Appendix A: Baseline Reports

February 2020

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January 2020

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GLOSSARY AND ACRONYMS

A	
AOI	area of influence
B	
bioquality	aspect of a plant community's conservation value, derived from the concentration of restricted range species occurring in the community.
Black Star species	plant species of highest conservation concern as a result of their very small global area of occupancy
Blue Star species	plant species of modest conservation concern as a result of their somewhat restricted global range (24 degrees square on average)
C	
CHA	critical habitat assessment
D	
DMU	discrete management unit – defined in IFC PS6 as an area with a definable boundary within which the biological communities or management matters have more in common with each other than they do with those in adjacent areas
E	
edaphic	of, produced by, or influenced by the soil
ESIA	environmental and social impact assessment
F	
FR	forest reserve
G	
GHI	Genetic Heat Index – a measure of the conservation importance of vegetation. High index represents higher importance. A continuous metric used to measure bioquality
Gold Star species	plant species of high conservation concern as a result of their small global area of occupancy
Green Star species	plant species of no conservation concern with respect to their area of occupancy. Could be of concern due to other characteristics, such as local use, or ecological dominance
I	
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
K	
KBA	key biodiversity area
KP	kilometre point

L	
LIDAR	light detection and ranging: an airborne or satellite-borne detection system that works on the principle of radar, but uses light from a laser and is used to map topography
M	
MCPY	main camp and pipe yard
P	
PS6	IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
R	
RBS	Rapid Botanic Survey
RoW	right-of-way
S	
sp. and spp.	abbreviation of species, singular and plural
Star rating	conservation rating for a species derived from the global range of the plant species, in terms of the number of degree squares in which a species is recorded as being present in (worldwide)
W	
WCS	Wildlife Conservation Society, Uganda

A1 BOTANY BIODIVERSITY BASELINE REPORT

A1.1 Introduction

This baseline report describes the habitats and flora:

- area of influence (AOI) and study area boundaries
- methods
- baseline conditions:
  - floral communities of conservation importance
  - floral species of conservation importance
  - forest reserves (FRs) and other protected areas
  - ecosystem services provided
  - sensitivity rankings
- key considerations.

FRs and other protected areas are included in this baseline report to assess the conservation importance of those protected areas in terms of habitat structure and quality, to identify the presence of vascular plants of conservation importance and to identify current threats and management measures focused on habitats and species of conservation importance.

This baseline report also provides the necessary data for the critical habitat assessment (CHA), see Section 8 and Appendix B.

A1.2 Area of Influence and Study Area Boundaries

A1.2.1 Area of Influence Boundary

The spatial AOI encompasses the project footprint and areas within an ecologically relevant distance of the project to account for habitat connectivity and potential direct and indirect project-related impacts (i.e., effects of habitat loss, facilitated access, habitat fragmentation, edge effects and spread of invasive species).

Where appropriate, the AOI includes downstream wetland and riparian habitats that are potentially at risk from project-related impacts (e.g., from accidental spills or sedimentation). Using a precautionary approach, the spatial AOI for habitats of conservation importance was generally defined by a 2-km-wide corridor centred on the pipeline route. The AOI therefore includes habitats associated with Lake Albert.

In accordance with International Finance Corporation Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC PS6) (IFC 2012), the AOI can be extended to incorporate the entirety of any discrete management units (DMU) identified by the CHA.

Most impacts to habitats, protected areas and species of conservation importance will occur during the construction phase and early operation. Indirect impacts such as human influx, including access to previously difficult-to-access land, may extend

beyond this duration. As such, the temporal AOI is defined as the construction period and the time required for habitat to be re-established to preconstruction condition. For new access roads and parts of construction facilities that may be transferred with the land to a third party when no longer needed for project use, the impacts will be considered permanent.

A1.2.2 Study Area Boundary

The study area is the same as the AOI; this provided a sufficient area over which to assess the potential effects of the project.

The 2-km-wide corridor was the focus of the habitat mapping work (Section A1.2.4). A map of the sites surveyed is provided in Section A1.2.4.1.

A1.2.3 Secondary Data

Secondary data were used to inform survey site selection, provide context to the information returned from the field surveys and to identify critical habitat qualifying features.

Secondary data sources included:

- light detection and ranging (LIDAR) data and satellite imagery (see Section A1.2.4.1)
- Protected Planet (2018)
- The Vegetation of Africa, a Descriptive Memoir (White 1983) – to Accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa
- International Union for Conservation of Nature (IUCN) Red List of Threatened Species (2017-3) database
- Ugandan Red List (WCS 2016)
- Global Invasive Species Database – Version 2015.1 (April 2018)
- citation sheets and management plans for protected areas, where available
- Field Guide to Common Trees and Shrubs of East Africa (Dharani 2011)
- Field Guide to Acacia of East Africa (Dharani 2006)
- The diversity and distribution of climbers and trellises in some forests of the Albertine Rift, western Uganda (Eilu 2003)
- Flora of Tropical East Africa (FTEA) 1948–2012 (Royal Botanic Gardens, Kew 2016)
- Density and diversity of tree species in forests of the Albertine Rift, western Uganda (Eilu, Hafashimana and Kasenene 2004)
- Distribution patterns of forest trees in Uganda and their historical significance (Hamilton 1974)
- Nature conservation in Uganda’s protected forest reserves (Howard 1991)
- Diversity and distribution of vascular plants in the Important Bird Areas of Uganda (Kalema 2005)
- Patterns of plant diversity in Uganda (Kalema and Bukenya-Ziraba 2005)
- Conservation checklist of the trees of Uganda (Kalema and Beentje 2012)
- The use of herbarium plant databases in identifying areas of biodiversity (Kalema 2008)

- concentration: the case of family Acanthaceae in Uganda
- Kenya trees, shrubs and lianas (Beentje 1994)
- publicly available scientific literature, information and studies
- environmental and social impact assessments (ESIAs) and other technical studies relevant to the AOI
- biodiversity baseline survey data collected by the Wildlife Conservation Society (WCS) on behalf of the Tilenga Project (Attachment A1.6).

A1.2.4 Habitat Mapping

Habitat mapping was undertaken using remote sensing, which is an effective approach used to map remote habitats across large areas. It was then refined using data collected from the botanical field surveys.

A1.2.4.1 Data Acquisition

The European Space Agency's Sentinel-2 satellite imagery was considered the most suitable for habitat mapping owing to its 10-m pixel size, 10 multispectral bands and five-day repeat coverage. Wet and dry season imagery was acquired to observe seasonal changes to key habitat types. Figure A1.2-1 shows the Sentinel-2 coverage along the pipeline route.

Four separate images were required to cover the full extent of the Tilenga Project in Uganda. Table A1.2-1 summarises the acquisition date for each Sentinel-2 image used in the habitat mapping. The project area's proximity to the lower left corner of Tile 36NUG resulted in it having to be covered using two different images.

In addition to satellite imagery, the following data sets have been used in the mapping:

- tree height data derived from LIDAR surveys undertaken as part of the Upstream Project
- slope data derived from the LIDAR Digital Elevation Model
- very-high-resolution aerial imagery
- existing Africover land cover mapping (FAO).

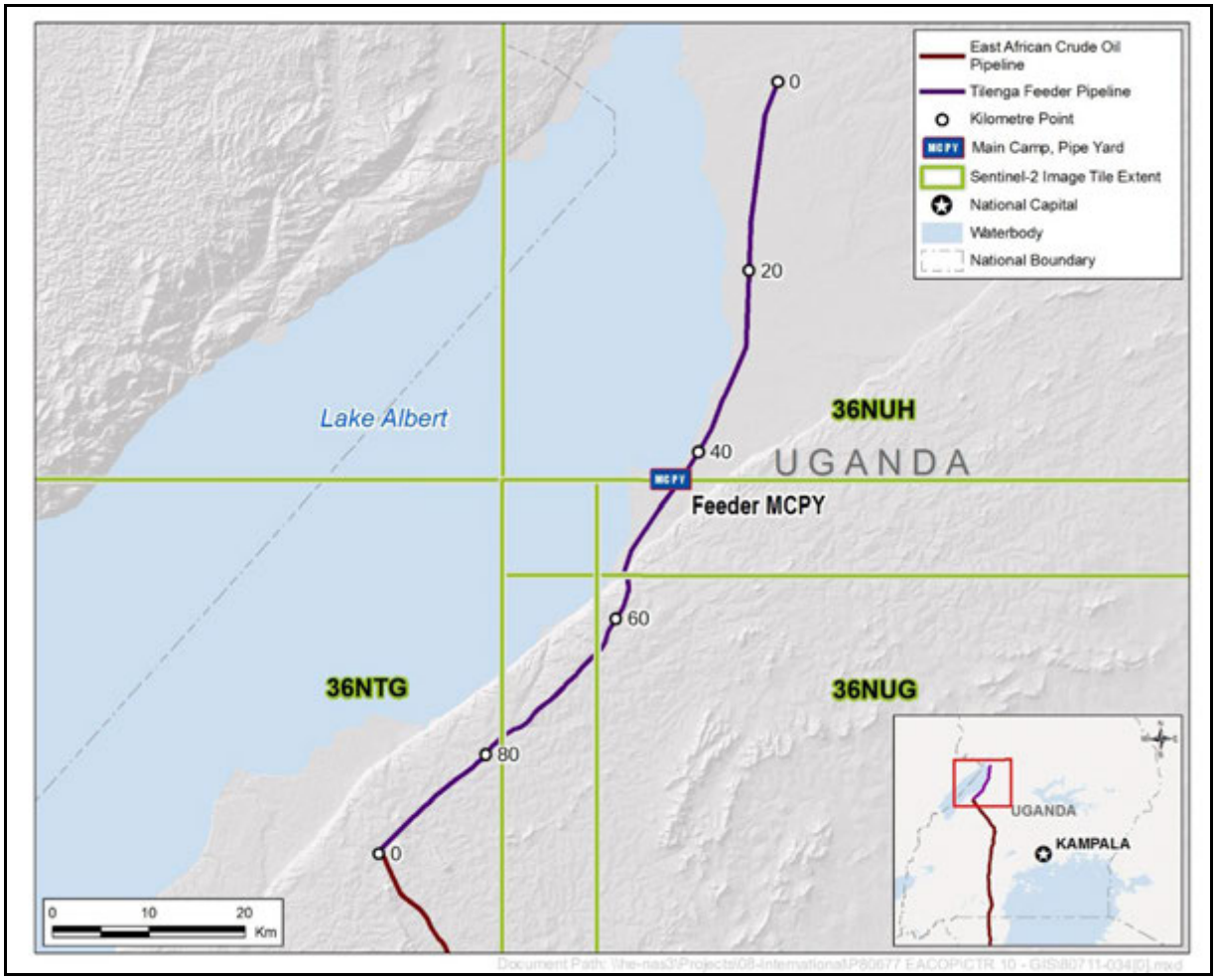


Figure A1.2-1 Satellite Image Coverage of the Pipeline Corridor

Table A1.2-1 Sentinel-2 Image Capture Dates

Image Tile Name	Image Acquisition Date	
	Dry Season	Wet Season
36NUH	23 January 2018	19 December 2016
36NTG	14 December 2017	7 June 2017
36NUG	14 December 2017 (West)	7 June 2017 (West)
	15 January 2017 (East)	6 December 2016 (East)

A1.2.4.2 Image Preparation and Enhancement

Each of the satellite images was enhanced using specialist software to reduce effects such as topographic shading, light and shadows from solar illumination and forest fires. Each Sentinel-2 image was clipped to match the 2-km-wide corridor.

A1.2.4.3 Integration of Survey Data into Vegetation Mapping

Physiognomic habitat classes were selected for mapping using the satellite imagery based on their occurrence throughout the project area and readily distinguishable differences in height and density. These habitat classes, shown in Table A1.2-2, are derived primarily from the physiognomic types defined by White (1983).

The data collected during the botanical surveys was used with the high-resolution aerial imagery to inform the analysis of the satellite imagery into the physiognomic habitat classes; see Attachment A1.1 Habitat Map. One of the key benefits of using remote sensing to map physiognomic habitat class is the ability to generate mapping over a very large area using data from a limited number of known sites. For each of the four images, a minimum of 10 example sites were studied for each of the physiognomic habitat classes present in the AOI.

Table A1.2-2 Physiognomic Habitat Classes in the Study Area

Habitat Class	Summary of Description
Natural Habitats	
Forest	Semi-evergreen rainforest, with canopy >10 m high and emergent trees evident. Crowns generally interlocking
Wetland Forest	Tall woody vegetation (>10 m in height) occurring within lower parts of the landscape with evidence of inundation or proximal to other wetland vegetation
Woodland	Open stands of trees of at least 8 m in height – canopy cover of 40% or more. Crowns never interlocking. Usually a layer of grass species dominates ground-level vegetation
Bushland	Open stands of bushes (usually 3–7 m tall) with a canopy cover of 40% or more
Wooded Grassland	Open woodland habitat dominated by *Combretum* sp. around native grasslands. Trees >7 m tall, bushes (3–7 m), dwarf trees and shrubs <2 m tall
Wetland	Permanent or seasonally inundated wetland area dominated by closed canopy of papyrus. Habitat periodically harvested in large uninterrupted tracts
Modified Habitats	
Shrubland	Open or closed stands of shrubs up to 2 m tall
Cultivation/ Pasture	Mosaic of small-scale cropping, fallow, tree-crops (banana or coffee) and human settlements. A modified grassland habitat with clear evidence of livestock grazing
Plantation	Monoculture of woody species cultivated for timber production

A1.2.4.4 Classification of Imagery in Habitat Maps

Each Sentinel-2 tile was processed using the Random Forests algorithm in the ERDAS IMAGINE geospatial tool; this allocates a habitat type, based on the statistical similarity, to each homogeneous area. This is a widely recognised geospatial tool commonly used to map large areas.

Following the automated classification of physiognomic habitat classes described above, the ESIA project team corrected any anomalies in the classification of the habitat types.

Maps showing the habitat types are presented in Attachment A1.1.

A1.2.4.5 Categorisation into Modified and Natural Habitats

Habitat were further categorised into modified and natural habitats in accordance with IFC Performance Standard 6 criteria (IFC 2012), which defines these as follows:

- Natural habitats are areas composed of viable assemblages of plant or animal species of largely native origin, or where human activity has not essentially modified an area's primary ecological functions and species composition.
- Modified habitats are areas of land that support a large proportion of flora and fauna species that are non-native in origin, or where human activity has substantially modified an area's primary ecological functions and species composition.

Areas composed of shrubland habitat were considered transitional habitat. These areas are included as modified habitats. The habitat map is presented in Attachment A1.1.

A1.2.5 Field Surveys

The baseline habitat and flora survey followed the RBS methodology (Hawthorne and Marshall 2016) and was undertaken by Dr James Kalema, Ahmad Bukenya, Kennedy Mullasa and Serunjugi Derick (botanical specialists from Makerere University) and Dr William Hawthorne and Dr Cicely Marshall (botanical specialists from the University of Oxford).

This approach is advantageous as the RBS assessment process addresses the data gaps of the IUCN Red List of Threatened Species (IUCN 2017) in which many vascular plants have not been evaluated; the IUCN Red List status of most plants in the study area is currently unknown.

The RBS assessment process is explained in more detail in Section A1.2.6.3 and the RBS manual (Hawthorne and Marshall 2016) is presented in Attachment A1.2.

The RBS has been used in a variety of projects around the world, including extractive industry projects that are funded by the World Bank and IFC, providing comparable data and indices for different regions (Hawthorne 1992, 1996; Hawthorne and Hughes 1997; Chua et al. 1998; Hughes et al. 1998; Tchouto 2004; Gordon et al. 2003, 2004; Hawthorne et al. 2007, 2008, 2009; Ndam et al. 2001; Marshall and Hawthorne 2012, 2013; Baksh-Comeau et al. 2016).

Within the AOI, the RBSs were undertaken in two phases, which included a portion of the wet and dry seasons. Phase 1 sampling was conducted between 4 May 2017 and 9 June 2017. Phase 2 sampling was conducted between 18 October 2017 and 14 November 2017. Local guides were employed to help the survey team find and access the sample sites.

Before the field work, 26 sample plots were established in key areas of natural homogenous vegetation within the study area, using satellite imagery and geographic information system data, with the aim of characterising the habitat types within the AOI, the right of way (RoW) and surrounding landscape.

Surveyors visited these 26 sample sites and used the RBS method to record or collect voucher specimens of all vascular plant species and assign an abundance category to each species. Canopy trees were recorded individually to give proportional estimates of species composition of the canopy. The altitude, landscape and soil type were also recorded for each sample site. Figure A1.2-2 shows the location of each sample site.

Voucher specimens were taken to the Makerere University Herbarium for identification. The identification of vouchers at Makerere University Herbarium was led by Dr James Kalema in coordination with international specialists.

A survey of the main camp and pipe yard (MCPY) was undertaken in August 2018. A biodiversity walkover assessment was employed rather than the RBS method, which included collecting information on the following parameters:

- inventory of habitat types, including modified and natural habitats (in accordance with the baseline assessment of the pipeline corridor) and existing threats to habitat quality
- habitats of conservation importance (in accordance with the botanical baseline assessment)
- habitats of conservation importance for priority species, i.e., fauna, avifauna, vascular plants and aquatic species that are nationally rare according to the Ugandan Red list (WCS 2016), globally rare (IUCN 2017), restricted range or endemic species, migratory species or congregatory species)
- priority vascular plant species i.e., nationally or globally rare, endemic or restricted range.

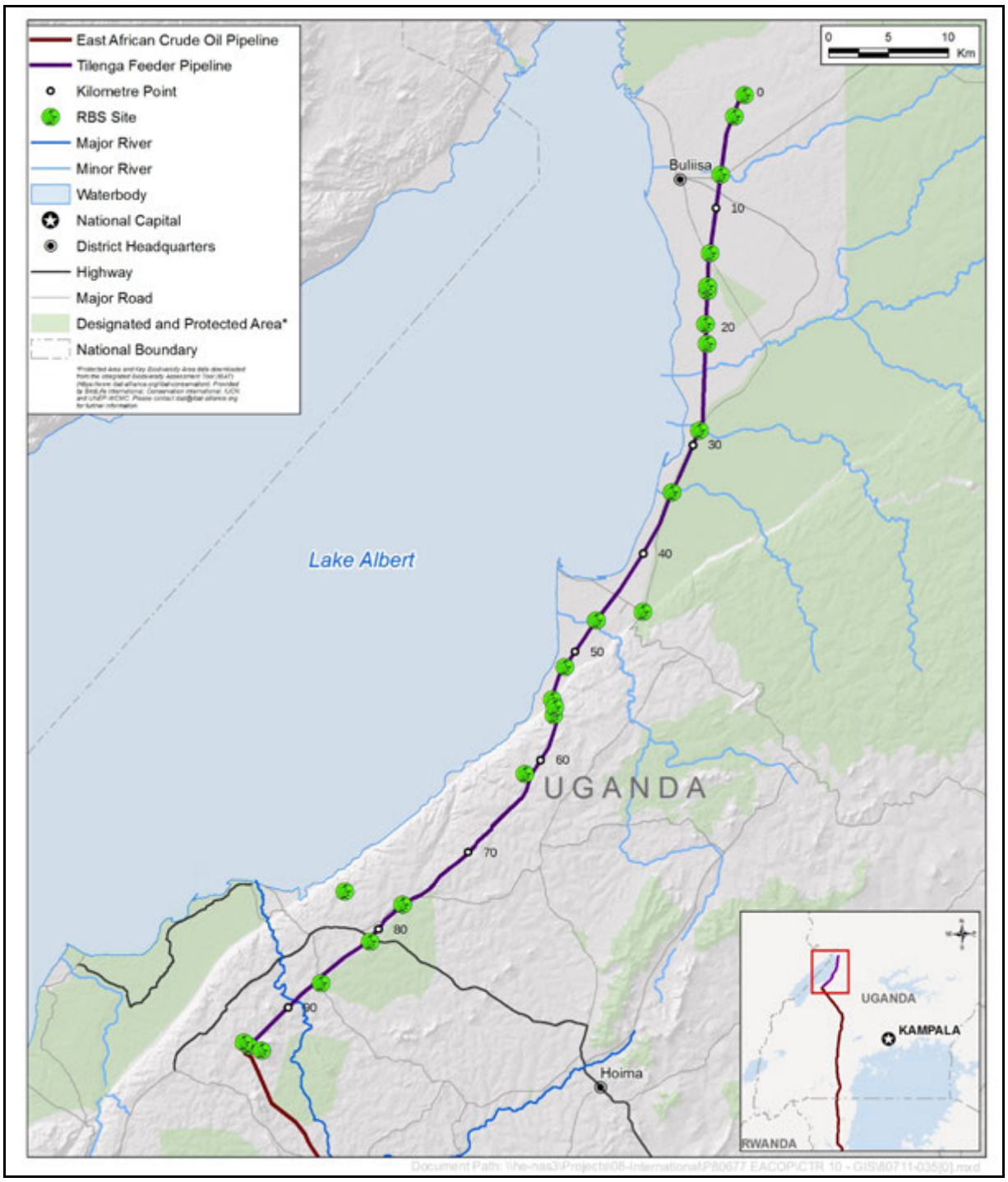


Figure A1.2-2 Sample Site Locations

A1.2.6 Data Analysis

Secondary data and the results of the field surveys were used to:

- characterise key habitats in the study area
- identify the presence of flora species of conservation importance i.e., nationally protected species, globally rare species and IUCN critically endangered, endangered and vulnerable species

- determine the bioquality of each habitat type; bioquality identifies how rare a particular species is relative to the global population of that species, as per RBS methodology.

A1.2.6.1 Identification of Habitat Types in the Study Area

The field data were analysed using a type of multivariate statistical analysis called ordination. Within the study area, four main habitats (or floristic vegetation groups) were identified, which were subdivided into vegetation types along the gradient of variation, namely:

- wetland and wetland forest comprising:
  - *Cyperus papyrus* dominated swamp
  - swampy grassland (with occasional woody species)
  - riverine and riparian forest
- *Acacia* sp. woodland, bushland, shrubland, thicket and wooded grassland, including:
  - very disturbed *Acacia* sp. woodland, wooded grassland and bushland
  - drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotic plant species
  - drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotic plant species; subgroup: *Combretum* woodland
  - *Acacia polyacantha* woodland in farmland
  - secondary thicket mixed with bushland species
- cultivated land.

Detailed descriptions of these habitats and vegetation types are presented in Attachment A1.3. A description of how these habitats and vegetation types align with the physiognomic habitat classes identified in the habitat map (Attachment1.1) is also presented in Attachment A1.3. Section A1.2.6.2 presents habitats of conservation importance with respect to the project AOI; all other habitat types, including those not of conservation importance along the RoW and in the broader region are presented in Attachment A1.3

A1.2.6.2 Identification of Habitats of Conservation Importance

The conservation value of each habitat was measured using the Genetic Heat Index (GHI) tool, which is an integral component of the RBS methodology (Hawthorne 1996, Hawthorne and Marshall 2016). The GHI tool estimates the botanical importance of the vegetation or plant communities based on a ranking of species rarity using star rating criteria (see Section A1.2.6.3) and identifies the concentration of globally rare species in a habitat. GHI scores are high where the habitat supports a high proportion of globally rare species; this is termed a hotspot (Marshall and Hawthorn 2016).

GHIs calculated for habitats across the whole of Africa range from 0 to 2700 (Marshall and Hawthorn 2016). Botanical specialists have confirmed that habitats in the AOI with a GHI between 150 and 249 are considered of moderate conservation importance, while those with a GHI over 250 are considered of global conservation importance.

A1.2.6.3 Identification of Species of Conservation Importance

In the context of this baseline assessment, vascular plants of conservation importance are defined as globally rare species, and endemic or restricted range species. Focus was given to species that may trigger critical habitat in accordance with Performance Standard 6 (IFC 2012). The presence of these plants in the study area was identified based on the following criteria:

- IUCN Red List of Threatened Species (2017): The field data were screened against IUCN's defined categories to assess the global rarity of species in the study and their sensitivity to change (Table A1.2-4). In the context of this baseline assessment, only species found in the AOI that are listed as IUCN vulnerable, endangered or critically endangered are of conservation importance. This criterion was also used to identify the presence of potential critical habitat trigger species in accordance with Criterion 1 (IFC 2012; Table A1.2-3). It is important to acknowledge that most vascular plant species in the study area are categorised as IUCN not evaluated.
- Species listed on the Ugandan Red List prepared by the Wildlife Conservation Society (WCS) in 2016 and which was upheld by the lead agencies of the Government of Uganda, conferring official recognition on the lists. Species are classified into Red List categories (Table A1.2-4) and assessed on information at the national (not global) level.

  The RBS star rating: the field data were screened against the RBS star rating criteria to determine the presence of endemic or restricted range species in the AOI (Table A1.2-4) This rating ranges from Black Star species (the rarest species on a global scale and of high conservation importance) to Green Star species (species that are common, widespread and of no obvious conservation concern). The global range of each species is expressed as degree squares occupied (one degree square is approximately 100 × 100 km squares). All plant species in the study area have a star rating (Hawthorne and Marshall 2016). The RBS star rating does not rely on Red Listing and takes into consideration records of a species' distribution and abundance. The star rating for each species is derived from a database of global plant rarity. This database was compiled from the same data sources used by IUCN when making evaluations on the statuses of vascular plant species (including herbarium records, monographs and the Genebank Information Management System.). However, in comparative terms, the RBS database is comprehensive with up-to-date information that accounts for historic and recent taxonomic changes. The RBS star rating method was used to identify the presence of critical habitat trigger species in accordance with Criterion 2 (IFC 2012).

Table A1.2-3 Quantitative Thresholds for Tiers 1 and 2 of Critical Habitat Criteria 1–2

Criteria	Tier 1	Tier 2
1. Critically endangered (CR)/endangered (EN) species	(a) Habitat required to sustain ≥10% of the global population of a CR or EN species or subspecies where there are known, regular occurrences of the species and where that habitat could be considered a DMU for that species (b) Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer DMUs globally for that species	(c) Habitat that supports the regular occurrence of a single individual of a CR species or habitat containing regionally important concentrations of a Red-Listed EN species where that habitat could be considered a DMU for that species or subspecies (d) Habitat of significant importance to CR or EN species that are wider ranging or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species (e) As appropriate, habitat containing nationally or regionally important concentrations of an EN, CR or equivalent national or regional listing
2. Endemic/restricted range species	(a) Habitat known to sustain ≥95% of the global population of an endemic or restricted-range species where that habitat could be considered a DMU for that species (e.g., a single-site endemic)	(b) Habitat known to sustain ≥1% but <95% of the global population of an endemic or restricted-range species where that habitat could be considered a DMU for that species, where data are available or based on expert judgment

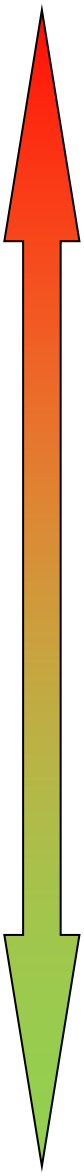
SOURCE: IFC (2012)

Table A1.2-4 IUCN Red List Criteria for Identifying Globally Rare Vascular Plants

Red List Categories	Definition
Critically Endangered (CR)	The best available evidence indicates that the species is facing an extremely high risk of extinction in the wild. These species are considered to have a very high sensitivity to change.
Endangered (EN)	The best available evidence indicates that the species is facing a very high risk of extinction in the wild. These species are considered to have a very high sensitivity to change.
Vulnerable (VU)	The best available evidence indicates that the species is facing a high risk of extinction in the wild. These species are considered to have a high sensitivity to change.
Near Threatened (NT)	The species has been evaluated against the criteria and does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. These species are considered to have a low sensitivity to change.
Least Concern (LC)	The species has been evaluated against the criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category. These species are considered to have a low sensitivity to change.
Data Deficient (DD)	Listing in these categories indicates that no assessment of extinction risk has been made, though for different reasons. Until an assessment is made, taxa listed in these categories should not be treated as if they were nonthreatened (IUCN 2012).
Not Evaluated (NE)	

SOURCE: Definitions adapted from IUCN (2012)

Table A1.2-5 Star Rating Criteria for Identifying Globally Endemic and Restricted Range Species

Conservation Importance of Species	Star Rating Colour	Range of Individual Species	Description
High  **Low**	Black	2.7 degree squares on average globally (1 degree square is approximately 100 x 100 km)	Local endemics – endemic to a small part of a region (e.g., a mountain range or forest block, small island groups, or corners of a region with unusual rainfall patterns) where they might be locally common or scattered within a slightly wider range. These are high conservation priority, global rarities and the places in which they are concentrated should similarly be highly ranked.
	Gold	8 degree squares on average globally	Some global conservation priority rarities. These might be quite common in parts of a biogeographic region but are not globally widespread, or they may occur in two or more average-sized countries but very sparsely.
	Blue	24 degree squares on average globally	Barely of global conservation concern. This category includes continentally widespread species, which are scattered in their range (typically riverine, coastal or high-altitude species); or extremely common throughout several countries and vegetation types but are not continentally widespread. They are often the species that add distinctiveness to unusual habitats, but unless many such species occur in a single sample (as often occurs on mountains) they have limited influence on the ranking of community level bioquality scores.
	Green	50 degree squares on average	Species of no obvious conservation concern in terms of their rarity because they are widespread, typically across a continent in appropriate and common habitats, wherever that habitat occurs, or even global. Continent-wide species that live only in scattered islands, or islands of montane forest, however, might well qualify for Blue or Gold Star status. These species, for instance, “widespread across tropical Africa, in Guineo-Congolian forest” generally account for more than half of all species in most regions.

SOURCE: Definitions adapted from Hawthorne and Marshall (2016)

A1.2.7 Sensitivity Ranking

The sensitivity of the habitat and botanical receptors has been ranked according to the botany section of the sensitivity table in Section 8.

A1.2.8 Data Considerations

Where it was not possible to acquire cloud-free Sentinel-2 imagery, the next most suitable image was selected.

Most of the vascular plants identified during this baseline assessment fall within the "Not Evaluated" category of the IUCN Red List (see Table A1.2-4). Many species have been identified for Red Listing by the IUCN East African working group (coordinated by the IUCN East African Plant Red List Authority, Quentin Luke (IUCN 2018), but are not yet on the list (IUCN 2017). As such, the IUCN Red List status of most plants in the AOI is currently unknown.

A1.3 Baseline Conditions

A1.3.1 Habitats of Conservation Importance

A1.3.1.1 Overview

Most habitat types in the AOI are categorised as modified with approximately 51% of the AOIis natural. Four main habitat types supporting different types of vegetation were identified during baseline studies:

- wetland and wetland forest comprising:
  - *Cyperus papyrus* dominated swamp
  - swampy grassland (with occasional woody species)
  - riverine and riparian forest
- *Acacia* sp. woodland, bushland, shrubland, thicket and wooded grassland including:
  - very disturbed *Acacia* sp. woodland, wooded grassland and bushland
  - drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotic plant species
  - drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotic plant species; subgroup: *Combretum* woodland
  - *Acacia polyacantha* woodland in farmland
  - secondary thicket mixed with bushland species
- *Brachiaria-Sporobolus-Chloris* dominated open grassland
- cultivated land.

All of these habitats are degraded and characterised by low bioquality (GHI 6–75), hence they are not of moderate (GHI 150 and 249) or global conservation importance (GHI 250+). Botanical specialists have described the majority of habitats identified during the RBS as highly degraded or secondary vegetation. A description of each of these habitat types and their GHI scores are presented in Attachment A1.2.

Anthropogenic activities have severely impacted natural habitats in Uganda. Natural habitat is characterised as fragmented with low land cover (National Environment Management Authority 2016; Winterbottom and Eilu 2016). Remnant stands of degraded riverine forest in the study area are thus considered of conservation importance in the context of the AOI and broader region. Section A1.3.1.2 presents

habitats of conservation importance with respect to the project AOI only; all other habitat types, including those not of conservation importance along the RoW and in the broader region are presented in Attachments A1.3.

A1.3.1.2 Riverine Forest

Baseline Condition

Remote sensing identified the presence of small and highly fragmented stands of wetland forest within the AOI between KP21 and KP94 (Table A1.3-1). These areas of wet woodland collectively comprise 166.4 ha, restricted to the margins of watercourses and springs, and are predominantly surrounded by bushland or thicket and cultivated land. The extent of wetland forests (i.e., riverine and riparian forests) is illustrated by Figure A1.3-1 and the habitat map (Attachment A1.1). Riverine forest qualifies as critical habitat under criterion 4: highly threatened and/or unique ecosystems. This is discussed in more detailed in the CHA (Appendix B).

Table A1.3-1 Approximate Location and Coverage (Ha) of Wetland Forest in the AOI Based on Remote Sensing

Approximate Location of Wetland Forest (KP)	Total Coverage in the AOI (ha) Based on Remote Sensing	Name of Adjoining River
21–23	11.9	Waiga
28–29	5.1	Waisoke
34–35	8.9	Sonso
76–77	1.0	Hoimo
81–82	3.2	Nyanswaswa
86–87	20.0	Rwamutonga
89–91	90.9	Wambabya
93–94	25.4	Nyamasoga

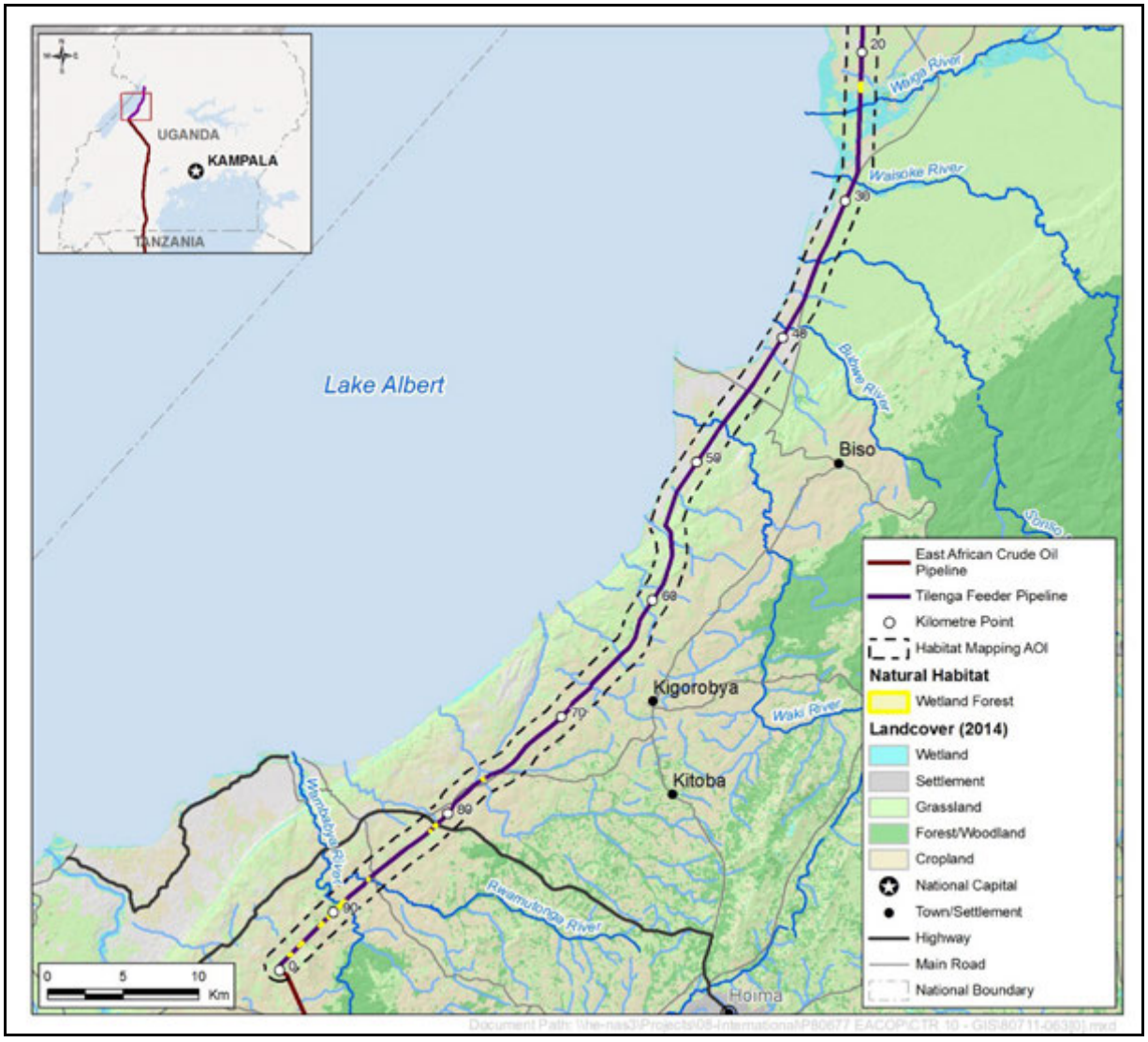


Figure A1.3-1 Location and Extent of Wetland Forest (i.e., Riverine Forest) in within the Area of Influence

The botanical survey confirmed the presence of highly degraded riverine forest (which also includes riparian forest) in the study area, which is a type of wet woodland. Several types of riverine forest are present in Uganda. Evergreen or semi-evergreen riverine forests, with tree height in excess of 20 m, occur on the fringes and banks of perennial streams in areas where annual rainfall exceeds 1000 mm. In contrast, riverine forests dominated by tree species that are deciduous for at least two months of the year are confined to the banks of watercourses in areas where annual rainfall is less than 800 mm (Kind et al. 2011); deciduous-type riverine forest is characterised by relatively open canopy maintained by browsing large mammals and periodic flooding. This enables heliophilous (sun-loving) vascular plants and trees to flourish (White 1983; Kind et al. 2011).

The RBS identified riverine forest within the study area at KP14, KP34.31, KP46.83 and KP94.65. The forest structure was notably variable with either predominantly taller trees or smaller shrubs forming a patchy canopy. These stands were characterised by an intermediate floristic composition between the vegetation types

swamp forest, *Cyperus papyrus* dominated swamp and *Acacia polyacantha* woodland in farmland. Riverine forests typically included the following dominant tree species:

- *Mangifera indica*
- *Ficus mucoso*
- *Ficus vallis-choudae*
- *Ficus sycomorus.*

Interspersed with the following species:

- *Albizia grandibracteata*
- *Crateva adansonii*
- *Elaeis guineensis*
- *Crateva adansonii*
- *Phoenix reclinata*
- *Markhamia lutea*
- *Trichilia emetica*
- *Borassus aethiopum*
- *Artocarpus heterophylla*.

These species are common and widespread elsewhere in Africa and the bioquality of the riverine forests in the study area is low (GHI range 6-25). The abundance of fig trees (i.e., *Ficus mucoso*, *Ficus sycomorus* and *Ficus vallis-choudae*) and the presence of cultivated trees such as *Artocarpus* sp. indicate habitat disturbance from people and grazing livestock.

Riverine forest within the RoW at KP46.8 (approximately 3 m from pipe centre-line) was found to support *Tamarindus indica*; this tree is listed as vulnerable on the Ugandan Red List (WCS 216).

Trend in Condition and Sensitivity to Change

Deforestation and forest degradation is occurring at a rapid rate in Uganda. Between 1990 and 2015, Uganda's forest cover was reduced from 4.9 million ha to 1.8 million ha. An average of 86,400 ha (2.1%) of forest cover per year was cleared between 2000 and 2015 (MWE 2016). Remnant areas of forests are under increasing anthropogenic pressures as the number and extent of forests decline (International Resources Group 2016; Ministry of Water and Environment 2016). In Uganda, riverine forests are fragmented, in a state of decline and highly threatened by anthropogenic activities, which continue to cause losses, fragmentation and degradation (International Resources Group 2016; Ministry of Water and Environment 2016); this is supported by information yielded by the RBS survey.

Existing threats to habitats include overexploitation of timber resources and habitat clearance for the development of plantations and agropastoral activities. This trend is likely to continue in the absence of intervention.

Wetland forests are unlikely to naturally regenerate if upstream seed stock is depleted and edaphic conditions and hydrology is altered; hence wetland forest is

unlikely to be resilient to substantial disturbance over large areas. Wetland forests (including riverine forests) are considered to have a high sensitivity to change.

A1.3.2 Flora Species of Conservation Importance

A1.3.2.1 Globally Rare, Nationally Rare, Black Star and Gold Star Species

Overview

In total, 351 species of vascular plants were identified within the study area during the field surveys. Of these, only 34 species (<10% of the total sample) have been assessed by the IUCN Red List of Threatened Species (IUCN 2017) and assigned a threat category. Within this sample, one tree species, *Milicia excelsa,* is categorised as IUCN lower risk and near threatened, and the remaining species are listed as IUCN least concern. Furthermore, none of the species recorded during the RBS qualifies as endemic or restricted range (Black Star) status or Gold Star status.

Of the 351 species recorded during RBS, four vascular plant species have been assessed by the Ugandan Red List of Threatened Species (WCS 2016) and assigned a threat category of either data deficient, vulnerable or endangered (Attachment A1.4). These species are discussed in Section A1.4.1 in more detail.

The supplementary WCS biodiversity baseline phase 2 data (Attachment A1.6) were screened against the star rating criteria to identify the presence of any globally rare or restricted range or endemic (Black Star) vascular plant species within 2 km of the pipeline corridor (this is described in Section A1.2.6.3). This identified the presence of one endemic or restricted range (Black Star) species within the study area, namely *Tinospora orophila* (IUCN endangered (Attachments A1.4 and A1.6). *Tinospora orophila* is known from a few locations in Burundi and Rwanda (IUCN 2017). Further surveys and validation of these species records would be required to explicitly verify the presence of *Tinospora orophila* in the study area. These Black Star species trigger critical habitat in accordance with Criterion 2, Tier 2 (IFC 2012), which is defined in Section A1.2.6.3.

Several of these tree species are protected in Uganda under the Forest and Tree Planting Act 2003 (amended 2016) and include commercial and cultivar tree species. Hence, these species are not considered of conservation importance unless they meet the criteria presented in Section A1.2.6.2. Tree species are listed on Schedule 8 and are presented in Attachment A1.5 and a licence will be needed to clear these tree species.

Baseline Condition

The baseline condition of each vascular plant species of conservation importance, their known Ugandan Red List (WCS 2016) status, IUCN (2017) category and star rating, and their proximity to the pipeline centre line are presented in Attachment A1.3 and described below.

Nymphaea nouchali

The aquatic herb *Nymphaea nouchali* is listed as critically endangered on the Ugandan Red List (WCS 2016). Within the study area this species was recorded in an area of *Cyperus papyrus*-dominated swamp of very low bioquality (GHI13) at KP21.4 (approximately 125 m from the pipe centre-line). In Uganda, records of this species are known from Lake Mutanda and Lake Bunyonyi (WCS 2016).

Nymphaea nouchali is IUCN least concern and is native to over 50 counties ranging from temperate and tropical Asia, Australia and much of tropical Africa. *Nymphaea nouchali* typically inhabits ponds, stagnant pools and the edges of lakes and swamps dominated by *Papyrus* sp. and drying mud (IUCN 2017).

Milicia excelsa

The deciduous tree *Milicia excelsa* is listed as endangered on the Ugandan Red List (WCS 2016). Within the study area this species was recorded among dry *Acacia* woodland of low bioquality (GHI 26) at KP81.2 (approximately 270 m from the pipe centre-line). *Milicia excelsa* is widely distributed throughout Uganda outside protected areas (WCS 2016).

This tree commonly occurs in a variety of forests types throughout tropical Africa at altitudes up to 1200 m. *Milicia excelsa* is IUCN lower risk and near threatened (IUCN 2017).

Tamarindus indica

Tamarindus indica is listed as vulnerable by the Ugandan Red List (WCS 2016). Within the study area this species was recorded in eight different survey sites in the following vegetation types of low bioquality: *Acacia polyacantha* woodland in farmland (GHI27-38), secondary thicket mixed with bushland species (GHI 13-42) and riverine or riparian forest (GHI 14).

This evergreen tree has a wide geographical distribution throughout Uganda and tropical Africa at an attitude up to 1500 m (IUCN 2917; WCS 2016).

Aeschynomene indica

Aeschynomene indica is listed as data deficient on the Ugandan Red List (WCS 2016). *Aeschynomene indica* was recorded at KP28.5 approximately 5 m from the pipeline centre-line in swampy grassland with occasional woody species type vegetation; the vegetation at KP28.5 is of low bioquality (GHI 23).

In Uganda, *Aeschynomene indica* has been recorded from within Semuliki National Park (WCS 2016). Elsewhere, this species has a wide global range and is native to Africa, Asia, Australia and southwest USA (IUCN 2017).

Tinospora orophila

The restricted range or endemic (Black Star) *Tinospora orophila* is not listed as nationally rare by the Ugandan Red List (WCS 2016), however this woody liana is classified as IUCN endangered (Ntore et al. 2017). *Tinospora orophila* is also considered by IUCN (2017) to be an Albertine Rift endemic.

Screening of the WCS data identified the presence of a *Tinospora orophila* at KP18, approximately 550 m from the pipe centre-line among modified habitat in Buliisa district. While this individual will not be directly impacted by habitat clearance during construction, further studies would be required to verify the presence or likely absence of this species in the RoW.

Specimens of this species have only been previously recorded near the Kibira National Park in northwestern Burundi and in Nyungwe National Park in southwestern Rwanda (Ntore et al. 2017). Hence, the identification of *Tinospora orophila* in the study area may potentially represent a new record of this species in Uganda and represents a plausible range expansion for this species (Dr William Hawthorn 2018, pers. comm.). Further analysis is required to fully validate this record to confirm this species' presence in Uganda and the study area.

A1.3.2.2 Trend in Condition and Sensitivity to Change

Nymphaea nouchali

The species is thought to have a limited geographical range in Uganda and be in a state of significant decline at the national level.

As *Nymphaea nouchali* is listed as critically endangered on the Ugandan Red List (WCS 2016), this species is considered to have high sensitivity to change.

Milicia excelsa

The species is thought to be in a state of decline at the national level (WCS 2016). The global population of *Milicia excelsa* is threatened by overexploitation for timber, particularly in West Africa (IUCN 2017).

As *Milicia excelsa* is listed as endangered on the Ugandan Red List (WCS 2016), it has a high sensitivity to change.

Tamarindus indica

The species is thought to be in a state of decline at the national level (WSC 2016) owing to overexploitation. The global population of this IUCN least concern species is large and geographically widespread with no known threats.

As *Tamarindus indica* is listed as vulnerable on the Ugandan Red List (WCS 2016), it has a moderate sensitivity to change.

Aeschynomene indica

Aeschynomene indica is listed as data deficient on the Ugandan Red List (WCS 2016). In a global context, *Aeschynomene indica* is a widespread species that grows in a wide range of habitats and faces no major threats.

As *Aeschynomene indica* is IUCN least concern and classed as a Green Star species it has a low sensitivity to change.

Tinospora orophila

Tinospora orophila is IUCN endangered and is only previously known from a few locations in Burundi and Rwanda (Ntore et al. 2017). Individuals outside protected

areas are under threat of habitat loss and degradation by conversion of land for agricultural use, wood harvesting and gold mining (Ntore et al. 2017). The identification of *Tinospora orophila* in Uganda*,* based on the WCS biodiversity baseline phase 2 data, may potentially represent a new record of this species in Uganda and represents a plausible range expansion for this species (Dr William Hawthorn 2018, pers. comm.). Further surveys and validation of the *Tinospora orophila* specimen is required to verify the occurrence of this species in the study area.

As *Tinospora orophila* is IUCN endangered and an endemic or restricted range (Black Star) species, it has a high sensitivity to change.

A1.3.3 Forests Reserves and Other Protected Areas

A1.3.3.1 Overview

Several forest and wildlife reserves are immediately adjacent to the pipeline; these protected areas are discussed in detail in Section 6 of the ESIA.

An analysis of satellite imagery and the botanical survey results indicate that the habitat integrity of the majority of FRs and other protected areas in Uganda has been adversely impacted. Habitats within each site appear to be degraded to varying degrees of anthropogenic disturbance, including the collection of timber and nontimber forest resources and habitat clearance.

While most of the reserves in the study area are not of high conservation value in terms of their botanical values, several of these reserves support fauna and avifauna of conservation importance (i.e., Bujawe FR); one reserve is of botanical value, namely Bugungu WR.

Bugungu WR is immediately adjacent to the pipeline and is a protected area supporting natural habitat (IFC 2012) and vascular plants of conservation importance. Protected areas that do not meet these criteria are not discussed.

A1.3.3.2 Bugungu Wildlife Reserve

Baseline Condition

The pipeline traverses the western edge of the Bugungu WR between KP27.3 and KP38.1, beyond the boundary of the WR; the WR is also a key biodiversity area (KBA).

Bugungu WR covers 474 km^2 (Protected Plant 2018) and serves as a buffer zone to the southwest boundary of the Murchison Falls National Park. The reserve supports semideciduous forest (BirdLife International 2018) and, identified from satellite imagery, wetlands, bushland, scrub and scattered trees.

Botanical surveys were completed at three locations outside the western boundary of the reserve near watercourses at KP34.31 and KP28.68, (approximately 39 m, 38.5 m and 4 m from the pipe centre-line respectively) and at one location within the reserve at KP43, approximately 2.6 km from the pipe centre-line. These sites comprised riverine or riparian forest and swampy grassland occasionally interspersed with woody species; all habitats were of low bioquality (GHI 14–27).

While natural habitats along the western boundary of the Bugungu WR were degraded and typically included the encroachment of cultivated trees (i.e., Mangifera sp., Elaeis sp. and Anacardium sp.) and areas of agriculture land (UWA 2013), habitat quality is considered to significantly improve further into the reserve.

Screening of the WSC biodiversity baseline phase 2 data identified the presence of nine endemic/restricted range (Black Star) species within the reserve, namely:

- *Alafia microstylis*
- *Digitaria melanotrichia*
- *Ecbolium hastatum*
- *Entada phaneroneura*
- *Isoglossa laxiflora*
- *Keetia purseglovei*
- *Leptonychia mildbraedii*
- *Pentarrhinum gonoloboides*
- *Snowdenia microcarpha*.

Trend in Condition and Sensitivity to Change

Forests and woodlands are under major threat in Uganda with rapid losses occurring within and outside protected areas. Between 1990 and 2015, Uganda's forest cover was reduced from 4.9 million ha to 1.8 million ha. An average of 86,400 ha (2.1%) of forest cover per year was cleared between 2000 and 2015 (Ministry of Water and Environment 2016). Hence forest and woodland habitat is therefore considered highly threatened and in a state of decline.

As Bugungu WR is a protected area, it has a high sensitivity to change.

A1.3.4 Ecosystem Services Provided

The habitats discussed in the preceding sections, with the species they comprise, generate a range of ecosystem services as set out below. Further details on the general nature and extent of the provisioning ecosystem services listed can be found in the land-based livelihoods section of Appendix A9 Socio-economic and Health Baseline Report.

Provisioning services:

- Community interviews identified and characterised the use of plants for provisioning services by local communities (i.e., trees used for construction and fuel; plants for food and medicinal products). These findings are presented in Appendix A9 and are summarised in Table A1.3-2. It has not been possible to assign scientific names to these plants without collecting specimens for specialist identification; typically, a single species will be known by a different common name from district to district and even, at times, by different common names within a local community sharing the same language.

Regulating services:

- climate change amelioration, in terms of carbon sequestration and carbon sinks, and attenuating directional or hemispherical surface albedo

- microclimate and climate regulation by vegetation and soils, in terms of regulating ambient temperatures and water vapour levels
- local water and air pollution control through waste assimilation, water and air filtration
- water regulation, erosion control and water catchment protection, in terms of maintaining higher flows in rivers and for longer duration; reducing flood surges; and reducing sedimentation of receiving waters through the stabilisation of riverbanks and steep slopes by vegetation, including riparian and emergent habitats
- erosion control of terrestrial habitats (i.e., arising from wind erosion), in terms of controlling ambient fugitive dust emissions though the stabilisation of soil by terrestrial habitats and maintaining edaphic conditions, including soil moisture levels
- regulation of ambient noise levels. Habitats and vegetation act as a natural sound barrier buffering noise emissions, including those arising from anthropogenic sources (e.g., vehicle movement, people and machinery).

Cultural services:

- ethical and biodiversity values, particularly maintaining populations of endangered and endemic species. These values are difficult to ascertain and are more likely to held by wealthier native and non-native populaces.
- sense of place and way of life. These locations are likely to provide value to local people who use these areas as part of their way of life and who have a special connection with them.
- eco-tourism, particularly in protected areas.
- aspects of these locations may provide spiritual, sacred or religious values, inspiration for culture and design, and cognitive development.

Habitat and species support:

- The abovementioned habitats provide important refuge, feeding, watering, breeding and nursery areas for many animals that spend only part of their life in such areas.

Other supporting services:

- The abovementioned habitats and the species they contain provide a range of supporting services such as photosynthesis and water, and carbon and nutrient cycling, and whose benefits are typically accounted for in other ecosystem services.

Table A1.3-2 Natural Resource Use (Wild Plants) by Local Communities

District	Subcounty	Settlement Name	Common Name of Wild Plant	Purpose	Point of Collection	Estimated Frequency of Collection	Proportion of Wild Plants Directly Used by the Collector (%)	Proportion of Collected Wild Plants Sold (%)
Hoima	Buseruka	Katooke	Mature Vines	Food	Wambabya forest	Anytime	50	50
Hoima	Buseruka	Katooke	Kibirizi, Omusesa, Omuyenje,Omuko and Omufuula	Medicine	Wambabya FR, Kayeera bushes and in gardens	Any time required	100	0
Hoima	Buseruka	Katooke	Nswiga nakati	Food	Wambabya forest, Kayeera bushes and gardens	Any time required	100	0

A1.3.5 Sensitivity Rankings

Based on the survey data, the trend in condition, sensitivity to change and the sensitivity of the receptors have been ranked and are shown in Table A1.3-3.

Table A1.3-3 Habitat and Flora Sensitivity Ranking

Ecology Receptor	Sensitivity Ranking	Rationale for Ranking
Wetland Forest (degraded)		
Natural habitat (as defined by IFC PS6 and the accompanying Guidance Note)	High (4)	Riverine and riparian forest (highly degraded) – type of wetland forest
Critical Habitat in accordance with Criterion 4	Very High (5)	Riverine (riparian) forest
Species listed as Vulnerable on the relevant national red list	Moderate (3)	Supports Ugandan Red Listed vulnerable species: • *Tamarindus indica*
Bugungu WR and KBA		
Legally protected, internationally or nationally recognised areas	High (4)	Designated as a wildlife reserve
Endemic or restricted range species triggering Tier 2 Critical Habitat as per IFC PS6	High (4)	Supports endemic or restricted range (Black Star) species: • *Alafia microstylis* • *Digitaria melanotrichia* • *Ecbolium hastatum* • *Entada phaneroneura* • *Isoglossa laxiflora* • *Keetia purseglovei* • *Leptonychia mildbraedii* • *Pentarrhinum gonoloboides* • *Snowdenia microcarpha*

A1.4 Key Habitat and Vascular Plant Considerations

A1.4.1 Habitats

Based on the outcomes of the botanical assessment, the following habitats with are considered sensitive receptors:

- riverine forest (scattered fragments between KP21 and 94).

A1.4.2 Flora

The RBS confirmed the presence of three species of vascular plants of conservation importance in the study area. The Ugandan Red List assessed these species (WCS 2016) as follows:

- *Nymphaea nouchali* – critically endangered (KP21.4)
- *Tamarindus indica* – vulnerable (KP55.9, KP61.6, KP2.14, KP13.79, KP55.26, KP7.15, KP51.51 and KP46.8)
- *Milicia excelsa* – vulnerable (KP81.2).

Screening of secondary data reported the presence of two endemic or restricted range (Black Star) species and one IUCN endangered species as follows:

- *Ecbolium hastatum*
- *Tinospora orophila* (also IUCN endangered).

Further surveys and validation of these species records would be required to explicitly verify the presence of *Tinospora orophila* and *Ecbolium hastatum* in the AOI.

The vascular plant species of conservation importance are summarised in Table A1.4-1.

A1.4.3 Protected Areas

The following protected area is within the project AOI and is considered a sensitive receptor:

- Bugungu WR and KBA (KP27.3 and KP38.1).

Table A1.4-1 Key Flora Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
Ecbolium hastatum	WCS records from within Bugungu WR and the Murchison Falls National Park**.** Further surveys are required to explicitly verify the presence of this species	Endemic or restricted range (Black Star)	Endemic or restricted range (Black Star) species have a highly localised distribution, niche and physical or environmental requirements. These species are particularly vulnerable to the impacts of habitat loss, degradation and fragmentation. Further verification is required to confirm if the *Ecbolium hastatum* record is a
Tinospora orophila	WCS records from modified vegetation near Buliisa approx. 500 m from the pipe centre-line	Endemic or restricted range (Black Star) IUCN listed endangered	
Aeschynomene indica	Swampy grassland, occasional woody species	Ugandan Red List data deficient IUCN listed least concern	
Nymphaea nouchali	Papyrus swamp (*Cyperus papyrus*)	Ugandan Red List critically endangered IUCN listed least concern	

Table A1.4-1 Key Flora Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
Milicia excelsa	Dry spectrum of secondary *Acacia* woodland, bushland or secondary thicket mixed with bushland species	Ugandan Red List endangered	misidentification or not. Most national rare species in the study area were recorded in degraded habitat types of low bioqualities. Clearance of these habitats supporting Ugandan Red List critically endangered and endangered species may potentially impact these populations in Uganda (depending on the number of individuals cleared) but will not impact populations at the global scale.
Tamarindus indica	Riparian or riverine forest *Acacia polyacantha* woodland in farmland; Secondary thicket mixed with bushland species; and riverine or riparian forest	Ugandan Red List vulnerable	

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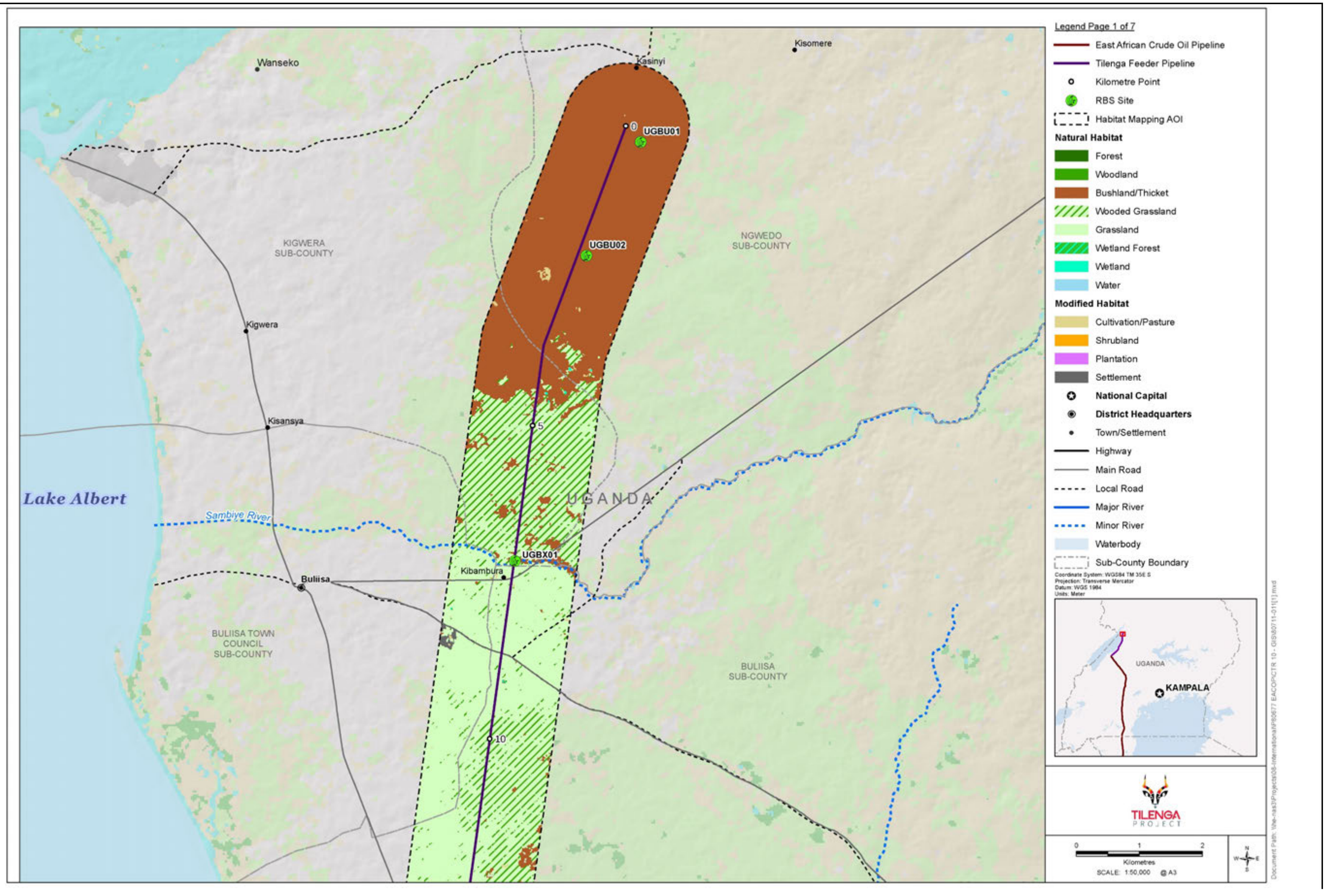
ATTACHMENT A1.1 HABITAT MAP


Legend Page 1 of 7
East African Crude Oil Pipeline
Tilenga Feeder Pipeline
Kilometre Point
RBS Site
Habitat Mapping AOI
Natural Habitat
Forest
Woodland
Bushland/Thicket
Wooded Grassland
Grassland
Wetland Forest
Wetland
Water
Modified Habitat
Cultivation/Pasture
Shrubland
Plantation
Settlement
National Capital
District Headquarters
Town/Settlement
Highway
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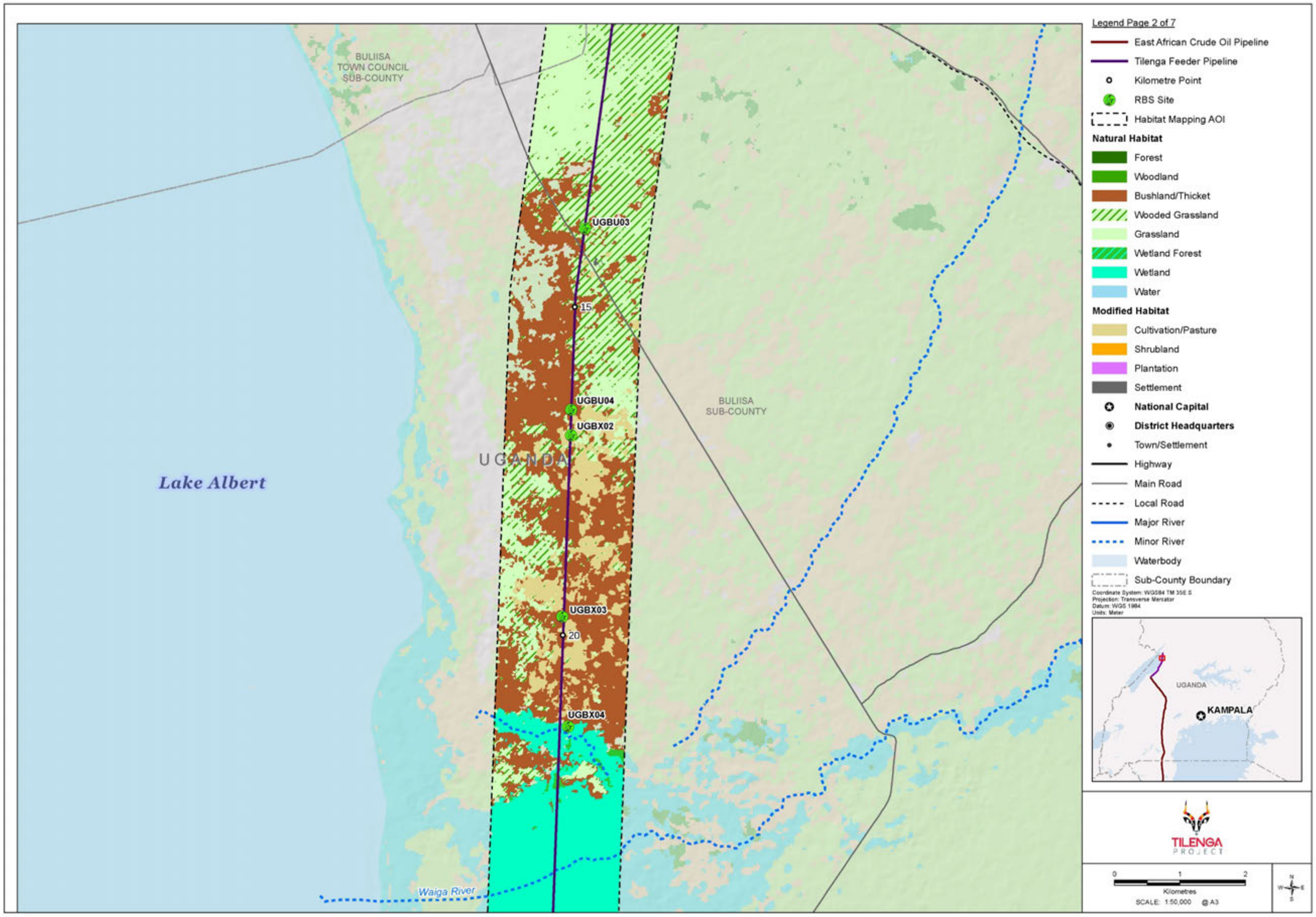
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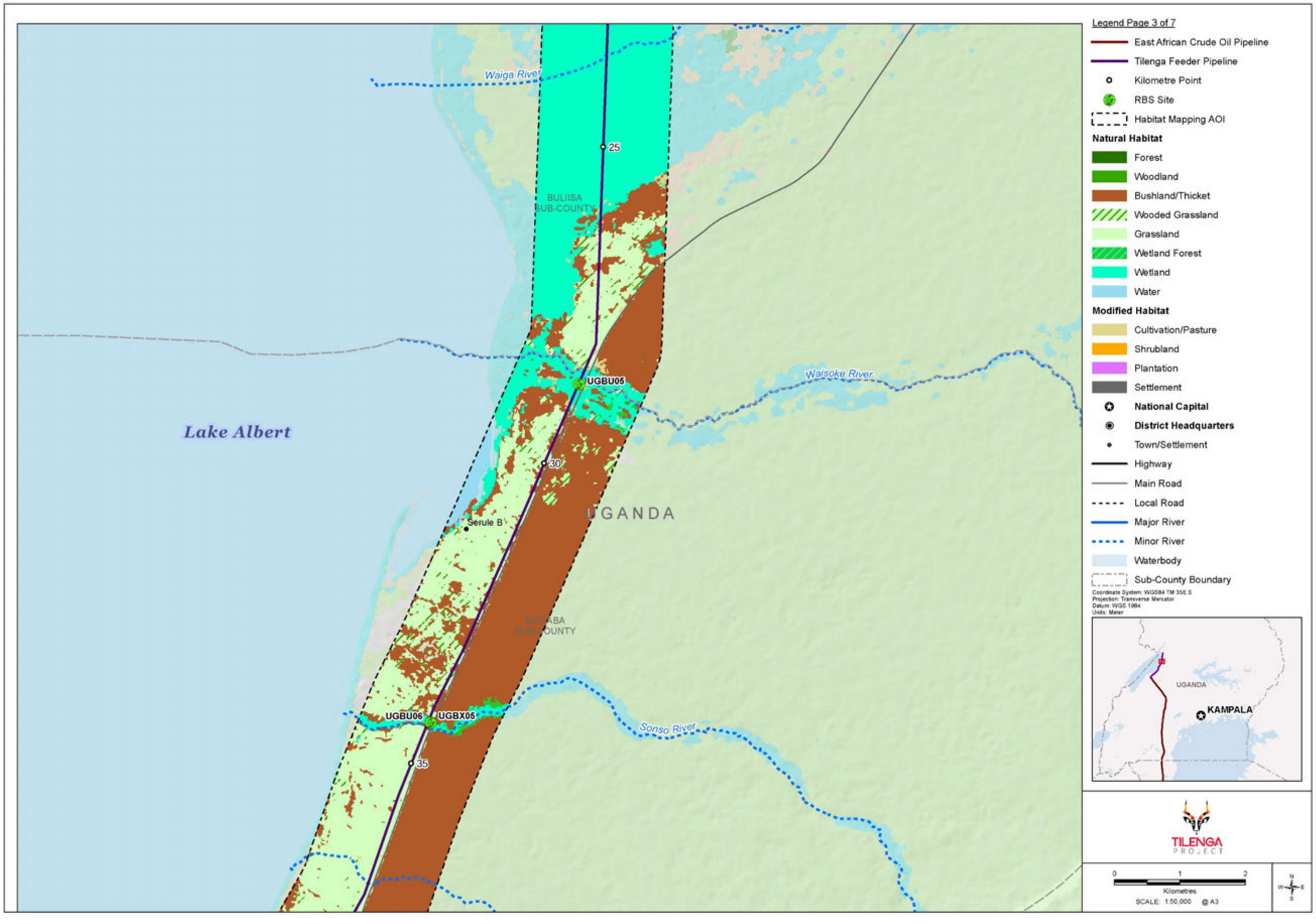
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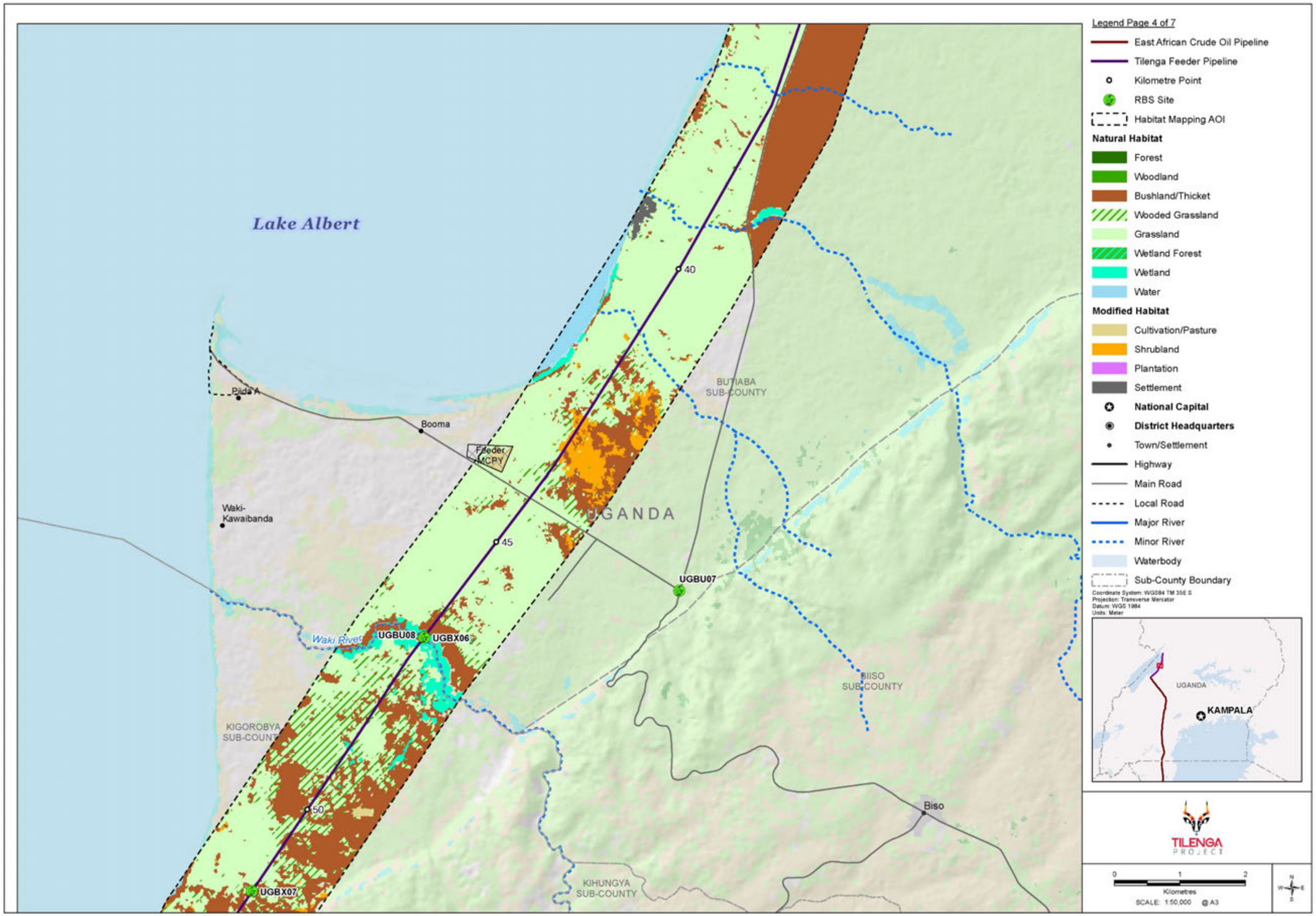
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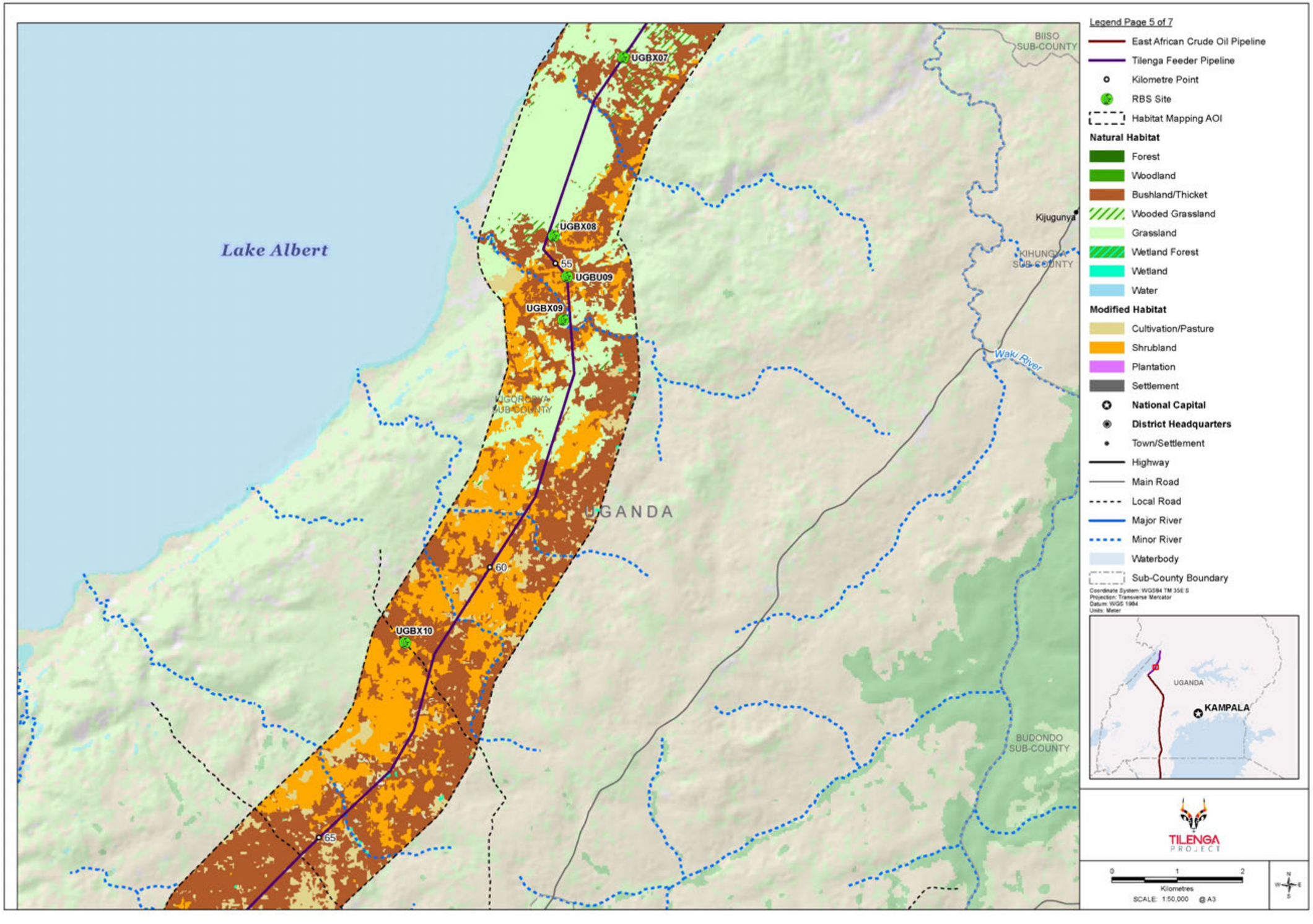
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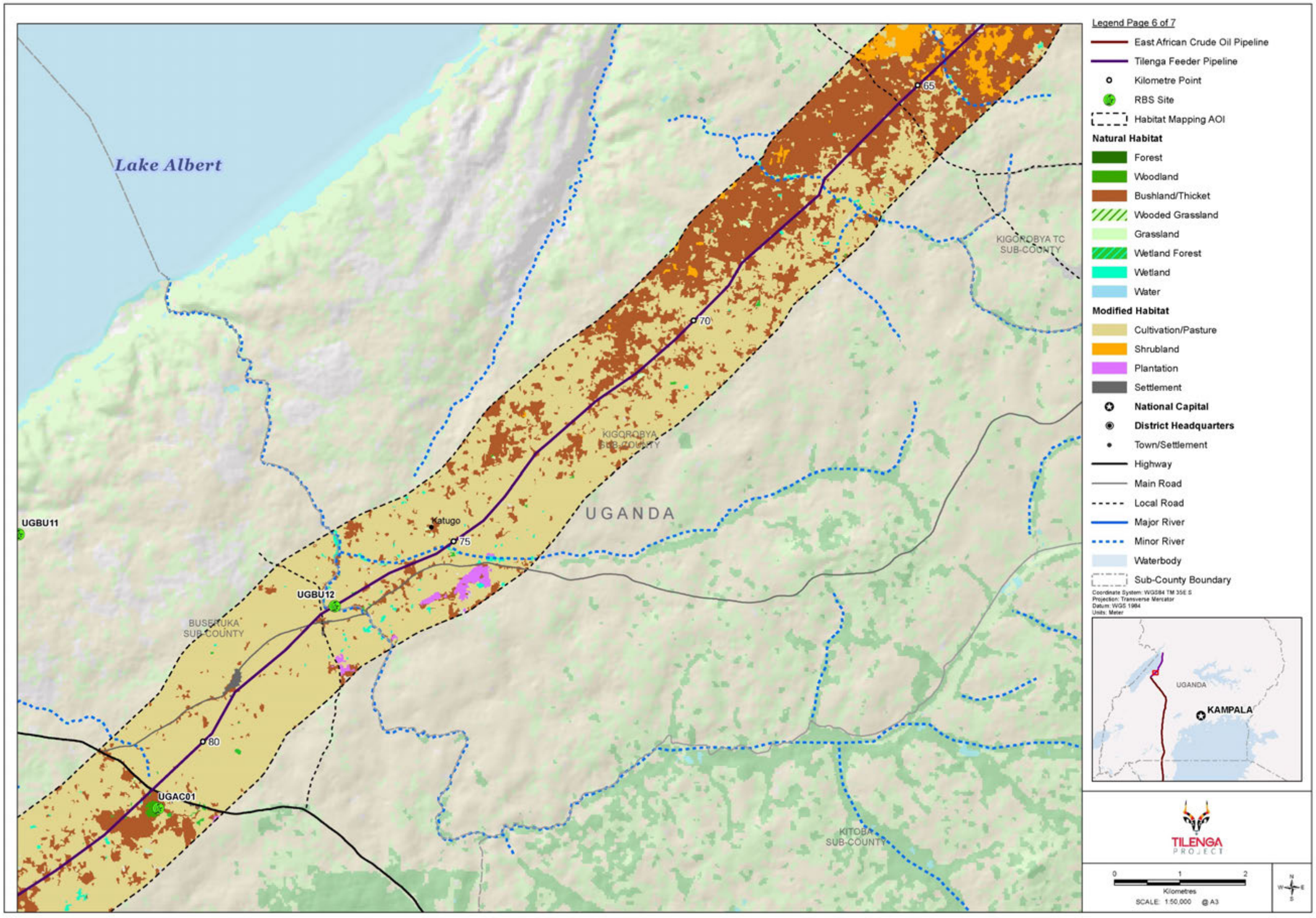
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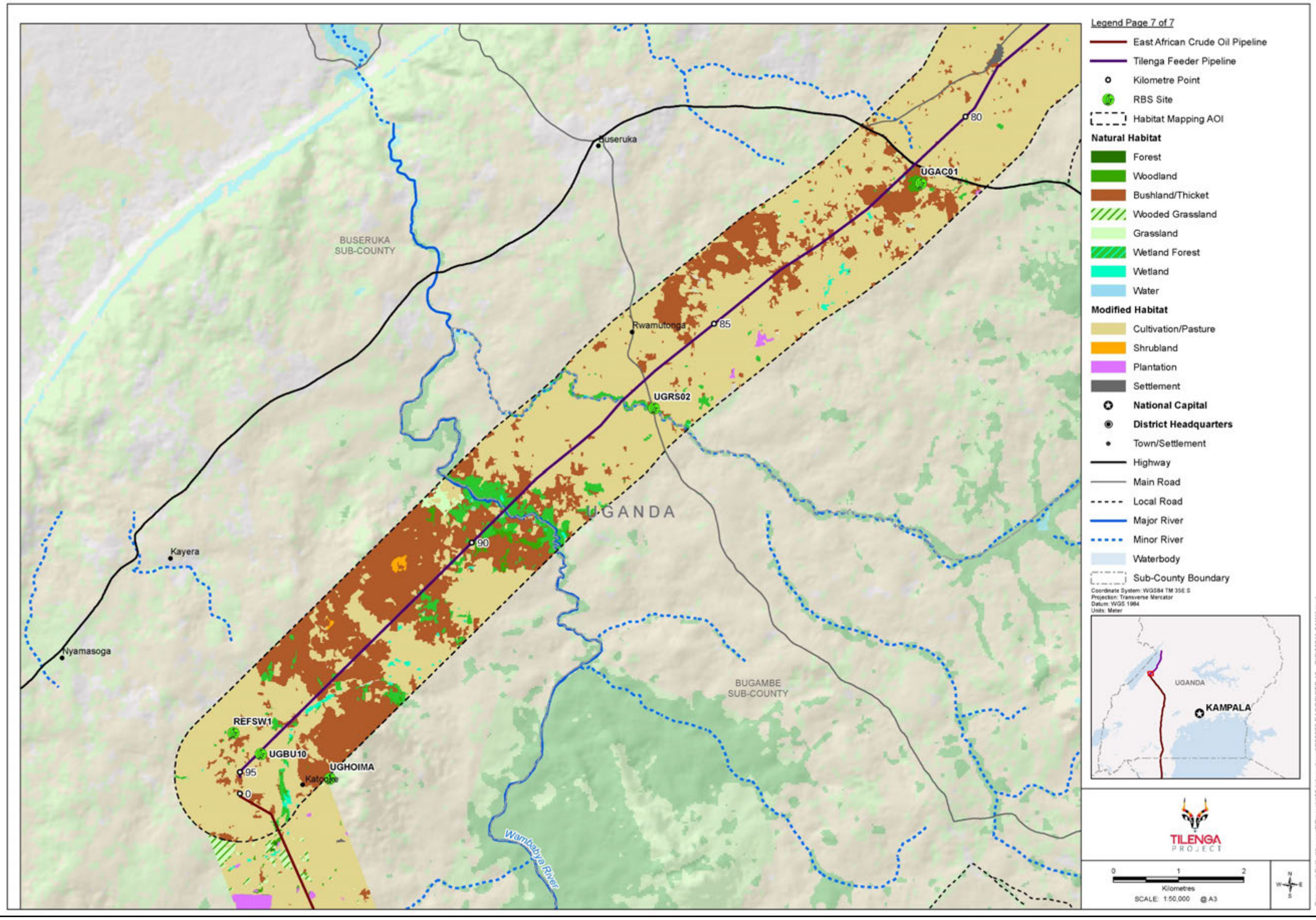
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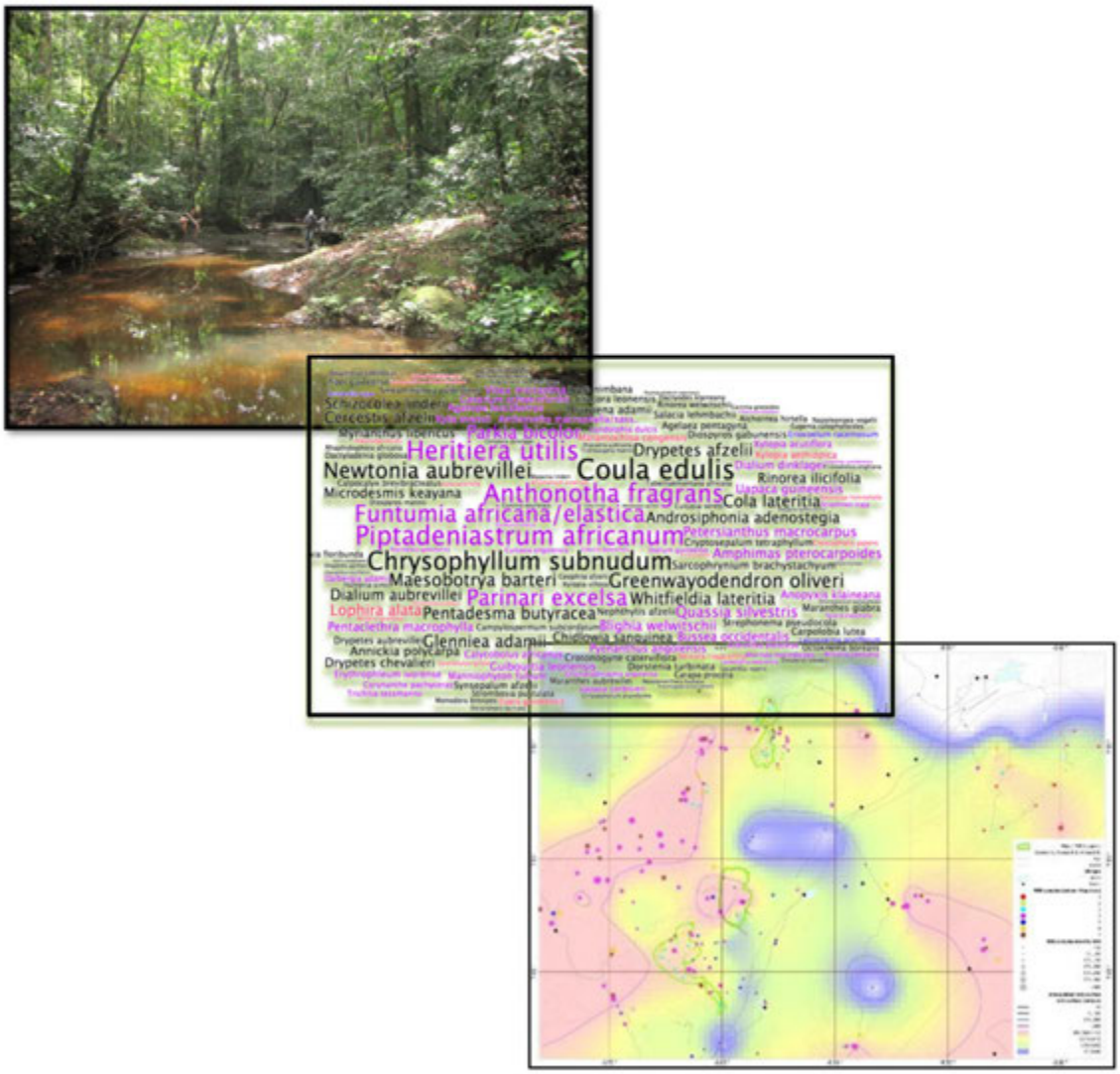
ATTACHMENT A1.2 RAPID BOTANIC SURVEY MANUAL AND MEASUREMENTS OF VEGETATION BIOQUALITY

A MANUAL FOR RAPID BOTANIC SURVEY (RBS) AND MEASUREMENT OF VEGETATION BIOQUALITY

W.D. Hawthorne & C. A. M. Marshall, June 2016



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QUICK SUMMARY

Rapid Botanic Survey (RBS) is primarily a field survey methodology for assessing species-rich plant communities, but it is associated with a range of non-field activities, analyses and outputs that can be considered part of RBS in a broad sense. This document is about the full range of typical RBS activities, from field to herbarium to database to output.

RBS outputs are used for mapping vegetation and prioritising areas for different management purposes, including conservation. RBS activities integrate species and community level assessments. RBS is particularly appropriate in species-rich, incompletely explored vegetation, but could be used in any plant community. RBS data are used to determine the main patterns of floristic variation in plant communities across a landscape. RBS is also used, even in well-known vegetation, for measuring bioquality 'temperature': the degree to which a sample is a biodiversity hotspot. RBS can be applied at any scale; it has been used to plan national and regional conservation strategies, as well as local Environmental Impact Assessments (EIAs).

RBS builds on a foundation of herbarium data and provides a generally more complete and less biased picture of plant biogeographic and ecological patterns than is available from herbaria alone. A typical survey involves databasing some existing herbarium and published data of various types, and enumeration of a suite of new RBS-specific samples in the field. The new samples fill the often substantial gaps in knowledge about plant distribution and provide data on a cross-section of habitats in a defined survey area, using a standardised approach.

The field survey tells us where each plant species lives within sampled landscapes. The background research meanwhile leads to the categorisation, into 'Stars', of the global rarity of each species as a basis for highlighting the global significance of local populations and vegetation patches. Plant communities, even local associations of species occupying a few square metres, are scored or evaluated based on the species found there and other local information collected during the surveys. The way in which Star ratings feed into community level "bioquality" valuations is described on p. 9.

Whilst biodiversity hotspots have been crudely and ambiguously defined on the broad global scale, RBS aims to achieve greater precision, higher resolution, practicality and transparency in biodiversity hotspot research. Global plant biodiversity is being eroded daily, and ideal solutions to its conservation are not going to be possible soon enough in many areas. One of the premises of RBS is that it is essential to make the most of what can be assessed with limited resources, rather than waiting for perfect answers. RBS promotes successive approximation and encourages fuzzy logic, when crisp logic and detailed studies would not lead anywhere fast enough. The RBS framework provides objective, transparent and repeatable, best-available answers that are open to refinement if time allows. This is one of the key differences between RBS and various other, 'Ivory Tower' approaches to biodiversity evaluation. Whilst the bull-dozers push back nature throughout the world, RBS places pragmatism before academic purity in a bid to do something before the subject matter disappears.

It is possible to define and use Star ratings and measure bioquality without RBS samples; and to make good use of RBS sample data without defining Stars. If you are interested in using RBS for purposes other than bioquality evaluation, skip to page 7.

RBS-derived data form a good foundation for studies in many related disciplines, for example the impacts of development or climate change on biodiversity, or studies of possible or actual impacts on species distribution.

ABBREVIATIONS AND GLOSSARY

Term	Abbreviation	Page	Meaning
Bioquality		9	A term expressing the global rarity of species in a community. A community with a higher concentration of globally rare plants has higher bioquality. This contrasts with biological diversity, which expresses the number of species in a community and their abundance. Bioquality emphasises the concentration of "high conservation value" elements (species, varieties, genes) of biodiversity in a community, in respect of their global rarity and distinctiveness. See GHI below.
Diameter at Breast Height	DBH		A standard measurement for the size of a tree. The bole diameter is measured 1.3 m above the ground, or equivalent on buttressed trees.
Environmental Impact Assessment	EIA		The process of assessing the likely significance of damage to the environment and biodiversity of an area caused by a proposed operation, e.g. mining or construction; often including recommendations for avoiding or mitigating the worst effects.
Genetic Heat Index	GHI	10	A standardised and practical index of bioquality in a plant community; a first approximation to a range size rarity score based on the weight allocated to each species by virtue of the species' Star.
Ordination		25	Ordination refers to a family of statistical methods, usually specific computer software, which attempts to reveal the relationships between ecological communities in respect of their species content, sometimes incorporating environmental variables.
Star		10	A category for a species, variety or subspecies indicating the significance of local populations for global biodiversity conservation. Based primarily on global rarity, the basis for weighting Stars relative to each other in the GHI. Sparseness of individuals in populations, ecology, taxonomic distinctiveness and variation within taxa are secondary considerations.
Range Size rarity Index			Weighted average score summarising a list of species, wherein the rarer species have higher weight. Unlike GHI, the analysis is self-contained, and rarity is based entirely on individual records in the database being analysed.
Rapid Botanic Survey	**RBS**	6	A survey including many samples of plant communities in a given area and using the protocols described in this document.

RBS HISTORY

RBS and associated methods for analysing and using RBS data were originally designed for rapid assessment of rain forest biodiversity in Africa, but RBS has since been used in other continents and vegetation types.

The sampling method was originally inspired by:

- Plant community lists on herbarium labels, for instance: "*this species is abundant in rocky, limestone ravines on the east of the hill, with Impatiens blogsii, Cynometra webberi, Julbernardia, Asteranthe asterias, Croton jacquesii*". This type of herbarium-based, label information is like a cut-down version of an RBS sample, though the species lists are usually incomplete or at least of unknown completeness and bias, and provide no means for checking the accuracy of the species listed.
- Some of the aspects of field survey associated with Braun-Blanquet phytosociology, notably respect for the value of subjective, surveyor's choice of representative sample sites (Westhoff & van der Maarel 1978; Wikum & Shanholtzer, 1978). This method was designed for European types of vegetation, is not ideal for rainforest, and the samples (relevés) are measured, unlike typical RBS samples.
- A national forest type survey in Ghana by Swaine and Hall (Hall & Swaine, 1981), which included a subset of unmeasured, so-called 'B' samples, to help interpolate data from a network of larger measured plots. Swaine and Hall (1976) had established in Ghana that records of just 30 random species provided enough information to identify the forest types established using full 50-150 species lists from measured 25 x 25m plots. RBS samples are similar to these B plots in that they are unmeasured, but are in general are more thorough samples of the local landscape unit.

RBS-like sampling evolved from these approaches during a survey of coastal forests in Tanzania and Kenya, where the sample units were called 'sublocalities' (Hawthorne et al., 1981; Hawthorne, 1984, 1993a). The protocol was subsequently developed into its current form in a national plant biodiversity survey of Ghana (Hawthorne & Abu Juam, 1995; Hawthorne, 1996), complementing a national forest tree inventory. The approach was initially designed to make maximum use of available data sources, including herbaria, plot based samples and published, whole-forest check-lists. RBS outputs have subsequently had a prominent influence in decisions about protected areas and objective allocation of global biodiversity funds in Ghana (Hawthorne *et al.*, 1998a). A bioquality hotspot map for Ghana's forest zone, derived from RBS, is shown in Figure 1.

RBS has since been used in a variety of projects around the world, providing comparable data and indices for different regions (Hawthorne 1992, 1996; Hawthorne & Hughes, 1997; Chua *et al.*, 1998; Hughes *et al.*, 1998; Tchouto, 2004; Gordon *et al.*, 2003, 2004; Hawthorne *et al.* 2007, 2008, 2009; Ndam *et al.*, 2001; Marshall & Hawthorne, 2012, 2013; Baksh-Comeau *et al.*, 2016). RBS has been carried out in Chile, Senegal, Liberia and Trinidad & Tobago, amongst other locations.

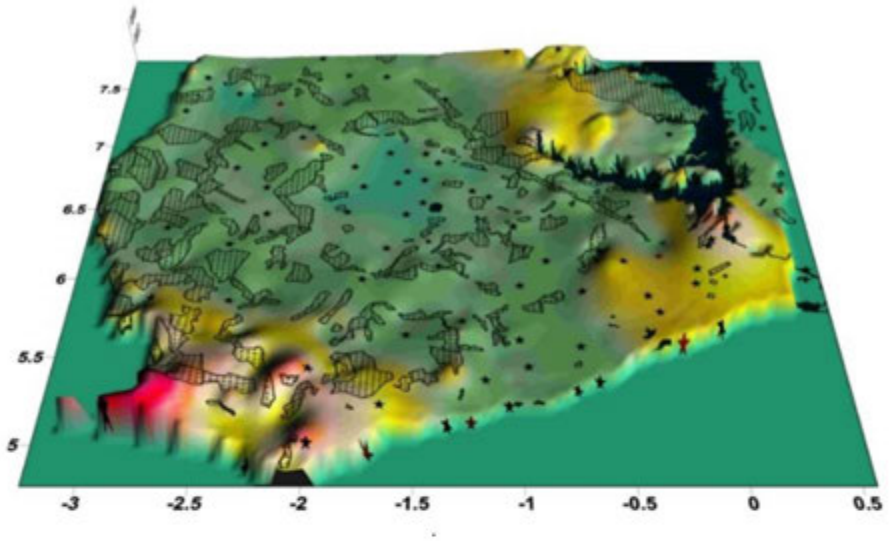

Figure 1 Ghana, showing forest reserves as outlines. The colours and the apparent landscape altitude indicate bioquality. Note the red 'peaks' or hotspots of GHI in the SW (species rich, wet evergreen forest); and around the south and west of Volta lake, which is the lake in the NE quarter of the map (dry, species poor forest). Following this survey, an increased proportion of the hotspot areas in particular received complete protection.

RBS AND BIODIVERSITY

The term biodiversity is usually defined as the variety of life at its various organizational levels, from the genes in populations to the living planet, or biosphere. RBS addresses a small but crucial part of this web.

Budgets are always limited and we cannot sample all types of organism rapidly: RBS focuses on vascular plants and is designed to deal with the vegetation in a specific landscape – it is part of a bottom up approach to biodiversity analysis. Most of the RBS focus is on named plants, i.e. formal taxa, rather than the subtler elements of biodiversity. However, RBS does also address indirectly some of the less tractable aspects of biodiversity:

- For the broad scale of biodiversity, the position of a surveyed landscape within a regional or global vegetation classification is an important theme when reporting RBS results, showing the significance of local vegetation types in a global context. We are developing an online RBS database for all RBS survey results, to help provide the bigger picture – pinpointing the status of the plant communities of an area in a global context.
- Regarding genetic diversity within species, it is usually impractical to consider in RBS the genetic variation within and between species if it is not covered by formal taxonomy (for instance, in terms of named varieties and subspecies). However, when species are categorised for RBS into Stars (p. 12), allowance is made where possible for the fact that species and other taxa are not all defined on an equal basis, but are susceptible to the varied and fickle sensibilities of taxonomists. One taxonomist's variety is another's species. The apparent genetic variation within species on the one hand and the relatedness of species to others can both be used to modify the biodiversity value attached by the RBS analysts to different species or infra-specific names. These aspects are considered as part of the rapid

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global rarity assessment for each species, so in this context RBS does strive to consider deeper aspects of biodiversity than can be covered by the formal plant names.

RBS does not otherwise deal with genetic issues, but it is proposed that the undocumented patterns of genetic variation within widespread species should match, to some extent, the patterns on which RBS focuses, in the species content of vegetation. Biogeographic factors like isolation, climatic history leading to refugia, and unusual environmental conditions today can be associated with clusters of endemic species, so one might expect they would be associated also with other local peculiarities in the composition of gene pools.

8

BIODIVERSITY, BIOQUALITY AND HOTSPOTS

Bioquality is often considered with reference to RBS samples, but both bioquality and RBS can be discussed or surveyed independently. Skip this section if your only interest is in RBS *per se*, for purposes other than surveying bioquality.

A CONFUSION OF HOTSPOTS

The term 'hotspot' implies an area rich in, or threatened by, something. For instance, for geologists a hotspot is an area with high levels of volcanic activity. The term ***Biodiversity Hotspot*** is used in a variety of ways in the literature, not only to mean areas with a high diversity of life:

1. Rich. A region rich in species, or in rare or endemic or endangered species (Allaby, 1998). It is important even with this simple definition to specify which types of species richness formula is meant, but often the term is used indiscriminately.
2. Rich and Risky. Regions biologically rich as in 1, but that are also threatened by destruction and therefore priorities for conservation action. This is the definition favoured by Myers and many others (e.g. Myers *et al.*, 2000).
3. Rich or Risky. The term hotspot is also applied explicitly in three different ways by the same authors, e.g. to specify richness, rarity and threat (Orme *et al.* 2005).

In the current context, definition 1 is followed for the meaning of "biodiversity hotspot", trying to avoid the confusion due to inclusion of threat in the concept.

To convey meaning 2, phrases like "Critical Biodiversity hotspot" or "threatened biodiversity hotspot" are more appropriate. Composite definitions as in 2 have the problem of weighting the relative importance of threat and species richness when ranking areas in an objective way.

BIOQUALITY

Because of the ambiguity inherent in the term biodiversity hotspot, and because areas "rich in endemics" depend on the size of the area being considered, the term **Bioquality** is used to convey the value associated with areas being rich in, i.e. hotspots of, globally rare species, taking into account the varied geographical ranges of the component species (Hawthorne & Abu Juam, 1995; Hawthorne 1996).

Like biodiversity, bioquality is a property of a set or community of species. Unlike true diversity measures, though, bioquality relates to the concentration of valued species in a sample or community. By contrast, diversity specifically denotes the numbers of species and their relative abundance (as in Fisher's alpha and the Simpson or Shannon-Weaver index).

If unspecified, bioquality implies the global value associated with representation of globally rare species in a sample of a community. The Genetic Heat Index (GHI) discussed below represents an attempt to formulate this sense of bioquality.

- If unqualified, *Bioquality* specifically implies *valued due to a high concentration of globally rare taxa,* and with a value weighted by the degree of rarity.
- However, more loosely, and if defined explicitly, one might use the term bioquality in other contexts where the biodiversity of a community is scored by summing, integrating or otherwise combining valuations of the component species. For example, "locally perceived bioquality" might imply species had been weighted according to the sensibilities of the human societies living in and around the

vegetation in question. Clearly, in these other cases one can expect many, often conflicting values by different groups of people for the same plant community.

- "Tree community bioquality" might be calculated as a GHI for tree species with individuals above a certain specified size class, within a sample area.

Vegetation on an old, urban rubbish tip can have a high diversity, with many different exotic and pioneer species, but if these are all globalised weeds, the bioquality would be very low. Conversely, a patch of forest dominated by hundreds of trees of one locally endemic tree species in a mono-specific genus has higher bioquality than a patch of similar forest with 100 widespread species. Every individual plant in the first case is part of a high priority, globally rare species, and in the second case there are no individuals of globally rare species. One expects, in general, to encounter globally rare plants (and genes) more frequently whilst walking randomly in high bioquality vegetation than in low bioquality vegetation.

BIOQUALITY ASSESSMENT USING THE GENETIC HEAT INDEX (GHI)

To recap and emphasize, bioquality could be expressed in various ways, and for different taxonomic groups, but when it is specified in terms of the Genetic Heat Index (GHI) for plant communities, it indicates the degree of global endemicity – the localness – represented there.

Bioquality assessment was developed hand-in-glove with the RBS field method. The techniques used to analyse RBS data reveal the main trends in vegetation content and local and regional peaks of bioquality, showing where globally rare species are concentrated, perhaps in particular valleys or rocky slopes. Such peaks are bioquality hotspots, and can be detected for any size of area providing there are enough species in the sample.

Bioquality can vary over a matter of metres, from hot to cool, so it is possible to use the GHI as a basis for objective, and fine-tuned environmental impact assessments (EIAs) – alerting operators to globally sensitive areas in a standard way and also providing a framework in which success or progress towards restoration can be monitored accurately and objectively.

Although herbarium collections have been used to indicate locations of supposed hotspots of rare plants, these often prove in retrospect to highlight areas with relatively easy access and are often areas (for instance 'Mt Cameroon') which on close inspection reveal a mosaic or gradient of hot and cold spots. Hotspots are traditionally mapped on broader scales and tend to be of little use for local management. RBS and the GHI, on the other hand, provide a means to highlight hotspots at all scales, down to clusters of rare plants on rocks.

STARS AND THE CALCULATION OF THE GHI

The Genetic Heat Index (GHI) is an index of bioquality for a sample, whether that sample is a single plot, or a forest or regional checklist. The GHI indicates the chance that a random species from the specified plant community is a globally rare one – a Black, Gold or Blue Star species - weighted by the degree of global rarity. To calculate GHI, species are assessed for Global rarity (put into Star categories) using all available data, and species lists for various community samples are assembled separately, ideally using RBS fieldwork. The spectrum of different Stars in the samples determines the GHI, The process is shown in Figure 2.

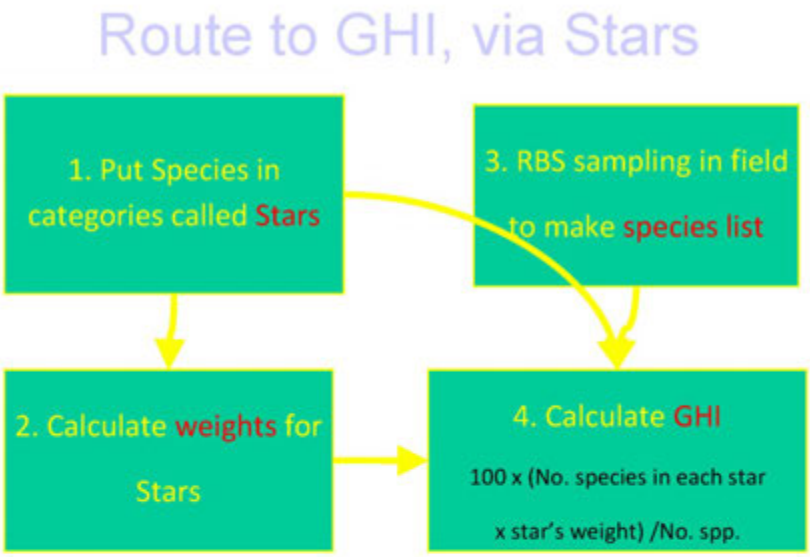

Figure 2: The steps for calculating the GHI of a sample of species

The three main steps are discussed in various sections, as follows:

- Step 1: Categorise and define species into Stars (p. 12)
- Step 2: Calculate and check weights for Stars (p. 17).
- Step 3: RBS sampling in the field (p.21).
- Step 4: Calculate GHI for samples of species (p. 20)

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STEP 1. CATEGORISE SPECIES INTO STARS

Species are allocated to colour coded categories of global rarity called Stars, based on their global distributions and, to a lesser extent, taxonomic and ecological rules.

