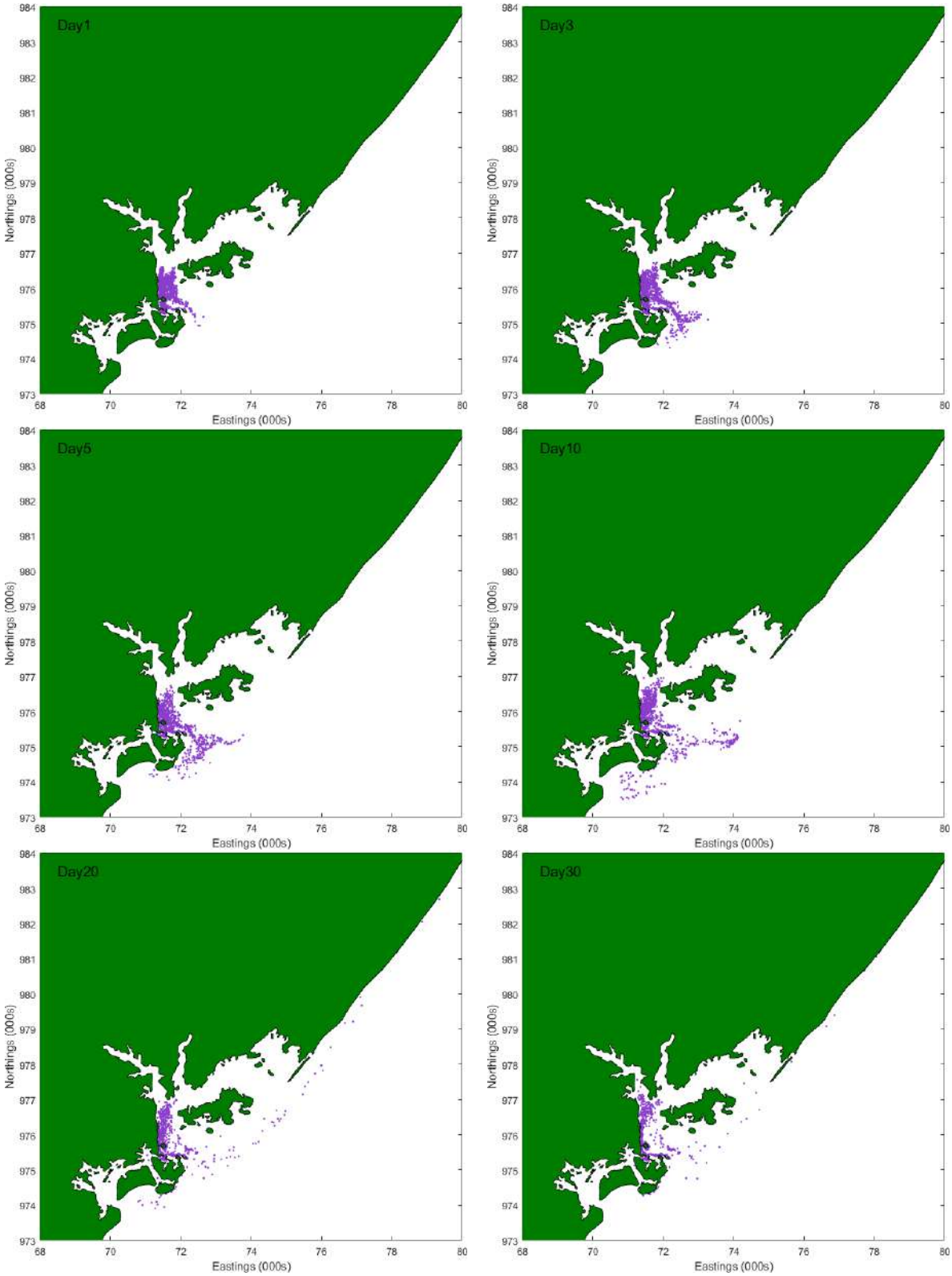


Figure C3. Scenario 5c: Spill impact during first 30 days of scenario, Transition Period