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Table 2. Global rarity is very much the strongest influence on the Stars allocated to species, but cannot be considered separately from various other issues.

Black Stars are the top, i.e. rarest, category. At the other extreme, Green Stars are widespread and of no special conservation concern in terms of their rarity. The sequence from high to low rarity or conservation value is: Black, Gold, Blue and Green Star[1].

In the earliest RBS in Ghana, heavily exploited but globally common species were originally distinguished as separate Reddish (Scarlet, Red or Pink) Stars (Hawthorne, 2001) depending on how intensively they were exploited. It is now the standard method to keep the bioquality index simpler and more specifically linked to global rarity, so all species are defined as Black, Gold Blue or Green Stars, even if heavily exploited. Where global usage status is well-known, Reddish Stars can be listed alongside, not instead of the four main Star colours (as with other conservation-related categories, such as IUCN status).

DEVELOPING A REGIONAL STAR FRAMEWORK

In order for the Star system to be comparable across regions, Stars defined in different continents should imply equivalent global rarity, although obviously the details of the distribution of species in a particular Star change from region to region.

Star	Ideal mean range* (tropical degree square or 100x100 km)	Standard Weight
Black	2.66	27
Gold	8	9
Blue	24	3
Green	(72)	(1) 0 for calculation of GHI

Table 1 Ideal, mean geographic ranges and standard weights for each Star

Global range is expressed as degree squares occupied, or 100 x 100 km squares (at higher latitudes), whichever is the larger area. So, degree square counts are used where most species' ranges lie below 40 degrees latitude, in the tropics and subtropics. The average geographical ranges expected for each Star is three times smaller than that of the next rarest Star (72/3 =24, 24/3=8, 8/3 ≈2.67), and the weights therefore decrease by the same factor (27, 9, 3, 0). As the ratio between mean range is used for weighting, not absolute range, slight variations in grid

[1] The colours of Stars can perhaps be remembered using the following symbology: Black Stars are exotic and invisible objects. Gold Stars are more conspicuous globally, but still with a significant global rarity value. Many Blue star species with a widespread and sparse distribution are riverine or sea-shore species, so the allusion is to blue water. Green suggests character-less background vegetation, a species adding no 'local colour' or local distinctiveness in a plant community.

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system used for counting range in different projects makes no significant difference, especially when one considers other factors that make any range size estimates imprecise.

The initial goal of Star rating is to estimate degree square (or 100 x 100 km) occupancy for the species of interest. Increasingly, this can be achieved by using published, digitised distribution data. Digitised distribution data remain patchy however, so a set of chorological (biogeography-related) rules can also be generated to allow the botanist to extract information from other sources such as Floras, monographs and biogeographic treatments of floras, and relate it to the Star categories.

To use digitised distribution data, a species list for the region of interest is required. This species list can be used to download and compile distribution records for the species. Sources of digital distribution data vary by region, but are commonly held by regional herbaria, and other herbaria with a history of collection in the region. Distribution data are also available through GBIF (www.gbif.org). *Global* distribution data for the species should be compiled, such that the global ranges of the species can be estimated (e.g. not only records from inside your region). This degree square occupancy estimate for each species should be referred to when using the regional framework for Star rating, keeping in mind the typical degree square occupancy suggested for each Star category. Degree square occupancy estimated in this way should be considered as the minimum occupancy, unless there is reason to believe that collection and digitisation has been particularly complete for a species. The Stars are as far as possible standardised globally, and adapted regionally into a regional Star definition framework. Thus far, regional frameworks have been developed as and when demanded by RBS-related projects, with separate projects for example covering all of: mainland tropical Africa, Trinidad and Tobago, Japan and the Brazilian cerrado. Each regional framework is work in progress, the best practicable answer that can be made at a stated time for a given region. Botanists are encouraged to debate both the definitions for each Star in the regional framework and the Stars allocated to particular species using these rules, both of which may change as plant exploration progresses.

The regional framework can be presented as a table or key (see example in Table 3), devised so that:-

- It is fairly easy to work out which Star most or all species in the region should be in, at least for a first approximation, from a summary of the global distribution pattern of the species, for instance from a published Flora or monograph or distribution data.
- The geographic ranges of species placed in the different Stars are significantly different, in terms of the mean and standard deviation of the geographic range for species in that Star, and are as close as possible to those defined in Table 1.

The rules are adapted regionally to yield Stars with similar mean geographical range in different regions, so Gold Star Chilean species, for instance, have an average range that is as close as possible to the Gold Star Ghanaian species[2].

[2] Insofar as exact alignment is not possible for the mean ranges of species in a given Star in each region, the weights for Stars could be fine-tuned within specific projects to reflect their relative rarity more precisely. However, as the results are of greatest interest when compared globally, we propose to use the same standard set of weights, as it would make no sense for a Blue, Black or Gold Star species to be weighted differently depending on region/project of assessment. The actual, statistical difference between the adjusted and default weight for Stars should in any case be stated when the Star framework is set up.

GHI weights for a given Star should always be based on extant facts, referring to all herbarium-based distribution data for a subset of or all species in the Star, rather than their hypothetical or modelled ranges. However, the primary categorisation of species into Stars is made practical by considering species range in terms of broad biogeographical categories, like 'widespread across tropical Africa'. The framework definition clarifies specifically what this might mean in terms of distribution patterns (e.g. "one or more records from each of East Central and West Africa", or 'known only from a single Kenya flora district).

The mean range of species in such categories is calculated for a subset of species, those which are more certain taxonomically and for which the reliable distribution data is available.

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Table 2 Meaning of the Stars, in general terms. More specific biogeographic criteria are devised for different regions, using precise geographic rules. The Typical Range column indicates a typical geographic range in degree squares. The mean range is derived from various projects, and should be taken as a target for new Regional frameworks. The stated range is not the absolute basis for the classification into Stars, but merely a guideline for devising the regional rules and setting weights.

Star	Typical range of individual taxa (mean)	Generalised definition: the spirit of the category.
Black	<5 (2.67).	'Local endemics'. Endemic to a small part of a region (a mountain range or forest block, small island groups, or corners of a region with unusual rainfall patterns) where they might be locally common; or scattered* within a slightly wider range. These are high conservation priority, global rarities and the places in which they are concentrated should similarly be highly ranked. Species known only from the type locality, or from there and a few areas within c. 100 km, are automatically Black Stars, unless there is reason to suspect they occur widely elsewhere (e.g., the name is a probable synonym of a widespread species). A species known only from a few scattered mountain tops in a region would also qualify.
Gold	5- 12 (8)	Some global conservation priority rarities. These might be quite common in parts of a biogeographic region (e.g. 'Upper Guinea', or across the Lesser Antilles), but are not globally more widespread, or they may occur in as many as two or more average-sized countries but very sparsely*.
Blue	12-50 (24)	Barely of global conservation concern. This category includes continentally widespread species, which are scattered* in their range, typically riverine, coastal or high altitude species; or they may be extremely common throughout several countries and vegetation types, but are not continentally widespread. It is difficult to dismiss these species as 'of no conservation concern'. They are often the species that add local 'colour' or distinctiveness to unusual habitats, but unless many such species occur in a single sample (as often occurs on mountains) they have limited influence on the ranking of community level bioquality scores.
Green	50+ (72 used as default baseline)	Species of no obvious conservation concern in terms of their rarity, because they are widespread, typically across a continent in appropriate and common habitats, wherever that habitat occurs, or even global. Continent-wide species that live only in scattered islands, or islands of montane forest, however, might well qualify for Blue or Gold Star status. These species, for instance 'widespread across tropical Africa, in Guineo-Congolian forest' generally account for more than half of all species in most regions.

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Table 3 Example of a Regional Star framework, developed for Trinidad and Tobago. Global range categories were defined for the Trinidad & Tobago (T&T) flora (left column). These were translated initially to Stars in the right hand column as shown (sometimes over-ruled by secondary adjustments). Very few changes would be required to the rules (mainly to Black and Gold Star definitions), for it to be usable in other parts of the Southern Caribbean.

Global range	Meaning of Global range category	Sub-conditions, if any, to qualify for Star	Star
1	Endemic or near endemic to T&T. Near endemics are, for example, on Venezuela's Patos island, Paria peninsular, in the Dutch Antilles or Grenada, not more widespread in S. America or Lesser Antilles.		**Black**
2	EITHER found more widely in, for example, Venezuela or Guyana, and southern Lesser Antilles; not just a small extension beyond T&T. OR apparent T&T endemics but with very plausible records or (including likely synonymy) from well outside T&T.		**Gold**
3	EITHER fairly widespread across Venezuela, the Guianas, southern Caribbean	but sparsely distributed, for example, scattered on a few higher Caribbean mountain tops	**Gold**
	OR widespread in Caribbean (to Greater Antilles) and also in northern S. America.	in most or all countries in range with several distant localities, or known to be very abundant in part of range	**Blue**
4	As 3, but extending, for example, to Brazil, Bolivia, Peru OR to Mexico and N. America (if both, see 5)	If, for example, only known in a distinct patch of northern Brazil, S. Guyana; or very scattered throughout	**Blue**
		As far as known, found regularly throughout most of the area at least on a 1 degree resolution.	**Green**
5	Widespread in the Americas, but either not generally in the Caribbean, or scattered throughout range	Normally distributed in range, for example, in most degree squares throughout forest or savannah belts	
		Unusually scattered or sparse, even allowing for restriction to forest, savannah or similar broad formations, for example, montane endemics on scattered peaks would belong here.	**Blue**
6	Widespread neotropical (as 5 but more densely distributed plus Caribbean)		
7	Globalised floristic elements	Widespread in Americas (probable origin), but also known today in the Old World	**Green**
8		Widespread global weeds; or seeds of global strand and seashore; origin obscure or Old World	
9		Exotics and garden or crop plants, commonly planted, not indigenous, at least to T&T	

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SECONDARY ADJUSTMENTS TO THE STAR FOR A TAXON

Once all species have been allocated a default Star based on geographic range, secondary adjustments – up or down one or more Stars from that which the regional framework prescribes for the recorded global range– are allowed for taxa that are judged to be, in effect, more or less globally rare (ecologically or taxonomically) than normal, providing data are judged to be reliable and according to the following considerations.

- Species with unusually scattered distributions within their whole range can be upgraded. Some 'scattered' species suggest a relict (once more widespread) distribution; other cases may be due to erratic, long distance dispersal. In both cases, these species are often associated with specific, scattered habitat e.g. isolated mountain tops.
- Species that tend to regenerate sporadically or occur very sparsely within their range may be upgraded a Star – if they are deemed to be, in effect, globally more than three times rarer than average for species with the same range.
- Some taxa, like canopy epiphytes and small aquatics, are under-sampled in herbaria compared to terrestrial shrubs with conspicuous flowers. Classifiers should try to compensate for this, if necessary downgrading very inconspicuous and significantly under-collected species relative to what the framework suggests, as it is reasonable to assume that they are commoner than they seem.
- Invasives, aggressive pioneers that are naturalised and expanding their range, typically dominant over large areas, can be downgraded a Star. They are in effected counted as globally less rare than their recorded range suggests. In practice, most such species are widespread Green Star species even without this adjustment.
- Species that are widely cultivated, such as *Coffea spp.* should have a lower Star than that implied by the supposed natural range, when assessing communities where such species are found persisting after, or escaping from cultivation. It may be appropriate and possible to distinguish escaped cultivars from wild-type ancestral plants, and score them separately. A separate informal name entry and higher weight Star can be introduced in the database to designate isolated wild and genetically distinct populations. ('*Coffea arabica*- wild Ethiopian population', Black Star; vs 'Coffea arabica (cult.)', Green Star)
- Species very isolated taxonomically from their nearest relative can also be upgraded, e.g. species of mono-specific genera. Species very dubiously distinct from other species can be downgraded.

In case of doubt, about taxonomy or range, the lower value (commoner option) from a range of Star options should as a rule be selected. Two very closely related and similar species are more likely to become sunk into one species by future taxonomists than two distantly related ones: secondary adjustments should help stabilise the Star assessment in the face of shifting taxonomic opinion.

Consideration of relatedness is justified not only to help stabilise assessments, but also because maintenance of both inter- and infra- specific genetic diversity globally is an aim of biodiversity conservation, and this is only partly captured in the formal taxonomy. The global range of taxa, the key criterion for Stars, is not at all independent of taxonomic opinion and patterns of variation. The importance of this approach becomes more obvious when one tries to assign Stars to infra-specific taxa.

STARS FOR DIFFERENT TAXONOMIC RANKS & INFLUENCE OF RELATEDENESS

Basic consideration of relatedness between taxa provides a philosophical framework for allocating Stars to infra-specific taxa: it allows a rationale for varieties and subspecies to be allocated a Star that is different from the species as a whole. Varieties, sub-species and forms (any infra-specific taxa – **VARS** below) can have higher, or the same Star as the species which contains them, for the following reasons.

- VARS are obviously always rarer globally than the species which includes them, as they are but part of the whole species. On the other hand, they may be very closely related to other VARS of the same species which together constitute the full species' range. It would make little sense if VARS were always higher-ranked on the basis of this greater rarity. That way we could end up with an illogical situation where two Black Star varieties constitute a Gold Star species.
- Yet, it is not unreasonable that a **species as a whole may be lower ranked than SOME of its VARS**, e.g., a Gold Star species composed of one Gold Star and one Black Star variety. This signals uncertainty over which variety is represented by any record referred to only at the species level. In the face of uncertainty, bioquality estimates should be conservative, so the Star for a species is always equal to that of its lowest ranked VAR. It is important to ensure all VARS of the species are considered, not just those from the region under study, so where some VARS are missing for a species otherwise included in a regional database, the Star of this species should be set at the default for the total species' range, pending more detailed assessment of all missing VARs.

Guidelines for secondary adjustment of Stars based on relatedness can be laid out as follows.

1. First of all calculate the Stars for species as a whole, as if no VARS had ever been published.
2. VARS can never have a lower ranked Star than their species as a whole. By default, all VARS have the same star as their species, so pending further consideration repeat the species' Star for all VARS.
3. When adequate data are available, consider the range of each VAR in turn, using the geographic guidelines as if each was a separate species. The VAR can be upgraded to a maximum of the Star it would be allocated if it were a separate species, but usually in view of the close relatedness of the VAR to other VARS it may be appropriate to allocate a Star between this value and that of the whole species.
4. If expert taxonomic opinion shows they are very well defined and distinct VARS, such that other taxonomists might well have treated them as a different species, prefer the higher ranked Star option. If the VARS are only subtly different, and have very similar sister VARS that would extend their range dramatically if considered together, choose the lower option.
5. If a VAR is different in only trivial ways (e.g. only slightly hairier flowers and stems), then be more disposed to use the same Star as for the species as a whole. Or, if populations of the VAR are more distinct than usual from the rest of the species, tend towards the Star suggested for the VAR if it were a distinct species.
6. If the VAR has a particularly narrow range in a distant locality, geographically isolated from the rest of the species, prefer the higher Star possibilities. If the range overlaps considerably with that of the rest of the species, maybe enclosed within it and not isolated ecologically, choose the lower option.
7. If all VARS (globally) of a species have been assessed, ensure the species' Star equals that of the lowest ranked VAR.

For example:

Begonia quadrialata is widespread across the Guineo-Congolian region.

- *Begonia quadrialata* subsp. *quadrialata* is widespread in West Africa, and Lower Guinea (to Gabon).
- *Begonia quadrialata* subsp. *nimbaensis* is endemic to the Nimba mountains of Upper Guinea in an area less than 50 km wide (in three 0.5 degree square cells, or one 1 degree square – Poorter *et al.*2004)

First, consider the species as a whole. It is very widespread and common and therefore Green Star. Likewise, the widespread subsp. *quadrialata* is Green Star.

If *B. quadrialata* subsp. *nimbaensis* were a distinct species, i.e. if it had species status, it would qualify for a Black Star. If the variety had been very distinct, it might have been kept as a Black Star species, given the very narrow range, but subsp. *nimbaensis* is very similar to the other subspecies, and so qualifies as Gold Star at best. In fact,

the two subspecies have recently been found growing closely together in intimately mixed colonies on Mt. Nimba suggesting even slighter genetic differences than previously thought. Knowing this, and that subsp. *nimbaensis* could soon be sunk, or reduced to a mere *forma*, leads us to downgrade it to Blue Star, reflecting very close affinity to the more widespread form. This has the useful side effect of helping stabilise the GHI of samples which include it, in the context of future likely taxonomic changes.

So, subsp. *nimbaensis* is Blue Star, yet the species as a whole is Green Star. i.e. the species as a whole has a lower rank than one of its subspecies as outlined above, the lowest, more conservative possible interpretation. The onus is on the botanist to specify the subspecies in these cases. Often the VAR can be deduced from geographic location of the specimen, so can be applied automatically once the species is determined (but this does not apply here).

On a slightly different basis, one can sometimes allocate Stars to unidentified specimens of known species in particular genera, at least within the context of a specific project area. If all species of a genus are Gold Star, then any unidentified specimen is very likely to be one of them (but unspecified maybe due to lack of flowers) and can be given a Gold Star in that context. Time spent trying to identifying sterile specimens for bioquality assessment is reduced if one knows there is no point spending a lot of time deciding which of several species of a Green star genus one has. This shortcut is not possible if various species from a genus have different Stars.

Tabernaemontana trees in West Africa belong to one of a few widespread (Green Star) and common species, so unidentified *Tabernaemontana* trees are also allocated Green Star. This is particularly useful because the species are common and can usually not be distinguished when infertile.

STEP 2. CHECKING WEIGHTS FOR STARS FROM GLOBAL RANGES

As a draft Star framework is developed, the mean global rarity for each Star is established for a sub-sample of the species in each Star from recent taxonomic monographs and revisions. It is assessed as the number of degree squares occupied (or of 100 x 100km grid squares outside the tropics and subtropics where degree squares become smaller than this area). This is only calculated for a subset of species because, for the majority of species, detailed degree square distribution maps are usually not available.

The category of the globally commonest species (Green star) is treated as a baseline of zero value, equivalent to an infinite range, but the value of 72 degree squares is taken as a standard value for the Green Star range, for weighting purposes. There is little need to calculate this range for many of the Green Star species, except to check that the concept is correctly applied and that the regional framework leads to Green Stars with a mean distribution of more than 50 d.s.. Weights for other Stars are calculated based roughly on the inverse mean global rarity of each Star (rounded to an integer), relative to this baseline, of 72 d.s,. for Green Star.

The aim is that Stars defined in different regions lead to sets of species with similar mean range. The framework rules for Stars should be adjusted as far as possible to lead to sets of species with the preferred mean range, although exact alignment is not always possible.

The rarest category - Black Star species – should be defined in a way which means they occupy as close as possible to 2.7 degree squares on average, as the weight of 27 (72/2.66=27) is used for standard calculation of GHI.

A standard grid should be specified for any survey, e.g. for tropical regions, the degree square grid with origin at the equator and the Greenwich meridian. The alignment of the surveyed area with respect to the degree square grid can influence the weights slightly, particularly for Black Star species. Many species with a narrow range that could fit in a single degree square have occurrences which straddle the standard latitude and longitude lines, falling in 2-4 grid cells. It is preferable to keep the range estimates objective rather than trying to minimise ranges

by shifting the grid origins for each species, not least because published data usually does not allow such regridded estimates. In regions where the grid alignment biases the estimated ranges (e.g. with a narrow mountain range running along a meridian line), a slightly higher than the default mean range (2.7) for Black Star species is acceptable.

STEP 4. CALCULATE GHI FOR A SAMPLE OF SPECIES

We will describe the RBS field methods below. Even though that is potentially Step 3 in the four step process for calculating bioquality, there is a lot more to RBS field methodology that needs to be explained. Here, readers only need note that a RBS sample provides a local list of species, and that a GHI can be calculated from any list of species. How meaningful the GHI is, though, depends on how the sample was assembled in the first place.

For any RBS (or other random or sub-complete) sample of species, a GHI is calculated by:

- Summing the number of species of each Star;
- Multiplying each subtotal by the Star's weight;
- Adding these weighted totals and dividing the sum by the total number of species that have any Star. Unidentified species and other species with no Star allocated, are completely ignored.
- This value is multiplied by a hundred and rounded to a whole number (to avoid the need for decimal places in the GHI).

Table 4 Worked example of calculation of GHI.

Star	A = Number of species in sample	B = Weight for Star	A x B
Black	2	27	=54
Gold	5	9	=45
Blue	13	3	=39
Green	50	0	=0
Unidentified or no Star allocated *	(6)	0	
Total, excluding *	70		140

GHI= 100 x (140 / 70) = 200

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RBS SAMPLING IN THE FIELD (STEP 3)

RBS fieldwork is Step 3 out of four key steps defined above for calculating the bioquality across a landscape. RBS has other uses, apart from bioquality scoring. In this section the RBS field methodology is introduced and explained, after a recap of generic RBS aims.

SUMMARY OF RBS AIMS

RBS aims, with minimal effort, to provide a rapid, yet penetrating and useful overview of the vascular plant biodiversity and vegetation in an area, in relation to the landscape, and to provide information on various aspects of plant distribution, including:

- Plant distribution in the surveyed area. RBS helps uncover unknown localities of rare species whilst paying due attention to the distribution of common ones.
- The main trends in vegetation variation and how species are distributed with respect to environmental variables, especially position in the landscape and disturbance history.
- Vegetation bioquality and conservation priority, at the finest scale practical for vascular plants. (See page 9 for discussion on how RBS can act as a bioquality thermometer.) A key aim of many RBS projects is to expose and dissect plant bioquality hotspots, employing a particular and precise definition of biodiversity hotspot, whereby:
  - the threat factor is excluded from the index of 'hotspotness', in contrast to Myers *et al.* (2000) where high threat is a necessary condition for a region to be counted as a hotspot;
  - The GHI can be applied at any scale, so RBS focuses on a fine scale and a bottom-up approach.

RBS outputs, including statistical summaries, bioquality and vegetation maps and annotated check-lists, are also useful for generating hypotheses on aspects of local ecology and biogeography, which may then be tested by further RBS sampling or more applied sampling or experiment.

RBS also has the following benefits, which can be considered secondary aims.

- RBS provides a context in which groups of botanists, foresters, ecologists, professionals or students, are in the field together, becoming familiar with the current status of the vegetation and landscape under investigation. RBS teams therefore learn about botanical and other local issues of relevance to the management of the vegetation, often whilst working with representatives of the relevant state and local authorities and communities.
- RBS facilitates the flow of relevant botanical information back and forth between local and global levels. Information collected locally is databased and published globally, if appropriate and ethical, whilst information from elsewhere flows "back to the roots". Local participants in RBS teams become informed about which species are globally rare, useful or otherwise considered valuable elsewhere. RBS can also facilitate production of field guides or other educational materials.

RBS IN RELATION TO OTHER SAMPLING APPROACHES

Many methods have been used for sampling plant biodiversity, and each has its own strengths and weaknesses. Three commonly used methods are compared with RBS in Table 5. These are:

- Herbaria, or rather databases of herbarium collections, can be used to generate samples of plant biodiversity data for particular places. These can be check-lists of all species ever recorded in given localities, districts or grid squares, and the sampling "method" is the informal and unplanned wanderings of plant collectors over the centuries (combined with the database query, if appropriate).
- The Gentry type transect method (see Missouri website, 2010) is a record of all plants with stems ≥ 2.5 cm (DBH) along ten 2 x 50 m transects, totalling 1/10 hectare at each site. There have been various modifications, and many types of small, measured plot that include all, or most plant species that have similar attributes, so are considered in the same column in Table 5.
- The relevé samples associated with the Braun-Blanquet method (Westhoff & van der Maarel, 1978), which has been the mainstay sample method for continental European phytosociology for almost a century, are subjectively sited to provide a 'typical' sample but are measured plots. The area is chosen in theory to include all species, so there is a problem in patchy vegetation in maintaining homogeneity with a square area whilst encompassing all the species. Nevertheless, the result can be similar sample to RBS, and very similar to an RBS made using the optional measured sample area.
- Even before biodiversity survey became an issue, foresters used a wide range of sample plot types for measuring tree density and size class distribution. These "Classic Forestry" plots normally include only trees larger than 30 cm DBH, sometimes with a subplot for smaller trees. Although individual trees are recorded in detail, the rest of the flora is ignored. There is therefore some overlap between the Gentry and Forestry plots, especially in terms of their measured area and focus on plants with stems above a certain diameter.

RBS field methods incorporate aspects of 'classical' herbarium collecting, ecological sampling and tree inventory. RBS is a less biased, and more systematic and thorough method for sampling plant communities than casual herbarium collection but is not as systematic (or random) as most forest inventories and other all-tree permanent plots used for growth studies.

Plant collectors vary in the amount of information they put on the labels for their herbarium specimens. Some collectors mention lists of species associated with each collected specimen. For example: "Growing with *Ceiba, Manilkara obovata, Microdesmis* and *Diospyros* with a dense under layer of *Olyra latifolia* in a shaded gulley". It is usually unclear how complete these lists are, and often names are generic, but they are still interesting when researching the ecology of the species represented by the specimen, and even of some interest when considering the other species in the list. RBS takes this several steps further, by requiring a thorough listing of the species in each landscape sub-unit. By altering the pattern of the collection compared to classic herbarium collections, RBS makes the variation in the vegetation the main focus, and the local check-list becomes the primary goal of the exercise.

RBS samples themselves are generally unmeasured and plotless, based around a point, and in a patch that represents a defined position within the spectrum of local vegetation and landscape conditions. As many species as possible locally, representing a highly representative majority at least, are recorded within the chosen vegetation type. Ideally, recording continues until no more species can be found easily in the defined area. An RBS database is a suite of micro-checklists like this, with extra information on the places and species concerned. Sometimes there are linked photographs and other details for the plants in the plots.

Table 5 Features of four types of botanical of floristic and vegetation sample to demonstrate the spectrum of attributes. Standard RBS samples lie between check-lists of species for a given area, derived from herbaria (left), and classic forestry tree inventory plots (right).

		Herbarium locality	*RBS*	*Gentry type transect*	*Classic Forestry Tree inventory plot*
Measured sample area		No	No (optional)	Yes	Yes (usually)
Completeness[3] for sampled landscape units		Very varied	High	Low	
How much choice does the surveyer have over…	..location of sample units?	Very high	High	High	Very low
	..physical limits of one sample?	Very high	High, e.g. to exclude patches different from sample definition	Low	Very low
	.. species to mention	Very high	Very low	Very low	
Range of plants sampled overall		Very high e.g. incl. mosses	High: all vascular plants	Medium (e.g. >2.5cm DBH)	Low (larger trees)
Homogeneity of vegetation of single sample		Very low, especially large localities over many decades	Very high	Moderate to low, as standard shape constrains the maximum "purity"	
Sample coherence[4]		Very low – species in a sample from varied eras and areas	Very High	Medium. Not as high as RBS, as the predefined plot shape can include varied patches	
Appropriate for GHI scoring?		With great care, (for completely sampled small localities or large regions)	Yes	No	

RBS aims to be more locally complete[2] than sample plots or transects. RBS samples are not confined to a standard square plot or transect, and they include all types of vascular plant, not just trees. RBS can provide 'purer' samples of a particular habitat, because samplers can specifically choose to ignore patches deemed unrepresentative of a stated target vegetation type (e.g., canopy gaps). The trade-off is that RBS samples are less constant in area and less random in sample location than are Forestry plots.

[3] **Completeness** for a landscape unit represents the extent to which the sample is a complete species listing for the defined locality, vegetation type, species types (i.e. vascular plants for RBS) and landscape unit combined. A feature of RBS is that it strives to generate samples that are as complete as possible, allowing for practical constraints, whereas most other sample types are explicitly token subsets.

[4] Sample **coherence** refers to the extent to which the list of species for a typical, single sample unit represents plants cohabiting closely, at one moment in time and in one place. High coherence should imply a narrow successional stage and a physically homogeneous ecological community. A very patchy sample area, e.g. forest with many canopy gaps, has lower coherence. The value in the table refers to typical, ideal samples of each type, but of course any sample can be forced to be highly incoherent.

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RBS is therefore a compromise between the extremes of plant sampling, designed to produce adequately reliable all-species datasets as rapidly as possible and at a resolution required for documentation and management of tropical plant biodiversity. RBS does not substitute for other types of plot. Each has a niche of its own. However, these other types of sample can often be modified to make them compatible with RBS surveys.

The question has been asked...Why call it 'Rapid', when some other methods are faster? The answer is that RBS achieves a near-complete inventory decades faster than that of casual herbarium collecting (which is compiled from fertile plants over sporadic visits for many decades). Other fast sampling methods rarely generate such a complete listing of all plant species, and even if they do, much time is spent on plot demarcation.

RBS AND CLASSICAL HERBARIUM COLLECTIONS

Many of the decisions about plant hotspots and conservation areas have historically been based on a legacy of herbarium collections, or on the same information published via Floras. Herbaria are essential for 'getting to know' the geographic patterns in a flora, for describing new species and understanding the relationships between plant groups. They are also essential for identifying collections, such as those produced by RBS itself. However, herbarium databases are not ideal on their own for spatial assessments of biodiversity on a practical, local scale. Some of the main differences between casual herbarium and RBS data are:

- Herbarium collectors generally target a small subset of the species in the landscape that are fertile at the time of visiting and considered useful for taxonomic purposes. Often, individual collectors have their own specific taxonomic group of interest, and it is quite usual that many of the commonest and most conspicuous plants in a forest at the time of a herbarium collection visit will not be recorded at all. (If a herbarium collector methodically collected all species and environmental details from discrete, well-documented, homogeneous sample areas, they would in effect be doing RBS).

- RBS surveyors, on the other hand, record as many species as possible – ideally all species regardless of whether they have flowers or fruits – so that absence of a species' record from a site at least shows that it was not obviously present at the time of the survey. At least, no plant species seen in the sample area are consciously excluded. Inevitably, even RBS surveys miss some species that are ephemeral or appear seasonally, epiphytes that are far out of reach and (the relatively few) species that are practically unidentifiable when not flowering, considering the time available for identification. But, there are often many fewer species missing after a weeks' work in a suite of RBS samples than following decades of collecting records for the same, albeit generally more vaguely defined, collecting locality.

- Common plants are not recorded in herbaria in proportion to their commonness. Collectors tend to give up re-collecting very common plants, and even when they are brought in for identification by amateurs, curators are not inclined to accept all specimens of the commoner species after a certain number has been included in the herbarium.

- Whereas the very common plants that are included tend to be recorded in herbarium databases from accessible regions closer to herbaria, collectors travelling further from the herbarium on difficult or expensive field trips often feel disinclined to "waste" their time and luggage or press space with widespread, common plants when they get there. Thus, we hypothesise that little-visited, remote sites are more likely to be represented in the herbarium record in a biased way, as if they were disproportionately rich in rarer species. RBS strictly avoids this "rarer species from remoter places" bias.

- Herbarium collectors tend to drift around the landscape and successive records may be from very different habitats. RBS is focused on creating a complete species list for any sample areas mentioned, usually one landscape unit at a time.

- Herbarium locality data tends to be rather imprecise and associated data, e.g. position in landscape, are recorded inconsistently or not at all by different collectors. These types of metadata are routinely recorded, and in a consistent way for RBS samples.

- Herbarium specimens for a given locality were often collected over a period of many decades, and species may be absent from the same areas today. RBS is linked to a very short collecting window, so implications are of known relevance to today's decisions.

Check-lists for particular areas derived from herbaria are therefore often 'incoherent ' lists of species collected at a wide range of times, from not very precisely localised areas, e.g. in both wetter and drier sites, with different levels of attention paid to different plant groups.

In spite of these limitations, herbarium data can still be useful for analysing spatial patterns at a broad spatial resolution (e.g. for Guyana, Ter Steege *et al.* 2000; for West Africa Poorter *et al.*, 2005). Surveys at a scale where individual "samples" have an area of more than 10,000 km^2 (roughly, a degree square) are perhaps the most appropriate use for herbarium data in most countries. The main problem even at this broad scale is that one can never be confident *a priori* that the results obtained are truly representative of what is on the ground today.

From the context of herbarium staff, who often form the backbone of RBS teams, RBS gets people into the field, to see what is happening today and to provide precisely localised snapshots of the biodiversity for this period. RBS is also typically associated with a period of increased data collation and "cleansing" of determinations on old specimens relevant to the survey area, along with a flurry of other beneficial activity in the herbarium. The RBS snapshots of the plant community can be compared to new samples in subsequent years (or seasons), and allow surveyors to monitor changes that occur over time with better resolution than if herbarium work had simply ticked on in the traditional manner, with at best a steady drip of more or less randomly located, fertile specimens.

In botanically interesting and little-known places, places where RBS is so much needed, RBS teams also select and photograph the best fertile specimens for herbaria independently of making ecological voucher collections for the basic RBS.

Typical analyses and outputs and their demands on RBS samples

RBS data can be analysed in various ways, but the three most commonly employed types of analysis are:

- Ordination or similar multivariate techniques (amply summarised at http://ordination.okstate.edu/). These provide a neutral, or 'all species equal' method to highlight the overall patterns in community composition across the landscape or through successional change.

- Bioquality scoring (p. 10), where all species are weighted by Star categories of global rarity, and a bioquality score (e.g., GHI) is derived from the array of Stars in each sample.

- Species x sampling effort charts, to allow prediction of how many species are likely to be represented in the whole sampled landscape based on typical rate of expansion of species list for samples to date.

A local species list in the range of 50-150 species is a useful order of sample size for these purposes, depending on the vegetation being surveyed. The same analyses can also be applied to measured sample plots or even herbarium locality samples, if various minimum criteria are met. RBS surveys can include measured samples (see p. 32) to provide extra information.

The shape and extent of plotless RBS samples depends on the shape and extent of landscape subunits, e.g. a watercourse, defining the sample. It makes little difference to the types of analysis outlined above whether a

set of species is from a measured or unmeasured area – they produce compatible results independently of scale. Smaller samples, and samples following natural boundaries are likely to be more homogeneous and thus can be more precisely defined ecologically (less blurred or mixed). Therefore indices of the content of small samples, and of samples with an adaptive shape, can be more extreme in an ordination, than a large sample e.g. a check-list for a whole forest. However, like a pH value for acidity of a bucket or a cup of water, or a centigrade value for temperature, the values are not otherwise affected by sample size or shape *per se*.

RBS data can therefore be analysed and compared with other sample types (e.g. more general check-lists for a whole forest, or more formal plots) independently of scale, providing the other lists are obtained as effectively random subsets or as almost complete lists of the same range of species groups (e.g. all vascular plants). Otherwise, differences in rarity and ecological response shown by different groups of organisms can strongly bias the results.

Providing the samples have enough species and are not biased by varied taxonomic coverage, results for check-lists of large areas tend towards the mean or higher end values of the plots within these areas: smaller (RBS style) samples are more useful for generating means and standard errors rather than a single overall score. Statistically, many RBS samples for smaller parts of the landscape should have a higher variance of bioquality, or of ordination score, than fewer larger samples across the same landscape. It is easier to capture smaller nuances and local facets of the vegetation with smaller plots, but also to pick up uninteresting statistical noise related to the vagueries of regeneration and random tree-falls.

SCOPE, RESOURCES AND THE NUMBER OF SAMPLES IN A SURVEY

An RBS is often project-based, and in any case is best planned as an enterprise of a few months or years. The scope of an RBS project should be defined with interested parties as concisely as possible, in terms of area on the map and the precise purpose of the survey. Examples are:

- 'to build up a national biodiversity database for our country, to tell us where our plant species live, how the forest varies and where the plant hotspots are; and as a training ground for student botanists';
- 'as a basis for delimiting plant hotspots precisely and a baseline for future EIAs around our mining concession to help plan operations in a way that minimises long term impacts to the flora';
- 'as a forum for forestry and the university herbarium to collaborate, especially concerning biodiversity conservation priorities in the forest reserves'.

A few samples outside the primary scope and theme are useful. For instance, management of a specific forest or park is often enhanced by gaining more data for species in a few selected areas outside of the boundaries; and forest management can be improved by samples showing which species regenerate well in fallow outside the forests.

Usually, one is trying to stretch a limited budget to survey a given area in as much detail as possible. It is advisable first to estimate how many samples can be completed with the available resources (vehicles, money, staff, and identification skills). Typical examples of productivity are:

- 2 RBS samples per day per team is a reasonable rate to expect from a team working in a tropical forest, reducing to 1 per day where logistics or plant biodiversity make for hard work; and increasing to 3-4 samples per day in species-poor vegetation where access is easy.
- A team for a week in the field is about the minimum useful survey effort, yielding 10-20 samples, suitable perhaps for surveying a single forest patch where the national vegetation pattern and flora is already fairly well known.
- In a team month about 40-60 samples can be completed and these are likely to highlight the major trends e.g. for a single 30,000 ha forest or small mountain.
- It is usually most efficient to plan RBS as a year or longer project, part-time, so that databases can be optimised in the same period. Over 2 to 4 years, it is possible to complete a survey of all the major forests of a modest sized country.
    - A single team surveyed Ghana's forest zone, and identified, input and analysed the data for more than 200 forest reserves, in three years (Hawthorne and Abu Juam, 1995), although some useful data had been inherited from earlier studies.
    - Over 3 years, 250 samples were completed by a team in Trinidad and Tobago, sampling the islands densely, but intermittently as the team members had other duties in the same period.

Projects with a broader geographical scope tend to have a lower sample intensity. Surveys with thousands of samples may have to be broken up into smaller themes for analysis anyway. Better then to complete a smaller survey and, on the basis of the results, survey adjacent areas, or fill in more detail for interesting parts of the same area.

PREPARATORY WORK BEFORE RBS FIELD SURVEYS

It is useful or essential to complete the following activities prior to starting RBS field work:

- Definition of the geographical scope, aims and aspirations for any survey.
- Choice and preparation of personnel.
- Review of literature and preparation of a database of species known in the area, typically by reference to herbarium collections or publications
- Initial GIS analysis, combining available maps of roads, place names, vegetation, land use and soils type or geology. Best available remote sensing imagery should be compiled and traced to highlight major vegetation types.

PLANNING THE PLACEMENT OF RBS SAMPLES

Having decided on the scope, and how many samples will be possible, it is useful to plan a rough layout of samples. As a first approximation, equal numbers of the projected sample total can be apportioned to equal divisions of the area (e.g., 1 % of the sample effort in each of one hundred cells in a grid superimposed on a map), but there may be priorities for the survey that overrule this even division (Figure 3). Varied vegetation and rugged landscapes probably deserve proportionately more samples than flat and homogeneous samples of constant vegetation type. It can be useful to plan by distributing counters, representing planned samples, across a map of the area.

Tentative vegetation maps, derived for instance from remotely sensed imagery, are also useful to help stratify the area for sampling. Even if only major vegetation types, they can be used to help allocate samples to each type, in proportion maybe to their perceived importance, or in proportion to the area of each type, in either case hopefully to obtain a representative sample of each major type.

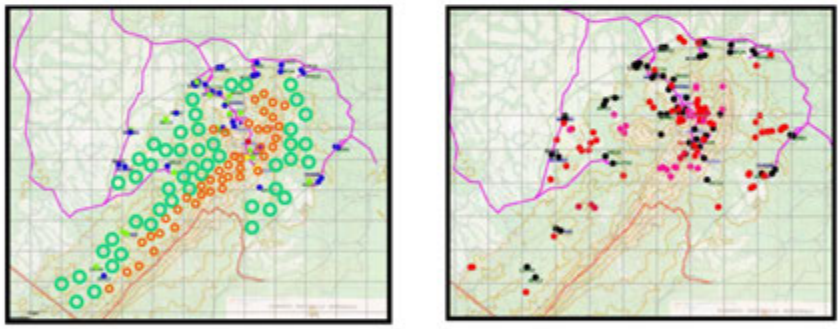

Figure 3 Default planned RBS samples (left) based on a 2km grid for a very steep-sided African mountain; and where the actual samples were placed a few months later (right). Filled small circles in both maps show completed samples; open hoops show samples planned for forest (large, green) or savanna (small, orange) based on a default strategy of maximum dispersion. Deviations from plan were due to a) the team discovering much of the SW corner of forest was very degraded (and obviously low bioquality) and slow to access; b) access to the ridge in the south was too dangerous due to heavy rain; and c) a transect line showing variation up the slope became the preferred strategy in the NE.

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SAMPLE DEFINITION

RBS sampling normally seeks to fulfil a broad sampling plan outlined above, and to find samples that are as different as possible from those already enumerated nearby. The survey director and team leader(s) must ultimately choose the location of a suite of samples that provides an adequate cross section of the full range of vegetation in question, dispersed appropriately.

- For example, if a grid square has been allocated three samples, they should usually be as different from each other as possible, generally by choosing different landscape features or disturbance history. A hill top, slope and valley, swamp or river might be chosen in one cell.

The choice of how to subdivide the spectrum of vegetation locally into individual sample units and the actual location of each sample depends on the aims of the survey, as interpreted by the team leader, who usually decides upon this precise sample definition after arriving in the predesignated sample area (e.g., a grid cell).

The sample definition must be broad enough to include more than the minimum number of species, discussed below (and enough individual, large trees if they are being counted separately – see p. 34). The spatial limits of a given sample are best defined by observable features of the vegetation and/or landscape. Easily visible landscape units are almost always worth sampling. Ecotone or Transition areas between e.g. slopes and ridge tops can be left out of one or both units by careful definition of sample limits. The sample definition can incorporate landscape features, vegetation structure, apparent disturbance history, and sometimes arbitrary physical limits to prevent surveyors wandering too far. Typical examples of definitions of single RBS sample sites might include:

- All forest plants on the flat part of hill top A.
- All species in a few-hectare oil palm plantation.
- Roadside plants along both sides of a particular stretch of road, up to but not including the wall of large trees >5cm DBH of the forest edge.
- All plants growing on a particular south facing cliff, accessed from various approaches.
- Plants from the rocks and cascades within river Y.
- All plants in an area of savanna in the dry season, and again (a separate sample to show seasonal variation) in the wet season. However, a study whose main aim was to follow phenological change

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should probably rather employ a permanently demarcated plot with subplots and tagged plants in a fine grid.

- Samples from burnt forest, and unburnt forest in the same area. However, for detailed regeneration studies, one should probably turn to measured regeneration samples.

Note that, in many of these cases, measured quadrats would be impossible to organise or to make internally consistent.

Closely linked to the choice of sampled vegetation type and location is the question of how to define the precise extent of any given sample. This sample definition is also the responsibility of the team leader, who must communicate and enforce the decision carefully with the whole team, and record the details on the field form.

Precise physical limits to the sample are most important where the vegetation is very heterogeneous, and are not so important within large tracts of low diversity vegetation, which can soon be sampled exhaustively even if one searches hundreds of metres from the starting point. Any tract of vegetation in the survey area that occurs in large, very homogeneous stands justifies at least one RBS sample, even if it has low interest or diversity. In vegetation like mangrove swamp forest where fewer than 40 species may occur altogether, but where the vegetation unit is physically well-defined, a sample with fewer species than the recommended minimum is acceptable. This low species count option is more useful than the other option, which would be to define the sample more broadly and include, for instance, a stand of mangroves plus the vegetation behind it.

- In cases where a constant vegetation type continues for miles in all directions, a roughly circular area around a convenient (for pressing) point is chosen.

At another extreme, consider a vegetation unit that contains many discrete patches of a clearly different type, like a nutty chocolate bar, each patch (or nut) many metres in diameter and very distinct from the matrix. For example, rock pools on the sea-shore or a set of small, isolated rocky outcrops (or termite or ant hills) in a meadow. At what point might one consider the internal patches as separate samples? When does one count pure nuts as a sample and pure chocolate as another, as opposed to counting the whole confection as a single sample? The decision can be based on species diversity as follows.

- If one such patch had clearly more than 40 species, one could make this a single sample, maybe with others as replicates (below). The sample description would be e.g. "rocky patch distinct from rest of meadow vegetation".
- If one patch is enumerated, and yields only 20 or so species, one could sample other clumps and add the species to the same sample, defining the sample as "Flora from 4 termite hills in the savanna"). This should then be contrasted with a separate sample with a definition like 'savanna excluding areas in and 1 m from termite hills'.
- If, having enumerated even several patches, or the matrix, the total species count is still below 40, one might then choose not to try to resolve the differences between the matrix and the patches, and treat the whole mosaic as one sample e.g. 'Meadow including the species only found on rocks within it'.
- One can always combine samples later, so a useful approach can be to define separate sub-samples with a view to possibly merging them later for some analyses. However, the more similar the flora of the possible subunits, the less efficient this approach becomes. Usually, the extent of the survey is so great that small local variants like this are best considered minor distractions, to be combined in more inclusive vegetation subunits.

The edges of forests are often a confusing tangle of forest and non-forest species. If the prime aim of the survey is to consider the conservation of the forest flora, it is best to avoid disturbed or transitional areas by stating 'sample more than 20m east of the road', or 'avoiding areas within 30m of the forest edge'. Then, if the team is

interested in seeing how the secondary or disturbed vegetation samples relate to others, use the opposite or similar definitions e.g. "sample at and within 1 m of the forest edge".

- When areas are inspected but then not sampled because they are deemed identical to other areas sampled already nearby, and there are enough replicates already, it is still useful for vegetation mapping purposes to record that the area is 'same as vegetation type XXYY01' with a GPS record. A special notebook and map could be kept for this purpose.

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REPLICATE SAMPLES

Samples should be repeated in the same vegetation types, but spread across the surveyed area. A good cross-section of the vegetation will require sufficient and well-dispersed replicates of samples in each of the various types of vegetation, so team leaders need to be observant, to anticipate what the main types are likely to be, following analysis. Samples of the same vegetation types across the map help the mapping of vegetation types, by interpolation or other GIS techniques. Once grouped into formal vegetation types following an ordination or classification, the different samples of the same type can be used to show statistics of variation for each type, across the landscape.

Samples in the same, perceived vegetation type in other grid cells should suffice for these aims if the strategy is using a fine grid to encourage dispersed samples; an equivalent arrangement of samples can also be enforced without a specific grid.

Some samples can also be repeated in exactly the same sample sites, for various reasons. Replicate samples in the same exact location but during different seasons could be used to control for effects of season on sample results, especially in highly seasonal vegetation like deciduous forests and savanna. Return visits could be used to compile separate sample lists. These could then be merged to form a single sample of that place, for most analyses. If only a single all-season sample is needed for the site, only new records need strictly be added at the later visits, but this is then not a replicate, and it may be difficult to remember what was sampled there previously, so a complete new sample is often the best choice.

Also, samples can be repeated for the same locations by the same or different teams on different occasions, to test team reliability, or the reliability of the results in general. Replicate samples by the same team in the same place are best done during the same season, but at least several days apart, as it can be easy to forget which species are already recorded for a sample if one has collected there recently. These separate enumerations of the same area can then be included in the same analyses – hopefully the inevitable variation between enumerations is much smaller than the variation between different samples.

- It is best to arrange for two samples enumerated by the same team on the same day to be as different in species composition as practical.

OPTIONAL MEASURED RBS SAMPLE AREAS (PLOTS)

Samples of a measured size, i.e. orthodox plots, can be included as RBS samples, if the surveyor wants to calibrate the species richness (or strict species-area curves) for given vegetation types. Another potential role for measured RBS plots is to act as more tightly controlled, standard sized samples, when a formal vegetation classification is being defined. Measured plots can provide data that are compatible with RBS data from unmeasured samples, but involve more work to obtain the same sized species list.

For instance, for forests in Ghana, 20 or 25m square plots have proved adequate for this purpose, optionally broken into 5 strips, which might be end to end (along a road or river) or side-by-side in a square. These can provide data on number of species per unit area that is not obtainable from unmeasured RBS samples. In one survey, a measured subplot was included within a normal RBS sample area. Each sample started with a full enumeration of a 20 x 20m plot. On completion, a line was drawn on the field sheet and further species records from the surrounding habitat were added, as for a standard RBS. Trees above 5 cm were enumerated in the small plot only, and a separate tally of 30+ cm trees was made for the RBS as a whole (30+ cm DBH tree stems in the measured subplot were flagged as belonging to both sample units).

Whilst collection of this additional measured plot data is often of modest extra value, it is often unachievable for certain vegetation subunits (e.g. cliffs), and may require an extra hour per sample point than an RBS plot with the equivalent species list. It may be of greatest value in herbaceous vegetation where enforced, closer scrutiny of the ground layer could be a helpful discipline.

WHAT TO RECORD IN EACH RBS SAMPLE?

As described above, for a single RBS sample, a landscape unit or other well-defined vegetation unit is chosen by the team leader, depending on both the general scope and plans and opportunistically, based on what is found on the ground. Then, over a few hours, as many plant species as possible – ideally all of the vascular plant species that occur there - are recorded. For less well known and diverse vegetation, this should involve collecting most or all records as specimens, rather than as observations. Each species from the plot need only be pressed once, and it is up to the booker to decide whether or not the species has already been pressed, with the default being to collect more rather than less. When a species is pressed and recorded on the form, it is not necessary for the booker to know its full scientific name, but short or useful names should be given to help keep track. Often, most of the specimens collected are sterile and a large part of the operation and skill required is concerned with organising and ultimately identifying these specimens, often by reference to a herbarium.

As a rule of thumb, a single RBS sample should yield more than 40 named species and not take more than 3 sampling hours, but the more species that are recorded the better, providing one does not sample outside the defined vegetation unit. Also, it is often the case for an efficient team in some vegetation types that after 2 hours, the species list for the sampled vegetation unit has been exhausted in that area.

- Typically, 50-150 species are in fact recorded in rain forest RBS samples, but savanna and other vegetation types may yield only 20-50 species in some localities, if that is the limit of the local diversity.

A complete species list for a sampled area of vegetation is very desirable, and should be the default aim for any sample, but this is not absolutely essential providing either more than 40 species can be identified in a sample before analysis, or almost all the species (more than 95%) are collected or recorded. Around and beyond 40 species, extra species records influence community scores only marginally, but do allow greater statistical confidence, and any records of extra species for the sample area are of course always valuable for distribution maps drawn from the data.

Data can in any case be statistically rarefied, or reduced to a standard "40 random species" per sample where needed. Mean and associated error values are, however, normally generated in respect of variation across individual sample scores (all species) within a given landscape unit (e.g. values for different plots in forest of a given altitude band).

ABUNDANCE SCORES

Simple abundance scores are allocated to each non-canopy species, reflecting their abundance specifically in the understorey of the sampled area and not, for instance, influenced by the abundance of the species in unsampled areas nearby.

- 1 = scattered or only seen once in the sample area. This is the default score, if a species does not attain 2 or 3.
- 2 = common in the sample area
- 3 = very abundant or dominant in its own stratum in the sample area

More precise definitions can be adopted depending on vegetation structure. For instance, for vegetation in Trinidad and Tobago survey, the following guideline was used: 3 – Easily found within ten seconds from any point in the sample area; 2 – seen at least every minute while sampling, but not achieving abundance 3; 1 – present, but not attaining abundance 2 or 3.

There are usually several species scoring 2, may be one or none scoring 3, with the large majority of species scoring 1 in most patches of species rich vegetation. These are rough estimates of abundance, made relative to other plants of their stratum/habit. It is usually easiest to do abundance scoring at the end of a sample, when everyone has become familiar with the patch of vegetation.

- In a sample of vegetation of wet rocks in a river, a plant scoring 3 might coat all of the scattered rocks seen, but would in no way attain the biomass of a tree species. For a ground herb, the ground would be carpeted by it for an abundance 3 score. Shrubs, Marantaceae or gingers would be in a thicket occupying most of the sample area to attain 3.

- There are often no species with an abundance score of 3 in a sample, and rarely more than one. As a rule of thumb, 2/3 or more of its stratum (understorey, herb layer etc) should be covered by the foliage of a species with abundance score of 3.

In practice, abundance scores make little difference to ordinations of RBS samples, and do not affect GHI calculations. They are useful to help work out where species reach their ecological optimum.

When canopy tree counts are being made (below), abundance scores for the non-canopy-tree component of the sample should reflect the performance of species excluding their abundance in the canopy – hence saplings recorded in the understorey should be recorded separately from the canopy records for the same species. As the canopy tree counters are usually independent of the other recorders, this would normally happen anyway.

CANOPY TREE COUNTS

In addition to the local species checklist output outlined above, in RBS samples of tree-dominated vegetation it is also useful to enumerate canopy trees over exactly the same sample area, and then a minimum of 40 individual canopy trees is also stipulated.

Trees above a predefined size, usually ≥ 30 cm DBH, and covering the same area as the main RBS sample, are simply identified and counted. Note, this is a count (summed separately for each species) totalling at least 40 individual trees, not a tally that must attain 40 different tree species. Often, only a few tree species are present.

The team may not stop searching for new species and extra trees before this target is reached. A larger number of counted trees is not a problem.

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WHY COUNT TREES AS WELL?

Tree species are often overlooked (underlooked?), as surveyors tend to concentrate on understorey plants, often inadvertently. The extra tree count requirement is useful to overcome this bias, and a specialist team member helps achieve it.

Also, in forest and denser savanna woodland, the requirement to count a minimum number of larger trees ensures a minimum area is covered or effort is applied by the survey team. The whole team should not stop searching for new species and extra trees, at least before the target of 40 canopy trees is reached.

Apart from these advantages, canopy tree counts are more subtly weighted abundance scores for larger tree species than the main RBS abundance scores could account for, and so are potentially useful for making a tree-centric classification of woodland. This can help link the complete RBS outputs on vegetation type, bioquality etc. to other tree-biased information, notably:

- Remotely sensed imagery: the reflectance of woodland is influenced most by the canopy trees; in some cases, maybe even individual trees can be spotted in the imagery and thus linked to the tree counts, enabling extrapolation from imagery alone.
- Classic forest inventory data: forest stock maps and classifications are often based on tree inventories, so canopy stem counts have a better chance of being correlated with independent forest classifications than the full plant community data.

DECIDING ON THE DBH THRESHOLD FOR TREES TO BE COUNTED

The tree count is merely a sketch of canopy tree composition, not a full tree inventory nor one which precisely picks out species with a given overhead exposure. To keep the count practical, the diameter (DBH) threshold for trees to be included in the canopy tree count is set before each plot enumeration such that:

- more than 40 trees above the threshold can be found in the sampled area, and
- the canopy sample is dominated by trees with crowns fully exposed from above.

Maybe the data would be marginally more useful if the canopy tree counts were the 40 largest trees in the sample area. However, this is impractical, so in most cases and in all forest, canopy trees are defined in the RBS as any tree with bole diameter ≥30 cm DBH.

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- Various extra rules can be useful for refining the link between understorey and canopy components of the sample, at the discretion of the team leader. For instance, along narrow streams, where a stream canopy tree may be sparser than in normal forest and rooted at some distance from the rest of the sampled stream flora, an additional horizontal or vertical distance can be applied by the surveyor within which the canopy trees must be rooted to be included. For instance, this threshold might be up to 5m from the water edge for the trees and maybe only 1 or 2 m for the lower vegetation. The limit should be chosen, depending on typical bank steepness, so that the resulting tree sample can exceed 40 individuals whilst still being the canopy of the stream basin; the understorey and canopy limits should both be narrow enough to reflect a special stream flora within them, if this is what the sample is designed to detect. These two distances should be documented on the plot description in the field form.

- Obviously if the area is grassland with only a few scattered large trees, the count is of little value and can be dropped. These samples will not feature in tree canopy analyses. In savanna woodland or thickets where the canopy is low (and often broken), and too few trees reach 30 cm DBH, the limit can be lowered to 20, 10 or even 5 cm DBH, a fact which is recorded with the field data, so such samples can be filtered from analyses if desired. It is best in the survey as a whole to adopt at most only one other such threshold apart from 30 cm DBH so results are comparable.

- Likewise, in more sparsely wooded or disturbed vegetation, a more lenient definition of DBH can be taken – e.g. to include leaning or forked trees where the lower diameter exceeds the limit even if the diameter at 1 .3 m vertically above the ground is not strictly so.

As with species records, more than 40 trees can be counted and the extra data are useful. Where this is so, the tree data can still be analysed alone, with abundance standardised to a proportion of the total tree count, or rarefied on the computer to yield 40 randomly chosen trees for a given analysis.

RELATING GENERAL ABUNDANCE AND TREE COUNT DATA

When trees are being counted separately, the normal RBS abundance score (1-3) explicitly excludes the canopy trees, and rather reflects understorey abundance, so the abundance and tree count scores returned from the field are independent of each other. However, for all-species ordinations and other all-species analyses weighted by abundance, the overall abundance score for species in the plots should be adjusted to include both strata. A reasonable conversion rate from tree counts to abundance scores is as follows:

- Canopy abundance score 1 = Up to a third (33.33%) of all canopy trees counted.
- Canopy abundance score 2 = One third up to two thirds of all canopy trees.
- Canopy abundance score 3 = Two thirds or more of canopy trees counted.

The species abundance in the sample as a whole is then taken for analysis as the higher of the two scores, i.e. observed non-canopy abundance and calculated canopy tree abundance scores.

RECORDING LOCAL PERCEPTIONS OF VEGETATION WITH RBS

Assessment of local usage and valuation of plant resources has been integrated into the RBS process. Local botanical experts are included in RBS teams, and with their help it is a relatively simple matter to collect basic ethnobotanical data, such as local names and priority species, alongside normal RBS activities. Ethnobotanic data collected as part of RBS can be used to provide evidence of the cultural and provisioning aspect of ecosystem services, and allows the differing values attached to biodiversity and ecosystem services by communities to be accounted for; these elements are considered best practise for ESIAs. Nationally or regionally, these data could be used to flag dwindling resources and prioritise support, or simply to record how people are using plants.

HOW DOES IT WORK?

1. Recruiting informants: At the beginning of the field work, the local people who know the most about the local vegetation are identified through community consultations. Typically, one or two local experts (e.g. a woman and a man) would accompany an RBS team at a time, but in each community or subset of communities different local experts can be recruited to reduce individual bias.
2. What is recorded: The local experts accompany the team to the field, and for each specimen collected, gives their name for the species, how they use it, and how important it is to their community (using a 1-3 score). Use notes are kept perfunctory, e.g. 'medicine for toothache', and preparation details are not requested; this protects the knowledge of local experts whilst providing enough relevant information for most applications. For canopy tree species, the informant who knows the most about trees should accompany the tree spotters.
3. Importance scoring: similar in philosophy and execution to abundance scoring, where species receive a score of 1 by default ('useful'); 2 for species that are more valued than average; and 3 for the very most useful species from the sample. Sometimes, no species in a sample will achieve a 3, sometimes several will, depending on the vegetation. It is usually easiest to do this exercise after all names and specimens have been recorded.
4. Workshops: Species identified as the most important through the 1-3 scoring can be discussed in greater detail with the communities. Typical questions would be: Is there enough of this plant around? Do you have any experience cultivating it? What could be done to improve the supply of this species?
5. Outputs and analysis:
    - A lexicon of local names and the scientific species to which they correspond. This activity is greatly facilitated by the collection of many specimens: it is possible to 'weed out' incorrectly named plants, and it becomes clear when a local name corresponds to several scientific species, or when two local names cover the same scientific species. This becomes very useful during the management stage, because it means that local people, scientists and managers can communicate about plant resources.
    - A summary of how people use plants locally. Plant uses are summarised into use categories, such as 'food', 'medicine', 'magic', 'materials'; the numbers of species used for each application are presented, with example uses detailed.
    - A list of the most important species locally, with notes about their supply and how they are currently managed.
    - An analysis showing to what extent local valuations correspond to global (bioquality) values, for which species and plant communities these two valuations diverge, and for local applications, a management plan that takes account of both areas of high bioquality and high local use value.
6. Follow up work: The data and outputs can form the basis for follow-up surveys conducted by specialists rather than botanists e.g. market surveys, detailed studies of the customs and rituals linked to plants;

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such studies are easier to conduct if the botanic element has already been sorted out. Agricultural species and farming practises are not specifically covered by the above approach, which focuses on the use and value of biodiversity: Studies of livelihoods, farming practises, and issues of compensation must be dealt with separately by the relevant experts.

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PROCESSING SPECIMENS AND DATA

RBS often generates many plant specimens, and much data. It is important to develop a strategy to optimise the identification of the specimens by sequential and thoughtful sorting. These aspects and other aspects relating to logistics and practicalities are dealt with in the Annexes below.

- Organisation of field team p. 48
- Identification and Herbarium work associated with RBS p. 49
- What resources do you need for a typical RBS? P. 49
- Data arrangement and input p. 51

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EXAMPLES OF RBS PROJECTS AND BIOQUALITY MAPS

RBS surveys with bioquality assessment started in Ghana, and subsequent projects have since been completed across West Africa, both Upper Guinea (see Figure 4), and Cameroon. A single Star Framework covers all of tropical Africa, though the details recorded in each project differ slightly, appropriate to project aims.

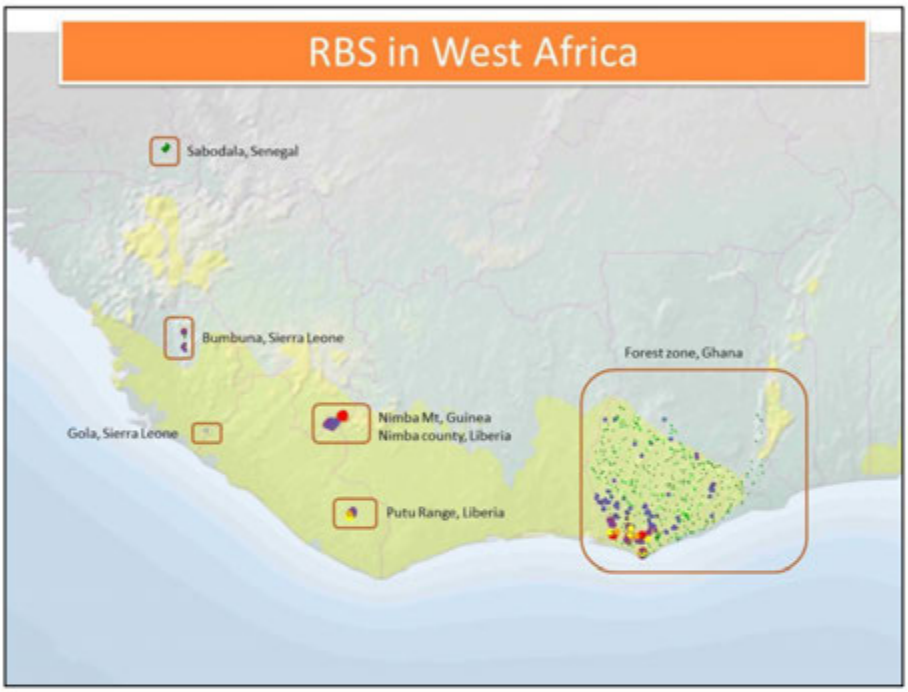

Figure 4 RBS projects in Upper Guinea

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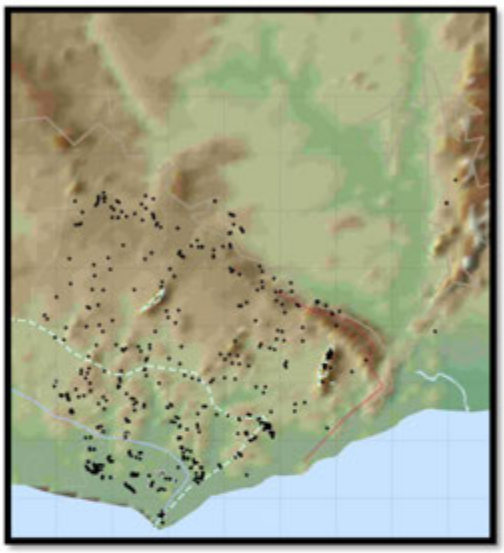
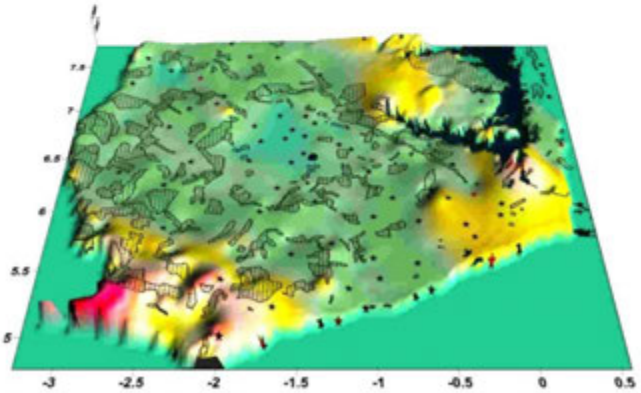
GHANA'S FOREST ZONE



A three year RBS (1990-1993) by a small team from Ghana's Forestry department, funded by the UK's Department for International Development (DfID) was the foundation for an assessment within 200 forest reserves, development of a conservation plan and subsequent increased protection; and the training of several botanists who have gone on to help inform and influence biodiversity management in the country (Hawthorne & Abu Juam, 1995; Hawthorne, 1992, 1996).

Subsequent surveys have filled in details for specific areas, including (GSBAs) Globally Significant Biodiversity areas (set up as a result of the national survey); Ankasa Conservation area (a baseline for conservation management); Subri F.R. and Afram Headwaters F.R. (baseline surveys for industrial plantation projects); and ongoing research by Marshall et al. looking in more detail at the gradient of bioquality in the SW corner.



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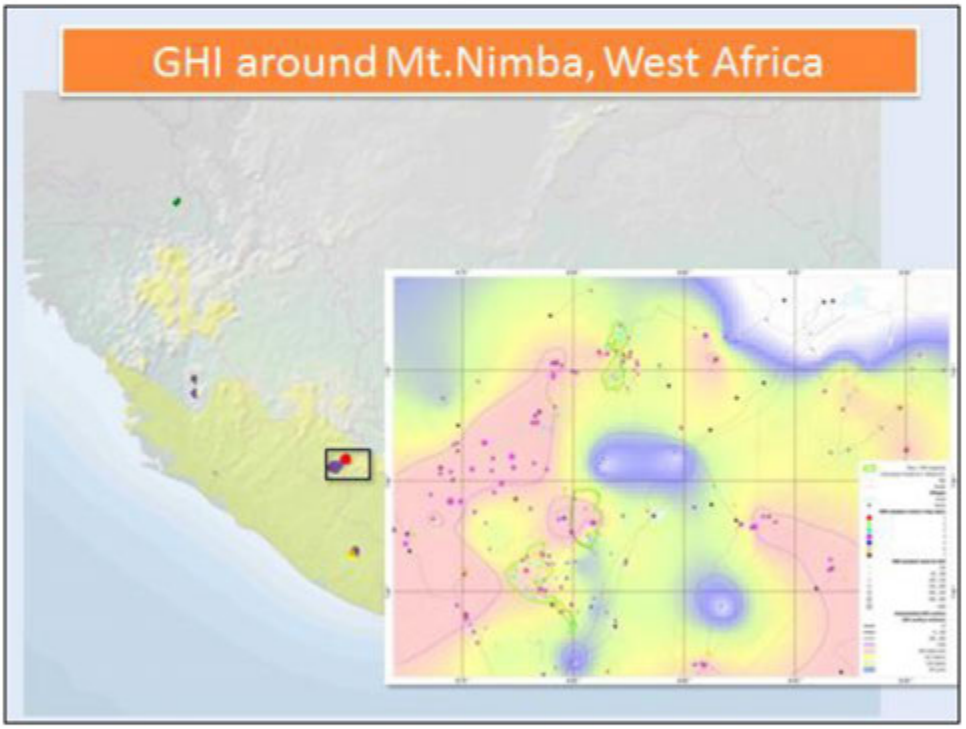
LIBERIA, NIMBA COUNTY

A survey commissioned for the Liberian portion of the Nimba and adjacent mountains, by ArcelorMittal Liberia (AML), in 2010-12, prior to mining in the area (Hawthorne & Marshall, 2013). The survey highlighted subtle patterns of GHI in the forests inside and around the mining concession. AML was able to avoid some of the impacts of mining, and used the results to target locally used and globally important species for restoration and other plantings. Much of the hottest forest in the area is to the west of the mine. Today, this area is being managed and conserved under a community forest, supported by AML.

The RBS here also included assessments of important, locally useful plants (Marshall & Hawthorne, 2013).

Other mining related surveys in the area include surveys of Guinean Nimba (2008-9); a proposed railway route to the coast and port area; and the Putu Range (2011), near Sapo N.P.



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TRINIDAD AND TOBAGO

This three year project involved the University of the West Indies, Forestry Dept. of Trinidad & Tobago and the University of Oxford, as well as various NGOS. It was funded by the UK government/DEFRA, though the Darwin Initiative. A bioquality framework was established for the whole country, including a generalized hotspot map, using RBS samples and the existing herbarium database. The project updated the national flora database, trained students and foresters, and the data contribute to forest and conservation policy and planning. As well as the globally significant hotspots detected in the mountains of both Trinidad and Tobago, warm spots (GHI 150-250) are located on the foothills of these mountains and in other areas to the south and east, and in the small islands in north west Trinidad.

Yellow and red areas indicate high bioquality areas, measured with the GHI. These areas contain high concentrations of rare plants and demand the most conservation attention. Ideally, these areas should be avoided during development and exploitation activities. If they cannot be avoided, they set a baseline against which restoration or offset activities can be measured. The RBS database was also used in a study of potential future impacts of climate change in the country (Maharaj, 2012)

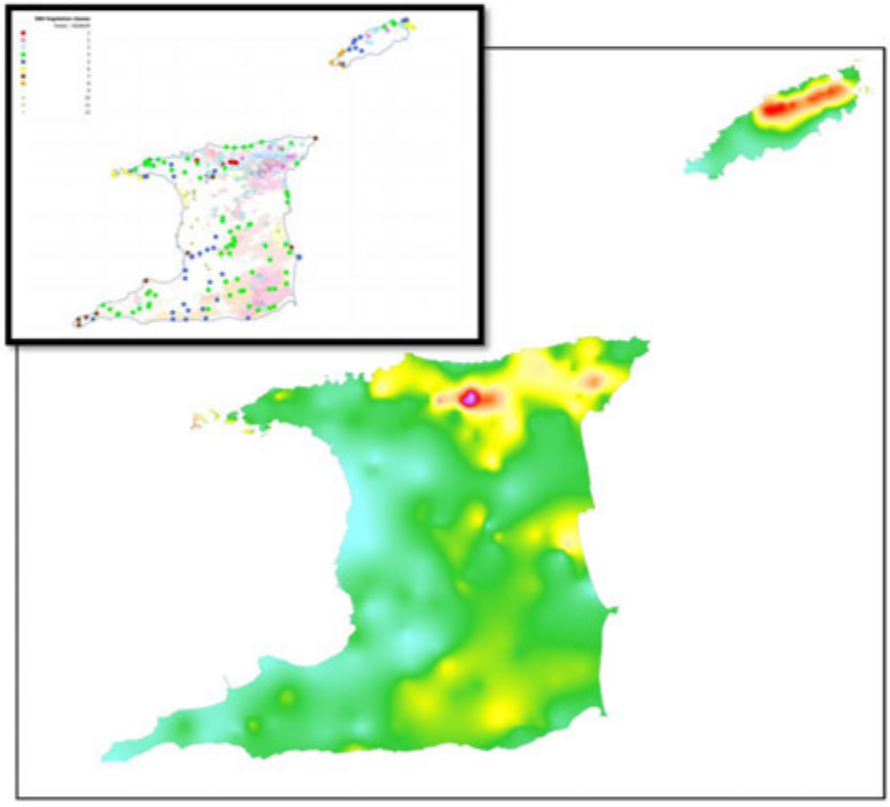

Figure 5 Bioquality hotspot map, Trinidad and Tobago. Peaks of GHI in red (at higher altitudes).

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CLIENTS AND PARTNERS

Our previous clients and sponsors include government departments, industry, charities and NGOs.

Government Departments:

Forestry Departments of Ghana, Liberia, Trinidad & Tobago, Brunei.

UK's DFID; DEFRA (Darwin Initiative)

Forestry & Wildlife division, Government of Ghana

Add in Cameroon?

Mining and Natural Resources Industry:

BP Biofuels (Brazil)

BHP Billiton; ArcelorMittal Liberia; SMFG (Guinea); Oromin (Senegal); Putu Iron Ore; Euronimba (Liberia)

Bumbuna dam Hydroelectric Power Scheme (Sierra Leone)

Commonwealth Development Corporation (Mt. Cameroon; Ghana Plantations).

Subri Industrial Plantations Ltd (Ghana)

Universities, NGOs and charities:

RSPB/Birdlife International

Kew Millennium Seed Bank

University of the West Indies, St.Augustine, Trinidad & Tobago

University of Talca, Maule Region, Chile

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APPENDIX A: NOTES ON RBS LOGISTICS

ORGANISATION OF FIELD TEAM

After arriving at the sample area, the team leader carefully discusses and ultimately refines and defines the limits of sample area with the survey team, taking great care to ensure the whole team is on the same wavelength as to the limits for the sample.

In any RBS sample area, a convenient, fairly central point is usually chosen for pressing and supervision, and botanical recording radiates from this point until new species for the sampled vegetation declines, perhaps to less than one in about five minutes of the whole team searching, and all the typical plants, and also most of the locally rarer plants, have been included. If 40 species haven't been achieved by this time, then more time should be spent searching more carefully, before stopping. Alternatively, if the team has been sampling briskly for more than three hours, and the specimen list is well above 100 and there is still no sign of the inflow ending, then it is time to think about stopping that sample, unless there is nothing else planned for the rest of the day.

Although the optimum organisation for collecting all species in the defined sample area varies with conditions and is a decision for the team leader, the following is often a good approach:

- The first few species are collected around the central press point with the whole team watching and helping.
- The team then all focus on the five metres around the sample area to collect the next suite of species, again so that collectors are aware of what is collected or recorded by others, and do not collect again.
- Thereafter, collectors gradually spread out to find new records independently. Inevitably some of the same species will be repeatedly collected, and the excess specimens are discarded, but this is still useful for the booker who ultimately has to codify the abundance of each species.
- It may be useful for collectors to collect into a tough dustbin-liner size polythene bag, but generally not to collect more than 10 species at once in case they forget details, and because specimens become lost or damaged if too many are stuffed into a bag.
- Generally a tree spotter (plus assistant) is a specialist and will move around the whole sampled area recording the trees, usually counting the canopy trees individually (see p. 34). Any extra non-tree, or smaller than canopy tree species they spot can also be collected. The assistant can help with the tree-spotting, tree climbing, catapulting of specimens or bagging of specimens. As the tree spotters usually cover the most ground, it is best to send the GPS with tracking turned on with the tree spotter.
- If some collectors are put in charge of other particular groups (e.g. grasses) the director should ensure all are absolutely clear of these limits (e.g. what about Xyridaceae, Cyperaceae etc), and that all plant types are covered in all parts of the sample area. In thick vegetation it is generally more efficient if the sample area is subdivided physically and different collectors work different areas looking for all types of species.
- Towards the end of the sample period, the booker or team leader, who has probably been centred around the press until then, should make one last tour around the area with other collectors, particularly to discuss and finalise which few species are common enough to earn the higher (2 or 3) abundance scores.

IDENTIFICATION AND HERBARIUM WORK ASSOCIATED WITH RBS

In typical tropical situations and diverse vegetation elsewhere, 100-200 specimens might be collected by one team per day, maybe 1,000-4,000 specimens per month or two. In these cases, part or all of every few days in the field should be spent by the field team keeping abreast of specimen management, by sorting into families at least. This helps the team become familiar with the names or other attributes of the plants, maybe alerting them to the need to collect more complete specimens, and the process also speeds up subsequent work in the herbarium.

For difficult floras, it takes as long or much longer to identify the plant specimens in a herbarium than the original field work, even with the high efficiency gains that are to be made by sorting together many months' collections and identifying all the specimens of the same taxon at once. Once all the various, mostly sterile specimens have been sorted together into apparent species ('morphospecies'), it is generally easier to spot the links to the usually rather different spectrum of fertile specimens in the herbarium.

After the identification phase, the specimens will probably have been arranged in order of species but, if not, they should be rigorously sorted into species order to facilitate data input, assuming most species are represented by more than one specimen.

WHAT RESOURCES DO YOU NEED FOR A TYPICAL RBS?

RBS sampling can be done by one botanist, with minimal collection of specimens if all the species are known well; and with minimal logistical effort if the sampled area can be easily reached. However, RBS is normally performed by a small team of people in species-rich and often remote areas, where at least some of the species are not known for certain by any of the field team. This then involves more attention to logistics and budget, and a rather more "industrial" approach to specimen collection than can be managed by one person.

RBS, in species-rich tropical vegetation at least, normally involves:

- A field team usually of 4 or more people. RBS is an excellent framework for students to learn practical field botany, as part of the team. More than one team can operate at once for large or hurried surveys, but then it is good to shuffle the members regularly, to discourage team-related biases and unusual practices creeping in.

  A typical RBS field team has the following staff:

  1. A booker (usually team manager) to make records onto forms or a ruled notebook and supervise the field team. The booker should senior enough be able to manage the individuals in the rest of the team, be technically competent and fully aware of the RBS goals and limitations, and have neat handwriting. Almost always with a higher degree or relevant diploma. In some cases the team leader and booker may be independent, in which case the booker is responsible for managing the inflow of specimens and other data, and the team leader may be helping with the identification and other aspects of supervision.
  2. A competent field botanist/tree spotter in charge of enumerating individual trees above a stated girth, and of organising collection of specimens for those trees in doubt. This is a specialised skill. Tree counts can be booked onto a separate form which is later joined with the main set prepared by the booker.
  3. 1 or 2 'ferrets' i.e. reasonably competent field botanists or people with a botanical eye at

least, to collect specimens of plants other than the large trees. There can be more, but more than two make it harder for the booker to manage, and there may be no gain in speed. Forest field staff, university technicians or academics can all fill this 'team engine' crucial role.

4. A "presser" to press the specimens. Neat and patient people are best.
5. Labourers, tree climbers, forest guards, cooks, camp attendants, drivers etc. depending on local norms can all be put to good use, and may be essential in some cases, but the core team of 1-4 can suffice. Usually, people like hunters or others with local knowledge of footpaths, interesting forest types and locally rare plants are extremely helpful, especially if they double as tree climbers, tree-spotters, or press carriers. They can also help develop a local plant name dictionary.

- Herbarium support. Usually herbarium technicians will participate in the field team, but in any case one or more assistants will be vital for helping to sift thousands of specimens in the herbarium.

- A secretary or research assistant is very useful for the heavy burden of data input. Else, the booker or other team members can take on this task.

- Use of a long bench space (10 m or more total length, a metre or more wide) is useful to facilitate specimen sorting. If nothing else is available, trellis tables or a conference room can be perhaps be used for a short period. If options exist, an air-conditioner is very much better than a fan in a specimen sorting room in hot seasons, for obvious reasons.

- Transport, camping and other logistical arrangements may well be necessary and in some cases form a large part of the total effort.

- Equipment requirements are usually the same and little different from normal botanical collecting, except for a much higher volume of specimen drying. Details depend on logistics and whether the field work involves returning to a herbarium daily or camping on 2-3 week field trips. Specimens to be pressed can go directly from hand to press, although a small bin-liner or sack for holding 10 minutes' worth of specimens prior to pressing can be used. This can lead to errors and losses however.

    - GPS (maybe a spare as they are so important. Certainly spare batteries). Maps etc. For forest use, a high sensitivity Garmin model like the GPSMAP 62 is very useful.
    - Booking equipment: clip board, spare pens etc.
    - Sharp bush knives
    - "Lunch" related equipment (even if only water bottles).
    - Digital cameras. To enhance interpretation and dissemination of the results. Also useful for making quick field guides etc. A good macro lens (focusing to within a cm or less) is recommended.

    Collecting and Pressing equipment

    - 3 pairs of secateurs.
    - Press with long robust straps, hopefully light press ends.
    - A lot of newspapers (200 or more sheets per day)
    - Corrugates: Aluminium corrugates are worth obtaining. Otherwise cardboard corrugates will do. Some for field use (spiny plants), most in camp to facilitate drying. If enough porters, the drying press interleaved with corrugates can be directly filled in the field to save time. Usually this is a job for the evening, and most corrugates left in camp .
    - Robust indelible black marker pens, for writing on leaves and newspaper.
    - A few sealable poly bags useful for fruits.

- Maybe a few bottles with spirit if there is a chance of meeting rare/fleshy species deserving good collections.
- Strong catapult, for shooting down canopy leaves is useful.
- Binoculars useful but not essential.
- Drying Oven: For protracted field work these need to be light and ideally collapsible, and their fuel supply and supply of heat (?electricity) needs to be thought about. Modified electric heater fans, arrays of 60 watt light bulbs, or camp cooking hot plates are the most convenient if there is electricity. Charcoal braziers, kerosene lamps, etc if not. Naked camp fires not a good idea. See separate document **"Making a plant drying oven".**
- Strong polythene sacks for storing bundles of dried specimens

- For RBS Data input, BRAHMS (see Brahms Online website) is strongly recommended, with other vegetation analysis (e.g. PC-ORD, R) and GIS software. The RBS data format is fairly simple, but a large survey involves many specimens with details to be managed and kept up to date. Analysis can involve fiddly manipulations of species, places and plot files, and display of results in particular involves manipulations that would be tedious using e.g. a spreadsheet. Therefore, Brahms is our preferred database and analysis tool for handling RBS data. Denis Filer is gradually enhancing Brahms' facilities to facilitate this.

DATA ARRANGEMENT AND INPUT

The following text describes the data management protocols normally employed by the author, using BRAHMS software.

SAMPLE NAMES (SAMPNAME)

All samples are given a mnemonic sample name in the field. In the Brahms database, this fits in the 8 letter character field SAMPNAME. SAMPNAME is normally composed of three parts:

e.g. SUBRS03

- 3 or 4 initial letters (SUB) are an abbreviation for the locality (Subri Forest Reserve) or other major organisational unit of the survey (e.g. team leader name, if there is more than one team).
- Two middle letters are codes (RS=Riverside) for a landscape unit or forest type.
- The final two letters are sequential to distinguish otherwise identical Sample codes (this is the third sample from Subri riverine forest).

The code is convenient for displaying on maps, graphs and in other outputs, and is also crucial for organising and linking the data tables efficiently inside the database.

MAJOR DATA TYPES

RBS sample data has four main components. In the following discussion, data management is explained by reference to the BRAHMS database software, which has been programmed to handle RBS data.

1. **Sample headers**. This relates to the header data on the field form (p. 54), i.e. data generally recorded once per sample like latitude and longitude of sample centre. There is a special plot metadata section of BRAHMS for dealing with this called the header file. The plant data records must all be identified with the same Sampname code.

2. **Sample plant data**. This relates to the main columns of data on the field form (p. 54), one record per species. It is best to input as the work progresses, even though most species records may only be recognised by unidentified vouchers at this stage. Each record is linked to the header by repeating the Sampname code. (Brahms automatically maintains a numeric code for each plot as well, and uses this to link Sample header and Sample plant data, based on the real-world Sampname code from the field).

3. **Herbarium plot voucher determination data**. Brahms manages the links between vouchers in sample data files and a separate **voucher determination file** (a separately typed rapid data entry (RDE) file which may relate to one or many sample data files).

4. Logistics often result in large piles of specimens being identified in batches. These are conveniently input into Brahms RDE determination files by a typist in the herbarium, from the piles of specimen. Sometimes experts in distant herbaria work on specimens of particular families, and produce separate lists of determination. Brahms facilitates the linking of these separate batches of determination RDE files into the Master voucher file; and from there the plot data can be updated automatically. Only the voucher number (**PREFIX, VOUCHER, SUFFIX**) fields and species name fields and determination person/date need be typed in **determination RDE files**. If specimen names to be typed in are sorted in species order, input in BRAHMS only involves looking species names up when the name changes, as the name and determination fields can be set to be auto-copied from one record to the next.

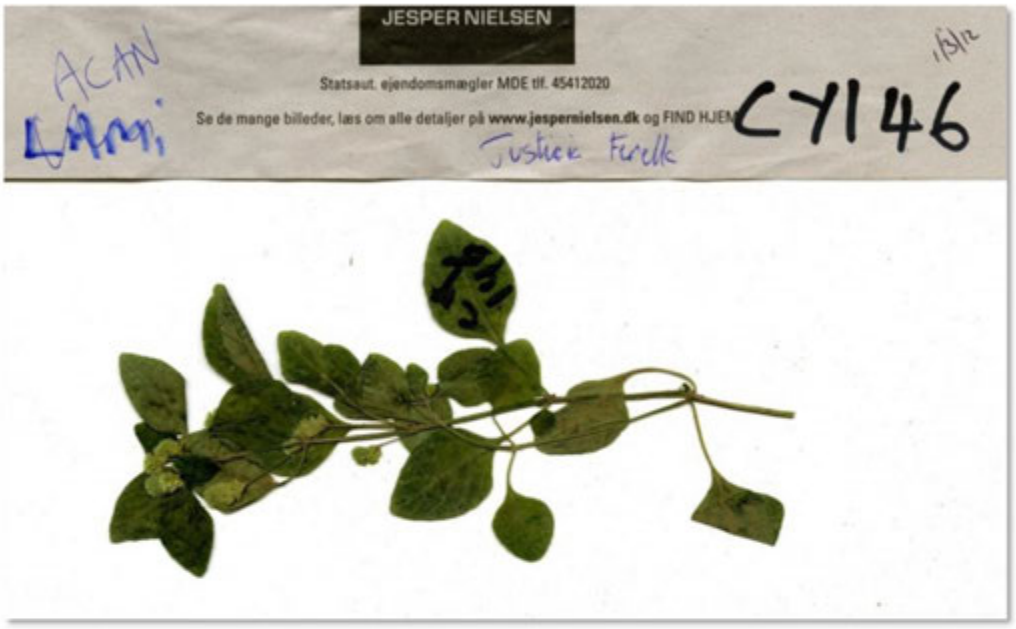
   In contrast to orthodox herbarium specimens, which may be identified with full collector names and a globally unique number, plot vouchers are conveniently allocated a short prefix (e.g. one unique to each field team) and are generally numbered from zero in each survey. The full prefix and number should be written using an indelible marker directly onto leaves (or a tag for fine leaflets) and the newspaper.

5. **Orthodox herbarium specimens**. Like ordinary one-off herbarium collections, these may be recorded outside samples, and so need a full set of data per specimen.

6. Additionally, if **photographs** have been taken, these can be linked to records of species, either of orthodox herbarium specimens if not in samples, or to sample plot data if from a sample record, or as standalone image records in the same database. These linked images can ultimately find their way onto the Virtual Field herbarium website.

If plot and voucher data are typed in the field, with especially the sample header data kept up to date, at least, the distribution of sample locations can be monitored on a GIS linked to Brahms.

Figure 6 RBS voucher, with data on foot of pressing newspaper. Voucher number CY146 (CY is the prefix) in standard lower right margin of outer sheet of paper, for easy filing and data input. The date indicates the identification has been typed in. The determination is centered and the family code lower left.



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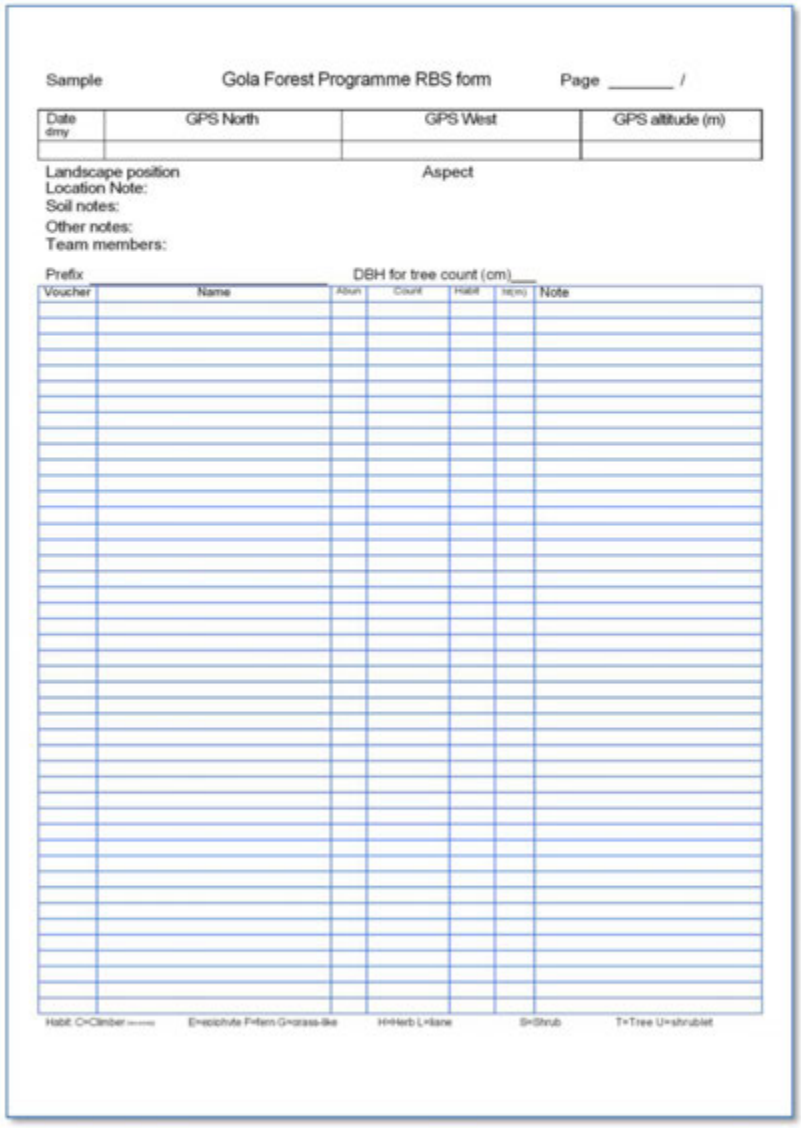
SAMPLE RBS FIELD FORM

This is an image of a typical (A4) field form. The prefix for specimen numbers is constant for at least a plot and marked at the top of the plant list grid in the form. The variable part of the voucher numbers only (the number after the prefix) are written under voucher.



Sample Gola Forest Programme RBS form Page _____ /

Date dmy	GPS North	GPS West	GPS altitude (m)

Landscape position Aspect
Location Note:
Soil notes:
Other notes:
Team members:

Prefix DBH for tree count (cm)___

Voucher	Name	Abun	Count	Habit	ht(m)	Note

Habit: C=Climber E=epiphyte F=fern G=grass-like H=Herb L=liane S=Shrub T=Tree U=shrublet

STAR FRAMEWORK DEFINITIONS IMPLEMENTED IN CHILE, MAULE REGIÓN 2009

(see Hawthorne, San Martin, Sepulveda, Penalillo.. *et al.* 2010)

Sistema clasificación ESTRELLAS

1a. Las especies que se encuentran tanto dentro como afuera de Chile.

2a. Ampliamente distribuidas en cono sur de Sud-América incluyendo el S de Brasil S., o ruderales bien distribuidas en la región Andina; o de distribución más amplia que lo anterior, por ejemplo, malezas neotropicales, o exóticas. **Estrella Verde**

2b. Más restringida, por ejemplo, de los bosques subantárticos o de Chile y Argentina.

3a. Común en Chile >5 regiones y que estén presentes en Argentina **Estrella Verde**

3b. De distribución levemente menos amplia. **Estrella Azul**

3c. Rara pero en Chile y Argentina. **Estrella Dorada**

1b. Especie endémica de Chile.

4a. >2 Regiones; si <5 debe ser abundante en estas regiones.

5a. >4 Regiones y abundante en las condiciones actuales. **Estrella Azul**

5b. 2-4 Regiones, o si es más amplia debe estar muy poco distribuido y con otros factores de priorización, por ejemplo género monoespecífico; rara en el rango de distribución, límite norte y sur de la especie, clasificada en alguna categoría de conservación. **Estrella Dorada**

4b. 1-2 Regiones, o hasta 4 regiones, pero restringida dentro de esta área.

6a. Abundante en >5 grados cuadrados. **Estrella Dorada**

6b. No es abundante en todo, ó en 1 a 5 grados cuadrados. **Estrella Negra**

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ATTACHMENT A1.3 MAIN VEGETATION GROUPS AND TYPES

Table Att1.3-1 Main Habitats and Vegetation Types Identified in the Study Area

Habitat Type Identified by the RBS	Vegetation Type	Sample or Plot Codes	Altitude Range (m)	GHI range	Code	Physiognomic Habitat Classes Illustrated in Habitat Map (Attachment A1.1)
Wetland and wetland forest	Swampy grassland, occasional woody species	UGBU05 UGRS02	618–1018	14–75	SG	Wetland
	Papyrus swamp (*Cyperus papyrus)*	UGBX04 UGBU12	619–996	1–13	SP	Wetland
	Riverine or riparian forest	UGBX05 UGBX06 UGBU06 UGBU08 REFSW1	612–1048	6–25	SE	Wetland forest
Woodland, Bushland, Shrubland, Thicket and Wooded grassland	Very disturbed *Acacia* woodland, wooded grassland and bushland; generally rather low lying Few trees, or tree layer replaced by cultivated species	UGBU10	1063	11	GW	Woodland, wooded grassland and bushland
	Drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotics	UGBU11 UGAC01	1055	26	GX	Woodland, wooded grassland and bushland
	Drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotics; subgroup: *Combretum* woodland	UGMS01	1055	26	GX	Woodland, wooded grassland and bushland
	Acacia polyacantha woodland in farmland	UGBX09 UGBX10 UGBU07	701–1019	27–38	AP	Woodland, wooded grassland and bushland
	Secondary thicket mixed with bushland species	UGBX01 UGBX02 UGBX03 UGBX07 UGBX08	626–791	13–42	DV	Woodland, wooded grassland and bushland

Table Att1.3-1 Main Habitats and Vegetation Types Identified in the Study Area

Habitat Type Identified by the RBS	Vegetation Type	Sample or Plot Codes	Altitude Range (m)	GHI range	Code	Physiognomic Habitat Classes Illustrated in Habitat Map (Attachment A1.1)
		UGBU01 UGBU02 UGBU03 UGBU04 UGBU09				
Cultivated land	Miscellaneous agricultural weeds of the Feeder AOI	UGHOIMA	-	19	XX	Cultivated land

Table Att1.3-2 MCPY Survey Results

Site	Location	Habitat type	Description of vegetation types
MCPY	KP44 36 N 317622 199861	*Brachiaria-Chloris* open grassland	The vegetation of this site is essentially open grassland on flat ground. The flora of the grassland is *Brachiaria-Sporobolus-Chloris* dominated open grassland. The grass layer is very short (c.10 cm on average) owing to heavy livestock grazing. Although most of the site is fenced off, there are openings through which cattle and other livestock may pass to access it for grazing. There are scattered trees, mainly of *Balanites aegyptiaca* that tend to be concentrated (or spared) on the side with dilapidated structures. These are large mature trees to c.10 m high.

Figure Att1.3-1 illustrates the location of the nine habitat types. Symbols are colour-coded to represent the different habitat types and sized in proportion to GHI (larger symbols have higher bioquality: a higher percentage of globally rare species). Note that several plots overlap. Descriptions of the habitat and vegetation types and their codes are presented in Table Att1.3-1.

Wetland and Wetland Forest

Three floristically distinct types of swamp and riverine (riparian) vegetation were identified within wetland and wetland forest habitat type, based on their species composition as follows:

- swampy grassland, occasional woody species (code SG)
- papyrus swamp (*Cyperus papyrus)* (code SP)
- riverine or riparian forest (code SE).

Papyrus swamps (Table Att1.3-1, code SP) were dominated by *Cyperus papyrus.*

The vegetation type swampy grassland, occasional woody species (Table Att1.2-1, code SG) describes other types of low lying wetland vegetation communities, characterised by the presence of *Typha* spp., *Setaria* spp., and occasionally with *Phoenix reclinata*, *Pseudospondias microcarpa* and *Cyperus papyrus.* Samples of this vegetation type generally fall within the "wetlands" during the habitat classification using statistical analysis, although sometimes this vegetation type falls within "grassland" found in surrounding wetlands.

The vegetation riverine or riparian forest (Table Att1.3-1, code SE) represents a floristically distinct cluster of samples associated with watercourses within the more open bushland of the plains of the feeder pipeline. It is intermediate in composition between swamp forest, papyrus swamp (code SP) and *Acacia polyacantha* woodland (particularly code AP). The structure is variable, with taller trees or smaller shrubs forming a patchy canopy. It has more species of open bushland and represents the "front-line" between the forces encouraging greater tree growth and less fire damage along watercourses, and annual fires sweeping through the surrounding bushland, and possibly disruption due to wildlife visiting or taking refuge along the streams in the dry season. "Degraded riverine forest" would be a reasonable interpretation. The presence of cultivated trees such as *Mangifera* and *Artocarpus,* and species from adjacent open swamp (e.g., *Persicaria setulosa*) or bushland indicate the "impurity" of the botanical samples owing to human and animal interference, and the local deep convolution of the edges of such patches.

A few good examples of evergreen or semi-evergreen riverine or riparian forest patches were identified within the study area or AOI. The habitat map described these as wetland forest. The most common tree species of wetland forest are the palm *Phoenix reclinata* and *Pseudospondias microcarpa.* Increasing disturbance has led to the invasion of fig species, including *Ficus sycomorus* and *Ficus vallis-choudae*.

The GHI of all wetland vegetation types sampled in the AOI is very low, and no restricted range species were found within them.

Woodland, Bushland, Shrubland, Thicket and Wooded Grassland

The great majority of habitat types mapped within the AOI as woodland, bushland, shrubland and wooded grassland represent various stages of maturity of secondary (typically *Acacia* sp.) wooded grassland, cultivated to varying degrees. The terms woodland, bushland, shrubland and wooded grassland are not very predictive of the floristic content, and often represent different stages of maturity of the same secondary *Acacia* woodland, with species changing in abundance and biomass, but not so clearly in presence or absence, depending on, e.g., time since clearance or current grazing levels. Vegetation is likely to move within these physiognomic states relatively quickly, depending on how heavily the land is being used at the time. The vegetation is secondary, regenerates easily and is of no concern from a conservation perspective. The vegetation is no doubt heavily used by people, but presumably would be easily substituted by similar vegetation outside the AOI.

There are some tiny fragments of probably secondary thicket mapped with the bushland habitat class (see discussion below), and some *Combretum* woodland (see discussion below). The GHI of all these vegetation types is low.

Acacia Vegetation

The survey identified the presence of three classes of secondary *Acacia* woodland, bushland or wooded grassland with a Guineo-Congolian influence as follows:

- very disturbed Acacia woodland, wooded grassland and bushland. Generally rather low lying. Lacking trees, or tree layer replaced by cultivated species (code GW)
- drier spectrum of secondary Acacia woodland, bushland or thicket with exotics (code GX)
- *Acacia polyacantha* woodland in farmland (code AP).

The GHI of these vegetation types were low. The vegetation is secondary and continues to be modified by human activity. Exotics and cultivated plant species regularly appear in the samples. Vegetation types GW and GX form a gradient in vegetation composition and are similar to each other.

Vegetation type GW samples were associated with a scanty tree layer or cultivated trees (e.g., *Pinus* sp. and mangoes); this type was associated with lower lying and thus cultivated land, and represents the more secondary, degraded or disturbed end of this vegetation spectrum.

Type GX represents the freer draining end of this vegetation spectrum, e.g., on rockier soils or small hilltops or slopes.

Vegetation type *Acacia polyacantha* woodland in farmland (code AP) was dominated by *Acacia polyacantha*, characteristic of more disturbed and lower-lying or riverine land. This species is associated with rich alluvial soils and fertile soils; thus the land is typically under cultivation within the study area, and the vegetation type described here was associated with cultivated species and weedy species of farm margins.

Acacia Vegetation – Combretum Woodland

Within the vegetation type “drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotics” (code GX), one instance of *Combretum* woodland (i.e., dominated by *C. molle and C. collinum*) was identified at sample number UGMS01 at KP3.8 (approximately 955 m from the pipe centre-line) on a hill with a radio-mast near where the two proposed pipeline sections meet. This woodland has been classified within the GX vegetation type (drier *Acacia* woodland).

Combretum molle woodland is an alternative secondary vegetation of the study area, and one that is fire-induced. It also replaces the natural evergreen bushland vegetation (see below) in upland areas (White 1983). *Combretum* woodland relies on the absence of grazing and disturbance to prevent the invasion of *Acacia* species.

Thickets and Bushland Vegetation

The natural climax vegetation of the study area, according to White 1983 (and excluding patches of riverine forests described above), should be evergreen and semi-evergreen bushland and thicket. According to White (1983), the principal bushy species of this thicket

vegetation type are *Allophylus africanus, Azima tetracantha, Canthium schimperanum, Carissa edulis, Capparis fascicularis, Capparis tomentosa, Erythrococca bongensis, Grewia bicolor, Maerua triphylla, Olea africana, Rhus natalensis, Tarenna graveolens* and *Turrea nilotica*. Climbing species of these thickets include *Cissus quadrangularis, Cissus rotundifolia, Senecio stuhlmannii* and *Vernonia brachycalyx*.

White noted in 1983 that this vegetation had already been extensively destroyed and was already only represented by small degraded relics on shallow soil, and by small patches of secondary regrowth. The thicket vegetation is replaced by secondary *Acacia* wooded grassland (as in the study area), which is characterised by pioneer *Acacia* species, including *Acacia hockii, A. gerrardii, A. kirkii, A. senegal*, as well as *Euphorbia candelabrum*.

The (re)establishment of thicket from these secondary *Acacia* wooded grasslands occurs when lianas (woody climbers) eventually smother the crowns of the *Acacia* trees, casting shade that allows the establishment of shrubs and bushes, which with time can suppress the regeneration of *Acacia* seedlings. Alternatively, *Euphorbia candelabrum* may shade the grass layer, permitting the invasion of less light-demanding woody species (White 1983).

The survey identified that the majority of the vegetation sampled (and occurring) within the study area was secondary *Acacia* wooded grassland vegetation type described above. However, the survey confirmed the presence of *Haplocoelum-Strychnos* thicket (code DV) within secondary thicket mixed with bushland species. This vegetation type (code DV – *Haplocoelum-Strychnos* thicket) was found to include some thicket species and surveyors observed some thicket vegetation in small patches mixed with bushland during the field survey.

The vegetation type “secondary thicket mixed with bushland species”, code DV, generally occurred on flat land or gentle slopes. The locations of this vegetation type are presented in Table Att1.3-2. Common treelets included *Lannea schimperi* and *L. schweinfurthii*, along with *Acacia brevispica*, *Euphorbia candelabrum* and *Carissa spinarum*. Although grasses were common (e.g., *Digitaria longiflora, Heteropogon contortus*), the bushes were in some patches coalesced into thicket clumps, within which grew some more typical thicket (possibly less fire tolerant) species such as *Haplocoelum foliolosum* and *Strychnos henningsii*.

Table Att1.3-2 Locations of Secondary Thicket Mixed with Bushland Species (Code DV)

Sample Name	KP	Distance from Pipe Centre Line (m)
UGBU01	0.1	303.3
UGBU02	2.1	134.3
UGBX01	7.1	8.6
UGBU03	13.8	6.0
UGBU04	16.6	1.4
UGBX02	17.0	9.6
UGBX03	19.7	23.8
UGBX07	51.5	1.3
UGBX08	54.5	86.6
UGBU09	55.3	3.1

This is an intermediate in species composition between (i) the more disturbed type of (probably secondary) thicket vegetation; and (ii) AP-*Acacia polyacantha* woodland that occurs throughout the route, and is prevalent in low-lying, secondary areas.

Haplocoelum foliolosum and *Strychnos henningsii* elsewhere (in East Africa) form distinctive, dense, and probably primary, riverine thickets, supporting the idea that these are species characteristic of “true” thicket vegetation. However, in the study area, this DV vegetation type is dominated by open bushland species and grasses, and overall composition of DV samples is very distinct from this “true” thicket vegetation type. Type DV “thicket” is therefore likely to be a secondary thicket vegetation type, mixed with more typical bushland species, where the (secondary) thicket occurs in very small pockets in the bushland matrix only.

Cultivated Land

The survey sampled miscellaneous agricultural weeds within the study area while travelling around Hoima. Cultivated land is included for completeness and is of no conservation concern.

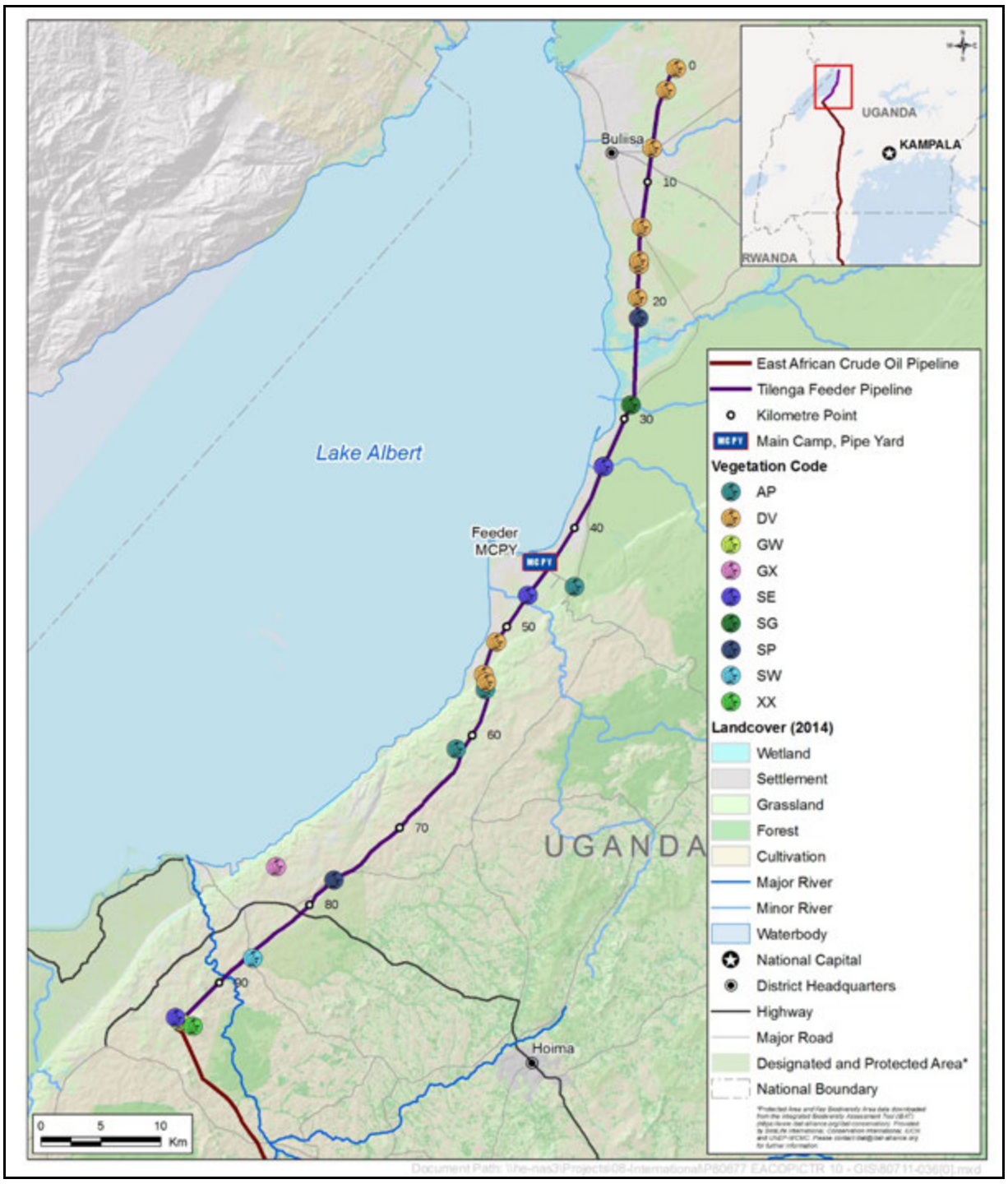

Figure Att1.3-1 Locations of the Main Vegetation Groups (Identified by Codes Presented in Table Att1.3-1)

ATTACHMENT A1.4 GLOBALLY RARE, RESTRICTED RANGE, ENDEMIC (BLACK STAR) OR NATIONALLY THREATENED VASCULAR PLANTS WITHIN THE STUDY AREA

Species	IUCN Status	Restricted-Range/Endemic (Star) Status	Ugandan Red List Status (WSC 2016)	Area of Endemism (see Figure Att1.4-1)	Habitats of Occurrence in the Study Area	Vegetation Type (VT) of Occurrence in the Study Area	GHI of VT[1]	KP	Approx. Distance from Pipe centre-line (m)
Ecbolium hastatum[2]	NA	Black	-	Mozambique	WCS records from within Bugungu WR and the Murchison Falls National Park		63	36–41[3]	Within 2 km
Tinospora [4]*orophila*	EN	Black	-	Albertine Rift	WCS record from modified habitat in Buliisa district		124	18	550
Aeschynomene indica	LC	Green	Data deficient	-	Wetland and wetland forest	UGBU05 Swampy grassland, occasional woody species	23	28.5	5
Nymphaea nouchali	LC	Green	Critically endangered	Africa, Asia, Australasia	Wetland and wetland forest	UGBX04 Papyrus swamp (*Cyperus papyrus*)	1–13	21.4	125

[1] Key: Green = low bioquality vegetation type, orange = moderate bioquality, red = high bioquality of conservation importance

[2] Further surveys and validation records are required to explicitly verify the species' presence in the study area

[3] Second record approximately >2 km from the study area

[4] Further surveys and validation records are required to explicitly verify the species' presence in the study area

Species	IUCN Status	Restricted-Range/Endemic (Star) Status	Ugandan Red List Status (WSC 2016)	Area of Endemism (see Figure Att1.4-1)	Habitats of Occurrence in the Study Area	Vegetation Type (VT) of Occurrence in the Study Area	GHI of VT[1]	KP	Approx. Distance from Pipe centre-line (m)
Milicia excelsa	LR	Green	Endangered	Africa (widespread)	Dry *Acacia* woodland	UGAC01 Dry spectrum of secondary *Acacia* woodland, bushland or thicket with exotics	26	81.2	270
Tamarindus indica	LC	Green	Vulnerable	Africa (widespread)	Woodland, bushland, shrubland, thicket, wooded grassland and grassland	UGBX09 *Acacia polyacantha* woodland in farmland	27	55.9	110
						UGBX10 *Acacia polyacantha* woodland in farmland	38	61.6	480
					Woodland, bushland, shrubland, thicket, wooded grassland and grassland	UGBU02 Secondary thicket mixed with bushland species	32	2.14	134.28
						UGBU03 Secondary thicket mixed with bushland species	42	13.79	5.98
						UGBU09 Secondary thicket mixed with bushland species	29	55.26	3.11
						UGBX01 Secondary thicket mixed with bushland species	13	7.15	8.57

Species	IUCN Status	Restricted-Range/Endemic (Star) Status	Ugandan Red List Status (WSC 2016)	Area of Endemism (see Figure Att1.4-1)	Habitats of Occurrence in the Study Area	Vegetation Type (VT) of Occurrence in the Study Area	GHI of VT[1]	KP	Approx. Distance from Pipe centre-line (m)
						UGBX07 Secondary thicket mixed with bushland species	19	51.51	1.34
					Wetland and wetland forest	UGBX06 Riverine or riparian forest	14	46.8	3

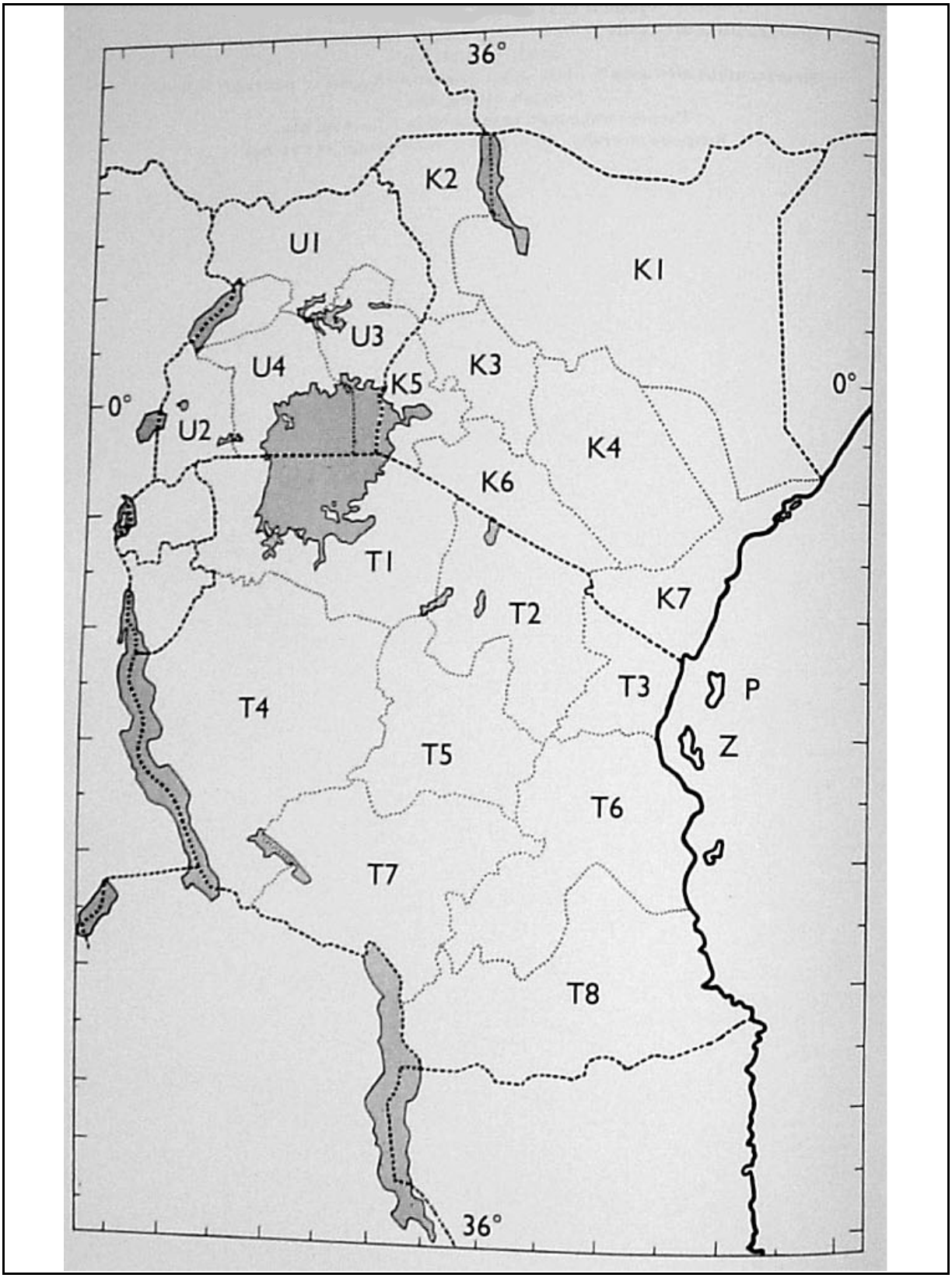

Figure Att1.4-1 Flora of Tropical East Africa Zones, Developed by The Royal Botanic Gardens, Kew and Used to Describe Species Distributions Through Tanzania, Kenya and Uganda (Royal Botanic Gardens, Kew 1948–2012)

ATTACHMENT A1.5 FLORA PROTECTED UNDER UGANDAN LAW

Several tree species are protected in Ugandan law under the Forest and Tree Planting Act 2003 (amended 2016). Tree species listed on Schedule 8 of the Forest and Tree Planting Act 2003 (amended 2016) are protected from felling without a licence. These species are often over exploited and the law is intended to curtail this. However, the law does not specifically relate to rare trees, so they are not considered as sensitive receptors, unless they are nationally rare, globally rare or endemic or restricted range (Black Star) species.

The Schedule 8 species found in the RBS sample plots are listed below along with their star rating and the plots in which they were recorded.

***Albizia coriaria* Welw. ex Oliv.** [*Fabaceae*] GN Star: **AP:** UGBX09 UGBX10 **DV:** UGBX01 **GX:** UGAC01 **XX:** UGHOIMA

***Albizia grandibracteata* Taub.** [*Fabaceae*] BU Star: **AP:** UGBX10 **GW:** UGBU10 **GX:** UGAC01 UGBU11 **SE:** UGBU06 UGBX05 **XX:** UGHOIMA

***Albizia* sp.** [*Fabaceae*]: **SP:** UGBU12

***Albizia zygia* (DC.) J. F. Macbr.** [*Fabaceae*] GN Star: XX: UGHOIMA

***Ficus asperifolia* Miq.** [*Moraceae*] GN Star Habit=S: **SE:** UGBU08

***Ficus ingens* (Miq.) Miq.** [*Moraceae*] GN Star: **AP:** UGBX09

***Ficus mucuso* Welw. ex Ficalho** [*Moraceae*] GN Star: **AP:** UGBX09 **SE:** UGBU06 UGBX05 UGBX06

***Ficus natalensis* Hochst.** [*Moraceae*] GN Star: **SP:** UGBU12 **XX:** UGHOIMA

***Ficus* sp.** [*Moraceae*]: **AP:** UGBX09 **DV:** UGBU02 UGBX01 **SE:** UGBU08 UGBX05 UGBX06 **SG:** UGBU05 UGRS02

***Ficus sycomorus* L.** [*Moraceae*] GN Star: **GW:** UGBU10 **SE:** UGBU06 UGBU08

***Ficus vallis-choudae* Delile** [*Moraceae*] GN Star: **SE:** UGBU08 UGBX06

***Mangifera indica* L.** [*Anacardiaceae*] GX Star Habit=T: **GW:** UGBU10 **GX:** UGAC01 **SE:** UGBU06 UGBX05

ATTACHMENT A1.6 GLOBALLY RARE AND RESTRICTED RANGE OR ENDEMIC (BLACK STAR) VASCULAR PLANTS RECORDED IN UPSTREAM STUDIES

The biodiversity database from the WCS biodiversity baseline phase 2 database includes many species records from upstream botanical studies. This database was screened against the list of star ratings to see if any endemic or restricted range (Black Star) vascular plant species were known within the study area. The presence of endemic or restricted range (Black Star) species within 2 km of the proposed pipeline is presented below.

Species of Vascular Plant	**Location(s) – Sample Names from WCS Database**	**Database Record Notes on Species Identification**
Aframomum uniflorum	BI	
Alafia microstylis	BUGUNGU WILDLIFE, BUSERUKA, KABWOYA, KAISO-	
Balsamocitrus dawei	NDONGO, NYAKASENENE	Type from Bunyoro Dist.; Ugandan endemic in FTEA "rainforest 900–1500 m"
Capparis subtomentosa	MURCHISON FALLS	Very few existing records of this species
Chrysophyllum muerense	KARUMA WILDLIFE, N 15 POINT 174, NDONGO, NYAKASENENE, RWEMBAHO	FTEA: "DISTR. U1, 2, 4 and on the eastern border of the Congo"
Cincinnobotrys speciosa	NYANSEKE	New name *Gravesiiella speciose* Species still very restricted
Digitaria melanotrichia	BUGUNGU WILDLIFE	Probably an identification error: FTEA says endemic to Tanzania Ufipa district at 2300 m
Ecbolium hastatum	BUGUNGU WILDLIFE, KABWOYA, KAISO-, MURCHISON FALLS	Unlikely to be found in Uganda – specimens need checking
Entada phaneroneura	BUGUNGU WILDLIFE	Apparently endemic to woodland around Lake Victoria
Euphorbia nyassae	BUSERUKA	Specimen needs checking as this species is "ONLY known from type collected in 1899" (CJB)
Ipomoea heterosepala	MURCHISON FALLS	Specimen needs checking: species supposedly endemic to North Somalia
Isoglossa laxiflora	BUGUNGU WILDLIFE, KABWOYA, KAISO-	Possible but specimens should be checked: this is a little-known species from Eastern DRC

Species of Vascular Plant	Location(s) – Sample Names from WCS Database	Database Record Notes on Species Identification
Keetia purseglovei	BI, BUGUNGU WILDLIFE, KARUMA WILDLIFE, KATANWA, MURCHISON FALLS, N 15 POINT 174, NDONGO, RWERA, SIBA	Complicated case as records only from W Gabon and e.g., Ishasha gorge, N.Kigezi Specimens should be checked
Laggera crassifolia	RWEMBAHO	This species is only confirmed in Ethiopia If confirmed in Uganda, then would no longer qualify as Black Star
Leptonychia mildbraedii	BI, BUGUNGU WILDLIFE, N 15 POINT 174, NDONGO, SIBA	Det of our specs confirmed by M.Cheek, but maybe more widespread than though before so status would need reviewing
Manilkara dawei	NDONGO, NYANSEKE	Known from Uganda, T1, and 2 isolated recs from Congo basin
Mimulopsis runssorica	BI	Ruwenzoris endemic + Toro. Was the sample at high altitude (>2500 m)? If not, then specimen needs checking
Oenanthe mildbraedii	N 15 POINT 174	FTEA: "Bogs; swamps; edges of streams in open Hagenia forest; wet depressions in grassland; also in similar places in forests; Acanthus bush"
Oldenlandia microcarpa	BULIISA - HUMAN	FTEA: Species only known T1, T4 (and "v close to *O. duemmeri*).
Ophrestia digitata	MURCHISON FALLS	Very little known about this species Specimen needs reviewing
Pentarrhinum gonoloboides	BUGUNGU WILDLIFE, KABWOYA, KAISO-, MURCHISON FALLS	Very little known about this species Specimen needs reviewing
Rytigynia beniensis	BI	Most species recorded as this in Uganda are the very similar *R. umbellata*
Snowdenia microcarpha	BUGUNGU WILDLIFE	Grass known only from Mt Elgon (U3) Specimen needs checking
Tiliacora latifolia	NDONGO, RWEMBAHO	Interesting species apparently known Bundongo FR and possibly Mozambique
Tinospora orophila	BULIISA - HUMAN	A roadside forest liane described from Rwanda
Tricliceras auriculatum	KABWOYA, KAISO-	This is an herb of granitic rocks known only from Mozambique (Flora. Zambesiaca)

Appendix A2: Aquatic Biodiversity Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

A	
anadromous	fish that are born in freshwater then migrate to the ocean as juveniles where they grow into adults before migrating back into freshwater to spawn
AOI	area of influence
aquatic	freshwater habitats or species only, in the context of this report
C	
cascade	tumbling, white water, e.g., waterfall, typical over bedrock or boulders
I	
IFC	International Finance Corporation
K	
KP	kilometre point
G	
glide	flowing water with an unbroken or undisturbed surface
M	
marginal vegetation	predominantly or fully aquatic vegetation growing in the marginal areas of a river (i.e., in the water along the edge of the river under typical flow conditions)
migratory [fish]	fish that undertake longitudinal movements within rivers or between lakes and rivers or the sea and rivers usually for spawning (reproduction) purposes (see also anadromous and potamodromous)
macrophyte	aquatic plant that is easily visible with the naked eye
mid-stream bar	raised area of the substrate forming a mound or hump running along the middle of the channel, the upper parts of which may or may not be exposed above the water surface
MW	megawatt
O	
online pond	pond directly connected to a river
P	
pool	still water area, i.e., no discernible flow, usually with a water depth greater than that of the main channel
potamodromous	fish that undertake migrations (usually for spawning) entirely in freshwater
R	
run	flowing water with a broken surface but no wavelets, white water or sound
riffle	fast-flowing water with some sound, a broken surface and small standing waves, but no white water
rapid	fast-flowing water with a loud sound, standing waves and white water

S	
side bar	raised area of the substrate forming a mound or hump running along the edge of the channel, which may or may not be connected to the bank or exposed above the water surface
sp. and spp.	abbreviation of species, singular and plural
U	
IUCN	International Union for Conservation of Nature
V	
VEC	valued environmental (and social) component

A2 AQUATIC BIODIVERSITY BASELINE REPORT

A2.1 Introduction

This baseline report describes the aquatic biodiversity:

- area of influence (AOI) and study area boundaries
- methods
- baseline conditions:
  - trends in condition and sensitivity to change
  - ecosystem services provided
- key considerations.

The report focuses on six rivers in the AO listed below. It also provides the data required to support the critical habitat assessment (CHA), see Appendix B.

A2.2 Area of Influence and Study Area Boundaries

A2.2.1 Area of Influence

The spatial area of influence (AOI) for the aquatic biodiversity surveys encompasses 250 m upstream and 750 m downstream of the proposed pipeline crossing location for the following watercourses:

- Sambiye River
- Waiga River
- Waisoke River
- Sonso River
- Waki River
- Wambabya River.

In some locations, Lake Albert falls just within the AOI, but the distance between the pipeline and lake varies between 1 and 12 km and the pipeline does not cross the lake at any point. The focus of this ESIA is on the major rivers crossed by the RoW, all of which drain into Lake Albert. Sampling was undertaken for these rivers thus removing the need for sampling points in the lake itself.

The Bubwe, Hoimo and Rwamutonga rivers are also within the AOI but, based on discussions with the national experts, who identified a high degree of similarity with the rivers listed above, these were not surveyed.

The 1 km length of AOI was chose to encompass the immediate area surrounding the potential crossing locations that could be impacted by construction activities.

Direct impacts on these watercourses occur only during the construction phase. The temporal AOI is the pipeline construction period plus the time required for the river to be re-established to pre-construction condition.

The habitat maps in Attachment A2.1 illustrate the AOI boundaries.

A2.2.2 Study Area Boundary

The desk-based study area includes the upstream and downstream catchment areas of the watercourses crossed by the pipeline to provide regional context for the field-survey data.

The field study area was the same as the AOI.

The six river crossings represent the main watercourses identified on satellite imagery and crossed by the AOI. The proposed survey sites were discussed with in-country aquatic ecologists familiar with the region to confirm that no other main watercourses required consideration.

Lake Albert is not crossed by the pipeline but all of the rivers drain into the lake. The rivers support the aquatic biodiversity of Lake Albert and there are potential impacts on Lake Albert fisheries so Lake Albert is included in the study area.

A2.3 Methods

A2.3.1 Secondary Data

The desktop study for aquatic biodiversity baseline data included a review of the following secondary data sources, the:

- FishBase[1] database
- International Union for Conservation of Nature (IUCN) Red List
- National Red List for Uganda (at the time of writing this had assessed the threat status of seven taxa, including invertebrates but not fish)
- National Policy for the Conservation and Management of Wetlands
- environmental and social impact assessments (ESIA) and other technical studies relevant to the same drainage basins
- scientific and grey literature
- data collected as part of the surface water baseline study (see Appendix A6).

The desktop study focused on the identification of aquatic habitats, fish and macroinvertebrate species known, or considered likely to occur, in the AOI. The secondary data were used to define the baseline survey methodology and, in combination with satellite imagery, were also used to identify potential sampling locations.

A2.3.2 Field Survey

The field survey was undertaken during June 2017.

The June survey was conducted between the wet and dry seasons because high water levels in watercourses during the wet season are unsafe to survey and obscure many habitat features. The dry season was avoided because many fish

[1] FishBase is an online global database of fishes

species move out of the main river channels to avoid risks associated with low water levels such as isolation, increased predation risk and poor water quality.

The six locations (Figure A2.3-1) were selected for:

- river habitat mapping
- multi-method fish surveys
- kick-sweep sampling for macroinvertebrates.

Detailed descriptions of the field methods are provided in Attachment A2.2.

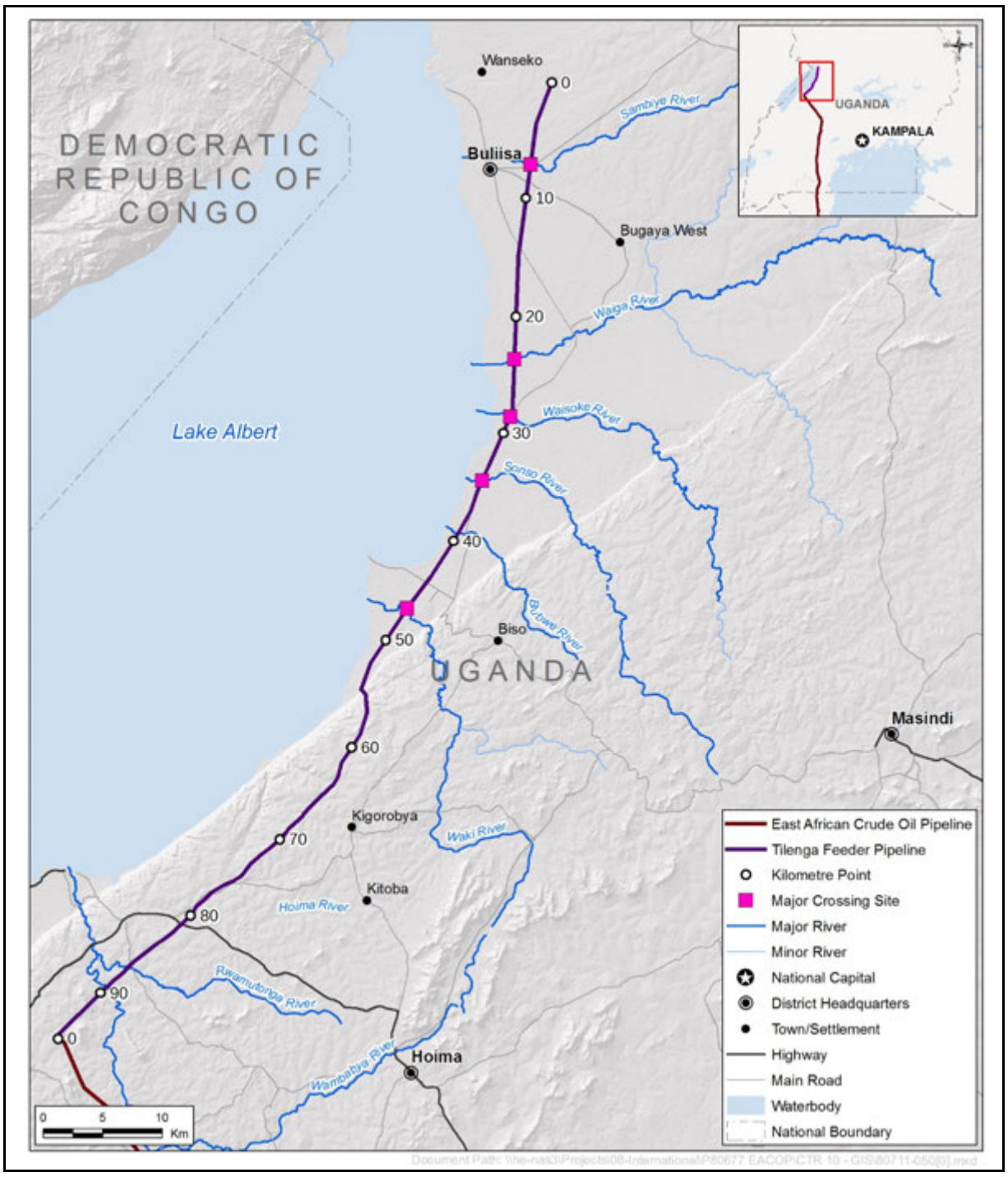

Figure A2.3-1 Aquatic Biodiversity Survey Locations

A2.3.3 Data Analysis

Fish species composition was identified using descriptions provided in Greenwood (1996) and their relative abundance was calculated. Preserved macroinvertebrate samples were sorted for identification in the laboratory using various keys and guides (Penmak 1953, Mandahl-Barth 1954, Merrit and Cummins 1997, De Moor et al. 2003a and 2003b, and Cumberlidge 2011). Most organisms were identified to genus level, though some were only identified to family level.

Information on endemism and conservation status was obtained from the IUCN and Ugandan National Red Lists.

A2.3.3.1 Sensitivity Ranking

The sensitivity of the aquatic biodiversity receptors has been ranked according to the aquatic biodiversity section of the sensitivity table in Section 8.

A2.3.4 Data Considerations

Although surveys were undertaken in all the targeted rivers, it should be noted that access was limited in some cases. This limited the ability of the surveyors to undertake more comprehensive surveys. Nonetheless, some data collection was still possible, and the data provide baseline information on the aquatic habitat and communities at the respective sites.

The ecology of many of the rivers in the AOI has been poorly studied and consequently there is a relative lack of information on specific habitats and species. This applies to all the watercourses and associated wetlands surveyed in this study. It is likely that, as more studies are undertaken throughout Uganda, more species will be identified and knowledge of the status and habitat requirements of species will improve.

Field survey data only provide a snapshot in time, so are unlikely to represent the full diversity of species supported at a site. Therefore, baseline assessments include secondary data as well as data gathered during field surveys. In cases of doubt about the presence of a particular species, a precautionary approach was taken in keeping with the International Finance Corporation (IFC) Performance Standard 6 (PS6) and the accompanying Guidance Note.

A2.4 Baseline Conditions

A2.4.1 Aquatic Habitats of Conservation Concern

The following sections of this report provide:

- an overview of the aquatic habitats in the AOI based on secondary data
- a description of the aquatic habitat at the surveyed sites.

Attachment A2.1 provides habitat maps illustrating the locations and extents of key habitat features within the area surveyed at each location.

A2.4.1.1 Overview

There are several recognised areas of biodiversity importance associated with the study area. These areas are illustrated in Figure A2.4-1 and are summarised as follows:

- Murchison Falls–Albert Delta Wetland System Ramsar site, which covers the upper Sambiye catchment but does not include the pipeline crossing of the Sambiye River

- Murchison Falls National Park (MFNP), which covers approximately 55% of the upper Sambiye catchment and approximately 85% of the upper Waiga catchment but does not include the pipeline crossings of those rivers
- approximately 70% of the upper Waisoke catchment and 90% of the upper Sonso catchment are covered by forest reserves.

All wetlands are afforded legal protection under the Ugandan National Policy for the Conservation and Management of Wetlands.

Rivers are generally important features owing to the ecosystem services they provide (e.g., drinking water, crop irrigation and fishing).

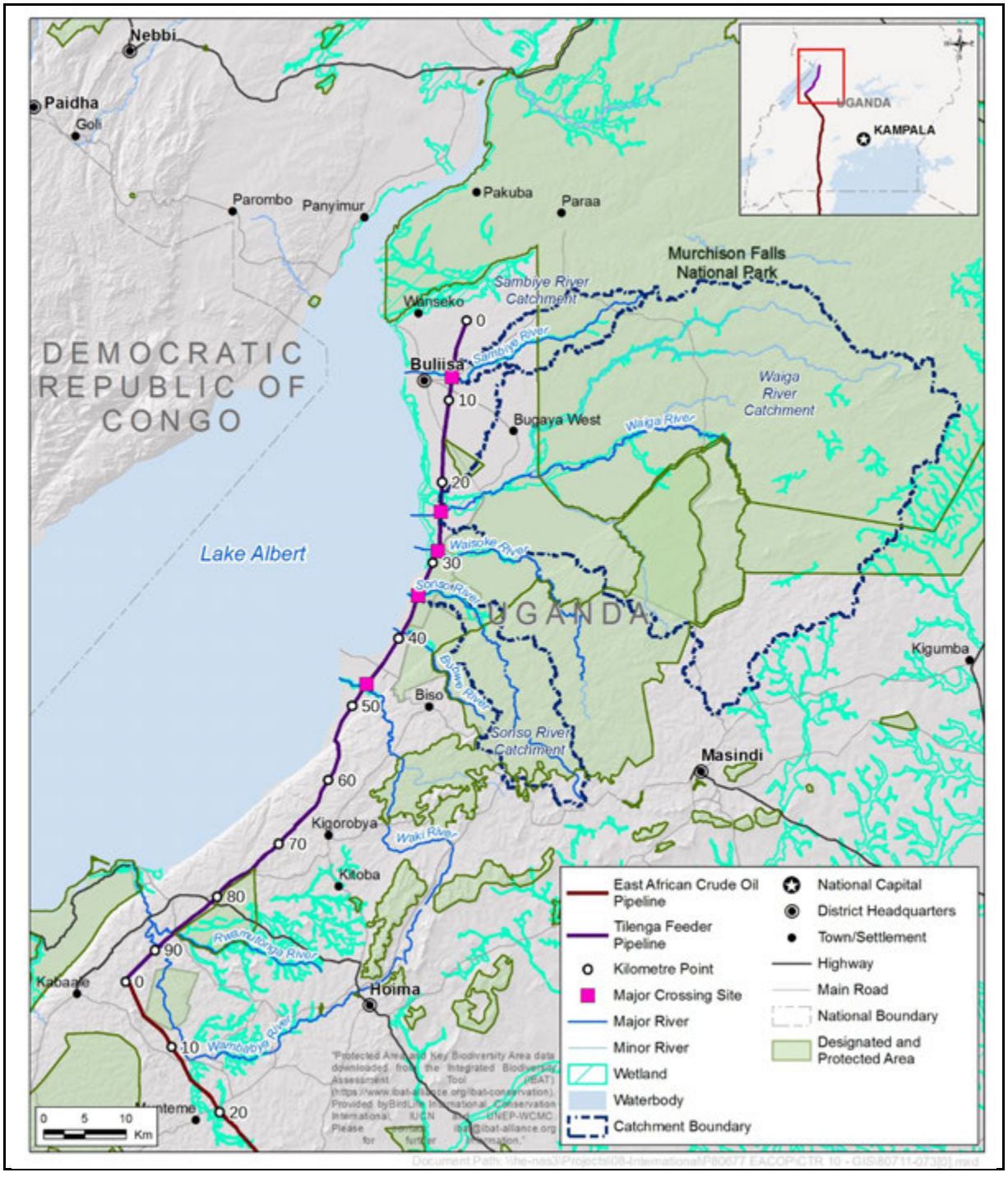

Figure A2.4-1 Areas of Biodiversity Importance Associated with the Study Area

A2.4.1.2 Sambiye River

Baseline Condition

At the time of the ESIA baseline survey this river channel at kilometre point (KP) 7 was dry and local inhabitants claimed that this was always the case, except during infrequent periods of extended heavy rainfall. This is supported by the evidence

presented in Appendix A6 Surface Water Baseline Report. Figure A2.4-2 shows the Sambiye River at the approximate location of the pipeline crossing.

Figure A2.4-2 Sambiye River

The value of this river channel from an aquatic ecology perspective is low. Some species of fish depend on the seasonal drying out of the waterbodies they inhabit to complete their lifecycles. Similarly, some macroinvertebrates have also adapted to live in ephemeral waterbodies. However, owing to the infrequency with which this channel is thought to flow it is considered unlikely that such fish or macroinvertebrates occur there.

Trend in Condition and Sensitivity to Change

The terrestrial vegetation in the river channel indicates it has been dry for a considerable period and probably has not flowed for months or possibly years. This trend is anticipated to continue.

From an aquatic biodiversity perspective, this river is considered to have low sensitivity to change.

A2.4.1.3 Waiga River

Baseline Condition

The survey location is at KP23 in a floodplain that includes large wetland components, intersected by numerous small tributaries of the Waiga River. Owing to the need to cross multiple turbid tributaries of unknown depth in the marshy wetland area, it was not possible to access or survey the main river channel. An alternative survey location, approximately 2 km from KP23, was identified at a large tributary of the Waiga River. Local inhabitants reported that this tributary contained

the same fish species as the Waiga River and it is likely that the macroinvertebrate community is also similar.

The surveyed river section was a relatively small channel with an average width of 4 m and depths ranging from 0.2 to 1.5 m, with an average depth estimated at 0.8 m. It is likely to be highly dynamic with flow conditions, water levels and water quality varying depending on the time of year and rainfall.

The river carries high loads of suspended silt. This results in a homogenous riverbed, comprised exclusively of fine silt mixed with sand. The highly turbid conditions restrict light penetration through the water column, inhibiting the growth of aquatic plants except for some emergent species in marginal and riparian areas. The high turbidity levels are likely to reflect the surrounding marshy wetland habitat. Another contributor is livestock that congregate along the banks to drink and bathe. Water quality was not assessed for nutrient levels at this location (see Appendix A6 Surface Water Baseline Report); secondary data reported in Appendix A6 indicates elevated total coliforms and *E. coli*, and nutrients are within national guidelines for potable water.

The surrounding habitat is predominantly intermittent wetland (see Figure A2.4-3) that is inundated during heavy rainfall creating connectivity between the flowing river channels and the surrounding wetlands and associated pools. Cattle were observed in the area and there was evidence they use the river (see Figure A2.4-4). Emergent macrophytes occurred intermittently along both banks and there was no evidence of submerged macrophytes, which was likely due to the observed high water turbidity (Figure A2.4-4). River bank damage by cattle is almost certainly a contributing factor to the turbid water conditions. The riverbed in the AOI is a mixture of silt and sand. In places mid-stream bars were observed, some of which had become exposed by receding water levels (Figure A2.4-4).

Figure A2.4-3 Waiga River Survey Area

Figure A2.4-4 Waiga River: Exposed Silt and Sand Bar Towards the Upstream Limit of the Survey Area

The macrophyte stands within the marginal areas of the channel provide structural features that could be used by fish as refuge or foraging areas (Figure A2.4-5). Predatory fish species may also use it as ambush locations using the vertical stems as camouflage.

Figure A2.4-5 Waiga River: Emergent Macrophytes and Marginal Vegetation

At this location, most fish were caught or observed in the marginal areas of the channel or the online pond close to the macrophytes (Figure A2.4-6).

Figure A2.4-6 Waiga River: Fish Surveys Near Dense Macrophyte Stands

A small, roughly circular, open water pond is present towards the upstream end of the River Waiga tributary survey area; the pond has a diameter of approximately 30 m, an average depth of approximately 0.6 m and a predominantly silt substrate. This pond is used for cattle and other livestock (Figure A2.4-7).

Figure A2.4-7 Waiga River: Cattle Drinking from the Online Pond

Trend in Condition and Sensitivity to Change

It was recorded during the survey that livestock damage the banks, disturb the riverbed and defecate and urinate in the water. This results in an increase of suspended sediment levels (which inhibits aquatic plant growth) and elevated nutrient levels within the water. Considering that human-related pressure on natural resource use is likely to continue, the condition of the river and banks is likely to remain unchanged or worsen.

Although wetland habitats can be highly sensitive to change, in this instance the poor macroinvertebrate community and fish community (see Section A2.4.2.2), comprising hardy species that can tolerate poor water quality, indicate an environment that has moderate sensitivity to change and which is likely to revert back to its current state fairly quickly following any disturbance.

A2.4.1.4 Waisoke River

Baseline Condition

This survey site is close to KP28.5, where the river passes under the road between Hoima and Buliisa.

Upstream of the road, the river channel passes through a wetland dominated by a dense cover of emergent macrophytes and grasses, obscuring most of the river channel (Figure A2.4-8).

Figure A2.4-8 Waisoke River: View Upstream from the Road between Biiso and Buliisa

The Waisoke River is small (approximately 2 m wide) with heterogeneous flow characteristics, including riffle, run, glide and some marginal slack water areas. The riverbed appeared to be sand and silt with some patches of cobble and boulders. Depths are variable, with deeper pools estimated to be more than 1 m and shallow marginal and riffle areas of less than 0.1 m.

The river passes under the road in a box culvert. Downstream of the culvert is a small open water area immediately followed by vegetation that completely obscured the river channel (Figure A2.4-9).

Figure A2.4-9 Waisoke River Culvert

Further downstream, the wetland vegetation opens in places. However, several sections of the river remain obscured by the non-native and highly invasive common water hyacinth (*Eichhornia crassipes*) (Figure A2.4-10).

Figure A2.4-10 Waisoke River Water Hyacinth

The river channel remains broadly similar over the survey area. Flow types are predominantly glide interspersed with small areas of run and occasionally slack water in marginal areas, or in deeper or wider pool sections. The riparian and marginal vegetation is extensive and, in many areas, obscured some or all of the channel (Figure A2.4-11).

Figure A2.4-11 Waisoke River Dense Riparian and Marginal Vegetation

One large area of open water was observed. The channel is much wider at this location with little or sparse riparian vegetation. Trampled and damaged areas of the banks indicate that the area is frequently used as a drinking spot for cattle (Figure A2.4-12).

Figure A2.4-12 Waisoke River: Small Pool off the River Used as a Livestock Watering Hole

Trend in Condition and Sensitivity to Change

The Waisoke River is affected by livestock and the alien invasive species, water hyacinth. The condition is anticipated to remain unchanged.

It is a perennial watercourse that comprises semi-natural habitat hence it is considered to have moderate sensitivity to change.

A2.4.1.5 Sonso River

Baseline Condition

The land surrounding the Sonso River close to KP34 is predominantly a mixture of seasonal wetland and dense scrub. Much of the river channel and the banks are inaccessible because of the dense vegetation (Figure A2.4-13).

Figure A2.4-13 Sonso River: Dense Scrub and Wetland Vegetation Surrounding the River

The wetland vegetation observed is predominantly emergent macrophyte species such as different types of reeds and rushes (Figure A2.4-14).

Figure A2.4-14 Sonso River: Wetland Habitat Dominated by Emergent Macrophyte Species

This type of habitat is valuable for wildlife, including invertebrates, amphibians, reptiles and small mammals. Many species of birds also use such habitats for nesting and foraging (Figure A2.4-15).

Figure A2.4-15 Sonso River: Weaver Bird (Ploceidae) Nest in Reed Beds Adjacent to the River Close to KP34

The river channel is predominantly narrow (1 m average width) and shallow (0.3 m average depth) with a silt and sand substrate. The surveyed section upstream of the culverted road crossing is surrounded on both sides by wetland habitat dominated by reed and rush species (Figure A2.4-16).

Figure A2.4-16 Sonso River: View of the Upstream Survey Area

In many places, the banks are sufficiently low to enable the river to readily flood into the surrounding wetland and this undoubtedly occurs frequently during periods of major rainfall. The flow types throughout this reach are predominantly glide interspersed with small sections of run and marginal slack water areas.

Immediately downstream of the culvert is a pool of deeper open water (Figure A2.4-17).

Figure A2.4-17 Sonso River: Pool Immediately Downstream of the Culvert Under the Biso-Buliisa Road

This pool is mainly still with a silt substrate. Local inhabitants informed surveyors that they regularly use this location for fishing. Several weaver bird nests were observed in a small tree overhanging the pool (Figure A2.4-18).

Figure A2.4-18 Sonso River: Weaver Bird Nests in Tree Overhanging Pool

Downstream of the pool, much of the river channel is inaccessible. In those areas where access is possible for surveying, the flow types observed were predominantly glide interspersed with small open areas and the occasional small section of run. These areas may provide refuge and foraging areas for some species and life stages of fish and various macroinvertebrates. They may also provide hunting opportunities for fish-eating birds and other fauna.

Typically, long sections of the river channel are choked with emergent macrophyte vegetation. The substrate throughout is predominantly silt or sand. The margins of the river channel on both banks are typically reed beds providing an almost indiscernible transition between the river channel and the adjacent wetland in many places (Figure A2.4-19).

Figure A2.4-19 A Typical Section of the Downstream Surveyed Reach on the Sonso River

Except for the road crossing and fishing in open areas, the observed habitat appears to be in an undisturbed state.

Upstream of the pipeline, approximately 90% of the upper Sonso catchment is within National Forest Reserves.

Trend in Condition and Sensitivity to Change

This site is subject to low levels of anthropogenic activity, but this is likely to increase with increasing land use pressures and the overall condition of the site, from an ecological perspective, is likely to decline.

The road upgrade being undertaken at the time of writing between Hoima, Butiaba and Wanseko crosses the Sonso river but should have a short-term impact only.

The Sonso River comprises natural habitat although the fish and macroinvertebrate communities within the river channel are considered to be poor in terms of their diversity and overall abundance. It has high sensitivity to change.

A2.4.1.6 Waki River

Baseline Condition

A 4.8-MW hydropower scheme is proposed for the Waki River but at the time of surveys had not yet been constructed (Figure A2.4-20). The scheme was originally anticipated to begin construction in 2014 and latest reports state that construction

was starting in December 2016. Such a scheme will undoubtedly have implications for the ecology of the river by altering flow patterns and creating a barrier to migration for aquatic animals, particularly fish.

Figure A2.4-20 Sign Indicating the Proposed Waki Hydropower Project.

The Waki River at KP47 flows through a channel with steep banks, almost vertical in many places. The channel is surrounded on both sides by a mixture of scrub, maize crop and bare ground, which local community members advised had been cleared for farming (Figure A2.4-21).

Figure A2.4-21 Waki River

Flow types throughout the surveyed reach were predominantly a mixture of run and glide with occasional slack water in marginal areas of the channel (Figure A2.4-22 and Figure A2.4-23).

Figure A2.4-22 Straight Section of the Waki River Channel with Predominantly Run Flow Type

Figure A2.4-23 Setting Nets in a Marginal Slack Water Area of the Waki River

The reach has a relatively firm clay-like substrate with occasional boulders and silt in slack water marginal areas. Despite much of the riparian zone having been cleared for agriculture or to allow cattle to drink from the river (Figure A 2.4-24), there are several stretches where the riparian vegetation overhangs the river channel creating potential refuge areas for fishes (Figure A 2.4-25).

Figure A 2.4-24 Waki River: Trampled and Damaged Area of Bank due to Cattle Drinking

Figure A 2.4-25 Waki River: Dense Riparian Vegetation Creating Shaded Areas and Potential Refuge Areas for Fish

Accumulations of coarse and large woody debris were also observed in some sections (Figure A2.4-26) and such habitat can provide good refuge for fish and macroinvertebrates.

Figure A2.4-26 Encroaching Riparian Plants and Woody Debris in the Waki River

The Waki River is heavily affected by high sediment loads likely to be originating from agricultural activities throughout its catchment. Evidence of ground clearance for arable farming and maize crops was observed during surveys. Large herds of cattle were observed being led to the river to drink and bathe (Figure A2.4-27). Local inhabitants also use the river for bathing and for washing clothes, machinery, vehicles and household items, which will be adversely affecting the water quality in the river.

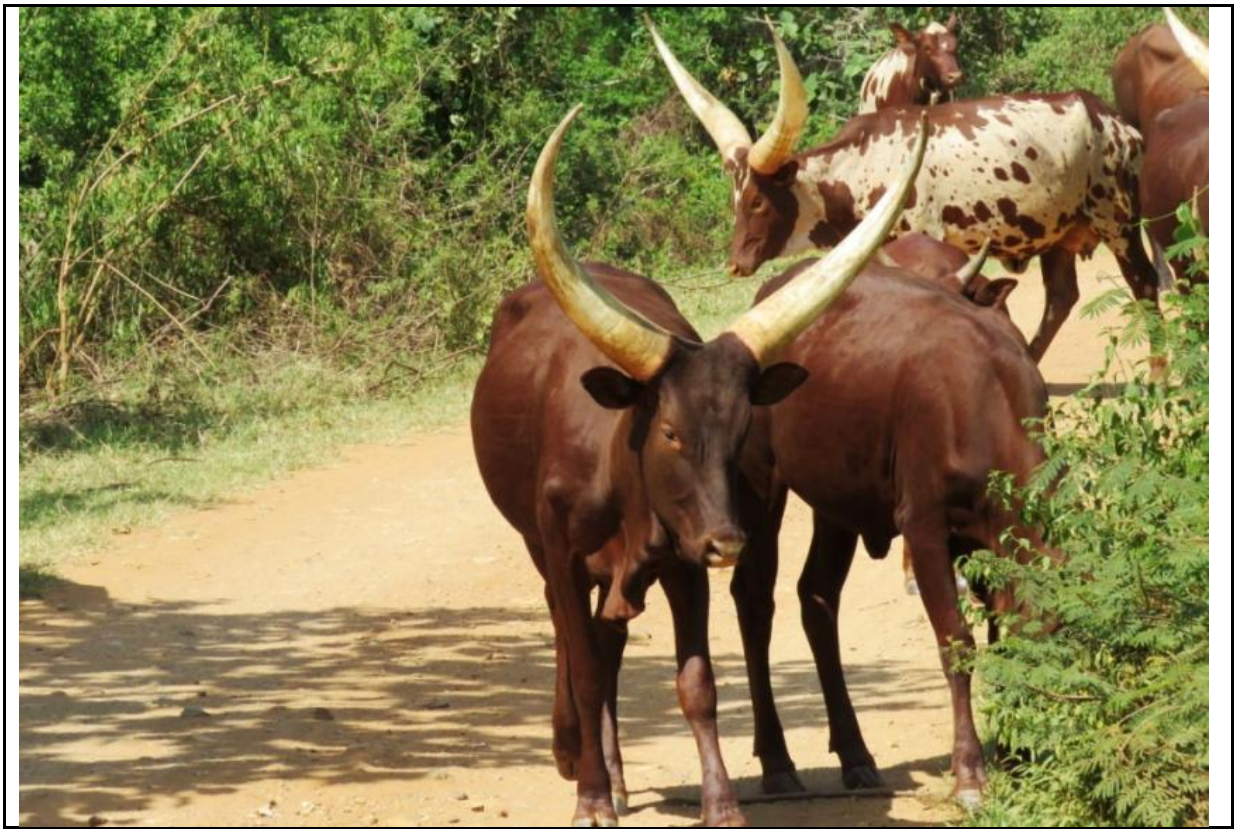

Figure A2.4-27 Ankole Long Horn Cattle Making Their Way to the Waki River to Drink and Bathe

Trend in Condition and Sensitivity to Change

Waki River habitat is already degraded with visually high suspended sediment loads and cleared riparian vegetation; it is likely that this condition will remain unchanged or may worsen given the planned hydropower scheme.

The Waki River supports semi-natural habitat and hence is of moderate sensitivity to change.

A2.4.1.7 Wambabya River

Baseline Condition

The northern area of land beyond the Wambabya River is an extensive floodplain, almost entirely flooded at the time of survey in June 2018. Rice paddies border most of the forest where large-scale reclamation is underway.

Figure A2.4-28 Rice Paddies North of the Wambabya River

The habitat surrounding the river is largely pristine, with the floodplain submerged up to 0.5 m in places. The river channel depth was recorded at a maximum of 2.9 m, and the open river channel is bordered by dense vegetation (Figure A 2.4-29). The river also flows through the nationally-protected Wambabya Forest Reserve, which is outside the project AOI. The river is known to be used by several fauna species of conservation importance (see Appendix A4 for further details).

Figure A 2.4-29 Wambabya River Bordered by Dense Vegetation

Trend in Condition and Sensitivity to Change

The Wambabya River habitat is currently pristine in places but is under threat from encroachment due to agriculture, primarily for rice. Within the protected area of Wambabya Forest Reserve, the river habitat is afforded more protection than it has when it is outside the protected area. Impacts on the river are considered likely to increase with increasing land use pressures and the overall condition of the site, from an ecological perspective, is likely to decline.

The road upgrade being undertaken at the time of writing between Hoima, Butiaba and Wanseko crosses the Wambabya river but should have a short-term impact only.

The Wambabya River comprises natural habitat although the fish and macroinvertebrate communities within the river channel are considered poor in terms of their diversity and overall abundance. It has high sensitivity to change.

A2.4.1.8 Ephemeral Rivers

The AOI crosses 20–50 ephemeral watercourses. Local experts advised that these would not be flowing at the time of the ESIA baseline surveys and they were therefore not surveyed. Small isolated pools may have remained, with aquatic life seeking refuge in such pools. However, finding these pools would have required a substantial amount of survey effort and may not have proven to be representative.

Furthermore, such pools are likely to be heavily impacted by people, wildlife and livestock.

A2.4.2 Flora and Fauna Species of Conservation Importance

Species of conservation importance are defined as those that are listed as vulnerable, endangered or critically endangered on the IUCN Red List; those that are migratory or congregatory; and those that are range-restricted or endemic. Keystone species are also considered to be of conservation importance.

IUCN threat categories are defined as follows:

- critically endangered – when the best available evidence indicates that a species is facing an extremely high risk of extinction in the wild. Critically endangered species are considered to have a very high sensitivity to change.
- endangered – when the best available evidence indicates that a species is considered to be facing a very high risk of extinction in the wild. Endangered species are considered to have a very high sensitivity to change.
- vulnerable – when the best available evidence indicates that a species is considered to be facing a high risk of extinction in the wild. Vulnerable species are considered to have a high sensitivity to change.
- near threatened – when a species has been evaluated against the criteria and does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. Near threatened species are considered to have a low sensitivity to change.
- least concern – when a species has been evaluated against the criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category. Least concern species are considered to have a low sensitivity to change.

Listing in the not-evaluated and data-deficient categories indicates that no assessment of extinction risk has been made, though for different reasons. Until an assessment is made, taxa listed in these categories should not be treated as if they were nonthreatened (IUCN 2012).

The following sections of this report describe aquatic fauna biodiversity based on secondary data and data from the fish and macroinvertebrate surveys.

A2.4.2.1 Overview

Fish

The FishBase (2018) and IUCN (2018) websites identified 72 species of fish occurring in Ugandan freshwater habitats listed by the IUCN as vulnerable, endangered or critically endangered. Many of these species were also considered to be endemic or at least range-restricted (i.e., only found in the Lake Albert basin). Regarding Lake Albert and its associated rivers (i.e., those surveyed as part of this baseline study), the total number of fish species reported varies but generally does not exceed 53 (NEMA 2009). Nine of these are considered to be endemic to the Lake Albert basin, namely:

- *Barbus huloti* (IUCN vulnerable)
- *Citharinus latus* (IUCN least concern, Uganda critically endangered)
- *Citharinus citharus* (IUCN not assessed, Uganda critically endangered)
- *Haplochromis alberianus* (IUCN not assessed, Uganda not assessed)
- *Haplochromis loati* (IUCN data deficient, Uganda endangered)
- *Haplochromis mahagiensis* (IUCN not assessed, Uganda endangered)
- *Haplochromis avium* (IUCN not assessed, Uganda endangered)
- *Lates macrophthalmus* (IUCN endangered, Uganda endangered)
- *Mesobola bredoi*. (IUCN not assessed, Uganda not assessed)

The Waki and Wambabya rivers are noted by NEMA (2009) as important sources of fish in the region but specific details on species are not provided.

Some fish species (e.g., *Barbus* spp. and *Clarias* spp.) migrate upstream (possibly from Lake Albert or lower reaches of the rivers) to spawn and are referred to as potamodromous.

Appendix B Critical Habitat Assessment (WCS and eCountability 2016) identifies the following fish species as triggering critical habitat status in Lake Albert and associated watercourses and wetland areas. In the absence of known barriers to movement along the watercourses within the project AOI, any or all of these species could be present in any or all of the watercourses crossed by the pipeline:

- Criterion 1: threatened species
  - *Citharinus citharus*
  - *Citharinus latus*
  - *Lates macrophthalmus*
  - *Mesobola bredoi*
  - *Marcusenius victoriae* (IUCN endangered, Uganda not assessed)
  - *Synodontis victoriae* (IUCN near threatened, Uganda endangered)
- Criterion 2: endemic and/or range-restricted species
  - *Mesobola bredoi*
  - *Marcusenius victoriae*
  - *Haplochromis alberianus*
  - *Haplochromis loati*
  - *Haplochromis mahagiensis*
  - *Haplochromis avium*
  - *Haplochromis wingatii* (IUCN data deficient, Uganda endangered)
  - *Lates macrophthalmus*
  - *Oreochromis leucostictus* (IUCN least concern, Uganda not assessed)
  - *Synodontis afrofischeri* (IUCN least concern, Uganda not assessed)
  - *Synodontis victoriae*.

Freshwater Macroinvertebrates

Freshwater macroinvertebrates, like the fish species in the study region, have been poorly studied. Notwithstanding this, there are 44 threatened dragonfly species and a further 19 listed as data deficient in the National Red List for Uganda (WCS

2016). Of these species, only one (*Pseudagrion bicoerulans*) is listed as IUCN vulnerable and this species has only been recorded from montane streams 2000 m above sea level. All other species are listed as IUCN not evaluated, data deficient, least concern or near threatened but are considered threatened (critically endangered, endangered or vulnerable) on the Uganda Red List (WSC 2016).

Upstream CHA identified the following freshwater macroinvertebrate species as triggering critical habitat status in Lake Albert and associated watercourses and wetland areas. In the absence of known barriers to movement along the watercourses within the project AOI, any or all these species could be present in any or all of the watercourses crossed by the pipeline: According to WCS (2016), eight species of mollusc that are endemic to, or severely range restricted within, Lake Albert have been identified as follows:

- Criterion 1: threatened species
  - *Gabbiella candida* (IUCN critically endangered, Uganda not assessed) – endemic to Butiaba, Lake Albert
  - *Gabbiella humerosa* ssp. alberti (IUCN endangered, Uganda not assessed) – endemic to Lake Albert
- Criterion 2: endemic and/or range-restricted species
  - *Bellamya rubicund* (IUCN not assessed, Uganda not assessed) – endemic to Lake Albert
  - *Ceratophallus bicarinatus* (IUCN least concern, Uganda not assessed) – restricted range to Butiaba, Lake Albert
  - *Ceratophallus faini* (IUCN data deficient, Uganda not assessed) – endemic to Lake Albert
  - *Gabbiella candida*
  - *Gabbiella humerosa* ssp. *alberti*
  - Gabbiella humerosa ssp. *kyogae* (IUCN least concern)
  - *Gabbiella walleri* (IUCN data deficient, Uganda not assessed)
  - *Biomphalaria stanleyi* (IUCN near threatened, Uganda not assessed) – endemic to Lake Albert
  - *Coelatura bakeri* (IUCN near threatened, Uganda not assessed).

A2.4.2.2 Waiga River

Fish

Nine fish species were caught and their relative abundance (percentage of the total catch) is illustrated in Figure A2.4-30.

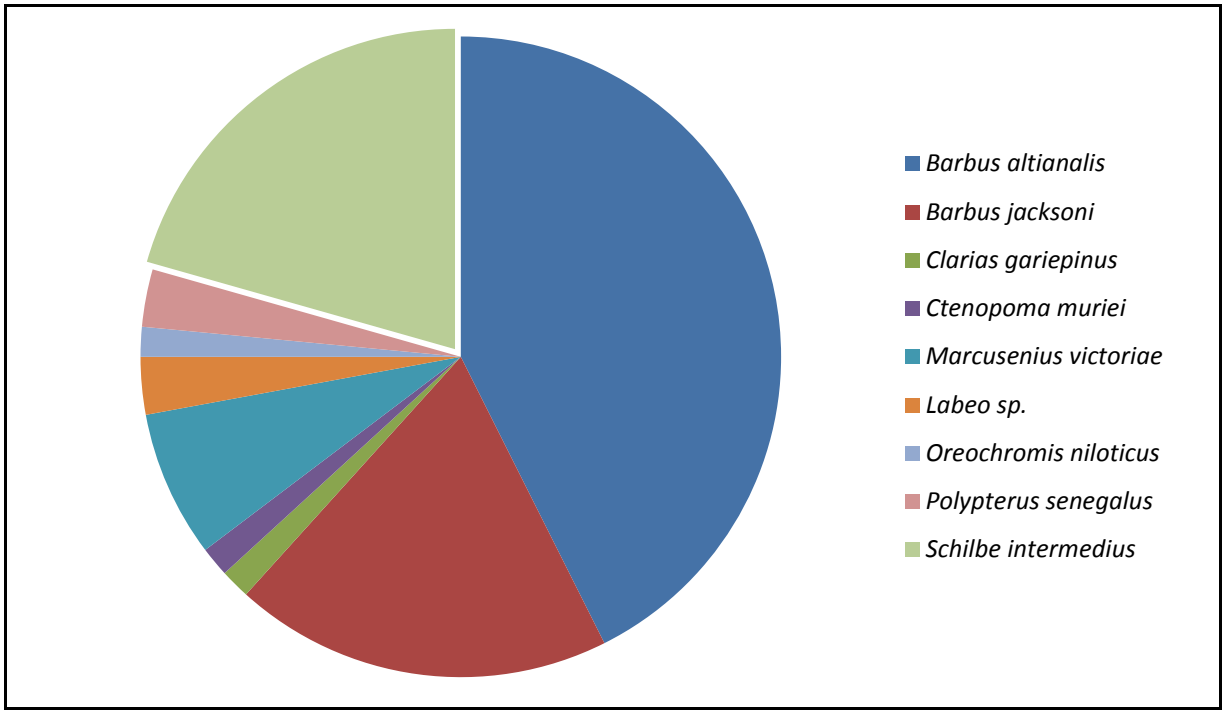

Figure A2.4-30 Waiga River Fish Survey Catch Composition

Most of the catch was *Barbus altianalis* and *Barbus jacksoni*, followed by *Schilbe intermedius* (Figure A2.4-30). These species are common and widespread across their global range and as such are listed by IUCN (2017) as least concern. *Barbus jacksoni* and *Schilbe intermedius* trigger critical habitat under Criterion 3 (migratory and/or congregatory species, see Appendix B Critical Habitat Assessment). Local fishermen also reported they have caught *Protopterus aethiopicus* (IUCN least concern) in this tributary. This is a cryptic species which often buries in the mud and can essentially hibernate in cocoons within dried parts of the floodplain during dry periods of the year only emerging during flood periods. It is also normally only active at night. The habits of this species make it difficult to catch without undertaking overnight surveys or undertaking extensive searches of the dried floodplain to look for the very small air holes used by cocooned *Protopterus* sp.

In addition, field surveys undertaken by AECOM in 2017 recorded the following species in the Waiga River:

- *Polypterus senegalis* (restricted range within Uganda, IUCN not assessed)
- Petrochephalus catastoma (IUCN not assessed)
- *Marcusenius victoriae* (IUCN least concern)
- *Labeo horie* (IUCN not assessed, endemic, migratory)
- *Barbus perince* (IUCN least concern, migratory)
- *Labeo coubie* (IUCN least concern, migratory)
- *Shilbe intermedius* (IUCN least concern, migratory, congregatory)
- *Clarias gariepinus* (IUCN least concern, migratory, congregatory)
- *Synodontis schall* (IUCN least concern, restricted range in Uganda)
- *Synodontis nigrita* (IUCN least concern, migratory)

- *Tilapia zilli* (IUCN least concern)
- *Oreochromis niloticus* (IUCN least concern).

Macroinvertebrates

Only three macroinvertebrate species were recorded for the Waiga tributary, the relative abundance of which (percentage of the total catch) is illustrated in Figure A2.4-31.

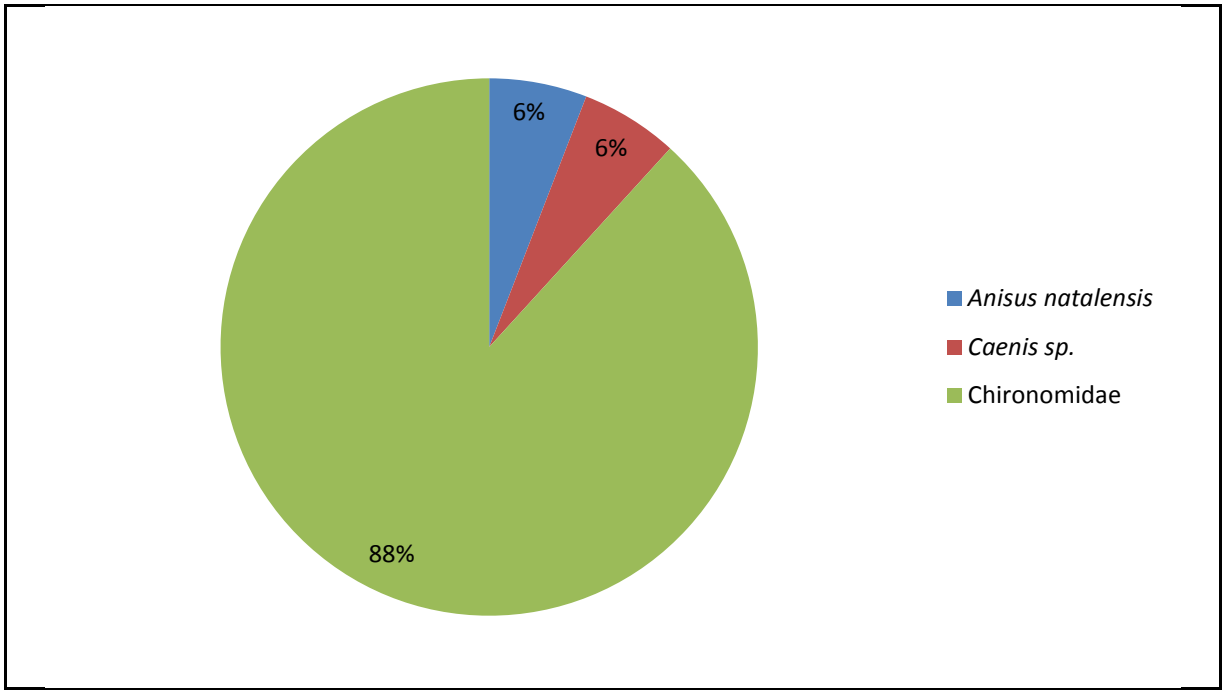

Figure A2.4-31 Waiga River Macroinvertebrate Community Composition

Chironomid larvae comprised most of the macroinvertebrates caught in the Waiga River. The only other species caught were a mollusc (freshwater snail) and a mayfly species. All three species can be found in relatively poor quality and slow flowing water.

The macroinvertebrate community was poor in terms of the number, diversity and abundance of species observed. Large numbers of adult damselflies (Zygoptera) and dragonflies (Anisoptera) were observed and there is the potential for their breeding in the area.

Despite the relatively poor macroinvertebrate community, which is a food source for fish, the fish community is relatively diverse with nine different species representing six families being recorded (Polypteridae, Mormyridae, Cyprinidae, Schilbeidae, Clariidae and Cichlidae). All these species, and *Protopterus aethiopicus* noted by local people, are hardy and can be found in slow flowing, turbid watercourses with relatively poor water quality.

A2.4.2.3 Waisoke River

Fish Surveys

The interface between open and vegetation-covered water appeared to be a habitat favoured by a catfish, *Clarias gariepinus* (IUCN least concern), with several individuals caught during surveys. Local inhabitants also reported that they regularly caught this species (locally known as mudfish) at the same location.

Six different fish species were caught and their relative abundance (percentage of the total catch) is illustrated in Figure A2.4-32.

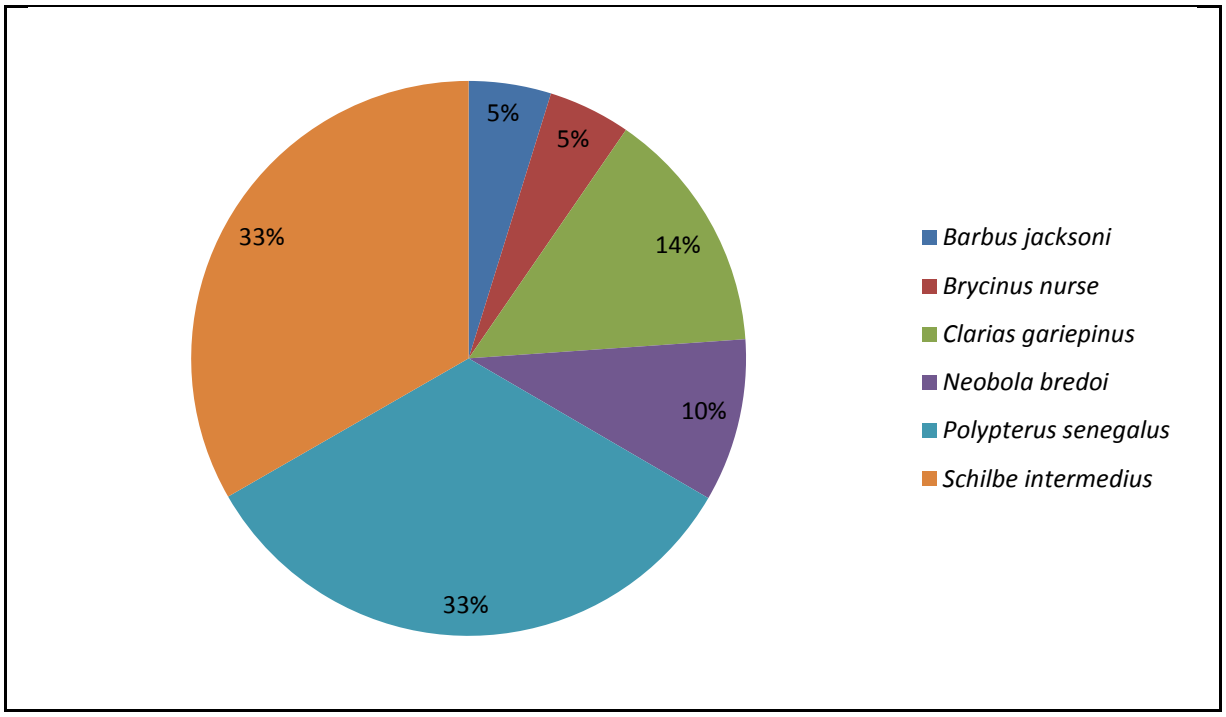

Figure A2.4-32 Waisoke River Fish Survey Catch Composition

Local inhabitants also reported that they often catch *Protopterus aethiopicus* (not assessed by IUCN, 2017), *Schilbe intermedius* (IUCN least concern), a small mormyrid species and small *Labeo* species.

Macroinvertebrate Surveys

Six macroinvertebrate species were recorded in samples from the Waisoke River and their relative abundance (percentage of the total catch) is illustrated in Figure A2.4-33.

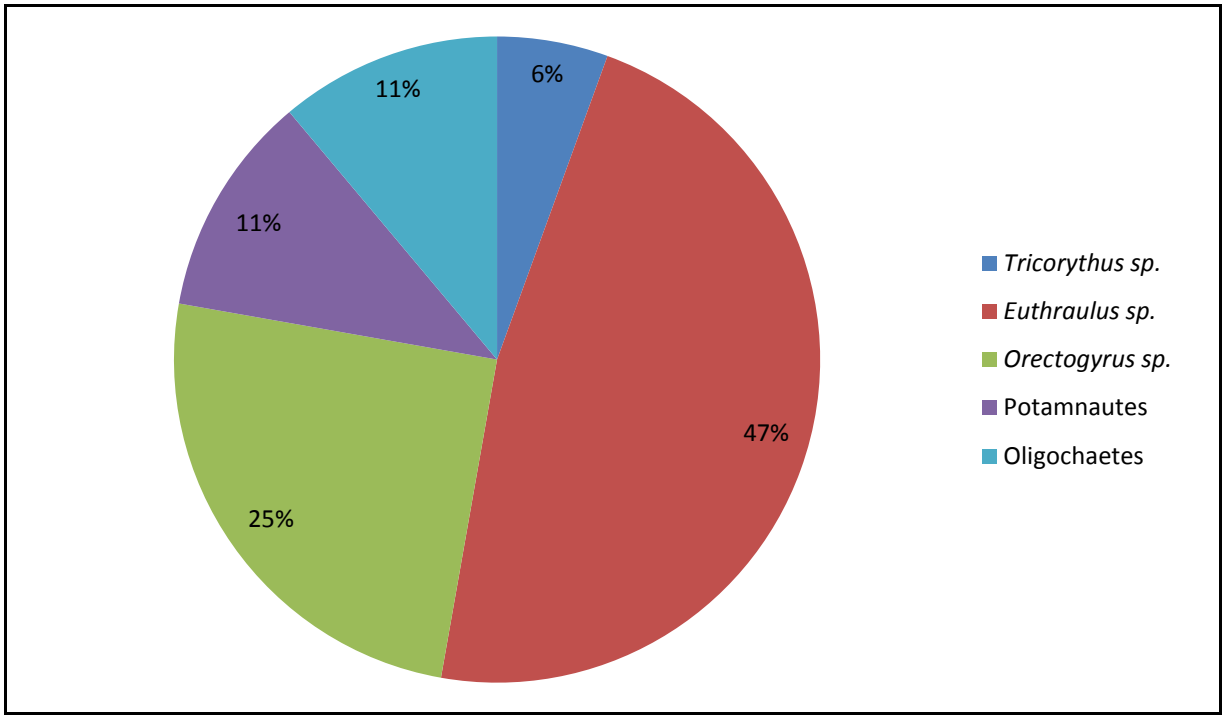

Figure A2.4-33 Waisoke River Macroinvertebrate Community Composition

Most of the macroinvertebrates caught in the Waisoke river were *Euthraulus* sp. (a mayfly), followed by *Orectogyrus* sp. (a water beetle).

The macroinvertebrate community was poor in terms of the number, diversity and overall abundance of species observed. This is probably a reflection of poor water quality and an absence of habitat important for supporting diverse and abundant macroinvertebrates.

The fish community was also considered to be relatively poor with low overall abundance and diversity.

A2.4.2.4 Sonso River

Fish Surveys

Only four species of fish were captured during surveys at the Sonso River, namely: *Aplocheilichthys bukobanus*, *Clarias gariepinus*, *Ctenopoma muriei* (synonym *Ctenopoma murie*) and *Polypterus senegalus*. All these species are categorised as IUCN least concern, except *Polypterus senegalus* which has not been assessed. The species and relative abundance (percentage of the total catch) are illustrated in Figure A2.4-34.

Local inhabitants said that they often catch *Protopterus aethiopicus* (IUCN not assessed), *Schilbe intermedius* (IUCN least concern), small mormyrid species and small *Labeo* species.

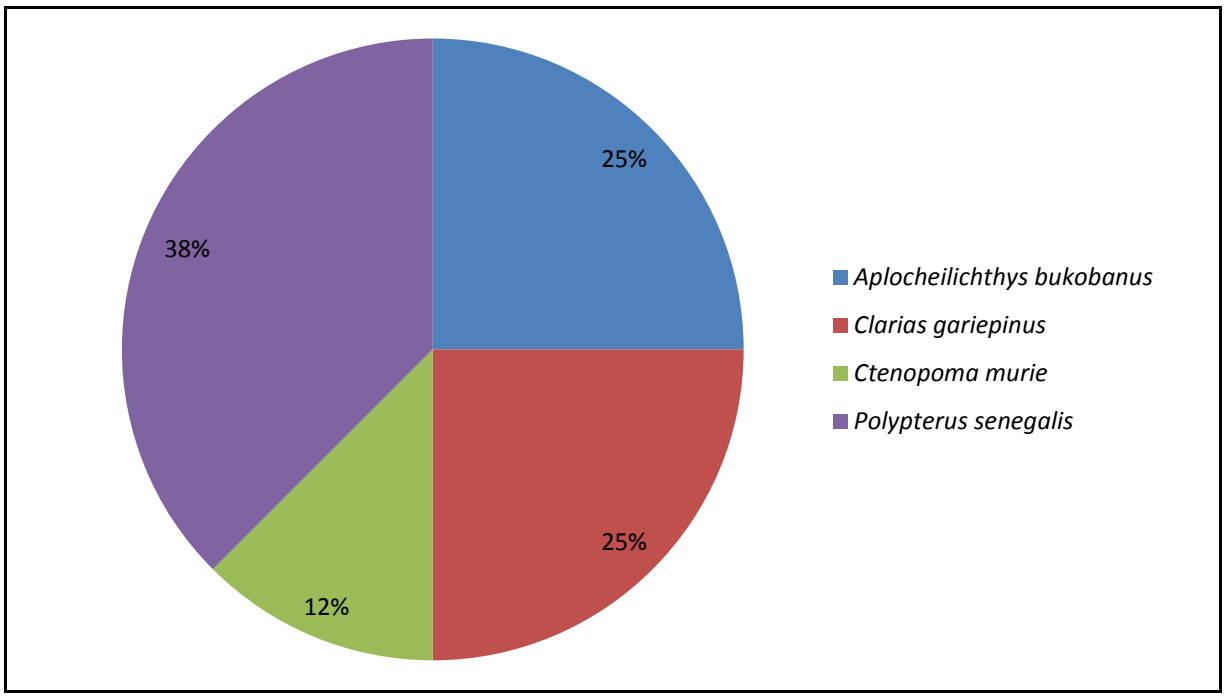

Figure A2.4-34 Sonso River Fish Survey Catch Composition

Macroinvertebrate Surveys

Six macroinvertebrate types were recorded in samples from the Sonso River. The macroinvertebrate catch composition (percentage of the total catch) is illustrated in Figure A2.4-35.

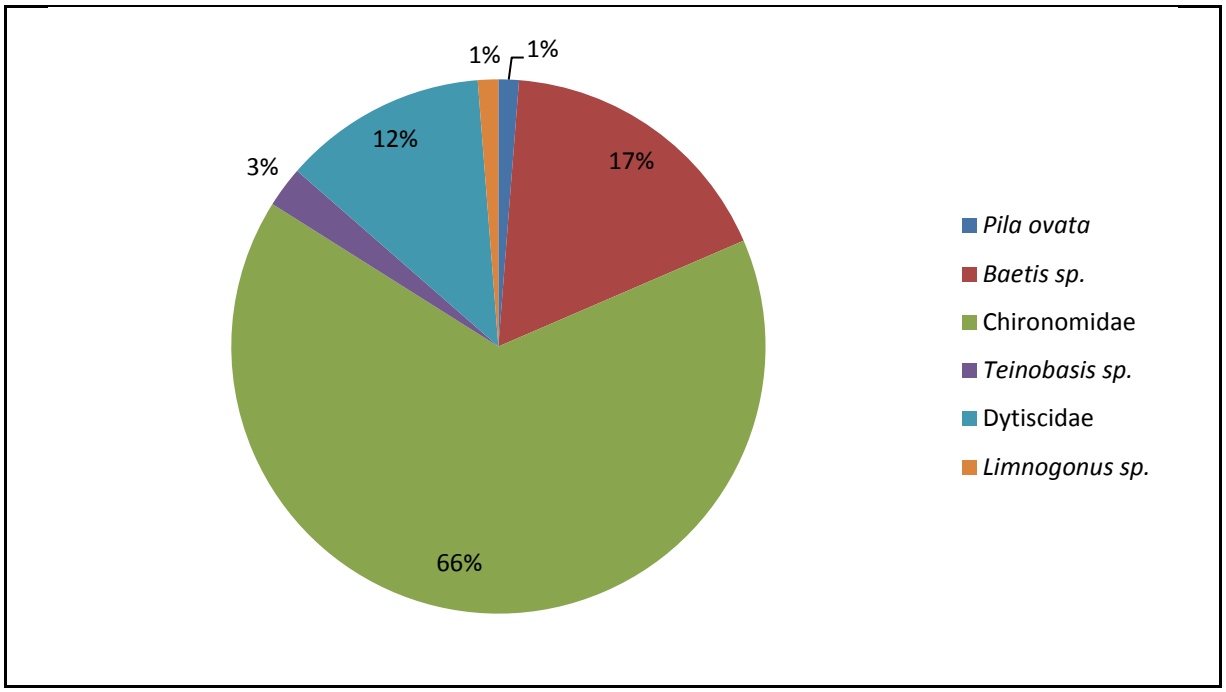

Figure A2.4-35 Sonso River Macroinvertebrate Community Composition

Most of the macroinvertebrates caught in the Sonso River were chironomid larvae.

Although the habitat immediately surrounding the river did not appear to be heavily impacted by land use, there were very few fish or macroinvertebrate species caught during surveys.

The surveys showed a relatively uniform habitat throughout the river with few variations in flow types, substrate composition, and channel width or channel depth. Such homogeneity is likely to be one of the factors contributing to the low diversity of fish and aquatic macroinvertebrates. Other factors could include fishing pressure and water quality.

Although the river channel appears to be in relatively poor condition, it is helping to maintain the surrounding wetland habitat. This habitat provides refuge and foraging opportunities for many other species including terrestrial and wetland invertebrates, birds, amphibians, reptiles and some mammals.

A2.4.2.5 Waki River

Fish Surveys

Seven different fish species were recorded during surveys in the Waki River, namely *Auchenoglanis occidentalis*, *Bagrus bajad*, *Raiamas senegalensis*, *Labeo horie, Schilbe intermedius*, *Synodontis frontosus* and *Synodontis nigrita.* All these species are IUCN listed least concern, except *Labeo horie,* which has not been assessed. The relative abundance of these species (percentage of the total catch) is illustrated in Figure A2.4-36. Local communities advised surveyors that other *Labeo* species were sometimes caught as well as small mormyrids.

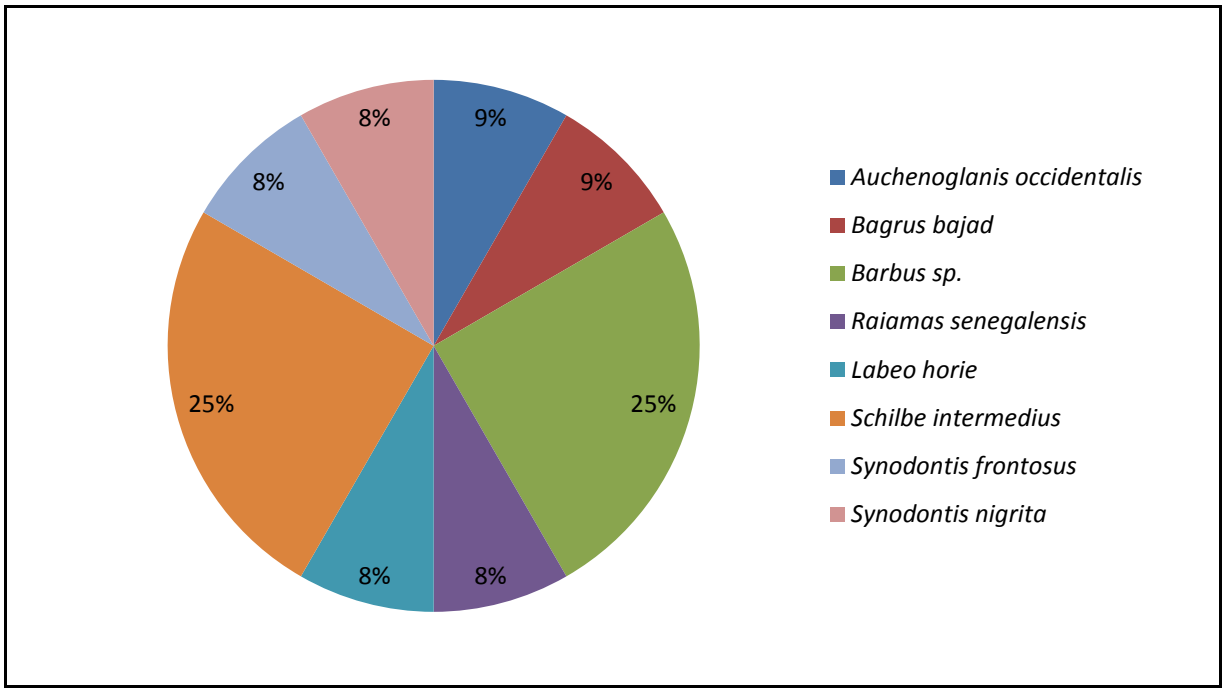

Figure A2.4-36 Waki River Fish Survey Catch Composition

Macroinvertebrate Surveys

Just three macroinvertebrate types were recorded in samples from the Waki River. The macroinvertebrate catch composition (percentage of the total catch) is illustrated in Figure A 2.4-37.

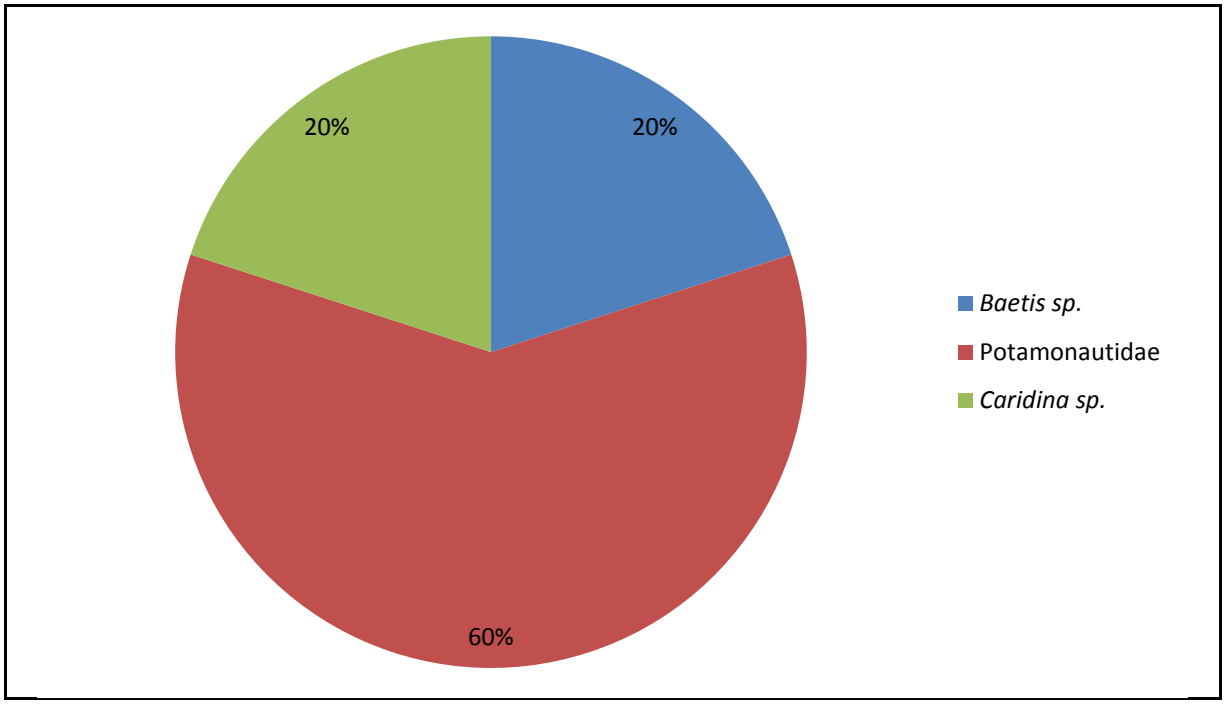

Figure A 2.4-37 Waki River Macroinvertebrate Community Composition

Most of the macroinvertebrates caught in the Waki River were freshwater crabs (Potamonautidae).

The Waki River habitat is considered degraded. However, eight species of fish were caught during the field survey indicating that the river has ecological potential if existing land-use pressures are managed.

A2.4.2.6 Wambabya River

Fish Surveys

Only three fish species were recorded in the Wambabya River: a species of *Astatotilapia* which could not be identified, *Clarias liocephalus* and *Amphilius jacksonii.*

All species found during the field surveys are classified by the IUCN as least concern and are not of conservation importance. However, it is likely that other fish species inhabit the river and surrounding wetlands that were not found by the survey. Local fishermen suggest the area is a seasonal breeding and feeding ground for fish, most notably *Haplochromine* species, many of which are species of conservation importance.

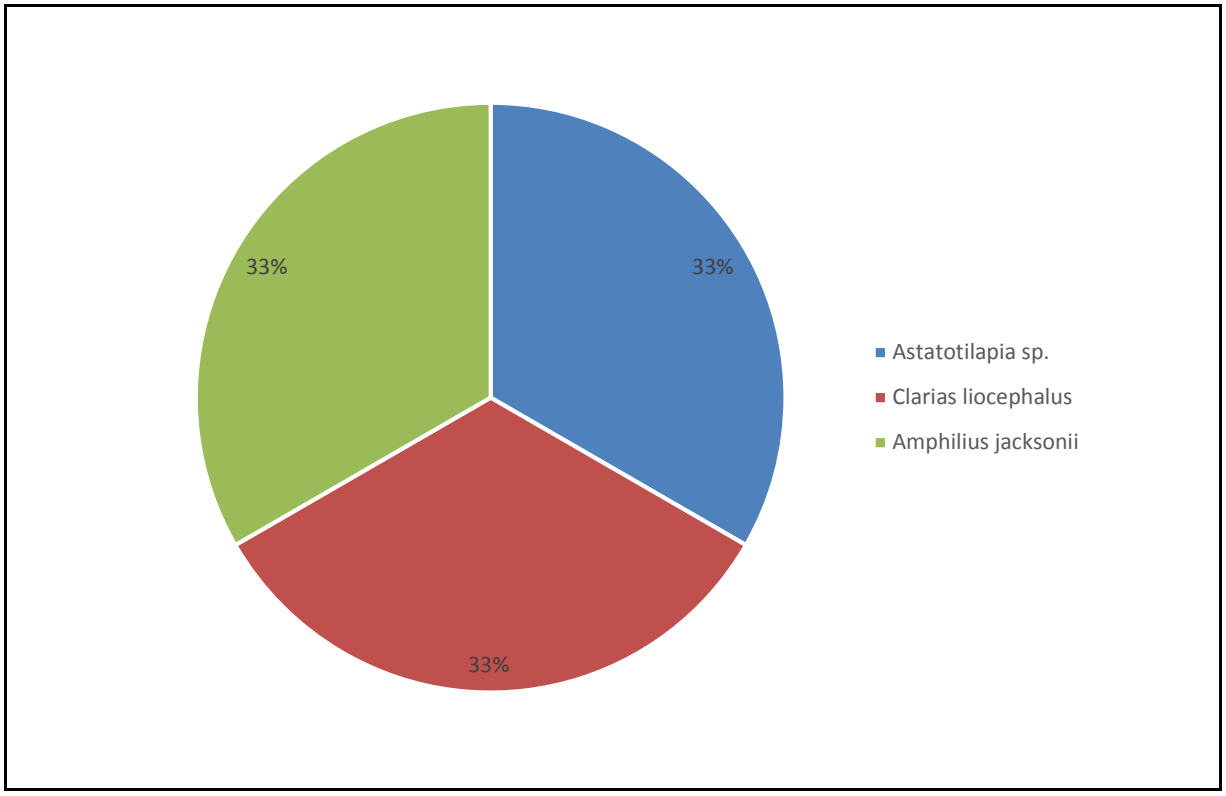

Figure A 2.4-38 Wambabya River Fish Survey Catch Composition

Macroinvertebrates

Seventeen macroinvertebrate species were recorded in samples from the Wambabya River. All but one species are listed as IUCN least concern or have not been assessed.

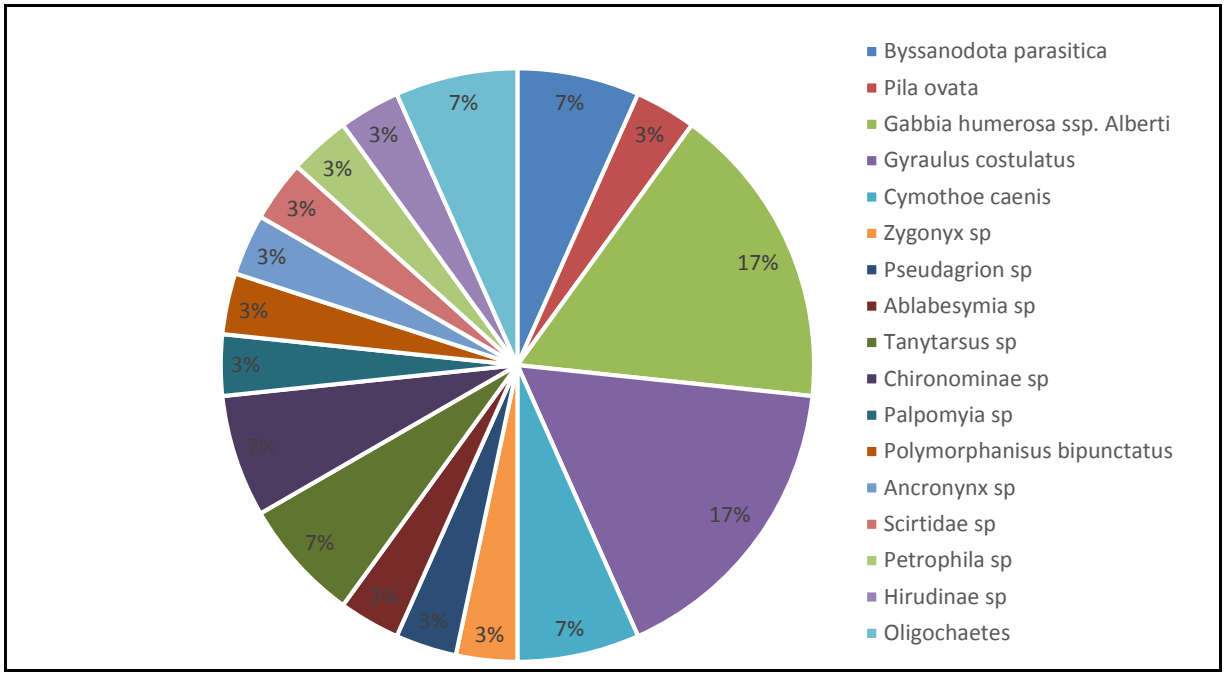

Figure A 2.4-39 Wambabya River Macroinvertebrate Community Composition

Gastropods, such as *Gabbiella humerosa,* were the most frequently recorded species. This species has a disjunct distribution[2] in the Great Lakes of central Africa, but is subdivided into six subspecies according to which lake they are found in (Van Damme and Lange 2017). The Lake Albert subspecies *Gabiella humerosa* ssp. *Alberti* is classed as endangered by the IUCN on the basis of being an endemic species to Lake Albert and being found in only five known locations (Kyambadde 2010).

A2.5 Ecosystem Services Provided

The Waiga, Waisoke, Sonso, Waki and Wambabya Rivers described in this report provide the following ecosystem services:

- fisheries and a source of other wild food, i.e., foraging for food. These provisioning ecosystem services are covered in the freshwater livelihoods section of Appendix A9 Socio-economic and Health Baseline Report.
- water regulation, whereby the river helps to retain and control the flow of water during heavy rainfall in the wet season. The vegetation and shape of the river are important factors in this role.
- habitat and species support services, whereby the river supports various fauna that use the water for drinking, cooling off in the heat or as a food source (for example, birds eating the insects that frequent the river). It also provides important connectivity between habitats, particularly during the wet season.

The Sambiye River could also be expected to provide these ecosystem services when in flow.

A2.6 Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the receptors has been ranked and is shown below in Table A2.6-1.

[2] A disjunct distribution is one where two or more groups of a species are related but considerably separated from each other geographically.

Table A2.6-1 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Sambiye River		
Legally protected, internationally or nationally recognised areas	High (4)	Approximately 55% of the Sambiye catchment falls within the Murchison Falls National Park.
Aquatic habitat of conservation importance	Low (2)	This is an ephemeral watercourse that was not in flow at the time of survey; local inhabitants claimed that this is always the case, except during infrequent periods of extended heavy rainfall. The site is therefore terrestrial for most of the time and thus has negligible value as an aquatic habitat.
Flora and fauna species of conservation importance	Very low (1)	No threatened aquatic species were identified during surveys as the watercourse was dry. Established terrestrial vegetation indicated that the river had not flowed at this location for some time and it is therefore considered unlikely to be a sensitive habitat or critical habitat for aquatic species.
Waiga River		
Legally protected, internationally or nationally recognised areas	High (4)	Upstream of the project, approximately 85% of the Waiga catchment falls within the Murchison Falls National Park.
Aquatic habitat of conservation importance	Moderate (3)	The surveyed area lies within a largely natural wetland area and is predominantly natural habitat. The Waiga is a permanent watercourse but does not link the Albertine Rift Lakes. Some disturbance from cattle was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). The following species were recorded during field surveys and trigger critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment: • *Barbus jacksoni* • *Schilbe intermedius.* AECOM 2017 also recorded another critical habitat trigger species, *Marcusenius victoriae.*

Table A2.6-1 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Waisoke River		
Legally protected, internationally or nationally recognised areas	High (4)	Approximately 70% of the upper Waisoke catchment (upstream of the project) falls within National Forest Reserves.
Aquatic habitat of conservation importance	Moderate (3)	The surveyed area lies within a large wetland area and is predominantly semi-natural habitat. The Waisoke is a permanent watercourse but does not link the Albertine Rift lakes. Some disturbance from cattle was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). The following species were recorded during field surveys and trigger critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment: • *Barbus jacksoni* • *Clarias gariepinus* • *Schilbe intermedius.*
Sonso River		
Legally protected, internationally or nationally recognised areas	High (4)	Upstream of the project, approximately 90% of the upper Sonso catchment falls within National Forest Reserves.
Aquatic habitat of conservation importance	High (4)	The surveyed area lies within a largely natural wetland area and is predominantly natural habitat. The Sonso is a permanent watercourse but does not link the Albertine Rift lakes. Some fishing activity was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). *Clarias gariepinus* was recorded and *Schilbe intermedius* was reported by local fishers during field surveys and these species trigger critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment.

Table A2.6-1 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Waki River		
Legally protected, internationally or nationally recognised areas	Moderate (3)	The Waki River discharges into Lake Albert, which is part of a Ramsar site. However, the Waki is not considered to be a notable component of this site due to its distance from the Nile–Lake Albert Delta.
Aquatic habitat of conservation importance	Moderate (3)	This watercourse comprises semi-natural habitat.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). *Schilbe intermedius* was recorded during field surveys and triggers critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment.
Wambabya River		
Legally protected, internationally or nationally recognised areas	High (4)	The Wambabya River discharges into Lake Albert, which is part of a Ramsar site. However, the Wambabya is not considered to be a notable component of this site due to its distance from the Nile–Lake Albert Delta. Upstream of the project, the river's catchment lies within a National Forest Reserve.
Aquatic habitat of conservation importance	Moderate (3)	The surveyed area lies within a large wetland and is predominantly semi-natural habitat. The Wambabya is also a permanent watercourse but does not link the Albertine Rift lakes. Some disturbance of encroachment from agriculture was evident.
Flora and fauna species of conservation importance	Very high (5)	Endemic and range-restricted species, *Gabiella humerosa* ssp. *Alberti* (IUCN endangered) is known to be present

A2.7 Key Considerations

Based on the outcomes of the aquatic ecology study, and particularly the known or likely presence of fauna species of conservation importance, the following watercourses are identified as sensitive receptors that require consideration in the ESIA:

- Waiga River
- Waisoke River
- Sonso River

- Waki River
- Wambabya River.

All the fish species recorded during the field surveys are on the IUCN Red List as either least concern or not assessed. Several endemic and or range-restricted (Lake Albert catchment) species were noted in the assessment and many of these are considered to trigger Tier 2 Critical Habitat status under Criterion 2 (endemic and or range-restricted species), see Appendix B Critical Habitat Assessment.

No anadromous (migrating between the sea and freshwater) species were encountered during surveys. However, several fish species were identified that undertake in-river migrations (potamodromous) for spawning purposes. Such species have the potential to be affected by temporary or permanent in-river obstacles (e.g., dams installed during the installation of the proposed pipeline).

Macroinvertebrate species were only identified to family or genus level and cannot be assessed in terms of their conservation status. The order Ephemeroptera includes species that are among the most sensitive organisms to environmental degradation (Wenn 2008). Their presence in Waiga, Waisoke, Sonso, Waki and Kibale Rivers, though in low numbers, is a potential indicator that these rivers are largely undisturbed in terms of the aquatic invertebrates present. However, it should be noted that aquatic invertebrates with mobile adult stages (e.g., flying adult forms) can be relatively quick to recolonise watercourses following any disturbance. The presence of large intact mats of macrophytes such as *Phragmites* sp., through which some of these rivers (e.g., Waiga and Waisoke) flow, is further evidence that the habitats are close to their natural conditions in at least some reaches. However, there are undoubtedly pressures being exerted which are likely to increase as human population density increases in the areas.

The presence of freshwater crabs (family Potamonautidae) in the Waisoke and Waki probably indicates good quality water as these invertebrates have been reported to dwell mainly in relatively pristine water conditions (Darwall and Smith 2011). The genus *Potamnautes,* found in the Waisoke River, has been reported to be either IUCN endangered or vulnerable (Cumberlidge 2011)[3].