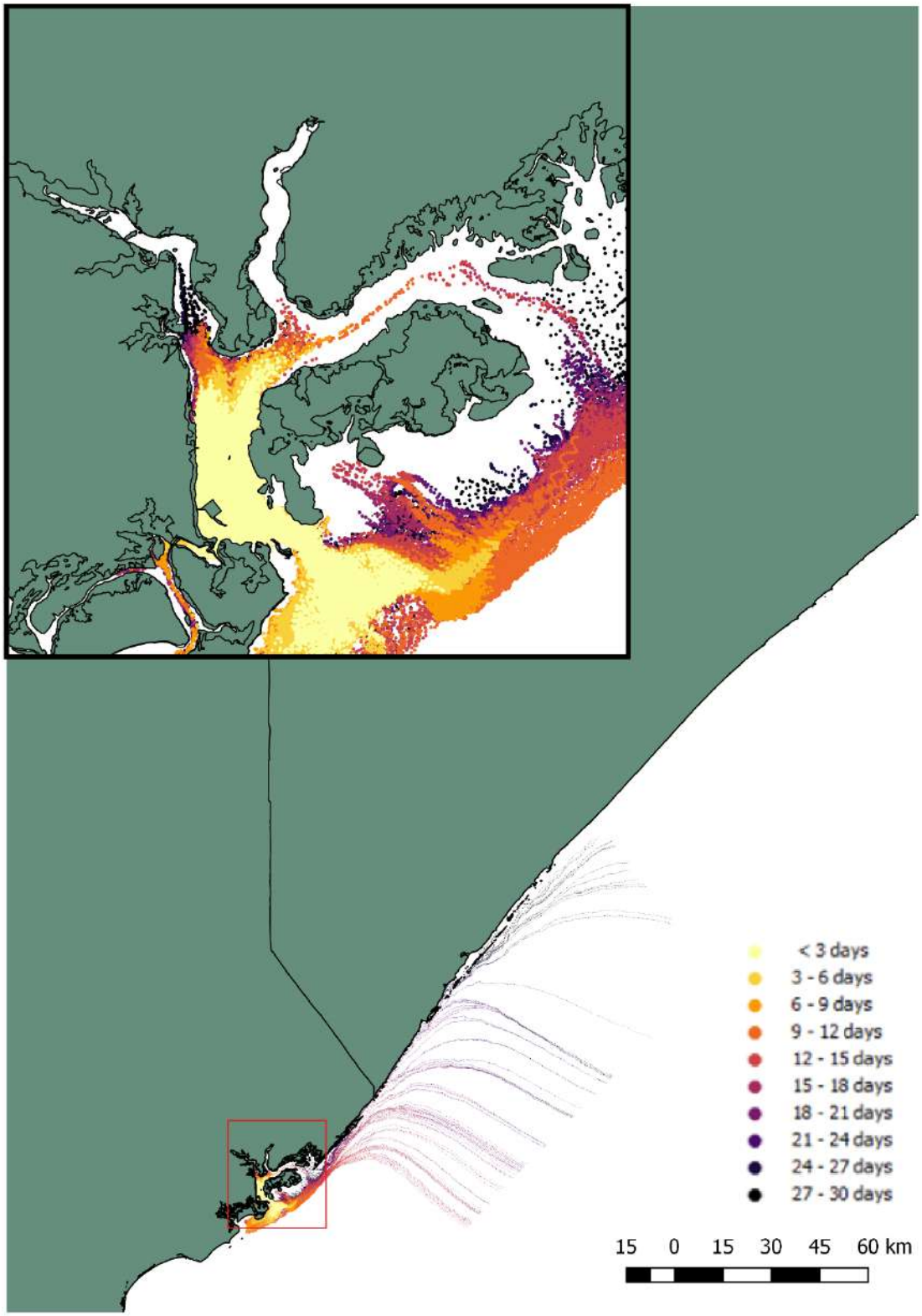


Figure C4. Scenario 5c: Total area impacted and minimum arrival time, Transition Period

C.2 Discussion of Additional Scenarios

The loss of a single compartment during the NE Monsoon and transition between SW and NE Monsoon have been modelled for comparison with the loss of two compartments during these respective seasons.

The two additional scenarios that have been modelled show a very similar pattern to results in Section 4.3 of the report. Both scenarios show oiling on a local and regional scale, having impact in Kenyan and Somalian waters and reaching local shorelines within three days.

Local impacts are still significant but are likely to be reduced when compared with the loss of two compartments with the spill not penetrating as far into the nearby channels. The regional scale impacts tend to be broadly similar in terms of distance travelled from the spill however it is clear that the loss of two components would result in a larger volume of oil affecting the offshore environment.

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