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ATTACHMENT A2.1 HABITAT MAPS

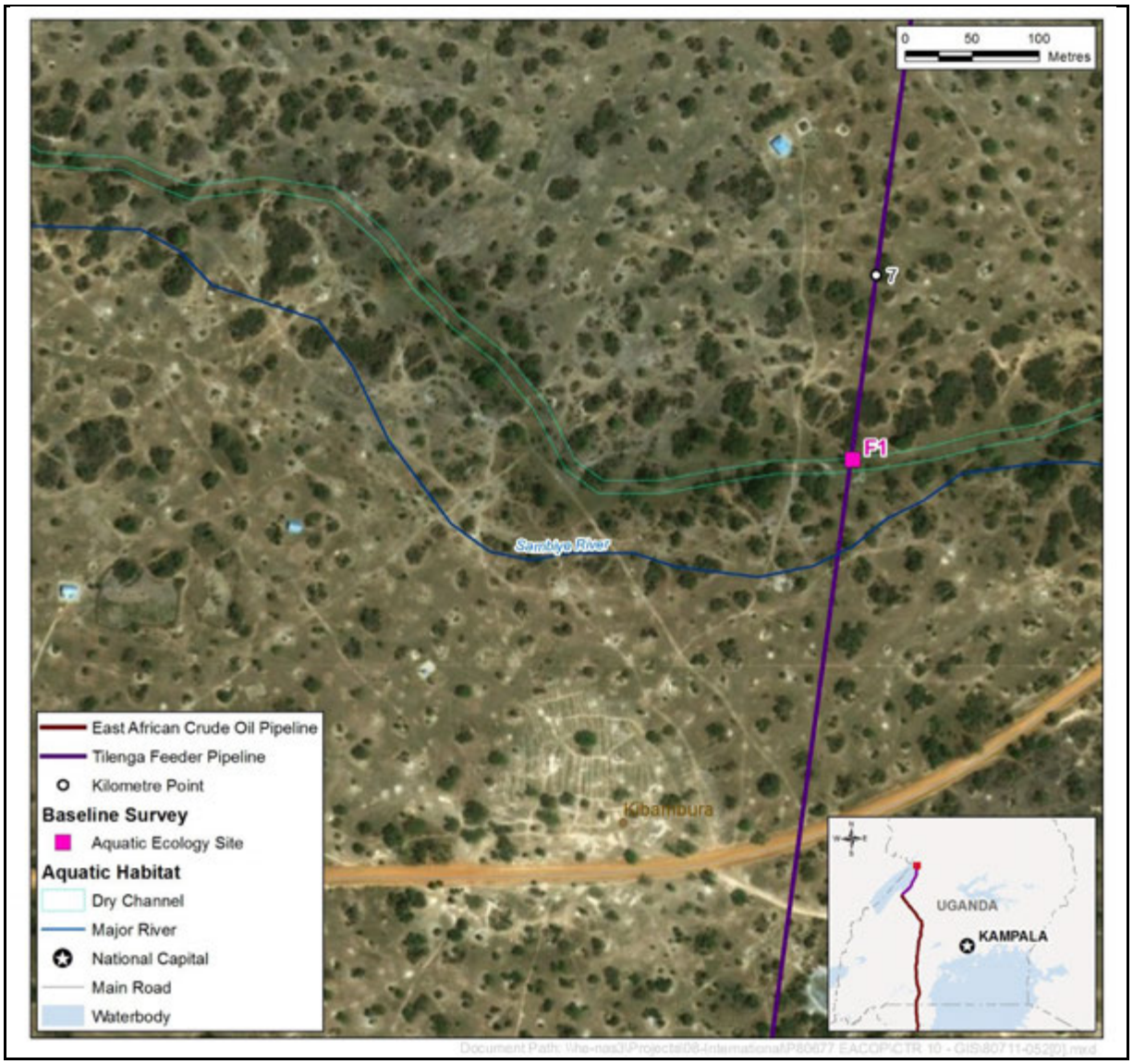

Figure Att2.1-1 Sambiye River Habitat

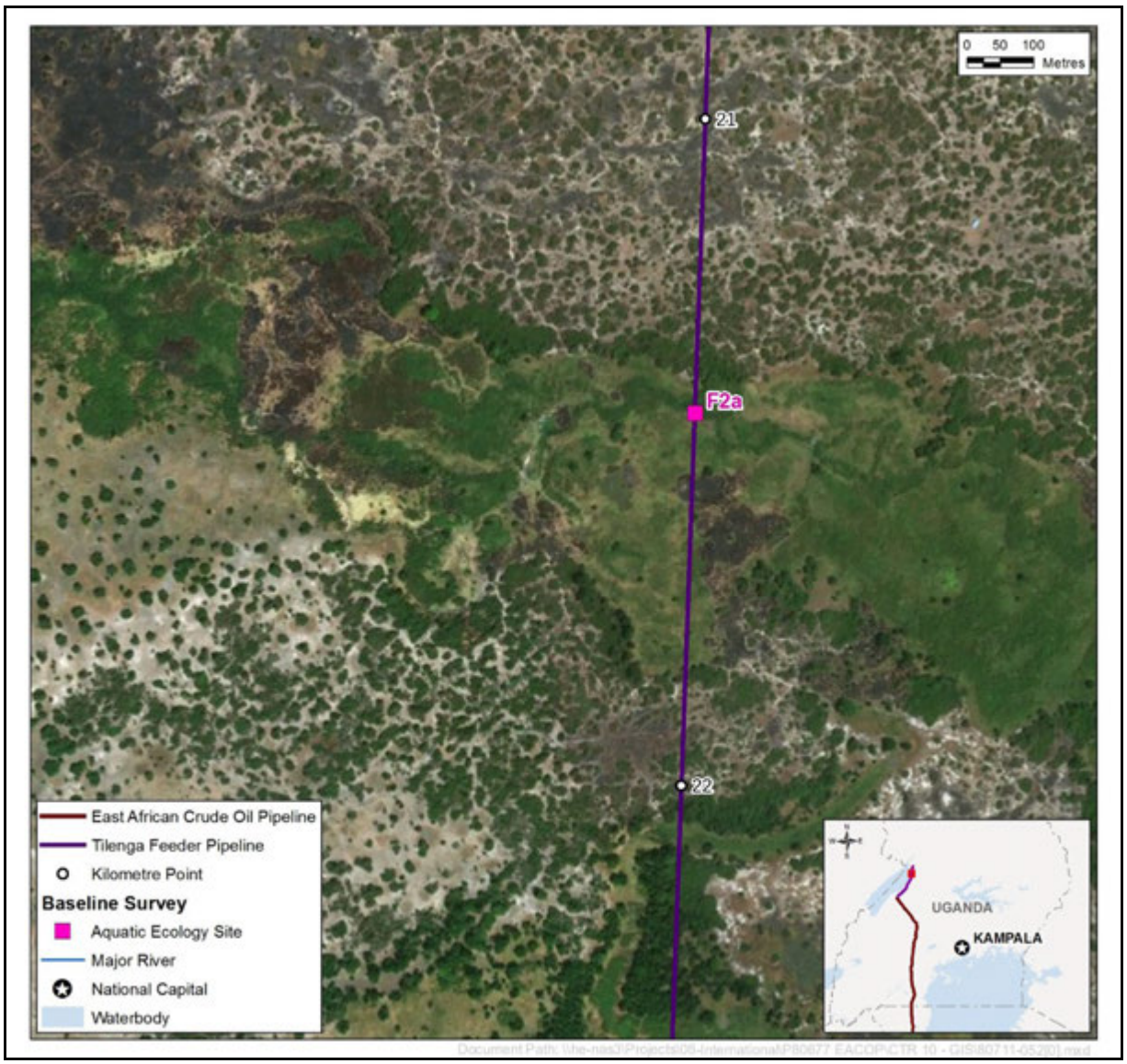

Figure Att2.1-2 Waiga River Habitat

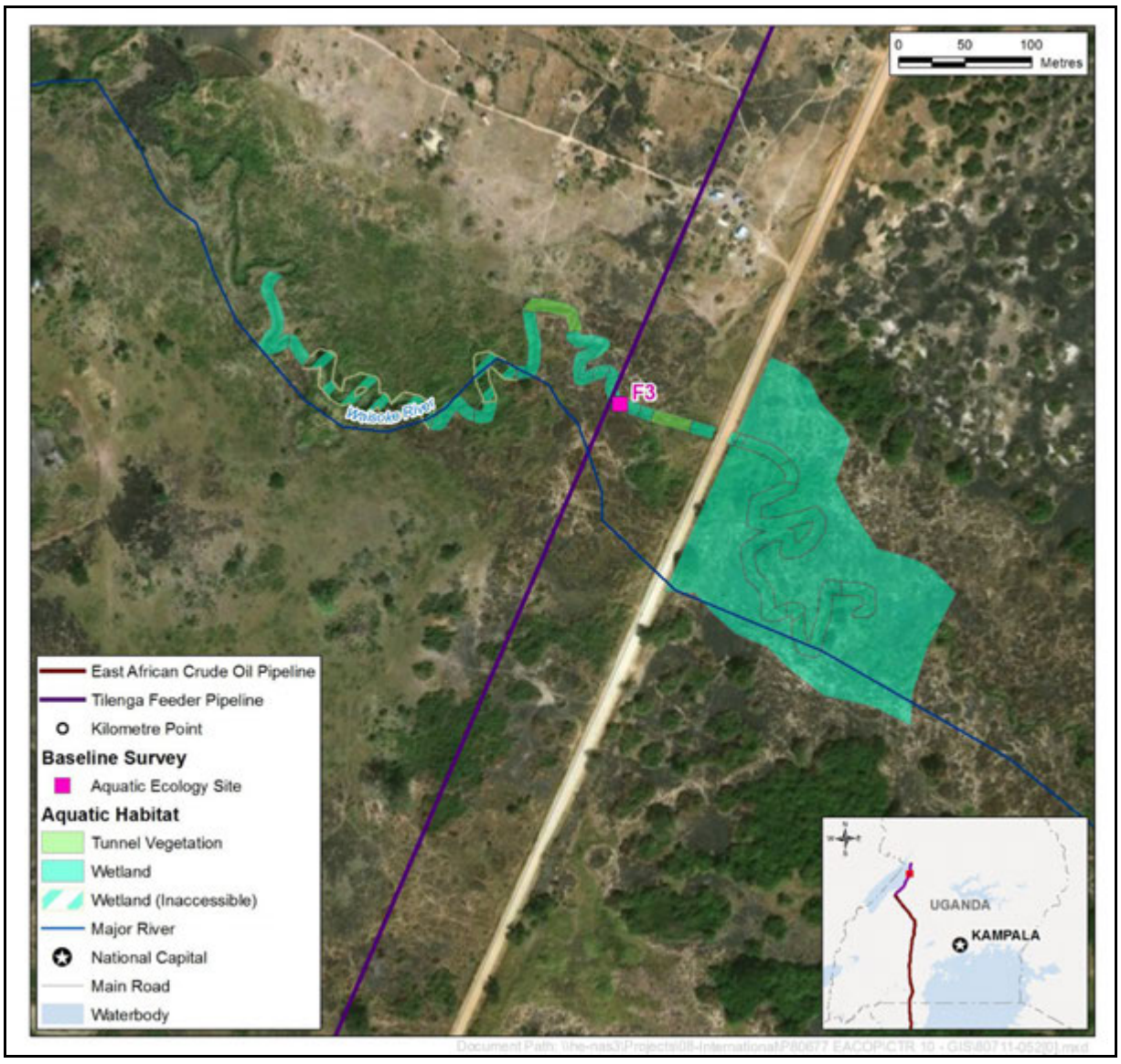

Figure Att2.1-3 Waisoke River Habitat

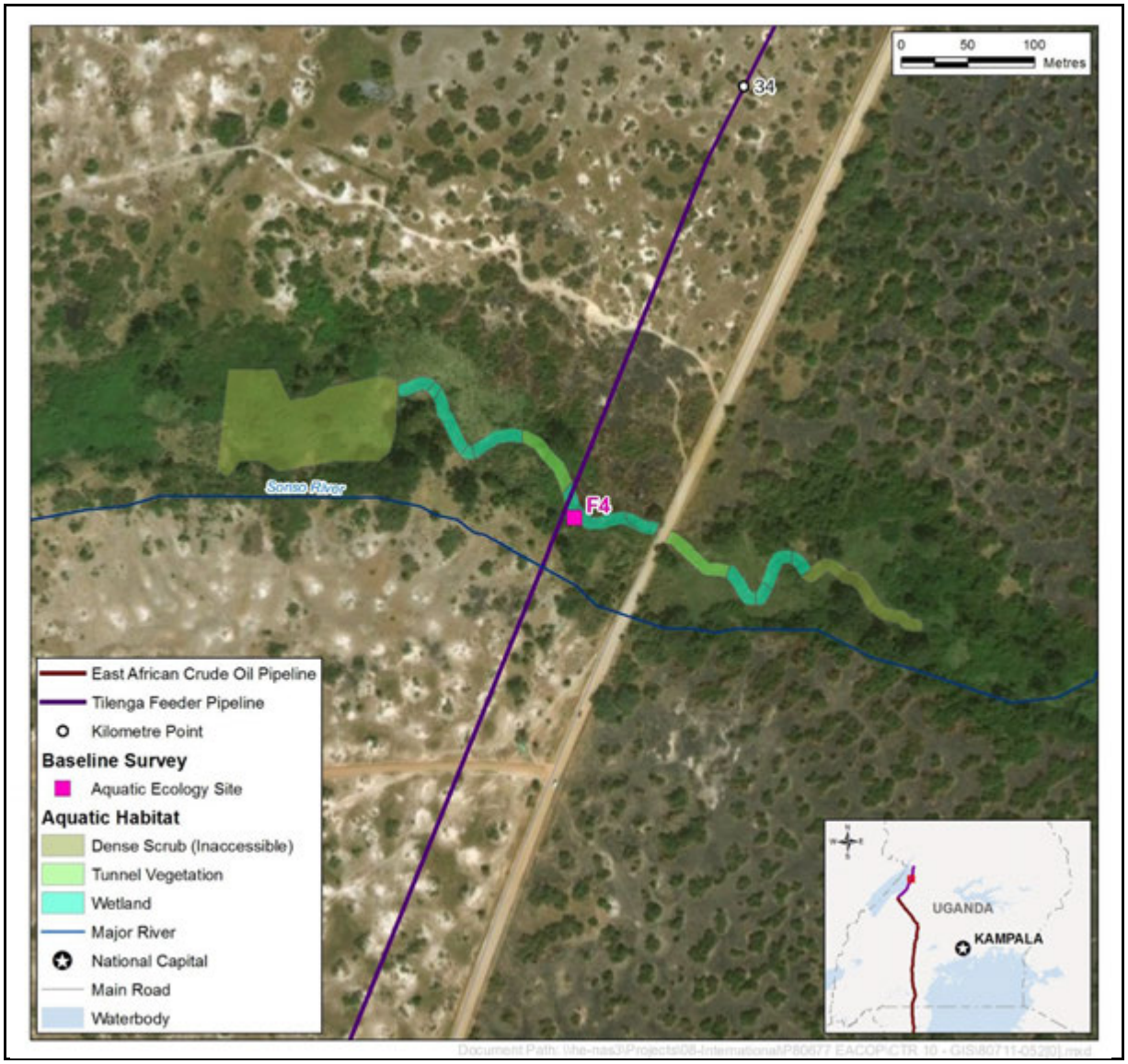

Figure Att2.1-4 Sonso River Habitat

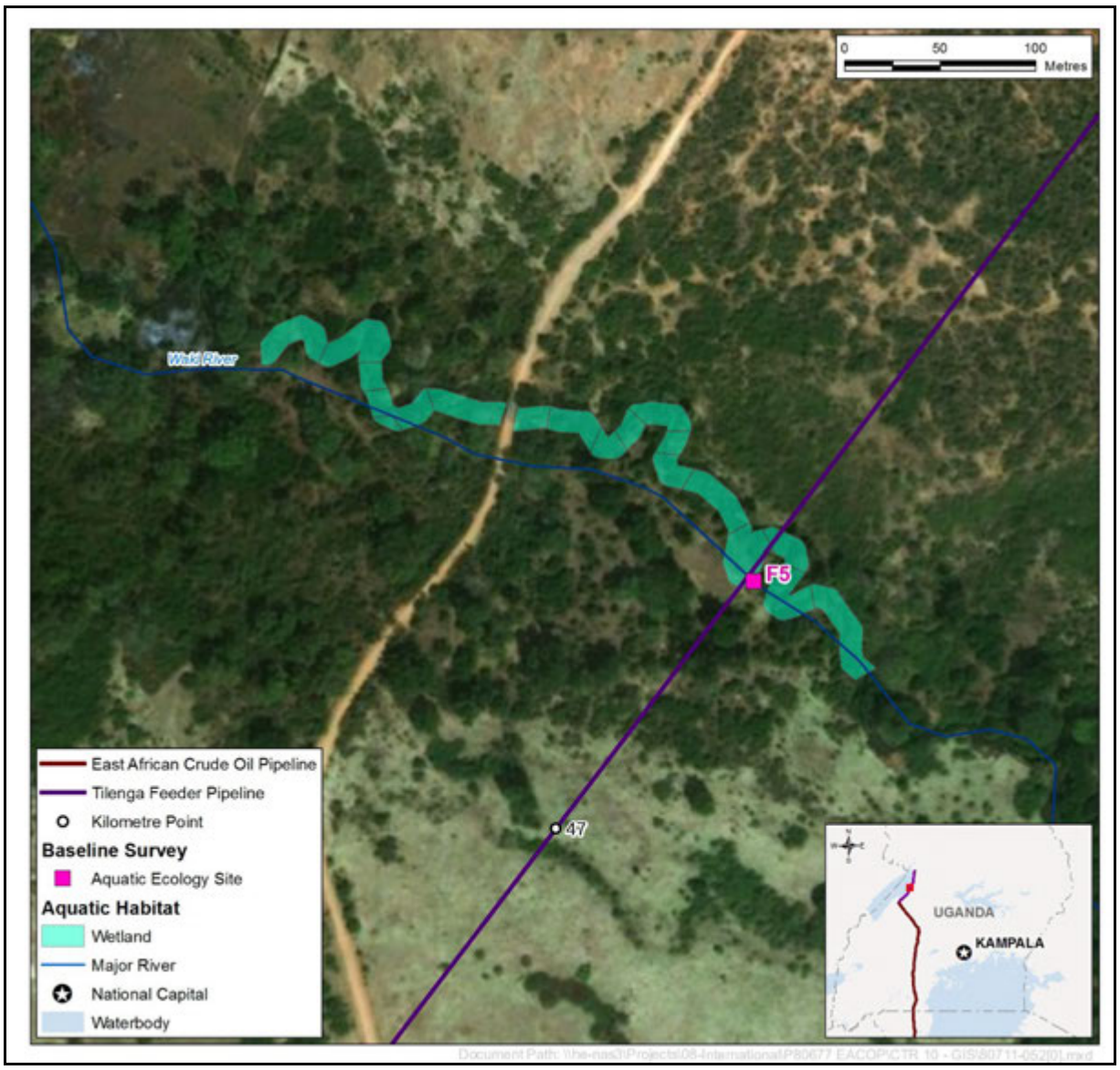

Figure Att2.1-5 Waki River Habitat

ATTACHMENT A2.2 DETAILED SURVEY METHODOLOGIES

Descriptions of the field survey methods are described below. The field survey methods used at each survey location are detailed in Table Att2.2-1.

Table Att2.2-1 Summary of Survey Methods

Survey Site Name or River	District	KP Location	River Habitat Mapping	Fish Surveys					Macroinvertebrate Surveys	Survey Method Rationale
				Electrofishing	Gill Nets	Hand Netting	Small Fish/ Crayfish Traps	Baited Fishing Hooks and Line		
Sambiye	Buliisa	KP7	Yes	No	No	No	No	No	No	Fish and macroinvertebrate surveys were not undertaken because the river channel was dry.
Waiga	Buliisa	KP23	Yes	Yes	Yes	Yes	Yes	No	Yes	Baited hooks and line were not used at this location owing to large numbers of cattle and several local inhabitants moving in and out of the water during surveys.
Waisoke	Buliisa	KP28	Yes	Yes	Yes	Yes	Yes	Yes	Yes	All survey methods were suitable for use at this location.
Sonso	Buliisa	KP34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	All survey methods were suitable for use at this location.

Table Att2.2-1 Summary of Survey Methods

Survey Site Name or River	District	KP Location	River Habitat Mapping	Fish Surveys					Macroinvertebrate Surveys	Survey Method Rationale
				Electrofishing	Gill Nets	Hand Netting	Small Fish/ Crayfish Traps	Baited Fishing Hooks and Line		
Waki	Buliisa	KP47	Yes	Yes	Yes	Yes	Yes	Yes	Yes	All survey methods were suitable for use at this location.
Wambabya	Buliisa	KP89	No	No	No	No	No	No	No	The survey site could not be accessed safely owing to its location in a steep-sided gorge and therefore no surveys were undertaken at this location.

Further information on individual field survey methods is provided below.

Site Selection

Proposed survey sites were selected following analysis of GIS files, which identified the proposed route of the Tilenga feeder pipeline. Any major watercourses that were visible on the GIS layers and which the pipeline route crossed were identified as requiring surveys. The proposed survey sites and pipeline route were also discussed with in-country aquatic ecologists familiar with the areas through which the proposed Tilenga feeder pipeline route passes to confirm that no other major waterbodies were present that might require surveying.

River Habitat Mapping

Habitat surveys were completed by surveyors walking along the river bank (where it was physically possible and safe to do so) for approximately 250 m upstream and 750 m downstream of the proposed pipeline crossing location and recording the key habitat features observed, including their precise location and extent. The survey methodology has been adapted from that outlined in Hendry and Cragg-Hine (1997), such that it incorporates habitat types for all species of fish. Habitat features recorded during the walkover survey included:

- flow type (e.g., glide, run, riffle, cascade, pool and rapid)
- substrate type (e.g., boulder, cobble, pebble, gravel, sand, silt as defined using the Wentworth scale)
- macrophyte presence and type (e.g., emergent linear, emergent broad-leaf, submerged linear, submerged broad-leaf, floating linear, floating broad-leaf)
- other key features (e.g., side bar, mid-stream bar, man-made dams, weirs, large woody debris, coarse woody debris, spawning area, fry or juvenile fish refuge area)
- evidence of birds nesting in mud banks adjacent to the river.

Field maps were subsequently transcribed into GIS for each survey site. Digital photographs of important habitat features were also obtained during surveys and these, with the maps, will provide a permanent digital record of the habitat at the time of the surveys and against which any future changes can be compared (e.g., post-construction recovery).

Photos of survey sites are included in the relevant location specific sections of Section A2.4 and habitat maps can be found in Attachment A2.1.

Fish Surveys

When undertaking fish surveys, a multimethod approach was adopted to increase the number of species of fish likely to be caught. This included electrofishing, hand netting, baited hooks or rod and line, gill nets and small fish and crayfish traps.

Electrofishing

Electrofishing was undertaken using a small portable electrofishing device equipped with a 2-m-long floating copper cathode and a handheld anode with a 47-cm diameter net-mounted anode on a 2-m handle. The device was battery powered with an output of approximately 1200 V (12 amps). Surveys were undertaken in water to a maximum depth of 1.2 m for

health and safety reasons. Surveyors waded in a downstream to upstream direction taking care to survey in all habitat types that were accessible by wading.

Gill Nets

A multi-panel gill net was used with mesh sizes ranging from 25 mm to 65 mm, a total length of up to 20 m (depending on the individual site characteristics and access) and a maximum depth of 1.5 m. Nets were equipped with a weighted bottom line and a surface line supported by floats attached to it. Nets were set at an angle to the flow and in a location that covered a range of in-channel habitat types. Nets were left in place for between two and four hours.

Hand Netting

Shallow marginal areas were hand netted from the bank using long and short handled hand nets with a mesh size of <1 mm and a net mouth diameter of between 200 mm and 300 mm. Fast sweeps through the habitat were undertaken to attempt to capture any fish present. This method can be useful for sampling slower swimming juvenile fish.

Small Fish and Crayfish Traps

Various types of small fish traps (minnow traps) and crayfish traps were deployed with some containing bait and others un-baited. The traps were mainly deployed in marginal areas of the river channel.

Baited Fishing Hooks and Line

At selected locations, and where the survey schedule allowed, hooks baited with small pieces of cooked meat or bread were deployed. The hooks were monitored constantly to ensure that any hooked fish were immediately retrieved, unhooked and transferred to water-filled buckets. Constant observation of the baited hooks also ensured that other wildlife (e.g., birds) was not accidentally hooked. Barbless hooks were used because any damage caused by this type of hook is negligible and heals rapidly.

Fish Processing

Any captured fish were immediately transferred to water-filled buckets with the water being refreshed roughly every 15 minutes to ensure that it did not become excessively warm and that dissolved oxygen levels were not excessively depleted.

Upon completion of the surveys all fish were identified to species by experienced fisheries ecologists and confirmed using descriptions provided in Greenwood 1996. Following processing of the catch, all fishes were returned alive close to their original site of capture.

Macroinvertebrate Surveys

Macroinvertebrates were sampled at multiple locations within each watercourse close to the location of the proposed pipeline crossing. Sampling methods included kick-sweep sampling and crayfish traps or small fish traps (minnow traps).

All samples were washed and cleaned on the river bank in 500 µm mesh nets and transferred to sample pots containing 70% ethanol solution. Preserved samples were then

returned to the laboratory for subsequent sorting and identification. The majority of organisms were identified to genus level with some only identified to family level. Various keys and identification guides were used including Pennak 1953, Mandahl-Barth 1954, Merrit and Cummins 1997, De Moor et al. 2003a, De Moor et al. 2003b and Cumberlidge 2011.

ATTACHMENT A2.3 FIELD SURVEY DATA

Table Att2.3-1 Fish Species Caught During Surveys Along the Tilenga Feeder Pipeline Route

Families	Species	KP_23 Waiga	KP_28 Waisoke	KP_34 Sonso	KP_47 Waki	KP_7 Sambiye
Polypteridae	*Polypterus senegalis*	2.9	33.3	37.5		
Mormyridae	*Gnathonemus victoriae*	7.4				
Characidae	*Brycinus nurse*		4.8			
Cyprinidae	*Labeo horie*				8.3	
	Labeo sp.	2.9				
	Barilius loati				8.3	
	Neobola bredoi		9.5			
	Barbus altianalis	42.6				
	B. jacksoni	19.1	4.8			
	B. kerstenii					
	Barbus sps.				25.0	
Bagridae	*B. bajad*				8.3	
	Auchinoglanis occidentalis				8.3	
Schilbeidae	*Schilbe intermedius*	20.6	33.3		25.0	
Clariidae	*Clarias gariepinus*	1.5	14.3	25.0		
	C. carsoni					
Mochokidae	*Synodontis frontosus*				8.3	
	S. nigrita				8.3	
Cyprinodontidae	*Aplocheilichthys sp.*			25.0		
Cichlidae	*Oreochromis niloticus*	1.5				
	Astatoreochromis sp					
	Astatotilapia sp.					
Anabantidae	*Ctenopoma murie*	1.5		12.5		
Percentage of overall total		34.9	10.8	4.1	6.2	
Number of species		9	6	4	8	-

Table Att2.3-2 Macroinvertebrates Caught During Surveys Along the Tilenga Feeder Pipeline Route

Macroinvertebrate Taxa			**River**			
Order	**Family**	**Genus**	**Waiga**	**Waisoke**	**Sonso**	**Waki**
Ctenobrachia	Pilidae	*Pila (P. ovata)*			1	
Plumonata	Planorbidae	*Biomphalaria*				
Plumonata	Planorbidae	*Anisus (N. natalensis)*	1			
Ephemeroptera	Caenidae	*Caenis*	1			
Ephemeroptera	Baetidae	*Baetis*			14	1
Ephemeroptera	Tricorythidae	*Tricorythus*		2		
Ephemeroptera	Leptophlebidae	*Euthraulus*		17		
Diptera	Chironomidae		15		53	
Odonata	Coenagrionidae	*Teinobasis*			2	
Odonata	Protoneuridae					
Coleoptera	Dytiscidae				10	
Coleoptera	Gyrinidae	*Aulonogyrus*				
Coleoptera	Gyrinidae	*Orectogyrus*		9		
Hemiptera	Corixidae	*Sigara*				
Hemiptera	Naucoridae	*Laccocoris*				
Hemiptera	Naucoridae					
Hemiptera	Nepidae	*Ranatura*				
Hemiptera	Gerridae	*Limnogonus*			1	
Decapoda	Potamonautidae	*Potamnautes*		4		
Decapoda	Potamonautidae					3
Decapoda	Atyidae	*Caridina*				1
Oligochaetes				4		

Appendix A3: Avifauna Biodiversity Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

A	
AOI	area of influence
C	
CHA	critical habitat assessment
E	
ESIA	environmental and social impact assessment
F	
FR	forest reserve
G	
GIS	geographic information system
I	
IBA	Important Bird Area, identified by BirdLife International as being of global importance for the conservation of bird populations, using an internationally agreed set of criteria
IUCN	International Union for Conservation of Nature
K	
KBA	Key Biodiversity Area
keystone species	one that has a disproportionate effect on its environment relative to its biomass and whose removal initiates considerable changes in ecosystem structure and loss of biodiversity
KP	kilometre point
S	
sp	abbreviation of species, singular
T	
TSC	timed species count
W	
WR	wildlife reserve

A3 AVIFAUNA BIODIVERSITY BASELINE REPORT

A3.1 Introduction

This baseline report describes the avifauna biodiversity:

- area of influence (AOI) and study area boundaries
- methods
- baseline conditions:
  - main avifauna habitat features
  - trends affecting habitat condition and their sensitivity to change
  - avifauna species
  - trends affecting species and their sensitivity to change
  - ecosystem services provided
  - sensitivity rankings
- key considerations

The report concludes with ranking the sensitivity of the sites and species and a summary of the key considerations arising from the baseline study.

The report also provides the necessary data for the critical habitat assessment (CHA), see Appendix B.

A3.2 Area of Influence and Study Area Boundaries

A3.2.1 Area of Influence Boundary

The area of influence (AOI) for the avifauna study is a 2-km corridor centred on the pipeline alignment, as this encompasses the area that has the potential for direct impacts during construction and operation. This is extended at certain locations where possible pathways exist to sites designated specifically for avifauna (e.g., a watercourse crossing upstream of an Important Bird Area [IBA]).

The temporal AOI for avifauna habitats of conservation importance is defined as the duration of the project construction phase extended by the time required for the habitat to recover to its pre-project potential (i.e., the habitat can support the species diversity and abundance, and ecological processes of the habitat in its pre-project condition). In the case of some new access roads that may be left in situ for third-party use once the project is completed, the impacts associated with these will be considered permanent.

A3.2.2 Study Area Boundary

The desk-based study area comprises a minimum 30-km corridor centred on the pipeline alignment in order to provide regional context to the data acquired during the field surveys. A 30-km corridor takes into account the mobility and range of bird species, a broader region, which is a study area larger than the AOI to provide

regional context. The study area for the field surveys is the same as the AOI (a 2-km corridor), as it provides data over a sufficient area to assess the potential effects of the project.

A3.3 Methods

A3.3.1 Secondary Data

The secondary data study for the avifauna biodiversity baseline included a review of the following data sources:

- International Union for Conservation of Nature (IUCN) Red List of Threatened Species
- National Red List for Uganda
- National Policy for the Conservation and Management of Wetlands
- citation sheets and management plans for protected areas, where available
- environmental and social impact assessments (ESIAs) and other technical studies relevant to the AOI
- scientific and grey literature[1] referenced throughout.

The desk-based study focused on identifying species that are known to occur in the AOI or are considered likely to occur in the AOI.

Secondary data and satellite imagery were used to identify potential survey locations and refine the baseline survey methodology.

A3.3.2 Field Surveys

The proposed survey sites were agreed with in-country ornithologists familiar with the habitats affected by the project. Surveys were undertaken during May 2017 to coincide with the wet season, and during December 2017 and January 2018 to coincide with the dry season. Walkover surveys of the main camp and pipe yard locations were undertaken in August 2018. Undertaking surveys during varying seasons enabled a robust dataset to be gathered to inform the impact assessment.

Proposed survey sites were selected following a review of satellite imagery overlain with the proposed project infrastructure. Legally protected and internationally and nationally recognised areas (such as IBAs) were identified and targeted for survey, with sampling in larger areas.

During field surveys, planned survey sites were reviewed daily and the survey plan adapted accordingly, subject to the quality of avifauna habitat observed during field surveys. In many cases, habitats identified from satellite imagery had subsequently been converted to agriculture. Similarly, many areas thought to be natural forest had been converted to eucalyptus plantations.

Field survey methods varied according to the habitat type being assessed. Further descriptions of the field methods are provided in Attachment A3.1. All survey locations are illustrated on Figure A3.3-1.

[1] Grey literature refers to literature that is produced on all levels of government, academia, business and industry in print and electronic forms, but which is not controlled by commercial publishers.

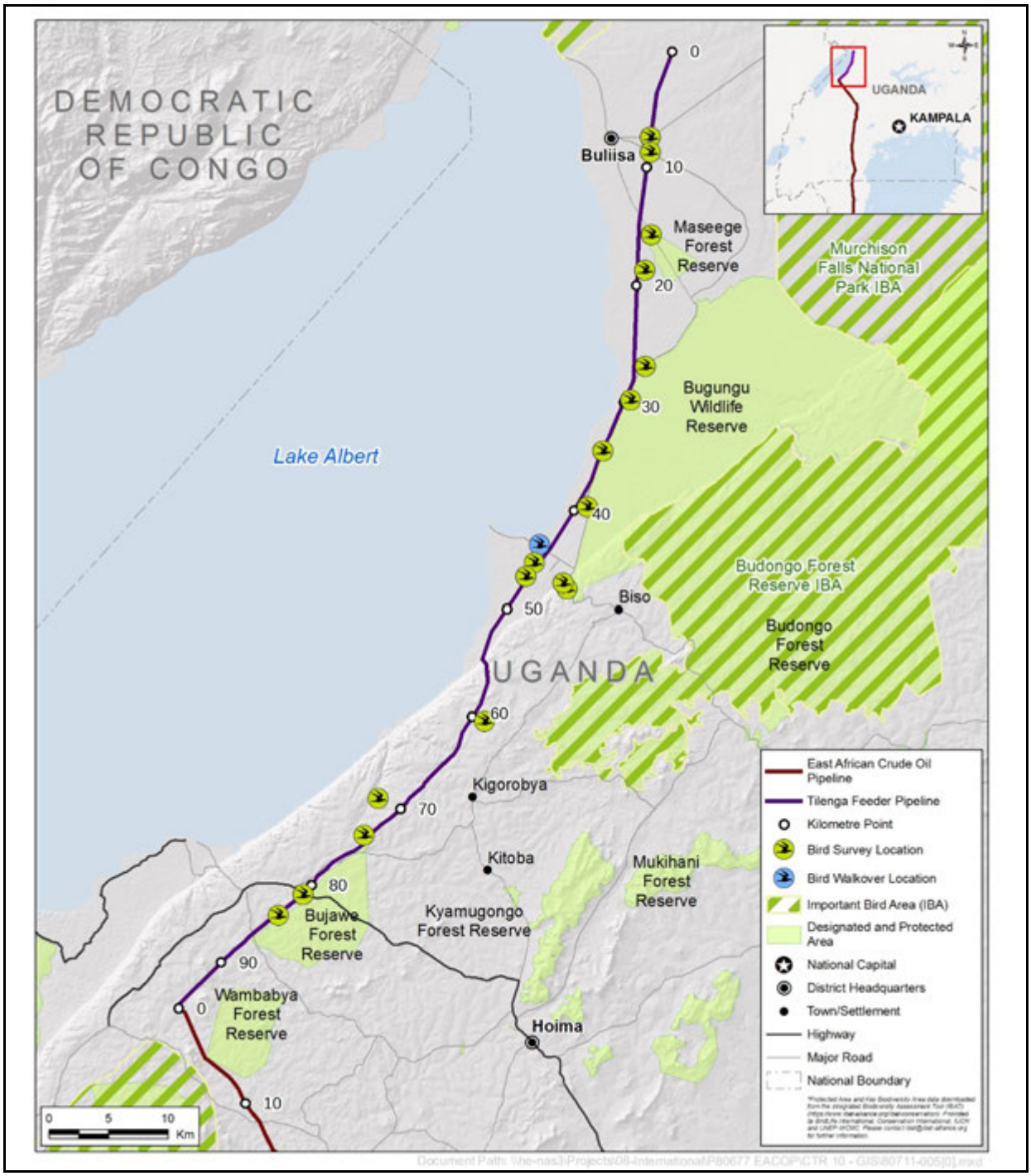

Figure A3.3-1 Avifauna Survey Locations

A3.3.3 Data Analysis

Information on endemism and conservation status was obtained from the IUCN Red List and the National Red List for Uganda (WCS 2016).

In addition, Bennun et al. (2000) gives a complete listing of all East African bird species that fall within regional Red List categories namely: critically endangered, endangered, vulnerable, near threatened and regionally restricted.

Within each valued environmental and social component (VEC), trends are also presented to allow appreciation of changes in their condition on a local and regional scale.

A3.3.3.1 Sensitivity Ranking

The sensitivity of the avifauna biodiversity receptors has been ranked according to the avifauna biodiversity section of the sensitivity table in Section 8 of the ESIA.

A3.3.4 Data Considerations

Field survey data provide a snapshot in time and are unlikely to represent the full diversity of species supported at a site. Baseline assessments therefore include secondary data and data gathered during field surveys. Where there is uncertainty as to whether a habitat is supporting particular avifauna species, a precautionary approach has been taken, in keeping with the International Finance Corporation Performance Standard 6 (PS6) and the accompanying Guidance Note.

The following data considerations are accounted for in this baseline:

- some species that inhabit dense vegetation, thickets and papyrus swamps may be undetected during the field survey and thus may be under-recorded
- although wet and dry season field surveys were completed, the level of rainfall from year to year can affect the number and diversity of species that are present; rainfall recorded at Bugungu Wildlife Reserve (WR) indicated that between May 2017 and February 2018 rainfall was well below the long-term average
- At certain river crossings it was not possible to gain access to the precise crossing location, so a representative sample of the habitat was recorded at the nearest readily accessible location. This is not considered to have affected the results, as in all cases, the sampled habitat appeared to be of the same character as that at the crossing point (typically papyrus swamp).

A3.4 Habitats of Conservation Importance

The following sections of this report provide:

- an overview of the habitats of conservation importance to avifauna in the study area based on secondary data
- a description of the surveyed sites.

Figure A3.3-1 illustrates the locations of these sites.

Table Att3.2-3 in Attachment A3.2 presents detailed information on the ground cover that was identified during field surveys.

A3.4.1 Regional Overview

Uganda is a bird-rich country, with about 1040 species recorded, of which about 800 are resident species (Carswell et al. 2005). The Albertine Rift has long been considered important for migratory bird species (Walther and Pirsig 2017).

The pipeline corridor avoids any significant Protected Areas, but the Lake Albert flats, which are pastoral areas, are known to be species-rich (D Pomeroy, unpublished data for Total). Uganda's predominantly small-scale farmlands are also species-rich however, other than species that require native trees for breeding, the species found there are typically not of conservation importance (Douglas et al. 2013).

Most sites outside protected areas are undergoing degradation. Land is cleared with trees cut for a variety of reasons (including firewood and charcoal) and thickets cleared for grazing.

The survey areas were divided into three locations:

- Albert Flats, kilometre point (KP) 0–54 (excluding section adjacent to Bugungu WR; see next bullet)
- Bugungu WR and Key Biodiversity Area (KBA), KP27–38
- above the escarpment, KP54–94.

See Figure A3.3-1 for details.

The project AOI encounters the following legally protected or internationally and nationally recognised areas:

- Lake Albert Catchment freshwater KBA comprises the entire extent of Lake Albert, including the shoreline. The project does not directly affect this KBA.
- Maseege Forest Reserve (FR) is not traversed by the pipeline but is within the avifauna AOI adjacent to KP15. This FR was included in surveys for the Albert Flats.
- Bugungu WR and KBA is not traversed by the pipeline but is within the avifauna AOI adjacent to KP27–38
- Bujawe FR is not traversed by the pipeline but is within the avifauna AOI adjacent to KP75–87 and was included in surveys above the escarpment.

A3.4.2 Albert Flats

A3.4.2.1 Baseline Condition

During the wet season, 8 locations were surveyed within the Albert Flats area while 22 locations were surveyed during the dry season (including repeat visits to the same location). The locality of the Albert Flats surveys was split into two sections: a southern section near Butiaba, and a northern section to the north of Bugungu WR.

The Albert Flats comprise natural and semi-natural grassland habitat with low variable incidence and concentration of shrubs and trees. There are also extensive areas of bushland, thicket and wetlands.

Evidence of degradation was noted during field surveys. In some places, bare ground has been exposed, typically indicating overuse by animals or people. Tree clearing and a high level of overgrazing is evident in most places.

Despite the degraded habitat, the Albert Flats has high avifauna species diversity, with 60 species being recorded at a single site during the field surveys. Grey-crowned cranes, *Balaerica regulorum* (IUCN endangered, Uganda endangered) were recorded during both the wet and dry season surveys. The African woollyneck, *Ciconia microscelis* (IUCN least concern, Uganda vulnerable) was also recorded in this area.

More details on the African woollyneck and grey-crowned crane can be found in Sections A3.5.2 and A3.5.5 respectively.

A3.4.2.2 Trend in Condition and Sensitivity to Change

The trend of overgrazing and tree clearance is likely to continue without protection. In the long-term, this is likely to reduce avifauna species diversity.

The Albert Flats comprises natural and semi-natural habitat that supports high avifauna diversity, and thus is considered to have high sensitivity to change.

A3.4.3 Bugungu Wildlife Reserve

A3.4.3.1 Baseline Condition

During the wet season, 8 locations were surveyed within and adjacent to Bugungu WR, while 24 locations were surveyed during the dry season (including repeat visits to the same location). The habitat comprises bushland, thickets with open areas of grassland and seasonal wetlands.

The habitat is largely intact with a low incidence of degradation. Cattle grazing and tree cutting for firewood do occur within the reserve boundaries but at a much lower rate compared to areas outside the reserve. There are 19 rangers employed at Bugungu WR, so while human impacts are reduced, they are not completely controlled.

Bugungu WR is species-rich for avifauna, with several survey locations having sightings of more than 50 different species within the one-hour timed species count (TSC). Desk-based information highlighted that up to 240 species have been recorded in Bugungu WR including shoebill, *Balaeniceps rex* (IUCN vulnerable, Uganda endangered) in the seasonal wetlands.

Important species recorded during the field visits include:

- pallid harrier, *Circus macrouris* (IUCN near threatened, Uganda critically endangered) during the dry season survey
- ovambo sparrowhawk, *Accipiter ovampensis* (IUCN least concern, Uganda VU)
- grey-crowned cranes during both wet and dry season surveys
- African woollyneck.

These species are described in detail in Section A3.5.

A3.4.3.2 Trend in Condition and Sensitivity to Change

It is reasonable to expect that the condition of habitats well inside the reserve will remain unchanged in the future, as Bugungu WR forms part of the MFPA and is classed as an IUCN Category III site. However, continued land-use pressure such as cattle grazing has led to marked degradation in some areas of the Bugungu WR and KBA, particularly along the Hoima–Bulissa road which is also being widened at the time of writing as part of the Hoima–Butiaba–Wanseko road project. Despite protective legislation in place, there is the risk of further degradation. The condition of habitats immediately outside the reserve is likely to decline and this could result in increased edge effects on the reserve.

Bugungu WR and its immediate surroundings support natural and semi-natural habitat with high avifauna diversity, hence this area has high sensitivity to change.

A3.4.4 Above Escarpment

A3.4.4.1 Baseline Condition

During the wet season, 12 locations were surveyed above the escarpment and 11 were surveyed during the dry season.

The majority of habitat outside protected areas is undergoing degradation, such as land clearance for agriculture and grazing, and deforestation for forest resources such as firewood and charcoal.

Above the escarpment, the habitat is mainly characterised by modified habitat such as shrubland and agriculture. Agricultural areas support small patches of native vegetation and few trees. Species richness based on the TSCs across the AOI ranged from 28 to 46 during the dry season surveys, reflecting the range of habitats, including agricultural habitats.

The habitat around KP84 is semi-natural and is characterised by scattered native trees and bushes with a low incidence of agricultural activity; KP65 is similar but supports degraded woodland and a wider variety of habitats than the agricultural areas.

The avian species composition of this area largely reflects the predominantly agricultural habitat with the mocking cliff chat, *Thamnolaea cinnamomeiventris* (IUCN least concern, Uganda not listed but with a local distribution) being a notable species.

One species of conservation importance, the ovambo sparrowhawk, *Accipter ovampensis* (IUCN least concern, Uganda vulnerable), was recorded in this area.

The ovambo sparrowhawk is described in detail in Section A3.5.4.

A3.4.4.2 Trend in Condition and Sensitivity to Change

In existing agricultural areas there will be no change in condition; however, in remaining semi-modified habitats, the trend of habitat conversion is likely to continue without protection and is likely in the long-term, to reduce avifauna species diversity.

This largely modified habitat is considered to have moderate sensitivity to change.

A3.5 Avifauna Species of Conservation Importance

Based on secondary data and the results of the field surveys, species of conservation importance within the AOI are presented below.

A3.5.1 Globally Threatened Species

Species of conservation importance are those that are listed as vulnerable, endangered or critically endangered on the IUCN Red List; those that are migratory or congregatory; and those that are range-restricted or endemic. Keystone species are also considered to be of conservation importance.

IUCN threat categories are defined as follows:

- critically endangered – a species is critically endangered when the best available evidence indicates that it is facing an extremely high risk of extinction in the wild. Critically endangered species are considered to have a very high sensitivity to change.
- endangered – a species is endangered when the best available evidence indicates that it is facing a very high risk of extinction in the wild. Endangered species are considered to have a very high sensitivity to change.
- vulnerable – a species is vulnerable when the best available evidence indicates that it is facing a high risk of extinction in the wild. Vulnerable species are considered to have a high sensitivity to change.
- near threatened – a species is near threatened when it has been evaluated against the criteria and does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. Near threatened species are considered to have a low sensitivity to change.
- least concern – a species is least concern when it has been evaluated against the criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category. Least concern species are considered to have a low sensitivity to change.

Listing in the categories of not evaluated and data deficient indicates that no assessment of extinction risk has been made, although for different reasons. Until an assessment is made, taxa listed in these categories should not be treated as if they were nonthreatened (IUCN 2012).

A3.5.1.1 Summary of Survey Results

Bird species richness was high in almost all sites, with several sites recording 40 or more species during a 1-hour TSC. Several sites recorded more than 50 species, indicating the importance of birds everywhere as contributors to ecosystem services; notably pollination, seed dispersal and pest control.

Table A3.5-1 Key Species of Conservation Importance

2016 No	COMMON NAME *Scientific Name* (Alternative Name)	Global					East Africa						Uganda					
		CR	EN	VU	NT	DD	CR	EN	VU	NT	RR	DD	CR	EN	VU	NT	RR	DD
23	GREAT WHITE EGRET *Ardea alba* (Great Egret)								✓									
25	GREY HERON *Ardea cinerea*									✓								
28	PURPLE HERON *Ardea purpurea*									✓								
33	AFRICAN WOOLLYNECK *Ciconia microscelis*									✓					✓			
85	SHORT-TOED SNAKE EAGLE *Circaetus gallicus* (includes Beaudouin's Snake Eagle *C.beaudouini*)															✓		
86	BROWN SNAKE EAGLE *Circaetus cinereus*									✓								
88	BATELEUR *Terathopius ecaudatus*									✓								
93	PALLID HARRIER *Circus macrourus*				✓					✓			✓					
94	MONTAGU'S HARRIER *Circus pygargus*									✓						✓		
104	OVAMBO SPARROWHAWK *Accipiter ovampensis*									✓					✓			
185	GREY-CROWNED CRANE *Balearica regulorum*		✓							✓				✓				
295	BATELEUR *Terathopius ecaudatus*									✓								
298	BROWN SNAKE EAGLE *Circaetus cinereus*									✓								
299	WESTERN-BANDED SNAKE EAGLE *Circaetus cinerascens*								✓									
323	AFRICAN MARSH HARRIER *Circus ranivorus*									✓								
388	SWALLOW-TAILED BEE-EATER *Merops hirundineus*									✓								
437	SPOT-FLANKED BARBET *Tricholaema lachrymosa*										✓							
477	RED-NECKED FALCON *Falco chicquera*									✓								
488	GREY PARROT *Psittacus erithacus*		✓							✓					✓			

Table A3.5-1 Key Species of Conservation Importance

2016 No	COMMON NAME *Scientific Name* (Alternative Name)	Global					East Africa						Uganda					
		CR	EN	VU	NT	DD	CR	EN	VU	NT	RR	DD	CR	EN	VU	NT	RR	DD
554	EMIN'S SHRIKE *Lanius gubernator*									✓								
601	RED-CHESTED SUNBIRD *Cinnyris erythrocercus*										✓							
652	GOLDEN-BACKED WEAVER *Ploceus jacksoni* (Jackson's Golden-backed Weaver)										✓							
663	RED-WINGED GREY WARBLER *Drymocichla incana*									✓								
701	GREY-CAPPED WARBLER *Eminia lepida*										✓							
799	RED-WINGED GREY WARBLER *Drymocichla incana*									✓								
803	RED-CHESTED SUNBIRD *Cinnyris erthrocercus*										✓							
817	GREY-CAPPED WARBLER *Eminia lepida*										✓							
880	RUFOUS SPARROW *Passer cordofanicus* (include Shelley's Rufous Sparrow *P. shelleyi*)										✓							
891	SPOTTED GREENBUL *Ixonotus guttatus*									✓								
911	TORO OLIVE GREENBUL *Phyllastrephus hypochloris*								✓							✓		
911	GOLDEN-BACKED WEAVER *Ploceus jacksoni* (Jackson's Golden-backed Weaver)										✓							
947	YELLOW-BILLED OXPECKER *Buphagus africanus*								✓									
961	BLACK-FACED FIREFINCH *Lagonostictats larvata*									✓								
Number of species		**0**	**2**	**0**	**1**	**0**	**0**	**0**	**4**	**20**	**8**	**0**	**1**	**1**	**3**	**3**	**0**	**0**

NOTES: CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened, RR = regionally restricted, DD = data deficient

In addition to the species recorded during field surveys (Table A3.5-1), the following species of conservation importance are potentially present within the AOI based on secondary data:

- lappet faced vulture, *Torgos tracheliotos* – IUCN endangered, Uganda critically endangered
- white-headed vulture, *Trigonoceps occipitalis* – IUCN critically endangered, Uganda endangered
- Denham's bustard, *Neotis denhami* – IUCN near threatened, Uganda critically endangered)
- black stork, *Ciconia nigra* – IUCN least concern, Uganda endangered
- shoebill, *Balaeniceps rex* – IUCN vulnerable, Uganda endangered
- hooded vulture, *Necrosyrtes monachus* – IUCN critically endangered, Uganda endangered
- African white-backed vulture, *Gyps africanus* – IUCN critically endangered, Uganda endangered
- Rüppell's griffon vulture, *Gyps rueppelli* – IUCN critically endangered, Uganda endangered
- African crowned eagle, *Stephanoaetus coronatus* – IUCN near threatened, Uganda endangered
- black-rumped buttonquail, *Turnix nanus* – IUCN least concern, Uganda endangered
- Pel's fishing owl, *Scotopelia peli* – IUCN least concern, Uganda endangered.

A3.5.2 African Woollyneck

A3.5.2.1 Baseline Condition

The African woollyneck shows a preference for natural wetland habitats in savannah and grassland, including rivers, streams, lakes, ponds, waterholes, lagoons, dams, floodplains, marshes, and freshwater and peat swamp forests. It will also use artificial habitats such as rice paddy fields. The African woollyneck generally avoids forests, but occasionally resides in light woodland or forest clearings. It is a primarily sedentary species, although it may make migratory north–south movements. The African woollyneck mainly breeds during the dry season in solitary pairs, but pairs have been seen to nest close together in East Africa. When not breeding, it is usually solitary or in pairs, but may flock together during migration. The nest is a large stick platform built 10–30 m (and sometimes up to 50 m) above the ground or over water, on the fork of a horizontal branch in a tall tree.

Predominantly carnivorous, its diet consists of fish, frogs, toads, snakes, lizards, large insects and larvae.

The main threats to the African woollyneck are:

- destruction of suitable nesting trees e.g., taller than 30 m
- loss of wetland areas.

This species was recorded in Bugungu WR (Section A3.4.3) and the Albert Flats (Section A3.4.2).

A3.5.2.2 Trend in Condition and Sensitivity to Change

The global population of African woollynecks is thought to be stable (BirdLife International 2016a), so the trend in condition is not anticipated to change.

It is listed as vulnerable nationally, hence it has moderate sensitivity to change.

A3.5.3 Pallid Harrier

A3.5.3.1 Baseline Condition

A migratory species, the pallid harrier winters in sub-Saharan Africa, preferring semi-desert, scrub, savannah and wetlands (BirdLife International 2017a). They migrate on a broad front, with only minor concentrations at bottleneck sites. Although they are most often seen singly, females and juveniles can form parties of 10–15 during migration. The pallid harrier breeds in northern Europe and central Asia and was thought to be undergoing a steep decline with a population estimate of 9–15,000 breeding pairs, although this estimate has increased in recent years.

The main threats to pallid harrier in Uganda are:

- loss of grassland due to burning, cutting and overgrazing
- use of pesticides, rodenticides and other chemicals.

This species was recorded in Bugungu WR (Section A3.4.3) during the dry season only.

A3.5.3.2 Trend in Condition and Sensitivity to Change

The global population is suspected to be declining in some areas but is largely uncertain in others. The partly nomadic nature of the species and its fluctuating numbers make assessment of the overall trend problematic (BirdLife International 2017a).

The pallid harrier is listed as critically endangered nationally, hence it has a high sensitivity to change.

A3.5.4 Ovambo Sparrowhawk

A3.5.4.1 Baseline Condition

The ovambo sparrowhawk is a partial migrant and engages in movements in response to rainfall changes (Global Raptors 2018). The ovambo sparrowhawk has been recorded in Uganda as a nonbreeding migrant in the drier northwest and the moister south (Carswell et al. 2005). The ovambo sparrowhawk is generally found in Acacia and mixed woodlands but this varies with locality; they use trees as perches from which to hunt smaller bird species.

The main threat to this species in Uganda is habitat loss in nonbreeding areas.

This species was recorded in surveys in all habitats of conservation importance, see Section A3.4.

A3.5.4.2 Trend in Condition and Sensitivity to Change

The global population trend appears to be increasing; this species has adapted well to exotic plantations and is increasing in much of its range (BirdLife International 2016b).

The ovambo sparrowhawk is listed as vulnerable nationally, hence it has moderate sensitivity to change.

A3.5.5 Grey-Crowned Crane

A3.5.5.1 Baseline Condition

Grey-crowned cranes inhabit wetlands such as marshes, pans and dams with tall emergent vegetation, riverbanks, open riverine woodland, shallowly flooded plains and temporary pools with adjacent grasslands, open savannas, croplands, pastures, fallow fields and irrigated areas (BirdLife International 2016c). The nest is a circular platform of uprooted grasses and sedges concealed in tall emergent vegetation in or along the margins of wetlands. The species nests in solitary pairs, but often flocks together and roosts communally at night in groups of 20–200 individuals during dry periods. The timing of breeding varies in relation to the rains, with the breeding of East African populations peaking during dry periods.

The grey-crowned crane has a varied diet consisting of seed heads, new tips of grasses, pulses, nuts and grains, insects, frogs, lizards and crabs.

The main threats to the grey-crowned crane include:

- loss and degradation of wetland breeding areas through drought related changes in land-use, drainage and overgrazing
- illegal captive trade relating to the pet trade and informal zoos
- hunting and egg capture
- disturbance resulting from habitat encroachment due to anthropogenic pressure
- conflict with farmers wishing to exclude them from agricultural areas
- in Uganda, the mortality of the species is high owing to electrocution and collision with overhead powerlines. This is likely to increase considerably across its entire range.

This species was recorded in Bugungu WR (Section A3.4.3) and the Albert Flats (A3.4.2).

A3.5.5.2 Trend in Condition and Sensitivity to Change

The population of the grey-crowned crane is estimated to have declined by 50% over a period of 19 years (1985–2004) (BirdLife International 2016c). If this data is extrapolated to a period of 45 years in the past (1967–2012) or past and future (1985–2030), assuming an exponential trend, the calculated rate of decline is approximately 65–79% (Beilfuss et al. 2007, Morrison et al. 2007). This trend is expected to continue.

Grey-crowned cranes are IUCN endangered and thus have a very high sensitivity to change.

A3.5.6 White-headed Vulture

A3.5.6.1 Baseline Condition

This species prefers mixed, dry woodland at low altitudes but has occurred up to 4000 m within its range. It is thought to be a long-lived resident and is territorial; it is often the first vulture species to arrive at carcasses to feed, owing to it generally flying at lower altitudes than other species. The white-headed vulture is a keystone species.

The species has an extremely large range over sub-Saharan Africa, but population estimates put the number of individuals at just 5500 globally (Murn et al. 2016).

It nests and roosts in trees with most nests being in *Acacia* sp. or baobabs. Clutch size is one, the egg being laid a couple of months after rains have finished and the dry season is underway.

The white-headed vulture is known from several protected areas in Uganda, including the Murchison Falls National Park (WCS 2016), but was not observed during the field surveys.

A3.5.6.2 Trend in Condition and Sensitivity to Change

Recent data suggest the already small population is declining at an extremely rapid rate across its range (BirdLife International 2017b). This trend is anticipated to continue.

White-headed vultures are IUCN critically endangered and thus have a very high sensitivity to change.

A3.5.7 Hooded Vulture

A3.5.7.1 Baseline Condition

The hooded vulture is often associated with human settlements north of the equator but is also widespread in sub-Saharan Africa; found in open grassland, forest edge, wooded savannah, desert and along coasts, and tends to occur at higher densities in areas where populations of larger vultures are low or non-existent. It feeds mainly on carrion, but also takes insects. The hooded vulture is a keystone species.

Breeding occurs between May–June, with nests occurring in trees with a clutch of one egg. Data and observations suggest that the species is undergoing a very rapid decline in its global population, with an estimated 83% decline over three generations (BirdLife International 2017c).

Main threats to the species include:

- conversion of habitat to agro-pastoralism, loss of nesting sites and reduced abundance of available food (primarily ungulate kills)
- poisoning, either intentionally by poachers (as vultures signal a kill) or unintentionally if the vultures ingest either anti-inflammatory drugs administered to cattle, or agricultural pesticides
- hunting for bushmeat and body parts for traditional medicine

- a single egg per year in a single breeding season with shared nesting means that the loss of one of the parents will often result in the loss of the offspring.

The hooded vulture is known to occur throughout Uganda (WCS 2016) but was not observed during the field surveys.

A3.5.7.2 Trend in Condition and Sensitivity to Change

The hooded vulture has experienced rapid population decline (BirdLife International 2017c) and this is anticipated to continue as the main threats to the species continue.

The hooded vulture is IUCN critically endangered and hence has very high sensitivity to change.

A3.5.8 Rüppell's Griffon Vulture

A3.5.8.1 Baseline Condition

The Rüppell's griffon vulture frequents open areas of Acacia woodland, grassland and montane regions. It is gregarious, congregating at carrion, soaring together in flocks and breeding mainly in colonies on cliff faces and escarpments at a broad range of elevations. Mundy et al. (1992) estimated a population of approximately 11,000 pairs. Rüppell's griffon vulture is a keystone species.

The main threats to this species include:

- conversion of habitat to agro-pastoralism, loss of nesting sites and reduced abundance of available food (primarily ungulate kills)
- poisoning, either intentionally by poachers (as vultures signal a kill) or unintentionally if the vultures ingest either anti-inflammatory drugs administered to cattle, or agricultural pesticides
- hunting for bushmeat and body parts for traditional medicine

Rüppell's griffon vulture is known from several protected areas in Uganda, including the Murchison Falls National Park (WCS 2016), but was not observed during the field surveys.

A3.5.8.2 Trend in Condition and Sensitivity to Change

New data suggest that this species has experienced a very rapid population decline of 97% (range: 94–99%) over three generations (56 years) (Ogada et al. 2016), including in Uganda (D. Pomeroy in litt. 2006). This trend is anticipated to continue.

Rüppell's griffon vulture is IUCN critically endangered and thus has very high sensitivity to change.

A3.5.9 African White-backed Vulture

A3.5.9.1 Baseline Condition

White-backed vultures nest in tall trees and prefer open, wooded savannah; nests are a platform of dry sticks lined with grass and leaves (BirdLife International 2017e). White-backed vultures lay a single egg per year and both male and female

tend the egg and the hatchling. Young fledge at about 6 months. White-backed vultures are typically monogamous and are known to nest in colonies of up to 10 breeding pairs with nests spaced between 50 and 200 m. Breeding occurs during the dry season.

White-backed vultures are typical scavengers and opportunists feeding on the prey left by other animals; they are not migratory but have extensive ranges. The white-backed vulture is a keystone species.

Main threats to the population of the white-backed vulture include:

- conversion of habitat to agro-pastoralism, loss of nesting sites and reduced abundance of available food primarily ungulate kills
- poisoning, either intentionally by poachers (as vultures signal a kill) or unintentionally if the vultures ingest either anti-inflammatory drugs administered to cattle, or agricultural pesticides
- hunting for bushmeat and body parts for traditional medicine
- a single egg per year in a single breeding season with shared nesting means that the loss of one of the parents will often result in the loss of the offspring.

There are substantial populations of white-backed vulture in several protected areas in Uganda, including the Murchison Falls National Park (WCS 2016), but it was not observed during the field surveys.

A3.5.9.2 Trend in Condition and Sensitivity to Change

Data on this species' population suggest the species has declined very rapidly, with a median estimated decline of 90% (BirdLife International 2017e); this trend is likely to continue in Uganda and other countries in west, east and southern Africa.

The white-backed vulture is IUCN critically endangered and thus has very high sensitivity to change.

A3.5.10 Lappet-faced Vulture

A3.5.10.1 Baseline Condition

Mundy et al. (1992) suggest the African population of lappet-faced vultures is at least 8000 individuals. The species breeds across sub-Saharan Africa and in the Middle East, with small populations remaining in southern Egypt. The East African population is estimated at 3000 individuals.

The species inhabits dry savannah, arid plains, deserts and open mountain slopes (BirdLife International 2017f). It ranges widely and is mainly a scavenger, feeding predominantly on large carcasses (Mundy et al. 1992). It is also known to hunt small reptiles, fish, birds and mammals, and has been observed group-hunting flamingo chicks (McCulloch 2006a). The lappet-faced vulture is a keystone species.

The main threats to this species are:

- poisoning, either intentionally by poachers (as vultures signal a kill) or unintentionally if the vultures ingest either anti-inflammatory drugs administered to cattle, or agricultural pesticides
- hunting for bushmeat and body parts for traditional medicine

The lappet-faced vulture is known from several protected areas in Uganda, including the Murchison Falls National Park (WCS 2016), but was not observed during the field surveys.

A3.5.10.2 Trend in Condition and Sensitivity to Change

Only a small, very rapidly declining population remains, owing primarily to poisoning and persecution, as well as ecosystem alterations. Recently published data (BirdLife International 2017f) suggests that the population in Africa is declining extremely rapidly and this trend is anticipated to continue.

Owing to the lappet-faced vulture being IUCN endangered, it has a very high sensitivity to change.

A3.5.11 Shoebill

A3.5.11.1 Baseline Condition

While the shoebill has a large range, it is only found in small, localised populations concentrated around swamps and wetlands. A very solitary bird, even within a pair, male and female will often feed at opposite ends of their territory. Shoebills both breed and forage in seasonally flooded marshes, dominated by a mixture of papyrus, reeds and grasses; though they may utilise separate areas of habitat for foraging and breeding (BirdLife International 2016d).

The shoebill usually forages in shallow water where it makes use of clear channels created by the movement of large animals. It prefers water that is poorly oxygenated, thus forcing fish closer to the surface and as such, more easily caught. The shoebill has a variable diet of fish, amphibians, water snakes and young crocodiles.

Shoebill nests are grassy constructions, up to 3 m wide on a mound of floating vegetation or a small island, often among dense stands of papyrus. They are monogamous, with a maximum clutch size of three but on most occasions, only one chick reaches fledging.

Main threats to the population of shoebills include:

- habitat loss through conversion to agriculture and pasture
- destruction of nest and breeding areas by fire
- hunting for food, trade (local and international) and cultural reasons.

The shoebill is known from several areas in Uganda, including the Murchison Falls National Park (WCS 2016), but was not observed during the field surveys.

A3.5.11.2 Trend in Condition and Sensitivity to Change

Shoebill populations are declining in Tanzania, Zambia and Rwanda, and possibly Uganda (BirdLife International 2016d). This trend is expected to continue.

The shoebill is IUCN vulnerable and endangered nationally, and thus has high sensitivity to change.

A3.5.12 Denham's Bustard

A3.5.12.1 Baseline Condition

Denham's bustard inhabits grasslands, grassy Acacia-studded dunes, fairly dense shrubland, light woodland, farmland, crops, dried marsh and arid scrub plains. It feeds on insects, small vertebrates and plant material (del Hoyo et al. 1996).

The breeding season is variable and consequently unclear, perhaps indicating opportunism in reaction to rainfall, with a clutch size of one or two eggs.

The main threats to the population of Denham's bustard are:

- hunting
- conversion of grassland and light woodland to agriculture
- collision with powerlines.

The Denham's bustard is known to occur close to the project AOI, within Murchison Falls National Park, but was not observed during the field surveys.

A3.5.12.2 Trend in Condition and Sensitivity to Change

This species is estimated to be undergoing a moderately rapid population decline owing to hunting pressure and conversion of grassland habitat for agriculture (BirdLife International 2016e). This trend is anticipated to continue.

Owing to its listing as nationally critically endangered, it has a high sensitivity to change.

A3.5.13 African Crowned Eagle

A3.5.13.1 Baseline Condition

The African crowned eagle's range stretches across sub-Saharan Africa. It inhabits forest, woodland, savannah and shrubland, as well as some modified habitats, such as plantations and secondary growth (Ferguson-Lees and Christie 2001); and can persist in small forest fragments including urban greenspace forests. The species has shown resilience to heavy deforestation and degradation in some areas.

It can feed on a variety of prey, although mainly mammals; its prey of choice is largely location-dependent according to habitat type (BirdLife International 2016f).

The main threats to this species are:

- deforestation
- collisions with anthropogenic structures and electrocution by power lines
- competition from humans for prey species
- disturbance and persecution by humans.

The African crowned eagle is known from several areas close to the project AOI in Uganda, including Budongo and Bugoma FRs and Lake Victoria (WCS 2016), but was not observed during the field surveys.

A3.5.13.2 Trend in Condition and Sensitivity to Change

Evidence suggests that this species is in moderately rapid decline due to loss of habitats and human-induced disturbance; this trend is anticipated to continue.

The African crowned eagle is IUCN near threatened and nationally endangered, and thus has a high sensitivity to change.

A3.5.14 Black Stork

A3.5.14.1 Baseline Condition

The black stork winters in Africa, migrating along well-defined routes from Europe and East Asia. The species inhabits old, undisturbed, open forests (from sea-level, up to mountainous regions [e.g., 2000–2500 m in altitude]) (Hancock et al. 1992). It forages in shallow streams, pools, marshes (del Hoyo et al. 1992), swampy patches, damp meadows, floodplains, pools in dry riverbeds (Hockey et al. 2005) and occasionally grasslands (del Hoyo et al. 1992); especially where there are stands of reeds or long grass. It generally avoids large bodies of water and dense forest. It is predominantly piscivorous although it may also take amphibians, insects, snails, crabs, small reptiles, mammals and birds (BirdLife International 2017g).

The nest is a large construction of sticks, positioned high in forest trees that are large enough to hold the nest away from the main trunk. Solitary nests are typically 1 km apart.

The global population is estimated to be 24,000–44,000.

The main threats to this species include:

- habitat degradation
- conversion of wetland wintering habitats to agriculture, desertification and pesticide pollution
- collisions with powerlines.

The black stork is known to occur within the Albertine Rift valley (WCS 2016), but it was not recorded during the field surveys.

A3.5.14.2 Trend in Condition and Sensitivity to Change

The species is listed as endangered nationally, owing to perceived population reduction in Uganda of approximately 50% over the last 10 years or three generations (BirdLife International 2017g). This trend in condition is anticipated to continue.

Owing to this listing, the black stork has a high sensitivity to change.

A3.5.15 Black-Rumped Buttonquail

A3.5.15.1 Baseline Condition

The black-rumped buttonquail has a large range and prefers open grassland habitat although its distribution is highly localised.

Little is known about its population, but the species is described as uncommon to locally common (Madge and McGowan 2002).

The main threats to this species are:

- habitat loss
- exploitation by humans.

The black-rumped buttonquail is known from several areas close to the project AOI in Uganda, including the Murchison Falls National Park, Lake Victoria and Lake Albert (WCS 2016), but was not observed during the field surveys.

A3.5.15.2 Trend in Condition and Sensitivity to Change

The global population of black-rumped buttonquail is decreasing (BirdLife International 2016g). The species is listed as endangered in Uganda, owing to a continuing decline in population and extent of habitat. It is likely that the trend of habitat loss and declining population will continue.

Owing to its listing as endangered nationally, the black-rumped buttonquail has a high sensitivity to change.

A3.5.16 Pel's Fishing Owl

A3.5.16.1 Baseline Condition

Pel's fishing owl has an extremely large range, with a globally stable population. The preferred habitat is riverine forests; the owl is also found where large trees are established on islands in rivers, swamps or lakes. The species is largely residential and has no seasonal movement, although young, nonbreeding birds may wander before claiming their own territories. Pel's fishing owl may move outside their own range in pursuit of prey (del Hoyo et al. 1992). It feeds nocturnally on fish and frogs, and nests in the hollows and forks of old trees.

The main threats to this species are anthropogenic:

- construction of dams
- water extraction
- overfishing and water quality degradation reducing stocks of prey species.

Pel's fishing owl is known from several protected areas in Uganda, including the Murchison Falls National Park (WCS 2016), but was not observed during the field surveys.

A3.5.16.2 Trend in Condition and Sensitivity to Change

Globally, the population appears to be stable but has not been quantified (BirdLife International 2017h). It is reported in Simmons and Brown (2006) that the species is likely to come under increasing pressure in the future if, as predicted by climate change models, the African continent becomes drier and the growing human population increasingly relies on and impacts the region's river systems.

In Uganda, it is listed as endangered on the basis of an estimated population size of less than 250 mature individuals. As such, Pel's fishing owl has a high sensitivity to change.

A3.6 Ecosystem Services Provided

The habitats described in this report, with the avifauna species they support, generate a range of ecosystem services as set out below.

Provisioning services:

- food (bushmeat hunting and egg gathering).

Regulating services:

- as noted in this report, many of the bird species (raptors, vultures and owls) within the AOI are keystone species that provide pest control and other regulating services

Cultural services:

- eco-tourism, particularly in protected areas
- use of feathers, bones and other body parts in ceremonial rituals.

Habitat and species support:

- The habitats described in this report provide important refuge, feeding, watering, breeding and nursery areas for a range of bird species.

Supporting services:

- pollination and seed dispersal.

A3.7 Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the receptors has been ranked and is shown in Table A3.7-1.

Table A3.7-1 Avifauna Receptors and Sensitivity Ranking

Avifauna Receptor	Sensitivity Ranking	Rationale for Ranking
Albert Flats		
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Natural and semi-natural habitats supporting high avifauna diversity
Avifauna species of conservation importance	Very high (5)	Supports a species listed as endangered on the IUCN Red List: • grey-crowned crane
Bugungu WR		
Legally protected, internationally or nationally recognised areas	High (4)	Nationally designated site (WR) and internationally recognised area (KBA)
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Natural and semi-natural habitats supporting high avifauna diversity

Table A3.7-1 Avifauna Receptors and Sensitivity Ranking

Avifauna Receptor	Sensitivity Ranking	Rationale for Ranking
Avifauna species of conservation importance	Very high (5)	Supports critically endangered, endangered and vulnerable species: • grey-crowned crane (IUCN endangered, Uganda endangered) • pallid harrier (IUCN near threatened, Uganda critically endangered) • African woollyneck (IUCN least concern, Uganda vulnerable)
Above Escarpment		
Avifauna species of conservation importance	Moderate (3)	Supports a species listed as vulnerable on the Uganda Red List • ovambo sparrowhawk, *Accipter ovampensis* (IUCN least concern, Uganda vulnerable)
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Habitats providing important feeding and breeding grounds
Avifauna Species		
Avifauna species of conservation importance	Very high (5)	Species listed as critically endangered or endangered on the IUCN Red List: • grey-crowned crane (IUCN endangered, Uganda endangered) • lappet-faced vulture (IUCN endangered, Uganda critically endangered) • white-headed vulture (IUCN critically endangered • hooded vulture (IUCN critically endangered, Uganda endangered) • African white-backed vulture (IUCN critically endangered, Uganda endangered) • Rüppell's griffon vulture (IUCN critically endangered, Uganda endangered)
Avifauna species of conservation importance	High (4)	Species listed as vulnerable on the IUCN Red List, or listed as critically endangered or endangered on the Uganda Red List: • shoebill (IUCN vulnerable, Uganda endangered) • African crowned eagle (IUCN near threatened, Uganda endangered) • Denham's bustard (IUCN near threatened, Uganda critically endangered)

Table A3.7-1 Avifauna Receptors and Sensitivity Ranking

Avifauna Receptor	Sensitivity Ranking	Rationale for Ranking
		• black stork (IUCN least concern, Uganda endangered) • black-rumped buttonquail (IUCN least concern, Uganda endangered) • Pel's fishing owl (least concern, Uganda endangered)
Avifauna species of conservation importance	Moderate (3)	Species listed as vulnerable on the Uganda Red List: • African woollyneck (IUCN least concern, Uganda vulnerable) • ovambo sparrowhawk (IUCN least concern, Uganda vulnerable)

A3.8 Key Considerations

A3.8.1.1 Habitats

Based on the outcomes of the avifauna biodiversity study, and particularly the known or likely presence of species of conservation importance, the following areas are identified as sensitive receptors:

- Albert Flats, KP0–54 (excluding section within Bugungu; see next bullet)
- Bugungu WR, KP27–38
- above the escarpment, KP54–94.

The Bugungu WR and Albert Flats areas supported the greatest diversity of species and numbers of species of conservation importance. However, even in areas of lower diversity, species of conservation importance were recorded, especially in semi-natural habitats that have not been degraded through grazing and agriculture.

A3.8.1.2 Avifauna

Several avifauna species of conservation importance have been identified that are key considerations for the impact assessment. These species are important because they are listed as IUCN critically endangered, endangered or vulnerable; some are migratory and congregatory; and some are endemic to Tanzania or range-restricted. Many of these species trigger critical habitat under criterion 1 (threatened species), and/or criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment.

The following species were recorded during the field surveys:

- African woollyneck
- pallid harrier (triggers critical habitat under criterion 1)
- ovambo sparrowhawk
- grey-crowned crane (triggers critical habitat under criterion 1).

The following species are potentially present within the AOI based on secondary data:

- lappet-faced vulture (triggers critical habitat under criterion 1)
- white-headed vulture (triggers critical habitat under criterion 1)
- Denham's bustard (triggers critical habitat under criterion 1)
- black stork
- shoebill (triggers critical habitat under criterion 1)
- hooded vulture (triggers critical habitat under criterion 1)
- African white-backed vulture (triggers critical habitat under criteria 1 and 3)
- Rüppell's griffon vulture (triggers critical habitat under criteria 1 and 3)
- African crowned eagle (triggers critical habitat under criterion 1)
- black-rumped buttonquail (triggers critical habitat under criteria 1 and 3)
- Pel's fishing owl (triggers critical habitat under criterion 1).

The key considerations for the impact assessment on avifauna species will be:

- loss of habitat
- disturbance during nesting and feeding, both of which occur throughout the year.

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ATTACHMENT A3.1 DETAILED SURVEY METHODOLOGIES

Introduction

The overall aims of these surveys were to provide a rapid assessment of the ornithological interest along the route of the pipeline, to allow an assessment of potential impacts of proposed pipeline construction. This information can subsequently be used to guide construction plans and any potential mitigation required to limit environmental disturbance. The data will also inform the ESIA and CHA, which will subsequently be used to help form the Construction Environmental Management Plan. Furthermore, the information gathered will provide a baseline against which the future recovery of habitats (and therefore ornithological recovery), following construction activities, can be evaluated.

Site Selection

Proposed survey sites were selected following analysis of geographical information systems (GIS) files, which identified the proposed route of the Tilenga feeder pipeline. Any protected areas were identified and targeted for survey with sampling in larger areas. The proposed survey sites along the pipeline route were also discussed with in-country ornithologists familiar with the areas that the proposed Tilenga feeder pipeline route passes.

During field surveys, site selection was honed based on habitat quality as in many cases, habitats identified from GIS files have subsequently been converted to agriculture and many forested areas have been converted to *Eucalyptus* plantations.

Field Surveys

Surveys were undertaken during May 2017, which coincides with the wet season, and January 2017 to coincide with the dry season. Undertaking surveys during each season facilitates a robust data set to be gathered in each season to inform future assessment.

Field surveys varied, subject to the habitat type being assessed. Open areas of savannah or agricultural land were sampled by TSCs (Bibby et al. 2000, Freeman et al. 2003). During TSCs, species recorded in the first 10 minutes are given a score of 6, then 5 for the next 10 minutes, down to 1 for the last minute (Freeman et al. 2003). The common species are recorded in most counts, usually with a score of six, while rare species only score an occasional one. Sites were walked freely within each area, recording all species in order of their being encountered, whether by sight or sound, but mainly remaining within the identified habitat. One exception is when there happened to be a small wetland within the area, often with some water birds, and these are highlighted in blue in the baseline TSC tables provided in Attachment A1.1 (May 2017 survey) and A1.2 (December 2017 survey), which are otherwise the results of the land bird counts.

For open waterbodies, total counts were undertaken and these are reported separately. In the case of swamps, species lists were collected (with a note if a species was seen or heard several times). All species data tables with the dates, times and other details of all counts are provided in the attachments.

Birds were mostly identified on sight, but two field guides were carried, namely Stevenson and Fanshawe (2002), and Sinclair and Ryan (2003), which were referred to when queries arose. In a few cases, interesting records that were less than certain are shown as 'probable', indicated by 'p' in data tables. These tables list species in the current East African order (DA Turner, in press). For calls, a smart phone (which has recordings of most Ugandan species) was used. Species encountered in the same habitat as a particular count, but outside the count time, are listed as P (present).

The avifauna survey team comprised:

- Derek Pomeroy (all surveys)
- Micheal Kibuule (all survey)
- Davina Kawwuma (specialist in forest birds).

Birds of Conservation Concern

The bird lists in the tables show species that are globally Red-listed by IUCN (online) or nationally by the Wildlife Conservation Society (WCS 2016). However, some other categories were also considered to be of concern, namely:

- Deforestation in Uganda is rampant. Birds commonly needing trees: FF are forest interior species, almost absent from the counts, F are less specialised forest birds, sometimes found in well-wooded areas outside forest, and f-species are nonforest birds that also commonly use trees (Bennun et al. 1996).
- Wetlands all over Uganda are being drained, large lakes are increasingly over-fished and polluted, all of which affects waterbirds. Those that usually occur on or by rivers and lakes are designated 'W' while birds that are more common at or near wetlands are labelled 'w' (NBDB unpub.).
- Grasslands are almost all over-grazed which adversely affects species that need longer grass – these are 'G' species.
- Aerial species (Swallows, Swifts, Bee-eaters) appear to be declining globally; these are labelled 'Ae'.

Habitat Descriptions

Vegetation structure, as the basis of land birds' habitats, was recorded for all non-aquatic sites, following the procedure described by Pomeroy (1992). The presence of trees is particularly important for many species (Douglas et al. 2013). To assess vegetation cover, plants were first considered as native or planted (non-native, exotic) and then divided into nonwoody (grass and herbs) and woody (shrubs and trees). The percentage cover in each category was then estimated in four vertical layers: 0–1, 1–3, 3–8 and >8 m high, and all within a 10-m radius of the count point. For woody vegetation, the first two height categories were considered to be shrubs and the latter two as trees. Savanna areas (those with ground layers dominated by grasses) were classified according to the long-established criteria of Pratt and Gwynne (1977). Here, a cover of more than 20% of shrubs or trees is referred to as bushland or woodland (B, W), respectively, while a cover of 2–20% is referred to as bushed or wooded (b, w). Lower levels are referred to as grasslands (G), although in some sites there was almost no grass, but considerable bare ground.

Most sites had six estimates, made at 5, 15, 25, 35, 45 and 55 minutes from the start of the TSC. These were considered random, as they were determined by time not by the

vegetation at any particular point. One small source of bias is that walking routes did not go through thickets, for obvious reasons.

For each site, various categories of human activity were recorded on a 0–3 scale.

ATTACHMENT A3.2 WET SEASON – TILENGA FEEDER PIPELINE TIMED SPECIES COUNT DATA

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR								Lake Albert Flats North							
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b	F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23
142	HELMETED GUINEAFOWL *Numida meleagris*	G					**2**														**3**	**1**						**5**		
155	SCALY FRANCOLIN *Pternistis squamatus*	F				**4**																						**P**		
154	CRESTED FRANCOLIN *Dendroperdix sephaena*								**4**						**5**		**4**	**6**		**3**	**6**	**1**						**6**		**p3**
	RING-NECKED DOVE Streptopelia capicola					**1**	**6**	**4**	**6**	**3**	**6**		**6**	**5**	**5**	**5**	**6**	**5**	**4**	**3**	**6**	**2**	**6**	**6**			**2**	**2**		
283	RED-EYED DOVE *Streptopelia semitorquata*	f	**6**	**3**		**5**		**5**		**6**	**5**		**6**	**5**	**1**	**6**	**2**		**6**	**3**	**5**							**3**		
285	VINACEOUS DOVE *Streptopelia vinacea (hybrid)*								**6**				**P**	**2**	**6**	**6**	**6**	**4**	**6**		**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**
	VINACEOUS DOVE HYBRID									**2**					**6**	**1**					**2**					**4**				

[2] Present outside count time refers to a chance sighting of a species, not within the TSC.

[3] Atlas No refers to the species number in the Uganda bird atlas (Carswell et al. 2005)

[4] FF – Forest specialist; F – Forest generalist; f – Other tree species; W – Waterbird specialist; w – wetland visitor; G – Grassland specialist; Ae – Aerial species; P – Palearctic migrant; A – Afrotropical migrant. See Attachment A3.1 for further details.

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P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

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			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17		F18a	F19b	F19a	F18b	F20	F21	F22	F23		
289	LAUGHING DOVE *Streptopelia senegalensis*			**6**		**2**	**6**				**4**		**6**											**4**		**5**				**4**	**5**		
269	BRUCE'S GREEN-PIGEON *Treron waalia*								**5**																								
268	AFRICAN GREEN-PIGEON *Treron calvus*		F		6	4																											
271	BLUE-SPOTTED WOOD DOVE *Turtur afer*		F		6	6		2	6	6		4		6			5	4	3	6	3	6	6	6	6	6	6		6	6	6	5	
270	TAMBOURINE DOVE *Turtur tympanistria*		F		4		5			1	6	6	5	5	5			3		1	1					5		6		1		6	
340	BATES'S NIGHTJAR *Caprimulgus batesi*		FF																			6											
342	LONG-TAILED NIGHTJAR *Caprimulgus climacurus*		A							1																							
358	AFRICAN PALM SWIFT *Cypsiurus parvus*				6			2	3	5	4		2			3	2	1	4	2	4	2	5	6	2		5	6	6			4	
323	WHITE-BROWED COUCAL *Centropus superciliosus*				6	5			6	4	5	6			6		2	4	5		3		6	2	5					6			
306	JACOBIN CUCKOO *Clamator jacobinus* (Black-and-white Cuckoo)		A								6							5									1					2	

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308	GREAT SPOTTED CUCKOO *Clamator glandarius*		P																								3*					
319	KLAAS' CUCKOO *Chrysococcyx klaas*		f						2	6				4			3		2			2	3		3	6		4		4		
320	DIEDERICK CUCKOO *Chrysococcyx caprius*				3				3		4	5			4	6	2				6	2	2		1	5	6	6	2		2	5
309	RED-CHESTED CUCKOO *Cuculus solitarius*		AF		4						2	6		2	6							4	3	5		3				6	5	
305	EASTERN GREY PLANTAIN-EATER *Crinifer zonurus*				5	6		2									4		2			6		6								
298	WHITE-CRESTED TURACO *Tauraco leucolophus*		F																2													
302	ROSS'S TURACO *Musophaga rossae*		F		4	5																										
185	**GREY-CROWNED CRANE *Balearica regulorum***		**WG**													**19**					***5***									******2**	
36	**MARABOU STORK *Leptoptilos crumeniferus***		**w**								**P**						**5**			**2**		**4**		**6**								
30	**AFRICAN OPENBILL STORK *Anastomus lamelligerus* (African Openbill)**		**AwG**														**3**				**4**	**4**										

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR									Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
32	ABDIM'S STORK *Ciconia abdimii*	AG										3																				
33	**AFRICAN WOOLLYNECK *Ciconia microscelis***	**W**										**2**								**2**												
9	**PINK-BACKED PELICAN *Pelecanus rufescens***	**W**										**P**										**P**										
28	**HAMERKOP *Scopus umbretta***	**w**										**6**			**2**			**4**	**5**				**6**									
17	**CATTLE EGRET *Bubulcus ibis***	**G**														**20**		**5**														
25	**GREY HERON *Ardea cinerea***	**W**														**5**																
26	**BLACK-HEADED HERON *Ardea melanocephala***	**w**													**5**	**3**		**P**							**2**			**6**				
23	**GREAT WHITE EGRET *Ardea alba* (Great Egret)**	**W**																					**P**									
22	**INTERMEDIATE EGRET *Ardea intermedia* (Yellow-billed Egret)**	**W**														**P**																
39	**HADADA IBIS *Bostrychia hagedash***	**w**				**4**						**6**				**P**	**4**		**5**													
223	**SPUR-WINGED LAPWING *Vanellus spinosus* (Plover)**	**WG**														**4**																

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Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR									Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
221	**AFRICAN WATTLED LAPWING *Vanellus senegallus* (Plover)**		**W**													**P**					**3**	**P**										
193	**JACANA *Actophilornis africana***		**W**													**P**																
73	BLACK-SHOULDERED KITE *Elanus caeruleus*		G																				1									
90	AFRICAN HARRIER-HAWK *Polyboroides typus* (Gymnogene)		f						3							2																
77	PALM-NUT VULTURE *Gypohierax angolensis*																		4	P												
88	BATELEUR *Terathopius ecaudatus*		G										3				3			6	3			6					2			3
85	SHORT-TOED SNAKE EAGLE *Circaetus gallicus* (includes Beaudouin's Snake Eagle *C.beaudouini*)																												4			
86	BROWN SNAKE EAGLE *Circaetus cinereus*				5																											
122	LONG-CRESTED EAGLE *Lophaetus occipitalis*		F					2												1												
116a	TAWNY EAGLE *Aquila rapax*		O														p2			4												

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			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17		F18a	F19b	F19a	F18b	F20	F21	F22		F23	
119	AFRICAN HAWK-EAGLE *Aquila spilogaster*																										4						
96	DARK CHANTING-GOSHAWK *Melierax metabates*												P			1			P		5	1	P		P			2					
	EASTERN CHANTING-GOSHAWK**																										P**						
104	OVAMBO SPARROWHAWK *Accipiter ovampensis*																							P1									
76	**AFRICAN FISH EAGLE *Haliaeetus vocifer***		**W**									**2**										**6**											
75	BLACK KITE *Milvus migrans* (Race *M.parasiticus* sometimes treated as full species Yellow-billed Kite.)		pA		P		p5								1					5					2	3					5		
369	SPECKLED MOUSEBIRD *Colius striatus*				4	6		6	6	6	4	4	5	4	2	1		6	6	5	5	6	4	5	5	4	5	5	4	6	6	6	
368	BLUE-NAPED MOUSEBIRD *Urocolius macrourus*					6		4	6		5	3	1	4			P				5	6				1	5		6	5			
409	ABYSSINIAN GROUND-HORNBILL *Bucorvus abyssinicus*																						P										

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			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
420	AFRICAN GREY HORNBILL *Lophoceros nasutus*														4		2						4	5	4	5		3			4
408	EURASIAN HOOPOE *Upupa epops* (***Includes *africana*African Hoopoe)		p																1										4		
404	GREEN WOOD-HOOPOE *Phoeniculus purpureus* (Red-billed Wood-hoopoe)				2																										
406	BLACK SCIMITARBILL *Rhinopomastus aterrimus* (Black Wood-hoopoe)																													4	1
456	LESSER HONEYGUIDE *Indicator minor* (Includes Thick-billed Honeyguide *I.conirostris*)		f																					4							
455	GREATER HONEYGUIDE *Indicator indicator* (Black-throated Honeyguide)		f		3				3			P												2	3				4		
465	NUBIAN WOODPECKER *Campethera nubica*					5		5		1		5			6				4	6	5			6	5	3		4	5	6	4	4
477	GREY WOODPECKER *Mesopicos goertae*		f																	5	6			5		6						
432	RED-FRONTED TINKERBIRD *Pogoniulus pusillus*					4					5										5	6		6								

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433	YELLOW-FRONTED TINKERBIRD *Pogoniulus chrysoconus*		f		5			1	6	6		5		5	6		6	6	6	6	6		6			6	5	6	5	6	6	6
437	SPOT-FLANKED BARBET *Tricholaema lachrymosa*																							6	3							
441	BLACK-BILLED BARBET *Lybius guifsobalito*												2		6				2	6	6	6		2	2	2	6	6	5			2
443	DOUBLE-TOOTHED BARBET *Pogonornis bidentatus*		f		3																											
389	RED-THROATED BEE-EATER *Merops bulocki*		W															3	5	6	5	5										
390	WHITE-THROATED BEE-EATER *Merops albicollis*		Af								5									4		3		6								
395	NORTHERN CARMINE BEE-EATER *Merops nubicus*		AG								P																					
393	MADAGASCAR BEE-EATER *Merops superciliosus*		A																1	3		2		5	1			3		1	4	
388	SWALLOW-TAILED BEE-EATER *Merops hirundineus*		A															6												5	5	4
385	LITTLE BEE-EATER *Merops pusillus*		G																					3		5	1					

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401	**BROAD-BILLED ROLLER *Eurystomus glaucurus***	**Afw**																							5								
378	**AFRICAN PYGMY KINGFISHER *Ispidina picta***	**fw**	2									3					3	4	5		5							2	4			5	
373	**GREY-HEADED KINGFISHER *Halcyon leucocephal* (Chestnut-bellied Kingfisher)**	**Afw**									P	5			2	1		5	5							2		1	6	5	4	1	
376	STRIPED KINGFISHER *Halcyon chelicuti*								6		6			1	5		4		3		6			5	4	5	6	3	1			
375	WOODLAND KINGFISHER *Halcyon senegalensis*	A									6	6	3				2	5	6	1	3	5	2		P				5	5	4	3
132	GREY KESTREL *Falco ardosiaceus*												P										P			1						
292	BROWN PARROT *Poicephalus meyeri* (Meyer's Parrot)																							6								
530	RED-SHOULDERED CUCKOO-SHRIKE *Campephaga phoenicea*				5				4	2														5								
749	CHIN-SPOT BATIS *Batis molitor*	f								6																						1	
751	WESTERN BLACK-HEADED BATIS *Batis erlangeri*	f																						3								

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746	BROWN-THROATED WATTLE-EYE *Platysteira cyanea* (Common Wattle-eye)		f		2	3					3	2	6	5	2		P	3	6	P	1	5	4		5		p2	5		5	3	6		
742	BLACK-AND-WHITE FLYCATCHER *Bias musicus* (Vanga Flycatcher)		f		4	6		2		5																							
844	BRUBRU *Nilaus afer*								2												1				3					6				
824	GREY-HEADED BUSH-SHRIKE *Malaconotus blanchoti*				6			6		1		3			6		4	3								2					6			3
836	NORTHERN PUFFBACK *Dryoscopus gambensis*		F							3	5		5	2			6	6	5	4	6	6	4	6				3	5			2		4
830	**MARSH TCHAGRA *Bocagia minuta***		**w**										**5**																				
831	BROWN-CROWNED TCHAGRA *Tchagra australis* (Brown-headed Tchagra)													4	6			2	4	1	5	1						4			3			2
833	BLACK-CROWNED TCHAGRA *Tchagra senegalus*				4	1		5	6		6	4	6	5	1	6	6	6	6	6	4	2	4		6		6	6	6	4	3	6	

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828	SULPHUR-BREASTED BUSH-SHRIKE *Cholorophoneus sulfureopectus* (Orange-breasted Bush-shrike)		f		4	5					3							5	6	3	5	4	4		2				5		1	2
841	TROPICAL BOUBOU *Laniarius aethiopicus*		f		4	6	5	6		6																						
843	BLACK-HEADED GONOLEK *Laniarius erythrogaster*		f		4	3		4	6	5	6	5	6	5	1	6	6	6	6	6	6	6	6	5	6	5	6	6	6	6	6	6
853	FORK-TAILED DRONGO *Dicrurus adsimilis* (Common Drongo)		f/F		3		6			5											4				6		5	6	6			4
815	**GREY-BACKED FISCAL *Lanius excubitoroides***		**Afw**									**3**				**6**				**4**	**5**			**2**	**1**	**4**	**6**	**4**	**6**		**4**	**5**
858	PIAPIAC *Ptilostomus afer*															3										P						
739	AFRICAN PARADISE-FLYCATCHER *Terpsiphone viridis*		f			5	5					6					1	5	5	1	5	6	6		4		2					
776	WESTERN VIOLET-BACKED SUNBIRD *Anthreptes longuemarei*		Af																											4		
777	**EASTERN VIOLET-BACKED SUNBIRD *Anthreptes orientalis***		**w**																										3			

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P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR									Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22		F23	
787	SCARLET-CHESTED SUNBIRD *Chalcomitra senegalensis*		f		1	4	4				1											3				2	5			5	4		
801	BEAUTIFUL SUNBIRD *Cinnyris pulchellus*									5	6	4	2		6	2	2	6	5	6	4	5	3	5	2	1	1	3	5	2	6	3
803	**RED-CHESTED SUNBIRD *Cinnyris erythrocercus***		**W**						5																							
808	VARIABLE SUNBIRD *Cinnyris venustus*		f		6	1																										
810	**COPPER SUNBIRD *Cinnyris cupreus***		**fw**		6	3		2																								
937	**GROSBEAK WEAVER *Amblyospiza albifrons* (Thick-billed Weaver)**		**fw**			3																										
925	RED-BILLED QUELEA *Quelea quelea*		A								2	3		6	4	2	6	5	5		3		5	5	5							
927	**BLACK BISHOP *Euplectes gierowii***		**w**			4		6		6																						
930	NORTHERN RED BISHOP *Euplectes franciscanus*		G					6		1						6	2					2	4				4					
928	BLACK-WINGED BISHOP *Euplectes hordeaceus* (Fire-crowned Bishop)																1						1									

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR									Lake Albert Flats North							
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
934	WHITE-WINGED WIDOWBIRD *Euplectes albonotatus*		G					5																							
893	BAGLAFECHT WEAVER *Ploceus baglafecht*		f			5		4																							
895	LITTLE WEAVER *Ploceus luteolus*				6				5	5	5	2	5	5	6	5		6		1	5	6	5		3	5	5	3		2	5	
897	SPECTACLED WEAVER *Ploceus ocularis*		f		6		6		6																				4		
903	LESSER MASKED WEAVER *Ploceus intermedius*								P																						
904	VITELLINE MASKED WEAVER *Ploceus vitellinus*										2	2	6		P	3				5					4	5	2	3	3			
908	BLACK-HEADED WEAVER *Ploceus cucullatus* (Village Weaver)				2	6		6	1	1	5								6				3								
910	**YELLOW-BACKED WEAVER *Ploceus melanocephalus* (Black-headed Weaver)**		**W**														**3**	**4**	**2**			**4**	**6**						**6**	**4**	
911	**GOLDEN-BACKED WEAVER *Ploceus jacksoni* (Jackson's Golden-backed Weaver)**		**w**							**5**						**5**															

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR									Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22		F23	
959	RED-BILLED FIREFINCH *Lagonosticta senegala*							5	6			6		5	5	5	4	4	P		2		5		1		3	4		4	3		
963	AFRICAN FIREFINCH *Lagonosticta rubricata* (Blue-billed Firefinch)											5																				
961	BLACK-FACED FIREFINCH *Lagonosticta larvata*		G																						6			2		5	2	
956	BROWN TWINSPOT *Clytospiza monteiri*		f																						3							
947	RED-WINGED PYTILIA *Pytilia phoenicoptera*					2																		5		3						
945	GREEN-WINGED PYTILIA *Pytilia melba* (Melba Finch)																														5	6
974	RED-CHEEKED CORDON-BLEU *Uraeginthus bengalus*				6	5		6	4	2	6	6	6	6	6	5	6	6	6		1	3	5		6	5	6	6	5	6	5	6
967	CRIMSON-RUMPED WAXBILL *Estrilda rhodopyga*														5																	
969	**COMMON WAXBILL *Estrilda astrild***		**wG**						**1**		**1**	**4**		**5**																		
970	BLACK-CROWNED WAXBILL *Estrilda nonnula*		f		6			4															2									

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR								Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
972	BLACK-FACED WAXBILL *Estrilda erythronotos* (Includes Black-cheeked Waxbill *E.charmosyna)*								2																						
980	BRONZE MANNIKIN *Spermestes cucullata*				6	6			p	4										5		6	6					2			
981	BLACK-AND-WHITE MANNIKIN *Spermestes bicolo*r (Red-backed Mannikin)		f			3																									
985	PIN-TAILED WHYDAH *Vidua macroura*		G					4			1					4	P	4	6			2	4				4	4	6			4
984	VILLAGE INDIGOBIRD *Vidua chalybeata* (Red-billed Firefinch Indigobird)							3								3															
880	RUFOUS SPARROW *Passer cordofanicus* (includes Shelley's Rufous Sparrow *P.shelleyi*)										2			3	6						5						6				
881	NORTHERN GREY-HEADED SPARROW *Passer griseus* (Parrot-billed Sparrow)							3		6						3	1							6							
529	YELLOW-THROATED LONGCLAW *Macronyx croceus*		G																		5										

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR										Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17		F18a	F19b	F19a	F18b	F20	F21	F22		F23	
995	YELLOW-FRONTED CANARY *Crithagra mozambica*					3		6		2																2							
489	FLAPPET LARK *Mirafra rufocinnamomea*		G								4			5	5	6	6	5	5	2	4	3	4			5		6					4
691	RED-FACED CROMBEC *Sylvietta whytii*		F						5						5			2					P2					2		5			
663	**RED-WINGED GREY WARBLER *Drymocichla incana***		**w**																					4									
667	YELLOW-BREASTED APALIS *Apalis flavida*		f							2														4				5					
664	BUFF-BELLIED WARBLER *Phyllolais pulchella*		f		1																					5							
677	GREY-BACKED CAMAROPTERA *Camaroptera brachyura*		f		6	6	6	5	6	5	6	6	5	6	6	3	6	6	6	6	6	6	6	6	6	6	3	6	6	6	6	6	5
701	**GREY-CAPPED WARBLER *Eminia lepida***		**fw**		6				6		6	2	5				5		4	5		6	6	5	5						5	3	
638	**RED-FACED CISTICOLA *Cisticola erythrops***		**w**			6		6	6	6		3		6			3		3	2				P									
641	TRILLING CISTICOLA *Cisticola woosnami*																					6	6								3	5	

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

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Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR									Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
645	RATTLING CISTICOLA *Cisticola chiniana*										6	5	6	1	6	6	6	6	5	5	5	5	6	6	6	6	6	6		4	6	5
647	**WINDING CISTICOLA *Cisticola marginatus***	**w**															1		3	5		4	P									
650	CROAKING CISTICOLA *Cisticola natalensis*	G						5											4										4			
652	SHORT-WINGED CISTICOLA *Cisticola brachypterus* (Siffling Cisticola)								4																					1		
655	**ZITTING CISTICOLA *Cisticola juncidis* (Fan-tailed Cisticola)**	**wG**														6	4		6		5	1	6				4		6			
658	**TAWNY-FLANKED PRINIA *Prinia subflava***	**fw**	6		6	6	6	6	6							6	6			2		5							6			
505	LESSER STRIPED SWALLOW *Cecropis abyssinica*																P															
512	**ANGOLA SWALLOW *Hirundo angolensis***	**w**				4														p3											1	
562	COMMON BULBUL *Pycnonotus barbatus* (Yellow-vented Bulbul)	f	6		6	6	6	6	6	6	6	6	6	6	6	5		6	6	6		6	4	6	6	5	4	6	6	6	6	6
811	NORTHERN YELLOW WHITE-EYE *Zosterops senegalensis*	f				1	5	6	P	2									6				1						3			

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

P = Present outside count time; p = probable[2]. Water birds shown in blue shading and birds found closer to water in bold.

Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology[4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR								Lake Albert Flats North							
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b	F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23	
764	BLACK-LORED BABBLER *Turdoides sharpei* (Sharpe's Pied Babbler)				6			3			6								4	5		6	2			6			1	
761	BROWN BABBLER *Turdoides plebejus*																						3	3			6				
762	ARROW-MARKED BABBLER *Turdoides jardineii*					2													1										6		
872	RPPELL'S STARLING *Lamprotornis purpuroptera* (Rüppell's Long-tailed Starling)					4		3	4		6	6			1	6		5	6	6	6		6	6	3	5	6	5		4	1
870	LESSER BLUE-EARED STARLING *Lamprotornis chloropterus* (Glossy Starling)					5			1		6			6	5									2			1	5			
876	VIOLET-BACKED STARLING *Cinnyricinclus leucogaster* (Plum-coloured Starling)		Af			6			4															4			6	6			6
588	BROWN-BACKED SCRUB-ROBIN *Cercotrichas hartlaubi*		f		6		4		6	4	5			5	4						3	2	6					1	2	5	
589	WHITE-BROWED SCRUB-ROBIN *Cercotrichas leucophrys*				6	6	6						2		4					2	6	3				1	5		3	3	2	
714	PALE FLYCATCHER *Bradornis pallidus* (Mouse-coloured Flycatcher)					5												p2													

Table Att3.2-1 Timed Species Counts Data for Tilenga Feeder Pipeline, May 2017

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Atlas No[3].	COMMON NAME Scientific Name (Alternative Name)	Ecology [4] (Habitat)	Above escarpment						Albert Flats South (Butiaba)						Bugungu WR										Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b		F16a	F16b	F17		F18a	F19b	F19a	F18b	F20	F21	F22		F23	
716	SILVERBIRD *Empidornis semipartitus*												1	4				1			4						6	6	5	6			5	
576	WHITE-BROWED ROBIN-CHAT *Cossypha heuglini*		f			5		6	6						3				4		6	5	5				1	6		4	6	6	
578	**SNOWY-CROWNED ROBIN-CHAT *Cossypha niveicapilla***		**Fw**						5		4						4		1											3	6		
586	SPOTTED PALM-THRUSH *Cichladusa guttata* (Spotted Morning Thrush)												2	4			5	6	6	6	5	5	5		2	5	5	6	6		6	4	6	
601	SOOTY CHAT *Myrmecocichla nigra*							4						6											1								
604	MOCKING CLIFF CHAT *Thamnolaea cinnamomeiventris* (Cliff Chat)													3	3																		
612	AFRICAN THRUSH *Turdus pelios*		f		1	4		3	5	5		3	5	5	2	2			6	6		5											
Number of species per site					**43**	**46**	**12**	**41**	**40**	**36**	**41**	**41**	**27**	**31**	**41**	**37**	**43**	**41**	**54**	**44**	**52**	**51**	**49**	**48**	**45**	**35**	**43**	**41**	**41**	**43**	**43**	**39**	
Number of-species in rivers and lakes					**11**																												
Number of wetland					**26**																												
Total number of species					**175**																												

Table Att3.2-2 Dates, Times and Other Details of Tilenga Feeder Pipeline Timed Species Counts

Serial	KP	Way Point	Name	UTM	Date 2017	Observer	Time	Temp °C
F1	81	175		36N0297655, 0170792	25-May	MK/DP	725	26
F2	84	176		36N0295576, 0169075	25	MK/DP	905	31
F3	75	177	Bujawe FR	36N 0302378, 0174250	25	MK/DP	1120	33
F4	73	178		36N0302756, 0175779	26	MK/DP	810	27
F5	69	179		36N0303910, 0178876	26	MK/DP	1020	29
F6	60	180		36N0312859, 0185371	26	MK/DP	1235	33
F7	48	181		36N0315410, 0194512	27	MK/DP	815	33
F8	47	182	Waki River	36N0316307, 0197459	27	MK/DP	1005	31
F9	48	183		36N 0316300, 0196269	27	MK/DP	1135	35
F10	sub-65	184	upper ESC.	36N 0319769, 0196409	27	MK/DP	1310	34
F11	sub-65	185	upper ESC.	36N0319426, 0196892	28	MK/DP	730	24
F12	45	186		36N 0317012, 0198595	28	MK/DP	850	28
F13	39	187	Bugungu WR	36N 0321424, 0203270	28	MK/DP	1100	29
F14a	29	188	WR HQ	36N0325075, 0212251	29	MK/DP	835	30
F14b	29	188	WR HQ	36N0325075, 0212251	30		930	26

Table Att3.2-2 Dates, Times and Other Details of Tilenga Feeder Pipeline Timed Species Counts

Serial	KP	Way Point	Name	UTM	Date 2017	Observer	Time	Temp °C
F15	REP FKP25	189	NU Waiga S	36N 0326293, 0215061	29	MK/DP	1005	33
F15 b	REP FKP25	189	NU Waiga S	36N 0326293, 0215061	30		1100	28
F16	34	190	Sonso	36N 0322733, 0207972	29	MK/DP	1130	33
F16b	34	190	Sonso	36N 0322733, 0207972	30		735	26
F17	REP FKP22	191	NU Waiga R	36N 0330025, 0218589	30	MK/DP	1215	28
F18a	7	192		36N0326689, 0234319	31	MK/DP	730	23
FKP18b	7	192		36N0326689, 0234319	31	MK/DP	1715	32
FK19A	9	193		36N 0326703, 0233046	31	MK/DP	835	26
FKP19b	9	193		36N 0326703, 0233046	01-Jun	MK/DP	1640	33
FKP20	West of o	194	CPF	36N0329644, 0242721	31-May	MK/DP	1035	29
FKP21	18	195		36N0326222, 0223139	01-Jun	MK/DP	715	27
FKP22	14	196	Masene FR	36N0326775, 0226119	01-Jun	MK/DP	830	29
FKP23	4.5	197		36N 0327502, 0237033	01-Jun	MK/DP	1005	31

Table Att3.2-3 Vegetation Percentage Cover for Native and Non-Native Plants[5]

Site	Bare	Native Vegetation Height (m)						Non-Native Vegetation Height (m)						Human Use					
		Nonwoody		Woody				Nonwoody		Woody									
		0–1	1–3	0–1	1–3	3–8	>8	0–1	1–3	0–1	1–3	3–8	>8	Cultivation	Fallow	Fire[6]	Tree Cutting	Grazing	People
F1	0	88	1	5	5	1	0	0	0	9.4	10	0	0	0	0	0	1	1	1
F2	0	62	0	28	26	9.2	0	0	0	5.5	0.8	0	0	0	0	0	0	2	0
F3	0	85	0	13	5		0	0	0	6.3	0	0	0	1	0	0	2	1	1
F4	0	88	0	11	8.3	0.8	0	0	0	2.5	1.7	0	0	0	0	0	1	2	0
F5	0	72	0	18	12	1.7	0	0	0	3.7	2.5	1.7	0	0	0	0	2	2	0
F6	0	65	0	23	28	5	0	0	0	8.8	16	11	3.8	1	0	0	1	1	1
F7	46	62	0	12	5.8	0.8	0	0	0	5	10	21	0	0	0	0	2	2	2
F8	20	97	2	3.7	5	12	0	0	0	1.7	0	0	0	0	0	0	1	0	0
F9	37	15	0	5	2.5	2.5	0	25	25	18	10	0	0	3	0	0	1	0	2
F10	33	45	0	34	35	10	0	0	0	0	0	0	0	0	0	0	0	2	1
F11	6.7	43	0	59	54	19	0	0	0	0	0	0	0	0	0	0	1	0	1
F12	56	0	1	54	2.8	1.5	0	0	0	0	0	0	0	0	0	0	0	3	1

[5] Refer to Attachment A3.1 Habitat Descriptions for details.

[6] Evidence of recent burning.

Table Att3.2-3 Vegetation Percentage Cover for Native and Non-Native Plants[5]

Site	Bare	Native Vegetation Height (m)						Non-Native Vegetation Height (m)						Human Use					
		Nonwoody		Woody				Nonwoody		Woody									
		0–1	1–3	0–1	1–3	3–8	>8	0–1	1–3	0–1	1–3	3–8	>8	Cultivation	Fallow	Fire[6]	Tree Cutting	Grazing	People
F13	30	33	0	38	36	11	0	0	0	0	0	0	0	0	0	0	0	0	0
F14	53	32	0	16	15	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0
F15	43	38	0	23	13	4.2	0	0	0	0	0	0	0	0	0	0	0	2	0
F16	37	33	0	30	22	3.7	0	0	0	0	0	0	0	0	0	0	0	1	0
F17	19	59	2.5	24	27	28	0	0	0	0	0	0	0	0	0	0	1	1	0
F18	53	41	0	10	11	3.3	0	0	0	0	0	0	0	0	0	0	0	2	1
F19	53	48	0	3.5	3.7	3.3	0	0	0	0	0	0	0	0	0	0	0	3	2
F20	49	53	0	12	8.3	3.3	0	0	0	0	0	0	0	1	1	0	1	2	2
F21	44	10	0	46	39	8.3	0	0	0	0	0	0	0	0	1	0	1	3	1
F22	60	12	0	28	33	8.7	0	0	0	0	0	0	0	0	0	0	1	3	1
F23	56	30	0	17	18	10	0	0	0	0	0	0	0	0	0	0	1	2	1

NOTES: Data are averages of six sites per 60-min counts.
Human data use is on a 0–5 scale, 1 being lowest level of use.

Table Att3.2-4 Species of Conservation Concern, Tilenga Feeder Pipeline Sites

Refer to Table A3.2-2 for survey site locations.

				Above Escarpment						Albert Flats South (Butiaba)						Bugungu WR							Lake Albert Flats North								
				F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b	F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23
Red Listed Species	Global	Critical	G-CR																												
		Endangered	G-EN												1					1										1	
		Vulnerable	G-VU																												
		Near Threatened	G-NT									1				1			1	1											
		Data Deficient	DD																												
	East African	Critical	R-CR																												
		Endangered	R-EN																												
		Vulnerable	R-VU																			1									
		Near Threatened	R-NT	1							1	1		2			1		2	2			3	1	1			1	3	3	2
		Data Deficient	DD																												

Table Att3.2-4 Species of Conservation Concern, Tilenga Feeder Pipeline Sites

Refer to Table A3.2-2 for survey site locations.

				Above Escarpment						Albert Flats South (Butiaba)						Bugungu WR							Lake Albert Flats North								
				F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b	F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23
		Regional Responsibility	R-RR	1				2	1	2	1	1	1	1	12	13		1	1	1	1	1	2	2	1				1	1	
	Uganda	Critical	U-CR																										1	
		Endangered	U-EN												1					1											
		Vulnerable	U-VU																1		1		1					1			
		Near Threatened	U-NT																		1							1			
		Data Deficient	DD																												
Habitat specialists	Forest specialist		FF																												
	Forest generalist		F		5	4	1	3	3	3	4	3	2	4	3		3	4	4	4	3	3	4	3	1	3	3	2	2	5	4
	Other tree species		f		23	19	10	14	15	14	10	13	7	8	10	9	10	10	15	13	13	15	14	13	13	10	13	11	14	13	14
	Water bird specialist		W			1			1			3				6	1	2	2	2	3	5	2							1	2
	Wetland visitor		w		4	6	1	4	5	3	5	8	2	2	3	7	10	4	9	7	4	6	4	6	4	1	4	4	5	3	6

Table Att3.2-4 Species of Conservation Concern, Tilenga Feeder Pipeline Sites

Refer to Table A3.2-2 for survey site locations.

			Above Escarpment						Albert Flats South (Butiaba)						Bugungu WR							Lake Albert Flats North								
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14a	F14b	F15a	F15b	F16a	F16b	F17	F18a	F19b	F19a	F18b	F20	F21	F22	F23
	Grassland specialist	G					4	2	1	4	2	1	2	1	1	6	3	4	2	6	5	6	3	2	1	5	2	4	2	2
	Aerial species	Ae		1	1	1	1	1	1	1		1			1	2	1	1	2	1	1	1	1	1	1		1	1		1

ATTACHMENT A3.3 DRY SEASON – TILENGA FEEDER PIPELINE TIMED SPECIES COUNT DATA

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
25	HELMETED GUINEAFOWL *Numida meleagris*	G								2	P		
34	SCALY FRANCOLIN *Pternistis squamatus*	F			3			4					
38	CRESTED FRANCOLIN *Dendroperdix sephaena*				3								
	RING-NECKED DOVE				3			1		6		4	3
62	RED-EYED DOVE *Streptopelia semitorquata*	f	6	6	5	3	2	5	5		5	5	4
64	LAUGHING DOVE *Streptopelia senegalensis*				4	6	5	2	4	6	6		6
	BLUE-SPOTTED WOOD DOVE *Turtur afer*	F			6				6		6		6
66	AFRICAN GREEN-PIGEON *Treron calvus*	F	6			4			2				

[7] Present outside count time refers to a chance sighting of a species, not within the TSC.

[8] FF = forest specialist; F = forest generalist; f = other tree species; W = waterbird specialist; w = wetland visitor; G = grassland specialist; Ae = aerial species; P = palearctic migrant; A = Afrotropical migrant

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
69	OVAMBO SPARROWHAWK Accipiter ovampensis	F	6	6	6	6	6	2		6		6	
70	TAMBOURINE DOVE *Turtur tympanistria*	F	4		5							1	
	LIZARD BUZZARD *Kaupifalco monogrammicus*	F			6								
82	LONG-TAILED NIGHTJAR *Caprimulgus climacurus*	A										1	
91	AFRICAN PALM SWIFT *Cypsiurus parvus*		6	4				2	4	3		5	6
104	WHITE-BROWED COUCAL *Centropus superciliosus*		6	5	5	5				6		4	
112	KLAAS' CUCKOO *Chrysococcyx klaas*	f								2		6	
114	DIEDERICK CUCKOO *Chrysococcyx caprius*		3							3			

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
118	RED-CHESTED CUCKOO *Cuculus solitarius*	AF	4										
125	EASTERN GREY PLANTAIN-EATER *Crinifer zonurus*		5		2	6		2					
	SHIKRA *Accipiter badius* (Little Banded Goshawk.)	F											p3
132	ROSS'S TURACO *Musophaga rossae*	F	4			5							
163	AFRICAN OPENBILL STORK *Anastomus lamelligerus* (African Openbill)	AwG											4
184	BLACK-HEADED HERON *Ardea melanocephala*	w											6
196	HADADA IBIS *Bostrychia hagedash*	w				4							
290	AFRICAN HARRIER-HAWK *Polyboroides typus* (Gymnogene)	f								3			
295	BATELEUR *Terathopius ecaudatus*	G											6

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
	BLACK-CHESTED SNAKE EAGLE *Circaetus pectoralis*			2									5
298	BROWN SNAKE EAGLE *Circaetus cinereus*		5										
308	LONG-CRESTED EAGLE *Lophaetus occipitalis*	F						2	4				
311	TAWNY EAGLE *Aquila rapax*	O					6						
314	AFRICAN HAWK-EAGLE *Aquila spilogaster*			p3									
337	BLACK KITE *Milvus migrans* (Race *M.parasiticus* sometimes treated as full species Yellow-billed Kite.)	pA	P								4		2
359	SPECKLED MOUSEBIRD *Colius striatus*		4	4		6	6	6	6	6	4	6	4
360	BLUE-NAPED MOUSEBIRD *Urocolius macrourus*					6		4		6	3		6
	CROWNED HORNBILL *Lophoceros alboterminatus*	f							4				6

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
379	EURASIAN HOOPOE *Upupa epops* (***Includes *africana*African Hoopoe)	p			1								
380	GREEN WOOD-HOOPOE *Phoeniculus purpureus* (Red-billed Wood-hoopoe)		2										
	RED-HEADED LOVEBIRD *Agapornis pullarius*	F					4						
383	BLACK SCIMITARBILL *Rhinopomastus aterrimus* (Black Wood-hoopoe)								6				
396	GREATER HONEYGUIDE *Indicator indicator* (Black-throated Honeyguide)	f	3							3			
401	NUBIAN WOODPECKER *Campethera nubica*					5		5				1	5
427	RED-FRONTED TINKERBIRD *Pogoniulus pusillus*				6	4							

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
428	YELLOW-FRONTED TINKERBIRD *Pogoniulus chrysoconus*	f	5	6				1	6	6	3	6	6
435	BLACK-BILLED BARBET *Lybius guifsobalito*												2
437	DOUBLE-TOOTHED BARBET *Pogonornis bidentatus*	f	3						4				
441	WHITE-THROATED BEE-EATER *Merops albicollis*	Af		1	6		6						
458	BROAD-BILLED ROLLER *Eurystomus glaucurus*	Afw					5						
460	AFRICAN PYGMY KINGFISHER *Ispidina picta*	fw	2										
467	GREY-HEADED KINGFISHER *Halcyon leucocephala* (Chestnut-bellied Kingfisher)	Afw		3	4								
468	STRIPED KINGFISHER *Halcyon chelicuti*									6			

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
476	GREY KESTREL *Falco ardosiaceus*				2								
502	RED-SHOULDERED CUCKOO-SHRIKE *Campephaga phoenicea*				3	5				4		2	
	COLLARED SUNBIRD *Anthodiaeta collaris*			5	1		3						
513	CHIN-SPOT BATIS *Batis molitor*	f										6	
515	WESTERN BLACK-HEADED BATIS *Batis erlangeri*	f											4
521	BROWN-THROATED WATTLE-EYE *Platysteira cyanea* (Common Wattle-eye)	f	2	4	6	3							
526	BLACK-AND-WHITE FLYCATCHER *Bias musicus* (Vanga Flycatcher)	f	4			6		2				5	
527	BRUBRU *Nilaus afer*									2			
529	GREY-HEADED BUSH-SHRIKE *Malaconotus blanchoti*		6	2	1			6				1	

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
533	NORTHERN PUFFBACK *Dryoscopus gambensis*	F			6				5			3	6
535	BROWN-CROWNED TCHAGRA *Tchagra australis* (Brown-headed Tchagra)			5	2								
537	BLACK-CROWNED TCHAGRA *Tchagra senegalus*		4			1		5		6			6
540	SULPHUR-BREASTED BUSH-SHRIKE *Cholorophoneus sulfureopectus* (Orange-breasted Bush-shrike)	f	4		3	5							
546	TROPICAL BOUBOU *Laniarius aethiopicus*	f	4	2	6	6	5	6	6			6	
548	BLACK-HEADED GONOLEK *Laniarius erythrogaster*	f	4	5	3	3	4	4		6	6	5	5
550	FORK-TAILED DRONGO *Dicrurus adsimilis* (Common Drongo)	f/F	3	4	2		6					5	
560	GREY-BACKED FISCAL *Lanius excubitoroides*	Afw									1		

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
	COMMON FISCAL *Lanius collaris*	G							1		4		
	COMMON SAND MARTIN *Riparia riparia* (Bank Swallow)	PW		4			4						
570	AFRICAN PARADISE-FLYCATCHER *Terpsiphone viridis*	f		2	3	5							
586	SCARLET-CHESTED SUNBIRD *Chalcomitra senegalensis*	f	1	2		4							
599	BEAUTIFUL SUNBIRD *Cinnyris pulchellus*			5							1	5	5
601	RED-CHESTED SUNBIRD *Cinnyris erythrocercus*	W								5			
607	VARIABLE SUNBIRD *Cinnyris venustus*	f	6			1							
608	COPPER SUNBIRD *Cinnyris cupreus*	fw	6			3	2	2					6
	LITTLE GREENBUL *Eurillas virens*	F			2								

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
616	GROSBEAK WEAVER *Amblyospiza albifrons* (Thick-billed Weaver)	fW				3							
621	BLACK BISHOP *Euplectes gierowii*	w				4		6				6	
623	NORTHERN RED BISHOP *Euplectes franciscanus*	G						6				1	
627	WHITE-WINGED WIDOWBIRD *Euplectes albonotatus*	G						5					
	YELLOW-MANTLED WIDOWBIRD *Euplectes macroura*	G									4		
631	BAGLAFECHT WEAVER *Ploceus baglafecht*	f			1	5		4			1		6
632	LITTLE WEAVER *Ploceus luteolus*		6		2					5		5	
634	SPECTACLED WEAVER *Ploceus ocularis*	f	6	1			6			6			5

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
643	LESSER MASKED WEAVER *Ploceus intermedius*									P			
646	BLACK-HEADED WEAVER *Ploceus cucullatus* (Village Weaver)		2	6	2	6	5	6	4	1	6	1	6
	VIEILLOT'S BLACK WEAVER *Ploceus nigerrimus*	f									6		
652	GOLDEN-BACKED WEAVER *Ploceus jacksoni* (Jackson's Golden-backed Weaver)	w										5	
665	RED-BILLED FIREFINCH *Lagonosticta senegala*							5		6	2		
667	AFRICAN FIREFINCH *Lagonosticta rubricata* (Blue-billed Firefinch)												3
670	RED-WINGED PYTILIA *Pytilia phoenicoptera*					2							
676	RED-CHEEKED CORDON-BLEU *Uraeginthus bengalus*		6	1	6	5	3	6	4	4	6	2	6

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
685	COMMON WAXBILL *Estrilda astrild*	wG							4	1	6		
686	BLACK-CROWNED WAXBILL *Estrilda nonnula*	f	6					4					
688	BLACK-FACED WAXBILL *Estrilda erythronotos* (Includes Black-cheeked Waxbill *E.charmosyna)*									2			
705	BRONZE MANNIKIN *Spermestes cucullata*		6			6			5	p		4	3
706	BLACK-AND-WHITE MANNIKIN *Spermestes bicolo*r (Red-backed Mannikin)	f				3							3
709	PIN-TAILED WHYDAH *Vidua macroura*	G						4					
713	VILLAGE INDIGOBIRD *Vidua chalybeata* (Red-billed Firefinch Indigobird)							3					

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
717	NORTHERN GREY-HEADED SPARROW *Passer griseus* (Parrot-billed Sparrow)			P			1	3	1		6	6	6
742	YELLOW-FRONTED CANARY *Crithagra mozambica*			5	5	3	4	6	2			2	1
787	RED-FACED CROMBEC *Sylvietta whytii*	F		4						5			
799	RED-WINGED GREY WARBLER *Drymocichla incana*	w			1								
	MOUSTACHED GRASS WARBLER *Melocichla mentalis (*African Moustached Warbler)								3				
802	YELLOW-BREASTED APALIS *Apalis flavida*	f										2	
811	BUFF-BELLIED WARBLER *Phyllolais pulchella*	f	1	4	1								5
814	GREY-BACKED CAMAROPTERA *Camaroptera brachyura*	f	6	6	6	6	5	5	5	6	6	5	6

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
817	GREY-CAPPED WARBLER *Eminia lepida*	fw	6							6			
	WILLOW WARBLER *Phylloscopus trochilus*	Pf		1									
818	RED-FACED CISTICOLA *Cisticola erythrops*	w			6	6	4	6	2	6	4	6	6
821	TRILLING CISTICOLA *Cisticola woosnami*			3			5		4				
831	CROAKING CISTICOLA *Cisticola natalensis*	G						5					
834	SHORT-WINGED CISTICOLA *Cisticola brachypterus* (Siffling Cisticola)									4	5		
841	TAWNY-FLANKED PRINIA *Prinia subflava*	fw	6	6	6	6	6	6	4	6	6		6
882	ANGOLA SWALLOW *Hirundo angolensis*	w				4	3						
914	COMMON BULBUL *Pycnonotus barbatus* (Yellow-vented Bulbul)	f	6	6	6	6	5	6	6	6	5	6	6

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
	PIED CROW *Corvus albus*										6		
933	NORTHERN YELLOW WHITE-EYE *Zosterops senegalensis*	f				1		6		P		2	
941	BLACK-LORED BABBLER *Turdoides sharpei* (Sharpe's Pied Babbler)		6					3					
943	BROWN BABBLER *Turdoides plebejus*										3		3
944	ARROW-MARKED BABBLER *Turdoides jardineii*					2							
958	RUPPELL'S STARLING *Lamprotornis purpuroptera* (Rüppell's Long-tailed Starling)					4		3	6	4			
961	LESSER BLUE-EARED STARLING *Lamprotornis chloropterus* (Glossy Starling)					5				1			2
965	VIOLET-BACKED STARLING *Cinnyricinclus leucogaster* (Plum-coloured Starling)	Af				6				4			

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
970	BROWN-BACKED SCRUB-ROBIN *Cercotrichas hartlaubi*	f	6							6		4	
971	WHITE-BROWED SCRUB-ROBIN *Cercotrichas leucophrys*		6	3		6							4
985	PALE FLYCATCHER *Bradornis pallidus* (Mouse-coloured Flycatcher)			4		5							
	NORTHERN BLACK FLYCATCHER *Melaenornis edolioides*			2									
994	WHITE-BROWED ROBIN-CHAT *Cossypha heuglini*	f		5	5	5		6		6	P		2
996	SNOWY-CROWNED ROBIN-CHAT *Cossypha niveicapilla*	Fw			2					5			
	MARICO SUNBIRD *Cinnyris mariquensis* (Mariqua Sunbird)			3	4		3						
	NORTHERN WHEATEAR *Oenanthe oenanthe*	P									5		

Table Att3.3-1 Timed Species Count Data for Tilenga Feeder Pipeline in Sites Above Escarpment

P = present outside count time; p = probable[7]. Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology [8] (Habitat)	FKP81/1	FKP81/2	FKP81/3	FKP84/1	FKP84/2	FKP73/1	FKP73/2	FKP69/1	FKP69/2	FKP65/1	FKP65/2
1019	SOOTY CHAT *Myrmecocichla nigra*							4	1				
1037	AFRICAN THRUSH *Turdus pelios*	f	1		4	4		3		5		5	
Number of species per site			43	36	43	46	26	41	28	40	27	36	40
Total number of species			133										

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road

FKP55 represents lower part of escarpment and FK56 the upper part.

Numbers represent presence in the TSC.

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	STRUTHIONIDAE																										
25	HELMETED GUINEAFOWL *Numida meleagris*	G						1													P			3			
38	CRESTED FRANCOLIN *Dendroperdix sephaena*					5			6	5		5		4	6	6	1	6		5	4	5	3	6	6		6
	RING-NECKED DOVE				6	5	6	1	5	5	2	5	5	6	4			5	4				3	6	6	3	
61	AFRICAN MOURNING DOVE *Streptopelia decipiens*					2											3				6	6				2	
62	RED-EYED DOVE *Streptopelia semitorquata*	f			6		6	3		1		6	6	2					6		5	5	3	5	5		6
63	VINACEOUS DOVE *Streptopelia vinacea - hybrid*				6	6	P	6	6	6		6	6	6	6	6		4	6		6	6		6			6

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	VINACEOUS DOVE HYBRID									6			1											2			
64	LAUGHING DOVE *Streptopelia senegalensis*						6	1			1																
	BLUE-SPOTTED WOOD DOVE *Turtur afer*	F			2	6		6	6		2	6			6	6	6			6		6			6	6	6
68	BLACK-BILLED WOOD DOVE *Turtur abyssinicus*																P				6	2				5	
66	AFRICAN GREEN-PIGEON *Treron calvus*	F																									1
69	OVAMBO SPARROWHAWK Accipiter ovampensis	F		6						5			4	3				6	3				6	6			
70	TAMBOURINE DOVE *Turtur tympanistria*	F		5			5		1			3	3					1	1	5	5						

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	LIZARD BUZZARD *Kaupifalco monogrammicus*	F																							4	
82	LONG-TAILED NIGHTJAR *Caprimulgus climacurus*	A	A																			6				
91	AFRICAN PALM SWIFT *Cypsiurus parvus*				1				6	2	6	6	1	4			1	2	4		1	4	2	5		3	4
94	WHITE-RUMPED SWIFT *Apus caffer*																							6		
100	COMMON SWIFT *Apus apus*	P	PM									1			6											
155	BLACK-BELLIED BUSTARD *Lissotis melanogaster*																4									
104	WHITE-BROWED COUCAL *Centropus superciliosus*						6	6	3	2	1	6	4	5	2	5	4		3	6	6	6		6	6	3	5

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107	JACOBIN CUCKOO *Clamator jacobinus* (Black-and-white Cuckoo)	A											**5**														
112	KLAAS' CUCKOO *Chrysococcyx klaas*	f		**4**		**4**		**6**		**3**		**6**		**2**	**4**								**2**	**3**		**6**	
114	DIEDERICK CUCKOO *Chrysococcyx caprius*						**4**			**2**									**6**				**2**	**2**			
118	RED-CHESTED CUCKOO *Cuculus solitarius*	AF		**2**			**6**																**4**	**3**			
125	EASTERN GREY PLANTAIN-EATER *Crinifer zonurus*									**4**				**2**		**1**					**4**		**6**				
131	WHITE-CRESTED TURACO *Tauraco leucolophus*	F												**2**													
152	GREY-CROWNED CRANE *Balearica regulorum*	WG	VU,R-NT, U-EN									**1**				**1**			***5***								

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161	MARABOU STORK *Leptoptilos crumeniferus*	w			6				5	5	6	1			2		6	2		4			4		3	1	
163	AFRICAN OPENBILL STORK *Anastomus lamelligerus* (African Openbill)	AwG								3									4				4				
166	AFRICAN WOOLLYNECK *Ciconia microscelisCiconia microscelis*	W	R-NT, U-VU															2									
170	PINK-BACKED PELICAN *Pelecanus rufescens*	W																				P					
171	HAMERKOP *Scopus umbretta*	w					2	4					4	5		6							6			P	
182	CATTLE EGRET *Bubulcus ibis*	G						5				1	5			4	5				4					2	

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184	BLACK-HEADED HERON *Ardea melanocephala*	w					**5**				**5**	**6**	**P**								**P**				**1**		
186	PURPLE HERON *Ardea purpurea*	W	R-NT																							**6**	
465	PIED KINGFISHER *Ceryle rudis*	W																									**6**
139	BLACK CRAKE *Zapornia flavirostra*	W																									**6**
187	GREAT WHITE EGRET *Ardea alba* (Great Egret)	W	R-VU																					**P**			
196	HADADA IBIS *Bostrychia hagedash*	w								**4**		**5**		**5**		**6**	**3**				**2**			**6**	**5**	**2**
227	AFRICAN WATTLED LAPWING *Vanellus senegallus* (Plover)	W							**2**		**4**	**6**			**6**	**4**	**6**		**3**		**3**		**P**		**4**	
202	SENEGAL THICK-KNEE *Burhinus senegalensis*	W															**3**									

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286	BLACK-SHOULDERED KITE *Elanus caeruleus*	G																						1			
290	AFRICAN HARRIER-HAWK *Polyboroides typus* (Gymnogene)	f			5						6																
323	AFRICAN MARSH HARRIER *Circus ranivorus*		R-NT																		3						
	MONTAGU'S HARRIER *Circus pygargus*	P	PM, R-NT, U-NT								6						3										
	PALLID HARRIER *Circus macrourus*	P	G-NT, R-NT, U-CR, PM								3																
291	PALM-NUT VULTURE *Gypohierax angolensis*													4				P								6	2

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295	BATELEUR *Terathopius ecaudatus*	G	R-NT							3					3			6	3								
	BLACK-CHESTED SNAKE EAGLE *Circaetus pectoralis*								4											5							1
298	BROWN SNAKE EAGLE *Circaetus cinereus*		R-NT									3										5					
308	LONG-CRESTED EAGLE *Lophaetus occipitalis*	F			6													1									
311	TAWNY EAGLE *Aquila rapax*	O								p2					3			4									
314	AFRICAN HAWK-EAGLE *Aquila spilogaster*																								2	1	
316	WAHLBERG'S EAGLE *Hieraaetus wahlbergi*																			3							

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320	DARK CHANTING-GOSHAWK *Melierax metabates*				5						6			P					5				1	P			
336	AFRICAN FISH EAGLE *Haliaeetus vocifer*	W														5	2			5			6		5	6	4
337	BLACK KITE *Milvus migrans*	pA	PM		6		1				1	6			5	3		5		6	6	2			2	4	5
359	SPECKLED MOUSEBIRD *Colius striatus*			4		4	2	5	6			6	6	6	6	4	6	5	5	6	6	5	6	4	6	6	4
360	BLUE-NAPED MOUSEBIRD *Urocolius macrourus*			4	4	6		5	2	P		6			5	6	3		5	2	6	5	6		5	3	3
363	ABYSSINIAN GROUND-HORNBILL *Bucorvus abyssinicus*																							P			
	CARDINAL WOODPECKER *Dendropicos fuscescens*				5			5							2					6	4	6					

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370	AFRICAN GREY HORNBILL *Lophoceros nasutus*				1	5	4	6	6	2	5	5				6	5				3	5		4			5
379	EURASIAN HOOPOE *Upupa epops* (***Includes *africana*African Hoopoe)	p	PM		4									1	4		3										
396	GREATER HONEYGUIDE *Indicator indicator* (Black-throated Honeyguide)	f													1	3	P										
401	NUBIAN WOODPECKER *Campethera nubica*						6	3	4					4		5	1	6	5	6							1
413	GREY WOODPECKER *Mesopicos goertae*	f																5	6								
427	RED-FRONTED TINKERBIRD *Pogoniulus pusillus*																		5				6				

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428	YELLOW-FRONTED TINKERBIRD *Pogoniulus chrysoconus*	f		5	4	5	6	6	5	6		4	6	6	6	1		6	6	5	4	6		6		6	
431	SPOT-FLANKED BARBET *Tricholaema lachrymosa*		R-RR									2			4	3				6	3	3			6	5	1
435	BLACK-BILLED BARBET *Lybius guifsobalito*				6	5	6	5	5			5		2	6	5	4	6	6		5		6			4	3
437	DOUBLE-TOOTHED BARBET *Pogonornis bidentatus*	f										4															2
440	RED-THROATED BEE-EATER *Merops bulocki*	W						6	4				3	5	6			6	5				5				
441	WHITE-THROATED BEE-EATER *Merops albicollis*	Af	AM															4					3				

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445	MADAGASCAR BEE-EATER *Merops superciliosus*	A	AM											1				3					2				
448	SWALLOW-TAILED BEE-EATER *Merops hirundineus*	A	R-NT			2							6		2	6				6		1			2	5	
458	BROAD-BILLED ROLLER *Eurystomus glaucurus*	Afw													3												
460	AFRICAN PYGMY KINGFISHER *Ispidina picta*	fw							2	3	2	4	4	5	3	5	P		5						6	5	5
467	GREY-HEADED KINGFISHER *Halcyon leucocephala* (Chestnut-bellied Kingfisher)	Afw			6	4	2	6	3				5	5	6	6						1			3	6	1
468	STRIPED KINGFISHER *Halcyon chelicuti*			1	3		5	2	4	4		5		3	5	5	6		6	6	6	2					

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470	WOODLAND KINGFISHER *Halcyon senegalensis*	A								2			5	6		6		1	3				5	2			5
476	GREY KESTREL *Falco ardosiaceus*																							P		2	
473	COMMON KESTREL *Falco tinnunculus* (includes *rufescens* sometimes referred to as Rock Kestrel)	P	PM												2												
	COLLARED SUNBIRD *Anthodiaeta collaris*											2									2						
515	WESTERN BLACK-HEADED BATIS *Batis erlangeri*	f																				5				6	
521	BROWN-THROATED WATTLE-EYE *Platysteira cyanea* (Common Wattle-eye)	f		5		6	2	5		P			3	6		5		P	1	3	6		5	4	5	5	6
527	BRUBRU *Nilaus afer*				5														1		5						

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529	GREY-HEADED BUSH-SHRIKE *Malaconotus blanchoti*						6	2		4			3			3					6						1
	ISABELLINE SHRIKE *Lanius isabellinus*	P	PM								5	1																
563	WOODCHAT SHRIKE *Lanius senator*	P	PM								4	1																
533	NORTHERN PUFFBACK *Dryoscopus gambensis*	F		2		6				6			6	5	5		1	4	6	5			6	4	5	5	6
535	BROWN-CROWNED TCHAGRA *Tchagra australis* (Brown-headed Tchagra)			4		6	6						2	4				1	5				1				
537	BLACK-CROWNED TCHAGRA *Tchagra senegalus*			5	4		1		5	6		6	6	6	5	6	3	6	4	4	6	6	2	4		2	6

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540	SULPHUR-BREASTED BUSH-SHRIKE *Cholorophoneus sulfureopectus* (Orange-breasted Bush-shrike)	f											5	6		6		3	5		4	1	4	4	5		
	BARN SWALLOW *Hirundo rustica* (Eurasian Swallow)	Pw	PM		6				6		5	5			2		6			6		6			3	6	5
548	BLACK-HEADED GONOLEK *Laniarius erythrogaster*	f		5	4	6	1	4	2	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
550	FORK-TAILED DRONGO *Dicrurus adsimilis* (Common Drongo)	f/F																	4		1						
560	GREY-BACKED FISCAL *Lanius excubitoroides*	Afw									4	1						4	5		4						

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road

FKP55 represents lower part of escarpment and FK56 the upper part.

Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
	COMMON SAND MARTIN *Riparia riparia* (Bank Swallow)	PW	PM									1								3						5	6
570	AFRICAN PARADISE-FLYCATCHER *Terpsiphone viridis*	f								1			5	5				1	5		3	1	6	6			
586	SCARLET-CHESTED SUNBIRD *Chalcomitra senegalensis*	f				4									2		3			3	1		3				6
599	BEAUTIFUL SUNBIRD *Cinnyris pulchellus*					5	6			2		5	6	5	2	4		6	4	6	2	5	5	3		5	
607	VARIABLE SUNBIRD *Cinnyris venustus*	f				5						3								3							1
608	COPPER SUNBIRD *Cinnyris cupreus*	fw							6						5	2						6			5	6	

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road

FKP55 represents lower part of escarpment and FK56 the upper part.

Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
890	YELLOW-THROATED GREENBUL *Atimastillas flavicollis* (Yellow-throated Leaflove)	f																									**4**
662	RED-HEADED WEAVER *Anaplectes rubriceps*	G																									**3**
	SPECKLED-FRONTED WEAVER *Sporopipes frontalis*				**3**																						
619	RED-BILLED QUELEA *Quelea quelea*	A		**6**			**4**			**6**		**2**	**5**	**5**	**2**				**3**				**5**	**3**		**5**
623	NORTHERN RED BISHOP *Euplectes franciscanus*	G								**2**							**2**						**4**				
624	BLACK-WINGED BISHOP *Euplectes hordeaceus* (Fire-crowned Bishop)									**1**													**1**				

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road

FKP55 represents lower part of escarpment and FK56 the upper part.

Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
631	BAGLAFECHT WEAVER *Ploceus baglafecht*	f				**5**																					
632	LITTLE WEAVER *Ploceus luteolus*			**5**			**6**						**6**					**1**	**5**				**6**	**5**			
634	SPECTACLED WEAVER *Ploceus ocularis*	f						**3**	**3**						**5**		**6**			**6**	**6**	**6**			**5**		**5**
643	LESSER MASKED WEAVER *Ploceus intermedius*															**6**						**2**					
644	VITELLINE MASKED WEAVER *Ploceus vitellinus*						**P**											**5**									
646	BLACK-HEADED WEAVER *Ploceus cucullatus* (Village Weaver)													**6**										**3**			

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road

FKP55 represents lower part of escarpment and FK56 the upper part.

Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
651	YELLOW-BACKED WEAVER *Ploceus melanocephalus* (Black-headed Weaver)	W								3		6	4	2						4		2	4	6	6		6
665	RED-BILLED FIREFINCH *Lagonosticta senegala*			5		6	5	2	4	4			4	P	5		2		2		6	6		5	5	2	
667	AFRICAN FIREFINCH *Lagonosticta rubricata* (Blue-billed Firefinch)																					3					
672	GREEN-WINGED PYTILIA *Pytilia melba* (Melba Finch)							6																			
676	RED-CHEEKED CORDON-BLEU *Uraeginthus bengalus*			6	6	6	6	6	4	6	6	4	6	6	6	1	2		1	6	6	6	3	5	4		
683	CRIMSON-RUMPED WAXBILL *Estrilda rhodopyga*						5															6					

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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FKP55 represents lower part of escarpment and FK56 the upper part.

Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
685	COMMON WAXBILL *Estrilda astrild*	wG		**5**																	**6**						
686	BLACK-CROWNED WAXBILL *Estrilda nonnula*	f																						**2**			
705	BRONZE MANNIKIN *Spermestes cucullata*																	**5**			**6**		**6**	**6**			
709	PIN-TAILED WHYDAH *Vidua macroura*	G				**3**				**P**			**4**	**6**									**2**	**4**			
716	RUFOUS SPARROW *Passer cordofanicus* (includes Shelley's Rufous Sparrow *P.shelleyi*)		R-RR	**3**	**1**		**6**	**3**								**5**			**5**								
717	NORTHERN GREY-HEADED SPARROW *Passer griseus* (Parrot-billed Sparrow)									**1**					**1**												

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road
FKP55 represents lower part of escarpment and FK56 the upper part.
Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
753	CINNAMON-BREASTED ROCK BUNTING *Fringillaria tahapisi*					3		5																		
258	KURRICHANE BUTTONQUAIL *Turnix sylvaticus* (Common Button-quail)	G										5								3						
703	AFRICAN QUAILFINCH *Ortygospiza atricollis* (includes Black-chinned Quailfinch *O.gabonensis)*	WG				3									4										3	
732	YELLOW WAGTAIL *Motacilla flava*	P	PM						2		6				5	5	5							2	3	2
733	AFRICAN PIED WAGTAIL *Motacilla aguimp*	w										1			4											

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
728	YELLOW-THROATED LONGCLAW *Macronyx croceus*	G				5									5	4	5		5								
742	YELLOW-FRONTED CANARY *Crithagra mozambica*					2																					
781	FLAPPET LARK *Mirafra rufocinnamomea*	G		5	1	6	5	6	6	6	3	3	5	5	5	5		2	4		3	5	3	4	6	3	3
947	YELLOW-BILLED OXPECKER *Buphagus africanus*		RVU													4	5										
787	RED-FACED CROMBEC *Sylvietta whytii*	F					5						2											P2			
	NORTHERN CROMBEC *Sylvietta brachyura*				2			2													2	3					

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
725	PLAIN-BACKED PIPIT *Anthus leucophrys*	G															5										
	MOUSTACHED GRASS WARBLER *Melocichla mentalis (*African Moustached Warbler)					4						3				5				4	2	2			5		
811	BUFF-BELLIED WARBLER *Phyllolais pulchella*	f										3									3	6				5	
814	GREY-BACKED CAMAROPTERA *Camaroptera brachyura*	f		6	6	6	6	6	6	6	5	6	6	6	6	5	2	6	6	6	6	6	6	6	6	6	6
817	GREY-CAPPED WARBLER *Eminia lepida*	fw	R-RR							5				4		2	4	5		6		3	6	6	6	6	6
818	RED-FACED CISTICOLA *Cisticola erythrops*	w		6						3		3		3		4		2								6	6

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
821	TRILLING CISTICOLA *Cisticola woosnami*																						6	6			2
825	RATTLING CISTICOLA *Cisticola chiniana*			1			6	5	3	6	4	6	6	5	6	6	4	5	5	5	6	6	5	6	6	5	6
828	WINDING CISTICOLA *Cisticola marginatus*	w								1				3		4		5					4	P			6
831	CROAKING CISTICOLA *Cisticola natalensis*	G												4							5						
837	ZITTING CISTICOLA *Cisticola juncidis* (Fan-tailed Cisticola)	wG								4				6			1		5	3	4	3	1	6		2	1
841	TAWNY-FLANKED PRINIA *Prinia subflava*	fw			4	6			6	6	6	6				5	5	2			4	1	5		1		
873	LESSER STRIPED SWALLOW *Cecropis abyssinica*									P																6	

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
882	ANGOLA SWALLOW *Hirundo angolensis*	w						2	4		1	5						p3									
914	COMMON BULBUL *Pycnonotus barbatus* (Yellow-vented Bulbul)	f		6	6	6	6	6	6		6	6	6	6	6	4	6	6		6	6	6	6	4	6	6	6
933	NORTHERN YELLOW WHITE-EYE *Zosterops senegalensis*	f												6										1			
941	BLACK-LORED BABBLER *Turdoides sharpei* (Sharpe's Pied Babbler)													4					5					6			
943	BROWN BABBLER *Turdoides plebejus*					4		2	5			5				2	1			4	1	4			4	2	6
944	ARROW-MARKED BABBLER *Turdoides jardineii*													1													
958	RUPPELL'S STARLING				6	2	1	1	6		4	5	5	6	6	6	6	6	6	5	6	6		3	2		5

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
	Lamprotornis purpuroptera (Rüppell's Long-tailed Starling)																										
961	LESSER BLUE-EARED STARLING *Lamprotornis chloropterus* (Glossy Starling)			6	5	1	5	4	5																		
965	VIOLET-BACKED STARLING *Cinnyricinclus leucogaster* (Plum-coloured Starling)	Af	AM													1											
970	BROWN-BACKED SCRUB-ROBIN *Cercotrichas hartlaubi*	f		5		1	4					4							3				2	6			
971	WHITE-BROWED SCRUB-ROBIN *Cercotrichas leucophrys*				3	6	4	4								4	4	2	6		5		3		3	2	
985	PALE FLYCATCHER *Bradornis pallidus*												p2									6					

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
	(Mouse-coloured Flycatcher)																										
991	SILVERBIRD *Empidornis semipartitus*			4								1	1		4		2		4	4	5						
994	WHITE-BROWED ROBIN-CHAT *Cossypha heuglini*	f					3							4					6				5	5		2	
996	SNOWY-CROWNED ROBIN-CHAT *Cossypha niveicapilla*	Fw								4				1													
1003	SPOTTED PALM-THRUSH *Cichladusa guttata* (Spotted Morning Thrush)			4		6		6	3	5	4	5	6	6	6	6	6	6	5	3	6	3	5	5	4	6	6
	MARICO SUNBIRD *Cinnyris mariquensis* (Mariqua Sunbird)																										5
862	EURASIAN REED WARBLER	Pw	PM					6								3	6			5	2	5			5	5	5

Table Att3.3-2 Timed Species Count Data for Tilenga Feeder Pipeline in the Bugungu Wildlife Reserve

P = present outside count time; p = probable; *sites along the pipeline climbing the escarpment, similar habitat to those on escarpment road
FKP55 represents lower part of escarpment and FK56 the upper part.
Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP(56*)/1	FKP(56)/2	FKP(56)/3	FKP*(55)/1	FKP(55)/2	FKP(55)/3	FKP39-41/1	FKP39-41/2	FKP39-41/3	FKP29/1	FKP29/2	FKP29/3	FKP29/4	FKP29/5	FKP25/1	FKP25/2	FKP25/3	FKP25/4	FKP25/5	FKP34/1	FKP34/2	FKP34/3	FKP34/4	FKP34/5
	Acrocephalus scirpaceus																										
	NORTHERN WHEATEAR *Oenanthe oenanthe*	P	PM																						1		
1019	SOOTY CHAT *Myrmecocichla nigra*			6																							
1028	MOCKING CLIFF CHAT *Thamnolaea cinnamomeiventris* (Cliff Chat)			3		4	3	6																			
1016	WHINCHAT *Saxicola rubetra*	P	PM														3								2		1
1037	AFRICAN THRUSH *Turdus pelios*	f		5	1		2	4	1					6		2		6					5				
Number of species per site				31	34	40	41	43	39	43	30	56	41	54	50	54	46	44	52	40	55	50	51	49	44	51	55
Total Number of species				174																							

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

P = present outside count time; p = probable
**** Numbers of birds in italics
Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP47/1	FKP47/2	FKP47/3	FKP45/1	FKP45[b]/2	FKP7/1	FKP7/2	FKP7/3	FKP7/5	FKP7/5	FKP9/1	FKP9/2	FKP9/3	FKP9/4	FKP18/1	FKP18/2	FKP18/3	FKP18/4	FKP14/1	FKP14/2	FKP14/3	FKP14/4
25	HELMETED GUINEAFOWL *Numida meleagris*	G																5							
34	SCALY FRANCOLIN *Pternistis squamatus*	F																P							
38	CRESTED FRANCOLIN *Dendroperdix sephaena*				1						1		6					6		6				4	
	RING-NECKED DOVE			3	3	6	5	5	6		3	5			6			2					1		
61	AFRICAN MOURNING DOVE *Streptopelia decipiens*							2			2	6	6				6		1	4	4		6		4
62	RED-EYED DOVE *Streptopelia semitorquata*	f		6	6	6	5											3	3	1					
63	VINACEOUS DOVE *Streptopelia vinacea (hybrid)*				3	1	2	6	6	6	5	6	6	6	6	6		6	6	6	6	6		6	6
	VINACEOUS DOVE HYBRID			2						4							6								

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

P = present outside count time; p = probable
**** Numbers of birds in italics
Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP47/1	FKP47/2	FKP47/3	FKP45/1	FKP45[b]/2	FKP7/1	FKP7/2	FKP7/3	FKP7/5	FKP7/5	FKP9/1	FKP9/2	FKP9/3	FKP9/4	FKP18/1	FKP18/2	FKP18/3	FKP18/4	FKP14/1	FKP14/2	FKP14/3	FKP14/4
64	LAUGHING DOVE *Streptopelia senegalensis*					2			4					5			3				1	4		3	
	BLUE-SPOTTED WOOD DOVE *Turtur afer*	F			6	6		6					6				6		6	6	6		6	4	
68	BLACK-BILLED WOOD DOVE *Turtur abyssinicus*					1					3		2			2			3		4		4	6	5
66	AFRICAN GREEN-PIGEON *Treron calvus*	F			6						6		4							2					
69	OVAMBO SPARROWHAWK Accipiter ovampensis	F		4					6					6	6			6				6			
70	TAMBOURINE DOVE *Turtur tympanistria*	F		6	6	3				6					5	5		1	3		5		5		
198	LONG-TAILED CORMORANT *Microcarbo africanus* (Reed Cormorant)	W			6																				

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP47/1	FKP47/2	FKP47/3	FKP45/1	FKP45[b]/2	FKP7/1	FKP7/2	FKP7/3	FKP7/5	FKP7/5	FKP9/1	FKP9/2	FKP9/3	FKP9/4	FKP18/1	FKP18/2	FKP18/3	FKP18/4	FKP14/1	FKP14/2	FKP14/3	FKP14/4
91	AFRICAN PALM SWIFT *Cypsiurus parvus*				5	5	3	6	2	6	6	4		5			3							2	
94	WHITE-RUMPED SWIFT *Apus caffer*							4																	
104	WHITE-BROWED COUCAL *Centropus superciliosus*			6	4	6		6	5		1		2			3		6		6			2		4
107	JACOBIN CUCKOO *Clamator jacobinus* (Black-and-white Cuckoo)	A												1											
109	GREAT SPOTTED CUCKOO *Clamator glandarius*	P	PM											3*											
112	KLAAS' CUCKOO *Chrysococcyx klaas*	f			3				3	4			6		6		5	4						2	
114	DIEDERICK CUCKOO *Chrysococcyx caprius*			5		3	6		1	6				6	5		3					2			

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118	RED-CHESTED CUCKOO *Cuculus solitarius*	AF		**6**											**3**			**6**				**5**			
125	EASTERN GREY PLANTAIN-EATER *Crinifer zonurus*				**5**	**2**																			
	SHIKRA *Accipiter badius* (Little Banded Goshawk.)	F				**1**																			
152	GREYCROWNED CRANE *Balearica regulorum*	WG	VU,R-NT, U-EN			**5**	**19**	**4**					**P**									******2**			
161	MARABOU STORK *Leptoptilos crumeniferus*	w																	**2**						
163	AFRICAN OPENBILL STORK *Anastomus lamelligerus* (African Openbill)	AwG				**2**															**5**				
165	ABDIM'S STORK *Ciconia abdimii*	AG	AM	**3**																					

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166	AFRICAN WOOLLYNECK *Ciconia microscelis*	W	R-NT, U-VU	**2**																					
170	PINK-BACKED PELICAN *Pelecanus rufescens*	W		**P**																					
171	HAMERKOP *Scopus umbretta*	w		**6**																					
477	RED-NECKED FALCON *Falco chicquera*	P	R-NT,P								**4**												**1**		
182	CATTLE EGRET *Bubulcus ibis*	G			**6**	**3**	**20**	**6**					**6**												
183	GREY HERON *Ardea cinerea*	W	R-NT				**5**																		
184	BLACK-HEADED HERON *Ardea melanocephala*	w				**2**	**3**		**2**	**6**	**3**														
177	BLACK-CROWNED NIGHT HERON *Nycticorax nycticorax*	pW	PM		**4**	**5**																			

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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462	MALACHITE KINGFISHER *Corythornis cristata*	W			**4**																				
465	PIED KINGFISHER *Ceryle rudis*	W				**5**																			
179	SQUACCO HERON *Ardeola ralloides*	W			**4**						**1**														
188	INTERMEDIATE EGRET *Ardea intermedia* (Yellow-billed Egret)	W					**P**																		
196	HADADA IBIS *Bostrychia hagedash*	w		**6**	**5**	**6**	**P**	**5**			**2**		**1**												
222	SPUR-WINGED LAPWING *Vanellus spinosus* (Plover)	WG					**4**																		
227	AFRICAN WATTLED LAPWING *Vanellus senegallus* (Plover)	W			**5**	**3**	**P**												**6**						
223	BLACK-HEADED LAPWING *Vanellus tectus* (Plover)	G				**1**																			

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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204	SPOTTED THICK-KNEE *Burhinus capensis* (Spotted Dikkop)																								2
231	JACANA *Actophilornis africana*	W					P																		
286	BLACK-SHOULDERED KITE *Elanus caeruleus*	G									4														6
290	AFRICAN HARRIER-HAWK *Polyboroides typus* (Gymnogene)	f					2					2													
323	AFRICAN MARSH HARRIER *Circus ranivorus*		R-NT					6																	
295	BATELEUR *Terathopius ecaudatus*	G	R-NT					3			P	6							3						
	BLACK-CHESTED SNAKE EAGLE *Circaetus pectoralis*							1				4				5			5		5				6
311	TAWNY EAGLE *Aquila rapax*	O														3			6						

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314	AFRICAN HAWK-EAGLE *Aquila spilogaster*											1			4										
316	WAHLBERG'S EAGLE *Hieraaetus wahlbergi*											1													
320	DARK CHANTING-GOSHAWK *Melierax metabates*						1		P	2									P						2
326	AFRICAN GOSHAWK *Accipiter tachiro*	F											5												
	EASTERN CHANTING-GOSHAWK**													P**											
336	AFRICAN FISH EAGLE *Haliaeetus vocifer*	W		2		4																			
337	BLACK KITE *Milvus migrans* (Race *M.parasiticus* sometimes treated as full species Yellow-billed Kite.)	pA	PM						2			3	5		3	5	3		6	6	5	5			

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359	SPECKLED MOUSEBIRD *Colius striatus*			4	4	6	1	5	5	5	5	6	6	5	4	6	6	6	4	6	6	6	5	6	6
360	BLUE-NAPED MOUSEBIRD *Urocolius macrourus*			3	5	4		6			6		5	5	1	5	6	5	3	6	2		6	2	6
	CARDINAL WOODPECKER *Dendropicos fuscescens*							3					5			3				1				3	
	BLACK-AND-WHITE CASQUED HORNBILL *Bycanistes subcylindricus*	F			3	6																			
370	AFRICAN GREY HORNBILL *Lophoceros nasutus*					3			4	3	5	6	6		5	1	6				1		1		
379	EURASIAN HOOPOE *Upupa epops* (***Includes *africana*African Hoopoe)	p	PM								P		5				3	4	1	3	1				

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383	BLACK SCIMITARBILL *Rhinopomastus aterrimus* (Black Wood-hoopoe)					**2**											**5**					**4**			**2**
396	GREATER HONEYGUIDE *Indicator indicator* (Black-throated Honeyguide)	f		**P**					**3**																
401	NUBIAN WOODPECKER *Campethera nubica*			**5**					**5**	**4**					**3**	**6**		**6**	**6**		**3**	**4**	**3**	**4**	**4**
413	GREY WOODPECKER *Mesopicos goertae*	f													**6**										
428	YELLOW-FRONTED TINKERBIRD *Pogoniulus chrysoconus*	f		**5**	**3**	**6**				**6**	**6**	**6**	**6**	**5**	**6**	**6**	**5**	**6**	**4**	**1**	**4**	**6**	**6**		**5**
431	SPOT-FLANKED BARBET *Tricholaema lachrymosa*		R-RR						**3**		**6**												**5**	**4**	**5**

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435	BLACK-BILLED BARBET *Lybius guifsobalito*								2	6	3	6	5	6	2	4	4		2					5	3
437	DOUBLE-TOOTHED BARBET *Pogonornis bidentatus*	f										4													
440	RED-THROATED BEE-EATER *Merops bulocki*	w				3																			
445	MADAGASCAR BEE-EATER *Merops superciliosus*	A	AM						1	3								1				4			
448	SWALLOW-TAILED BEE-EATER *Merops hirundineus*	A	R-NT									4	1			6	6	5		2	6	5	2	1	1
451	LITTLE BEE-EATER *Merops pusillus*	G												1	5										
460	AFRICAN PYGMY KINGFISHER *Ispidina picta*	fw		3	5					4	6		5	2		6	4				5	5	5		

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467	GREY-HEADED KINGFISHER *Halcyon leucocephala* (Chestnut-bellied Kingfisher)	Afw		5	3		1		2	6	2	6	6	1			3	4	3	4	6	1		2	
468	STRIPED KINGFISHER *Halcyon chelicuti*								4	3	4		6	6	5	3	6			3					
470	WOODLAND KINGFISHER *Halcyon senegalensis*	A		6		6			P									5				4			
476	GREY KESTREL *Falco ardosiaceus*					6									1				5						
473	COMMON KESTREL *Falco tinnunculus* (includes *rufescens* sometimes referred to as Rock Kestrel)	P	PM					2			4														
554	EMIN'S SHRIKE *Lanius gubernator*		R-NT														4							5	
	COLLARED SUNBIRD *Anthodiaeta collaris*				6																				

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515	WESTERN BLACK-HEADED BATIS *Batis erlangeri*	f										5													
521	BROWN-THROATED WATTLE-EYE *Platysteira cyanea* (Common Wattle-eye)	f		2		4						4		5	p2			3	1	3		6		5	
529	GREY-HEADED BUSH-SHRIKE *Malaconotus blanchoti*			3	2				2									6						5	
563	WOODCHAT SHRIKE *Lanius senator*	P	PM					5																	
533	NORTHERN PUFFBACK *Dryoscopus gambensis*	F			5					5			3	3					6	3	2		3		
535	BROWN-CROWNED TCHAGRA *Tchagra australis* (Brown-headed Tchagra)				4			1						4				3							
537	BLACK-CROWNED TCHAGRA *Tchagra senegalus*			4		5	6	6	6	6		6	6	6		4	3	4	4	3		3		3	1

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540	SULPHUR-BREASTED BUSH-SHRIKE *Cholorophoneus sulfureopectus* (Orange-breasted Bush-shrike)	f							2		3											1			
	BARN SWALLOW *Hirundo rustica* (Eurasian Swallow)	Pw	PM		3	2		6			5	6				6	3		6		6		6	5	6
346	PEARL-SPOTTED OWLET *Glaucidium perlatum*											P													
548	BLACK-HEADED GONOLEK *Laniarius erythrogaster*	f		5	3	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6
550	FORK-TAILED DRONGO *Dicrurus adsimilis* (Common Drongo)	f/F							6	6				5					6							
560	GREY-BACKED FISCAL *Lanius excubitoroides*	Afw		3	1		6	2	1	4				6	4	5	6		6	2	4	4			

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564	PIAPIAC *Ptilostomus afer*				3		3								P										
	COMMON SAND MARTIN *Riparia riparia* (Bank Swallow)	PW	PM		3	6					6					5			6		6				6
570	AFRICAN PARADISE-FLYCATCHER *Terpsiphone viridis*	f		6	6	6			4					2											
574	WESTERN VIOLET-BACKED SUNBIRD *Anthreptes longuemarei*	Af																				4			
586	SCARLET-CHESTED SUNBIRD *Chalcomitra senegalensis*	f									1		5	5	2			5				4		4	
599	BEAUTIFUL SUNBIRD *Cinnyris pulchellus*			4		4	2		2	3		3	4	1	1	6	5	2	6	5	3	6	2	6	6
	LITTLE GREENBUL *Eurillas virens*	F				4																			

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616	GROSBEAK WEAVER *Amblyospiza albifrons* (Thick-billed Weaver)	fW				5																			
662	RED-HEADED WEAVER *Anaplectes rubriceps*	G			5																				
619	RED-BILLED QUELEA *Quelea quelea*	A		3	3	5	2		5			6	3			2				6			4	6	4
623	NORTHERN RED BISHOP *Euplectes franciscanus*	G					6					2		4											
632	LITTLE WEAVER *Ploceus luteolus*			2			5		3	3				5	5			2				5	2		
634	SPECTACLED WEAVER *Ploceus ocularis*	f			5							6	2			6		4	4	4	4		3	4	3
643	LESSER MASKED WEAVER *Ploceus intermedius*					1		4					3				6			6					

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644	VITELLINE MASKED WEAVER *Ploceus vitellinus*			2			3		4	3				2	5										
646	BLACK-HEADED WEAVER *Ploceus cucullatus* (Village Weaver)																				4				2
651	YELLOW-BACKED WEAVER *Ploceus melanocephalus* (Black-headed Weaver)	W				5												6	6		4	4			3
652	GOLDEN-BACKED WEAVER *Ploceus jacksoni* (Jackson's Golden-backed Weaver)	w	R-RR				5																		
665	RED-BILLED FIREFINCH *Lagonosticta senegala*			6	1	6	5		1	4	1	4		3				4	4	4		3	3	6	1
667	AFRICAN FIREFINCH *Lagonosticta rubricata* (Blue-billed Firefinch)			5																3	2				3

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663	BLACK-BELLIED FIREFINCH *Lagonosticta rara*	G				3						3	2												
668	BLACK-FACED FIREFINCH *Lagonosticta larvata*	G	R-NT						6	2								5			1	2			
669	BROWN TWINSPOT *Clytospiza monteiri*	f							3																
670	RED-WINGED PYTILIA *Pytilia phoenicoptera*														3										
672	GREEN-WINGED PYTILIA *Pytilia melba* (Melba Finch)																4		1	6	6	5	2		
676	RED-CHEEKED CORDON-BLEU *Uraeginthus bengalus*			6		5	5	6	6	6	3	6	6	6	5	4	6	6	3	3	3	5	2	6	4
685	COMMON WAXBILL *Estrilda astrild*	wG		4																					

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

P = present outside count time; p = probable
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Numbers represent presence in the TSC.

Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP47/1	FKP47/2	FKP47/3	FKP45/1	FKP45[b]/2	FKP7/1	FKP7/2	FKP7/3	FKP7/5	FKP7/5	FKP9/1	FKP9/2	FKP9/3	FKP9/4	FKP18/1	FKP18/2	FKP18/3	FKP18/4	FKP14/1	FKP14/2	FKP14/3	FKP14/4
688	BLACK-FACED WAXBILL *Estrilda erythronotos* (Includes Black-cheeked Waxbill *E.charmosyna)*																		**3**					**6**	
705	BRONZE MANNIKIN *Spermestes cucullata*					**4**				**2**	**1**		**1**												
709	PIN-TAILED WHYDAH *Vidua macroura*	G					**4**			**4**				**4**											
713	VILLAGE INDIGOBIRD *Vidua chalybeata* (Red-billed Firefinch Indigobird)						**3**																		
716	RUFOUS SPARROW *Passer cordofanicus* (includes Shelley's Rufous Sparrow *P.shelleyi*)		R-RR							**6**						**1**	**6**								**P**
717	NORTHERN GREY-HEADED SPARROW *Passer griseus* (Parrot-billed Sparrow)						**3**	**1**								**4**	**5**								

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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732	YELLOW WAGTAIL *Motacilla flava*	P	PM		6	6		5			5	4	1			1	3		6	4	5			6	5
742	YELLOW-FRONTED CANARY *Crithagra mozambica*								2								3								
781	FLAPPET LARK *Mirafra rufocinnamomea*	G					6	5	5				2	6			6								
787	RED-FACED CROMBEC *Sylvietta whytii*	F												2											
	NORTHERN CROMBEC *Sylvietta brachyura*																		5						
799	RED-WINGED GREY WARBLER *Drymocichla incana*	w	R-NT													1									
	MOUSTACHED GRASS WARBLER *Melocichla mentalis (*African Moustached Warbler)										1	3									4			3	

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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Atlas No.	COMMON NAME Scientific Name (Alternative Name)	Ecology	Conservation	FKP47/1	FKP47/2	FKP47/3	FKP45/1	FKP45[b]/2	FKP7/1	FKP7/2	FKP7/3	FKP7/5	FKP7/5	FKP9/1	FKP9/2	FKP9/3	FKP9/4	FKP18/1	FKP18/2	FKP18/3	FKP18/4	FKP14/1	FKP14/2	FKP14/3	FKP14/4
802	YELLOW-BREASTED APALIS *Apalis flavida*	f												5											
811	BUFF-BELLIED WARBLER *Phyllolais pulchella*	f											2		5										
814	GREY-BACKED CAMAROPTERA *Camaroptera brachyura*	f		6	6	1	3		6	6	6	6	6	6	3	6		6	6	6	6	6	6	3	6
817	GREY-CAPPED WARBLER *Eminia lepida*	fw	R-RR	2	5	6			5			6	5				5	5		4		3		6	5
818	RED-FACED CISTICOLA *Cisticola erythrops*	w		3																				3	
821	TRILLING CISTICOLA *Cisticola woosnami*															2						3		5	4
825	RATTLING CISTICOLA *Cisticola chiniana*			5	4	2	6	6	6	6	6	5	5	6	6	5	6	4	6	3		6	6	6	

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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834	SHORT-WINGED CISTICOLA *Cisticola brachypterus* (Siffling Cisticola)																	1							
837	ZITTING CISTICOLA *Cisticola juncidis* (Fan-tailed Cisticola)	wG					6							4			3								
841	TAWNY-FLANKED PRINIA *Prinia subflava*	fw			5	4	6				6		5								6		3	3	
882	ANGOLA SWALLOW *Hirundo angolensis*	w						6														1	4		
914	COMMON BULBUL *Pycnonotus barbatus* (Yellow-vented Bulbul)	f		6	6	6	5	3	6	6	6	6	6	4	5	6	6	6	6	6	6	6	6	6	6
941	BLACK-LORED BABBLER *Turdoides sharpei* (Sharpe's Pied Babbler)													6								1			
943	BROWN BABBLER *Turdoides plebejus*					4			3	6			3						2	5	5		6	2	5

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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944	ARROW-MARKED BABBLER *Turdoides jardineii*																	**6**							
958	RUPPELL'S STARLING *Lamprotornis purpuroptera* (Rüppell's Long-tailed Starling)			**6**	**6**	**5**	**6**	**4**	**6**	**6**	**6**	**6**	**5**	**5**	**3**	**5**	**6**		**6**		**6**	**4**	**2**	**6**	**5**
961	LESSER BLUE-EARED STARLING *Lamprotornis chloropterus* (Glossy Starling)								**2**	**1**	**5**	**5**	**6**							**5**	**P**		**6**		
965	VIOLET-BACKED STARLING *Cinnyricinclus leucogaster* (Plum-coloured Starling)	Af	AM						**4**	**6**															
948	WATTLED STARLING *Creatophora cinerea*	F									**6**														
970	BROWN-BACKED SCRUB-ROBIN *Cercotrichas hartlaubi*	f																**2**				**5**			

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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971	WHITE-BROWED SCRUB-ROBIN *Cercotrichas leucophrys*				3						5		6	5	1			3		1	4	2	3		3
985	PALE FLYCATCHER *Bradornis pallidus* (Mouse-coloured Flycatcher)				6	5													4						
	NORTHERN BLACK FLYCATCHER *Melaenornis edolioides*										1		2			2					2			1	
991	SILVERBIRD *Empidornis semipartitus*							3		5		6	5	6	6	6	6						2	4	3
994	WHITE-BROWED ROBIN-CHAT *Cossypha heuglini*	f				6				6			1	1				4	2	5		6	3	1	
996	SNOWY-CROWNED ROBIN-CHAT *Cossypha niveicapilla*	Fw			4													3				6			

Table Att3.3-3 Timed Species Count Data for Tilenga Feeder Pipeline in the Albert Flats

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1003	SPOTTED PALM-THRUSH *Cichladusa guttata* (Spotted Morning Thrush)				2	6		6	5	6	5	6	6	6	5	6	6	6	5	2	6	4	6	6	6
862	EURASIAN REED WARBLER *Acrocephalus scirpaceus*	Pw	PM		6	6						5	5							4	6		5	3	6
	NORTHERN WHEATEAR *Oenanthe oenanthe*	P	PM					6								5									
1016	WHINCHAT *Saxicola rubetra*	P	PM					5			3								2						
1037	AFRICAN THRUSH *Turdus pelios*	f		3	5	6	2														2				
Number of species per site				41	51	60	37	36	45	41	44	40	51	43	35	39	40	43	45	40	43	43	37	45	39
Total number of species				170																					

Table Att3.3-4 Species of Conservation Concern – Above Escarpment FKP65–84, Bagungu Wildlife Reserve 25-41 and (55–56), and Albert Flats FKP7–18 plus 45–47

Sites				**Above Escarpment**	**Bugungu WR**	**Albert Flats**
Target Species						
	Globally	Endangered	G-EN		1	1
		Near- threatened	G-NT		1	
		Vulnerable	G-VU			
	Regionally	Endangered	R-EN			
		Vulnerable	R-Vu		2	
		Near- threatened	R-NT	3	4	10
		Regional responsibility	R-RR	3	3	4
	Uganda	Endangered	U-EN		1	1
		Vulnerable	U-VU		1	1
		Near- threatened	U-NT		1	
Ecological feature	Forest specialist		FF			
	Forest generalist		F	15	11	11
	Tree species		f	36	35	34
	Wetland specialists		W		9	13
	Wetland visitor		w	20	26	24
	Grassland specialists		G	10	17	18
Migrants	Palearctic		P	5	14	13
	Afrotropical		A	9	14	8

Table Att3.3-5 Dates, Times and Other Details of Tilenga Feeder Pipeline Timed Species Counts for Sites Above Escarpment

FKP	Way Point	UTM	Date 2018	Observers	Start Time	Temp °C	Notable Weather
81/2	175	36N0297655, 0170792	17-Jan	MK/DP	940	27	Warm
81/3	175	36N0297655, 0170792	18-Jan	MK/DP	730	20	Cool
84/2	176	36N0295576, 0169075	17-Jan	MK/DP	1100	29	Hot
73/2	178	36N0302756, 0175779	18-Jan	MK/DP	855	27	Warm
69/2	179	36N0303910, 0178876	19-Jan	MK/DP	755	22	Mild
65/2	180	36N0312859, 0185371	19-Jan	MK/DP	950	28	Warm

Table Att3.3-6 Dates, Times and Other Details of Tilenga Feeder Pipeline in the Albert Flats

FKP	Way Point	Name	UTM	Date 2018	Observers	Start Time	Temp °C	Notable Weather
45/2	186	Pond site butiaba	36N 0317012, 0198595	20-Jan	MK/DP	935	29	Cloudy
47/2	182	Waki River	36N0316307, 0197459	21-Jan	MK/DP	1715	31	Warm
47/3	182	Waki River	36N0316307, 0197459	27-Jan	MK/DP	800	28	Mild
7/3	192	Clerk ranch	36N0326689, 0234319	22-Jan	MK/DP	1725	32	Warm, windy
7/4	192	Clerk ranch	36N0326689, 0234319	25-Jan	MK/DP	1610	33	Hot, windy
7/5	192	Clerk ranch	36N0326689, 0234319	26-Jan	MK/DP	705	22	Cool
14/2	196	Masene FR	36N0326775, 0226119	23-Jan	MK/DP	1735	31	Warm
14/3	196	Masene FR	36N0326775, 0226119	25-Jan	MK/DP	820	26	Warm
14/4	196	Masene FR	36N0326775, 0226119	26-Jan	MK/DP	1725	32	F. hot
18/2	195		36N0326222, 0223139	23-Jan	MK/DP	1625	33	F. hot, windy
18/3	195		36N0326222, 0223139	25-Jan	MK/DP	705	23	Cool
18/4	195		36N0326222, 0223139	26-Jan	MK/DP	1605	34	Hot, windy
9/3	193		36N 0326703, 0233046	25-Jan	MK/DP	1725	31	Warm
9/4	193		36N 0326703, 0233046	26-Jan	MK/DP	820	29	Warm

Table Att3.3-7 Dates, Times and Other Details of Tilenga Feeder Pipeline Timed Species Counts for Sites in Bugungu Wildlife Reserve

FKP	Way Point	Name	UTM	Date 2018	Observers	Start Time	Temp °C	Notable Weather
39-41	187	Bugungu WR	36N 0321424, 0203270	19-Jan	MK/DP	1715	33	Hot
39-41	187	Bugungu WR	36N 0321424, 0203270	21-Jan	MK/DP	725	24	Mild
56/2	184	upper ESC.	36N 0319769, 0196409	18-Jan	MK/DP	1700	31	Warm
56/3	184	upper ESC.	36N 0319769, 0196409	20-Jan	MK/DP	715	26	Mild
55/2	185	upper ESC.	36N0319426, 0196892	20-Jan	MK/DP	815	28	Warm
55/3	185	upper ESC.	36N0319426, 0196892	20-Jan	MK/DP	1725	33	Hot
29/3	188	WR HQ	36N0325075, 0212251	21-Jan	MK/DP	915	30	Hot
29/4	188	WR HQ	36N0325075, 0212251	22-Jan	MK/DP	745	25	Mild
29/5	188	WR HQ	36N0325075, 0212251	24-Jan	MK/DP	1705	32	Hot, windy
34/3	190	Sonso	36N 0322733, 0207972	22-Jan	MK/DP	855	29	Warm
34/4	190	Sonso	36N 0322733, 0207972	22-Jan	MK/DP	835	29	Warm
34/4	190	Sonso	36N 0322733, 0207972	24-Jan	MK/DP	715	24	Mild
25/3	189	NU Waiga S	36N 0326293, 0215061	22-Jan	MK/DP	1010	33	Warm
25/4	189	NU Waiga S	36N 0326293, 0215061	23-Jan	MK/DP	720	25	Cool
25/5	189	NU Waiga S	36N 0326293, 0215061	24-Jan	MK/DP	825	29	Warm

Table Att3.3-8 Results of the Main Camp and Pipe Yard Walkover Survey

COMMON NAME Scientific Name	Conservation Status	Habitat and Ecology
African harrier-hawk (*Polyboroides typus*)	IUCN least concern	Open grassland with scattered trees
Southern red bishop (*Euplectes orix*)	IUCN least concern	Open grassland with scattered trees. Congregatory species
Grey kestrel (*Falco ardosiaceus*)	IUCN least concern	Open grassland
Piapiac (*Ptilostomus afer*)	IUCN least concern	Open grassland
Cattle egret (*Bubulcus ibis*)	IUCN least concern	Open grassland

Appendix A4: Fauna Baseline Report

April 2019

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GLOSSARY AND ACRONYMS

A	
AOI	area of influence
C	
CFR	central forest reserve
CH	critical habitat
CHA	critical habitat assessment
CMS	Convention on Migratory Species
CR	critically endangered
CSWCT	Chimpanzee Sanctuary and Wildlife Conservation Trust
CWA	community wildlife area
D	
DD	data deficient
E	
EA	exploration area
EN	endangered
ESIA	environmental and social impact assessment
F	
FR	forest reserve
G	
GIS	geographical information systems
GPS	global positioning systems
I	
IFC	International Finance Corporation
IUCN	International Union for the Conservation of Nature
L	
LC	least concern
lek	an aggregation of males that gather together to engage in competitive displays to entice visiting females who are looking for prospective mates
M	
MFPA	Murchison Falls Protected Area
MFNP	Murchison Falls National Park
N	
NE	not evaluated
P	
PS6	Performance Standard 6

T	
TUOP	Tullow Uganda Operations Pty
U	
UWA	Uganda Wildlife Authority
V	
VES	visual encounter survey
VU	vulnerable
W	
WCS	Wildlife Conservation Society
WR	wildlife reserve

A4 FAUNA BIODIVERSITY BASELINE REPORT

A4.1 Introduction

This baseline report describes the Tilenga Project fauna biodiversity, including:

- the area of influence (AOI) and study area boundaries
- methods
- baseline conditions:
  - trends affecting condition and sensitivity to change
  - ecosystem services provided
- key considerations.

This baseline report also provides the necessary data for the critical habitat assessment (CHA), see Appendix B.

A4.2 Area of Influence and Study Area Boundaries

A4.2.1 Area of Influence Boundary

For fauna species of conservation importance, the spatial AOI encompasses the direct project footprint and areas within an ecologically relevant distance of the project to account for potential indirect impacts arising from, for example, facilitated access, edge effects, spread of invasive species, and permanent habitat loss and fragmentation. An ecologically relevant distance is defined by the mobility of a species, and the habitat connectivity and the potential impact pathways between the species and the project. Using a precautionary approach, the spatial AOI was generally defined by a 10-km-wide corridor, a broader region, centred on the pipeline route to account for the mobility of some fauna species.

In accordance with International Finance Corporation (IFC) Performance Standard 6 (PS6), the AOI may need to be extended to incorporate the entirety of any discrete management units identified for endangered or critically endangered, endemic or range-restricted, migratory or congregatory, or keystone species.

Most fauna disturbance will occur during and immediately after the construction phase. Any indirect impacts associated with facilitated access and induced development will typically be of much longer duration. The temporal AOI is defined, therefore, as the duration of project construction period extended by the time required for the relevant habitat to be re-established to preconstruction condition. For new access roads that may be transferred to a third party when no longer needed for project use, the impacts will be considered permanent.

A4.2.2 Study Area Boundary

The desk-based study area boundary is the same as the AOI. The study area for field surveys was a 2-km-wide corridor centred on the pipeline route, as this

provided data over a sufficient area to assess the potential project effects. A list of the field sites surveyed during the two field surveys is provided in the methods section and in Figure A4.3-1. Secondary data sources were collected for the wider AOI to put this corridor into the context of the Albertine Graben.

A4.3 Methods

A4.3.1 Secondary Data

A combination of aerial imagery, landcover maps, published journal articles, biodiversity action plans, distribution maps (e.g., International Union for the Conservation of Nature (IUCN) data) and management plans were used to identify potential survey locations and put the results of the field surveys into a regional context. In addition to the relevant policies and acts covering wildlife protection in Uganda, and species- and site-specific peer-reviewed journals and plans, the following documents were consulted when establishing the fauna biodiversity baseline for the project AOI, the:

- Environmental Sensitivity Atlas for the Albertine Graben (NEMA)
- Strategic Plan for the Northern Albertine Rift of Uganda 2011–2020
- Uganda National Biodiversity Strategy and Action Plan 2 (2015–2025)
- Murchison Falls Protected Area (MFPA) General Management Plan (2012–2022).

Although several of the above documents cite hydrocarbon exploration as a driver for their production, they have not been developed in association with this project. They are national and regional strategies aimed at the conservation and sustainable use of wildlife. However, there have been surveys directly undertaken with other phases of this project (namely the oil exploration activities in Murchison Falls National Park (MFNP)) that have been used to guide this baseline owing to an overlap in the AOI. Previous surveys also highlighted regional gaps and data deficiencies and resulted in the production of a draft Red List for Uganda (WCS 2016). The following documents have informed the baseline for the Tilenga feeder pipeline:

- Brief Study of Eastern Chimpanzees in Uganda (Ganas-Swaray and Koojo 2017)
- National Red List for Uganda (WCS 2016)
- Tullow Uganda Operations Pty (TUOP) EA2 Biodiversity Field Survey Report
- TUOP EA1 and EA2 Natural and Critical Habitat Assessment
- Implementation of Avoidance: Gap Analysis for Research on Critical Habitat Species (Nampindo et al. 2017)
- Uganda National Biodiversity Data Bank
- Uganda National Biodiversity Strategy and Action Plan 2 (2015–2025)
- Environmental Sensitivity Atlas for the Albertine Graben
- Strategic Plan for the Northern Albertine Rift of Uganda 2011–2020
- iNaturalist–Afribat project database
- Convention on Migratory Species (CMS) database

- IUCN Red List of Threatened Species
- Centre for Biodiversity database at the National Museums of Kenya (houses bat specimens from Uganda, Tanzania and Kenya)
- citation sheets and management plans for protected areas, where available
- environmental and social impact assessments (ESIA) and other technical studies relevant to the AOI
- scientific and grey literature[1] referenced throughout.

Focal species for the baseline surveys were identified through a review of the IUCN Red List (identifying those species which are vulnerable, endangered or critically endangered), the draft Red List for Uganda (using the same conservation categories, but at a national level) and relevant conservation legislation and conventions implemented in Uganda. Searches were also undertaken for those species considered endemic, migratory, evolutionarily distinct or congregatory. Specialists were also consulted on species considered to be data deficient; if these species were thought likely to be of conservation concern and within the project AOI, they were included. Focal species are listed in Attachments A4.2, A4.3 and A4.4.

A4.3.2 Site Selection

Proposed survey sites were selected following a review of geographic information system files that included data on the proposed pipeline route and secondary data. Protected areas were identified and targeted for surveying; as were habitats such as wetlands and riparian habitats that might support species of interest, and potentially important wildlife corridors. The proposed survey sites in the AOI were discussed with in-country fauna specialists familiar with the areas through which the proposed route traverses. The site surveys targeted areas that were considered to support species of conservation importance and where potential impacts from the scheme could be greatest. This level of survey was sufficient to understand the likelihood or to confirm presence of these species within the habitats.

After the wet season surveys, site selection for the dry season surveys was refined based on habitat quality; some sites were removed or added. Within each survey site, two or three sampling points were chosen for more-detailed survey techniques for representative samples of the habitat in that area. The number of survey sites is considered sufficient to enable characterisation of the AOI for faunal species.

A4.3.3 Field Surveys

Field surveys were undertaken from May–July 2017 for the wet season, and from December 2017–January 2018 for the dry season. Walkover surveys of the main camp pipe yard were undertaken in August 2018. Undertaking surveys during each season enables a robust dataset to be gathered in each season to inform further assessment.

A variety of survey types was used at each site to gather information on a broad array of species. Various ecological habitats (notably woodland, thicket, bushland,

[1] Grey literature refers to literature that is produced on all levels of government, academia, business and industry in print and electronic forms, but which is not controlled by commercial publishers.

riparian, cropland and aquatic) were surveyed for mammals (including bats), reptiles, amphibians and invertebrates based on standard biological survey methodologies.

The following methods were used at most sites:

- walked transects and direct observation
- interviews with local community members and Uganda Wildlife Authority (UWA) rangers
- camera traps
- Sherman traps (mammals and herptiles)
- visual encounter surveys (herptiles)
- pitfall trapping (herptiles)
- dip netting (herptiles)
- sweep netting (invertebrates)
- night-time surveys
- mist netting (bats)
- bat activity surveys using handheld and static detectors.

These survey methods are described in detail in Attachments A4.5 (mammals), A4.6 (invertebrates) and A4.7 (herpetofauna). Figure A4.3-1 illustrates the locations of each survey site. Identification of herpetofauna followed Schiøtz (1999), Spawls et al. (2002, 2006) and Channing and Howell (2006). The AmphibiaWeb (2015) and The Reptile Database (Uetz and Hošek 2015) were also used. The conservation status of the herpetofauna followed the IUCN Red Listing (IUCN 2017) and the Ugandan Red List (WCS 2016).

A targeted chimpanzee (*Pan troglodytes schweinfurthii*) study was undertaken by Jessica Ganas-Swaray and Sam Mugume in the area during October 2017. This study comprised a review of published and unpublished information on chimpanzees around the western-most part of the proposed pipeline route. Additionally, consultations regarding chimpanzee presence were undertaken with organisations involved in chimpanzee conservation and studies in this area. Data from the desk study was used to help guide the areas selected for field work.

During the field survey, which included the deployment of 14 trail cameras on potential chimpanzee pathways, one team of four skilled chimpanzee experts collected data from communities and forests in the chimpanzee study areas. This was accomplished via community and individual interviews and recce walks in areas of potential chimpanzee habitat and direct walks to known or suspected chimpanzee locations to check for signs of chimpanzees.

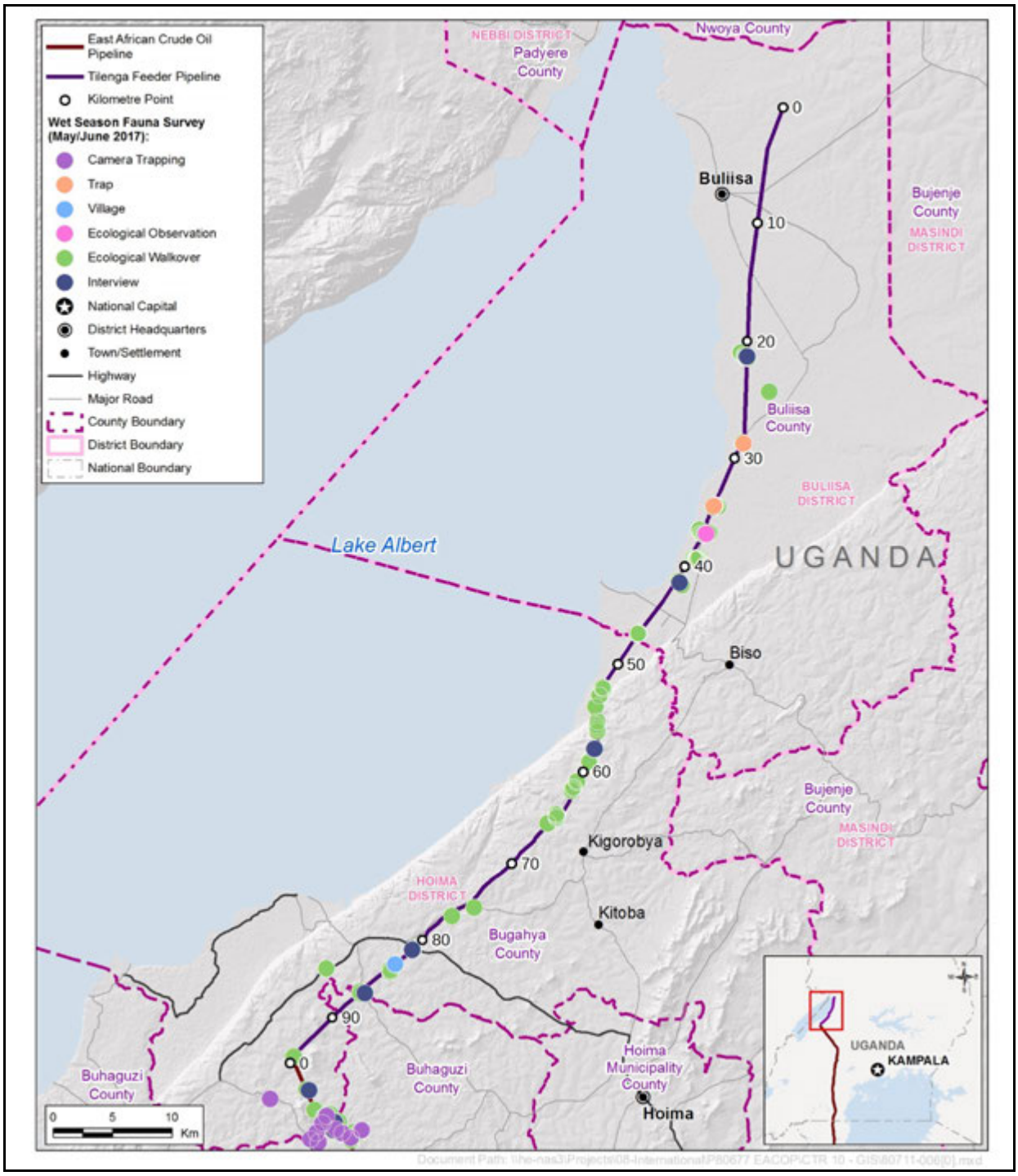

Figure A4.3-1 Survey Locations along the Tilenga Feeder Pipeline Route

A4.3.4 Data Analysis

Data have not been statistically analysed or used to create rarefaction curves (as in WCS and eCountability 2016). Although there is merit in this approach to show if reasonable survey effort has been expended, it can be very subjective and, in the worst cases, misleading with such small sample sizes. The approach in this baseline has been to confirm if a species is present or determine the likelihood of its presence, rather than to determine that an adequate survey has been undertaken to confirm its absence.

Where species scoped into this assessment have been recorded in a protected area, how the species use a protected area and contribute to site integrity is discussed (e.g., specific functions, if known). The protected area as a whole is not discussed in detail in this report, beyond the fauna receptors above.

A4.3.4.1 Sensitivity Ranking

The sensitivity of the fauna biodiversity VECs has been ranked according to the fauna biodiversity section of the sensitivity table in Section 8.

A4.3.5 Data Considerations

Field survey data only provide a snapshot in time and are unlikely to represent the full diversity of species supported at a site. Baseline biodiversity surveys are designed to be rapid; they are good at confirming the presence of species and can be used to assess the habitat suitability of areas for species of conservation concern. However, they are often insufficient to confirm the absence of a species from an area, determine population sizes or absolutely confirm species use of an area (e.g., identify all the movement corridors used on a daily or seasonal basis).

Baseline assessments therefore include secondary data and data gathered during field surveys. The secondary data assessment and field surveys provided sufficient information to describe the baseline conditions of the AOI accurately. In case of doubt regarding the presence of a species, a precautionary approach was taken, in keeping with IFC PS6 and the accompanying Guidance Note.

The following are considerations relative to the data collected for this baseline study:

- Good secondary data existed for the MFPA. Data outside protected areas were fewer and harder to find.
- Some of the data on species of interest from Bugungu were more than 20 years old. These still provide useful background information to contextualise information obtained from UWA rangers in the forest reserve (FR).
- Some of the species scoped into the assessment have not been assessed at the global scale, especially invertebrate groups, which makes most invertebrate species qualify as not evaluated. However, because some species are local endemics they would potentially qualify as critically endangered or endangered. Data from previous studies have been used to assign conservation importance and have guided the draft Red List for Uganda.
- The Tilenga feeder pipeline could not be walked and surveyed in its entirety. Sufficient representative habitats along the route have been surveyed to enable extrapolation of findings along the route.

- Data regarding conditions of receptors or trends only exist for some of the larger, more-charismatic species subject to longer-term studies within the protected areas. Outside protected areas, habitat conversion and condition can be used to make cautious assumptions regarding trends in species distribution and abundance.
- For some species, there is no information on seasonal movement timings or routes. They may have been recorded at various locations along the pipeline route. However, data on their movement to, from or between these locations were not available.
- Camera traps were often found by members of local communities, who visited on several occasions to look at them; these visits could have altered the behaviour and activity of any wild animals potentially using the area.
- Dry conditions prevailed during the wet season survey period, especially along the escarpment and lowland lake edge; this may have affected animal habits. Habitats could still be assessed and their values could be assigned. However, some conclusions regarding seasonal habitat use is based on informed assumptions using multiple data sources and not on direct observation.
- Owing to health and safety constraints, some of the available sampling techniques were not used at some sites. For example, mist netting for bats was only undertaken at sites within a 30-min drive of the survey team's accommodation owing to the project restrictions on night-time driving for health and safety reasons.
- Night-time surveys were limited to the places where it was safe for surveyors to visit after dark.

A4.4 Baseline Conditions

A4.4.1 Fauna Habitats of Conservation Importance

The following sections of this report provide:

- an overview of the fauna habitats in the broader region based on secondary data
- a description of the habitat at the surveyed sites.

A4.4.2 Overview

The project AOI is in the northern Albertine Graben, an area with its own strategic plan. The Environmental Sensitivity Atlas for the Albertine Graben (2010) notes the area as having medium-high species richness. The wider graben is known to support high levels of species richness and globally significant numbers of endemic and threatened species. Figure A4.4-1 presents the project AOI within context.

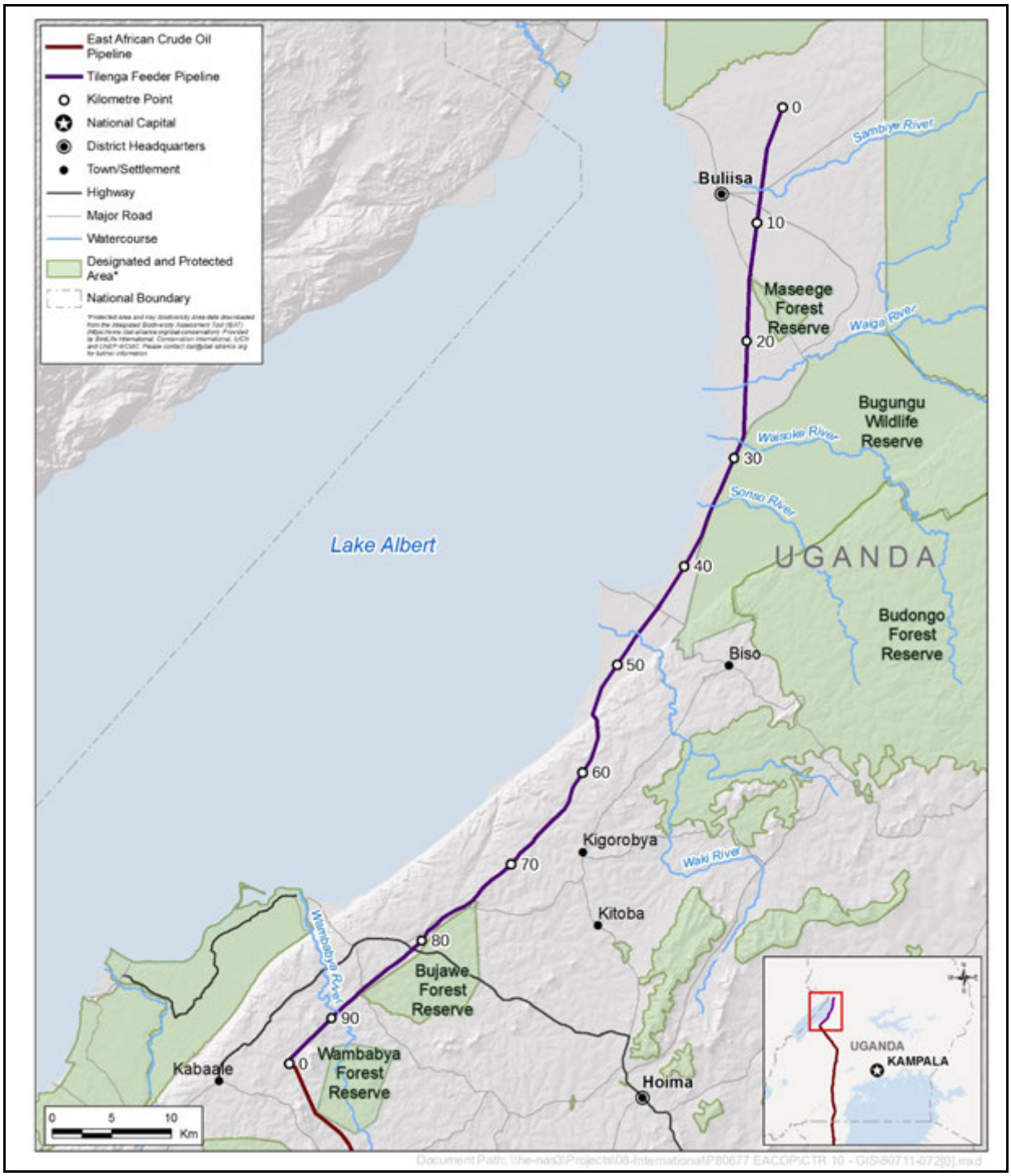

Figure A4.4-1 Context of the Tilenga Feeder Pipeline in the Northern Albertine Graben

A4.4.3 Bugungu Wildlife Reserve

A4.4.3.1 Baseline Condition

The Tilenga feeder pipeline traverses along the western edge of the Bugungu WR (the route is just outside the reserve boundary) to the west of an existing road (the Hoima to Buliisa road) that is regarded by the Uganda Wildlife Authority (UWA) as the western extent of the reserve (Figure A4.4-2). The road is being widened at the time of writing, as part of the Hoima–Butiaba–Wanseko road project, to facilitate access for oil-field development.

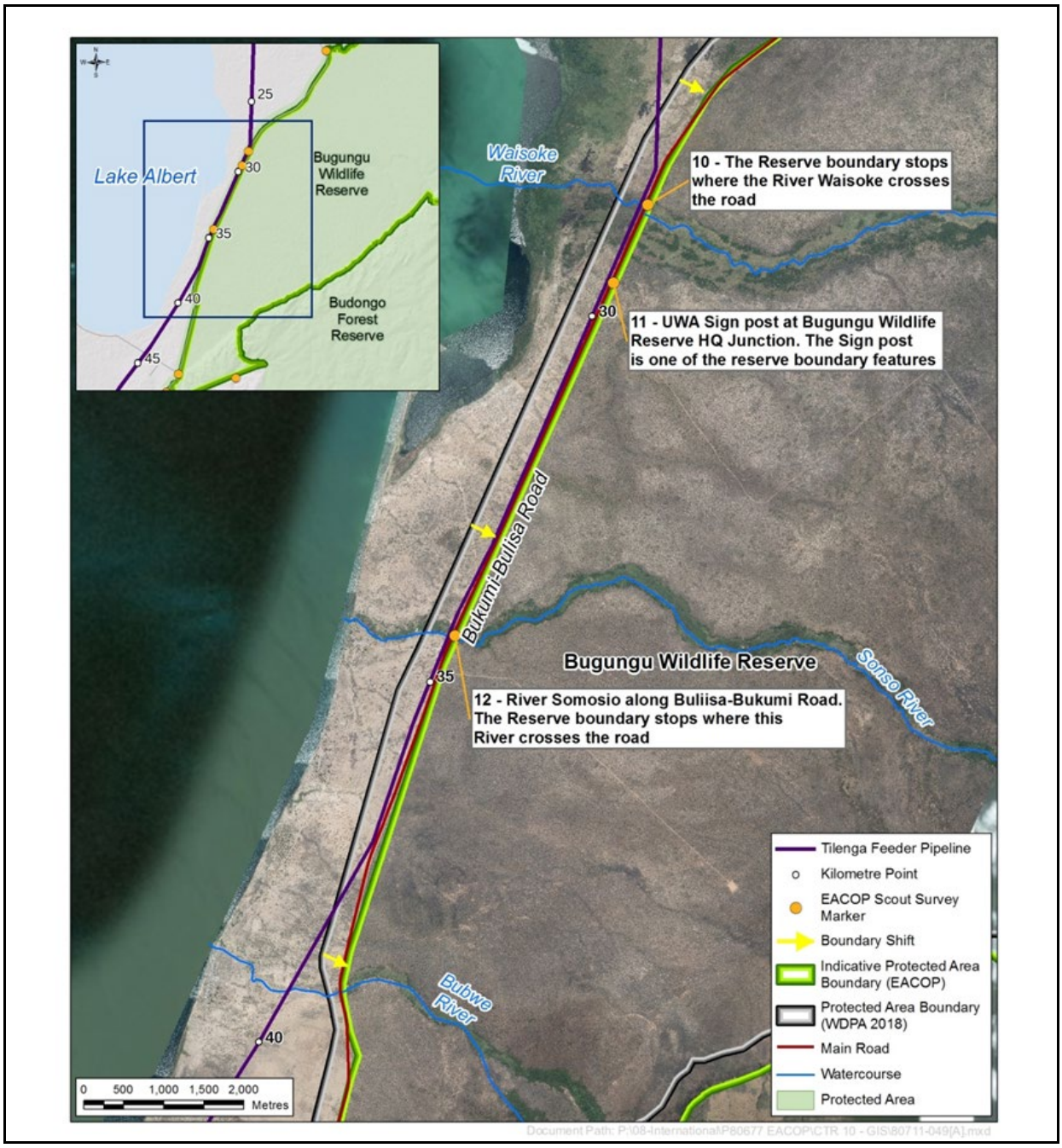

Figure A4.4-2 Bugungu Wildlife Reserve and Key Biodiversity Area Boundary

Habitats inside the reserve are a mosaic of open grassland with scattered trees and scrub. The WCS and eCountability (2016) report notes that the closed woodland in Bugungu is the most species-rich habitat within the reserve. The Tilenga feeder pipeline route does not cross any such habitat or result in any fragmentation, loss or damage of such habitat. However, the Bugungu WR is part of the wider MFPA, which acts as a buffer to the MFNP and provides opportunities for seasonal movements for mammal species within the MFNP.

The habitat in the Bugungu WR is largely intact with a low incidence of degradation; cattle grazing and tree cutting for firewood do occur within the reserve boundaries but at a much lower rate compared with areas outside the reserve. The reserve has only 19 rangers to cover its entirety, so, although human impacts are reduced, they are not completely controlled. Habitats outside the reserve in the area traversed by the pipeline are markedly different to those inside in the reserve. They have been heavily grazed and are degraded and very open in character (UWA 2013), see Figure A4.4-3. It has previously been noted that “There is evidence of agricultural practices along the Buliisa–Biso road that forms the western boundary of Bugungu Wildlife Reserve. These opened up areas for agriculture block the migratory routes for wildlife from the reserve trying to access water from Lake Albert” (UWA 2013). This suggests that the levels of protection provided to the Bugungu WR are proving to be effective.

Figure A4.4-3 Habitats Outside (left) and Within Bugungu Wildlife Reserve (right) (Kob in Right-Hand Picture)

Chimpanzee nests have previously been recorded in the Bugungu WR (WCS and eCountability 2016). The data on these nests have been requested from the authors of the 2016 report. At present, it is assumed that nests were recorded in the region where the Bugungu WR abuts the Budongo FR on the eastern edge of the WR. Chimpanzee movement in the area is not well understood, but it is likely that chimpanzees are moving between reserves through remnants of riparian forest.

The Bugungu WR supports several mammal species of conservation importance, including:

- Uganda kob, *Kobus kob* (IUCN least concern, Uganda not listed)
- lion, *Panthera leo* (IUCN vulnerable, Uganda critically endangered)

- African elephant, *Loxodonta africana* (IUCN vulnerable, Uganda critically endangered).

These species are described in more detail in Section A4.4.8.3. In addition, this reserve sits within an area identified as Tier 1 critical habitat for chimpanzee and as Tier 2 critical habitat for a range of other fauna species, including lion and smooth chameleon (WCS and eCountability 2016), see Appendix B Critical Habitat Assessment.

A4.4.3.2 Trend in Condition and Sensitivity to Change

It is reasonable to suggest that the condition of habitats well inside the reserve will remain unchanged in the future, as the Bugungu WR forms part of the MFPA. However, with continuing land-use pressure outside the protected areas network, the condition of habitat immediately outside the reserve is likely to decline, which could cause increased edge effects to the reserve itself. The Hoima to Buliisa road is being widened to a 6-m-wide two-lane carriageway with 1-2 m shoulders, at the time of writing. The widening to the east is within the reserve.

The Bugungu WR and its immediate surroundings support natural and seminatural habitat that supports IUCN vulnerable species and has been identified as critical habitat, therefore it has high sensitivity to change.

A4.4.4 Maseege Central Forest Reserve

A4.4.4.1 Baseline Condition

The Tilenga feeder pipeline is within 200 m of the Maseege Central Forest Reserve (CFR) between approximately KP15 and KP16.5. Originally gazetted as an industrial and commercial forest plantation, it is the only CFR in the Rift Valley near Lake Albert and, as such, protects Lake Albert, as noted in the Sensitivity Atlas. It also contributes to the protection of the River Waiga, which drains into Lake Albert. It is a corridor for wildlife between Lake Albert and the MFNP (NEMA 2010).

No fauna species of conservation importance were found in the Maseege CFR. Nevertheless, the Maseege CFR sits within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016), see Appendix B Critical Habitat Assessment.

A4.4.4.2 Trend in Condition and Sensitivity to Change

It is likely that the overall trend of habitat decline that typifies Uganda's forests will be seen more in the Maseege CFR with further encroachment due to agriculture. The main road connecting Hoima and Buliisa passes through the reserve and is being upgraded at the time of writing, so there is high likelihood of increased traffic using the road, which could affect fauna within the reserve.

Considering that the CFR is gazetted as industrial and commercial and yet is within an area identified as Tier 1 critical habitat for chimpanzee, the forest reserve has a moderate sensitivity to change.

A4.4.5 Bujawe Forest Reserve

A4.4.5.1 Baseline Condition

The Tilenga feeder pipeline route passes within 1 km of the Bujawe FR, but does not enter the reserve. At the time of survey, it was noted that large portions of this FR have been converted to agriculture and pine plantation, thereby reducing its conservation value. However, the FR supports common primate species and is noted in the Sensitivity Atlas for the protection it affords the Hoimo and Rwamutunga Rivers, which are sources of water for people and livestock. It is not known how efficient this rivers protection is, given the modified condition of the FR. The Sensitivity Atlas indicates that the Bujawe FR provides commercial tree planting opportunities with local employment opportunities.

The following species of conservation importance were noted during interviews with local community members, although no direct evidence of these was observed in the field:

- chimpanzee, *Pan troglodytes ssp. Schweinfurthii,* (IUCN endangered, Uganda endangered)
- Temminck's ground pangolin, *Smutsia temminckii*, (IUCN vulnerable, Uganda vulnerable).

Further details on these species can be found in Section A4.4.8.3. In addition, this reserve sits within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016), see Appendix B, Critical Habitat Assessment.

A4.4.5.2 Trend in Condition and Sensitivity to Change

Large parts of the FR have been and continue to be cleared for crop cultivation by local communities (OAG 2010). This trend is anticipated to continue.

The Bujawe FR comprises modified habitat yet is within an area identified as Tier 1 critical habitat for chimpanzee, so has moderate sensitivity to change.

A4.4.6 Wetland and Aquatic Habitats

A4.4.6.1 Baseline Condition

Fauna species supported by wetland and aquatic habitats have been recorded on the following watercourses in the AOI:

- Waiga River (KP23.5): permanent flow
- Waisoke River (KP28.5): permanent flow
- Sonso River (KP34.5): permanent flow
- Bubwe River (KP39.4): seasonal flow in the stretch surveyed
- Waluka (Kanyaranyara) River (KP41.2): seasonal flow in the stretch surveyed
- unnamed river at KP58: permanent flow
- Hoimo River (KP77): permanent flow
- Wambabya River (KP89.4): permanent flow.

These rivers act as movement corridors for several species. The Ugandan lowland shrew, *Crocidura selina* (IUCN data deficient, Uganda endangered and endemic) was recorded on two of the watercourses (Waisoke and Sonso Rivers). In addition, daily (nocturnal) hippopotamus corridors between Lake Albert (refuge) and the Bugungu WR were confirmed on the Waiga, Waisoke, Sonso and Waluka Rivers (field signs noted and confirmed during interviews with UWA rangers). Figure A4.4-4 confirms hippopotamus and Ugandan lowland shrew presence on the Sonso River. Photographs of river crossings are given in Attachment A4.1.

Figure A4.4-4 Hippopotamus and Ugandan Lowland Shrew on the Sonso River

The area between the Waiga and Waisoke Rivers, bounded by the Bugungu WR to the east and Lake Albert to the west, used to be the Bukumi–Bugungu Controlled Hunting Area (UWA 2013). This area was previously noted for the mammal species it supported and its role as a corridor for animals leaving the cover of the Bugungu WR to reach the water and Lake Albert.

As well as providing some cover and protection for animal movements, the rivers are valuable habitats in their own rights. They also drain water from the escarpment into Lake Albert thus helping to maintain the water level in Lake Albert and consequently supporting the fish and other aquatic life within the lake. The quality of the water entering the lake is, therefore, important and the riparian fringes help to maintain a buffer and filter some substrates before they enter the water.

A4.4.6.2 Trend in Condition and Sensitivity to Change

Degradation of wetlands outside protected areas is anticipated to continue due to land use pressures. While papyrus itself will readily regenerate, any increasing pressure on these wetland systems will likely affect the flora and fauna present.

Wetlands within the project AOI comprise natural habitat that provide important ecological function (including, but not limited to, connectivity) and are therefore considered to have high sensitivity to change.

A4.4.7 Potential Wildlife Corridors

A4.4.7.1 Baseline Condition

Previous studies in the project AOI have identified the potential for wildlife movement corridors across the region. These include:

- daily movements by animals between Lake Albert and the Bugungu WR
- seasonal movements of animals from the lowland areas north to the Nile River
- the potential for elephant movements south from the MFPA to the escarpment and beyond
- a corridor linking the MFNP, and Budongo and Bugoma FRs. This will not be affected by the Tilenga Project.

By providing connectivity, corridors are noted as key ecological targets in the Strategic Plan for the Northern Albertine Rift of Uganda. Their importance is also specifically recognised in the Operational Guidelines for Oil and Gas Exploration and Production in Wildlife Protected Areas (UWA 2014).

As has already been noted in Section A4.4.6.1, daily (nocturnal) hippopotamus corridors have been confirmed between Lake Albert and the Bugungu WR on the Waiga, Waisoke, Sonso and Waluka Rivers. It is likely that other species make similar journeys under the cover of the rivers and the associated riparian vegetation. Given the level of habitat modification outside the reserve, it is also likely that most of these movements are also undertaken along watercourses connected to the lake. Data for the region also suggest that greater levels of animal activity in the region occur around the Nile River during the dry season (UWA 2013).

Elephants within the MFNP have previously been recorded moving northwards (away from any project activities) during the wet season (UWA 2013). Elephants have also been recorded south of the Nile River (Plumptre et al. 2015), specifically, in the Bugungu WR (WCS and eCountability 2016). Limited information exists on elephant movement or behaviour in this region outside the MFNP. However, the following can be used cautiously when trying to establish a baseline:

- The absence of a well-documented movement corridor may indicate that species movements are not regular or established, or that only small numbers of animals move through the project AOI.
- No evidence of elephant activity was recorded in the Bugungu WR during the comprehensive surveys in the 1990s (Allan 1996).
- No evidence of elephant activity was noted in the Kabwoya WR or the Kaiso Tonya Community Wildlife Area (south of the Bugungu WR) during previous surveys (Plumptre et al. 2009).
- The area around Bugungu is not noted as a key elephant poaching area (UWA 2017).
- The area around the Bugungu WR is not noted as a key elephant crop-raiding area (UWA 2013).
- Social surveys undertaken as part of this project did not return results for elephants raiding crops in this region.

- The wet season baseline transects for this survey did not identify any evidence of elephant activity.

Based on the above, information on elephant movements outside the MFNP, especially to the south, is not well-documented. Elephants have recently (2015) been recorded in the Bugungu WR, but their use of the area and areas outside the MFPA is not well-studied. Therefore, the value of the project AOI to elephants needs to be assigned tentatively using the available data and recommendations for mitigation measures should be made accordingly.

A4.4.7.2 Trend in Condition and Sensitivity to Change

There is insufficient information available to comment on the trend in condition of wildlife corridors.

Wildlife corridors provide important ecological function and therefore have high sensitivity to change.

A4.4.8 Fauna Species of Conservation Importance

Species of conservation importance are defined as those that are listed as vulnerable, endangered or critically endangered on the IUCN Red List; those that are migratory or congregatory; and those that are range-restricted or endemic. Keystone species are also considered to be of conservation importance.

IUCN threat categories are defined as follows:

- critically endangered: A species is critically endangered when the best available evidence indicates that it is facing an extremely high risk of extinction in the wild. Critically endangered species are considered to have a very high sensitivity to change.
- Endangered: A species is endangered when the best available evidence indicates that it is facing a very high risk of extinction in the wild. Endangered species are considered to have a very high sensitivity to change.
- vulnerable: A species is vulnerable when the best available evidence indicates that it is facing a high risk of extinction in the wild. Vulnerable species are considered to have a high sensitivity to change.
- near threatened: A species is near threatened when it has been evaluated against the criteria and does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. Near threatened species are considered to have a low sensitivity to change.
- least concern: A species is least concern when it has been evaluated against the criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category. Least concern species are considered to have a low sensitivity to change.

Listing in the categories of not evaluated or data deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until an assessment is made, taxa listed in these categories should not be treated as if they were nonthreatened (IUCN 2012).

A4.4.8.1 Overview of Mammal Findings

Primary and secondary data collection has identified scattered assemblages of mammals along the Tilenga feeder pipeline AOI. The surveys identified a good number of small mammal species (Rodentia, Insectivora and Chiroptera) and some medium sized mammals (Primates and Mesocarnivores) and large mammals (e.g., buffalo, kob and hippopotamus). Most of these species are adaptable, habitat generalists and widespread in areas of suitable habitats. Complete mammal species records for the wet and dry season surveys are presented in Table Att4.5-2 in Attachment A4.5.

As predicted from the secondary data review, most of the records for species of conservation importance come from protected areas or natural and seminatural habitats connected to protected areas. These areas act as refuges and population sources owing to their protection from intense human activities (e.g., livestock grazing and the conversion of land to agricultural use). Most of the important areas for mammals along the route are the rivers connected to Lake Albert (and their associated riparian habitats), rivers and riparian corridors flowing from the escarpment, and protected areas such as the Bugungu WR. However, despite some species being recorded on riparian corridors inside and outside protected areas like the Bugungu WR, areas outside protected areas were experiencing habitat loss, conversion and degradation, mainly due to livestock grazing. This is a wider consideration across Uganda and is acknowledged in the latest National Biodiversity Strategy (NEMA 2016).

Owing to the condition of the habitats within the Tilenga feeder pipeline AOI, their greatest value to the local and regional mammal population is their use as corridors between areas of importance, rather than supporting the species themselves.

A4.4.8.2 Bats

Baseline Condition

Of Uganda's 95 documented bat species, the IUCN lists two as threatened.

During the wet and dry seasons, and the MCPY survey, 14 species of bat were identified in the project AOI, as listed in Table A4.4-1. No bat species of conservation importance were found during the fauna baseline studies.

Table A4.4-1 Bat Species Recorded During Field Surveys

Family and common name	Scientific name	IUCN Status
Pteropodidae		
Ethiopian epauletted fruit bat	*Epomophorus labiatus*	Least concern
Hipposideridae		
Noack's leaf-nosed bat	*Hipposideros ruber*	Least concern
Molossidae		
Angolan mops bat	*Mops condylurus*	Least concern
Dwarf mops bat	*Mops nanulus*	Least concern

Table A4.4-1 Bat Species Recorded During Field Surveys

Family and common name	Scientific name	IUCN Status
Little free tailed bat	*Chaerephon pumilus*	Least concern
Nycteridae		
Hairy long-eared bat	*Nycteris hispida*	Least concern
Large-eared slit-faced bat	*Nycteris macrotis*	Least concern
Bates's slit-faced bat	*Nycteris arge*	Least concern
Cape long-eared bat	*Nycteris thebaica*	Least concern
Vespertilionidae		
Silvered bat	*Glauconycteris argentata*	Least concern
African yellow bat	*Scotophillus dinganii*	Least concern
Butterfly bat	*Glauconycteris variegata*	Least concern
Megadermatidae		
Yellow-winged bat	*Lavia frons*	Least concern
Heart-nosed bat	*Cardioderma cor*	Least concern

Trend in Condition and Sensitivity to Change

No bats of conservation importance were identified during the study. All the species have low sensitivity to change and were not considered further in the assessment.

A4.4.8.3 Large Mammals

Baseline Condition

A total of 37 fauna species was recorded during the surveys (see Table A4.4-2). The highest number of large mammal species in one location, 23 species, was found in the Bujawe FR; no large mammal species were found in the Maseege FR. Table Att4.5-2 in Attachment A4.5 provides the full field survey results.

Most of the species recorded are common and widespread with the exception of species in bold in Table A4.4-2, which are considered of conservation importance.

Although no evidence of lion and African elephant were recorded during the field surveys, they are known to inhabit the Bugungu WR, which abuts the eastern edge of the project AOI. Consequently, to protect the integrity of the entire reserve, these species of conservation importance have been scoped into the assessment.

Table A4.4-2 Large Mammals Recorded During the Field Surveys

Family and Common Name	Scientific name	IUCN	Uganda Status
Cercopithecus			
Vervet monkey	*Cercopithecus pygerythrus*	Least concern	Not listed
Black and white colobus	*Colobus guereza*	Least concern	Not listed
Olive baboon	*Papio anubis*	Least concern	Not listed
Red-tailed monkey	*Cercopithecus ascanius*	Least concern	Not listed
Chimpanzee	***Pan troglodytes* ssp. *schweinfurthii***	**Endangered**	**Endangered**
Bovidae			
Sitatunga	***Tragelaphus spekii***	**Least concern**	**Vulnerable**
Oribi	*Ourebia ourebi*	Least concern	Not listed
African buffalo	*Syncerus caffer*	Least concern	Not listed
Bushbuck	*Tragelaphus scriptus*	Least concern	Not listed
Bohor reedbuck	***Redunca redunca***	**Least concern**	**Endangered**
Bush duiker	*Sylviicapra grimmia*	Least concern	Not listed
Uganda kob	*Kobus kob* ssp. *Thomasi*	Least concern	Not listed
Suidae			
Bushpig	*Potamochoerus larvatus*	Least concern	Not listed
Warthog	*Phacochoerus africanus*	Least concern	Not listed
Hippopotamidae			
Hippopotamus	***Hippopotamus amphibius***	**Vulnerable**	**Vulnerable**
Leporidae			
African savanna hare	*Lepus victoriae*	Least concern	Not listed
Felidae			
Serval	*Leptailurus serval*	Least concern	Not listed
Leopard	***Panthera pardus***	**Vulnerable**	**Vulnerable**
Canidae			
Side-striped jackal	*Canis adustus*	Least concern	Not listed
Hyaenidae			
Spotted hyena	*Crocuta crocuta*	Least concern	Not listed
Procaviidae			
Rock hyrax	*Procavia capensis*	Least concern	Not listed
Eastern tree hyrax	*Dendrohyrax arboreus*	Least concern	Not listed
Viverridae			
Servaline genet	*Genetta servalina*	Least concern	Not listed

Table A4.4-2 Large Mammals Recorded During the Field Surveys

Family and Common Name	Scientific name	IUCN	Uganda Status
African civet	*Civettictis civetta*	Least concern	Not listed
Large-spotted genet	*Genetta maculata*	Least concern	Not listed
Herpestidae			
Banded mongoose	*Mungos mungo*	Least concern	Not listed
Slender mongoose	*Herpestes sanguinea*	Not evaluated	Not listed
White-tailed mongoose	*Ichneumia albicauda*	Least concern	Not listed
Marsh mongoose	*Atilax paludinosus*	Least concern	Not listed
Large grey mongoose	*Herpestes ichneumon*	Least concern	Not listed
Mustelidae			
Spot-necked otter	***Hydrictis maculicollis***	**Near threatened**	**Endangered**
Hystricidae			
Crested porcupine	*Hystrix cristata*	Least concern	Not listed
Manidae			
Temminck's ground pangolin	***Smutsia temminckii***	**Vulnerable**	**Vulnerable**
Tree pangolin	***Phataginus tricuspis***	**Vulnerable**	**Vulnerable**
Orycteropodidae			
Aardvark	*Orycteropus afer*	Least concern	Not listed
Lorisidae			
East African potto	*Perodicticus ibeanus*	Least concern	Not listed
Galagidae			
Galago	Four possible species, two of which were reported, all least concern	Least concern	

Sitatunga

A swamp specialist, the sitatunga (IUCN least concern, Uganda vulnerable) is only found in permanent marsh and wetlands. Mostly diurnal, the species is most active in the morning and late afternoon. They usually occur in the swamp's deepest parts, where they wade through channels to feed. In areas with little human disturbance, they will also feed along lake shores or in forest wetlands. Reeds, sedges and grasses form the bulk of their diet. They live alone or in small groups of females, or one male with several females.

The global population is estimated at about 170,000, with 40% living in protected areas. The distribution is becoming increasingly localised in certain parts of its range owing to continuing habitat degradation and hunting; populations may

disappear from many areas and become restricted to those regions that support stable or increasing populations (East 1999).

The main threats to this species are:

- habitat loss, especially the loss of wetlands and dispersal routes, which has caused many populations to become isolated
- changes in water level that alter vegetation structure and could cause an increase in predation or hunting.

The field studies recorded sitatunga at Hoimo River near KP77.

Bohor Reedbuck

The Bohor reedbuck (IUCN least concern, Uganda endangered) is associated with woodland and floodplain grassland across much of its range. They are effectively water-dependent grazers, but show a strong preference for extensive areas of floodplains and open inundated grasslands where access to water may become restricted during the dry season (Kingdon and Hoffmann 2013a).

The global number is estimated at about 100,000, although populations are gradually declining except in some East African parks. About 75% of the estimated total occurs in protected areas (East 1999).

The Bohor reedbuck is ranked as Uganda endangered owing to the estimated continuing decline of at least 20% of the population within five years (or two generations, whichever is longer). Evidence of the Bohor reedbuck was recorded at the Hoimo River near KP77, Bubwe River at KP37 and Waiga River near KP21.

The main threats to this species are:

- hunting
- loss of habitat from the expansion of human settlement and associated livestock.

Temminck's Ground Pangolin

Temminck's ground pangolin (IUCN vulnerable and Uganda vulnerable) is a predominantly solitary, terrestrial species that inhabits mainly savannah woodland in low-lying regions with moderate to dense scrub. It also occurs in floodplain grassland, rocky slopes and sandveld, but does not inhabit forest or desert. The species occurs widely on well-managed livestock farms where it is afforded protection from human persecution, but it is absent from croplands. The most important habitat requirements are a sufficient population of its various ant and termite prey species and the availability of dens or aboveground debris in which to shelter. The female gives birth to a single young after a gestation period of 105–140 days (Pietersen et al. 2014).

Temminck's ground pangolin is IUCN vulnerable owing to the ongoing and projected population decline of 30–40% over a 27-year period (Pietersen et al. 2014).

The species' main threats are:

- ongoing exploitation for traditional medicine and bushmeat throughout its range
- increased intercontinental trade to Asia.

Evidence of this species was recorded in the Bujawe FR.

Tree Pangolin

The tree pangolin (IUCN vulnerable and Uganda vulnerable) occurs predominantly in moist tropical lowland forests and secondary growth, but also in dense woodlands, especially along watercourses (Gaubert 2011). There is some evidence to suggest that the species can adapt to some habitat modification, as individuals have been caught on abandoned or little-used oil palm trees in secondary growth. The tree pangolin is the most common of the African forest pangolins and reaches relatively high densities in suitable habitat (Kingdon and Hoffman 2013b). A nocturnal species, it is equally at home on the ground and in trees. It feeds exclusively on ants and termites, and breeds year-round.

The main threats to the species are:

- ongoing exploitation for traditional medicine and bushmeat throughout the species' range
- increased intercontinental trade to Asia.

Evidence of this species was found near KP58.

Leopard

Leopards (IUCN vulnerable and Uganda vulnerable) are widely distributed across Africa and Asia, but populations have become reduced and isolated, and they are now extirpated from large portions of their historic range. Leopards have limited levels of ecological resilience to human-caused habitat fragmentation in Africa, so are more restricted to conservation areas than some other big cats (Stein et al. 2016).

Leopard is considered a keystone species that has a disproportionate effect on its environment relative to its biomass and whose removal initiates significant changes in ecosystem structure and loss of biodiversity (IFC 2012).

The main threats to this species are anthropogenic and include:

- habitat fragmentation
- reduction in range owing to the conversion of natural habitats to agriculture and grazing land
- reduced prey base
- conflict with livestock and game farming, as leopards may feed on livestock, which causes conflict with farmers.

Leopards were recorded by camera trap at the Waisoke River.

Uganda Kob

The Uganda kob (IUCN least concern, Uganda not assessed) is a congregatory species during breeding with large populations within the MFPA and Bugungu WR.

Although still numerous in Western Uganda, kobs are now far less common in other areas of East Africa. The species disappeared from Kenya in the 1960s and has since disappeared from Tanzania (IUCN 2016a) because of habitat loss and increased hunting. The most recent population estimate puts the total numbers at

100,000 with 98% living in protected areas (East 1999). They prefer low-lying flats or gently rolling country free of seasonal extremes and close to permanent water. Kobs graze on short grass and are dependent on larger animals to create suitable grazing conditions.

The Uganda kob is a lekking species that is classed as stable or increasing in numbers throughout Uganda. Kobs are also known to prefer more open habitats within the Bugungu WR. Previous surveys of the species recorded the greatest number of kob in the heart of the WR and between the Waisoke and Sonso Rivers (Allan 1996), i.e., not at the extremities of the WR boundary. As individuals, they develop attachments to particular localities and regularly return to the same grazing areas and water places.

Uganda kobs were reported at the Waiga (KP21), Waisoke, Sonso, Bubwe (KP37) and Waluka Rivers, and KP41.

Hippopotamus

The hippopotamus is IUCN vulnerable and Uganda vulnerable. The ecological requirements for hippopotamus include a supply of permanent or seasonal water and adequate grazing on open grassland within a few kilometres of the aquatic habitat. The primary threats to hippopotamus are habitat loss or degradation, and illegal and unregulated hunting for meat and ivory (from the canine teeth). Their reliance on freshwater habitats often leads to conflict with human land use and freshwater resources (Lewison and Pluháček 2017).

Hippopotamuses were reported at the Waiga (KP21), Waisoke, Sonso, Waluka and Waki Rivers.

Lion

Lions are IUCN vulnerable and their global population has undergone a reduction of about 43% in the period 1993–2014 (Bauer et al. 2017). Recent research suggests that the species may comprise several genetically distinct subpopulations that are of increasing importance for conservation (Bauer et al. 2017). In most of its range, the lion meets the criterion for IUCN endangered with the inferred rate of a decline of over 50% in three generations, but this trend is lessened by a few subpopulations in a restricted geographical range.

Lions are known to use both the MFNP and the wider MFPA (including the Bugungu WR). Lions were not recorded during the 2015 surveys of the MFPA (Plumptre et al. 2015), but were recorded in the Bugungu WR in 2016 (WCS and eCountability 2016). In addition, lions were noted in 2017 as predators of livestock in this area by the Kigorobya Town Council during the social baseline studies for this project. This species ranges over a wide area, is declining in numbers and is a focal species of the Strategic Plan for the Northern Albertine Rift.

The lion is a keystone species and an important driver for tourism in the region. However, it should be noted that the tourism ‘zone’ within the Bugungu WR is some way to the east of the project AOI in the heart of the reserve.

The main threats to lions include:

- conflict, as livestock predation brings the species into conflict with farmers, so they are persecuted. Their scavenging nature makes them particularly vulnerable to poisoned carcasses deliberately put out to eliminate predators.
- prey base depletion with the bushmeat trade leading to large collapse in prey populations across large parts of the African savanna (Lindsey et al. 2013a)
- traditional medicine with bones and other parts considered of medicinal value across the lion's range and with increasing interest from Asian markets (Bauer et al. 2017)
- trophy hunting with concern that management regimes across the species range have not always been stringent enough to maintain a sustainable offtake, which is proposed at one male lion per 2000 km^2 (Packer et al. 2011).

African Elephant

The African elephant is IUCN vulnerable and migratory, tending to move between a variety of habitats (Blanc 2008). Elephants have recently (2015) been recorded in the Bugungu WR, but their use, if at all, of the reserve and the areas outside the MFPA is not well studied. Within the MFPA, elephants have been seen moving north, away from any project affected areas.

The main threats to the elephant are:

- poaching for meat and ivory
- loss and fragmentation of habitat caused by ongoing human population expansion and rapid land conversion.

Spot-Necked Otter

The spot-necked otter (IUCN near threatened, Uganda endangered) inhabits freshwater habitats where water is un-silted, unpolluted and rich in small to medium-sized fish. In riparian and lacustrine habitats, adequate vegetation in the form of long grass, reeds, dense bushes and overhanging trees, and large boulder piles are essential for providing cover during periods of inactivity and for denning (Reed-Smith et al. 2015). The spot-necked otter specialises in hunting fish by sight in clear, deeper and flowing waters, and is the most aquatic of the African otter species. If prey is abundant enough, otters will form large, social all male or juvenile groups; two females with cubs have been known to form loose packs using the same core area simultaneously. Although comparatively common in the great lakes of Central and East Africa, they are also found in streams, rivers and impoundments up to altitudes of 2500 m (Yalden et al. 1996).

The main threats to this species are:

- the alteration and degradation of freshwater habitats and riparian vegetation, often exacerbated by overfishing and agricultural practices that can lead to shoreline erosion and denuding of the important vegetation cover used by otters
- human presence or activity being disruptive to otter denning and having changed and depleted the otter prey base
- pollution of waters by agricultural, societal and livestock wastes
- being killed for food and skins.

Spot-necked otters were recorded at the Hoimo (KP77) and Wambabya (KP89) Rivers.

Chimpanzee

Chimpanzees are the most abundant and widespread of the great apes. There are four subspecies, the most abundant being *Pan troglodytes schweinfurthii,* which has an estimated global population of 181,000–256,000, about 5000 of them in Uganda.

Chimpanzees are found discontinuously across the forest belt of Africa in primary and secondary moist lowland forest, swamp forest, submontane and montane forest, dry forest, forest galleries in savanna woodland and farmland (Oates 2006). They live in multimale–multifemale, fission–fusion communities averaging 35 members. The largest known community has about 50 members (Mitani and Watts 2005). Across species distribution, the annual home ranges are smaller in mixed forest than in woodland forest mosaics: one of the smallest known is 6 km² in the Budongo FR in Uganda.

Chimpanzees are omnivorous and opportunistic feeders. Fruit forms about half their diet and is typically supplemented with terrestrial herbaceous vegetation, leaves, stems, seeds, flowers, bark, pith, honey, mushrooms, resin, eggs and animal prey such as insects and medium-sized mammals. They are the most carnivorous of the great apes (Hulme et al. 2016).

Chimpanzees in the region encourage tourism and research, and are noted seed dispersers, which makes them keystone species.

The main threats to this species are:

- poaching. This is mostly opportunistic, but some animals are targeted for the bushmeat trade, though this is uncommon in Uganda. Infants of killed adults often become pets or are trafficked internationally for the exotic pet trade. Intentional killing of chimpanzees sometimes occurs when they come into conflict with people protecting their crops. Owing to low population densities and slow reproductive rates, hunting often leads to the local extirpation of chimpanzee populations.
- habitat loss and degradation. Subsistence slash-and-burn agriculture has severely reduced the availability of chimpanzee habitat. Extensive land conversion in western Uganda has destroyed much of the submontane forest used by the species.
- disease. Because chimpanzees and humans are so similar, chimpanzees succumb to many diseases that afflict humans. Infectious diseases, including outbreaks of respiratory disease and anthrax, are the main causes of death in several chimpanzee populations that have been habituated to human presence.

Chimpanzees are known to occur in the Wambabya FR, which is outside the project AOI. Historic records from the Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT) have also highlighted previous use of the Wambabya River (which is crossed by the AOI at KP89.4) by chimpanzee (Figure A4.4-5). Chimpanzees are listed on the Strategic Plan for the Northern Albertine Rift of Uganda. They are known to use both protected and unprotected forests in the area, and riverine corridors (McLennan and Plumptre 2012). Specifically, nationally significant

populations exist in the Wambabya, Bugoma and Budongo FRs (Lamprey 2017). Consequently, it is possible that chimpanzees use this river for seasonal foraging resources and access to seasonal resources, despite there being no evidence of them recorded during the field surveys. However, it should be noted that most of the chimpanzee surveys concentrated on the Wambabya–-Bugoma corridor and not the land to the west of Wambabya.

Figure A4.4-5 Wambabya River (not Actual Pipeline Crossing Location)

The CSWCT records prompted the project to undertake a more detailed assessment of the potential for chimpanzees to use the southern end of the Tilenga feeder pipeline route, including the Wambabya River. This survey included structured community interviews, unstructured interviews in the field and reconnaissance walks (Ganas and Koojo 2017). They did not record any direct chimpanzee evidence on the river. However, several interviews indicated chimpanzee use near to the Wambabya River and the southern extent of the Tilenga feeder pipeline route.

Other information about chimpanzees in this area helps to put the CSWCT findings into context:

- Previous biodiversity surveys (2014–2015) recorded chimpanzee or evidence of chimpanzee activity in the Bugungu WR (site-specific data have not been provided, so it is assumed that these signs were recorded where the Bugungu WR abuts the Budongo FR). This indicates that chimpanzees may move westwards out of the FRs.

- Interviews with the UWA as part of this assessment noted that there had been no obvious movements of chimpanzees in or through the Bugungu WR in the last couple of years. This implies that any movements are potentially infrequent or at least seasonal.
- No chimpanzees were noted in surveys of the Kabwoya WR or Kaiso Tonya CWA, which the Wambabya River traverses before entering Lake Albert (Plumptre et al. 2009). This may mean that any chimpanzee movements west of Wambabya at the southern end of the Tilenga feeder pipeline route are mainly above the escarpment.

Based on the information obtained to date, it is considered likely that the habitats along the river are used by chimpanzees, at least seasonally. However, the river is most likely acting as a movement corridor through the landscape and either providing seasonal foraging resources or enabling chimpanzees to access seasonal resources; this would need confirming through further studies.

Trend in Condition and Sensitivity to Change

Sitatunga

The increased fragmentation of habitat and increased human presence mean that the sitatunga is more readily accessible to hunters. The ever-increasing loss of wetlands throughout their range has restricted former movement routes, so many populations are becoming isolated. This is likely to lead to continuing population decline.

Though of least concern globally, the sitatunga is vulnerable nationally and thus has a moderate sensitivity to change.

Bohor Reedbuck

The Bohor reedbuck has been removed from large parts of its natural range by overhunting and loss of habitat resulting from the encroachment of human settlements and livestock. Its numbers are in gradual decline over most of its remaining range, apart from some protected areas in East Africa (IUCN SSC Antelope Specialist Group 2016b).

Though of least concern globally, the Bohor reedbuck is endangered at a national level and thus has a high sensitivity to change.

Temminck's Ground Pangolin

Exploitation of Temminck's ground pangolin for traditional medicine and bushmeat is likely to continue until greater protection is provided. This will result in continuing projected population reduction (Pietersen et al. 2014).

As Temminck's ground pangolin is IUCN vulnerable, it has high sensitivity to change.

Tree Pangolin

Although the most abundant of the African pangolins, the tree pangolin is actively hunted for its scales and for informal bushmeat markets. It is reported that the availability of this species is becoming rarer within markets, so it can be inferred that the population is declining (Waterman et al. 2014).

As the tree pangolin is vulnerable both globally and nationally, it has a high sensitivity to change.

Leopard

Evidence suggests that leopard populations have been dramatically reduced because of continued, targeted killing where leopard is in conflict with human communities, habitat fragmentation, increased illegal wildlife trade, excessive harvesting for ceremonial use of skins, prey base declines and poorly managed trophy hunting (Stein et al. 2016).

Over the last 20 years, there has been a considerable decrease in habitat that is favourable to leopards. Leopard population density across the range of the species is known to track the biomass of principle prey species, medium-sized and large wild herbivores. Prey species are increasingly under threat from an unsustainable bushmeat trade, which is leading to collapses in prey populations across large parts of savannah Africa. A commercialised bushmeat trade has caused an estimated 52% decline in ungulate populations in East Africa and, as a result, an inferred collapse of the leopard population of over 50% (Stein et al. 2016).

Future decline is anticipated unless targeted conservation efforts are taken (Stein et al. 2016).

The leopard is IUCN vulnerable and Uganda vulnerable, and is considered a keystone species, so it has high sensitivity to change.

Uganda Kob

The cause of Uganda kob decline in Kenya and Tanzania was the expansion of agriculture and settlements. Hunting is a major threat, especially outside protected areas, but also within them where protection is not fully effective. Continuing population decline is anticipated in response to ongoing land-use pressures.

The Uganda kob is a congregatory species, but does not trigger critical habitat under criterion 3 (migratory and/or congregatory species). It is therefore considered to have low sensitivity to change.

Hippopotamus

Lewison 2007 (reported in Lewison and Pluháček 2017) determined that combinations of habitat loss and even moderate levels of adult mortality from hunting (1% of adults) can lead to relatively high probabilities of hippopotamus population declines over the next 30–40 years.

As the hippopotamus is IUCN vulnerable, it has high sensitivity to change.

Lion

Although attention is currently focused on lion hunting reforms to ensure sustainability, the leading causes of population decline (habitat loss and prey base depletion) are more difficult to address and are likely to continue (Bauer et al. 2017).

As the lion is IUCN vulnerable, it has high sensitivity to change.

African Elephant

Poaching for ivory and meat has traditionally been the major cause of the species' decline. Although illegal hunting remains a significant factor in some areas, particularly in Central Africa, the most important perceived threat is the loss and fragmentation of habitat caused by ongoing human population expansion and rapid land conversion. A specific manifestation of this trend is the reported increase in human–elephant conflict, which further aggravates the threat to elephant populations (Blanc 2008).

Although elephant populations may be declining in parts of their range, major populations in Eastern and Southern Africa accounting for over two thirds of all known elephants on the continent are increasing at an average annual rate of 4.0% per annum. The magnitude of population increases in Southern and Eastern Africa is likely to outweigh the magnitude of population declines elsewhere in the species' range, thereby resulting in a stable global population.

As the elephant is IUCN vulnerable, it has high sensitivity to change.

Spot-Necked Otter

Although this species is widespread, it is restricted to areas of permanent fresh water with good shoreline cover. Its abundance appears to be dependent on suitable habitat cover (Reed-Smith 2010) and recent studies have shown population declines due to habitat loss, watercourse changes caused by drought, increased human populations and increased persecution (either threat based or for consumption or medicinal purposes). Beyond anecdotal evidence identifying the absence of otters from areas where they were seen 10 years ago, few data are available on the species.

For the above reasons and the lack of effective conservation measures, a continuing decline in the overall spot-necked otter population of at least 20% is projected for the next three generations, or 23 years (Pacifici et al. 2013).

As the spot-necked otter is IUCN near threatened and nationally endangered, it has a high sensitivity to change.

Chimpanzee

Although some eastern chimpanzee populations appear to be stable, particularly in well-managed, protected areas east of the Albertine Rift, human population growth, road construction and the conversion of habitat to agriculture will increasingly adversely affect chimpanzees. Chimpanzee numbers in Uganda are declining.

The chimpanzee population projection for the period between 1980 and 2055 (three generations) is expected to be a decline of over 50%. The prediction of the continuing decline of eastern chimpanzee populations is a precautionary approach based on the rapidly increasing human population in East Africa and the degree of political instability in some range countries (Plumptre et al. 2016).

As the chimpanzee is IUCN and Uganda endangered, it has a very high sensitivity to change.

A4.4.8.4 Small Mammals

Baseline Condition

In total, 21 small mammals were either captured in bucket pitfall or Sherman traps, or identified through informal interviews with local community members (see Table A4.4-3).

Table A4.4-3 Small Mammal Species Recorded During Field Surveys

Family and Common Name	Scientific Name	IUCN	Uganda Red List
Muridae			
Multimammate rat	*Mastomys natalensis*	Least concern	Not listed
House rat	*Rattus rattus*	Least concern	Not listed
Hinde's rock rat	*Aethomys hindei*	Least concern	Not listed
African marsh rat	*Dasymys incomtus*	Least concern	Not listed
Rusty-bellied brush furred rat	*Lophuromys sikapusi*	Least concern	Not listed
Yellow-spotted brush-furred rat	*Lophuromys flavopunctatus*	Least concern	Not listed
Southern African vlei rat	*Otomys irroratus*	Least concern	Not listed
Big-eared swamp rat	*Malacomys longipes*	Least concern	Not listed
Barbary striped grass mouse	*Lemniscomys barbarus*	Least concern	Not listed
Typical striped grass mouse	*Lemniscomys striatus*	Least concern	Not listed
Jackson's soft furred mouse	*Praomys jacksoni*	Least concern	Not listed
Temmincks's mouse	*Mus musculoides*	Least concern	Not listed
Nesomyidae			
Northern giant pouched rat	*Cricetomys gambianus*	Least concern	Not listed
Soricidae			
African giant shrew	*Crocidura olivieri*	Least concern	Not listed
Naked-tail shrew	*Crocidura littoralis*	Least concern	Not listed
Bicoloured musk shrew	*Crocidura fuscomurina*	Least concern	Not listed
Uganda lowland shrew[2]	*Crocidura selina*	Data deficient	Endangered
Gliridae			
Woodland dormouse	*Graphiurus murinus*	Least concern	Not listed
Sciuridae			
Boehm's bush squirrel	*Paraxerus boehmi*	Least concern	Not listed
African giant squirrel	*Protoxerus stangeri*	Least concern	Not listed
Red-legged sun squirrel	*Heliosciurus rufobrachium*	Least concern	Not listed

[2] The Uganda lowland shrew is classified as endangered on the Uganda National Red List

Only one small mammal species is of conservation importance, the Ugandan lowland shrew (*Crocidura selina),* which was recorded during the wet season.

Uganda Lowland Shrew

The Uganda lowland shrew is IUCN data deficient and Uganda endangered. This endemic species has only been recorded in three lowland forests in Uganda and, potentially, one locality in Kenya (unconfirmed) (Gerrie and Kennerley 2016). Very little is known about the species, but it appears to favour tropical moist forests and swamps.

The Uganda lowland shrew was recorded during the field surveys in riparian vegetation on the banks at the Waisoke River (KP28) and Sonso River (KP38) crossings.

Trend in Condition and Sensitivity to Change

Uganda Lowland Shrew

The Uganda lowland shrew is an endemic species that is threatened by habitat loss. As mentioned in Section A4.4.6.2, the loss of riparian vegetation is expected to continue and thus so is the population of the Uganda lowland shrew.

The Uganda lowland shrew is IUCN data deficient, but Uganda endangered and endemic, so has a high sensitivity to change.

A4.4.8.5 Reptiles

Baseline Condition

Table Att4.7-1 in Attachment A4.7 provides the full field survey results for reptiles and amphibians. A total of 26 reptile species belonging to four orders, Chelonii (turtles and tortoises), Sauria (lizards and skinks), Crocodylia (crocodiles) and Serpentes (snakes), were recorded along the project AOI (see Table A4.4-4). The most species-rich site was the Wambabya River and its immediate surroundings. Two-thirds of the survey sites along the route could be considered species-poor, with only four or fewer species being recorded. The most common reptile species encountered were:

- *Trachylepis maculilabris* (28 recorded)
- *Agama agama* (22 recorded)
- *Varanus niloticus* (19 recorded)
- *Naja melanoleuca* (12 recorded)
- *Acanthocercus atricollis* (10 recorded).

Table A4.4-4 Reptile Species Recorded During Field Surveys

Family and Common Name	Scientific Name	IUCN	National Red List
Agamidae			
Common agama	*Agama agama*	Least concern	Least concern
Common tree agama	*Acanthocercus atricollis*	Least concern	Least concern
Chamaeleonidae			
Graceful chameleon	*Chamaeleo gracilis*	Least concern	Least concern
Smooth chameleon	*Chamaeleo laevigatus*	Least concern	Least concern
Geckonidae			
Tropical house gecko	*Hemidactylus mabouia*	Not evaluated	Least concern
Brooke's house gecko	*Hemidactylus brookii*	Not evaluated	Least concern
Chevron-throated dwarf gecko	*Lygodactylus gutturalis*	Not evaluated	Least concern
Scincidae			
Speckle-lipped skink	*Trachylepis maculilabris*	Not evaluated	Not listed
Striped skink	*Trachylepis striata*	Not evaluated	Not listed
African red-sided skink	*Trachylepis perrotetii*	Not evaluated	data deficient
Rainbow skink	*Trachylepis quinquetaeniata*	Not evaluated	Not listed
Testudinidae			
Bell's hinged tortoise	*Kinixys belliana*	Not evaluated	Not listed
Typhlopidae			
Lineolate blind snake	*Afrotyphlops lineolatus*	Not evaluated	Not listed
Boidae			
Central African rock python	*Python sebae*	Least concern	Not listed
Colubridae			
Emerald snake	*Hapsidophrys smaragdina*	Not evaluated	Not listed
Spotted bush snake	*Philothamnus semivariegatus*	Not evaluated	Not listed
Elapidae			
Jameson's mamba	*Dendroaspis jamesoni*	Least concern	Not listed
Black mamba	*Dendroaspis polyepis*	Least concern	Not listed
Forest cobra	*Naja melanoleuca*	Not evaluated	Not listed
Viperidae			
Puff adder	*Bitis arietans*	Not evaluated	Not listed
Lamprophiinae			
Brown house snake	*Lamprophis fuliginosus*	Not evaluated	data deficient
Psammophidae			
Striped sand snake	*Psammophis sibilans*	Not evaluated	Not listed

Table A4.4-4 Reptile Species Recorded During Field Surveys

Family and Common Name	Scientific Name	IUCN	National Red List
Varanidae			
Nile monitor	*Varanus niloticus*	Not evaluated	Not listed
Pelomedusidae			
Helmeted turtle	*Pelomedusa subrufa*	Not evaluated	Not listed
Crocodylidae			
Nile crocodile	*Crocodylus niloticus*	Least concern	Not listed
Gerrhosauridae			
Sudan plated lizard	*Broadleysauras major*	Least concern	Not listed

Most East African reptile species, except for the chameleons, have not been evaluated in terms of conservation importance or priorities. The IUCN Red List shows that most of the reptiles are not evaluated with very few, *Acanthocercus atricollis* (common tree agama), *Agama* (common agama), *Lygosoma sundevalli* (Sundevall's writhing skink), *Crocodylus niloticus* (Nile crocodile) and *Dendroaspis polylepis* (black mamba), assessed globally. These species are IUCN least concern.

Species of conservation importance include:

- rainbow skink, *Trachylepis quinqueteniata,* Uganda vulnerable
- smooth chameleon, *Chamaeleo laevigatus*, IUCN least concern, Uganda endangered.

Although the Nile crocodile is considered least concern on the global scale, it is an action-plan species for the Northern Albertine Rift and was recorded along the project AOI (see Table Att4.7-1 in Attachment A4.7).

Rainbow Skink

The rainbow skink lives on rock outcrops in mesic and arid savanna (Spawls et al. 2002). No population data are available. It is listed as vulnerable in Uganda as it is known from fewer than 10 locations and there is a decline in the area, extent or quality of its habitat.

It was recorded during the wet season surveys at KP55, KP56, KP59, KP64 and KP67.

Smooth Chameleon

The smooth chameleon was previously known from around the Bugungu WR area and was listed as a critical habitat trigger in previous reports for the region. However, this species has now been declassified because it is commonly found and abundant in wetland vegetation in north and north-eastern Uganda.

The smooth chameleon is an arboreal savannah chameleon that is widespread (Tilbury 2010). It lives in bushes, shrubs and trees but readily descends to the

ground. Globally, the species is common and populations are reportedly stable. The smooth chameleon is listed as endangered in Uganda because it is only known in five or fewer locations and there is a continuing decline in the area, extent or quality of its habitat.

It was recorded during the field surveys in the Bugungu WR.

Trend in Condition and Sensitivity to Change

Rainbow Skink

Although no population data are available for the rainbow skink, this species will continue to be under threat if habitat loss continues at the current rate across Uganda.

As the rainbow skink is Uganda vulnerable, it has a moderate sensitivity to change.

Smooth Chameleon

Although globally the smooth chameleon population is thought to be stable, the continuing loss of habitat will continue to threaten this species in Uganda.

As the smooth chameleon is Uganda endangered, it has a high sensitivity to change.

A4.4.8.6 Amphibians

Baseline Condition

There is little information available on reptile and amphibian populations in the region crossed by the project AOI. However, information does exist for the Albertine Graben and the MFPA, which has mainly been collected through other studies associated with oil exploration in the region. From a review of the available information, based on the known distribution and habitat preferences, the following species of conservation importance could use habitats crossed by the route, though they were not recorded during the baseline surveys:

- *Pelusios chapini* (Zaire hinged terrapin): Uganda critically endangered; found in wetlands along the shore of Lake Albert
- *Trionyx triunguis* (African soft-shelled turtle): Uganda critically endangered; found in the Murchison Falls–Albert Delta wetland system
- *Phrynobatrachus auritus* (golden puddle frog): Uganda endangered; found in the Budongo, Bugoma and Wambabya FRs
- *Aparallactus lunulatus* (reticulated centipede-eater): Uganda vulnerable; found in Semuliki National Park and the Kabwoya WR.

In addition, some data deficient species have been recorded by previous studies of the region, but were not recorded during the Tilenga feeder pipeline baseline surveys.

Table Att4.7-1 in Attachment A4.7 provides the full field survey results for reptiles and amphibians. A total of 16 amphibian species, all of order Anura, was recorded along the project AOI, see Table A4.4-5. The Wambabya River (KP89) and immediate surroundings had the highest diversity with 13 species, followed by the

Waiga River (KP21) with 9 species. The most common amphibian species encountered were:

- *Hoplobatrachus occipitalis* (15 recorded)
- *Phrynobatrachus natalensis* (14 recorded)
- *Hyperolius kivuensis* (13 recorded)
- *Amietophrynus regularis* (15 recorded)
- *Afrixalus quadrivittatus* (9 recorded)
- *Ptychadena mascareniensis* (9 recorded)
- *Hyperolius viridiflavus* (8 recorded).

Most species recorded were of IUCN least concern. Only one species of conservation importance was recorded during the field surveys, the Albertine Rift tree frog, *Leptopelis kivuensis* (IUCN least concern, Uganda vulnerable and endemic to the Albertine Rift).

Table A4.4-5 Amphibian Species Recorded During Field Surveys

Family and Common Name	Scientific Name	IUCN	National Status
Buffonidae			
Guttural toad	*Amietophrynus gutturalis*	Least concern	Not listed
African common toad	*Amietophrynus regularis*	Least concern	Not listed
Dicroglossidae			
Crowned bullfrog	*Hoplobatracus occipitalis*	Least concern	Not listed
Hyperoliidae			
Four-lined spiny reed frog	*Afrixalus quadrivittatus*	Least concern	Not listed
Sharp-nosed reed frog	*Hyperolius acuticeps*	Least concern	Not listed
Cinnamon-bellied reed frog	*Hyperolius cinnamomeoventris*	Least concern	Not listed
Kivu reed frog	*Hyperolius kivuensis*	Least concern	Not listed
Common reed frog	*Hyperolius viridiflavus viridiflavus*[2]	Least concern	Not listed
Arthroleptidae			
Albertine Rift tree frog	*Leptopelis kivuensis*	Least concern	Vulnerable
	Leptopelis sp.	Least concern	Not listed
	Arthroleptis sp.	Least concern	Not listed
Phrynobatrachidae			
Natal dwarf puddle frog	*Phrynobatrachus natalensis*	Least concern	Not listed
Phyxichepalidae			
Angola river frog	*Amietia angolensis*	Least concern	Not listed

Table A4.4-5 Amphibian Species Recorded During Field Surveys

Family and Common Name	Scientific Name	IUCN	National Status
Ptychadenidae			
Anchieta's ridged frog	*Ptychadena anchietae*	Least concern	Not listed
Macarene grass frog	*Ptychadena mascareniensis*	Least concern	Not listed
Grassland ridged frog	*Ptychadena porosissima*	Least concern	Not listed

The areas listed below are considered 'sensitive' based on the herpetofauna populations or assemblages they support:

- the Bugungu WR (KP25: 45), with better assemblages inside the reserve than outside owing to the stability of habitats inside the reserve
- the escarpment (KP55), where herpetofauna are already threatened by subsistence farming and local cattle grazing.

Albertine Rift Tree Frog

The Albertine Rift tree frog inhabits glades, swamps, riverine vegetation and forest clearings near water (Spawls et al. 2002). The species is abundant where it occurs (IUCN 2016). It is listed as Uganda vulnerable because its range is less than 20,000 km^2 and the continuing decline in the area, extent or quality of its habitat.

Trend in Condition and Sensitivity to Change

Albertine Rift Tree Frog

Although within its range the Albertine Rift tree frog population is thought to be stable, in Uganda the ongoing loss of habitat will continue to threaten this species.

As the Albertine Rift tree frog is listed as nationally vulnerable, it has a moderate sensitivity to change.

A4.4.8.7 Invertebrates

As well as confirming the presence of important species for conservation, butterflies and dragonflies, in their roles as indicators, also provide information about habitat quality and function. This information can be used in conjunction with the results of other species surveys to identify sensitive habitats at a landscape scale and strengthen other assumptions. For instance, the invertebrate surveys support general assumptions made about the importance of certain habitats based on the results of the mammal surveys. The highest number of butterfly species was recorded on the Sonso River, with more species being found on the section of river inside the Bugungu WR. Similarly, reflecting the habitat degradation and conversion discussed in Section A4.4.5, only one species of butterfly was recorded around the Bujawe FR.

The invertebrate surveys identified several widespread species throughout the AOI (see Tables Att4.6-1 and Att4.6-2 in Attachment A4.6). Some of these species have strong habitat associations, which show that the habitats encountered still retain

some of their original functions, despite varying degrees of habitat modification in the region. Species requiring further consideration in this impact assessment are shown in Table A4.4-6. Many of the species encountered during the survey have not been assessed at the global level and their conservation importance has been assigned using the Uganda Red List. Information on trends for most species is unavailable. It is interesting to note the comment in the Uganda Red List regarding the inclusion of so many butterfly species:

> "It will be noted that there are a large number of threatened species in the butterfly lists compared to other taxa. This is primarily due to the rapid rate of loss of forests outside of the Central Forest Reserves, the majority of which are located in Western Uganda and the restricted range of many of these forest dependent species. The 235 data deficient species illustrates how little has been done to date to understand the status of butterflies."

Over both surveys, 202 species of butterflies and 61 species of dragonflies were recorded along the project AOI.

Table A4.4-6 Butterflies of Conservation Importance

Species	Habitat	IUCN Status	Uganda Red List Status	Sites Present	Notes
Anthene indefinite	Savanna/forest edge	Not evaluated	Vulnerable	Waisoke River (KP28), Bulwo River (KP36 and 37), KP56–59 and KP61	Species prefers moist savanna and forest. It is restricted to East Africa, including the Democratic Republic of Congo
Anthene liodes	Savanna/forest edge	Not evaluated	Vulnerable	KP15 and 16 (Maseege FR), KP20, KP22–23, KP61 and Bulwo River (KP36–37) on feeder route, and Wambabya River (KP89)	Only previously recorded in the Budongo and Namwasa forests
Colotis chrysonome	Savanna	Not evaluated	Vulnerable	KP15 and KP16 (Maseege FR), KP36 and KP37, and KP39 along the feeder route	This species is only known in Northern Uganda from a few records. They are uncommon and prefer arid savanna, but are always found resting in shade on hot days.

Table A4.4-6 Butterflies of Conservation Importance

Species	Habitat	IUCN Status	Uganda Red List Status	Sites Present	Notes
Platylesches moritili	Savanna/riverine forest	Not evaluated	Vulnerable	KP84 on the feeder route	This species was only previously known from the West Nile (Mt Kei and Otzi FRs) and it is considered to have a restricted range in Uganda
Prosopalpus styla	Savanna/forest edge	Not evaluated	Vulnerable	KP13, KP15 and KP16 9, KP36–37 (Bubwe River), KP64 and KP93	Species prefers open ground in savanna and forests but mostly forests
Pentila tachyroides	Forest	Not evaluated	Critically endangered (due to be revised to endangered owing to additional records)	KP89 (Wambabya River)	Previously known only from Bbaale County (Sango Bay FR) until recently, when it was recorded in Nabugabo area in a severely degraded forest
Semalea arela	Forest	Not evaluated	Data deficient	KP15 and KP16 (Masege FR)	This is the first record of this species in Uganda

All but one dragonfly species recorded along the project route are listed as IUCN of least concern, but several species are ranked on the Uganda Red List. Table A4.4-7 presents the dragonfly species that were identified during the surveys. In both surveys, the Bugungu WR, specifically from KP34–39, recorded the highest number of dragonfly species.

Table A4.4-7 Dragonflies of Conservation Importance

Species	Habitat	IUCN Status	Uganda Red List Status	Sites Present	Notes
Acisoma inflatum	Streams and wetlands near forests	Least concern	Vulnerable	KP36–39, KP21–23 (Waiga River) and KP79	Habitat degradation is a possible threat
Acisoma variegatum	Streams and wetlands near forests	Least concern	Vulnerable	KP37 (Kafu River)	Habitat degradation is a possible threat

Table A4.4-7 Dragonflies of Conservation Importance

Species	Habitat	IUCN Status	Uganda Red List Status	Sites Present	Notes
Agriocnemis palaeforma	Papyrus swamps	Vulnerable	Endangered	KP16 (feeder)	This is a Uganda–Rwanda endemic species that inhabits papyrus swamps
Azuragrion vansomereni	Widespread	Least concern	Data deficient	KP0 (feeder)	There are barely any records of this species in Uganda
Chlorocypha victoriae	Forest streams	Least concern	Vulnerable	KP07, KP08, KP11, KP13, KP16 and KP25–27	Forests in Uganda have undergone remarkable degradation
Hadrothemis camarensis	Forest	Least concern	Vulnerable	Wambabya River (KP0–KP15 areas)	It has only been recorded in the Bugoma FR and forest corridor wetlands in Hoima district
Pseudagrion (B) torridum	Shoreline habitats	Least concern	Vulnerable	Maseege FR (KP15–16), KP28 (Waisoke River), KP39, stream between KP23 and 24, and Bujawe forest (KP86–87)	Shoreline habitats are currently under immense threat in Uganda
Pseudagrion (B) glaucoideum	Forest	Least concern	Listed as critically endangered (due to be revised to endangered owing to additional records)	KP21 and river between KP22 and 23	Was only known from Semuliki and recently from KP271 (Kibale River)

As with the mammal survey results, records of important invertebrates outside protected areas are scarce. The project surveys have identified that some species of conservation interest use the following watercourses inside and outside protected areas:

- Waiga River (KP23.5), permanent flow
- Waisoke River (KP28.5), permanent flow
- Bubwe River (KP37.4), seasonal flow in the stretch surveyed

- Wambabya River (KP89.4), permanent flow.

A dragonfly species endemic to Uganda and Rwanda was also found in wetland around KP16 and a vulnerable butterfly species was recorded along the edge of the Bujawe FR.

As noted in the critical habitat gap analysis for this project (Nampindo et al. 2017), most potential critical habitat triggers in this region are known from or confined to forest habitats; these are not crossed by the project AOI. However, important forest species (e.g., *Pentila tachyroides*) that have been recorded along a watercourse (e.g., the Wambabya River) indicate that the riparian vegetation still has some function as a forest and is likely to facilitate movements to and from forested areas.

Trend in Condition and Sensitivity to Change

Based on the degraded quality of the habitats along the project AOI and taking into consideration information on habitat quality trends (NEMA 2016), it is assumed that populations of invertebrates are declining.

As many of the species of butterfly and dragonfly recorded during the surveys are nationally endangered, and range-restricted and congregatory, they are considered to have high sensitivity to change.

A4.4.9 Ecosystem Services Provided

The habitats discussed in the preceding sections (the Bugungu WR, the Maseege and Bujawe FRs, and wetland and aquatic habitats throughout the AOI), with the species they support, provide a range of ecosystem services. Further details on the general nature and extent of the provisioning ecosystem services can be found in the land-based livelihoods section of Appendix A9 Socio-economic and Health Baseline Report.

Provisioning services include:

- wood and wood fuel, including collection for charcoal manufacture. In some areas these activities are legal and in others they are not.
- food (hunting, gathering and foraging). In some areas these activities are legal and in others they are not.
- collection of medicinal products
- trapping of wildlife for the live trade market.

Cultural services include:

- ethical and biodiversity ‘non-use’ values, particularly in terms of maintaining populations of endangered and endemic species. These values are difficult to determine.
- sense of place and way of life, as these locations are likely to provide value to local people living near and using these areas in terms of the way of life and through a special connection with such areas
- eco-tourism, particularly in protected areas
- aspects of these locations may provide spiritual, scared or religious values; inspiration for culture and design; and cognitive development.

A4.4.10 Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the receptors has been ranked and is shown in Table A4.4-8.

Table A4.4-8 Fauna Sensitivity Ranking

Fauna Receptor	Sensitivity Ranking	Rationale for Ranking
Bugungu WR		
Legally protected, internationally or nationally recognised areas	High (4)	Nationally designated for biodiversity purposes
Fauna habitats of conservation importance	High (4)	Comprises natural habitat[1]
Flora and fauna species of conservation importance	High (4)	This area supports a range of species of conservation importance, including lion and smooth chameleon and chimpanzee (WCS and eCountability 2016)
Maseege CFR		
Legally protected, internationally or nationally recognised areas	Very low (1)	Designated as a FR for plantation forestry purposes
Fauna habitats of conservation importance	Moderate (3)	Comprises habitat in the process of transitioning from natural to modified habitat
Flora and fauna species of conservation importance	High (4)	This reserve sits within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016)
Bujawe FR		
Legally protected, internationally or nationally recognised areas	Moderate (3)	Designated as a FR and retains some biodiversity value
Fauna habitats of conservation importance	Moderate (3)	Comprises modified habitat with some biodiversity value
Flora and fauna species of conservation importance	High (4)	This reserve sits within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016)
Wetland and aquatic habitats		
Fauna habitats of conservation importance	High (4)	Habitats providing connectivity, such as (but not limited to) riparian corridors and wetlands providing ecological linkages
Flora and fauna species of conservation importance	High (4)	Supports IUCN vulnerable and Uganda vulnerable species: • hippopotamus • Ugandan lowland shrew, which triggers Tier 1 critical habitat (see Appendix B Critical Habitat Assessment)

Table A4.4-8 Fauna Sensitivity Ranking

Fauna Receptor	Sensitivity Ranking	Rationale for Ranking
Wildlife corridors		
Fauna habitats of conservation importance	High (4)	Habitats providing connectivity, such as (but not limited to) riparian corridors and wetlands providing ecological linkages
Flora and fauna species of conservation importance	Very high (5)	Supports African elephant, a Uganda critically endangered species

NOTES: [1]As defined by PS6 and the accompanying Guidance Note

A4.5 Key Considerations

A4.5.1 Habitats

According to the outcomes of the fauna biodiversity study and particularly the known or likely presence of species of conservation importance, the following areas were identified as sensitive receptors:

- Bugungu WR is within an area identified as Tier 1 critical habitat for chimpanzee and as Tier 2 critical habitat for a range of other fauna species, including lion, African elephant and smooth chameleon.
- Maseege CFR owing to its location within an area identified as Tier 1 critical habitat for chimpanzee
- Bujawe FR comprises modified habitat yet is within an area identified as Tier 1 critical habitat for chimpanzee, and supports IUCN and Uganda vulnerable species such as the Temminck's ground pangolin.
- wetland and aquatic habitats such as Waiga, Waisoke, Sonso and Waluka rivers based on the recorded presence of Ugandan lowland shrew (IUCN data deficient, Uganda endangered and endemic) and hippopotamus (IUCN and Uganda vulnerable).
- wildlife corridors providing connectivity such as (but not limited to) riparian corridors and wetlands.

A4.5.2 Fauna

Some species identified during the survey are of conservation importance and are key considerations for the impact assessment. These species are important because:

- they are listed as IUCN endangered or vulnerable
- are endemic to Uganda
- some are of conservation importance in Uganda (i.e., included in species action plans or the Uganda Red List) or are listed in the CMS database.

Table A4.5-1 summarises species of conservation importance.

Table A4.5-1 Key Fauna Considerations

Species	Location(s)	Conservation Status
Large mammals		
Chimpanzee	Wambabya River	IUCN endangered, Uganda endangered
Sitatunga	Hoimo River	IUCN least concern, Uganda vulnerable
Bohor reedbuck	Hoimo, Bubwe and Waiga Rivers	IUCN least concern, Uganda endangered
Leopard	Waisoke and Waiga Rivers	IUCN vulnerable, Uganda vulnerable
Spot-neck otter	Hoimo and Wambabya Rivers	IUCN near threatened, Uganda endangered
Temminck's ground pangolin	Bujawe FR	IUCN vulnerable, Uganda vulnerable
Tree pangolin	KP58	IUCN vulnerable, Uganda vulnerable
Uganda kob	Waiga, Waisoke, Sonso, Bubwe and Walubkuba Rivers	IUCN least concern, Uganda not listed, congregatory, key prey species for lion
Hippopotamus	Waiga, Waisoke, Sonso, Walubkuba and Waki Rivers	IUCN vulnerable, Uganda vulnerable
Lion	Bugungu WR	IUCN vulnerable, Uganda critically endangered
African elephant	Bugungu WR	IUCN vulnerable, Uganda critically endangered, migratory
Small mammals		
Uganda lowland shrew	Sonso and Waisoke Rivers	IUCN data deficient, Uganda endangered, endemic
Reptiles		
Rainbow skink	KP55, KP56, KP59, KP64 and KP67	IUCN least concern, Uganda vulnerable
Smooth chameleon	Bugungu WR	IUCN least concern, Uganda endangered
Amphibians		
Golden puddle frog	Budongo, Bugoma and Wambabya FRs	IUCN least concern, Uganda endangered
Albertine Rift tree frog	Recoded during ESIA baseline survey – location not noted in field report	IUCN least concern, Uganda vulnerable and endemic to the Albertine Rift

Table A4.5-1 Key Fauna Considerations

Species	Location(s)	Conservation Status
Butterflies		
Anthene indefinite	Waisoke River (KP28), Bulwo River (KP36 and 37), KP56–59 and KP61	IUCN not evaluated, Uganda vulnerable
Anthene liodes	Maseege FR (KP15–16), KP20, KP22–23, KP61 and Bulwo River (KP36 and 37), and Wambabya River (KP89)	IUCN not evaluated, Uganda vulnerable
Colotis chrysonome	Maseege FR (KP15 and16), KP36, KP37 and KP39	IUCN not evaluated, Uganda vulnerable
Platylesches moritili	KP84	IUCN not evaluated,
Prosopalpus styla	KP13, KP15, KP16, River Bubwe (KP36–37), KP64 and KP93	IUCN not evaluated, Uganda vulnerable
Pentila tachyroides	Wambabya River	IUCN not evaluated, Uganda critically endangered
Semalea arela	Maseege FR	IUCN not evaluated, Uganda data deficient
Dragonflies		
Acisoma inflatum	KP36–39, River Waiga (KP21–23) and KP79	IUCN least concern, Uganda vulnerable
Acisoma variegatum	Kafu River	IUCN least concern, Uganda vulnerable
Agriocnemis palaeforma	KP16	IUCN vulnerable, Uganda endangered
Azuragrion vansomereni	KP0	IUCN least concern, Uganda data deficient
Chlorocypha victoriae	KP07, KP08, KP11, KP13, KP16, KP25, KP26 and KP27	IUCN least concern, Uganda vulnerable
Hadrothemis camarensis	Wambabya River	IUCN least concern, Uganda vulnerable
Pseudagrion (B) torridum	Maseege FR (KP15 and 16), Waisoke River (KP28), KP39, stream between KP23 and KP24, and Bujawe forest (KP86 and KP87)	IUCN least concern, Uganda vulnerable
Pseudagrion (B) glaucoideum	KP21 and river between KP22 and KP23	IUCN least concern, Uganda critically endangered

A4.6 References

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ATTACHMENT A4.1 RIVER CROSSING PHOTOGRAPHS

ATTACHMENT A4.2 MAMMAL SPECIES SCOPED INTO ASSESSMENTS

Potential Critical Habitat Triggers from Previous CHA Work in the Region	**Important Species to Scope in from Ugandan Red List (Some Duplication with CHA List)**	**Widespread Species**
Alcelaphus buselaphus ssp. *Lelwel* (Lelwel's hartebeest)	*Panthera leo* (Lion) – MFPA – CR (Albertine Rift action plan species)	*Hydrictis maculicollis* (African spot-necked otter) – **widespread** – EN
Crocidura selina – EN and endemic	*Crocuta crocuta* (spotted hyena) – MF – CR	*Tragelaphus spekii* (sitatunga) – **widespread** – vulnerable
Pan troglodytes (chimpanzee) – EN	*Neoromicia helios* (savanna pipistrelle) – Hoima district/Wambabya – CR	*Hippopotamus amphibius* (hippopotamus) – **widespread** – vulnerable
Crocuta crocuta (spotted hyena) – CR	*Loxodonta africana* (African elephant) – MF – CR (Albertine Rift action plan species and ACCN)	*Panthera pardus* (leopard) – **widespread** – vulnerable
Kobus kob thomasi (Uganda kob)	*Crocidura selina* (Ugandan lowland shrew) – Hoima district – EN and endemic	All Prosimians (as per ACCN)
Lophocebus ugandae (Uganda mangabey) – vulnerable and endemic – now considered same as grey-cheeked mangabey	*Mops congicus* (Congo free-tailed bat) – Budongo – EN	All monkeys (accept baboons, as per ACCN) – good primate assemblage at Wambabya (black and white colobus, blue monkey, red-tail monkey, Ugandan mangabey)
Loxodonta africana (African elephant) – CR	*Mops trevori* (Trevor's free-tailed bat) – Budongo – EN	
Panthera leo (lion) – CR	*Pan troglodytes* (chimpanzee) – EN (Albertine Rift action plan species)	
Redunca reduna wardi (Bohor reed buck) – EN	*Redunca reduna wardi* (Bohor reed buck) – EN – MF	
Mops congicus (Congo free-tailed bat) – EN	*Poelagus marjorita* (Central African grass rabbit) – Hoima – vulnerable	
Mops trevori (Trevor's free-tailed bat) – EN	*Mops brachypterus* (Peter's free-tailed bat) – Budongo – vulnerable	
Neoromicia helios (savanna pipistrelle) – CR	*Mops demonstrator* (Mongalla free-tailed bat) – Wambabya – vulnerable	
Thamnomys venustus – vulnerable (global), DD (Uganda) and Albertine Rift endemic	*Mops midas* (Midas' giant free-tailed bat) – Budongo – vulnerable	

Potential Critical Habitat Triggers from Previous CHA Work in the Region	**Important Species to Scope in from Ugandan Red List (Some Duplication with CHA List)**	**Widespread Species**
Chaerephon russatus	*Otomops martiensseni* (Martienssen's free-tailed bat) – Budongo – vulnerable	
	Phataginus tricuspis (tree pangolin) – Budongo – vulnerable	
	Smutsia gigantea (giant pangolin) – MF, Budongo – vulnerable	
	Smutsia temminckii (ground pangolin) – MF – vulnerable	
	Lophocebus ugandai (Ugandan mangabey) – Bugoma, Wambabya – vulnerable and endemic	
	Chaerephon bemmeleni (gland-tailed free-tailed bat) – DD (least concern global)	
	Aonyx congica (Congo clawless otter) – DD (near threatened global)	
	Myotis tricolor (Cape hairy bat) – DD (least concern global)	
	Scotoecus albofuscus (light-winged lesser house bat) – DD (DD global)	
	Chaerephon ansorgei (Ansorge's free-tailed bat) – DD (least concern global)	

ATTACHMENT A4.3 BUTTERFLY AND DRAGONFLY SPECIES SCOPED IN TO ASSESSMENTS

Potential Critical Habitat Triggers (Butterflies and Dragonflies) from Previous CHA Work in the Region	**Important Species to Scope in from Ugandan Red List (Some Duplication with CHA List)**
Elattoneura nigra	*Epitolina catori* – CR – Mpanga FR
Acraea alciope (*Alciope Bematistes*)	*Liptena opaca* – CR – Mpanga FR
Andronymus caesar (white dart)	*Micropentila mpigi* – CR – Mpanga FR
Andronymus gander (migrant dart)	*Euptera elabontas* – CR – Mpanga FR
Bicyclus procora (cinnamon bush brown)	*Andronymus caesar* – EN – Bugoma
Euphaedra paradoxa	*Andronymus gander* (migrant dart) – EN – Budongo
Hypocopelates mera	*Xan thodisca vibius* (vibius orange) – EN – Budongo
Iridana marina	*Iridana marina* – EN – Budongo
Lachnocnema magna (large woolly legs)	*Lachnocnema magna* (large woolly legs) – EN – Bugoma
Leptosia marginea (black-edged spirit)	*Liptena hapale* – EN and Albertine Rift endemic – Budongo
Leptosia medusa (dainty spirit)	*Liptena undina* – EN – Budongo
Liptena hapale	*Micropentila bunyoro* – EN – Budongo
Liptena undina	*Uranothauma heritsia* (light branded blue) – EN – wetlands in Hoima district
Micropentila bunyoro	*Euphaedra paradoxa* – EN – Wambabya and Bugoma
Mylothris hylara	*Leptosia marginea* (black-edged spirit) – EN – Bugoma
Thermoniphas togara (bright chalk blue)	*Leptosia medusa* (dainty spirit) – EN – Bugoma
Uranothauma heritsia (light branded blue)	*Mylothris hilara* – EN – Budongo
Xan thodisca vibius (vibius orange)	*Celaenorrhinus ovalis* – vulnerable – Budongo, Bugoma
	Ceratrichia wollastoni – vulnerable – Budongo
	Ceratrichia aurea – vulnerable – Budongo
	Mmonza alberti – vulnerable – Bugoma
	Osmodes omar – vulnerable – Bugoma
	Anthene ituria – vulnerable and Albertine Rift endemic – Bugoma
	Anthene scintillula – vulnerable – Wambabya

Potential Critical Habitat Triggers (Butterflies and Dragonflies) from Previous CHA Work in the Region	**Important Species to Scope in from Ugandan Red List (Some Duplication with CHA List)**
	Falcuna orientalis – vulnerable – Bugoma, Budongo
	Liptenara hiendlmayri – vulnerable and Albertine Rift endemic – Budongo
	Telipna sheffieldi – vulnerable and endemic – Mpanga FR
	Acraea alcinoe – vulnerable – Bugoma
	Bebearia laetitioides – vulnerable – Wambabya, Bugoma, Budongo
	Euphaedra rex – vulnerable – Bugoma, Budongo
	Euriphene butleri – vulnerable -Bugoma
	Euryphura chalcis – vulnerable – Wambabya, Bugoma
	Hypolimnas bartteloti – vulnerable – Bugoma
	Neptis carpenteri – vulnerable – Bugoma
	Belenois sudanensis – vulnerable – Bugoma
	Pseudopontia paradoxa – vulnerable – Bugoma
	Elattoneura nigra (black threadtail) – EN – MF
	Platycypha lacustris (forest jewel) – vulnerable – Wambabya and Bugoma
	Hadrothemis camarensis (saddled jungleskimmer) – vulnerable – Bugoma and forest corridor wetlands
	Malgassophlebia bispina – vulnerable – Budongo

ATTACHMENT A4.4 REPTILE AND AMPHIBIAN SPECIES SCOPED INTO ASSESSMENTS

Potential Critical Habitat Triggers (Reptiles and Amphibians) from Previous CHA Work in the Region	**Important Species to Scope in from Ugandan Red List (Some Duplication with CHA List)**
Arthroleptis adolfifriederici (Rugege forest squeaker)	*Arthroleptis poecilonotus*, vulnerable and Albertine Rift endemic
Phrynobatrachus auritus (Golden puddle frog)	*Xenopus vestitus* (Kivu clawed frog) – Wambabya – EN and Albertine Rift endemic
Ptychadena christyi (Christy's grassland frog)	*Phrynobatrachus auritus* (golden puddle frog) – Wambabya – EN
Xenopus ruwenzoriensis (Uganda clawed frog)	*Arthroleptis poecilonotus* – MF, Wambabya – vulnerable
Xenopus vestitus (Kivu clawed frog)	*Leptopelis kivuensis* (Kivu tree-frog) – vulnerable and Albertine Rift endemic
Arthroleptis poecilonotus (Mottled squeaker)	*Xenopus ruwenzoriensis* (Uganda clawed frog) – Budongo – vulnerable and Albertine Rift endemic
Leptopelis kivuensis (Kivu tree frog)	*Ptychadena christyi* (Christy's grassland frog) – Lake Albert, escarpment below Bugoma – vulnerable and Albertine Rift endemic
Ptychadena chrysogaster (Golden-bellied rocket frog)	*Ptychadena chrysogaster* (golden-bellied rocket frog) – Hoima – vulnerable and Albertine Rift endemic
	Pelusios adansonii (Adonson's hinged terrapin) – CR – MF, along Lake Albert shoreline
Pelusios adansonii (Adonson's hinged terrapin)	*Trionyx triunguis* (African soft-shelled turtle) – CR – shores of Lake Albert
Pelusios chapini (Zaire hinged terrapin)	
Trionyx triunguis (African soft-shelled turtle)	*Holaspis guentheri* (saw-tailed lizard) – vulnerable – Budongo
Gonionotophis poensis (Western forest file snake)	*Trachylepis quinquetaeniata* (rainbow skink) – vulnerable – MF
Gonionotophis capensis (Cape file snake)	*Gonionotophis capensis* (Cape file snake) – vulnerable – Budongo
Grayia smythii (Smyth's African water snake)	*Toxicodryas blandingii* (Blanding's tree snake) – vulnerable – Budongo
Grayia thollloni (Tholloni's water snake)	
Hapsidophrys lineatus (black-lined green snake)	
Hormonotus modestus (Uganda house snake)	
Kinixys erosa (serrated hinge-back tortoise)	
Naja haje (Egyptian cobra)	

Potential Critical Habitat Triggers (Reptiles and Amphibians) from Previous CHA Work in the Region	**Important Species to Scope in from Ugandan Red List (Some Duplication with CHA List)**
Philothamnus carinatus (thirteen-scaled green snake)	
Polemon christyi (Eastern snake-eater)	

ATTACHMENT A4.5 MAMMAL SURVEYS

Methods

Walked Transects – Looking at the Ground

Transect surveys were undertaken at habitats with the potential to support mammal species inside and outside protected areas. At each location, the surveyors searched for mammals and signs of mammal activity, and noted the suitability of the habitat(s) to support focal species. Although the surveyors were mindful of focal species, full inventories of species that occurred or could occur in each habitat were created.

On the transect walk, members of the local community were interviewed about which mammals they knew to occur in the area. A field guide was used for reference during these interviews. Interviewees were also asked which mammals were currently present and which had been see in the past but not recently.

The searches looked for mammals and mammal signs on the ground and in trees.

Surveys at Night

Night-time surveys were primarily undertaken to identify bats in selected areas crossed by the route that had the highest potential to support them. While in the field for the night surveys, surveyors used the opportunity to look in the trees and bush stands for the presence of nocturnal primates (galagos and pottos) or ground species, mainly carnivores.

Trapping, Mist Netting and Acoustic Techniques

Small mammals are mostly obscure, cryptic and secretive, which means that observation methods and interviews will never be appropriate for conducting surveys of these groups. For all three groups, intrusive trapping methods were used to complete inventories.

Trapping protocols were used to gain insights into which species of small mammals existed. For rodents and shrews, Sherman traps were set in the different survey locations for three consecutive nights with a total of 40 traps set each trapping day. Protocols require that traps be left in place for periods of at least three trapping days.

Traps were baited with a mixture of maize floor, margarine, peanut butter and silverfish. The bait had been prepared at least 24 hours before it was used to enable it to start fermenting, which increases the aroma of the bait and thus its appeal to small mammals.

Mist nets were used to survey and capture bats in selected locations. These surveys were started at dusk and lasted for three hours. In addition to mist netting, an AR150 bat detector (acoustic survey) was used to record bat activity in the survey areas for the duration of the surveys. Mist netting techniques capture both fruit- and insect-eating bats, but tend to have higher success with fruit bats, which, unlike insectivorous bats, do not use echolocation to detect obstacles in their flight path. Acoustic techniques only record insectivorous bat activity and thus miss fruit bats.

Camera Trapping

Camera traps were deployed in suitable locations on the Waiga, Sonso, Waisoke, Bubwe and Walukuba Rivers to collect data passively on mammal occurrence. The benefit of using trap cameras is that they unintrusively capture mammal activity and presence for the length of time they are deployed if the batteries do not run out. Cameras were left in place for a minimum of 21 days. The concern with camera traps is that they are sometimes discovered by members of the public, which can lead to equipment theft. In addition, increased human activity around camera traps sometimes alters or deters animal behaviours in the areas around the cameras.

Survey Locations Selection

Potential habitats to target for surveys were determined by reviewing landcover maps and aerial photography. Habitats crossed with the potential to comprise natural habitats or to contain areas of natural and modified habitats were targeted for the surveys. Focal species habitat associations and distribution maps were also consulted.

Results

General Quality of Habitats Crossed

Observations were made at several locations to assess the nature of the vegetation cover and, therefore, its suitability for mammal species occurrence or ranging. Most of the target survey areas were largely human affected and, therefore, mostly modified. Their value as important habitats for mammals overall and, specifically, focal species of mammals has been much compromised by humans through settlement, agriculture and vegetation clearance. Table Att4.5-1 summarises the observations on land cover and its potential for supporting populations of mammals in the areas visited. Table Att4.5-2 presents the wet and dry season field survey data for mammals within the AOI.

Table Att4.5-1 Potential for Mammals Within the AOI

Landcover in AOI	**Fauna Potential**
Bujawe FR (36 N 293096 167244) riverine forest surviving only around the watercourse, farming all the way to the edge of the wetland. Very degraded narrow riverine forest, not many prospects for large mammals.	Low potential for large mammals
Near KP84 (36 N 295677 169027) patch of wooded bushland with *Acacia* sp. as dominant trees, tree stand was being cleared	Area has some potential to hold species such as vervet monkeys, olive baboon, bush duiker and bush buck
Near KP81 (36 N 290259 156811) an area of bushed woodland near KP81, woodland provides good refugee that could be used by mammals. Borders a bush fallow through which line crosses.	
36 N 290297 156815 area of bush fallow and starting to be cultivated, traversed by pipeline	Not much prospects for large mammals, but may be good for medium-sized and small mammals

Table Att4.5-1 Potential for Mammals Within the AOI

Landcover in AOI	Fauna Potential
36 N 297561 170868 agricultural area	No large mammal prospects
River Hoimo on feeder route (36 N 300800 1735652883). Most of riparian vegetation cleared	Low potential for large mammals
Near KP75 – Bujawe FR (36 N 302670 174310). Wetland in valley facing hill with natural vegetation of low stature. The reserve is converted for plantation forestry growing pine trees.	low prospects for mammals
Near KP56 (36 N 312946 189612) riverbed generally dry at time of survey except for a pond measuring about 3 × 10 m	Low prospects
36 N 312925 189586 a small pond at this location could be a temporary water source for wildlife	Low prospects for mammals in the general area
36 N 312942 189395 a small pond at this location could be a temporary water source for wildlife	Low prospects for mammals in the general area
36 N 313026 189375 – riparian vegetation along dry riverbed, no signs of mammal evident. Transect walked along riverbed	Low prospects for mammals in the general area
36 N 312965 189872 African civet latrine	Not significantly important for wild mammals
Near KP54 (36 N 312832 191200) a very open area below escarpment with very dotted scattered trees and termite mounds	
Near KP52 riparian situation, riverbed crossed by pipeline. Riverbed covered by dense vegetation, no water at time survey, may have water in August.	If any mammals occur or range in this area, the kind of habitat here would provide connectivity
The area between KP52 and KP54 is largely scrub with very short open grass in areas. Part being opened for cultivation.	Not much potential for large mammals
Near KP37 – River Bubwe had discontinuous water in the valley. The river flows from within the Bugungu WR toward Lake Albert. The riverine vegetation is very degraded outside the reserve but is near natural in the reserve.	Low potential outside the Bugungu WR although wildlife does leave the park freely at different times of the day and year
Reserve side has good riverine vegetation, out of reserve is highly modified. Hippopotamuses may use the river valley. Fairly intact on the reserve side but degraded outside the reserve.	May have some potential for ranging, grazing and watering of species in the Bugungu WR
Vegetation cover very much converted outside the Bugungu WR to the extent that there was no ground cover at the time of surveys. No ground level cover, photos on GPS.	
About 500 m from KP21. Open bushed grassland area, heavily grazed, very short grass. May be good corridor for ungulates, no animals or signs observed.	

Table Att4.5-1 Potential for Mammals Within the AOI

Landcover in AOI	Fauna Potential
36 N 325393 220477 at Waiga River edge with papyrus and phragmites reeds in water channel, a side pond of water with baby crocodiles, potential watering point for wildlife, potential for bats, rodents and shrews	Has hippopotamuses and crocodiles. Also has the potential to act as a corridor between Lake Albert and water courses through the Bugungu WR.
Sonso River (36 N 322911 208127) – The river flows through the Bugungu WR and out toward Lake Albert. Has good seminatural to natural vegetation in the reserve, but gets increasingly degraded outside the reserve.	Evidence was recorded of buffalo and hippopotamus prints, porcupine dig, vervets, kob prints on the reserve side
36 N 323075 207982 record of a leopard tortoise	
Near KP58 (36 N 312736 187655) area highly modified for grazing and wood extraction. Grass cover reasonable for grazing between two hills with some wood stand.	Low potential for holding significant populations of mammals
36 N 310884 184152 area through which pipeline crosses near KP62. Largely a bushed wooded area. Grass cover reasonable, woody biomass good. Narrow strip about 200 m across on riverside then gardens. The seasonal river valley carries water only in wet season and briefly, it was dry at the time of survey. Most riparian vegetation cleared for gardens.	Owing to human use of the general surrounding area, there is no likelihood that the area will have significant populations of mammals if any
River Kacuro crossing near KP67 (36 N 307741 180098) pipeline crosses riverbed in the general area where a small river channel about 2 m across crosses through gardens	Low prospects for large mammals

Table Att4.5-2 Mammal Survey Results

Common Name	Species Name	Survey Area																	
		Bujawe FR KP178	Wambabya River KP89	KP81	River Hoimo (2883)	River Crossing near KP67	KP58	KP56	KP54	KP52 River Crossing	River Waki	KP41 (3046)	River Walukuba near KP39	River Crossing Near KP37 (River Bubwe)	River Sonso	River Waisoke	River Waiga near KP21	Maseege FR	Sambiye River
Red-tailed monkey	*Cercopithecus ascanius*	1	1											1					
Vervet monkey	*Cercopithecus pygerythrus*	1	1	1	1		1	1		1	1		1	1		1	1		
Black and white colobus	*Colobus guereza*	1	1			1	1			1	1		1	1		1			
Chimpanzee	*Pan troglodytes* ssp. *Schweinfurthii*	1	1																
Olive baboon	*Papio anubis*	1	1	1	1	1	1	1		1	1		1	1	1	1	1		
Uganda kob	*Kobus kob* ssp. *Thomasi*											1	1	1	1	1	1		
Oribi	*Ourebia ourebi*						1					1	1	1					
Common reedbuck	*Redunca redunca*				1									1			1		
Bush duiker	*Sylicicapra grimmia*	1			1	1	1				1	1	1	1			1		
African buffalo	*Syncerus caffer*	1					1					1	1		1	1			
Bushbuck	*Tragelaphus scriptus*	1			1		1		1	1	1	1	1	1	1	1	1		
Sitatunga	*Tragelaphus spekii*				1														
Hippopotamus	*Hippopotamus amphibious*										1		1		1	1	1		
Bushpig	*Potamochoerus larvatus*	1					1				1				1	1	1		
Warthog	*Phacochoerus africanus*										1			1	1	1			
African savanna hare	*Lepus victoriae*	1			1			1	1				1	1			1		
Serval	*Leptailurus serval*	1					1										1		
Leopard	*Panthera pardus*															1	1		
Side-striped jackal	*Canis adustus*	1			1	1													
Eastern tree hyrax	*Dendrohyrax arboreus*	1																	
Rock hyrax	*Procavia capensis*	1				1													
African civet	*Civettictis civetta*	1					1							1					
Large-spotted genet	Genetta maculata						1												
Servaline genet	*Genetta servalina*													1		1			
Marsh mongoose	*Atilax paludinosus*	1														1			
Large grey mongoose	*Herpestes ichneumon*	1					1	1	1		1		1	1			1		
Slender mongoose	*Herpestes sanguinea*			1										1					
White-tailed mongoose	*Ichneumia albicauda*	1		1				1					1	1					
Banded mongoose	*Mungos mungo*			1	1			1	1		1		1	1					
Spot-necked otter	*Hydrictis maculicollis*		1		1														
Crested porcupine	*Hystrix cristata*	1			1	1	1										1		
Tree pangolin	*Phataginus tricuspis*						1												
Temminck's ground pangolin	*Smutsia temminckii*	1																	
Aardvark	*Orycteropus afer*														1				
East African potto	*Perodicticus ibeanus*	1																	

Table Att4.5-2 Mammal Survey Results

Common Name	Species Name	Survey Area																	
		Bujawe FR KP178	Wambabya River KP89	KP81	River Hoimo (2883)	River Crossing near KP67	KP58	KP56	KP54	KP52 River Crossing	River Waki	KP41 (3046)	River Walukuba near KP39	River Crossing Near KP37 (River Bubwe)	River Sonso	River Waisoke	River Waiga near KP21	Maseege FR	Sambiye River
Galago	Four possible species – sp. 1	1	1																
Galago	Four possible species – sp. 2	1																	
Typical striped grass mouse	*Lemniscomys striatus*												1	1	1	1		1	
Jackson's soft-furred mouse	*Praomys jacksobi*		1																
Northern giant pouched rat	*Cricetomys gambianus*															1			
Hinde's rock rat	*Aethomys hindei*												1	1				1	1
African marsh rat	*Dasymys incomtus*															1			
Woodland thicket rat	*Grammomys dolichurus*												1						
Multimammate rat	*Mastomys natalensis*													1	1				1
Rusty-bellied brush-furred rat	*Lophuromys sikapusi*												1	1	1				
Yellow-spotted brush-furred rat	*Lophuromys flavopunctatus*												1						
Lesser cane rat	*Thyronomys gregorianus*	1			1	1	1		1				1	1		1			
Bicoloured musk shrew	*Crocidura fuscomurina*													1					
Naked-tail shrew	*Crocidura littolaris*															1			
Savanna dwarf shrew	*Crocidura nanilla*																	1	
Ugandan lowland shrew	*Crocidura selina*														1	1			
Tumultuous shrew	*Crocidura turba*													1					
African giant squirrel	*Protoxerus stangeri*	1																	
Red-legged sun squirrel	*Heliosciurus rufobrachium*	1																	
Striped ground squirrel	*Xerus erythropus*	1		1	1	1	1		1				1	1			1		

ATTACHMENT A4.6 INVERTEBRATE SURVEYS

Methods of Insect Surveys

Secondary Data

Acquisition of secondary data primarily involved:

- searching for relevant published ecological studies within the AOI
- consultation with the UWA and National Forestry Authority regarding areas of the AOI within their jurisdiction, species distribution, known sensitive locations, known migration and dispersal routes, and any known threats or anthropogenic impacts already having an effect along the route
- compiling records for rare, endemic or threatened species within 2 km of the pipeline route using the IUCN Red List (IUCN 2017) and the Uganda National Draft Red list of species (WCS 2016)
- obtaining and reviewing existing habitat maps for the AOI.

Invertebrates within the 2-km field survey corridor that are listed on IUCN Red List as endangered (EN), vulnerable (VU) or critically endangered (CR) and species nationally listed as EN, VU, CR and data deficient (DD) were noted (IUCN 2017). The DD species are considered because most are undersurveyed, too rare to be encountered or relic species on the verge of extinction. The results are summarised in the scoping report.

Primary and Field Data

Appropriate butterfly and dragonfly surveys were undertaken in the wet and dry seasons. Several habitats and habitat types crossed by the route were surveyed to provide representative baseline data for the two insect taxa. The surveyed focused mainly on:

- habitat assessment to determine the potential of each habitat to support important invertebrate species
- transect walks to confirm the likelihood of species presence or absence (based on habitat assessment).

Field Sampling Protocols

Sweep Netting for Adult Butterflies and Dragonflies

Pre-selected sites were visited and surveyed. A two-person effort was used to scan the areas. The species present were recorded as they were encountered. An indication of abundance of each was also noted. Individuals were identified in the field; only those species difficult to identify were collected and preserved for further processing. Butterflies were dried and stored in individual envelopes. Only male dragonflies were taken. These were soaked in acetone for eight hours to preserve colours that easily fade on storage and placed in envelopes for further taxonomic work. Details of all the records were entered in notebooks. Aspects of the daily weather (e.g., sunny, cold, cloudy and windy) and habitat condition were noted, especially those relating directly to the selected invertebrates.

Baited Traps for Butterflies

Baited traps for butterflies were largely used to survey specific subfamilies within the butterfly faunas and were set only in forests and woodland areas along established transects. Fermented bananas mixed with mangoes were used as bait.

Results

Table Att4.6-1 presents the results of the wet and dry season butterfly surveys.

Table Att4.6-2 presents the results of the wet and dry season dragonfly surveys.

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Nymphalidae																																				
Actinote acerata	W																								1	1							1		
Actinote alicia	W			1																										1			1		
Actinote aurivilli	F												1																						
Actinote bonasia	F			1																						1									
Actinote encedon	W		1															1				1	1							1			1		
Actinote jodutta	F												1												1										
Actinote penelope	F			1																															
Actinote quirinalis	F			1																					1	1									
Actinote semivitrea	F			1																															
Actinote sotikensis	F																								1								1		
Acraea braesia	O																				1														
Acraea caecilia	O												1									1													
Acraea caldarena	O							1																											
Acraea cepheus	F																	1		1															
Acraea egina	W		1																		1		1										1		
Acraea macaria	F																					1													
Acraea natalica	W							1	1	1			1																						
Acraea neobule	W												1																						
Acraea pseudegina	W		1																	1		1	1							1					1
Acraea quirina	F			1																													1		
Acraea zetes	W												1					1	1		1		1		1					1	1				
Amauris niavius	W																									1									
Amauris tartarea	f.		1	1						1															1								1		
Ariadne enotrea	F		1	1																															
Bebearia carshena	F		1																																
Bebearia cocalia	f.		1																						1					1			1		
Bebearia laetitioides	F		1																																
Bicyclus mollitia	F		1																																
Bicyclus safitza	W			1																						1				1		1			
Bicyclus sambulos	F		1																																
Bicyclus sandace	F		1																																

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Bicyclus saussurei	F																												1						
Bicyclus sophrosyne	f.		1																																
Bicyclus vulgaris	W		1	1		1		1	1				1					1					1		1	1				1		1		1	
Byblia anvatara	M		1							1								1	1	1	1	1	1	1			1	1				1		1	
Catuna crithea	F		1																						1										
Charaxes achaemenes?	O																	1																	
Charaxes bipunctatus	FL																						1												
Charaxes brutus	f.																															1			
Charaxes castor	W																						1			1								1	
Charaxes etheocles	F		1																																
Charaxes jasius	O									1									1				1	1											
Charaxes kahldeni	F																	1					1									1		1	
Charaxes tiridates	FL																						1												
Charaxes varanes	W		1							1				1				1		1		1	1	1			1	1				1			
Charaxes viola	f.		1																																
Charaxes zoolina	O																	1					1									1		1	
Cyrestis camillus	F		1																																
Danaus chrysippus	M		1					1		1			1		1	1		1		1	1	1	1	1		1	1			1		1	1	1		1
Elymnias bammakoo	F		1																																
Eurytela dryope	W			1					1	1			1					1					1		1							1			
Gnophodes betsimena	F			1																			1												
Gnophodes chelys	F		1																																
Hamanumida daedalus	W		1							1			1																						
Heteropsis perspicua	O			1				1																											
Hypolimnas anthedon	F		1																																
Hypolimnas dinarcha	F		1																																
Hypolimnas misippus	M		1					1				1	1			1			1	1	1	1	1	1		1					1				1
Hypolimnas salmacis	F		1																																
Junonia chorimene	O							1	1	1			1		1			1		1	1	1	1				1					1			
Junonia hierta	M																		1			1	1	1						1	1				
Junonia oenone	W		1				1	1	1	1			1		1					1		1	1	1			1				1			1	1
Junonia orithya	M									1						1			1		1	1													

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Junonia sophia	W		1	1					1											1		1	1			1							1		
Junonia terea	W		1	1		1							1							1	1		1		1	1				1			1		
Libythea labdaca	M		1										1					1			1														
Melanitis leda	W								1																			1				1		1	
Neptis melicerta	F		1																																
Neptis metella	f.																								1										
Neptis nemetes	f.		1																																
Neptis saclava	W		1	1		1			1	1			1					1		1	1	1	1								1	1	1	1	
Neptis serena	W			1					1											1	1		1		1	1				1			1		
Pardopsis punctatissima	W																									1									
Phalanta eurytis	M		1																																
Phalanta phalanta	M		1	1		1				1								1		1	1		1									1	1		
Protogoniomorpha parhassus	f.		1																							1									
Pseudacraea lucretia	f.		1																																
Pseudoneptis bugandensis	F		1																																
Salamis cacta	F		1																																
Sevenia occidentalium	M		1																													1			
Telchinia serena	W					1		1	1	1			1					1		1		1	1	1		1							1		1
Tirumala petiverana	M									1										1		1	1	1		1									1
Vanessula milca	f.		1																																
Ypthima albida	f.			1					1																1	1				1			1		
Ythima asterope	O		1									1							1													1			
Ythima doleta	W											1																							
Ypthimomorpha itonia	f.							1	1																										
Lycaenidae																																			
Anthene amarah	O									1			1			1			1	1		1	1				1	1						1	
Anthene indefinita	O		1								1	1	1	1						1		1		1											
Anthene larydas	F			1																															
Anthene liodes	f.		1						1		1											1						1	1			1			
Anthene lunulata	W		1																																
Anthene princeps	O																															1			
Axiocerces harpax	W												1																						

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Axiocerces tjoane	O												1																						
Azanus isis	F			1																1															
Azanus jesous	M																			1		1	1							1					
Azanus moriqua	W																																	1	
Azanus natalensis	W																										1					1			1
Cacyreus lingeus	f.			1		1			1	1			1							1		1	1			1			1		1				
Chilades trochylus	W											1	1							1		1	1				1					1			1
Cigaritis mozambica	O																																		
Citrinophila erastus	FL																																		
Cupidopsis cissus	W												1										1												
Eicochrysops hippocrates	W													1											1					1					
Eresina sp. *(*sp. near *toroensis)*	F												1																						
Euchrysops malathana	O		1	1		1																1													
Euchrysops osiris	W												1									1													
Hypolycaena antifaunus	F																				1														
Hypolycaena liara	F		1	1																															
Hypolycaena pachalica	O															1			1	1		1	1				1						1			
Hypolycaena philippus	W		1	1						1		1	1									1											1			
Lachnocnema bibulus	W																						1													
Lachnocnema divergens	F																									1										
Lachnocnema durbani	W																	1																		
Lampides boeticus	M							1	1	1			1																							
Lepidochrysops parsimon	O																1			1																
Leptotes pirithous	M					1		1																1					1							
Megalopalpus zymna	F		1																																	
Oboronia punctatus	F		1																															1		
Pentila pauli	f.																							1												
Pentila tachyroides	F		1																																	
Ptelina carnuta	O		1																																	
Thermoniphas distincta	F																									1										
Tuxentius cretosus	O		1										1																							
Uranothauma falkensteini	W			1					1			1																								

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Zizeeria knysna	W		1	1		1		1		1			1			1				1	1	1	1	1		1	1	1					1		1	1
Zizina antanossa	W								1											1		1	1					1								
Zizula hylax	W									1			1				1			1	1	1	1				1									
Pieridae																																				
Afrodryas leda	W																					1														
Appias epaphia	M			1											1		1	1	1	1		1	1	1			1								1	
Belenois aurota	M		1	1		1			1				1		1	1		1	1	1	1	1	1	1			1	1				1		1	1	1
Belenois creona	M		1	1				1	1				1		1	1	1	1	1	1	1	1	1	1			1	1				1		1	
Belenois gidica	M																					1														
Belenois solilucis	f.		1																																	
Belenois subeida	f.		1													1				1	1	1		1												
Belenois theora	f.		1																					1												
Belenois thysa	f.			1																			1													
Catopsilia florella	M		1					1		1			1		1	1	1	1	1	1	1	1	1	1	1	1		1					1	1	1	1
Colotis antevippe	O		1			1									1	1	1		1	1	1	1	1	1			1						1		1	
Colotis aurigineus	W							1							1					1		1	1	1									1		1	
Colotis aurora	O																1					1	1								1					
Colotis chrysonome	O																			1	1	1											1			
Colotis danae	W								1							1				1		1	1										1		1	1
Colotis eris	O														1							1	1													
Colotis eucharis	W														1	1	1		1	1		1	1	1			1						1		1	1
Colotis euippe	O									1			1									1	1	1				1					1			
Colotis evagore	M							1		1			1		1	1				1			1								1					1
Colotis evenina	O		1																																	
Colotis ione	O																		1	1		1	1				1			1						
Colotis protomedia	O																		1	1		1	1							1						
Dixeia orbona	W																						1													
Dixeia pigea	W																			1			1													
Eronia cleodora	O																					1	1	1			1						1			
Eurema desjardinsi	W																			1																
Eurema hecabe	M		1	1		1		1	1				1		1		1	1		1	1	1	1	1	1	1	1	1						1		
Eurema regularis	W		1			1			1	1			1		1			1		1	1	1	1	1									1	1	1	1

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Eurema senegalensis	F		1	1																			1												
Leptosia hybrida	F		1																																
Leptosia nupta	f.			1					1								1				1	1	1											1	
Leptosia wigginsi	F		1	1																		1										1			
Mylothris agathina	W					1																					1					1			
Mylothris chloris	W			1									1								1														
Mylothris rubricosta	S																						1	1			1								
Nepheronia argia	F		1																																
Nepheronia buqueti	O																				1	1	1												
Nepheronia pharis	F		1																																
Nepheronia thalassina	f.		1																																
Pinacopteryx eriphia	O									1			1		1	1		1	1	1	1	1					1								
Hespeiidae																																			
Acleros mackenii	f.		1			1																				1									
Acleros ploetzi	f.		1	1																				1							1				
Ankola fan	F																							1											
Borbo borbonica	M					1																	1							1					
Borbo fetuellus	W																				1														
Borbo gamella	W		1										1																						
Caenides dacela	F		1																																
Celaenorrhinus galenus	F		1	1																															
Chondrolepis niveicornis	F		1																																
Coeliades libeon	M		1																																
Eretis lugens	W		1			1																				1				1		1		1	
Eretis umbra	O							1																											
Gegenes hottentota	O		1					1	1				1									1					1				1		1		
Gegenes niso	W																							1									1		
Metisella midas	S								1																										
Osmodes laronia	F		1																												1				
Pelopidas mathias	M								1											1		1					1			1					
Platylesches moritili					1																														
Prosopalpus styla	f.	1		1					1												1										1		1		

Table Att4.6-1 Wet and Dry Season Butterfly Survey Results

Species	Ecotype	KP93	KP89 (Wambabya River)	Bujawe FR	KP84	Bujawe Area (KP81)	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP61	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP22 and KP23	KP20	KP16, KP17 and 18	KP16	Masege FR	KP13	KP07 (Sambiye River)	KP0 (CPF)
Sarangesa phidyle	O																										1	1								
Semalea sp	F					1																														
Semalea arela																																1			
Spialia diomus	O								1																										
Spialia spio	O							1														1									1			1		
Tagiades flesus	F																												1						
Xanthodisca vibius	F		1																																
Papilionidae																																			
Graphium angolanus	M		1																																
Graphium leonidas	M		1																																
Graphium policenes	f.		1																1																
Papilio chrapkowskoides	f.									1			1							1			1												
Papilio cynorta	FL		1																																
Papilio dardanus	W		1																																
Papilio demodocus	M		1	1				1	1	1			1			1		1		1	1		1	1		1	1				1	1			1
Papilio nireus	f.		1																																
Papilio phorcas	F		1																																
Riodininae																																			
Abisara neavei	F		1																										1						

Table Att. 1.6-2 Wet and Dry Season Dragonfly Survey Results

Species	Wambabya River	KP89 (Wambabya River)	Bujawe FR	KP81 (Bujawe Area)	KP79	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52 (near)	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–and 37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP21	KP20	KP16 and KP17 and 18 (Feeder)	KP16	KP13	Maseege FR	KP07 (Sambiye River)	KP0 (CPF)
Zygoptera																																		
Africallagma glaucum																									1									
Agriocnemis inversa																					1				1			1						
Agriocnemis palaeforma																														1				
Azuragrion vansomereni																																		1
Ceriagron glabrum																		1	1	1					1									
Chlorocypha curta	1		1	1																														
Chlorocypha trifaria	1																																	
Chlorocypha victoriae																							1	1						1	1		1	
Copera nyansana			1																															
Elattoneura glauca	1	1					1	1				1						1	1	1	1	1	1	1						1		1		
Ishnura senegalensis							1												1															
Phaon irridipenis	1																					1									1			
Platycypha lacustris	1						1																											
Pseudagrion (A) hageni	1																						1							1	1			
Pseudagrion (A) kersteni	1			1			1						1																		1			
Pseudagrion (A) melanicterum			1																															
Pseudagrion (A) spernatum		1	1	1																										1				
Pseudagrion (B) glaucoideum																									1		1							
Pseudagrion (B) sublacteum																1		1	1			1				1								
Pseudagrion (B) torridum			1															1		1		1			1	1			1			1		
Anisoptera																																		
Acisoma inflatum					1													1	1	1					1		1							
Aethriamanta rezia																									1									
Anax tristis		1																							1									
Atoconeura kenya	1																																	
Brachythemis leucosticta											1		1	1	1		1	1	1	1	1	1			1	1				1				1
Chalcostephia flavifrons																				1														
Crocothemis erythraea																			1	1					1									
Diplacodes deminuta																	1								1									
Diplacodes lefebvrii																					1													
Diplacodes luminans																					1													

Table Att. 1.6-2 Wet and Dry Season Dragonfly Survey Results

Species	Wambabya River	KP89 (Wambabya River)	Bujawe FR	KP81 (Bujawe Area)	KP79	KP75 (near MBC-1 KP74)	KP67	KP64 (close)	KP62 (Near and Toward KP61)	KP59 (near)	KP58	KP56	KP55 and 56	KP54	KP52 (near)	Waki River	KP41 (near)	KP39	KP36 and 37	Bulwo River (KP36–and 37)	Sonso River	Waisoke River	KP26 and KP27	KP25	Waiga River	KP23 and 24	KP21	KP20	KP16 and KP17 and 18 (Feeder)	KP16	KP13	Maseege FR	KP07 (Sambiye River)	KP0 (CPF)
Gynacantha manderica	1																						1											
Hadrothemis camarensis	1																																	
Hemistigma albipunctum																				1	1				1									
Ictinogomphus ferox													1	1				1		1	1	1								1				
Micromacromia camerunica																						1									1			
Nesciothemis farinosa	1						1											1									1			1				
Notogomphus lujai			1						1																1									
Olpogastra lugubris																						1												
Orthetrum abbotti																		1					1												
Orthetrum caffrum		1	1	1																			1								1	1			
Orthetrum chrysostigma			1				1													1														
Orthetrum hintzi		1	1				1																											
Orthetrum icteromelas																		1																
Orthetrum julia	1	1		1		1	1			1								1	1	1	1	1	1		1				1	1				
Orthetrum stemmale			1	1			1									1		1	1		1					1		1			1			
Orthetrum trinacria																	1					1												
Palpopleura deceptor																			1	1														
Palpopleura lucia		1	1				1	1										1	1	1	1		1		1			1			1			
Palpopleura portia	1																				1		1		1			1			1			
Pantala flavescens				1						1							1	1	1	1	1									1				1
Paragomphus elpidius														1																				
Paragomphus viridior		1																																
Parazyxomma flavicans	1		1																															
Phyllomacromia sp. ? *melania*																							1											
Trithemis aconita				1																														
Trithemis annulata											1				1		1	1	1	1	1													
Trithemis arteriosa													1	1				1	1	1														
Trithemis nuptialis	1																													1				
Trithemis stictica				1																										1	1			
Urothemis assignata																	1	1	1	1	1	1			1					1			1	1
Zygonyx torridus		1																1													1			

ATTACHMENT A4.7 HERPETOFAUNA SURVEYS

Survey Methods

Field surveys were undertaken in to identify the locations of reptiles and amphibians, and which species were present. These surveys recorded all the amphibians and reptiles observed with particular emphasis on species of conservation importance and those species specifically identified as critical habitat trigger species in the previous CHA reports (WCS 2016, TBC 2016).This was mainly based on visual encounter surveys (VES) within 500 m around a previously georeferenced point or on setting of pitfall traps within the perimeter of this point in some sites and, in a few incidences, dip netting. The amphibians or reptiles were identified as close to the KP given as possible.

- Amphibia and reptilia are two distinct classes of vertebrates that are, for study purposes, often grouped together and named herpetiles (the study of which is called herpetology).
- Herpetological surveys provide information on habitat quality and the environmental variables that control species diversity of the target taxa.
- The surveying activity involved looking for amphibians and reptiles in their representative habitats within and close to the project locations within the AOI.
- The surveys took seasonality into account and were performed in the dry and wet seasons.

Three methods were applied, depending on the behaviour of the target species and the nature of the habitat:

- VES
- pitfall trapping
- dip netting.

However, their effectiveness depends greatly on the weather conditions and the time of the day.

Literature Review

Before fieldwork, a literature review focused on the AOI, the habitat composition past and present, the distribution and diversity of the herpetofauna in the AOI if any, and the adjacent habitats and ecosystems.

Groundtruthing: Habitat Stratification

Key amphibian and reptilian habitats were stratified for ease of sampling. The key habitats for amphibians focused on for the purposes of the surveys included lentic habitats and vegetated wetlands, particularly those identified in previously classified features. Suitable habitats for reptiles included rocky outcrops and woodlands. Where relevant, the edges of roads were carefully monitored for any sun-basking reptiles. The surveys in these habitats were repeated in the dry season to capture seasonality data.

As with the other field surveys, the surveys focused on the AOI. Key habitats and features along the route were generally subjected to surveys, including permanent or temporary wetlands, rivers, FRs and WRs.

Visual Encounter Surveys

A VES is a well-known and robust method for surveying herpetofauna. It is similar to the timed-constrained count method described by Heyer et al. (1994). VESs are used to document the presence of amphibians and are effective in most habitats and for most species that tend to breed in lentic habitats. They generate encounter rates of species in their habitats in a unit hour.

The method comprises moving through a habitat, turning over logs or stones, inspecting retreats and watching out for and recording surface-active species. The data gathered using this procedure provide information on the species richness of the habitat. For amphibian fauna, the best results are achieved when the surveys take place after dusk in the evenings between 1800 and 2100 hours, as this is when most amphibians are active. A daylight reconnaissance precedes surveys to check for hazards and other features that could hamper the night surveys. Early-morning surveys are unsuitable for these taxa, as species will be torpid and may not be easily found.

Dip-Net Sampling

A standard dip net is shown in Figure Att4.7-1. Specimens of aquatic species or tadpoles caught by dip netting were preserved for later identification if not identifiable in the field.

Figure Att4.7-1 An Example of a Dip Net for Sampling Aquatic Herpetofauna and Tadpoles

Pitfall Trapping with Drift Fence

At selected sites along the pipeline route near identified habitats, pitfall traps were set up with a drift fence in the study area to sample any surface dwelling herpetofauna. Using drift fences with bucket pitfall traps (Figures Att. 1.7-2 and Att. 1.7-3) is the commonest technique for studies on individual species or herpetofaunal communities and has been successfully used for amphibians (Mitchell et al. 1993; Heyer et al. 1994; Handley and Varn 1994; Msuya 2001).

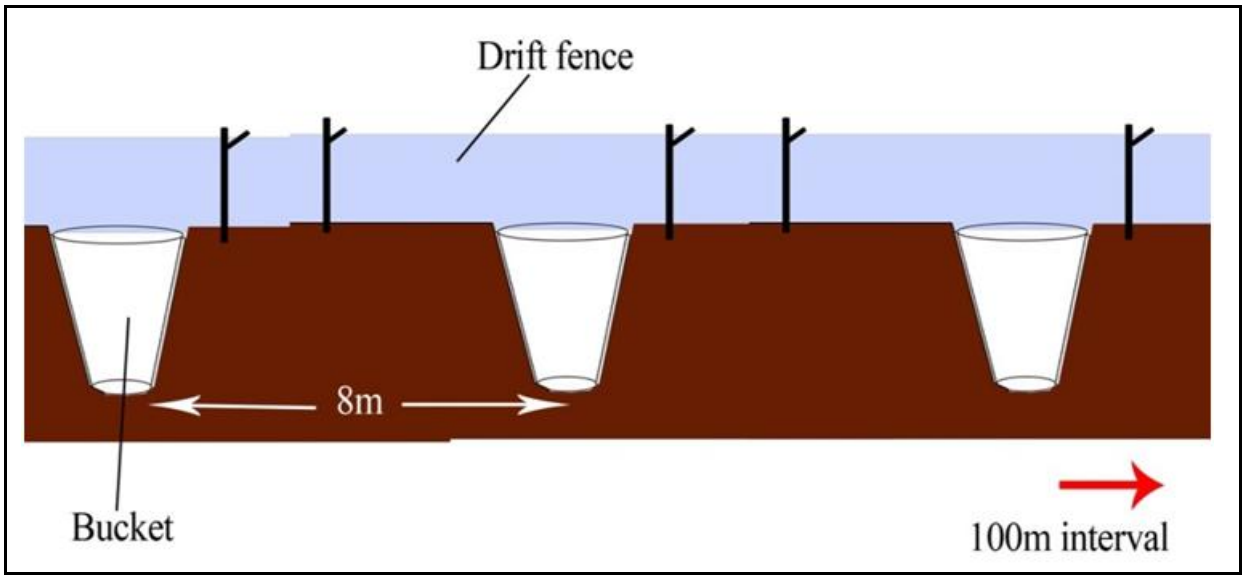

Figure Att4.7-2 Schematic of the Drift Fence Layout

Figure Att4.7-3 Pitfall Trap with Drift Fence for Herpetiles

The results of studies employing drift fences with pitfall traps provide valuable insights into population and community ecology, and the behavioural patterns of secretive and difficult-to-study species (Dodd 1991). This method was used to determine the relative abundance, sex ratio, habitat preference and movements of the herpetofauna. Each drift fence consists of eleven 20-L plastic buckets placed at an interval of 8–10 m and covering a total length of 100 m. The buckets were placed in holes dug in the substrate such that their rim was level with the ground.

A 100-m-long and 0.5-m-high drift fence of black polythene supported vertically by wooden laths was set in an alternating manner with the buckets in the line to permit the detection of the directional movement of species. The pitfall traps were inspected twice daily.

Opportunistic Encounters

Opportunistic records were those made outside the sampling points or hours but in the surrounding area to be affected by the project. They help to complete the checklist of the animals as far as possible. Amphibians and reptiles are mobile, so may be encountered outside their preferred habitats both spatially and temporally.

Species Identification and IUCN Red Listing

Identification of herpetofauna followed Schiøtz, (1999), Spawls et al., (2002, 2006) and Channing and Howell (2006). The AmphibiaWeb (2015) and The Reptile Database (Uetz, P. and Jirí Hošek (eds.) 2015) were also used. The conservation status of the herpetofauna followed the IUCN Red Listing (IUCN 2017) and the Ugandan Red List (WCS 2016).

Consultations

For survey sites inside the protected areas, park rangers were interviewed to establish the reptilian species known to be present. Outside the protected areas, local people who confirmed that they had stayed in the area for a long time (up to 10 years) and had been involved in activities such as farming and grazing in the area were consulted about the occurrence of reptilian species.

Results

Table Att4.7-1 lists the 16 amphibian and 25 reptilian species recorded during baseline surveys. This list has been supplemented by the results of other surveys in the region (biodiversity surveys of MFPA and impact assessments associated with oil exploration). This represents a diverse assemblage for the region, with most of the herpetofauna interest being associated with wetlands, rivers and riparian vegetation. Despite the size of the herpetofauna population, few species of conservation importance were identified. Most of the species recorded or potentially present are widespread and have not been identified as conservation priorities at a global or national scale. One Albertine Rift endemic has been recorded, as well as the potential presence of important species using wetlands associated with the edge of Lake Albert. The Nile crocodile (*Crocodylus niloticus*), a focal species in the Action Plan for the North Albertine Rift, has also been confirmed using watercourses crossed by the AOI.

Amphibian Species

A total of 16 species, all of order Anura and belonging to eight families and 10 genera, were recorded in 20 sites of the Tillenga feeder pipeline AOI inhabited by amphibian fauna (Figure Att4.7-4). Site KP89 had the highest diversity with 13 species, followed by KP87 (12 spp.), KP21 (9 spp.), then KP43 and KP93 (7 spp. each). Sites with the fewest species recorded were KP14 and KP47 each with one species, followed by KP26 and KP69 (2 spp. each), then KP64 and KP95 (3 spp. each) (Figure Att4.7-5).

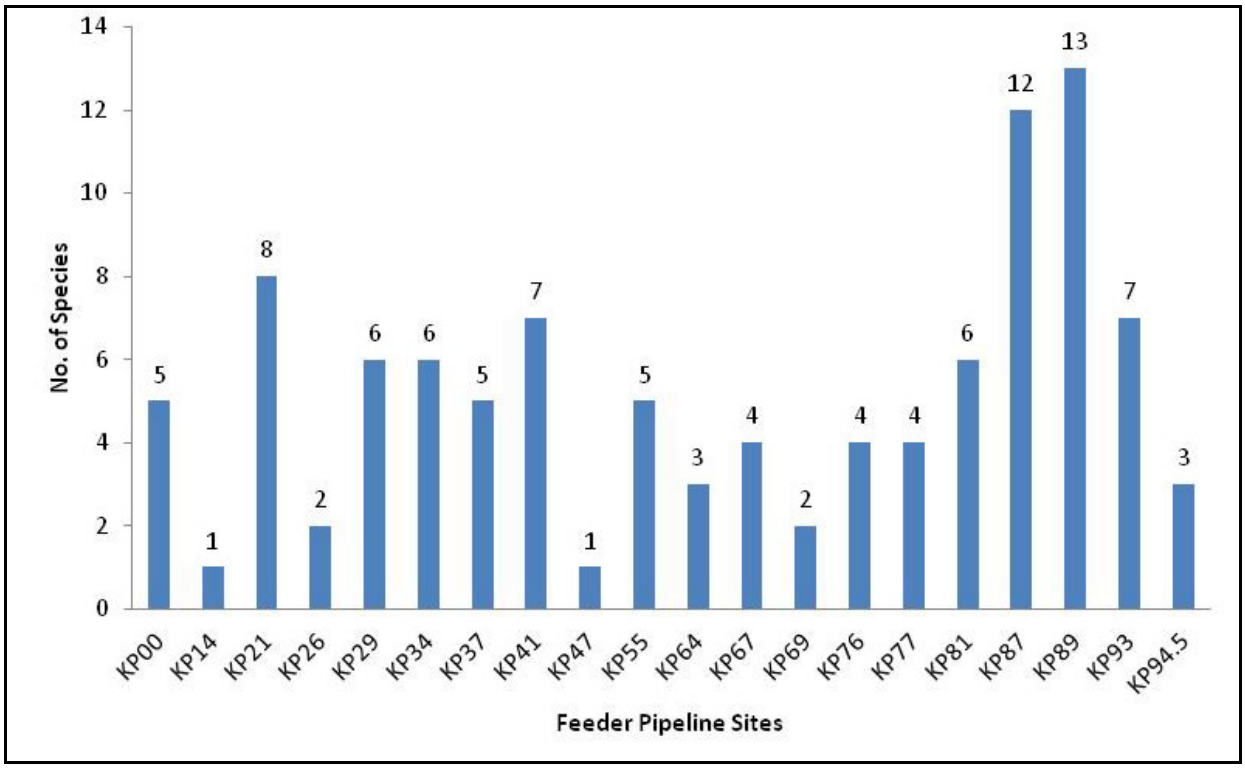

Figure Att4.7-4 Amphibian Species Diversity in the AOI

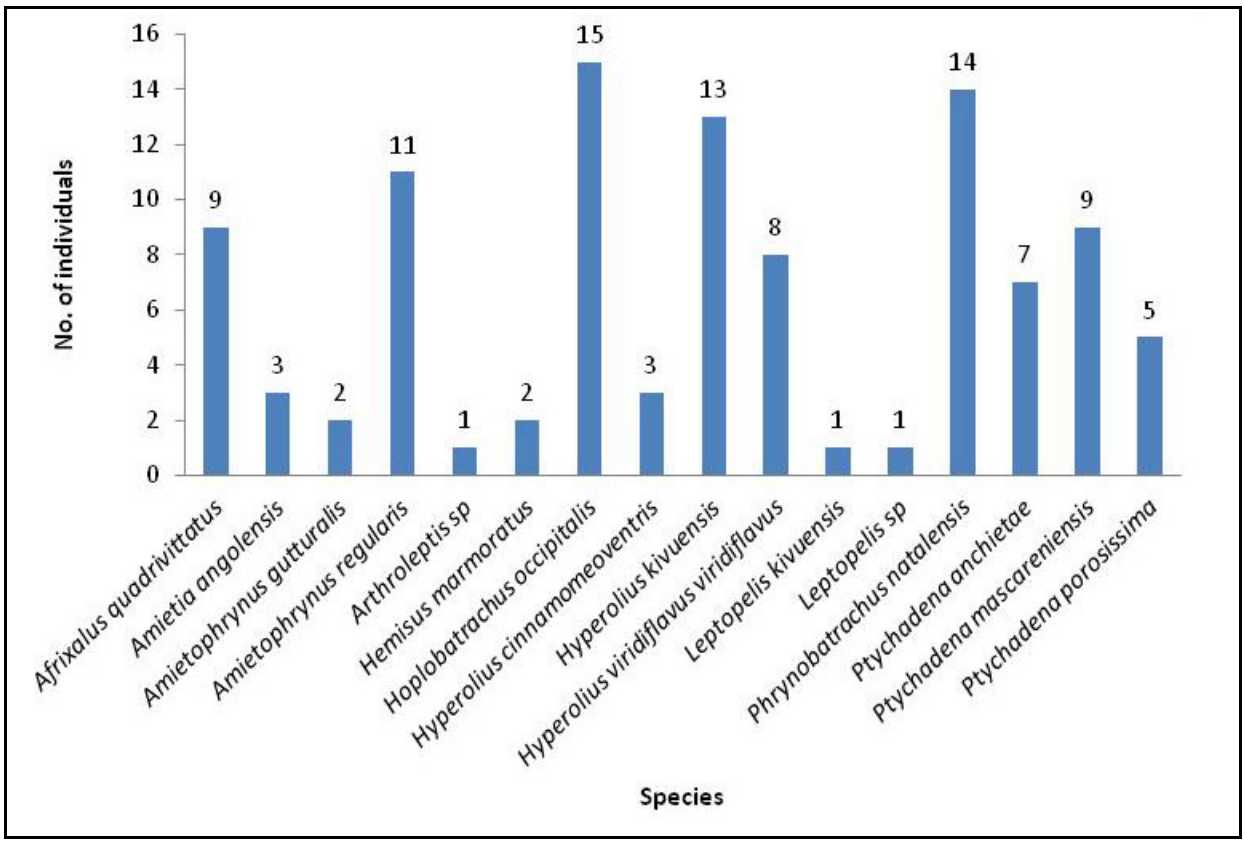

Figure Att4.7-5 Amphibian Species Distribution in the AOI

The commonest recorded species were *Hoplobatrachus occipitalis* in 15 out of the 20 sites inhabited by amphibian fauna, followed by *Phynobatrachus natalensis* (14/20), *Hyperolius kivuensis* (13/20), *Amietophrynus regularis* (11/20), then *Afrixalus quadrivittatus* and *Ptychadena mascareniensis* (each in 9/20 sites). The least recorded species were *Arthroleptis* sp., *Leptopelis kivuensis* and *Leptopelis* sp. (each recorded in only one site), then *Amietophrynus gutturalis* and *Hemisus marmoratus* (2 sites each) and *Amietia angolensis* and *Hyperolius cinnamomeoventris* (3 sites each).

Reptile Species

A total of 25 species belonging to four orders (Chelonii (turtles and tortoises), Sauria (lizards and skinks), Crocodylia (crocodiles) and Serpentes (snakes)), 13 families and 19 genera were recorded in the 37 sites of the Tilenga feeder pipeline inhabited by reptilian fauna (Figures Att4.7-6 and Att4.7-7). The most species-rich sites were KP88 and KP89 each with 11 species, followed by KP55, KP87 and KP92 (8 ssp. each), KP67 and KP71 (7 ssp. each). Most of the other sites had few species recorded in them (species poor), with 24/37 sites (65%) having four and fewer species each in diversity.

The commonest recorded species were *Trachylepis maculilabris* recorded in 28 out of the 37 sites in which amphibians were recorded, followed by *Agama agama* (22/37), *Varanus niloticus* (19/37), *Naja melanoleuca* (12/37) and *Acanthocercus atricollis* (10/37). Most of the species (15/25) or 65% were recorded four or less times in the habitats in which reptiles were recorded. These species can, for now, be said to be less common.

Table Att4.7-1 Reptile and Amphibian Survey Results

Location	Species	Global IUCN	National Red List	Confirmed (C) or Possible (P)	Ecosystem Service or Function (if Known)	Considerations
KP21, Waiga River	Nile crocodile (*Crocodylus niloticus*)	LC		C	Keystone species	Strategic Plan for the Northern Albertine Rift of Uganda focal species. Umbrella species for wetlands and rivers. Threat noted – overgrazing by livestock up to the banks of the river
KP21, Waiga River	Sudan beaked snake (*Letheobia cf sudanensis*)	LC	DD	C		First record of species in Uganda
KP21, Waiga River and associated wetlands	Zaire hinged terrapin (*Pelusios chapini*)	NE	CR	P		Found in wetlands along the shore of Lake Albert. Recorded nearby in MFNP and Kabwoya WR
KP28, Waisoke River	Nile crocodile (*Crocodylus niloticus*)	LC		C	Keystone species	Strategic Plan for the Northern Albertine Rift of Uganda focal species. Umbrella species for wetlands and rivers.
KP33, Sonso River	Nile crocodile (*Crocodylus niloticus*)	LC		C	Keystone species	Strategic Plan for the Northern Albertine Rift of Uganda focal species. Umbrella species for wetlands and rivers.
KP47 and 52	Nile crocodile (*Crocodylus niloticus*)	LC		C	Keystone species	Strategic Plan for the Northern Albertine Rift of Uganda focal species. Umbrella species for wetlands and rivers.
KP56, Hoimo River; 55; and 59	Rainbow skink (*Trachylepis quinquetaeniata*)	NE	VU	C		Already known from Bugungu WR and MFPA
KP64 and 67	Rainbow skink (*Trachylepis quinquetaeniata*), tawny plated lizard (*Gerrhosaurus major*)	NE	VU	C		
KP89, Wambabya River	Kisenyi forest tree frog (*Leptopelis kivuensis*)	NT	VU	C		Albertine Rift endemic species
KP89, Wambabya River	Golden puddle frog (*Phrynobatrachus auritus*)	LC	EN	P		Recorded previously in Wambabya FR
KP89, Wambabya River	Reticulated centipede-eater (*Aparallactus lunulatus*)	NE	VU	P		Recorded previously further downstream in Kabwoya WR

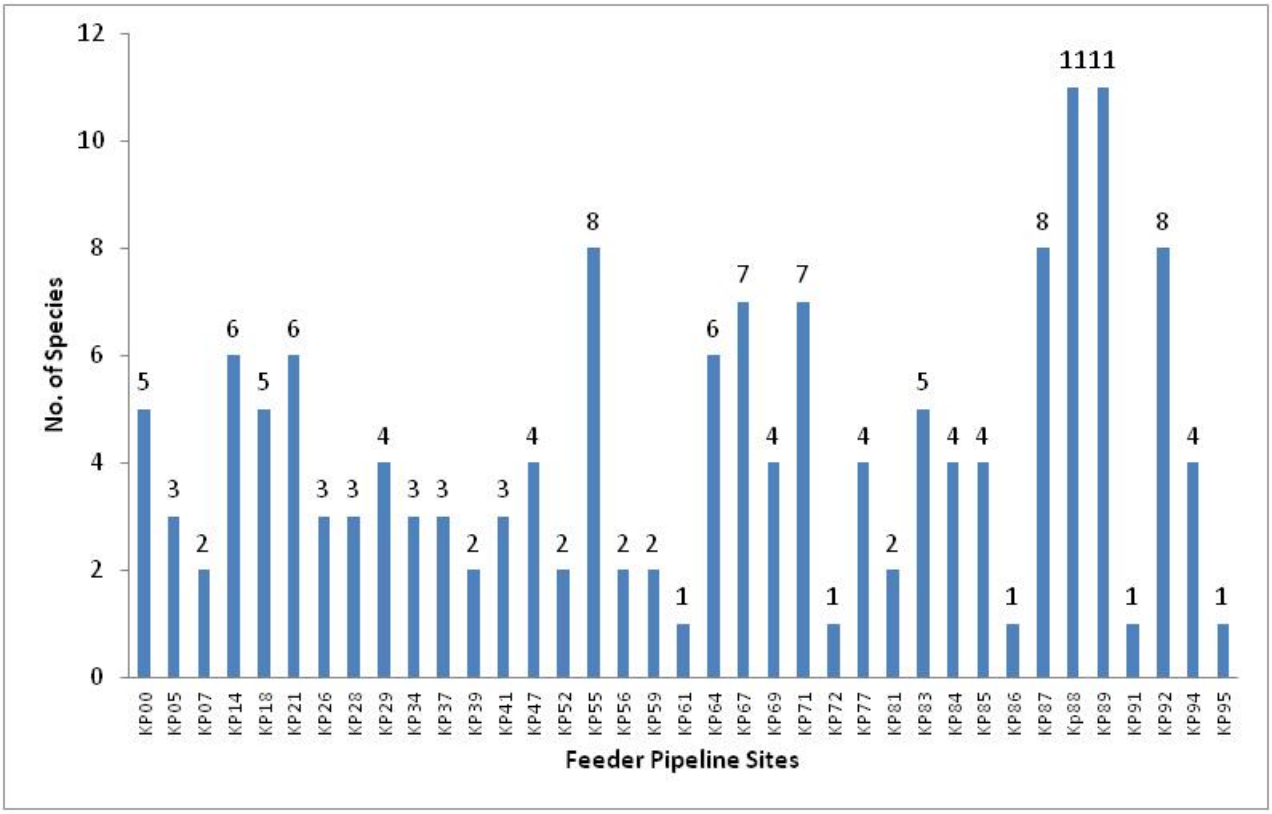

Figure Att4.7-6 Reptilian Species Diversity in the AOI

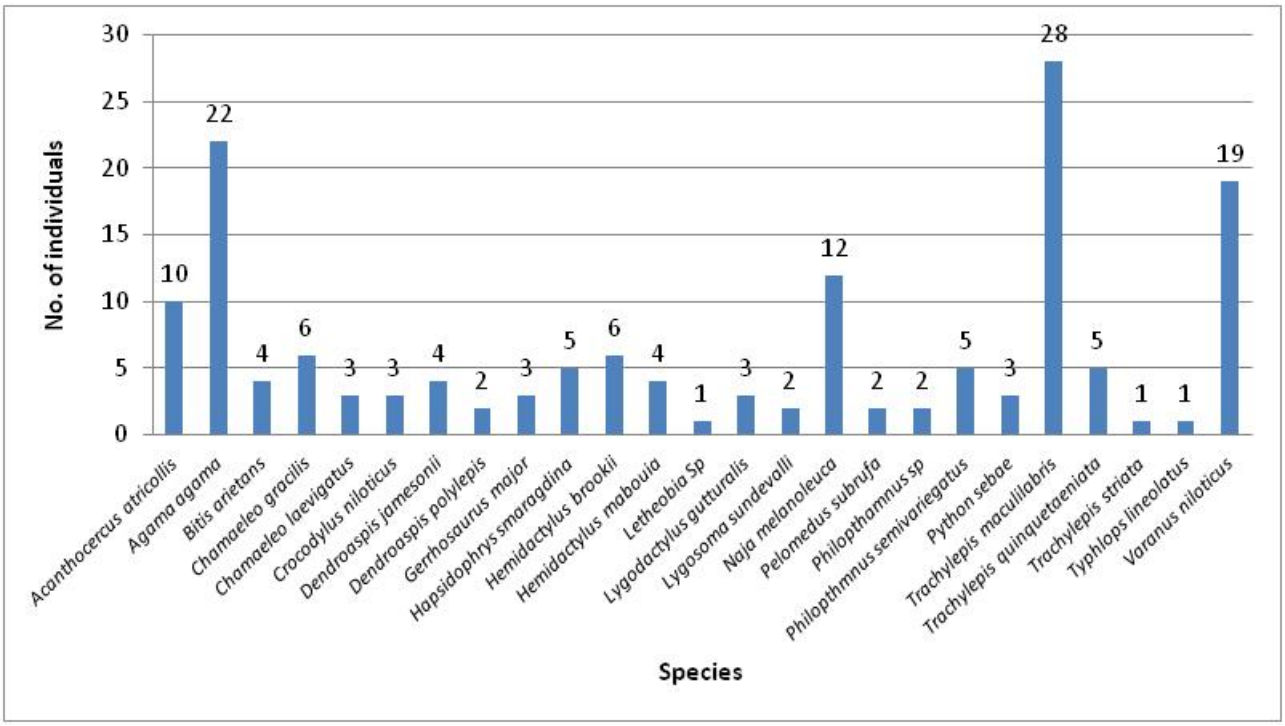

Figure Att4.7-7 Reptilian Species Distribution in Sites along the Tilenga Feeder Pipeline

IUCN Red Listing

IUCN Red-List Status for Amphibians

There were no IUCN highly rated amphibian species of conservation importance along the Tilenga feeder pipeline route. All the species are of low risk-least concern (LC) except the Kisenyi forest tree frog, *Leptopelis kivuensis,* which is globally near threatened (NT) and has been assigned vulnerable (VU) status at country level (WCS listing 2016). Two Arthloleptid species could only be indentified to generic levels and need further analysis.

IUCN Red-List Status for Reptiles

Most of the reptile species of East Africa have not been evaluated for a long time, except for the chameleons (Tolley and Trape 2014; Tolley et al. 2014). In this report, the IUCN (2017) Red List shows that most of the reptiles have not been evaluated (NE) with very few, *Acanthocercus atricollis* (common tree agama), *Agama agama* (common agama), *Lygosoma sundevalli* (Sundevall's writhing skink), *Crocodylus niloticus* (Nile crocodile) and *Dendroaspis polylepis* (black mamba), given a least concern rating globally. See Table Att4.7-2.

Table Att4.7-2 Key Areas of Herpetofauna Interest

Site/Area	Habitat	Taxon
River Waiga and Maseege FR – Buliisa	Riverine wetland and forest	Amphibians and reptiles – new record of *Letheobia cf sudanensis*. Threat: overgrazing up to riverbanks during dry season; encroachment on FR
Lake Albert flats – Buliisa	Seasonal wetlands	Rich in herpetofauna – threat: overgrazing by cattle
Bugungu WR – Buliisa	Seasonal wetlands and riverine vegetation associated with Waisoke and Sonso rivers	Biodiversity rich in both reptiles and amphibians. Relatively stable
Escarpment	Rocky habitats, woodlands, wooded grasslands, riverine forests, streams and associated wetlands and landscapes modified by agriculture	Rich in herpetofauna. Ecotone between fauna of the dry and hot Albertine lowland below and the wet mid-altitude landscape of Hoima and beyond. Threat: subsistence farming and local cattle grazing
River Wambabya–Rwmutonga – Buseruka	Riverine forest	Rich in herpetofauna. Threat: forest encroachment

ATTACHMENT A4.8 CHIMPANZEE STUDY

Brief Study of Eastern Chimpanzees (*Pan troglodytes schweinfurthii*) in UGANDA:

Tilenga Feeder Pipeline and the East African Crude Oil Pipeline Alternative

Jessica Ganas – Swaray, PhD

&

Sam Mugume Koojo, PhD

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2 Executive Summary

Upon the request of Total East Africa Midstream we, (Dr. Jessica Ganas and Dr. Sam Mugume Koojo) conducted desk based studies and targeted field surveys of endangered Eastern Chimpanzees (*Pan troglodytes schweinfurthii*) in Western Uganda, as part of an alternative pipeline routing study to support the East African Crude Oil Pipeline (EACOP) and the Tilenga feeder pipeline corridor Environmental and Social Impact Assessment. The desk and field surveys focused on areas of the proposed Tilenga feeder pipeline corridor, and a proposed alternative pipeline route to the EACOP pipeline corridor (Northern Alternative route). The proposed Northern Alternative route, provides a potential option to avoid transecting a documented wildlife corridor between Bugoma and Wambabya Forest Reserves (FR) known to support chimpanzee populations. Surveys reported herein took place from 03 – 08 October 2017. In accordance with International Finance Corporation (IFC) Performance standards (PS) 6, this study provides information to understand the potential effects of the EACOP routes on the chimpanzee populations in the region as well as help with making decisions on mitigation measures for either potential pipeline routes. The primary objectives of this study were to:

1) Collect desk-based and field information on the presence and distribution of chimpanzees near:
    a. The planned Tilenga feeder pipeline, in between kilometer points 87 – 95.
    b. The proposed northern EACOP alternative pipeline route.
2) Conduct a brief desktop assessment of the second EACOP alternative pipeline route, the "southern alternative" route.

5

The desk study comprised a review of published and unpublished information on chimpanzees in the area of the proposed Tilenga feeder pipeline and the western-most part of the proposed EACOP pipeline. Additionally, consultations regarding chimpanzee presence were undertaken with organizations involved in chimpanzee conservation and studies in this area. Data from the desk study was used to help guide the areas selected for field work.

During the field survey, one team consisting of four skilled chimpanzee experts collected data from communities and forests located within the study areas via community and individual interviews and recce walks in areas of potential chimpanzee habitat and direct walks to known chimpanzee locations.

Information from interviews reported seasonal presence of chimpanzees in both the Tilenga feeder pipeline and Northern EACOP Alternative route study areas. Field research confirmed chimpanzee presence in four distinct areas within the northern alternative route study area, but did not confirm chimpanzee presence within the Tilenga feeder pipeline study area.

Because of the presence of chimpanzees in the region of the Northern Alternative route, we preliminarily conclude that this area may not be the best alternative to avoid chimpanzee disturbance and impact in the Wambabya-Bugoma corridor. We therefore recommend strong mitigation measures in the Wambabya-Bugoma corridor as the current most viable option to avoiding disturbing chimpanzees in this region. Measures such as construction only when chimpanzees are absent, or their presence is at its minimal should be prioritised. Second, ensuring that work along the section where there are chimpanzees is done in single phase taking the shortest time possible will also be important to implement.

However, it is also strongly recommended that to be able to make practical informed mitigation decisions, further information on when chimpanzees range in a specific location and

how often they are there is needed. To that end, a monthly monitoring programme is suggested lasting at least one year to begin soon.

A desk review of the Southern Alternative route confirmed that there are likely chimpanzees near this route, in particular the areas neighboring the southern portion of Bugoma FR and in and near the Kyamurangi, Rwengeye, and Kasato FRs. Field work would be necessary to better understand the presence and distribution of population(s) in these areas.

As part of the upstream project assessment, information was also collected on chimpanzee presence along the road from Biso – Masindi – Murchison Falls passing through Budongo FR. This road is part of the national road network identified by the government of Uganda for upgrade as an "Oil Road" and is aimed at supporting upstream production. Results from the Biso-Masindi-Murchison Falls road survey show that chimpanzees occur in areas near the road from Biso, through Budongo FR, and approximately 8 km east past Budongo FR. These areas have riverine forest connections to Budongo FR and it is possible that the chimpanzee communities mentioned during the interviews may still use Budongo FR to some degree. A more detailed analysis of chimpanzee habitat use in this area is necessary to formulate accurate mitigation plans. There were no chimpanzees reported near the road from Masindi north to the entry gate at Murchison Falls National Park. Approximately half of this section is 7-8 km from Budongo FR making it likely impossible for chimpanzees to cross over from Budongo to this area. As well, it may have been a long time since suitable forest or areas were available to chimpanzees and they may have been extirpated from this region long ago.

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3 Introduction

There are plans to develop a number of oil fields in the Lake Albert Basin in Western Uganda which would supply crude oil to a Central Production Facility (CPF) located in Buliisa. The Tilenga feeder pipeline is planned to be constructed to transport crude oil southward from the CPF. This pipeline will be constructed parallel to Lake Albert and terminate at the Export Pipeline Facility (EPF) located adjacent to the Government funded oil refinery in Kabaale (Figure 3.1). The East Africa Crude Oil Pipeline (EACOP) is planned to transport crude oil from the outlet flange of EPF located at the Kabaale EPF, southeast across Uganda, into Tanzania (Figure 3.1).

Figure 3.1: Tilenga Feeder Pipeline and Uganda Portion of EACOP (from RSK Uganda Scoping Report, 2017)

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This study is focused on assessing the southern portion of the proposed Tilenga feeder pipeline and a proposed EACOP Northern Alternative route so as to inform broader studies for the Environmental and Social Impact Assessments (ESIAs) of the two projects. In addition, a potential Southern Alternative route for the EACOP Project was also assessed based on desk review only. The Tilenga feeder pipeline and EACOP Northern Alternative routes were selected because they fall within an area where a critical habitat analysis (CHA) which was conducted as part of the Tilenga feeder pipeline studies that identified a Discrete Management Unit (DMU) based on the presence of chimpanzees (*Pan troglodytes).* (Figure 3.2, 3.3, 3.4).

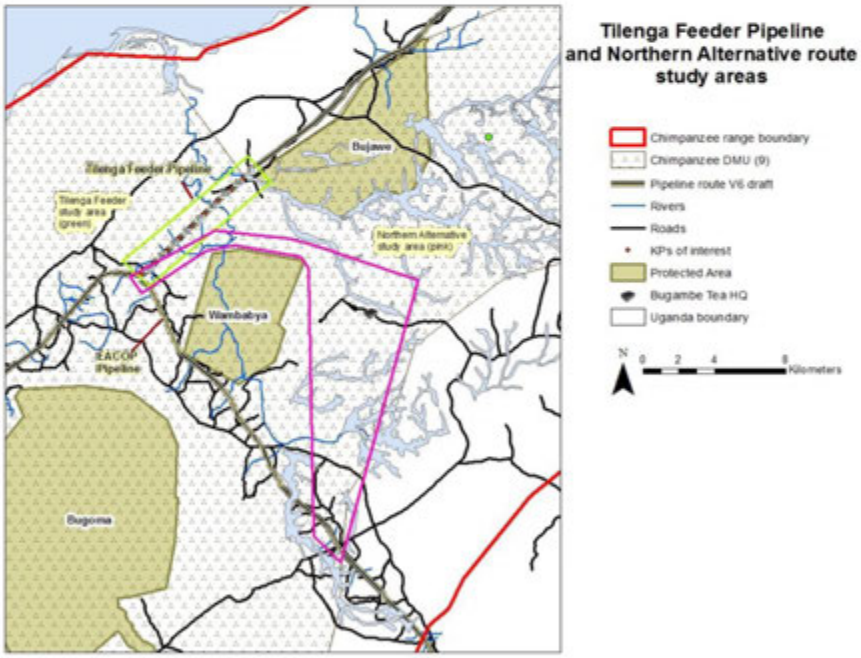

Figure 3.2: Study Area

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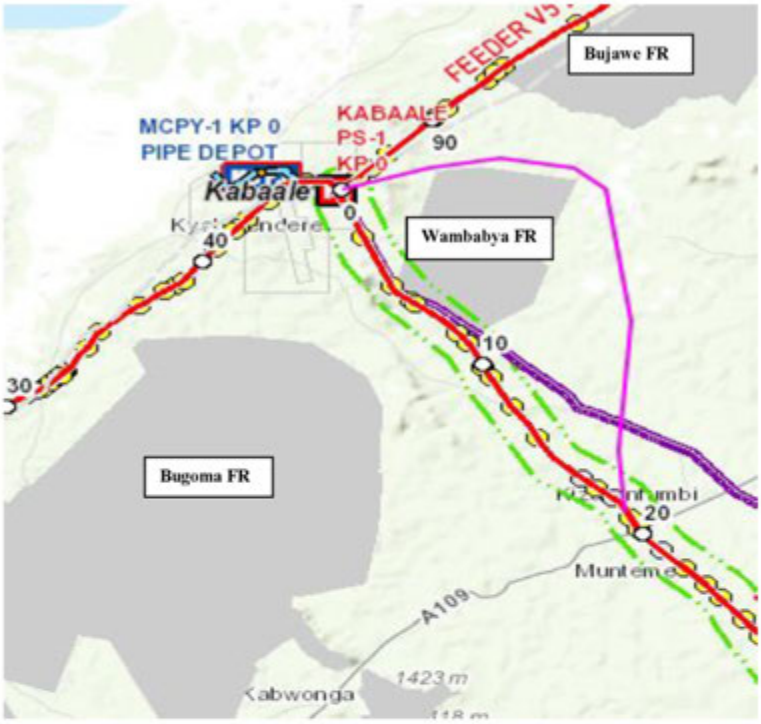

Figure 3.3: Map of the Northern Alternative Route

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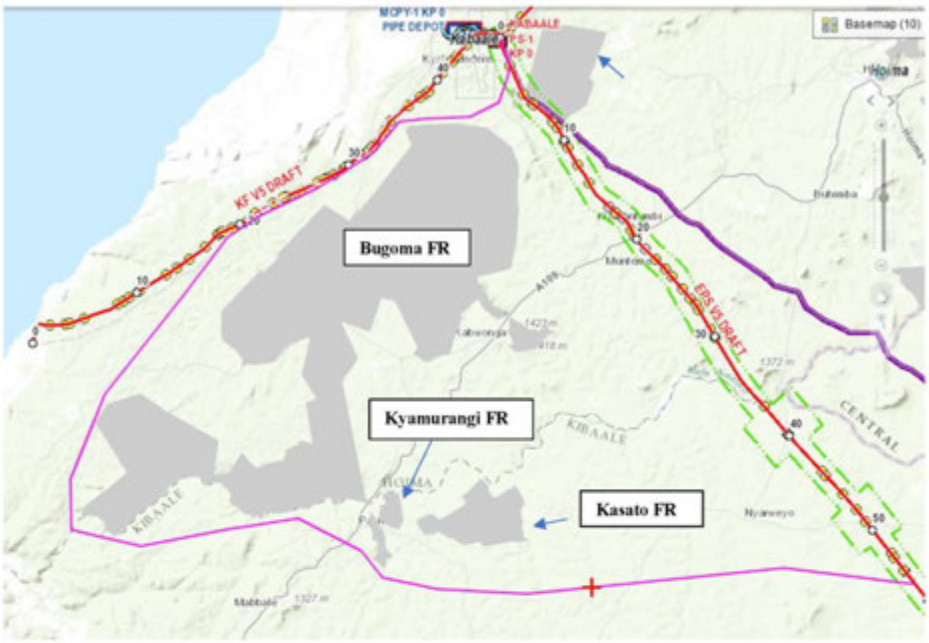

Figure 3.4: Map of the Southern Alternative Route

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Previous biodiversity impact assessment studies for these proposed projects have focused on Critical Habitat Assessment (CHA) of the Tilenga feeder pipeline and overall biodiversity surveys of the EACOP. (The Biodiversity Consultancy (TBC) & Fauna, Flora International (FFI) 2015, Wildlife Conservation Society (WCS) and eCountability (a Consultancy) 2016). Field surveys (walkovers and camera trapping) of the western-most part of the proposed EACOP route have been undertaken by the ESIA consultants. These biodiversity studies have been undertaken as part of the requirements of International Finance Corporation (IFC) Performance Standards PS.6, which require projects to seek avoiding impacts on biodiversity, with the overall goal of no net biodiversity loss; both the upstream and EACOP Projects are committed to comply with these standards.

As part of the studies for the Tilenga Feeder Pipeline, the CHA identified a Discrete Management Unit (DMU) based on the presence of chimpanzees [(*Pan troglodytes)*, DMU 9]. Chimpanzees are classified as endangered by the International Union for Conservation of Nature (IUCN), and are under threat across their range. Uganda is home to the eastern subspecies *Pan troglodytes schweinfurthii,* and the area in which the project is located is within the Albertine Rift, one of the most biodiverse eco regions in Africa (Plumptre *et al.* 2007). Importantly, the Albertine Rift is also a very significant area for chimpanzee conservation. Indeed, it is home to the largest non-contiguous population of chimpanzees in Uganda, and thus is a stronghold for this subspecies (Plumptre *et al.* 2010).

Certain areas where these pipelines are planned to be located fall within chimpanzee DMU 9. As such it is important, as part of PS6 methodology, that the presence and distribution of chimpanzees in these areas are documented to allow an evaluation of the potential effects on

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chimpanzees from pipeline construction and operation and allow implementation of measures to ensure net biodiversity gain in areas of critical habitat.

To date, there are no known studies that document chimpanzee presence along the Tilenga feeder pipeline where it crosses into DMU 9 (although anecdotal information is available). Preliminary studies undertaken as part of investigations for the Tilenga feeder pipeline demonstrate that chimpanzees are using the area where the EACOP pipeline would travel between Bugoma and Wambabya FRs (Lamprey 2017). Both Wambabya and Bugoma FRs are home to relatively large populations of chimpanzees and thus can be considered of conservation importance (Plumptre *et al*. 2003, Hänni 2015).

In considering the potential effects on chimpanzees in the area between Wambabya and Bugoma FRs, the team was requested to investigate a "northern alternative route", which would be located toward the north of Wambabya FR and then travel southeast and reconnect with EACOP at kilometer point 20 (Figure 3.3) avoiding the area between the two FRs. If no, or very few, chimpanzees were found along the northern alternative route, it could serve as a viable alternative to the proposed pipeline route, given the fact that ESIA studies demonstrated that the area in between Wambabya and Bugoma FRs is important for chimpanzees.

The objectives of this study were to:

1) Collect desk-based and field information on the presence and distribution of chimpanzees near:
    a) The planned Tilenga feeder pipeline, in between kilometer points 87 – 95.
    b) The proposed northern EACOP alternative pipeline route.
2) Conduct a brief desktop assessment of the second EACOP alternative pipeline route, the "Southern alternative" route.

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A request was also made to conduct a brief survey of another area, a road traveling from Biso, through Budongo Forest Reserve, to Masindi, and then northward to Murchison Falls National Park. These roads are planned for upgrade by the government of Uganda to support oil development in the Lake Albert Basin. TOTAL E&P Uganda requested preliminary information on the potential presence of chimpanzees in the vicinity of this road network. Details of this are contained in addendum 1 of this report.

4 Methods - Pipelines

4.1 Study Area – Pipelines

There were three areas of study associated with pipeline route options: a) Tilenga feeder pipeline, b) Northern EACOP alternative route c) Southern EACOP alternative route (desktop review, methods for this review are outlined in section 4.1.4. All study locations were primarily located within DMU 9, which is a chimpanzee specific DMU (WCS & eCountability 2016, Figure 3.1, Appendix 10.4). The area is classified as "Mixed Landscape" in the CHA report, and is characterized by village areas and corresponding agriculture, bush fallow, and highly degraded small remnant tropical and riverine forests along watercourses and in waterlogged areas (WCS & eCountability 2016; McClennan & Plumptre 2012). It is also part of the Albertine Rift, which runs from the northern end of Lake Albert, Uganda, to the southern end of Lake Tanganyika, Tanzania.

4.1.1 Tilenga feeder pipeline

The Tilenga feeder pipeline is planned to be constructed to transport crude oil southward from the Central Production Facility (CPF) located in Buliisa and will terminate at the Export Pipeline Facility (EPF) located adjacent to the proposed oil refinery in Kabaale (Figure 3.1). Although most of this pipeline is proposed to be located outside of the Chimpanzee DMU 9, a

relatively small portion would fall inside of this DMU, at KP 87 – 95 (Figure 3.1). The field work for the Tilenga feeder pipeline was conducted in the vicinity of these KPs.

4.1.2 Northern alternative route

A northern alternative route was proposed as an alternative to the proposed EACOP route through the wildlife corridor between Wambabya and Bugoma FRs (Figure 3.3). The rationale for this consideration is that if it has no chimpanzee presence, it would minimize disturbance to chimpanzee populations in this region. The northern alternative route is proposed to start at KP 0 of the EACOP and be located around the north side of the northern boundary of Wambabya FR, and then turn southeast to connect with EACOP again at KP 20 (Figure 3.3). The fieldwork for the northern alternative route covered the whole of the proposed alternative route

4.1.3 Southern alternative route

A second proposed alternative route would traverse south from Kabaale (instead of east between Wambabya and Bugoma FRs), and run parallel to Bugoma FR before turning east near the southern end of Bugoma and continuing along to travel in a northeasterly direction to connect back with the main alignment at KP 58 (Figure 3.4). To assess the possibility of chimpanzee presence near this route, Google Earth satellite imagery (forest cover) was consulted and published and unpublished reports were reviewed.

4.2 Surveys - Pipelines

Surveys took place from 03 Oct – 08 Oct 2017. The team consisted of two team leaders (JGS & SMK) and two Ugandan field assistants who also work as forest monitors for the Jane Goodall Institute – Uganda and are skilled in community interactions and chimpanzee surveys. Data were collected using three methods: a) structured community interviews, b) unstructured

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interviews, and c) recces/direct walks. EACOP Project team members accompanied the study team during the surveys.

During the planning phase of this study, local conservation NGOs and researchers working on chimpanzee conservation in the area were contacted to better understand the presence of chimpanzees. These data were incorporated into the field work plans to fine-tune the investigation. See Appendix 10.1 for further details of organizations and information provided.

Based on examining areas relatively near the proposed pipelines, as well as information from local NGOs and researchers, the field study team first set out to interview people and/or communities about chimpanzee presence in these areas. Northeast of KP 87, DMU 9 ended and southwest of the pipeline, the area overlapped into the study area of biodiversity work being conducted by the ESIA consultants. Therefore, these areas were not investigated in either direction. For the proposed Northern alternative route, a web GIS map showing the probable location of the route was given to the team which helped in estimating the location of the pipeline using ArcGIS, and drawing the map of the study area (Figure 3.2). Most of the study area for this alternative route fell within DMU 9 except for a section at the south east corner (Figure 3.2).

In order to obtain data for both study areas, the road network was followed to access villages, which may not always have been at the precise location of the proposed pipeline, or fell just outside the study area. This likely did not affect the results of the study. Local residents often have very good knowledge of the areas larger than their own community, and thus this method was still very useful.

4.2.1 Community interviews – structured

Structured interviews were conducted after first gaining permission from District and Sub-County leaders, who then invited community members to participate. Structured interviews were with a group of both male and female community members (~10-30 people). During interviews, the participants were asked about the major economic activity in the area, chimpanzee presence in their community (including their forests and farms), how often and when chimpanzees were seen/heard, number of individuals seen, and any conflict they may have with the chimpanzees. A copy of the questionnaire can be found in Appendix 10.2. Interviews were conducted in a combination of Runyoro, Alur, Swahili and/or English. Information gathered from both structured and unstructured interviews (see 4.2.2) were used to direct where searches for evidence of chimpanzees would be conducted by either reconnaissance (recce) walks or direct walks (see section 4.2.3 – 4.2.4).

4.2.2 Unstructured interviews

Unstructured interviews were interviews where individuals or small groups of people in various locations in the study area were approached when the team happened to spot them. These included: farmers, people washing clothes in a river, people walking along the road, and traders. Generally, in these instances, the team only asked them the basic questions about chimpanzee presence: a) are there chimpanzees in the area, b) where are they located and c) when was the last time you saw them.

4.2.3 Reconnaissance (recce) walks

After gaining a better understanding of where chimpanzees may range in the study areas (via interviews), recces or direct walks were conducted to investigate these locations, and when chimpanzee evidence (nests or crop damage) was found, the GPS locations were recorded.

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Recces for this study were not 'traditional' recces in which observers walk a path of least resistance in a pre-determined direction, not varying by more than 40° (Kühl *et al.* 2008). Since the primary objective of this study was to gain a better understanding of the location of chimpanzees in the study areas, recces were biased to place them in locations where the chimpanzees were thought to range (drawing on information collecting during community interviews). During a recce walk, data were collected on the indirect presence of chimpanzees. Examples of indirect evidence include sleeping nests, feeding remains, and dung.

Additional information was collected from chimpanzee nests when located. Each nest was classified by its age (fresh, recent, old, very old), following Tutin & Fernandez (1984). Many times, multiple nests were located in a single tree, or trees that were very close together, and thus one GPS location was recorded to represent multiple nests (Plumptre *et al* 2003; Mugume 2016).

Table 1. Definition of nest age classifications

Nest age classification	Description
Fresh	Leaves forming the nest are completely green
Recent	Leaves forming the nest are changing color; a mixture of green and brown leaves
Old	Leaves forming the nest are brown, but the nest is still entirely formed with branches
Very old	There are no leaves remaining, but the nest is still identifiable by broken branches

4.2.4 Direct walks

In addition to recces, local people took the team directly to the known locations of chimpanzee evidence, rather than walking a recce through a forest patch and collecting data. Indirect evidence (primarily nests) were recorded at such locations.

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5 Results and Discussion

5.1 Interview responses

Considering both the Tilenga feeder pipeline and the proposed Northern alternative route study areas, 33 interviews were conducted (7 structured and 26 unstructured). Of these interviews, 79.4% of respondents said that they had either seen or heard chimpanzees in the area (e.g. directly near their community, farm or forest. Table 2). Two of the positive responses reported that they only knew of the chimpanzees in Wambabya FR.

Information from the structured interviews show that in general, chimpanzees use areas outside the FRs on a seasonal basis, and that communities do not have conflict with chimpanzees (e.g. crop-raiding and/or aggression towards humans). There are exceptions, such as in the village of Kyaisamba, where chimpanzees nest (seasonally) very close to the village's water pump, and when the chimpanzee are there, it makes it difficult for community members to get water. People also reported during the interviews that when chimpanzees have been directly observed, they have seen between 4 to 15 individuals (Table 2).

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Table 2. Results of the structured interviews. Villages are listed by name, with the collective answers given afterwards. For "where have they been seen/heard", community members pointed in the direction chimpanzees were head/seen, and the direction was quantified with a compass bearing (e.g. "180° S"). Quantifying in this manner aided the team in case they would be required to investigate chimpanzee presence without the assistance from community members.

Village name	Chimps found in the area?	Where have they been seen/heard?	How many times have they been seen/heard in them in the last year?	Which months were they last seen/heard?	How many individuals have been seen?	Any human- chimpanzee conflict?
Kahoro	Yes	a) 60° NE, b) 320° W, and c) 180° S	Very frequently; most recent sighting mid-September 2017	Every month	"many"	No
Kasiita	Yes	a) 200° S, b) 140° E, c) 70° E	Four times	June, July, March, October	Up to 9	No, but people fear them based on what they hear about chimpanzees (attack people, etc.)
Katamwa	Yes	Moving between Wambabya FR and community land	Hear them every day	November 2017	Only hear them, cannot confirm number	Minimal; sometimes come to eat jackfruit
Katoke	Yes, but in Wambabya FR	Hard to see	Three times	March 2017	10+	None
Kijumba	Yes	Wambabya FR	Twice in the last year; most recent was two weeks before the interview	September 2017, sometime in 2016	Unknown, only heard them	Minimal; chimpanzees eat honey from community's tended bee hives
Kyaisamba	Yes	All around village area, in particular at 0°N	Frequently	June 2017. Nested 5 minutes walk from village (140° SE)	Up to 15	Yes, chimpanzees nest very close to village and near water well. Sometimes chimps prevent community members from getting water. Also crop raid sugar cane, pineapple, banana, avocado
Rwengabi	Yes	Very close; a) 0°N, b) 80°E	Some periods where they are seen often, other periods where they are not seen.	Unknown	4-5	Some, chimpanzees come to eat jackfruit and mangoes (Season for jackfruit = Jan /Feb; mangos = June/ July)

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5.2 Recces and direct walks

Five recces and three direct walks were conducted. Indirect evidence of chimpanzees (nest, crop damage) was found on three recces, and on all direct walks (Figure 5.1).

5.3 Chimpanzee presence: Tilenga feeder pipeline

For the study area of the Tilenga feeder pipeline, 11 interviews were considered to reference areas near Tilenga. Of these interviews, 54.5% (6) reported that chimpanzees ranged in the area. However, out of these six, three only referred to chimpanzees within Wambabya Forest Reserve only. Two interviews reported that chimpanzees ranged close to Rwamutonga river which serves as a portion of the southern boundary of Bujawe Forest Reserve and crosses the Tilenga feeder pipeline (Figure 5.1).

During one of these interviews, one respondent said that she had heard chimpanzees a few days before our interview, along the Rwamutonga riverine forest. A 1.13 km recce was later conducted along this river, beginning at the location of the interview, but no evidence of chimpanzees were found (although three species of monkeys [Black and white colobus, Red tailed monkeys and Vervet monkeys were observed]). The habitat consisted of a highly degraded riverine forest, with recent deforestation and active farming around the remaining fragments. It is important to note that chimpanzees have previously been documented to range along this river, approximately 4-5 kilometers to the east of this location (McLennan 2008; McCarthy *et al*. 2015, McCarthy, M., pers comm). There is a strong possibility that the groups of chimpanzees documented on the Rwamatongo River by McLennan and McCarthy are the same chimpanzees referred to in these two interviews. If so, then these data suggest that this area near (<500 m) the planned Tilenga feeder pipeline is used by chimpanzees seasonally.

Since this field work was aimed at an initial identification of areas potentially used by chimpanzees, a more thorough investigation of this area was not feasible. To better understand when and how chimpanzees use this area, it is suggested that monthly surveys are conducted. For details, see section 7 on monitoring recommendations.

5.4 Chimpanzee presence: Northern alternative route

Based on interview and field observations, multiple chimpanzee groups range in the area proposed as the Northern alternative route. Twenty-four interviews reported that chimpanzees ranged in the area. Based on information gained during these interviews, three direct walks and four recces were conducted to search for chimpanzee evidence. Indirect evidence was documented on three out of the four recces and all three direct walks (Table 3, Figure 5.1).

The first recce in this study area was conducted near Kahara village, in a forest patch that connected into Wambabya FR (Figure 5.1, Table 3). Here, community members reported that chimpanzees were heard and seen frequently, and correspondingly, the team observed four nests inside the forest reserve. However, based on chimpanzee behavior and average home range, it is expected that they move out of the forest reserve to look for easy food such as jackfruit and sugarcane that are within the vicinity.

The second recce was conducted within a forest patch inside the Bugambe Tea Plantation (Figure 5.1, Table 3). Here, workers conveyed to the team that chimpanzees had been seen a few days prior to the team's arrival. A recce in this forest area recorded 11 nests. After conducting the recce, local people told the team that chimps had crossed the access road in the tea plantation 30 minutes previously. There are multiple forest patches within the tea plantation, but it is unknown how and when chimpanzees use them. The proposed pipeline would run near this area and depending on the precise location, could result in visual and auditory disturbance to

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chimpanzees at this location and also potentially result in habitat loss. Therefore, if the alternative route is to be considered further it would be important to obtain more information about when and how often chimpanzees use each of these forest patches. This would help develop an understanding of potential impacts on chimpanzees and with the development of mitigation measures. Importantly, this area is also home to the Bugambe Tea Plantation, a very large industrialized farm. Constructing a pipeline through this area may be difficult to achieve. A third recce in another forest patch in the Bugambe Tea Plantation, did not yield any chimpanzee evidence.

The fourth recce was conducted in a very small riverine forest near the village of Kisiita (Figure 5.1, Table 3) where 12 nests were observed. This forest patch was highly degraded, consisting only of a few trees on each side of the river. At the time of the recce, active brick making using sand from the river was occurring.

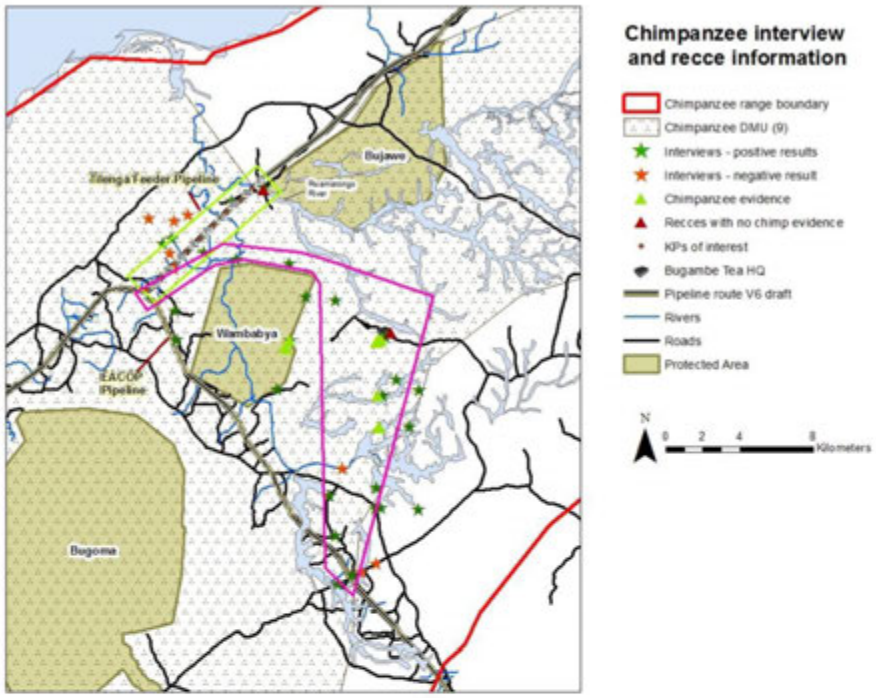

Figure 5.1: Interview Results and Recces/Direct Walks in Tilenga/Northern Alternative Study Areas[1]

[1] *Note: one chimpanzee evidence point can represent more than one nest.*

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Table 3. Description of data collected on recces and direct walks.

Recce (R)/Direct walk (D)	Pipeline study area	Encountered chimp evidence?	Type of evidence	Number of nests
Riverine forest along Rwamatongo River, which is the southern boundary of Bujawe FR (R)	Tilenga	No	n/a	n/a
Forest patch #1 within Bugame Tea Plantation (R)	Northern alternative	Yes	Nests	11
Forest patch #2 within Bugambe Tea Plantation (R)	Northern alternative	No	n/a	0
Kahara village forest, where it leads into Wambabya FR (R)	Northern alternative	Yes	Nests	4
Riverine forest near Kisiita (R)	Northern alternative	Yes	Nests	12
Near Rujunju village(D)	Northern alternative	Yes	Nest	1
Kyaisamba village (D)	Northern alternative	Yes	Nests	11
Village crop damage area (D)	Northern alternative	Yes	Crop damage evidence from sugar cane	No nests, but feeding remains of sugar cane by chimpanzees observed

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5.5 Chimpanzee nest characteristics

In total (recces and direct walks), 39 nests of three different age classes were recorded. Most of the nests were classified as very old, followed by old, and recent (Figure 5.2). The classification of nests depends on the amount of leaves still intact within a nest. A nest that has lost all of its leaves is considered very old, which is an index of the age of the nest. Out of experience and as well following standard methodology (Tutin & Fernandez 1984), new nests are typically less than two days, recent nests are those ~ two weeks, old nests are those over two weeks and less than four months old, while very old nests are typically older than four months.

The number of nests per site in this study does not give an indication of the number of chimpanzees in a group. This is because replications (as part of systematic survey methodology) to determine the number of new nests per night were not conducted, sometimes chimpanzees re-use nests, and also mothers sleep together with their infants. What these nests do confirm is the presence of chimpanzees in this area. When we compare the recce information with community interviews, we speculate that perhaps the reason we did not find new nests was that anecdotally, community members told us that chimpanzees feed on jackfruit and mangos in their gardens, and during our study period (October 2017) neither of these ripe fruits were available. Jackfruits and mangoes within this area are known to be fruiting and ripe during January/February and June/ July (interview results and SMK pers obs). This is somewhat typical for chimpanzees, as their movements are partially dictated by food availability (Furuichi *et al.* 2001; Stanford & Nkurunungi 2003; Tweheyo & Lye 2005). Documenting what foods are eaten by chimpanzees in this area and when they are available will help to understand which times of the year chimpanzees are using areas outside of the forest reserves.

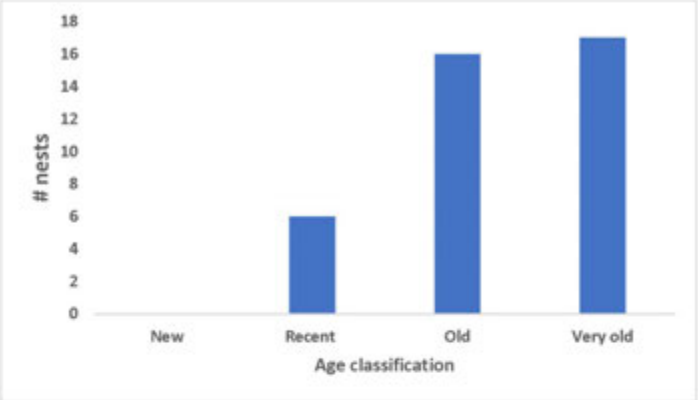

Figure 5.2: Age Classification of Chimpanzee nests in Northern Alternative study area

5.6 Chimpanzee habitat quality and use

Only small patches of highly degraded forest remain in the Tilenga and Northern alternative study areas. The landscape consists of primarily villages and agricultural activities. Considering the six forest patches where indirect evidence of chimpanzees was found, all were found in varying degrees of human induced degradation. Forest is the preferred habitat for chimpanzees and such degradation of forest habitats means that chimpanzees utilize areas outside forest patches. To the extreme was a nest found in a single tree ~200 meters behind a community member's home. Forest patches where chimpanzee nests were located were characterized by a strip of only 5 or 6 trees wide on each side of the river, with cleared forests/farming/other human activities enclosing it. From the field observations, it is clear that human activities are placing enormous pressure on the remaining chimpanzee habitats in the area. Any further human activities should proceed with extreme caution and must be undertaken only if effective mitigation efforts are formulated, implemented and mitigation activities

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monitored to ensure the remaining chimpanzees in this landscape are not further negatively affected.

5.7 Southern alternative route

Using the desktop analysis, an estimate of chimpanzee presence near this potential route was possible. A survey conducted in 2015 by the Jane Goodall Institute (JGI) – Switzerland documented chimpanzee nests in both the western and southern edges of Bugoma Forest Reserve (Hänni 2015), which in some areas is relatively near the potential pipeline route (500 – 1000 m, Figure 3.4). The JGI study only documented nesting sites and not any other information about where chimpanzees travelled. Current research in Bugoma FR being conducted at the time of writing (November 2017) shows that chimpanzees are using the southern portion of Bugoma FR less than previously documented, but that they still travel to southern areas of Bugoma to exploit important food sources such as figs (C. Hobaiter, pers. comm.).

As the potential alignment moves away from Bugoma FR, it approaches the forest reserves of Kyamurangi, Rwengeye, and Kasato, as well as other riverine and forest fragments, which are remnants of the tropical high forest which used to cover much of this area (Figure 3.4). A survey in 2010 of Kasato FR documented chimpanzees (Plumptre *et al.* 2010). Likewise, data from the IUCN show that these areas fall within known chimpanzee range (Humle *et al.* 2016). However, there are no detailed documented studies of these areas to allow any estimates about the size or location of chimpanzee populations.

While there are chimpanzees in at least some of the areas near the proposed Southern alternative route, if this route was to be taken forward, field work would be required to better understand precisely where chimpanzees are in these areas, and when and how often they use them.

6 Summary/Conclusions

6.1 *Tilenga feeder pipeline study area*

- Although community members reported during the interviews that chimpanzees ranged in the area (near KPs 88 and 90), no evidence of chimpanzees was found during the recces.
- Interviews with communities suggest chimpanzees range seasonally along the Rwamatongo River, which is crossed by the proposed pipeline near KP 87 (Figure 5.1). Data from other researchers have documented chimpanzees along this river 4-5 km to the east of the proposed crossing point.
- To make informed mitigation management decisions, it is important to document the seasonal use of this area by chimpanzees. To effectively do so, a monthly monitoring program is proposed in this area.

6.2 *Northern alternative study area*

- Based on the results using all three surveys methods, chimpanzees were noted along the proposed Northern alternative route.
- Twenty-four interviews documented positive responses about chimpanzees ranging in the interviewed area (Figure 5.1)
- Indirect evidence of chimpanzee (nests or crop-damage) was documented at five out of six survey locations (Figure 5.1)
- Because chimpanzees ate seasonally available jackfruit outside of forest patches and that the ages of chimpanzee nests documented in these areas were primarily 'old' and 'very old' suggests that chimpanzees use these areas on a seasonal basis (Figure 5.2)

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- Due to the time period when jackfruits are ripe, it is possible that chimpanzees mostly use the area during January/ February and June/ July.
- To make informed mitigation decisions, if the pipeline were to be built in this area, it is important to collect detailed information about when and how often chimpanzees use each of the forest patches to accurately mitigate the effects of project activities on chimpanzees.

6.3 Chimpanzee habitat quality

- In both study areas, only small patches of highly degraded forest remain in a landscape of villages and agricultural activities.
- Chimpanzee evidence (primarily nests) was documented in riverine forests where a small strip of trees (5 – 6) remained on each side, small finger like islands of forest within a large-scale tea plantation, and clumps of trees near villages.
- Human activities (i.e. deforestation, agriculture) are putting enormous pressure on the remaining chimpanzee habitats in the area. Any further human activities should proceed with extreme caution and monitoring is strongly recommended.

6.4 Southern alternative route

- Chimpanzees have been documented in the western and southern edge of Bugoma FR, between 500 and 1000 m at its closest points from the potential pipeline corridor.
- Chimpanzees also range around Kyamurangi, Rwengeye, and Kasato FRs as well as other forest fragments (where the pipeline could be located), but knowledge of these populations are poor. If the southern alternative was to be considered further, field work would be required to assess chimpanzee distribution in the vicinity of the proposed alignment.

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7 Preliminary recommendations for mitigation and offsets

There is not enough detailed information on chimpanzee habitat use in the two main study areas (Tilenga feeder pipeline, Northern alternative route) to make definitive mitigation recommendations. However, this survey shows that there are chimpanzees along the Northern alternative route and therefore they could be significantly impacted by construction of the pipeline. It is predicted to primarily be the auditory and visual disturbance that would affect the chimpanzees. Although not much published research has been conducted in this area, one study examining the effects of oil exploration (and corresponding noise) on various mammals in Gabon found that apes (including chimpanzees) responded negatively by substantial temporary habitat avoidance during seismic activity (Rabanal *et al*. 2010). Further, some unverified reports have suggested that when disturbed by these types of activities, chimpanzees will migrate to adjacent areas, which results in stress to these chimpanzees, as well as other chimpanzee groups they may encounter (Rainer, White and Lanjouw 2013). Chimpanzees are territorial and are known to severely wound or kill intruders into their territory (Mitani *et al* 2010; Boesch *et al.* 2008). Therefore, disturbances from construction of the pipelines could potentially result in stress, injury or even death of chimpanzees. Monitoring chimpanzees before, during and after construction, in either location, along with proper mitigation measures throughout the process can ensure no net loss of chimpanzees in these areas. Further, if the pipeline is constructed and buried underground leaving the area to regenerate, then the construction may not have a long term impact on chimpanzee presence in a given area (if the chimpanzees return to the area after construction). As such we propose the following mitigation measures based on the two scenarios below.

The Northern alternative route has two possible chimpanzee habitat use scenarios, and based on those, preliminary ideas about mitigation could be formulated.

(A) **Year Round Use:** Chimpanzees could be using these areas year-round. If construction of a pipeline through this area is the selected option, the pipeline construction methodology should consider a rapid and close spread approach where the construction is performed in the shortest time duration possible with spread activities sequenced to limit chimpanzee exposure to noise and activities associated with pipeline construction. Based on current information collected by the team, it does not appear that in any of the areas investigated, chimpanzees use them year-round.

(B) **Seasonal Use:** Chimpanzees could be using these areas on a seasonal basis. Evidence (information from interviews and the ages of the chimpanzee nests documented) collected during the study suggest that this scenario is most likely. With this scenario in mind, it would be very possible to construct the pipeline with minimal disturbance to chimpanzees by undertaking construction at a time of the year when the chimpanzees are not using that particular area. However, to best understand when that time period would occur, detailed monthly habitat use by chimpanzees would be needed. If over a year, monthly data were collected to better understand where and when chimpanzee groups are ranging, then recommendations could be made as to what time period(s) construction could be undertaken to avoid disturbing chimpanzees (see section 8).

To gain an improved understanding of chimpanzee habitat use of the areas along both the Tilenga pipeline (KP 87 – 90.5) and the EACOP area in DMU 9, including the Northern alternative route; so that practical mitigation measures can be made, a monthly chimpanzee monitoring programme should be implemented in the earliest possible timeframe. This will

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collect relevant baseline information to inform the decision making process at the earliest time. The corridor area in between Bugoma and Wambabya FRs is a known chimpanzee habitat and chimpanzees are known to range in this area at least seasonally, which is why the Northern alternative route was investigated but additional information collected within this corridor will also be important to inform mitigation measures specifically for this area.

Accordingly, for the three study areas (Tilenga feeder pipeline, EACOP corridor area in between Bugoma and Wambabya FR and the northern alternative route), we propose the following:

- On a monthly basis, a team should:
  - conduct interviews with communities to determine the presence or absence of chimpanzees and;
  - undertake recces and direct walks using the methodology of the current study.

The justification for monthly monitoring is that there is evidence for seasonal use of habitats and a one-time survey does not give accurate information on year-round habitat use. Further, this population of chimpanzees is under much human pressure and active habitat loss. The chimpanzees' use of the area is predicted to be very dynamic, and thus collecting data each month will allow a better estimate of where chimpanzees range and during what time periods. Collecting data using surveys and recces will ensure accurate information on chimpanzee presence is collected. Likewise, interviewing communities monthly will raise awareness to the information needed, and community members will likely become more observant of when and where they hear or observe chimpanzees, which will strengthen the information collected.

Field data collection should be performed by Field Assistants who are familiar with chimpanzee ecology and field survey. It is recommended that an initial period of training is

provided to the Field Assistants. A supervisor would be required to provide the training and oversee the monthly field surveys. Input would also be required to design the study/field work, analyze the data, and write up monthly reports and provide mid-study and final reports. Particular villages and field recce locations should be selected before the outset of the fieldwork. These locations may change, or new locations added in the field, depending on any new information on chimpanzee presence collected during the study.

Following the best practices model of the mitigation hierarchy, offsets are a "last-resort" measure of a no-net loss or gain of biodiversity in accordance with PS 6 standards. If mitigation measures are not possible and habitats for chimpanzees in this region are lost and correspondingly chimpanzee individuals/populations are affected as a result of the oil pipeline construction and related activities, then biodiversity offsets, following generally accepted standards, would be required.

Currently, there are groups working in this region on chimpanzee conservation programmes. It is recommended the offsets focus on supporting these experts currently working in the field, rather than begin additional efforts. The following groups are working to protect chimpanzees in this area, and would benefit from support to their projects.

1) **The Jane Goodall Institute – Uganda.** In the past they have conducted forest monitoring of this area. They also focus on education and community projects to reduce the pressure of forests that contain chimpanzees.
2) **Chimpanzee Sanctuary and Wildlife Conservation Trust (Chimp Trust).** They have conservation field projects including monitoring and education near Bugoma and Wambabya FRs

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3) **The Bulindi Chimpanzee Project**: a multidisciplinary chimpanzee conservation project in the region focusing on monitoring a group of 22 chimpanzees in a forest patch in the Hoima district. This project works with local communities to help alleviate the pressure on forests by providing them with resources as well as conducting education programs.

If offsets are required, TOTAL can liaise with any of these groups to develop appropriate chimpanzee conservation measures in the region

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8 Addendum 1: Biso – Masindi & Masindi – Murchison Falls roads

Introduction

The team was requested to conduct a brief survey along the Biso – Masindi & Masindi – Murchison Falls National Park road for a proposed road upgrade project (Figure A. 1). This study was commissioned to gain a better understanding of whether chimpanzees occur in the vicinity of the proposed roads for upgrade. The landscape along this road comprises sugarcane plantation, gardens with annual/perennial crops and human settlement. It also travels through the southern end of Budongo Forest Reserve, a moist, semi-deciduous forest and grassland that contains a sizeable chimpanzee population (Plumptre 1996; Plumptre & Cox 2006). The survey continued along the road to the entrance of Murchison Falls National Park where it was terminated.

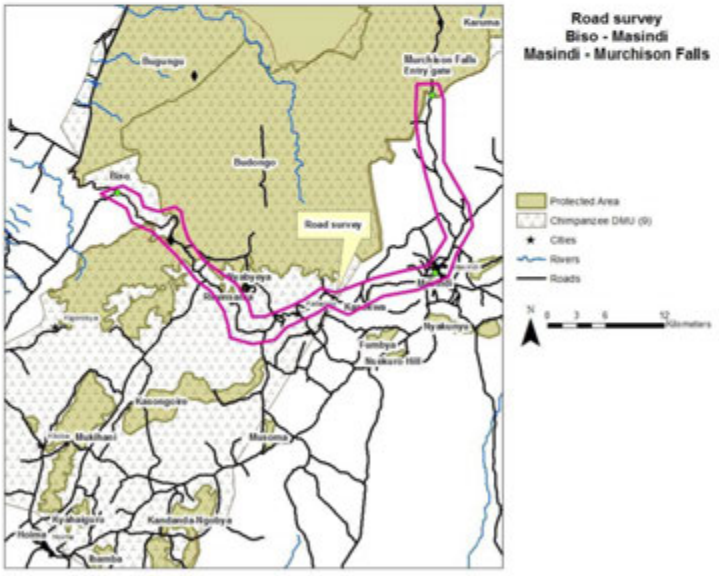

Figure A.1 Map of the Biso-Masindi-Murchison Falls study area

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Methods

For this section (Biso-Masindi-Murchison Falls road survey to the north), an unstructured interview methodology was used exclusively, talking to people along the road when appropriate. The team randomly stopped and interviewed people within villages along the road.

Result/Discussion

On the road from Biso to Masindi, seven interviews indicated chimpanzees ranged in the area (starting from Hakimi A to the outskirts of Bwinamira 3 (Figure A.2). It should be noted that no more interviews were conducted after Bwinamira 3 (about 9 km after the road exited Budongo Forest Reserve) because the landscape did not appear favorable for chimpanzees (i.e. large sugar cane plantations all around, villages with no suitable trees, densely human populated areas, Figure A.2). However, it is important to note that there are chimpanzees and a chimpanzee research site at Kasokwa Forest Reserve (Janette Wallis, pers. comm, Mugume pers obs), which is found directly adjacent to the road to Masindi (Figure A.2). All interviews indicated chimpanzee habitat use in the area to be seasonal. Whilst the road upgrades are the responsibility of the Ugandan National Roads Authority (UNRA), it is recommended that follow-up research is conducted long before road upgrades begin to determine chimp usage of the areas along roads to the east and west of Budongo Forest Reserve. Understanding the seasonality of the chimpanzees' use of this area will be important to implement informed mitigation measures.

On the road from Masindi to the entrance gate of Murchison Falls National Park (where permission was not granted to enter and continue surveying), the three interviews conducted all indicated chimpanzees do not range anywhere near this road. In fact, most interviewees indicated

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that they had never known chimpanzees to range in the area. At the completion of the survey, the team spoke with Uganda Wildlife Authority staff at the Murchison Falls entry gate who indicated they hear chimpanzees to the north, inside the park. The team is confident to state that chimpanzees do not occur along the Masindi road going north toward Murchison, and thus no mitigation would be needed.

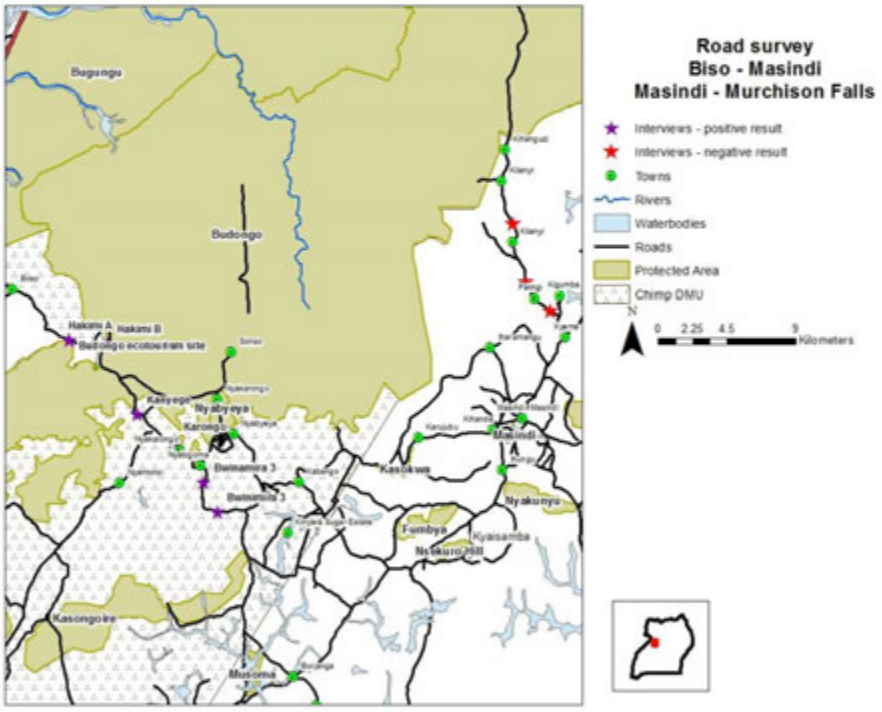

Figure A.2: Road survey results of the Biso-Masindi-Murchison Falls Road

Summary of the findings

- Chimpanzees range seasonally along the Biso – Masindi road, occurring from Hakimi A to Bwinamira 3. (Figure A.2).
- Although no interviews of local people were held, chimpanzees have been documented at the Kasokwa Forest Reserve (Figure A.2).
- Chimpanzees do not occur near the road going north from Masindi to the entry gate at Murchison Falls National Park (Figure A.2).

Recommendation

Detailed mitigation measures should be implemented in areas where chimpanzees were found.

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10 Appendices

10.1 Providers of chimpanzee presence information for the study area

Location	Population estimate	Source (all *Pers. comm.*)	Notes
North of Wambabya along the River Wambabya that runs towards Lake Albert (outside the FR)	*"Supposedly a group here"*	Dr. Matt McLennan - Oxford Brookes University	Anecdote: owner of Lake Albert Safari Lodge in Kabwoya Wildlife Reserve wants to develop chimp trekking here
Multiple groups west of Wambabya FR (all on village land)	Multiple groups	Dr. Matt McLennan - Oxford Brookes University	
Along the Rwamatonga river at the southern border of Bujawe Forest Reserve	Unknown	Drs. Matt McLennan/Maureen McCarthy, Max Planck Institute- EVA	
One chimp group along the Rwamatongo river slightly to the west of the other group (see above)	One group, number of individuals currently unknown	Dr. Matt McLennan	1°28.773'N, 31°, 16.717'E, could be remnants of the 'Bujawe chimps' after the forest at the Bujawe Forest Reserve border was cleared
South of Wambabya Forest Reserve, on village land	Unknown	Dr. Matt McLennan	
Remaining forest along the Rwamatongo River that borders the Southern part of Bujawe Forest Reserve	Unknown	Dr. Matt McLennan	Would certainly expect chimps to be here"
9 km southwest of Wambabya Forest Reserve	One group (?)	Dr. Matt McLennan - Oxford Brookes University	Location: 1°22.404'N, 31°13.718'E
Bugoma Forest Reserve northern sector	Multiple groups	Dr. Catherine Hobaiter, University of St. Andrews	Sudies Bugoma chimps, based in Kaseeta.

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Location	Population estimate	Source (all *Pers. comm.*)	Notes
Bugoma Forest Reserve	Survey of Forest Reserve completed. Analysis of data n progress	Dani Hänni -JGI Switerland	Data being analyzed at the time of writing (November, 2017)
Wambabya Forest Reserve	Survey of Forest Reserve completed. Analysis of data in progress as of November 2017	Dani Hänni -JGI Switerland	Data being analyzed at the time of writing (November, 2017)
East of Bugoma Forest Reserve, near St. Josephs College, Munteme	~60 individuals	Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT)	
Southeast of Wambabya Forest Reserve , in Rusuge & Nyarugabo parishes	Several chimp communities	Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT)	
Eastern Wambabya Forest Reserve , moving out to community forests, Katanga parish	Several chimp communities	Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT)	Tea plantation in the area has conserved some forests that contain chimps. These chimps are different than what is found in the community reserve forests. Outside the tea plantation, there are also chimps on private land
Near the Hydropower plant, just north of Wambabya Forest Reserve		Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT)	Could be a group from Wambabya Forest Reserve
Area from N Wambabya Forest Reserve, SE along the borders, in and out of FR	Unknown	Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT)	Possibly living in degraded areas

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10.2 Community interview data sheet

Uganda Tilenga and EACOP Projects
Baseline chimpanzee studies
October 2017

Date:	**Time:**
Village name:	**Village GPS location**
Team:	**No. adults present** **Male:** **Female:**

1) **What is the major economic activity in this area?**

2) **What is the type of land tenure in this area?**

3) **What is the average acreage per house hold?**

4) **Are there Chimpanzees in the area?**

5) **Where do you see them?**

6) **How many times have you seen them or heard them in the last 12 months?**

7) **How many do you see?**

8) **Which months of the year do you see them?**

9) **Are there any problems as a result of having chimpanzees in this area? If yes list them.**

10) **Do they raid your crops and which ones?**

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11) How have you solved the problems in 9 and 10?

12) What would you recommend government and other organizations to do for you?

13) Other important information

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10.3 Photographs during field work.

(i) Community interview

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(ii) Chimpanzee nest (a)

(iii) Chimpanzee nest (b)

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(iv) Chimpanzee crop damage (sugar cane)

(v) Bugame Tea Plantation

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(vi) Degraded habitat near Kisiita

(vii) Road through Budongo forest reserve

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(viii) Road to Masindi after passing through Budongo forest reserve

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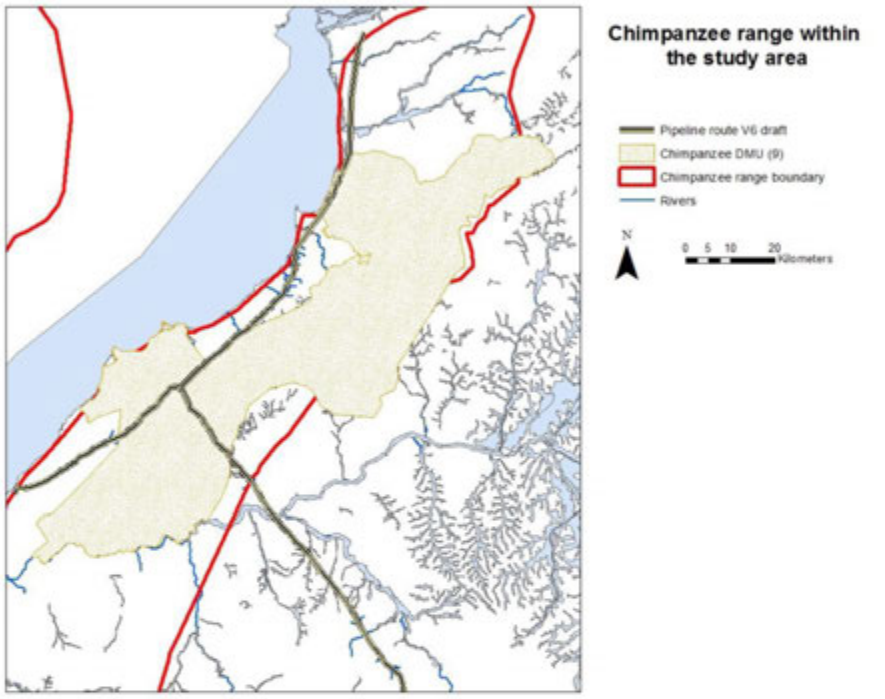
Appendix 10.4

A map of DMU 9 and the known range of chimpanzees in the study area (from the IUCN).



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Appendix A5: Geology and Soil Baseline Report

February 2020

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ATTACHMENT A5.1 FIELD SURVEY DATA 5-25

GLOSSARY AND ACRONYMS

Symbols	
°	degree symbol
>	greater than
<	less than
%	percent
A	
A horizon	surface horizon (topsoil layer) composed of mainly mineral matter with well-incorporated organic matter
acric	property of ferralsols with very low cation exchange capacity in the subsoil/B horizon
Acric Ferralsol	description of soil classification: good physical properties; poor fertility; less susceptible to erosion than most other intensely weathered tropical soil; dominated by low-activity, iron-rich clay
AOI	area of influence
Arenosol	description of soil classification: deep sandy soil, sometimes calcareous; low water and nutrient storage capacity
B	
B horizon	subsurface or originally subsurface horizon in which the original rock or parent material has been mostly or entirely altered by weathering and soil-forming processes
C	
Calcisol	description of soil classification: calcareous; mostly alluvial; colluvial and aeolian deposits; occasionally salt affected
Cambisol	description of soil classification: soil having a cambic B horizon or an umbric A horizon which is more than 25 cm thick
CEC	cation exchange capacity
CPF	central processing facility
D	
Defra	Department of Environment, Food and Rural Affairs
diagnostic horizon	soil horizon, some or all of whose properties are used for classification purposes in the FAO Soil Legend
E	
EACOP	East African Crude Oil Pipeline
ESIA	environmental and social impact assessment
F	
FAO	Food and Agriculture Organization
Ferralsol	description of soil classification: strongly weathered soil of the humid tropics with high iron and aluminium oxide contents

G	
GIS	geographical information system
graben	a block of the earth's crust lying between two faults and displaced downwards relative to the blocks on either side, as in a rift valley
H	
ha	hectare
horizon	see "soil horizon" below
I	
ISO	International Organization for Standardization
K	
KP	kilometre point
L	
Lixic Ferralsol	description of soil classification: good physical properties; poor fertility; less susceptible to erosion than most other intensely weathered tropical soil; dominated by low-activity, iron-rich clay
loam	soil that is not predominantly sand, silt or clay
M	
Mb	body-wave magnitude
meq/100 g	milliequivalents per 100 grams
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/m	millisiemens per metre
N	
NARL	National Agricultural Research Laboratories
NARO	National Agricultural Research Organisation
P	
Petric Plinthosol	description of soil classification: iron-rich soil characterised by the presence of a petroplinthic horizon
pH	power of hydrogen
ppm	parts per million
R	
RoW	right-of-way
S	
sodic	sodic soil has more sodium than most other soil and is classified in part by a poor structure and low permeability
soil horizon	layer of soil, usually approximately parallel to the soil surface, with distinct characteristics produced by soil-forming processes
SU	standard unit
T	
TPH	total petroleum hydrocarbons

U	
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA	United States Department of Agriculture
UXO	unexploded ordnance
V	
VEC	valued environmental [and social] components

A5 GEOLOGY AND SOIL BASELINE REPORT

A5.1 Introduction

This baseline report describes the geology and soil:

- area of influence (AOI) and study boundaries
- methods
- baseline conditions
  - characteristics of the soil and geology in the AOI
  - trends in condition and sensitivity to change
  - ecosystem services provided
  - sensitivity rankings
- key considerations.

Although geology is not considered a valued environmental component (VEC), geology information is included in this report because it informs the soil baseline and other aspects of the environmental and social impact assessment (ESIA).

A5.2 Area of Influence and Study Boundaries

A5.2.1 Area of Influence

The geology and soil AOIs are based on the pipeline footprint and construction and operation of:

- the 30-m pipeline right-of-way (RoW)
- construction camp and facilities
- access roads.

Aggregates are considered in the project description (see Section 2.4.2 of the ESIA) and have not been discussed in this section.

A5.2.2 Study Boundaries

The study area boundary is the 2-km pipeline corridor (Figure A5.2-1). However, in some cases, a broader region is considered to give context in respect of mining, earthquakes and landslips.

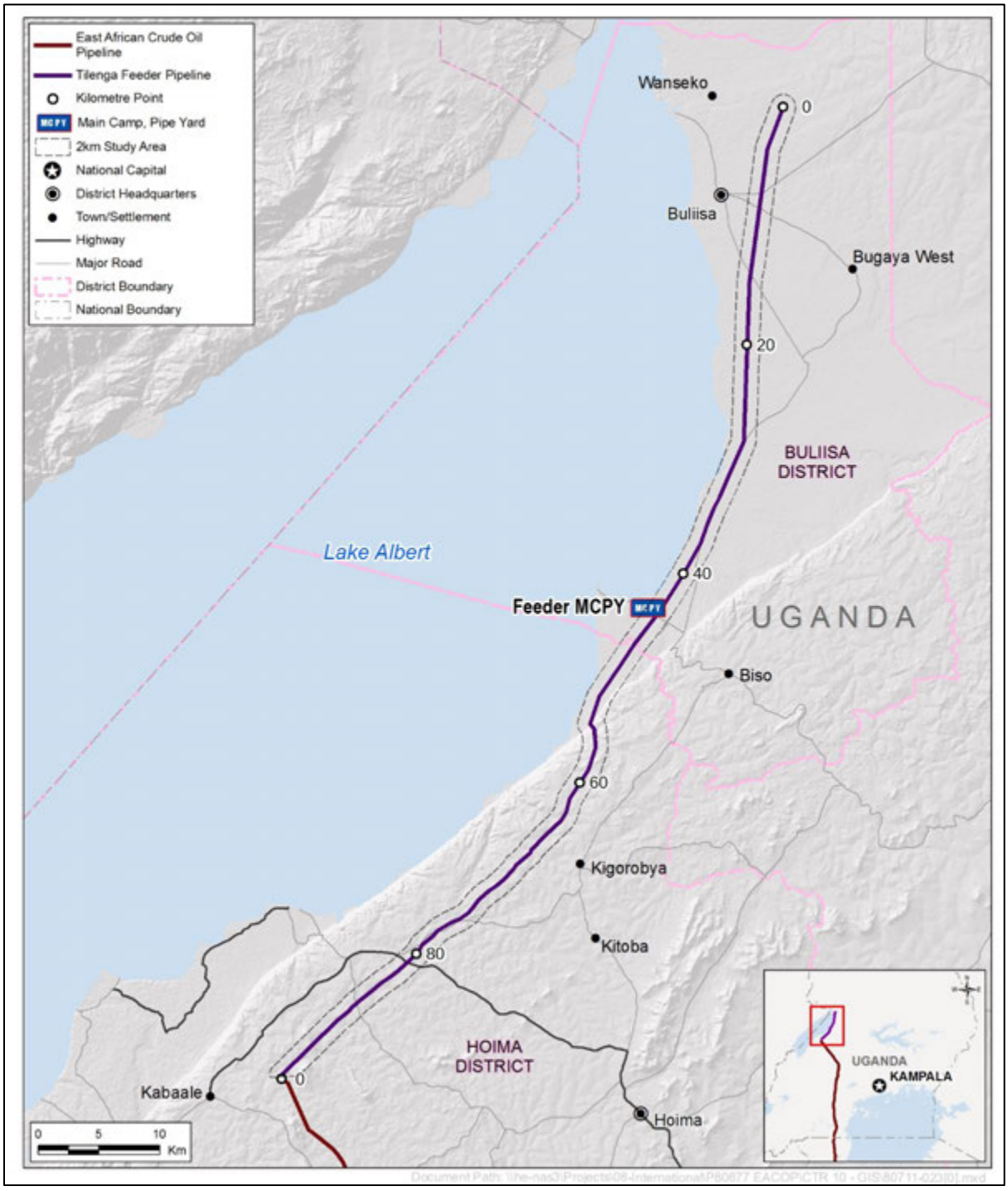

Figure A5.2-1 Study Area Boundary

A5.3 Methods

A5.3.1 Secondary Data

A5.3.1.1 Geology

A review of the following resources was undertaken to characterise the geology baseline:

- data collected during the scoping project phase (RSK–GIE initial site visit report 2017)
- data on quarrying and mining operations in the study area
- geology maps and reports
- data from the Sustainable Management of Mineral Resources Project: Geological Mapping, Geochemical Surveys and Mineral Resources Assessment in Selected Areas of Uganda (GTK Consortium 2012).

The key resources reviewed during the desktop study include:

- Explanation of the Geology of Sheet 59 (Kiboga), Report No. 7 (Geological Survey of Uganda (Johnson and Williams 1961).
- Geological Atlas of Africa with notes on stratigraphy, tectonics, economic geology, geohazards, geosites and geoscientific education of each country (Schlüter 2006)

A5.3.1.2 Soil

A review of national soil maps and reports was conducted to establish existing soil classifications, use and productivity.

The location and nature of potential sources of contamination, particularly heavy metals and hydrocarbons, were evaluated in a review of information from Internet searches. Data collected during the scoping phase of the project included those sourced from initial reconnaissance site visits along the route. Information collected during this visit was considered when developing the field survey plan.

Data from Isabirye et al. (2004) and Kaizzi (2017) were plotted in a geographical information system (GIS) to illustrate the soil types being traversed by the pipeline. Soil texture and slope derived from digital elevation data were compared to assess the risk of erosion in the study area. See Appendix G1 of the ESIA for the soil erosion risk assessment report.

For the erosion risk assessment, soil descriptions were transposed into the following classes:

- sandy, light silty soil, peaty
- medium, calcareous
- heavy.

The classes were then cross compared with the landscape gradients of the area within the study area for the following categories:

- very steep >11°
- steep 7–11°

- moderate 3–7°
- gentle 2–3°
- level ground <2°.

Using the above information, terrain within the study area was categorised to identify areas at high and very high risk of soil erosion. The categorisation was based on the risk assessment in Table A5.3-1, which was developed using the UK Department of Environment, Food and Rural affairs (Defra) manual on controlling soil erosion (Defra 2005). Although based on a UK manual, the categorisation is applicable to the soil types found in the study area.

Table A5.3-1 Erosion Risk Categories

Soil or Slope	Very Steep Slopes >11°	Steep Slopes 7–11°	Moderate Slopes 3–7°	Gentle Slopes 2–3°	Level Ground <2°
Sandy soil Light silty soil Peat soil	Very high	Very high	High Gentle	Moderate	Lower
Medium and calcareous soil	Very high	High	Moderate	Lower	Lower
Heavy soil	Very high	Lower	Lower	Lower	Lower

Sites with a very high erosion risk were screened against the proximity of downslope VECs sensitive to sediment runoff according to the ESIA sensitivity ranking (see Appendix D of the ESIA).

The key resources reviewed during the desktop study include:

- Global yield gap atlas (Kaizzi 2017)
- International soil classification system for naming soil and creating legends for soil maps (FAO 2014)
- Construction code of practice for the sustainable use of soil on construction sites (Defra 2009)
- Control of water pollution from linear construction projects. Technical guidance (CIRIA C648 2006)
- National Land Use Policy (Ministry of Lands, Housing and Urban Development 2006)
- Controlling soil erosion, A manual for the assessment and management of agricultural land at risk of water erosion in lowland England, PB4093 (Defra 2005)
- Soil resource information and linkages to agricultural production (Isabirye et al. 2004)
- Soil Map of the World (FAO-UNESCO 1988)
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is

Soil horizon A is a surface horizon (topsoil layer) composed of mainly mineral matter with well-incorporated organic matter. Soil horizon B (sodic) comprises subsurface or originally subsurface horizons in which the original rock material has been mostly or entirely obliterated by weathering. The soil profile changes with depth, which varies between locations. It was recorded at each inspection pit. Changes in soil colour, texture and structure indicate the boundary of a new horizon. A sodic soil has more sodium than most other soil and is classified in part by a poor structure and low permeability. Soil that is highly sodic will disperse in water and is prone to slaking (breakdown in aggregate size).

Bulk soil samples were obtained from the exposed profiles in each inspection pit. The samples were packed securely in cool boxes with ice packs and kept dark before being despatched with a sample chain of custody form to an ISO 17025 laboratory for analysis.

Quality control samples where obtained by duplicate sampling. These samples were submitted for testing with anonymous identifiers that would not indicate whether they were a sample blank or duplicate.

The soil analysis comprised fertility parameters to characterise the soil in terms of their nutrient levels, base status, organic matter status and ability to support crop establishment and growth; and contamination parameters to characterise the level of heavy metal and hydrocarbon contamination from a soil, plant, animal and human health perspective.

The analysis parameters comprised:

- fertility: soil particle size, pH, electrical conductivity, phosphorus, potassium, magnesium, cation exchange capacity (CEC), exchangeable bases and total organic matter
- contamination: arsenic, cadmium, hexavalent chromium, lead, manganese, mercury, nickel, selenium, copper, zinc, molybdenum and total petroleum hydrocarbons (TPH).

Where a sodic B horizon was suspected from the soil profile description or the land management practices (for example, overirrigation), soil samples from the B horizon were collected and tested for cation exchange capacity and exchangeable bases.

Table A5.3-3 shows the sample analysis suites.

Table A5.3-3 Sample Analysis: Samples SU001–SU006

Soil Sample Identifier	Approximate KP	Fertility Analysis (No. of Samples) (Soil A Horizon)	Contamination Analysis (No. of Samples) (Soil A Horizon)	B Horizon Analysis (Soil B Horizon)
SU001	0 (CPF)	1	1	–
SU002	20	1	1	–
SU003	40	1	1	–
SU004	60	1	1	–

Table A5.3-3 Sample Analysis: Samples SU001–SU006

Soil Sample Identifier	Approximate KP	Fertility Analysis (No. of Samples) (Soil A Horizon)	Contamination Analysis (No. of Samples) (Soil A Horizon)	B Horizon Analysis (Soil B Horizon)
SU005	80	1	1	–
SU006	95 (PS1)	1	1	–

A5.3.4 Data Considerations

While denser field survey sample spacing may have contributed to a more-detailed soil type classification, the data collected are considered sufficient to describe baseline soil conditions in the study area.

In addition to the field survey, Isabirye et al. (2004) and Kaizzi (2017) were also used to map soil resources within the AOI. The soil type classifications resulting from the Tilenga feeder pipeline baseline soil survey did not always correspond with the mapped soil type reported in Isabirye et al. (2004) and Kaizzi (2017). Isabirye et al. (2004) and Kaizzi (2017) provide consistent and comparable soil data and information in the AOI and broader region, whereas the field survey provides point data relevant only to the sampling location. Soil profile data in Isabirye et al. (2004) and Kaizzi (2017) may sometimes be incomplete, which explains the inconsistencies with the field survey classifications. Where inconsistencies exist at individual sample sites, the field survey data have been given preference.

The FAO classification (FAO 2014) uses both topsoil and subsoil diagnostic properties to determine broad soil types. As topsoil physicochemical properties are more important than subsoil properties in determining soil fertility and erodibility (susceptibility to erosion), the focus of the soil survey was on topsoil sampling and analysis. Furthermore, FAO soil type can be determined from topsoil and subsoil morphology without detailed laboratory analysis of subsoil material.

The erosion risk assessment used GIS mapping based on data from Isabirye et al. (2004) and Kaizzi (2017). In a more-detailed assessment, professional judgement would be used to assess each site in situ. However, the GIS mapping assessment of soil erosion is considered to be sufficient for the purposes of this baseline study. Detailed data considerations relating to the erosion risk assessment are presented in Appendix G1 of the ESIA.

A5.4 Baseline Conditions

A5.4.1 Baseline Condition of Geology and Soil

A5.4.1.1 Geology – Secondary Information

In Uganda, Precambrian crystalline rock, including gneiss and granite, constitutes approximately 90% of the land area. The remaining rock types are mostly younger volcanic and sedimentary rocks. The regolith covering the crystalline rock is

weathered material that varies from rock fragments near the bedrock interface to well-weathered soil and hardened laterite at the surface. This regolith layer varies in thickness, but averages approximately 30 m (British Geological Survey 2001).

The Tilenga feeder pipeline traverses Cenozoic alluvial and rift sediments (approximately KP0–KP55) and Precambrian gneiss and granite complexes (approximately KP55–KP95) (Geological Survey of Uganda 1961; Schlüter 2006).

Figure A5.4-1 presents the general geology along the pipeline route.

Seismicity and Earthquakes

Earthquakes in Uganda are associated with the East African Rift system (UNESCO 2013). Uganda lies between two parts of the system; an eastern branch and a more seismically active western branch, neither of which is traversed by the proposed Tilenga feeder pipeline. The western branch mostly overlaps the eastern border of the Democratic Republic of the Congo; the eastern branch traverses from southern Tanzania to northern Kenya.

Other tectonic features that influence earthquake occurrences in Uganda include the:

- Rwenzori Mountains: Tectonic movements cause stress accumulation that is released along the border and boundary faults of the mountains. The faults include Nyamwamba, Kicwamba, Bwamba, Kitimbi–Semuliki, Ruimi–Wasa and Bunyoro–Toro.
- Katonga fault: This fault starts in the foothills of the Ruwenzori Mountains, traverses Lake Victoria and connects to the Winam Gulf in western Kenya and the Speke Gulf south of Lake Victoria in Tanzania.
- Aswa Shear Zone: The shear zone is observed in Uganda from Nimule at the Uganda–Sudan border to where it joins Mount Elgon on the eastern border with Kenya.

This tectonic setting makes Uganda earthquake prone; the country had major earthquakes on:

- 2 October 1929 in the Toro region of western Uganda, which measured 5.9 on the Richter scale and triggered landslides
- 18 March 1945 in the Sembabule–Masaka region, which measured 6.0 on the Richter scale, killed five people and destroyed buildings in Masaka town
- 20 March 1966 in the Toro region in western Uganda, which measured 6.6 on the Richter scale, killed 150 people, injured a further 1300 and caused economic losses estimated at $1 million (USD)
- 7 September 1990 in the Lake Victoria region (epicentre at Nakiwogo on the lakeshore), which measured 5.0 on the Richter scale and destroyed semipermanent buildings around the Nakiwogo landing site
- 9 October 1991 in the Lake Albert area (epicentre around Butiaba), which measured 5.3 on the Richter scale and destroyed semipermanent buildings in and around Butiaba
- 5 February 1994 in Kisomore (Kabarole district), which measured 6.2 on the Richter scale, killed eight people and destroyed property estimated at $61 million (USD)

- 10 September 2016 in Bukoba, Tanzania, which measured 5.9 on the Richter scale and was felt in Uganda.

Figure A5.4-1 shows the presence of major faults in areas crossed by the pipeline. The Tilenga feeder pipeline traverses a major fault with a scarp that bounds the south-east of the Albertine graben at approximately about KP55. The figure also shows historical earthquakes in the region, including their approximate magnitude.

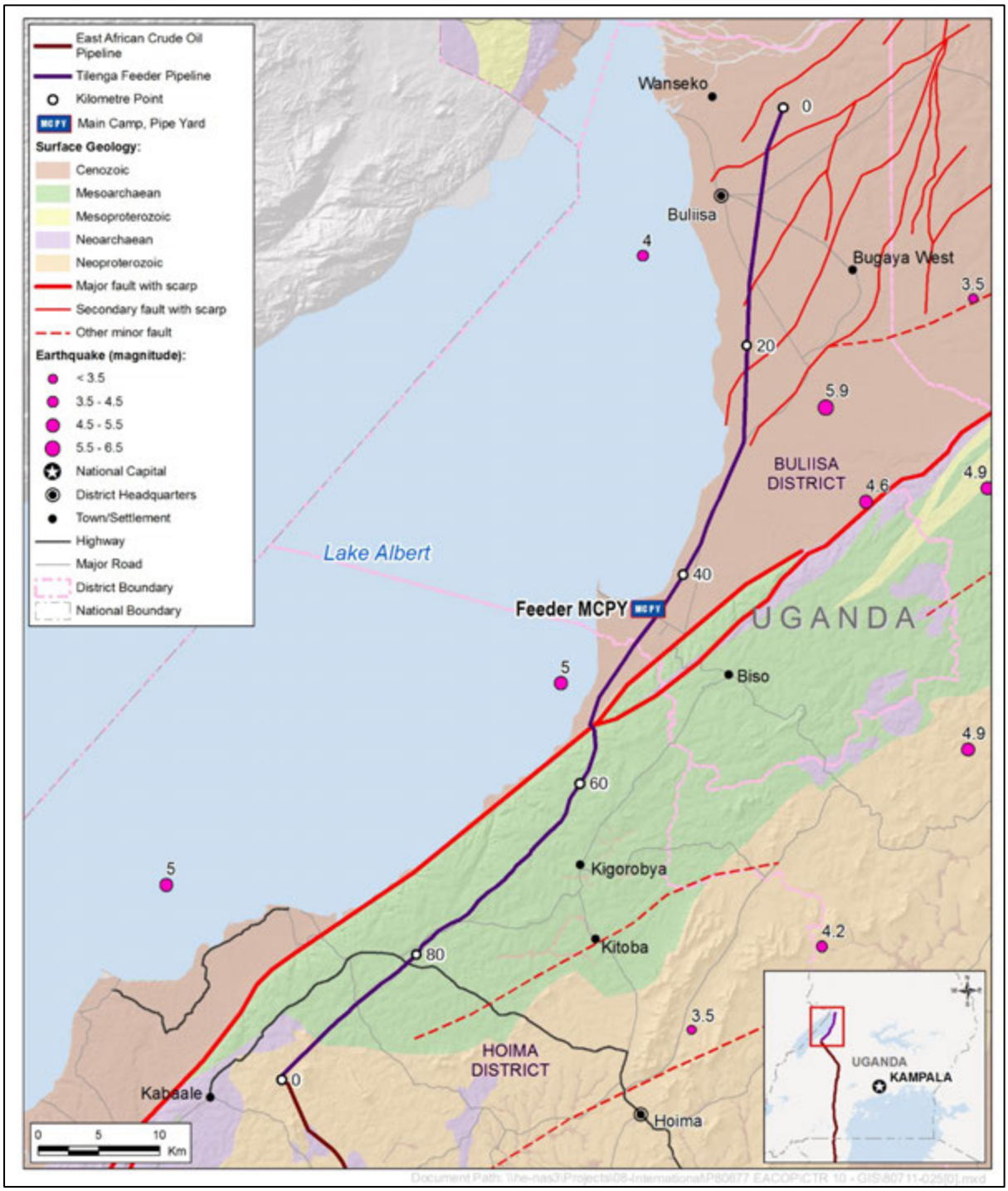

Figure A5.4-1 Geology

SOURCE: GTK Consortium (2012)

Landslides and Sinkholes

A review of secondary data did not identify any landslides or sinkholes within the AOI and across the broader region at the time of writing. However, the Tilenga feeder pipeline traverses a scarp at approximately KP55, which is more likely to be prone to erosion and landslides.

Mining and Quarrying

A review of secondary data indicates that there may be existing mining and quarrying operations inside the AOI and broader region; no further information is available at the time of writing.

Artisanal and small-scale mining, including unlicensed mining, is described in the Socio-economic and Health Baseline Report (Appendix A9).

A5.4.1.2 Soil

Soil types within the AOI and broader region are shown in Figure A5.4-2. Table A5.4-1 and Attachment A5.1 present the soil classifications identified during the field survey.

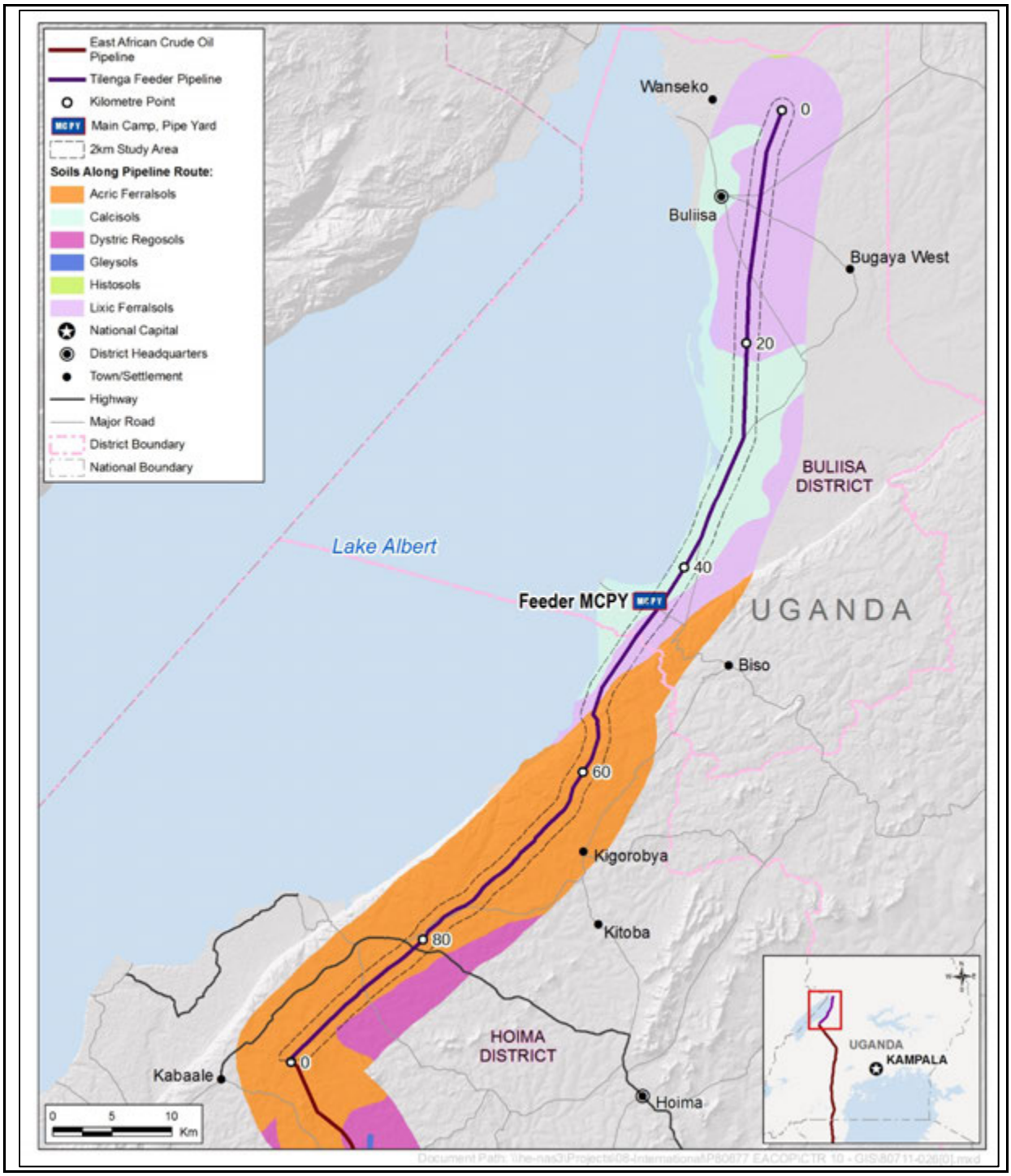

Figure A5.4-2 Soil Types

SOURCE: Isabirye et al. (2004); Kaizzi (2017)

Table A5.4-1 Sampling Point Soil Classifications

Sample Number	Sampling Point (Approximate KP)	Topsoil Depth (cm)	Field Description	Classification (FAO 2014)	Textural Classification (USDA 2017)
SU001	0	20	Topsoil: dark greyish brown sandy horizon Subsoil: brown sandy horizon	Arenosol	Loamy sand
SU002	20	30	Topsoil: very dark grey loamy sand with subangular blocky structure Subsoil: brown sandy clay horizon	NA	Sandy loam
SU003	40	20	Topsoil: dark brown loamy sand horizon Subsoil: brown sandy loam horizon	Ferralsol	Sandy clay loam
SU004	60	30	Topsoil: very dark grey sandy clay loam Subsoil: yellowish red sandy clay horizon	NA	Sandy clay
SU005	80	30	Topsoil: black sandy clay loam horizon Subsoil: dark brown sandy clay loam horizon	Cambisol	Clay loam
SU006	95 (PS1)	15	All three horizons had dark reddish brown soil with distinct indurations in the lower two horizons	Petric Plinthosol	Clay

SOURCE: FAO 2014; USDA 2017

NOTE: NA = data not available.

The soil texture along the pipeline ranged from clay loam to loamy sand. No potential sodic B horizons were observed during the field survey. Figure A5.4-3 presents soil profiles showing some of the representative soil types along the pipeline route.

Soil profile at approximately KP0 (CPF). Soil classification (FAO 2014): Arenosol. Textural soil classification (USDA 2017): loamy sand	Soil profile at approximately KP40. Soil classification (FAO 2014): Ferralsol. Textural soil classification (USDA 2017): sandy clay loam
Soil profile at approximately KP80. Soil classification (FAO 2014): Cambisol. Textural soil classification (USDA 2017): clay loam	Soil profile at approximately KP0 EACOP (PS1). Soil classification (FAO 2014): Petric Plinthosol. Textural soil classification (USDA 2017): clay

Figure A5.4-3 Soil Profile

Soil Structure

Soil texture, a measurement of the relative content of sand, silt and clay particles, has been shown to vary along the length of the AOI (see Table A5.4-1). However, soil types with a high sand content, i.e., sandy clay loam and sandy loam, were

found to be present along most of the route and were identified at 50% of the sample locations.

Soil containing high proportions of sands have been shown to be less vulnerable to dust and silt generation. However, soil with a low sand content was also identified at two of the sample locations (KP80 and KP95). Further, the potential for dust generation is also greatly influenced by the moisture content of the soil. It is likely that many sections of the route will be prone to dust generation during the dry season, when moisture content will typically be low.

Sandy soil tends to have a relatively low bulk density owing to its larger particle size, so will be less sensitive to compaction and will potentially have higher permeability. Soil comprising primarily silt and clay, for example, KP60 and KP95, has a higher bulk density, so will be more sensitive to compaction and potentially less permeable. Silty clay soil also has poor trafficability when wet.

The topsoil depth within the study area was found to range from 15 to 30 cm, although for most of the route the depth was 20–30 cm (Table A5.4-1). Thin topsoil (<5 cm) was not encountered during the field survey, although it is likely that such soil may be present along the route, particularly in areas of steep slopes or where shallow soil is developed on exposed bedrock. Soil horizons were typically found to be well delineated.

Soil Productivity and Nutrient Content

The soil between KP0 and KP53.9 is characterised as low in productivity, with some areas not used for agriculture. The soil between KP53.9 and KP94.4 is more productive (low–medium) and the land is predominantly used for growing crops, specifically maize and coffee (Kaizzi 2017). Soil types and characteristics along the Tilenga feeder pipeline have been outlined in Table A5.4-2.

Table A5.4-2 Soil Types and Characteristics

KP (km)	FAO Classification	Description	Land Use	Productivity	Drainage
0–21.3	Lixic Ferralsol	Reddish-brown sandy loam with occasional ironstone Kaiso sand and clay parent rock	Cotton, cassava, grazing	Low	Well drained
21.3–44.3	Calcisol	Black clay and sand Recent lake and river alluvium parent material	None	Low	Well drained
44.3–53.9	Lixic Ferralsol	Reddish-brown sandy loam with occasional ironstone Kaiso sand and clay parent material	Grazing	Low	Well drained

Table A5.4-2 Soil Types and Characteristics

KP (km)	FAO Classification	Description	Land Use	Productivity	Drainage
53.9–77	Acric Ferralsol	Shallow dark brown or black sandy loam, often very stony Granite, gneiss, schist, amphibolite parent rock	Occasional coffee, maize	Low to medium	Well drained
77–93.1; 94.4–95.1	Acric Ferralsol	Reddish and reddish brown gritty clay loam Basement complex granite and gneiss and schist parent rock	Arabica coffee, maize	Low to medium	Well drained
93.1–94.4	Acric Ferralsol	Dark red clay loam. occasionally lateritised Karagwe– Ankolean phyllite parent rock	Coffee, maize	Medium to high	Well drained

SOURCE: National Agricultural Research Laboratories (NARL), and Global yield gap atlas (Kaizzi 2017) and Ministry of Lands, Housing and Urban Development (2006)

The electrical conductivity of the samples ranged from 3.8 to 17.5 µS/m and averaged 8.3 µS/m; this would be considered low to moderate. Sample SU005 (KP80) had the highest electrical conductivity at 17.5 µS/m. The cation exchange capacity (CEC) of this sample was 26.2 meq/100 g soil and it had a moderate amount of organic matter (4.6%). However, it was nutrient poor, with low levels of phosphorous, magnesium and potassium. This dark soil was described by the surveyors as in a transitional phase owing to material having been deposited from the nearby slopes.

All the other samples contained very low levels of extractable nutrients and had a low organic matter content.

Phosphorus, potassium, and magnesium are macronutrients required by plants for basic biological functions such as growth, photosynthesis and respiration (Singh and Schulze 2015). Deficiencies can negatively affect vegetative growth and yield, and result in increased mortality rates.

The soil types identified along the pipeline route were Lixic Ferralsols, Acric Ferralsols and Calcisols (Table A5.4-2 and glossary). Soil pH ranged from 6.4 to 7.2, which indicates that most of the profiles were within the slightly acidic to moderately alkaline range, so have good agricultural production potential. Most of the topsoil had low to medium organic matter content and high base status, which indicates that soil could be productive if well managed. Most of the soil had low to very low extractable phosphorus levels.

The results of the soil laboratory tests for parameters potentially indicative of fertility are presented in Table A5.4-3.

Table A5.4-3 Results of Fertility Suite Analysis: Samples SU001–SU006

Parameter	Limit of Detection	Units	Sample Number					
			SU001	SU002	SU003	SU004	SU005	SU006
Soil Particle Size (Sand)	–	% separates	84.00	66.00	66.00	46.00	44.00	34.00
Soil Particle Size (Silt)	–	% separates	7.00	19.00	13.00	13.00	22.00	24.00
Soil Particle Size (Clay)	–	% separates	9.00	15.00	21.00	41.00	34.00	42.00
pH	–	–	6.7	7.0	6.4	6.7	7.2	6.7
Electrical Conductivity	–	mS/m	4.30	4.90	3.80	11.00	17.46	11.36
Phosphorus	–	ppm	1.50	2.50	1.50	1.50	1.80	1.50
Potassium	0.002	mg/kg	0.27	0.16	0.38	0.52	0.20	0.10
Magnesium	0.001	mg/kg	2.00	1.80	1.20	8.60	24.04	12.99
CEC	–	meq/ 100 g soil	4.10	5.30	6.20	10.10	26.18	16.12
Exchangeable Base (Magnesium)	–	meq/ 100 g soil	0.32	0.65	0.80	1.30	3.46	2.15
Exchangeable Base (Calcium)	–	meq/ 100 g soil	1.80	3.70	4.60	7.10	19.60	12.21
Total Organic Matter	–	%	0.69	1.24	1.75	3.47	4.56	5.18

Soil Erosion Risk

Soil erosion risk was categorised in the erosion risk assessment; the full document can be found in Appendix G1 of the ESIA.

The landscape along the route is dominated by gentle slopes and light to medium textured soil with a low to moderate erosion risk. However, there are several areas with a high to very high erosion risk where the slopes are steeper and the soil is less heavy. The variability of soil erosion risk reflects the change in soil type and slopes.

Soil along the pipeline route that has been identified as having a very high erosion risk (KP54.25–55.5 and KP91.5) has been included in the sensitivity tables (see Section A5.4.4).

Soil Quality

The results of the soil laboratory tests for parameters potentially indicative of:

- fertility are given in Table A5.4-3

- contamination are given in Table A5.4-4.

Six samples were analysed for parameters indicative of fertility or contamination.

Potential Sodic B Horizons

A sodic B horizon is a subsoil layer in which sodium occupies greater than 15% of the exchange complex (i.e., the exchangeable sodium content is greater than 15% of the cation exchange capacity; by definition, therefore, the combined exchangeable calcium and magnesium content would be less than 85% of the CEC). Soil with a high exchangeable sodium content is associated with adverse physical conditions such as slumping or compaction and deflocculation of clay particles, which makes them more susceptible to erosion. Potential sodic B horizons were not observed during the field survey.

Soil Contamination

The results of the soil laboratory tests for parameters potentially indicative of contamination are presented in Table A5.4-4.

The results of the laboratory analysis:

- copper was detected in two samples at a maximum of 0.12 mg/kg
- manganese was detected in six samples at a minimum of 0.06 mg/kg and a maximum of 0.40 mg/kg
- zinc was detected in three samples at a maximum of 0.30 mg/kg.

The above values are within the range of natural background levels typical for soil in Uganda. No arsenic, cadmium, hexavalent chromium, lead, mercury, molybdenum, nickel, selenium or TPH were detected in the samples, which indicates no contamination at the sampling locations.

The study area traverses land used primarily for grazing and agriculture. At the time of writing, there is no evidence of existing sources of potentially significant contamination such as industrial or commercial centres or heavily populated urban areas within the study area.

Oil seeps, where hydrocarbons naturally escape to the Earth's surface, have been identified in several locations in the Albertine graben (Patton et al. 1995; Cassie et al. 2006; Lirong et al. 2006). Although the extent of the seeps is uncertain, at least eight "low-confidence" seeps are known to occur in Lake Albert (Cassie et al. 2006). The nearest recorded oil seep (Runga-1) is approximately 300 m outside the study area (Petroleum Authority of Uganda 2017). Although oil seeps have not been observed within the study area boundary, it is possible they may exist or that hydrocarbons from seeps outside the boundary have migrated laterally to within the boundary.

A military artillery test area is known to have existed within close to the Tilenga feeder pipeline soil study area, so it is possible that unexploded ordnance (UXO) could occur in the study area. The Ugandan authorities will undertake a survey to assess the UXO risk in the study area.

Table A5.4-4 Results of Contamination Suite Analysis: Samples SU001–SU006

Parameter	Limit of Detection	Units	Sample Number					
			SU001	SU002	SU003	SU004	SU005	SU006
Arsenic	0.001	mg/kg	ND	ND	ND	ND	ND	ND
Cadmium	0.001	mg/kg	ND	ND	ND	ND	ND	ND
Hexavalent Chromium	0.003	mg/kg	ND	ND	ND	ND	ND	ND
Lead	0.005	mg/kg	ND	ND	ND	ND	ND	ND
Manganese	0.001	mg/kg	0.25	0.10	0.17	0.06	0.40	0.32
Mercury	0.001	mg/kg	ND	ND	ND	ND	ND	ND
Nickel	0.004	mg/kg	ND	ND	ND	ND	ND	ND
Selenium	0.001	mg/kg	ND	ND	ND	ND	ND	ND
Copper	0.001	mg/kg	ND	ND	ND	ND	0.12	0.08
Zinc	0.001	mg/kg	ND	0.10	ND	ND	0.26	0.30
Molybdenum	0.003	mg/kg	ND	ND	ND	ND	ND	ND
TPH	1.0	mg/kg	ND	ND	ND	ND	ND	ND

NOTE: ND = not detected

A5.4.2 Trend in Condition and Sensitivity to Change

The soil types within the study area are of reasonable agricultural quality but are vulnerable to differing pressures. External physical (for example, vehicle movements) or chemical (for example, fertiliser use) pressures may reduce the soil quality as result of nutrient loss, compaction, erosion and/or contamination. Within this area of Uganda, there has been long-term drought and flooding and heavy rainfall at different times. Some areas have experienced both drought and flooding during the same year (see climate baseline, Appendix A12). Drought and flooding may exacerbate weathering, make soil more prone to erosion and cause the loss of nutrients and organic matter.

Current and future agricultural activities and practices are also likely to affect the soil within the study area. Animals and machinery can diminish protective plant cover and cause soil structural damage and erosion., Fertiliser is now required to improve soil fertility in many areas. If used incorrectly, fertiliser can cause diffuse and point-source pollution to surface and groundwater. In addition, there is increasing evidence of severe soil degradation caused by erosion resulting from mining or deforestation in Uganda (Lufafa et al. 2003).

Stakeholders engaged as part of the Tilenga feeder pipeline social baseline surveys have commented that much of their land is less fertile and productive than it has been in the past. Continuing use of the land within the study area for agriculture and grazing is likely to result in continuing deterioration in soil quality.

A5.4.3 Ecosystem Services Provided

The soil in the AOI and their associated micro-organisms provide a range of ecosystem services.

Provisioning services:

- quarrying operations for rock and construction aggregate materials.

Regulating services:

- soil quality regulation, nutrient cycling, carbon storage and water storage and flow control.

A5.4.4 Sensitivity Rankings

A5.4.4.1 Fertility

Table A5.4-5 summarises the sensitivity ranking for soil fertility based on the sensitivity table in Appendix D. The fertility sensitivity scores are based on soil descriptions in the World Reference Base for Soil Resources (WRB) (FAO 2014) and the data from Isabirye et al. (2004) and Kaizzi (2017). A location-specific ranking based on the soil classification information collected during the field survey is also provided. This was supported by data gathered by the soil field surveys.

Table A5.4-5 Soil Fertility Sensitivity Ranking

Fertility (KP Ranges)	Sensitivity Ranking	Rationale for Ranking
6 locations	Very low (1)	No ecosystem or agricultural value
1 location	Low (2)	Soil with low agricultural productivity
2 locations	Moderate (3)	Soil with moderate agricultural value. May take up to three years to fully recover
1 location	High (4)	Soil with high agricultural productivity. May take three to six years to fully recover
None recorded but may occur locally	Very high (5)	Soil with very high agricultural productivity or ecosystem value

A5.4.4.2 Compaction

Table A5.4-6 summarises the sensitivity ranking for soil compaction based on the sensitivity table in Appendix D. The compaction sensitivity scores are based on soil descriptions in the World Reference Base for Soil Resources (WRB) (FAO 2014) and the data from Isabirye et al. (2004) and Kaizzi (2017).

Table A5.4-6 Soil Compaction Sensitivity Ranking

Compaction (KP Ranges)	Sensitivity Ranking	Rationale for Ranking
None recorded but may be found to occur locally	Very low (1)	Not susceptible to erosion or compaction
1 location	Low (2)	Soil will respond well to restoration techniques to mitigate compaction
1 location	Moderate (3)	Soil will usually respond moderately well to restoration techniques to mitigate compaction. May take up to three years to fully recover
None recorded but may occur locally	High (4)	Soil that may need more intensive restoration techniques to mitigate compaction. May take three to six years to fully recover
None recorded but occur locally	Very high (5)	Soil that may be difficult to restore to its former condition

A5.4.4.3 Erosion

Table A5.4-7 summarises KP ranges for soil with sensitivity rankings of very high risk for erosion. The erosion risk assessment focuses on areas of very high sensitivity rankings only due to high potential for erosion to occur in these locations. The erosion sensitivity scores are in the erosion risk assessment (Appendix G1 of the ESIA).

Table A5.4-7 Soil Erosion Sensitivity Ranking

KP Ranges	VEC	Sensitivity Ranking	Rationale for Ranking
2 locations	Soil	Very high (5)	Soil at very high risk of erosion, according to soil type and slope

A5.4.4.4 Soil Contamination

Throughout the length of the study area, the value of the soil varies. However, contamination was not identified at any of the locations in the study area and, owing to the predominantly rural nature of the study area, contamination is unlikely to exist. Therefore, soil is considered to have a moderate sensitivity to contamination.

UXO may exist in certain areas within the study area, although the risk of UXO being encountered is considered low.

A5.5 Key Considerations

Soil sensitivity rankings range from very low to very high, depending on the soil type; there is considerable variation along the entire length of the AOI.

Soil is recognised as providing both regulating ecosystem services (for example, erosion regulation and soil quality regulation) and provisioning ecosystems services (e.g. aggregate for construction).

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ATTACHMENT A5.1 FIELD SURVEY DATA

Survey Methodology

The following methods were used at all the sampling sites:

- An accessible route was identified and GPS was used to navigate to the predetermined sampling location, or as close as practicably possible. Geological units and vegetation cover types (e.g., eroded and non-eroded land) were used as a guide when choosing pit and profile sites. A typical site was selected on the whole land unit and at least 5 m away from large trees or termite mounts, with the least-disturbed or contaminated area.
- A soil profile pit was excavated at each identified location to a depth of 80–100 cm where possible, or to a depth where the bedrock was encountered. Once excavated, the profile was examined and the main horizons identified.
- The dimension of the pits was approximately 0.5 m wide × 1.2 m long × 1.0 m deep. Where pits were dug on sloping ground, the long axis of pit was orientated down slope. The dominant slope was measured with a clinometer.
- During pit excavation, the topsoil and subsoil were kept separate. The sampling face of the pit was cleared of roots, spills and any spade marks
- Sampling horizon boundaries (including topsoil and subsoil) were marked on the sampling face. A graduation tape (marked at 10 cm intervals) was placed on the face, with pit identification label, before the soil profile was photographed.
- The soil profile was described to 80 cm depth or to a bedrock contact if the latter was encountered above this depth.
- At each site, the description of the soil profile (and soil horizons) was documented in terms of soil texture, colour, mottling, presence and colour of nodules and stoniness using a field reporting template (Brief Soil Profile Description sheet). Once the soil profile had been described, the profile soils were provisionally classified using the FAO (2014) systems.

Soil sampling was undertaken once the soil profile had been documented. Sampling methodology was in accordance with guidelines listed on the Brief Soil Profile Description sheet template and provisional classification in the FAO (2014) systems

Samples were securely packed in cool boxes with ice packs and stored in the dark before being dispatched to the laboratory with a sample chain of custody form. The samples were sent to SGS, an internationally accredited laboratory in Mwanza, Tanzania. In Tanzania, the SGS holds ISO 17025 laboratory accreditation from the South African National Accreditation System.

Samples were submitted to SGS for the following analysis suites:

- soil fertility (A horizon). Six samples were submitted for analysis.
- potential contamination (A horizon). Six samples were submitted for analysis.

Table Att5.1-1 Field Descriptions of Soil Types along the Pipeline Route

Soil Sample Identifier	Kilometre Point (KP)	Brief Description of Soil Type and Field Classification (FAO 2014)
SU001	KP0	Dark greyish brown (10YR 4/2) sandy horizon from 0–20 cm over brown (7.5YR 4/4) sandy horizon between 20 and beyond 100 cm depth. The soil structure was single grains in both horizons. The major soil diagnostic property was arenic, which is typical of Arenosol.
SU002	KP20	Very dark grey (7.5YR 3/1) loamy sand within 0–30 cm with subangular blocky structure over brown (7.5YR 4/2) heavily compacted sandy clay horizon with lumbs between 30 and more than 60 cm depth
SU003	KP40	Dark brown (7.5YR 3/2) 0–20 cm loamy sand horizon sitting on brown (7.5YR 4/4) sandy loam horizon. The structure in all the horizons was subangular blocky. Field classification is Ferralsol.
SU004	KP60	Very dark grey (7.5YR 3/1) sandy clay loam from 0–30 cm over yellowish red (5YR 4/6) sandy clay horizon between 30 to over 70 cm depth. All the horizons had a subangular blocky structure. Some cracks showed that there was some 2:1 clay. Probable vertic properties owing to presence of cracks on the soil surface but the cracks were not very pronounced as in typical Vertisol.
SU005	KP80	Black (7.5YR 2.5/1) sandy clay loam horizon from 0–30 cm sitting over dark brown (7.5YR 3/2) sandy clay loam horizon from 30 and beyond 80 cm depth with subangular blocky structure. The soil is within the transition stage. It is within the deposition position because of the materials brought from the upper slope. This soil would best be classified as a Cambisol undifferentiated horizon owing to the continuous addition of new materials.
SU006	KP0 (EACOP)	All the three horizons, topsoil within 0–15 cm and subsoil 15–35 cm and 35–65 cm, had dark reddish brown (5YR 2.5/2) with distinct indurations in the lower two horizons (plinthic material). Granular structure in the A and B2 horizons and subangular blocky structure in the B1 horizon. Soil displays typical characteristic of Petric Plinthosol.

Appendix A6: Surface Water Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

Symbols	
%	percent
A	cross-section area of flow in a channel (m^2)
AREA	drainage basin area (km^2) (a parameter used to calculate the mean annual flood)
DAMBO	(dimensionless) proportion of the drainage basin covered by wetland (a parameter used to calculate the mean annual flood)
g	acceleration due to gravity (9.81 m/s^2)
MAF	mean annual flood. The mean annual flood has a theoretical statistical return period of 2.3 years.
MAR	mean annual rainfall (mm). (a parameter used to calculate the mean annual flood)
n	roughness factor in the Manning uniform flow equation
P	wetted perimeter of a channel (m)
Q	discharge (m^3/s)
Q_T	peak flood flow with an estimated return period of T years
R	hydraulic radius (m), calculated as the ratio A/P
S1085	slope of the catchment between the 10th and 85th percentiles of the main stream length (m/km). (a parameter used to calculate the mean annual flood)
S_b	channel bed slope (m/m).
S_e	energy slope in a channel (m/m). S_e approximated by the channel bed slope (S_b)
SFREQ	stream frequency calculated as the number of stream junctions on a 1:50,000 scale map divided by AREA (a parameter used to calculate the mean annual flood)
ρ	fluid (water) density (1000 kg/m^3)
Ω	stream power per unit channel length (W/m)
Units	
°C	degrees centigrade
µS/cm	micro-Siemens per centimetre
kg	kilogramme
km	kilometre
km^2	square kilometre
L	litre
m	metre
m^3/s	cubic metre per second
masl	metres above sea level

mg	milligram
mg/L	milligram per litre
µg/L	microgram per litre (1000 µg/L = 1 mg/L)
mL	millilitre (1000 mL = 1 L)
mm	millimetre
NTU	nephelometric turbidity unit
s	second
W	watt
A	
AOI	area of influence
APHA	American Public Health Association
Aquaread	trademark multiparameter water quality probe
B	
bankfull discharge, level, width	discharge, water level or width of a river whose flow is just contained within the banks
BCPF	Buliisa Central Processing Facility
BOD	biochemical oxygen demand
BS	British Standard
C	
CFU	colony forming units (bacteria)
channel planform	shape of the course of a watercourse when viewed from above. For example, the planform of a watercourse may be straight, sinuous, meandering or braided (division of a channel into two or more anastomosing, or intertwining, channels).
CPF	central processing facility
COD	chemical oxygen demand
D	
DIN	German Institute for Standardisation
DO	dissolved oxygen (mg/L or % saturation)
drainage basin	an area of land that drains under gravity to a location on a watercourse. The terms “catchment” and “watershed” have the same meaning.
DWRM	Directorate of Water Resources Management under the Ministry of Water and Environment, Uganda
E	
EACOP	East African Crude Oil Pipeline
EC	electrical conductivity (µS/cm)
ERU	existing road upgrade
ESIA	environmental and social impact assessment

G	
gauged watercourse	a watercourse on which a river gauging station is located. A river gauging station is a location where flow and water quality are monitored by hydrologists and environmental scientists.
I	
ISO	International Organization for Standardization
K	
KP	kilometre point
L	
LIDAR	light detection and ranging: an airborne or satellite borne detection system that works on the principle of radar, but uses light from a laser and is used to map topography
M	
MEMD	Ministry of Energy and Mineral Development, Uganda
MCPY	main camp and pipe yard
MWE	Ministry of Water and Environment, Uganda
N	
NEMA	National Environment Management Authority, Uganda
P	
PAH	polycyclic aromatic hydrocarbon
pH	measure of the acidity or alkalinity of a liquid
R	
return period	average number of years in the long term between hydrometeorological events of a similar magnitude
S	
SGS	African Assay Laboratories Ltd, in Mwanza, Tanzania
SWS	Schlumberger Water Services
T	
TEPU	Total E&P Uganda
TDS	total dissolved solids (mg/L)
TPH	total petroleum hydrocarbons (mg/L)
TSS	total suspended solids (mg/L)
turbidity	measure of the amount of cloudiness in water (NTU)
V	
VEC	valued environmental and social component
W	
WGS84 TM35E_S	World Geodetic System 1984 Transverse Mercator zone 35 East-South (the EACOP project map projection)

A6 SURFACE WATER BASELINE REPORT

A6.1 Introduction

This baseline report describes the surface water:

- area of influence (AOI) and study area boundaries
- methods
- baseline conditions:
  - trends in condition and sensitivity to change
  - ecosystem services
  - sensitivity rankings
- key considerations.

A water source study is being conducted concurrently with this environmental and social impact assessment (ESIA). Information obtained by the water source study has been used to inform the surface water baseline and impact assessment. The water source study objective is to investigate and develop:

- water resources to supply construction facilities, pipeline construction and hydrostatic pressure testing (hydrotesting) of the constructed pipeline
- a strategy for using surface water as a potential source of supply for hydrotesting.

Lake Albert has been identified as a potential source of hydrotest water but has not been included in surface water surveys or investigations at the time of writing.

Baseline surface water investigations for supplying hydrotest water, including Lake Albert if it is confirmed that lake water will be used for the hydrostatic test, will be included in the water use permit application to the Department for Water Resources Management (DWRM) with jurisdiction for water abstractions.

Surface water may occur as permanent or ephemeral watercourses (channels and floodplains), wetlands and waterbodies. The term “ephemeral” is used for those watercourses with seasonal flow and those with flow just following rainfall.

A6.2 Area of Influence and Study Area Boundaries

A6.2.1 Area of Influence Boundary

The AOI for the construction phase includes:

- the project footprint at the location where the pipeline or access road crosses a watercourse or waterbody
- waterbodies downstream of the crossing point, including Lake Albert.

The spatial AOI for construction varies from 2–5 km downstream of the pipeline crossing point, depending on the extant quantity of water and its quality, including sediment concentrations and turbidity, in the watercourse and the quantity and quality of any water discharged.

The AOI also includes surface waterbodies, such as Lake Albert, that will be used to supply water to the project. At the time of writing, surface water is considered a potential water resource for hydrotesting, while water for other needs (construction) will be sourced from groundwater.

The temporal AOI for construction is the period that includes abstraction and discharge and a short recovery period of less than one year.

The spatial AOI for operation is 2–5 km downstream of watercourses and waterbodies and the temporal AOI for operation is the life of the project, approximately 25 years.

A6.2.2 Study Area Boundary

A6.2.2.1 Introduction

The study area comprises the upstream catchment areas of the watercourses crossed by the pipeline, access roads or discharge points and downstream to key valued environmental and social components (VEC). This is because land use in catchments upstream of the project influences the flow and water quality regimes at the crossing points and downstream VECs. The distance between the pipeline and Lake Albert varies between 1 and 12 km.

Water scarcity for communities was assessed along the pipeline and along project roads which are also in the AOI.

A6.2.2.2 Pipeline Crossings

The pipeline route crosses many minor tributaries. These are characterised by indistinct channels of indeterminate width when viewed on satellite imagery, small catchment areas up to approximately 20 km^2 and ephemeral flow. In addition, the route crosses nine major watercourses, which are the focus of this report. Table A6.2-1 lists the watercourses, crossing point locations and their catchment areas upstream of the pipeline crossing. All nine watercourses drain into Lake Albert. The watercourses and their upstream catchments are shown in Attachment A6.1. Images of the pipeline crossings are shown in Attachment A6.3.

Table A6.2-1 Pipeline–Major Watercourse Crossings and Upstream Catchments

Watercourse	KP	Upstream Catchment Area (km^2)
Sambiye River	7	106
Waiga River	21–25	1849
Waisoke River	28–29	566
Sonso River	34.3	214
Bubwe River	39	70
Waki River	46.9	533
Hoimo River	77	159

Table A6.2-1 Pipeline–Major Watercourse Crossings and Upstream Catchments

Watercourse	KP	Upstream Catchment Area (km^2)
Rwamutonga River	87	125
Wambabya River	89.5	645

A6.2.2.3 Road Crossings

Assessed project road watercourse crossings comprise:

- new temporary access roads
- new permanent access roads
- existing access roads upgraded by the project.

Table A6.2-2 lists the project access roads and the watercourses they cross.

Table A6.2-2 Project Access Road–Watercourse Crossings

Pipeline KP	Road ID	VEC Location (Road KP)[1]	Catchment Area (km^2)	Basin
0	ERU–BCPF	No crossing	–	Lake Albert
44	ERU–MCPY	No crossing	–	

NOTES: [1]Distance from start of road. The start of road is assumed the junction with a national or district road.
ERU = existing road upgrade. BCPF = Buliisa central processing facility. MCPY = main camp and pipe yard.

Neither the existing road to be upgraded by the project between the central processing facility (CPF) and Katanga village (ERU–BCPF) nor the road ERU–MCPY which links the Buliisa–Hoima road with the MCPY crosses any watercourses (Attachment A6.4). Consequently, no road crossings are assessed in this report.

A6.2.2.4 Construction Facilities

Table A6.2-3 presents the construction facility for the pipeline and the waterbodies that are located nearby. Attachment A6.4 presents a map of the project facility.

Table A6.2-3 Construction Facilities: Watercourses Nearby

Pipeline KP	Facility	Watercourse Type	Distance to Watercourse/VEC from Facility (m)	Catchment Area (km^2)	Basin
44	MCPY	Ephemeral wetland	150 m (north)	-	Lake Albert

A6.2.3 Survey Area Boundary

The survey area used for the water quality survey was the proposed pipeline watercourse crossing point or the nearest accessible location (see Section A6.3.2).

Water quality samples collected were considered representative of both pipeline and road crossings.

A6.3 Methods

A6.3.1 Secondary Data

The following secondary data were used when preparing this report:

- Satellite imagery was used to inspect watercourses and their catchment areas.
- Satellite imagery and light detection and ranging (LIDAR) data were used to estimate watercourse dimensions and channel capacity at crossings.
- Historical river flow records acquired from the DWRM for select river gauging stations near the pipeline to characterise the flow regime at watercourse crossings.
- A published flood study for Southwestern Uganda (MWE 2010) was used to estimate flood flows at watercourse crossings.
- Water quality data were obtained from a water quality survey undertaken in 2009–2010 (Schlumberger Water Services (SWS) 2010) and from the Tilenga Project environmental and social baseline study (AECOM 2017).
- The *Uganda Water Supply Atlas* (MWE 2017c) was used for assessing community water scarcity.
- Reports and scientific publications were reviewed (see Section A6.6).

A6.3.2 Field Surveys

A6.3.2.1 Water and Sediment Quality

Water Quality

Baseline surface water quality sampling surveys were undertaken during the dry and wet seasons in 2017 on selected rivers that are crossed by the Tilenga feeder pipeline to characterise their basic physical, chemical and microbiological water quality. Table A6.3-1 lists the survey dates.

Table A6.3-1 Water and Sediment Survey Dates

Survey	Start	End
Dry season	5 July 2017	6 July 2017
Wet season	17 November 2017	19 November 2017

Sampling sites were determined beforehand and were located at pipeline crossing points or at the nearest accessible location. Table A6.3-2 lists the locations of the sampling sites. The locations are also shown in Attachment A6.1. Attachment A6.5 presents photographs of the sampling sites. The rivers selected for sampling were sampled by SWS (2010), the intention being to identify any significant change in water quality since 2010 (Section A6.4).

Table A6.3-2 Rivers Sampled for Water and Sediment Quality

Watercourse	KP	Basin	Sampling Location (WGS84 TM35E_S)		Elev. (masl)	Location of Sampling Site
			Easting	Northing		
Waiga River	22.5	Lake Albert	207923	10220324	630	Buliisa–Hoima road bridge 5.7 km upstream of pipeline crossing
Waisoke River	28.5	Lake Albert	202496	10213744	627	Buliisa–Hoima road bridge 0.1 km upstream of pipeline crossing
Sonso River	34.3	Lake Albert	200092	10208376	627	Buliisa–Hoima road bridge 0.1 km upstream of pipeline crossing
Waki River	46.9	Lake Albert	193624	10197760	631	Rural road bridge 0.2 km downstream of pipeline crossing

Water sampling was conducted in accordance with BS EN ISO 5667-6:2016: Guidance on sampling rivers and streams. The global positioning system coordinates of sampling locations were recorded and samples were collected using a clean, empty sample bottle as a single-use bailer. Where this was impractical, a bucket with rope was used. The collected water was transferred to a labelled sample bottle. The bottles and bucket were washed in the river water three times before sampling to reduce the risk of cross-contamination.

The samples were packed securely in cool boxes with ice packs and kept dark before and during transit for analysis. The samples were analysed by the Environment and Oils Laboratory of African Assay Laboratories Ltd (SGS) in Mwanza, Tanzania, an internationally accredited laboratory. SGS holds ISO/IEC 17025 laboratory accreditation issued by the Canadian Association for Laboratory Accreditation Inc.

Onsite measurements of water quality and laboratory analyses on water samples are described in Section A6.3.3.

Sediment Quality

A baseline sediment-quality survey was conducted during the wet season water sampling campaign (Table A6.3-1 and Table A6.3-2). The sediment survey collected a sample of riverbed sediment from each of the water quality sampling sites. These sites were judged sensitive sediment areas.[1]

At each sampling site, two sediment subsamples were taken from the riverbed on opposite sides of the river by driving a length of sampling tube (50-mm diameter polyvinyl chloride pipe) 0.1–0.2 m into the riverbed below the water surface. The subsamples were homogenised then placed in a glass jar and ziplock bag. Where

[1]A sensitive sediment area is characterised by erodible sediment that, if mobilised by flowing water, may be transported and deposited downstream, thereby redistributing the mobilised sediment.

one side of the river was inaccessible, a second subsample was taken elsewhere on the same side of the river.

Onsite observations of sediment quality and laboratory analyses on sediment samples are described in Section A6.3.3.

A6.3.3 Data Analysis

A6.3.3.1 Flow and Flood Regimes

Pipeline Crossings

Flow Regime

The flow regime of rivers crossed by the pipeline route is represented here by the median or 50-percentile monthly flow at the crossing point.[2] The median flow was calculated in preference to the mean monthly flow because the mean can be influenced by extreme values. It is expected that 50% of monthly flows will exceed the median and 50% will be lower.

Of the rivers that cross the pipeline route, the Waki and Wambabya Rivers are gauged (Table A6.3-3, Attachment A6.1). Daily flow records for gauging stations on these rivers were acquired from the DWRM for the periods given in Table A6.3-3. Figure A6.3-1 shows the daily flow records.

Table A6.3-3 Available Daily Flow Data

River Gauging Station	Area (km^2)	Period of Record
85214 Wambabya River at Buseruka	780	1970–1979
85216 Waki 1 River at Siba Forest	239	1970–1978

SOURCE: DWRM

[2]The median or 50-percentile flow is the middle flow value in a list of flow values arranged in order from smallest to largest.

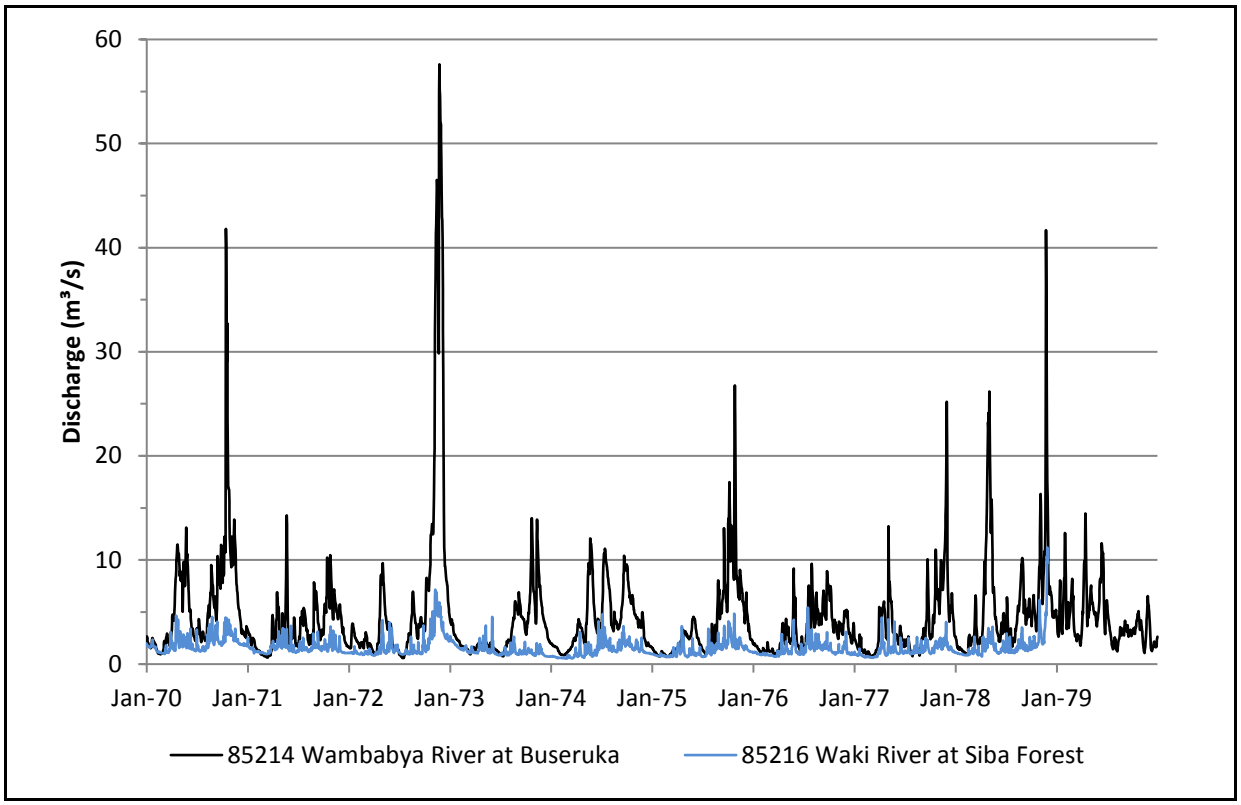

Figure A6.3-1 Wambabya and Waki Rivers, Daily Flows, 1970–1979

The daily flow records were processed to obtain monthly mean flows at the gauging stations. For each "target" river crossed by the pipeline, a donor station was selected based on geographical proximity. The monthly record at the donor station was transposed to the target river to generate an estimated monthly mean flow record on the target river at the pipeline crossing. Table A6.3-4 presents the donor stations and the target rivers. A record for the Sambiye River was not estimated because this river is an ephemeral river, unlike the rivers which are permanent; transposition of the Wambabya or Waki River records would not result in a representative record for the Sambiye River.

Table A6.3-4 Transposition of Flow Records to Rivers at Pipeline Crossings

Donor River and Gauge Station	Area (km^2)	Target River at Pipeline Crossing	KP	Area (km^2)
85216 Waki 1 River at Siba Forest	239	Waiga River	21–25	1849
85216 Waki 1 River at Siba Forest	239	Waisoke River	28–29	566
85216 Waki 1 River at Siba Forest	239	Sonso River	34.3	214
85216 Waki 1 River at Siba Forest	239	Bubwe River	39	70
85216 Waki 1 River at Siba Forest	239	Waki River	46.9	533
85216 Waki 1 River at Siba Forest	239	Hoimo River	77	159
85214 Wambabya River at Buseruka	780	Rwamutonga River	87	125
85214 Wambabya River at Buseruka	780	Wambabya River	89.5	645

The transpositions were made by multiplying each monthly gauged flow value by the ratio of the target river catchment area to the donor river catchment area. Median monthly flows were then calculated from the estimated monthly flow record. Owing to the proximity of the rivers, this was considered a valid approach. The estimated median monthly flows at the pipeline crossing points are presented in Section A6.4.

Flood Regime and Floodplain Flows

A quantitative assessment of the magnitude and frequency of floods and floodplain flows was conducted using the available data for the nine major watercourses draining across the pipeline route. The first step was to estimate the mean annual flood at the crossing points. The second step was to multiply the mean annual flood estimate by a series of statistical frequency factors to obtain estimates of larger, less frequent floods.

Two methods were used to estimate the mean annual flood:

- the “annual maximum series” method
- the regional mean annual flood equation.

The annual maximum series method was used on the Waki and Wambabya Rivers, and the results were transposed to the Rwamutonga and Hoimo Rivers. These are all upland rivers with similar physiography; it was assumed that their flood regimes are similar. The method involved extracting the annual maximum flood flow in each year of available record and calculating the mean of the annual maxima (the mean annual flood). Transposition was undertaken using ratios of target to donor catchment areas, as for the monthly median flows (Table A6.3-4).

The catchments of the Sambiye, Waiga, Waisoke, Sonso and Bubwe Rivers are partly in the uplands and partly in the Rift Valley. The sections of the rivers in the Rift Valley are likely to be characterised by storage of water in wetlands, high evapotranspiration losses from wetland vegetation and infiltration of river water into underlying sedimentary rocks. These factors cause their flood regimes to be dissimilar to those of the Waki, Wambabya, Hoimo and Rwamutonga Rivers. The mean annual flood was estimated on the Sambiye, Waiga, Waisoke, Sonso and Bubwe Rivers using the following regional equation developed specifically for use in Southwestern Uganda (MWE 2010):

$$MAF = 10^{-1.705005} \cdot AREA^{0.53849} \cdot S1085^{0.381989} \cdot SFREQ^{0.231968} \cdot (1+DAMBO)^{-7.707848} \cdot MAR^{0.389604}$$

where:

MAF	is the mean annual flood (m^3/s)
AREA	is the drainage basin area (km^2)
S1085	is the slope of the catchment between the 10th and 85th percentiles of the main stream length (m/km)
SFREQ	is the stream frequency calculated as the number of stream junctions on a 1:50,000 scale map divided by AREA
DAMBO	is the (dimensionless) proportion of the catchment covered by wetland

MAR is the mean annual rainfall (mm).

Catchment-specific values of the parameters AREA, S1085, DAMBO and MAR were derived for five of the nine pipeline crossings (Table A6.3-5). A region-average value of SFREQ was calculated from the values for the 17 catchments given in MWE (2010). Table A6.3-5 presents the values of AREA, S1085, SFREQ, DAMBO and MAR for the rivers used in the analysis.

Table A6.3-5 Parameter Values for Watercourses at Pipeline Crossings

KP	Watercourse	AREA (km^2)	S1085 (m/km)	SFRQ	DAMBO	MAR (mm)
KP7	Sambiye River	106	4.9	0.42	0.000	1100
KP21–25	Waiga River	1849	4.4	0.42	0.030	1100
KP28–29	Waisoke River	566	12.4	0.42	0.010	1250
KP34.3	Sonso River	214	18.3	0.42	0.016	1250
KP39	Bubwe River	70	30.2	0.42	0.014	1250

SOURCE: MWE (2010)

The estimates of mean annual flood at the pipeline crossing points on the main rivers are presented in Section A6.4.

Peak flood flows with return periods[3] (T) of T= 5, 10, 20, 50 and 100 years were estimated at the same pipeline crossings using the following equation:

$Q_T = MAF \cdot (Q(T)/MAF)$

where:

Q_T is the peak flood flow with an estimated return period of T years

(Q(T)/MAF) is the ratio of the T-year flood to the mean annual flood. Values for (Q(T)/MAF) for different return periods are given in Table A6.3-6.

Table A6.3-6 Flood Frequency Factors for Southwestern Uganda

Return Period T (y)	Flood Frequency Factor (Q(T)/MAF)
5	1.416
10	1.893
20	2.419
50	3.199
100	3.856

SOURCE: MWE (2010)

[3]Return period, also known as the recurrence interval, is the average number of years in the long term between events of a similar magnitude. It is a measure of the likelihood of occurrence of an extreme event.

Estimates of MAF and Q_T for the major watercourses at pipeline crossing points are presented in Section A6.4.

The occurrence of floodplain flows was estimated at the major watercourse crossings. The bankfull flow capacity of each river channel at the crossing point was estimated and compared with the estimate of MAF and Q_T. Satellite imagery and LIDAR data were used to estimate the width, depth, cross-sectional area, hydraulic radius and slope of the river channel at bankfull discharge level at each crossing. These parameters were entered into the Manning uniform flow formula[4] to estimate the bankfull flow capacity of the channel. The Manning equation is given by:

$$Q = (A \cdot R^{(2/3)} \cdot S_b^{0.5})/n$$

where:

Q is the flow (m^3/s)

A is the cross-sectional area of flow (m^2)

R is the hydraulic radius (m), calculated as the ratio A/P, where P is the wetted perimeter (m)

S_b is the channel bed slope (m/m)

n is a roughness factor. Values of n used in the analysis were obtained from Chow (1959).

Channel dimensions, values of n and estimated capacities are presented in Attachment A6.6. The assessment of the flood regime and the occurrence of floodplain flow are presented in Section A6.4.

Road Crossings and Project Facilities

Flow and flood regimes in watercourses crossed by project roads and in watercourses that receive drainage from project facilities were not quantified, as it was inappropriate to transpose flow records from the river gauging stations in Table A6.3-3 to the ephemeral channels owing to the differences in scale of catchment area and flow processes.

A6.3.3.2 River Channel Morphology and Stability

Pipeline Crossings

Qualitative assessments were made of river channel morphology and stability at and downstream of pipeline crossings. Using satellite imagery, the river channel planform[5] was categorised as straight, sinuous, meandering or braided. The materials comprising the bed and banks, and riparian vegetation were assessed using a combination of satellite imagery and observations made during the sediment quality survey (see Section A6.4). Stream power per unit channel length was calculated at the pipeline crossings.

[4]The Manning uniform flow formula estimates the flow in an open channel from the dimensions and slope of the channel. The formula is given above.

[5]The planform is the shape of a river's course when viewed from above.

Stream power is defined as “the rate of energy supply at the channel bed that is available for overcoming friction and transporting sediment” (McEwen 1994 cited in Barker et al. 2009). Stream power is considered a measure of the energy available to drive fluvial geomorphological change (Barker et al. 2009).

For each major watercourse, stream power per unit channel length was estimated at the mean annual flood. Stream power is expressed by:

$\Omega = \rho \cdot g \cdot Q \cdot S_e$

where:

- Ω is the stream power per unit channel length (W/m)
- ρ is the fluid (water) density (1000 kg/m^3)
- g is the acceleration due to gravity (9.81 m/s^2)
- Q is the flow, here the mean annual flood, MAF (m^3/s)
- S_e is the energy slope (m/m). S_e is approximated by the channel bed slope (S_b).

Calculations of stream power are presented in Attachment A6.7. The assessment of river channel morphology and stability is presented in Section A6.4.

Road Crossings

Valley floors crossed by project roads will be the VECs of road drainage. As flood flows were unavailable, stream power could not be calculated reliably. Consequently, assessment of the stability (potential for enhanced erosion) of the receptor of road drainage, valley floor soil, was qualitative. Receptor stability assessment results for road crossings are presented in Section A6.4.

A6.3.3.3 Water and Sediment Quality and Sensitivity to Contamination

Pipeline Crossings

Water Quality

At all sites, a calibrated portable digital multiparameter water quality sonde (Aquaprobe) was used to measure:

- water temperature
- electrical conductivity (EC)
- total dissolved solids (TDS)[6]
- pH
- dissolved oxygen (DO)
- turbidity.

[6]TDS was calculated internally by the Aquaprobe based on the equation TDS = EC·0.65.

Field tests of total coliforms and *E. coli* were undertaken at all sites using a portable DelAgua single incubator water testing kit. Samples were incubated on CHROMagar ECC broth for 24 h at 44°C.[7]

Observations were made at all the sites of:

- odour
- gas bubbles
- algae
- iridescence
- bacterial aggregates
- precipitates
- colour.

Attachment A6.8 presents the onsite measurements taken at each sampling location during the dry and wet seasons.

For every water sampling location, the following laboratory analyses were performed:

- total suspended solids (TSS)
- chloride
- biochemical oxygen demand (BOD)
- total petroleum hydrocarbons (TPH).

The following analyses were conducted on one sample taken from the Waisoke River during the wet season (the Waisoke River was selected because it was considered representative of the rivers crossing the pipeline route):

- chemical oxygen demand (COD)
- total hydrocarbons (C_{10}–C_{40})
- polycyclic aromatic hydrocarbons (PAH)
- dissolved metals (arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, vanadium, zinc)
- sulphate
- calcium.

Sampling quality control procedures were implemented at all sampling sites and are reported in Attachment A6.16.

Analytical methods used by SGS were those specified by:

- Standard Methods for Examination of Water and Wastewater (APHA 2012)
- German Institute for Standardisation (DIN).

SGS' water analysis methods and limits of detection are presented in Attachment A6.9.

[7]Using CHROMagar ECC broth enabled simultaneous analysis of total coliforms and *E. coli*. The prescribed incubation temperature for both types of bacteria is 37°C. However, it was impossible to adjust the incubation temperature of the particular test kit used in this survey. Incubation at 44°C favours the growth of *E. coli* relative to total coliforms. As the presence of *E. coli* is an indicator of faecal contamination and total coliform bacteria are ubiquitous in natural waters, this was not considered to affect the conclusions.

The results of laboratory analyses performed on water samples from each sampling location are presented in Attachment A6.10. Laboratory reports of water analyses for the dry season survey are shown in Attachment A6.11 and for the wet season survey in Attachment A6.12.

Secondary water quality data obtained from SWS (2010) and AECOM (2017) for rivers along the Tilenga feeder pipeline are presented in Attachments A6.17 and A6.18 respectively.

The baseline condition of water quality is described in Section A6.4.

Sediment Quality

The following observations were made of sediment at each sampling location:

- texture
- colour
- odour
- presence of biota
- presence of detritus
- depth of sediment sampled.

The following laboratory analyses were performed on liquid leached from the sediment samples using deionised water and, in the case of the metals analyses, using mixed acid:

- pH
- chloride
- TPH
- total phenols
- sulphides
- metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium and zinc.

Sampling quality control procedures were implemented at all sampling sites and are reported in Attachment A6.16.

The analytical methods used by SGS were those specified by APHA (2012). SGS' sediment analysis methods and limits of detection are presented in Attachment A6.13.

The results of onsite observations of the sampled sediment and of the laboratory analyses performed on sediment samples are shown in Attachment A6.14. Laboratory reports of analyses on sediment samples are shown in Attachment A6.15. The baseline condition of sediment quality is described in Section A6.4.

Sensitivity of Watercourses to Potential Contamination

Based on the water and sediment quality survey results and the assessment of catchment areas using satellite imagery, qualitative assessments were conducted for the surveyed watercourses and the main watercourses that were not surveyed. The existing contamination and sensitivity to potential future contamination of watercourses at pipeline and road crossings were determined. The assessments took into account the legally protected status of land, land use, the presence of

wetlands up- and downstream of crossings, the nature of human settlement, and the likely users or VECs of the watercourses at and downstream of crossings. The sensitivity of watercourses to potential contamination was ranked according to the table for water quality sensitivity in Appendix D of the ESIA.

Attachment A6.19 shows the assessment of the nine major watercourses crossed by the pipeline. Attachment A6.20 shows the assessment for waterbodies near construction facilities.

A6.3.3.4 Water Scarcity for Community Use

Relative water scarcity was assessed for communities along the pipeline and the existing road to be upgraded by the project (ERU–BCPF) which links Katanga village with the CPF at the northern end of the pipeline.

The concept of relative scarcity of water has several dimensions. The balance between rainfall and evaporation primarily controls water scarcity. This can affect whether flows in watercourses are permanent or ephemeral. In addition, scarcity is controlled by the provision of, for example, wells, boreholes and irrigation diversion weirs to supply water to communities and their economic activities. Water resources can be over-exploited. Over-exploitation can lead to scarcity for users nearby or located downstream. In addition, water quality also has a bearing on water scarcity in relation the uses for which water is required.[8] Contamination of water can cause scarcity, for example, of drinking water.

The assessment of water scarcity was undertaken at two levels: at the level of districts and subcounties, and along the pipeline. The *Uganda Water Supply Atlas* (MWE 2017c) was used for the district and subcounty level assessment. For the districts and subcounties through which the pipeline route passes, the percentage of the population without access to safe water supplies and the percentage of nonfunctioning water points were obtained from the atlas' percentages for the population with access to water and for functioning water points.

Along the pipeline, the information below was used to assess water scarcity:

- the distribution of homesteads, watercourses and boreholes
- the settlement pattern: nucleated or dispersed, based on the interpretation of satellite imagery
- likely livelihood activities based on the interpretation of satellite imagery
- the likely uses of water by the community
- the water resource exploited: surface water or groundwater
- the source of water supply, e.g., shallow well, deep borehole or surface watercourse. Here, data from the baseline field groundwater survey of wells and boreholes and social surveys provided details of actual sources of water.
- the average distance to the water source estimated where possible using satellite imagery
- the likely reliability of the source during the dry season and drought

[8]The uses of water considered in this assessment included domestic, livestock watering, irrigation and industrial.

- the likely existing contamination concerns taking into account the findings of the surface water and groundwater quality surveys (see Section A6.4 and Groundwater Baseline Report in Appendix A7)
- the sensitivity of the source to contamination. The categorisation of sensitivity followed the assessments of sensitivity to groundwater contamination (see Groundwater Baseline Report in Appendix A7) and surface water (see Section A6.4).
- any water-related concerns identified at the villages surveyed during the social survey.

Water scarcity was categorised as high, moderate or low (Table A6.3-7) depending on the:

- possible distance to the water source (a measure of the human effort needed to obtain water)
- likely reliability of supply (a measure of water quantity and its temporal availability)
- likely sensitivity of the source to contamination (a measure of water quality and the consequence of future contamination).

The traffic-light highlighting is repeated in the assessment tables and is intended to assist interpretation of results.

Table A6.3-7 Categories of Relative Water Scarcity

Indicator	Relative Water Scarcity		
	Low	Moderate	High
Distance to water source (km)	0–0.5	0.5–1	>1
Reliability of supply	Reliable (supply always available during the dry season)	Variable (supply may or may not be available during the dry season)	Unreliable (supply always unavailable during the dry season)
Sensitivity to contamination	High (e.g., shallow well or borehole with a hand pump or a motorised pump that is an important source of good quality water)	Moderate (e.g., a surface watercourse or shallow well without a hand pump that is unprotected against microbiological contamination)	Low (e.g., a heavily contaminated waterbody or a waterbody with naturally poor water quality)

The assessment of water scarcity for communities along the pipeline is presented in Attachment A6.21. The assessment of water scarcity for communities along access roads is presented in Attachment A6.22.

A6.3.4 Data Considerations

A6.3.4.1 Flow and Flood Regimes

Flow Regime

Data record length (i.e., the representativeness of the range of flows in the long term) and record completeness are key data considerations with respect to flow

regime. Synchronous daily flow records for the 10-year period 1970–1979 were acquired for the Wambabya and Waki rivers from the DWRM. This was the only consecutive data for a 10-year period that was made available. The pipeline crosses both rivers. The records for the Wambabya and Waki rivers were substantially complete, as shown in Figure A6.3-1.

The generation of estimated flow records at locations that are not gauged relies extensively on the physiographic similarity of the target catchment to the donor catchment. The “donor” rivers, the Wambabya and Waki Rivers are essentially upland rivers. The “target” rivers, the Rwamutonga, Hoimo and Waki Rivers are also essentially upland rivers and the transposition of records on the Wambabya and Waki Rivers to the pipeline crossings on these rivers is relatively secure. The Bubwe, Sonso, Waisoke and Waiga Rivers have smaller proportions of their catchment areas in the uplands and, for this reason, the transposition to their pipeline crossings is likely to be less accurate. Overall, however, the records estimated at all the river crossings are considered sufficiently representative of their flow regimes and can be used to inform the impact assessment.

Flood Regime

Two methods were used to estimate the mean annual flood at pipeline crossing points on watercourses. Firstly, the annual maximum series method with transposition of results to physiographically similar catchments made maximum use of available data, but was considered inappropriate for the Bubwe, Sonso, Waisoke, Waiga and Sambiye Rivers which, as noted above, are less similar to the upland Wambabya and Waki Rivers. For the Bubwe, Sonso, Waisoke, Waiga and Sambiye Rivers, the regional equation for mean annual flood was used which had been developed by MWE (2010) for use on ungauged catchments in Southwestern Uganda. The use of the two methods on different rivers is considered to provide estimates of mean annual flood of acceptable accuracy for the purposes of the ESIA.

Satellite imagery and LIDAR were used to estimate the dimensions of river channels at pipeline crossings. While not as accurate as field-surveyed data, the accuracy of the estimates of bankfull flow at each crossing is considered to be acceptable for the purposes of the ESIA.

A6.3.4.2 River Channel Morphology and Stability

Using satellite imagery, supported by field observations during the sediment sampling survey, to assess bed and bank materials in channels at crossing points is considered to provide sufficient information for the impact assessment.

A6.3.4.3 Water and Sediment Quality and Sensitivity to Contamination

Water and Sediment Quality

Several sampling quality control procedures were implemented to ensure that accurate and reliable survey data were collected. The quality control procedures used are described and duplicate sample results are compared with the original sample results in Attachment A6.16. Overall, the quality control analysis shows that the data collected are sufficiently accurate to enable a reliable assessment of water

quality at the time of sampling and for the parameters analysed and can be used to inform baseline conditions.

Sensitivity of Watercourses to Potential Contamination

The number of watercourses sampled for water and sediment quality is considered sufficient to indicate the likely water quality status of all watercourses crossed by the pipeline. Using satellite imagery to assess the nature of catchments is considered a powerful aid to understanding the potential influences on surface water quality. Consequently, the results of the assessment are considered to provide a reliable picture of existing contamination and sensitivity to potential change and can be used to inform baseline conditions.

A6.3.4.4 Water Scarcity for Community Use

The qualitative assessment of relative water scarcity for community use was based largely on inspection of satellite imagery and experience of planning and developing rural water supplies in Africa. Although the distribution of homesteads within the 2 km pipeline corridor was available and field water quality surveys, albeit of a relatively limited number of village boreholes and watercourses, had been undertaken, no detailed survey and inventory data were available on water sources for homesteads, their yields, water quality and seasonal reliability. The analysis was, therefore, necessarily qualitative and based on three indicators: distance to water source (where known), reliability of supply and sensitivity to contamination (Table A6.3-7). Where the combination of indicators could lead to different assessments of relative scarcity, the final categorisation was based on professional judgement. Despite being qualitative and partly subjective, the results of the assessment are considered to provide a reliable picture of relative water scarcity along the pipeline and can be used to inform the impact assessment.

A6.4 Baseline Conditions

The baseline condition of surface water is described below in terms of:

- flow and flood regimes at pipeline crossings
- river channel morphology and stability
- water and sediment quality and potential for contamination
- water scarcity for communities along the pipeline and project road ERU–BCPF between Katanga and the CPF.

A6.4.1 Baseline Condition of Surface Water

A6.4.1.1 Flow and Flood Regimes

Pipeline Crossings

Table A6.4-1 and Figure A6.4-1 present the estimated flow regimes (median monthly flows) at the main river crossings. A bimodal flow distribution is evident in most rivers, with higher flows in April and May and in October and November reflecting the rainfall maxima in these months and a dry season between December and March and a secondary dry spell in June and July.

Estimates at watercourse crossings of the MAF and floods with return periods of 5, 10, 20, 50 and 100 years are presented in Table A6.4-2 along with estimates of the flow capacity of the river channels at bankfull level and a qualitative assessment of the frequency of floodplain flow.

The Sambiye River lacks a defined channel and ephemeral flow will always occur in the floodplain. The channel capacities of the Waiga, Waisoke, Sonso, Bubwe and Wambabya Rivers are considerably less than their mean annual floods. Consequently, these rivers may be expected to flow across their floodplains several times a year during floods smaller and more frequent than the mean annual flood. The Hoimo and Rwamutonga Rivers may flow over their banks on average once a year for floods equal to and greater than the mean annual flood. The Waki River may flow on its floodplain once on average every five years.

Construction Facilities

Table A6.4-3 lists the watercourses adjacent to the construction facility. Water in the ephemeral floodplain may be characterised as occurring after rainfall and may persist for weeks or months.

Table A6.4-1 Estimated Median Monthly Flows at Main Watercourse Crossings, m^3/s

KP	Watercourse	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
7	Sambiye	ND												
21–25	Waiga	8.05	7.58	8.05	12.53	14.08	9.75	10.99	12.07	13.07	14.08	14.62	9.75	11.53
28–29	Waisoke	2.46	2.32	2.46	3.84	4.31	2.98	3.36	3.69	4.00	4.31	4.48	2.98	3.53
34.3	Sonso	0.93	0.88	0.93	1.45	1.63	1.13	1.27	1.40	1.51	1.63	1.69	1.13	1.34
39	Bubwe	0.30	0.29	0.30	0.47	0.53	0.37	0.42	0.46	0.49	0.53	0.55	0.37	0.44
46.9	Waki	2.32	2.19	2.32	3.61	4.06	2.81	3.17	3.48	3.77	4.06	4.21	2.81	3.33
77	Hoimo	0.69	0.65	0.69	1.08	1.21	0.84	0.94	1.04	1.12	1.21	1.26	0.84	0.99
87	Rwamutonga	0.32	0.20	0.26	0.58	0.82	0.43	0.48	0.64	0.82	1.08	1.18	0.55	0.56
89.5	Wambabya	1.64	1.04	1.30	2.97	4.25	2.21	2.48	3.30	4.22	5.59	6.10	2.81	2.89

NOTE: ND = no data

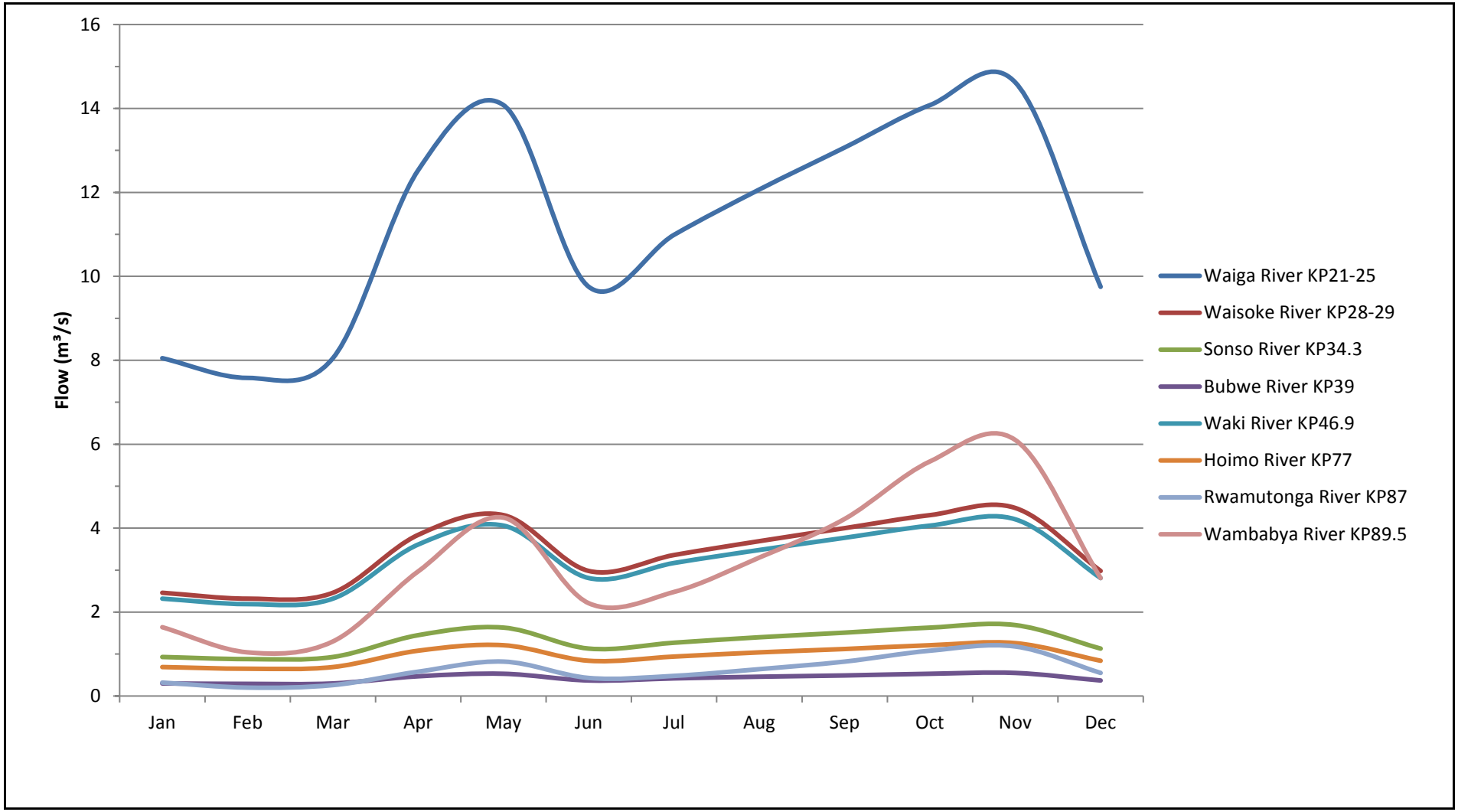

Figure A6.4-1 Streamflow Regime at Watercourse Crossings

Table A6.4-2 Flood Frequency Estimates at Main Watercourse Crossings and Occurrence of Floodplain Flow

KP	Watercourse	MAF (m^3/s)	Estimated Flood Flow QT (m^3/s) with Return Period T (years)					Estimated Bankfull Flow Capacity (m^3/s)	Assessment of Frequency of Floodplain Flow at Pipeline Crossings
			T=5	T=10	T=20	T=50	T=100		
7	Sambiye River	4	6	8	10	13	15	70	Channel absent. Bankfull flow capacity is for floodplain. Floodplain flow will occur for all flows and floods.
21–25	Waiga River	20	28	38	48	64	77	7	Bankfull capacity exceeded by MAF. Floodplain flow will occur for all floods exceeding bankfull capacity.
28–29	Waisoke River	19	27	36	46	61	73	7	Bankfull capacity exceeded by MAF. Floodplain flow will occur for all floods exceeding bankfull capacity.
34.3	Sonso River	13	18	25	31	42	50	10	Bankfull capacity exceeded by MAF. Floodplain flow will occur for all floods exceeding bankfull capacity.
39	Bubwe River	8	11	15	19	26	31	5	Bankfull capacity exceeded by MAF. Floodplain flow will occur for all floods exceeding bankfull capacity.
46.9	Waki River	13	18	25	31	42	50	19	Bankfull capacity may contain floods up to T=5 years. Floodplain flow may occur for T>5 years.
77	Hoimo River	5	7	9	12	16	19	6	Bankfull capacity may contain floods up to MAF. Floodplain flow may occur for T>MAF.
87	Rwamutonga River	4	6	8	10	13	15	3	Bankfull capacity exceeded by MAF. Floodplain flow may occur for T>=MAF.
89.5	Wambabya River	21	30	40	51	67	81	16	Bankfull capacity exceeded by MAF. Floodplain flow may occur for all floods exceeding bankfull capacity.

Table A6.4-3 Construction Facilities and Aboveground Installations: Watercourses Nearby

KP	Facility	Nearest Watercourse Type	Approximate Catchment Area (km^2)	Observations
44	MCPY	Ephemeral wetland (150 m north)	-	Seasonally flooded grassland oriented parallel to the shore of Lake Albert. The lake shore lies approximately 500 m north of the floodplain. A channel in the floodplain is absent. The floodplain may be a zone where groundwater may exist at shallow depth.

Lake Albert

Lake Albert is the largest surface waterbody within the AOI. The largest rivers flowing into the lake are the Semliki River from Lake Edward and the Victoria Nile from Lake Victoria through Lake Kyoga. The Albert Nile flows out of the lake. Outflows from both Lake Victoria and Lake Albert have been shown to fluctuate between 1000 and 2000 m^3/s with an average outflow of about 1250 m^3/s (107 million m^3 per day (m^3/d)). Data indicate (Nsubuga et al. 2014) that there is a strong correlation between inflows, in this case from Lake Victoria to Lake Albert and outflows from Lake Albert, and this has been relatively constant over time, with a constant mass balance between inflows and outflows.

Local studies (MWE 2013) show that inflows from the Victoria Nile River help to maintain the level of water in Lake Albert and its rate of flow is considerably higher than that of the Semliki River, which has annual flows between five and thirty times less than the corresponding annual flows in the Victoria Nile River. Studies also revealed that the rivers (e.g., Waisoke and Waiga River) in the Lake Albert basin catchment area (i.e., south of the Victoria Nile River) have relatively stable dry season flows compared to rivers (e.g., Tangi River) in the Albert Nile sub-basin catchment area (i.e., north of the Victoria Nile) which exhibit seasonal variation.

Although Lake Albert is not entered, all the rivers crossed by the pipeline drain into the lake. The Bubwe River crossing is nearest to Lake Albert at 1.3 km.

A6.4.1.2 River Channel Morphology and Stability

Pipeline Crossings

Table A6.4-4 presents estimates of stream power and assesses stream channel stability based on stream power, channel planform, bed and bank materials, and riparian vegetation.

The Sambiye River lacks a defined channel; flows occur along the floodplain. The floodplain is considered relatively stable.

The main channels of the Waiga, Waisoke, Sonso and Waki Rivers meander on sandy-silty beds with sandy-silty banks. Erosion on the outside and sediment deposition on the inside of meander bends are likely to be occurring at natural rates during floods. Although stream power is relatively high, the floodplains are choked with papyrus which provides protection to banks, rendering the channels relatively stable.

The Bubwe River at KP39 is considered unstable, as papyrus swamp vegetation is absent and bank protection is reliant on degraded grasses and shrubs. Erosion and deposition processes are likely to be more active along this river.

The floodplains of the Hoimo, Rwamutonga and Wambabya Rivers at their pipeline crossings on the plateau are relatively narrow compared to channel width, suggesting channels are incised into bedrock. Riparian vegetation is relatively thick. Consequently, channels are considered relatively stable.

The Wambabya and Waki Rivers cross a narrow shoreline strip below an escarpment. Once on the Rift Valley floor, the Wambabya and Waki channels meander across the coastal plain on lacustrine sands and silts. Riparian vegetation

consists of forest and papyrus, which protect against excessive erosion. Channels on the shoreline plain below the escarpment are therefore considered relatively stable.

Construction Facilities

Table A6.4-5 presents an assessment of the stability of the ephemeral wetland adjacent to the MCPY. The ephemeral wetland is considered relatively stable.

Table A6.4-4 Main Pipeline Crossings: Assessment of River Channel Morphology and Stability

Watercourse	KP	Stream Power (W/m)[1]	Estimated Floodplain Width (m)	Channel Bankfull Width (m)	Channel Planform	Channel Bed Materials	Channel Bank Materials	Riparian Vegetation	Stable or Unstable Channel
Sambiye River	7	290	59	Channel absent	Sinuous[2]	Sand, silt	Sand, silt	Degraded savannah	Stable
Waiga River	21–25	451	5200	6	Meandering	Sand, silt	Sand, silt	Swamp vegetation, grass	Stable
Waisoke River	28–29	410	600	6	Meandering	Sand, silt	Sand, silt	Swamp vegetation	Stable
Sonso River	34.3	255	50–60	9	Meandering	Sand, silt	Sand, silt	Swamp vegetation	Stable
Bubwe River	39	455	20–30	3	Meandering	Sand, silt	Sand, silt	Grass, shrubs	Potentially unstable
Waki River	46.9	944	60	9	Meandering	Sand, silt	Sand, silt	Discontinuous woodland, swamp vegetation	Stable
Hoimo River	77	638	10	7	Sinuous	Basement rock, coarse gravel	Silt, clay	Thick woodland and swamp vegetation	Stable
Rwamutonga River	87	78	30	8	Sinuous	Basement rock, coarse gravel	Silt, clay	Thick woodland	Stable
Wambabya River	89.5	309	20	10	Meandering	Basement rock, coarse gravel	Silt, clay	Thick woodland	Stable

NOTES: [1]Stream power is calculated at the MAF (see Attachment A6.7). [2]This applies to the floodplain.

Table A6.4-5 Project Facilities: Assessment of Stability of Watercourses Nearby

KP	Project Facility	Watercourse Type	Distance to Watercourse/VEC from Facility (m)	Land Cover	Likely Nature of VEC Soil	Evidence of Existing Erosion	Stable or Unstable Receptor
44	MCPY	Ephemeral wetland	150 m (north)	Grassland	Sandy-silt	None	Stable

A6.4.1.3 Water and Sediment Quality and Sensitivity to Contamination

Water Quality

The results of the onsite measurements, microbiological analyses and observations made during the present survey at sampling points on the Waiga, Waisoke, Sonso and Waki Rivers in relation to national water quality standards are presented in Attachment A6.8.[9] Comparison of the laboratory analyses results in relation to national water quality standards is presented in Attachment A6.10. Relevant secondary water quality data from samples taken in August 2010 (SWS 2010) and in 2014, 2016 and 2017 (AECOM 2017) are presented in Attachment A6.17 and Attachment A6.18 respectively. The results exceeding national water quality standards are highlighted in **bold**. Analysis of the data is summarised below.

Physical Water Quality

- Water temperatures at the times of sampling ranged from 22.0 to 22.9°C in the dry season and from 21.5 to 23.7°C in the wet season. A consistent seasonal pattern is not evident in the data. The water temperatures measured in August 2010 (SWS 2010) were similar to those measured during the present survey. The water temperatures measured in the ephemeral Sambiye River by AECOM (2017) ranged from 26.5 to 30.5°C. It is considered that the measurements were made in stagnant pools.
- Turbidity exceeded national drinking water standards for treated and natural waters in the Waiga, Waisoke and Waki Rivers in the dry season, but was within the prescribed limits in the other rivers and in the wet season at the times of sampling. Turbidities measured in August 2010 and June 2017 exceeded national drinking water standards (SWS 2010; AECOM 2017). Turbidity, which is related to TSS (below), is variable depending on rainfall and variation in flow in the days preceding sampling. Turbidity can temporarily exceed national drinking water standards in the wet and dry seasons.
- TSS concentrations ranged from 10.3 to 87.2 mg/L at the times of sampling in the dry season and from 11.5 to 29.8 mg/L in the wet season. TSS concentrations of 120 mg/L and 86 mg/L were measured in the Waiga River in dry season conditions (AECOM 2017). TSS concentrations are variable and are usually related to rainfall and flow variability in the days preceding sampling.
- Water colour at the time of sampling during the wet season was light brown in the Waiga and Waisoke Rivers and grey in the Sonso and Waki Rivers. Water colour was not observed during the dry season.
- Water tested had an organic smell at the time of sampling during the dry season, which was absent at the time of sampling in the wet season. This could be due to use of the river by livestock.
- Gas bubbles and iridescence were absent at the times of sampling.

Chemical Water Quality

- pH was circumneutral in both seasons and within the range prescribed by national drinking water standards at all sampling sites. Similar pH values were measured in August 2010 (SWS 2010) and 2014 (AECOM 2017).

[9]National potable water quality standards are incorporated into the project environmental standards.

- river water tested was relatively lightly mineralised and within national drinking water standards for EC and TDS. This is indicated by the TDS concentrations, which were calculated from EC. Similar EC and TDS were obtained by SWS (2010) and AECOM (2017).
- chloride concentrations ranged from <0.2 to 4.1 mg/L when sampling during the dry season and from 3.5 to 69.9 mg/L during the wet season. Chloride concentrations were consistently higher during the wet season, but well within national potable water standards. Similar Cl concentrations were measured by SWS (2010) and AECOM (2017).
- an iron concentration of 0.76 mg/L was measured in the Waisoke River during the wet season, which is well above the national water quality standard for natural and treated water of 0.3 mg/L. Elevated iron concentrations exceeding the national standard were measured by SWS (2010) in the Waiga, Waisoke, Sonso and Waki Rivers and by AECOM (2017) in the Sambiye and Waiga Rivers. This may have a geological cause, owing to the relative abundance of iron in the geology of Western Uganda.
- one sample (from the Waisoke River) was analysed for dissolved metals in a 2017 campaign. With the exception of barium and zinc, all the other metals analysed were below the laboratory detection limit. AECOM (2017) observed exceedances of national standards for aluminium and manganese in the Waiga River. This may have a geological cause, owing to the relative abundance of these minerals in the geology of Western Uganda.
- TPH, total hydrocarbons (C_{10}–C_{40}) and PAH concentrations were below detection limit in all rivers sampled in the present campaign and that of SWS (2010). AECOM (2017) observed some TPH species above detection limit in the Sambiye River in 2014. A single ethylbenzene determination was above detection limit in the Waiga River (AECOM 2017).
- dissolved oxygen (DO) concentrations were observed to be variable, but relatively high, mostly between 54% and 96% DO saturation. A low value of 26% DO saturation was recorded in the wet season in the Sonso River. The data does not show a consistent seasonal pattern. SWS (2010) measured DO concentrations ranging from 3.7 to 6.7 mg/L in the same rivers which, in terms of percentage saturation, is similar to those observed in the present campaign. Values of DO measured by AECOM in the Sambiye River ranged from 5.3 to 10.3 mg/L.
- nutrients were observed by SWS (2010) and AECOM (2017), concentrations in the rivers were relatively low at the times of sampling. Orthophosphate was recorded in the Waiga River in 2016 and 2017 (AECOM 2017) but were undetected by SWS (2010). Nitrate was observed ranging from <0.29 to 1.4 mg N/L, while nitrite ranged from <0.006 to 0.37 mg N/L across all rivers sampled by SWS (2010) and AECOM (2017).
- BOD results in the wet season ranged from 12 to 20 mg/L. A single COD result indicated an oxygen demand of 26.8 mg/L. These results suggest a moderately high rate of biological activity in the rivers sampled, consistent with the presence of aquatic vegetation, and should not be interpreted as indicating anthropogenic pollution. Very low BOD levels were observed for the dry season samples. These are considered erroneous and unrepresentative.

Microbiological Water Quality

- Microbiological quality of water was poor in all the rivers sampled, with total coliforms and *E. coli* levels exceeding national water quality standards in every

sample. This is consistent with the fact that the rivers are used by cattle for watering and by people for domestic purposes. Faecal coliforms measured in August 2010 also exceeded national drinking water standards (SWS 2010).

- algae and bacterial aggregates were mostly absent at the times of sampling. Algae were observed in the dry season in the Waiga River.

The onsite and laboratory analytical results from all three data sources suggest that water quality in the rivers at the times of sampling was good and the level of anthropogenic contamination was low. Exceedances of national water quality standards were observed for:

- turbidity: exceedances were measured in the Waiga, Waisoke and Waki Rivers during the dry season water quality survey. Exceedances were also measured in August 2010 and June 2017 (SWS 2010; AECOM 2017). The exceedances are likely to be due to rainfall and flow variation in the days preceding the sampling and are likely to be temporary.
- aluminium: two exceedances of the limit for natural and treated water in the Waiga River (AECOM 2017), likely to be due to natural geological causes
- iron: exceedances of the limit for natural and treated water in all rivers sampled by the current survey, SWS (2010) and AECOM (2017), likely to be due to natural geological causes
- manganese: two exceedances of the limit for natural and treated water in the Waiga River (AECOM 2017), likely to be due to natural geological causes
- total coliforms and *E. coli:* exceedances in all current samples, likely to be due to use of the rivers by wild animals, livestock and by people for domestic purposes.

All hydrocarbon analyses in the rivers sampled were below the detection limits at the times of sampling during the current survey and SWS (2010) sampling campaigns. Some TPH species were observed above detection limit in the Sambiye River (AECOM 2017).

Lake Albert

Baseline water quality studies were undertaken at Lake Albert between 2014 and 2017 (AECOM 2018) and the following observations were made:

- The water of Lake Albert is more saline than that of other surface waterbodies within the area.
- Physio-chemical water quality analysis results show that most of the parameters analysed comply with national potable water quality standards except for aluminium and iron which exceeded the corresponding limits.
- Elevated iron and aluminium exceedances were detected only in near-shore samples and this can be linked to the water quality of inflows from the Victoria Nile River. Elevated iron and aluminium were also detected in samples taken from other waterbodies draining the area and groundwater boreholes.
- No petroleum hydrocarbons were detected in any samples above the laboratory detection limits. There are no water quality standards for this parameter.
- Trace concentrations of toluene and ethylbenzene were noted but at levels ranging from three to four levels of magnitude lower than national potable water quality standards.

Sediment Quality

The results of onsite observations and laboratory analyses of sediment are presented in Attachment A6.14. The analytical laboratory reports are presented in Attachment A6.15.

At all sites, the results show that:

- the pH was circum-neutral
- hydrocarbon, phenol and sulphide levels were below the detection limit
- chloride was present L.

Several metal concentrations were above the detection limit at the time of sampling at a small number of sites, where the sample had been taken downstream of a road: the Waiga River recorded vanadium and zinc; zinc was also recorded in the Waisoke and Waki Rivers. All other metals analyses were below detection limit.

In summary, sediment quality may reflect the presence of nearby roads. Contamination by hydrocarbons and phenols was absent.

Sensitivity of Watercourses to Potential Contamination

Pipeline Crossings

The assessment of the sensitivity of watercourses to potential contamination is presented in Attachment A6.19. The Waiga, Waisoke and Sonso Rivers were assessed as having a very high sensitivity to potential change in water quality. Their catchments are covered with natural vegetation in good condition, legally protected by the Murchison Falls National Park, Bugungu Wildlife Reserve and Budongo Forest Reserve.

The Sambiye, Bubwe, and Waki Rivers were assessed as having a high sensitivity to potential change in water quality. Their catchments are partially within legally protected areas (the Murchison Falls National Park, Bugungu Wildlife Reserve and Budongo Forest Reserve) and partially settled with subsistence agriculture and livestock rearing.

The Hoimo, Rwamutonga and Wambabya Rivers were assessed as having a moderate sensitivity to potential change in water quality. Their catchments are relatively densely settled with subsistence agriculture, some plantation agriculture and livestock rearing.

Construction Facilities

The assessment of the sensitivity to potential contamination of the ephemeral wetland near the MCPY construction facility is presented in Attachment A6.20. Water quality during periods of surface water occurrence is assessed as very good on the basis that the wetland has a sparsely settled, rural catchment where livestock grazing is the main activity. Consequently, the wetland's sensitivity to potential contamination is assessed as high.

There is no similar assessment for project roads since no watercourses are crossed by project roads.

A6.4.1.4 Water Scarcity for Community Use

Project Districts and Subcounties

Water scarcity was considered at two levels: the districts and subcounties through which the pipeline passes and at a more focused level along the pipeline route (see Section A6.3.3.4). Table A6.4-6 provides estimates of the percentage of the population in project districts and subcounties without access to safe water supplies and the percentage of water sources that are nonfunctional. These statistics were obtained from the Uganda Water Supply Atlas 2017 (MWE 2017c) which provides statistics on the percentage of the population with access to safe water supplies. The locations of the districts are shown in Attachment A6.2.

Table A6.4-6 Rural Non-Access to Safe Water Supplies along the Pipeline by District and Subcounty

District or Subcounty (SC)	Population (People/km^2)	Non-Access to Safe Water (%)	Source Nonfunctionality (%)	Reasons for Nonfunctionality
Buliisa district (population 120,039)	0–50	30	26	Low yield 8.3% Tech. breakdown 50% Water quality 33.3% Alt. nearby 8.3%
Kigwera SC	100–250	22	19	
Buliisa Town Council	100–250	5	5	
Buliisa SC	50–100	29	21	
Butiaba SC	100–250	74	29	
Hoima district (population 642,584)	100–250	34	16	Low yield 20.0% Tech. breakdown 60% Water quality 20.0%
Kigorobya SC	100–250	37	26	
Buseruka SC	100–250	58	21	
Kabwoya SC	50–100	51	13	

SOURCE: MWE (2017)

Buliisa district has a relatively low population and low population density compared with Hoima district. However, project subcounty population densities in both districts are comparable. Water scarcity as measured by the percentage of people without access to safe water supplies is similar in Buliisa and Hoima districts with 30 and 34% non-access rates respectively. In terms of nonfunctionality of water supplies, water scarcity is higher in Buliisa district where 26% of sources are not functioning compared to 16% in Hoima district.

At subcounty level, water scarcity is lower but also more variable in Buliisa district than in Hoima district. The percentage of people without access to safe water in Buliisa district varies from 5% in Buliisa Town Council area to 74% in Butiaba

subcounty. Lack of access to safe water varies from 37% to 58% of the population in the subcounties of Hoima district.

In terms of nonfunctionality of water supplies, water scarcity is greater in Buliisa district than in Hoima, but is broadly similar at subcounty level, with the exception of Buliisa Town Council where nonfunctionality is 5% of sources. Reasons for nonfunctionality are dominated by technical breakdown in both districts, with the next most common problem being poor water quality in Buliisa district and low source yield and water quality in Hoima district (MWE 2017c).

Pipeline Route

When considered in terms of the balance between rainfall and evaporation, water scarcity varies along the pipeline route. Variation in the balance is largely due to variation in elevation. Between KP0 and KP54, the route is situated in the Rift Valley at an elevation of approximately 650 masl. The mean annual rainfall at this elevation varies from 1000 from 1200 mm (MWE 2013). A short dry season lasts two to four months between December and February. The mean annual potential evapotranspiration varies from approximately 1480 to 1550 mm, resulting in an excess of evaporation over rainfall at an annual timescale and semi-arid conditions. Those watercourses that flow permanently do so because their headwaters are at a higher elevation in the relatively well-watered uplands.

From KP54 to KP56.5, the pipeline route climbs the Rift Valley escarpment to a plateau at an average elevation of approximately 1100 masl. The mean annual rainfall at this elevation varies from 1200 from 1400 mm (MWE 2013). The mean annual potential evapotranspiration varies from approximately 1300 to 1400 mm (MWE 2013), approximately equivalent to rainfall at an annual timescale. However, at short timescales, rainfall exceeds evaporation resulting in greater water availability, which is manifest in the form of streamflow and springs.

Access to groundwater via shallow wells and deep boreholes (see Groundwater Baseline Report in Appendix A7) ameliorates the scarcity of surface water resources. The assessment of water scarcity for the communities presented in Attachment A6.21 takes into account access to groundwater as well as to surface water, as both are used by communities. Water scarcity is also related to the functioning of handpumps and other types of infrastructure. The assessment shows that water is scarcest towards the northern end of the pipeline and scarcity reduces in a southerly direction.

From KP0 to approximately KP20, water scarcity is assessed to be high. This is mainly due to the semi-arid climate in the Rift Valley, the unreliability of surface water sources and the distance to water that needs to be walked by livestock and people. There are relatively few wells and boreholes in this zone and a considerable number were found to be not functioning.

From KP20 to approximately KP54, water scarcity is assessed to be moderate. This is mainly because of the proximity of Lake Albert and the rivers that flow into Lake Albert. Both are important sources of water for people and livestock.

From KP54 to KP56.5, the pipeline route climbs the Rift Valley escarpment to a plateau at an average elevation of approximately 1100 masl. There is greater

rainfall and improved water availability, which is manifested in the form of streamflow and springs.

From KP51 to KP56, the pipeline route is largely uninhabited as the route climbs the Rift Valley escarpment. From KP56 to the end of the pipeline at KP95, the pipeline route is situated on the relatively well-watered and more densely populated Rift Valley plateau. Water scarcity here is assessed to be low. This is due to the likelihood that the numerous watercourses, while they may be small, are mostly permanent and therefore reliable sources of water for livestock. Shallow wells and boreholes are more numerous and were found to be functioning.

Project Roads

The only project roads are the existing roads to be upgraded between Kasinyi near the upstream Tilenga Project CPF and Katanga village on the shore of Lake Albert and between the Buliisa–Hoima road and the MCPY at KP44 (Attachments A6.2 and A6.4). An assessment of water scarcity for communities along these roads is presented in Attachment A6.22. Relative water scarcity was assessed as low at Kasinyi village at the proposed entrance to the CPF. There were reported to be six boreholes with handpumps in Kasinyi, four of which were operational in 2015 (Artelia Eau & Environnement 2015). When borehole water is unavailable, people walk 3 km to the River Nile or 9 km to Lake Albert to obtain water. Water scarcity was assessed as low at Katanga at the western end of the pipeline road to be upgraded (ERU–BCPF). There are two public boreholes and two shallow wells in Katanga. The Nile River and Lake Albert are relatively close for livestock watering.

Water scarcity near ERU–MCPY is assessed at Booma, some 1.8 km west of the road, as low. This is because Booma receives water from a gravity flow scheme and the communities there also have access to water from Lake Albert and the ephemeral wetland near the MCPY.

Construction Facilities

As Booma is 0.8 km northwest of the MCPY, the comments above in relation to ERU–MCPY also apply to water scarcity near the MCPY. Water scarcity near the MCPY is considered low (Attachment A6.23).

A6.4.2 Trend in Condition and Sensitivity to Change

A6.4.2.1 Flow and Flood Regimes

A review of Ugandan government reports suggests that several environmental changes have taken place in Uganda. Land cover has undergone rapid change because of increasing population pressure on land. Human activities such as timber cutting, clearing land for agriculture, settlement and overgrazing have affected the natural vegetation cover, which has resulted in deforestation, encroachment on wetlands and land degradation (MEMD 2013; Government of Uganda 2016). Soil productivity has declined, and soil erosion is a major cause of river siltation (NEMA 2009). These processes are likely to intensify in future. Increased pressure is also evident in the rangelands of the cattle corridor. Increasing livestock numbers have led to overgrazing of the savannah, reduced groundcover and increased soil

erosion. Consultation and literature indicate that these processes are likely to intensify.

Water resources along the watercourses traversed by the AOI are relatively undeveloped; they are used mainly for livestock watering and domestic purposes. People collecting water from the rivers takes place on a relatively small scale, but, as populations grow and agriculture intensifies, the pressure to pump water from the rivers for public water supply and agricultural and commercial uses will increase, which is likely to lead to reduced flows downstream. The sensitivity to change depends, therefore, on current levels of use in relation to available resources and likely future development pressure. The Rift Valley escarpment offers potential to generate hydropower. The Kabalega hydropower plant on the Wambabya River approximately 7 km downstream of the pipeline crossing at KP89.5 is the first such project on watercourses crossed by the pipeline. The Waki hydropower project is proposed on the Waki River approximately 2.5 km upstream of the pipeline crossing at KP46.9. The Orio hydropower project is proposed on the Hoimo River approximately 5 km downstream of the pipeline crossing at KP77.

As agriculture intensifies and soil degrades, flood volumes and peak flows may increase. Wetlands and swamps in floodplains tend to attenuate floods by slowing water velocities, thus delaying and reducing peak flows. Although riparian zones are legally protected, there is a national trend of wetland encroachment and conversion to farmland. A corresponding trend for increased flooding and flood risk may be expected as a result. It is presently unclear whether this is occurring in the rivers traversed by the AOI.

A6.4.2.2 River Channel Morphology and Stability

Floods deliver water and sediment from land to river channels. Siltation in floodplains is set to continue at an increasing rate as soil erosion intensifies (see Section A6.4.2.1). As the floodplains are incised, continuing siltation maintains the stability of the river channels, providing the swamp vegetation cover remains. Over time, continuing siltation may cause water levels during floods to rise, thereby possibly causing increasing inundation of public infrastructure or informal settlements on floodplains.

A6.4.2.3 Water and Sediment Quality and Sensitivity to Contamination

Water and sediment quality are under increasing pressure from growing populations and intensified human activities. Urbanisation and the use of pesticides and fertilisers by farmers is increasing across Uganda (MEMD 2013; Government of Uganda 2016). It is assumed that the same trends are occurring in the project catchments, particularly in the Waki, Hoimo, Rwamutonga and Wambabya catchments, which are not legally protected, threatening water supplies and associated ecosystems in the long term. As water quality deteriorates, sensitivity to potential contamination is likely to reduce.

A6.4.3 Ecosystem Services Provided

The watercourses and waterbodies in the AOI, including Lake Albert, described herein provide the following ecosystem services.

Provisioning services:

- water for local people in rural communities, their livestock and agricultural activities. Water is also collected from rivers by entrepreneurs using vehicles and pumps to sell to people in urban areas.
- water for hydroelectricity generation at the Kabalega hydroelectric power station on the Wambabya River in Hoima district about 7 km downstream of the pipeline crossing
- sources of water and food for visiting wild animals and birds.

Regulating services:

- floodplains regulate floods by slowing water velocities; storing water on their surfaces and transmitting water relatively slowly downstream and reducing peak flows
- wetlands along watercourses regulate water quality by acting as filters causing reduction of suspended sediment and associated metals, and local water purification through microbial breakdown of organic matter.

Habitat and species support:

- waterbodies provide habitat and support for aquatic and terrestrial species.

Cultural services:

- benefits to people from the watercourses in terms of cultural services, such as for recreation or being of spiritual value, were not identified during the study.

A6.4.4 Sensitivity Rankings

A6.4.4.1 Flow Regime

Pipeline Crossings and Lake Albert

Based on the trend in condition and the sensitivity to change, the sensitivity of Lake Albert and the nine watercourses with respect to their flow regimes and uses within the AOI are shown in Table A6.4-7. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D of the ESIA.

Table A6.4-7 Surface Water Flow Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse/VEC	KP	Sensitivity Ranking	Rationale for Ranking[1]
Sambiye River	7	Low (2)	Provides water directly for rural communities and livestock. Water demand will rise.
Waiga River	21–25		
Waisoke River	28–29		
Sonso River	34.3		
Bubwe River	39		
Waki River	46.9		
Hoimo River	77		

Table A6.4-7 Surface Water Flow Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse/VEC	KP	Sensitivity Ranking	Rationale for Ranking[1]
Rwamutonga River (tributary of Wambabya River)	87	Moderate (3)	Provides water directly for rural communities and hydropower generation downstream. Water demand will rise.
Wambabya River	89.5	Moderate (3)	
Lake Albert	N/A	Low (2)	Provides water directly for rural communities and livestock. Water demand will rise.

NOTE: [1]Rationale relates to the situation at the time of writing. Species and habitats of conservation concern have been considered within the biodiversity VEC in Section 8.2.

Construction Facilities

The sensitivity of the flow regime to change in watercourses that will receive drainage from project facilities is presented in Table A6.4-8. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D of the ESIA.

Table A6.4-8 Surface Water Flow Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse/Distance from Facility	Sensitivity Ranking	Rationale for Ranking
44	MCPY	Ephemeral wetland (150 m north)	Low (2)	Waterbody provides a seasonal source of water for rural communities and livestock

A6.4.4.2 River Channel Morphology and Stability

Pipeline Crossings

Based on the trend in condition and the sensitivity to change, the sensitivity of the nine watercourses with respect to the stability of their channels within the AOI is shown in Table A6.4-9. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D of the ESIA.

Table A6.4-9 River Channel Morphology and Stability Sensitivity Rankings – Pipeline Crossings

Watercourse/VEC	KP	Sensitivity Ranking	Rationale for Ranking
Sambiye River	7	Low (2)	Channel absent. Natural floodplain in uncohesive materials with grass and tree cover. Considered to be stable.

Table A6.4-9 River Channel Morphology and Stability Sensitivity Rankings – Pipeline Crossings

Watercourse/VEC	KP	Sensitivity Ranking	Rationale for Ranking
Waiga River	21–25	Low (2)	Natural channel in uncohesive materials. Continuous swamp vegetation along the river channel. Floodplain is grass covered.
Waisoke River	28–29	Low (2)	Natural channel in uncohesive materials. Continuous swamp vegetation along the river channel. Floodplain is grass covered.
Sonso River	34.3	Low (2)	Natural channel in uncohesive materials. Continuous swamp vegetation along the river channel. Floodplain is grass covered.
Bubwe River	39	High (4)	Natural channel in uncohesive materials. Riparian vegetation along river channel is a discontinuous cover of grass and scrub. Floodplain is grass and scrub covered.
Waki River	46.9	Low (2)	Natural channel in uncohesive materials. Discontinuous woodland and swamp vegetation along river channel and floodplain.
Hoimo River	77	Low (2)	Natural channel with bedrock or gravel bed and cohesive silt-clay banks. Riparian vegetation is thick woodland and swamp vegetation.
Rwamutonga River	87	Low (2)	Natural channel with bedrock or gravel bed and cohesive silt-clay banks. Riparian vegetation is thick woodland.
Wambabya River	89.5	Low (2)	Natural channel with bedrock or gravel bed and cohesive silt-clay banks. Riparian vegetation is thick woodland.

Construction Facilities

The sensitivity of the waterbody to the north of the MCPY with respect to its morphology and stability is presented in Table A6.4-10. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D of the ESIA.

Table A6.4-10 River Channel Morphology and Stability Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse/ Distance from Facility	Sensitivity Ranking	Rationale for Ranking
44	MCPY	Ephemeral wetland (150 m north)	Low (2)	Wetland with uncohesive materials. Vegetation cover is grassland.

A6.4.4.3 Water and Sediment Quality and Sensitivity to Contamination

Pipeline Crossings and Lake Albert

Based on the trend in condition and the sensitivity to change, the assessment of the sensitivity of the main watercourses and Lake Albert to potential contamination is shown in Attachment A6.19. The results are summarised in Table A6.4-11. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D of the ESIA.

Table A6.4-11 Water and Sediment Quality and Sensitivity to Contamination Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse/VEC	KP	Sensitivity Ranking	Rationale for Ranking
Sambiye River	7	Moderate (3)	The mid catchment is relatively densely settled with subsistence agriculture and livestock rearing. Water quality at times of flow is likely to be good.
Waiga River	21–25	Very high (5)	Catchment is in a legally protected area with no settlement. Water quality is likely to be natural.
Waisoke River	28–29	Very high (5)	Catchment is in a legally protected area with no settlement. Water quality is likely to be natural.
Sonso River	34.3	Very high (5)	Catchment is in a legally protected area with no settlement. Water quality is likely to be natural.
Bubwe River	39	High (4)	Catchment is sparsely settled with subsistence agriculture and livestock rearing. Water quality is likely to be very good.
Waki River	46.9	Moderate (3)	Headwaters are relatively densely settled with rainfed and plantation agriculture. Natural forest cover in mid catchment. Sparsely settled with subsistence agriculture and livestock rearing in the lower catchment. Water quality is likely to be good.
Hoimo River	77	Moderate (3)	Catchment is relatively densely settled with subsistence agriculture and livestock rearing. Water quality is likely to be good.
Rwamutonga River	87	Moderate (3)	Catchment is relatively densely settled with subsistence agriculture and livestock rearing. Water quality is likely to be good.
Wambabya River	89.5	Moderate (3)	Catchment is relatively densely settled with subsistence and plantation agriculture and livestock rearing. Water quality is likely to be good.

Table A6.4-11 Water and Sediment Quality and Sensitivity to Contamination Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse/VEC	KP	Sensitivity Ranking	Rationale for Ranking
Lake Albert	N/A	Moderate (3)	Catchment is densely settled with subsistence and plantation agriculture and livestock rearing. Water quality is likely to be good.

Construction Facilities

The assessment of the sensitivity of waterbody to the north of the MCPY with respect to potential contamination is presented in Attachment A6.20. The results are summarised in Table A6.4-12. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D of the ESIA.

Table A6.4-12 Sensitivity to Contamination Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse/Distance from Facility	Sensitivity Ranking	Rationale for Ranking
44	MCPY	Ephemeral wetland (150 m north)	High (4)	Rural catchment sparsely settled with livestock rearing. Water quality likely to be very good during periods of surface water occurrence.

A6.5 Key Considerations

A6.5.1 Introduction

Key considerations for surface water VECs are summarised below for:

- flow in watercourses
- river channel morphology and stability
- water and sediment quality and sensitivity to contamination.

A6.5.2 Flow in Watercourses

Flow in most watercourses crossed by the pipeline is considered to have a low sensitivity to change. This is because there are relatively few uses of the watercourses other than providing water for a dispersed rural population and livestock. Present and likely future demands, based on available information, are relatively low. The exceptions are the Wambabya River (KP89.5) and its tributary, the Rwamutonga River (KP87). The Wambabya River is used for hydroelectricity generation at the Kabalega hydroelectric power station in Hoima district approximately 7 km downstream of the pipeline crossing at KP89.5. The Wambabya River is considered to have a moderate sensitivity to change in flow.

Surface water occurrence in the ephemeral wetland north of the MCPY at KP44 is considered to have a low sensitivity to change. This is because the wetland provides an ephemeral source of water only for rural communities and livestock.

A6.5.3 River Channel Morphology and Stability

The morphology and stability of the watercourses traversed by the AOI are considered to have a low sensitivity to change. This is because the floodplains contain aquatic vegetation that limits flow velocities, inhibits erosion and makes these watercourses very stable. The exception is the Bubwe River (KP39), which is considered to have a high sensitivity to change. This Bubwe River has riparian vegetation comprising a discontinuous cover of grass and scrub. The floodplain is grass and scrub covered.

The stability of the ephemeral wetland north of the MCPY at KP44 is considered to have a low sensitivity to change, principally due to the grass cover.

A6.5.4 Water and Sediment Quality and Sensitivity to Contamination

The following watercourses were considered to have a high or very high sensitivity to change:

- Waiga River (KP21–25)
- Waisoke River (KP28–29**)**
- Sonso River (KP34.3)
- Bubwe River (KP39).

The catchments of the Waiga, Waisoke and Sonso Rivers are situated within the Murchison Falls National Park, Bugungu Wildlife Reserve and Budongo Forest Reserve with no settlement and are predominantly natural. Water quality in these rivers is likely to be natural. The catchment of the Bubwe River is sparsely settled with subsistence agriculture and livestock rearing; water quality is likely to be very good.

Water quality in the ephemeral wetland north of the MCPY at KP44is considered to have a high sensitivity to change, as the land is sparsely populated, causing water quality to be relatively good in times of surface water occurrence.

A6.6 References

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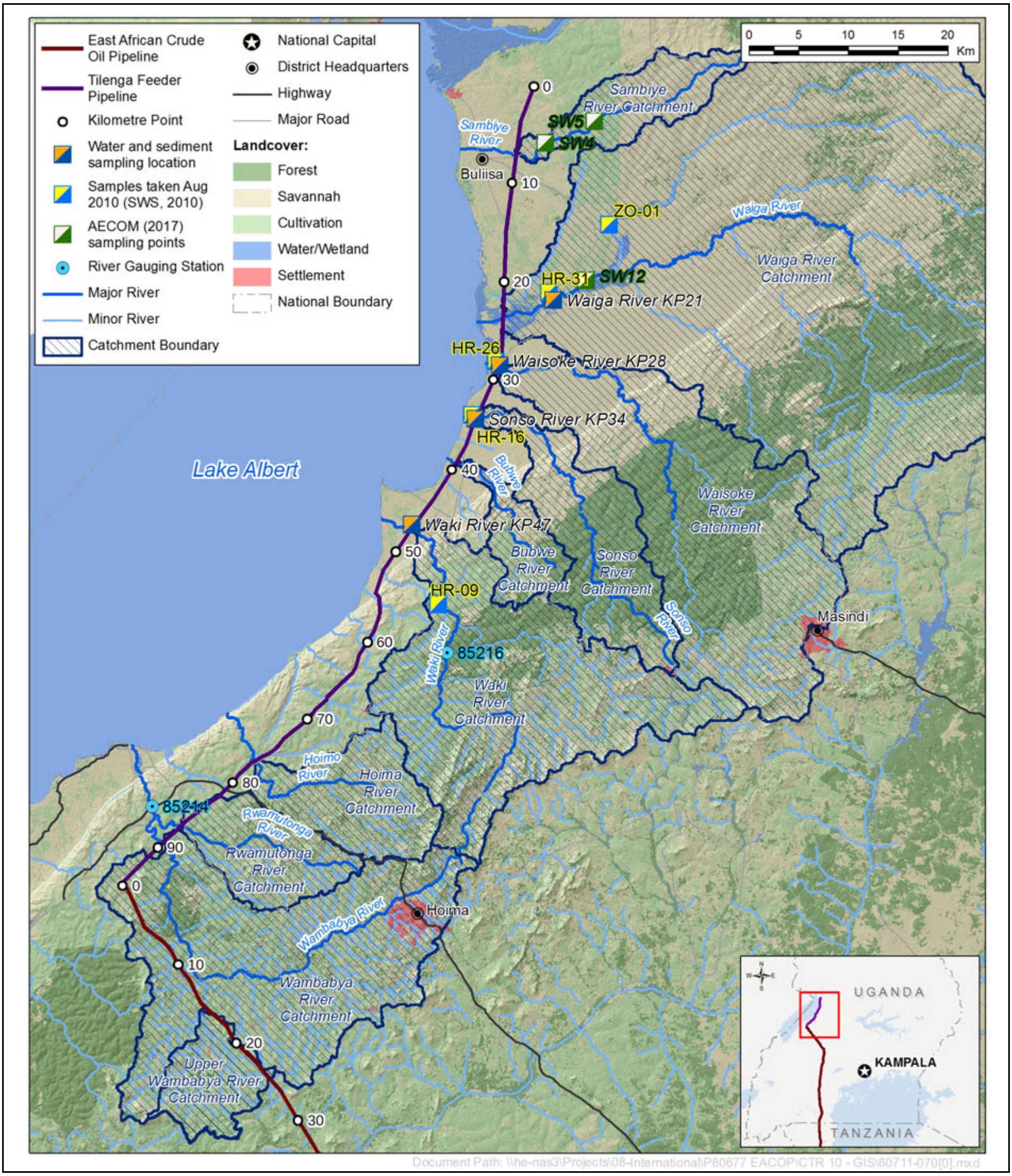
ATTACHMENT A6.1 MAIN WATERCOURSES AND UPSTREAM CATCHMENTS


East African Crude Oil Pipeline
Tilenga Feeder Pipeline
Kilometre Point
Water and sediment sampling location
Samples taken Aug 2010 (SWS, 2010)
AECOM (2017) sampling points
River Gauging Station
Major River
Minor River
Catchment Boundary
National Capital
District Headquarters
Highway
Major Road
Landcover:
Forest
Savannah
Cultivation
Water/Wetland
Settlement
National Boundary
0 5 10 15 20 Km
Lake Albert
Sambiye River
Sambiye River Catchment
SW5
SW4
Buliisa
0
10
ZO-01
Waiga River
Waiga River Catchment
20
HR-31
SW12
Waiga River KP21
HR-26
Waisoke River KP28
30
Sonso River KP34
HR-16
40
Bubwe River
Waisoke River Catchment
Waki River KP47
50
Bubwe River Catchment
Sonso River Catchment
HR-09
Sonso River
Masindi
60
Waki River
85216
Waki River Catchment
70
Hoimo River
Hoima River Catchment
80
85214
Rwamutonga River
Rwamutonga River Catchment
90
0
Hoima
Wambabya River
10
Wambabya River Catchment
20
Upper Wambabya River Catchment
30
UGANDA
KAMPALA
TANZANIA
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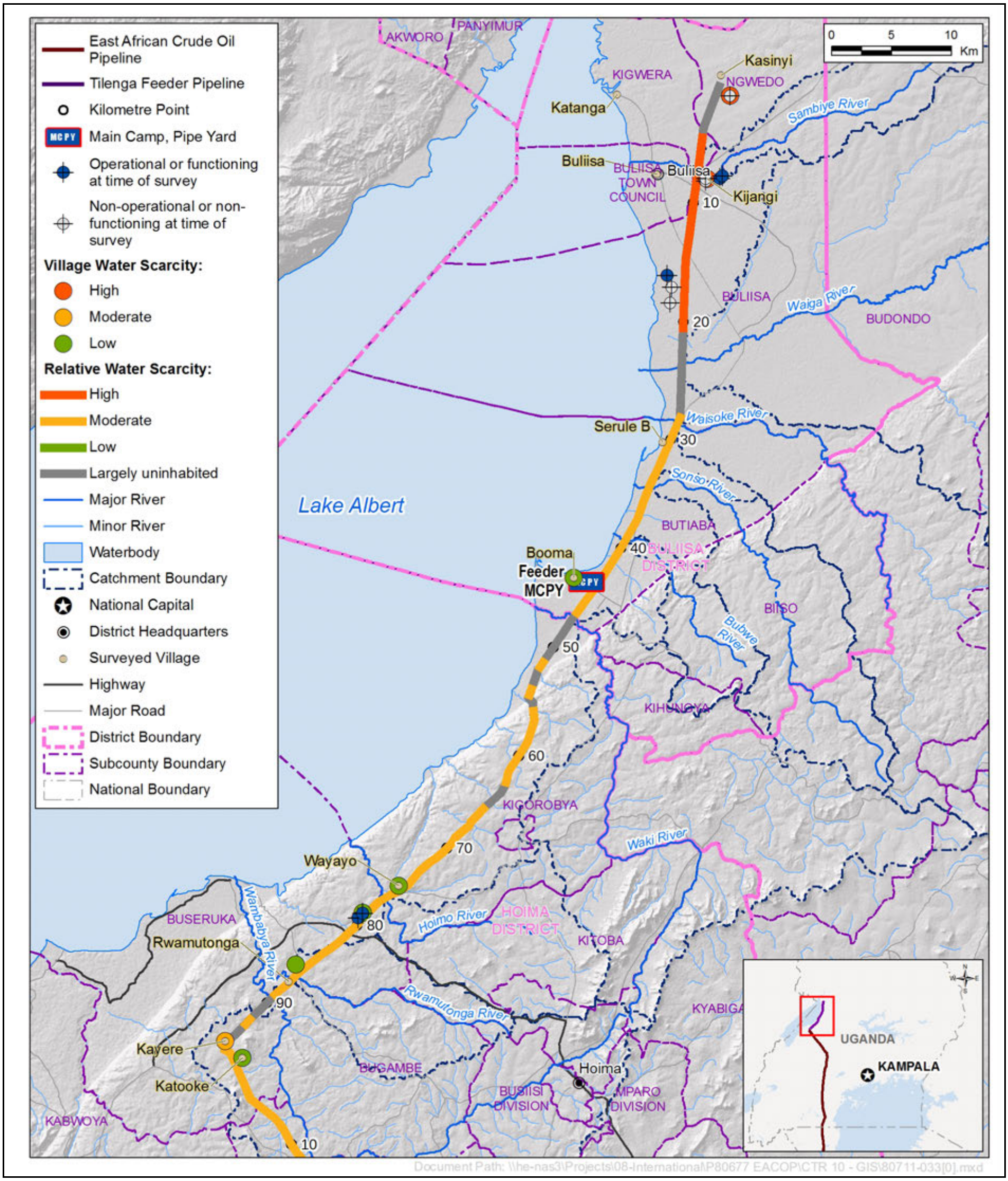
ATTACHMENT A6.2 WATER SCARCITY ALONG THE PIPELINE


East African Crude Oil Pipeline
Tilenga Feeder Pipeline
Kilometre Point
MCPY
Main Camp, Pipe Yard
Operational or functioning at time of survey
Non-operational or non-functioning at time of survey
Village Water Scarcity:
High
Moderate
Low
Relative Water Scarcity:
High
Moderate
Low
Largely uninhabited
Major River
Minor River
Waterbody
Catchment Boundary
National Capital
District Headquarters
Surveyed Village
Highway
Major Road
District Boundary
Subcounty Boundary
National Boundary
0 5 10 Km
AKWORO
PANYIMUR
KIGWERA
Katanga
Kasinyi
NGWEDO
Sambiye River
Buliisa
BULIISA TOWN COUNCIL
Kijangi
BULIISA
Waiga River
BUDONDO
Serule B
Waisoke River
Lake Albert
Sonso River
BUTIABA
Booma
Feeder MCPY
BULIISA DISTRICT
BISO
Bubwe River
KIHUNGYA
KIGOROBYA
Waki River
Wayayo
BUSERUKA
Wambabya River
Hoima River
HOIMA DISTRICT
KITOBA
Rwamutonga
Rwamutonga River
KYABIGA
Kayere
Katooke
BUGAMBE
Hoima
BUSIISI DIVISION
MPARO DIVISION
KABWOYA
UGANDA
KAMPALA
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ATTACHMENT A6.3 KEY WATERCOURSES AT PIPELINE CROSSINGS

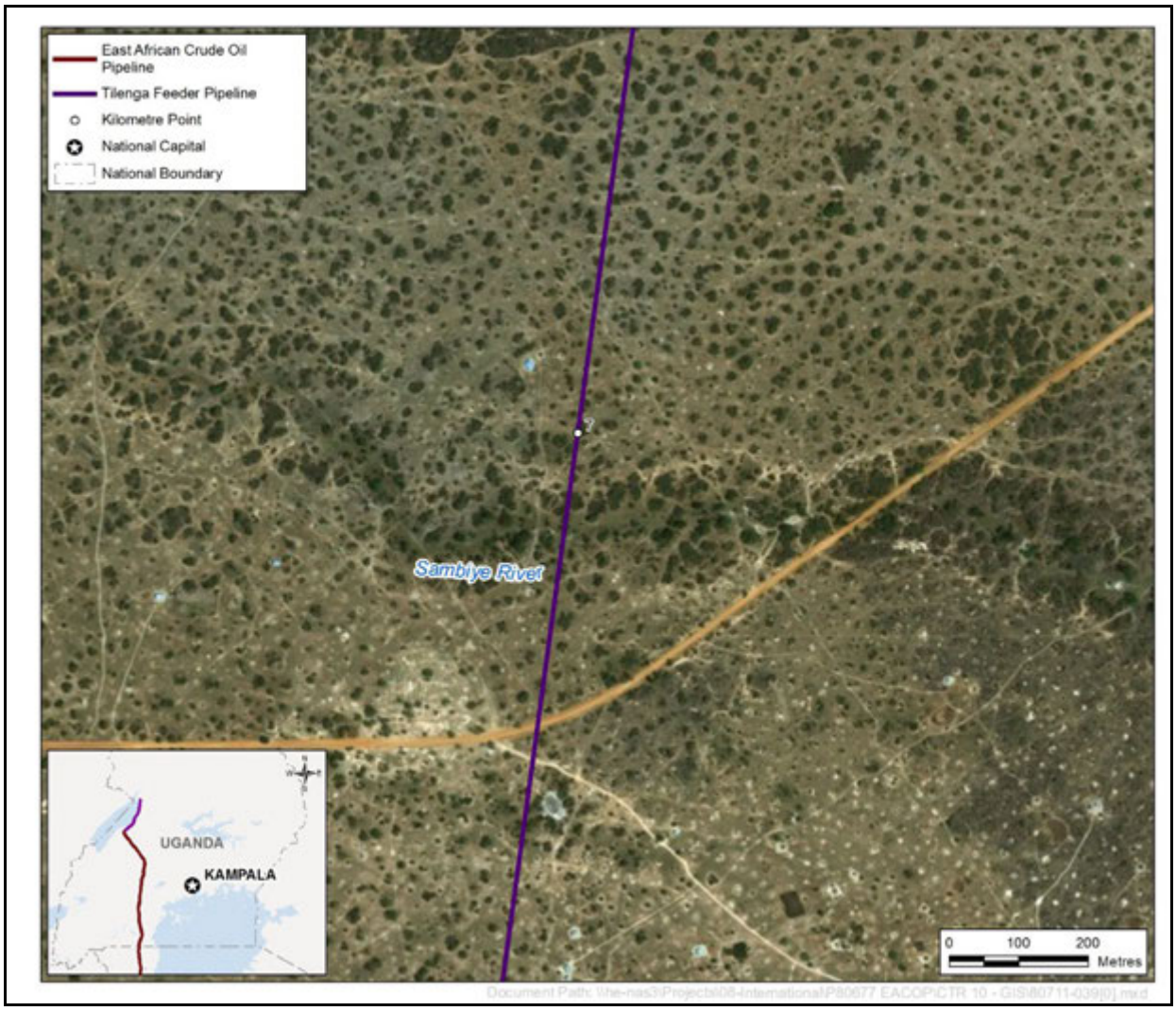

Figure Att6.3–1 Sambiye River at KP7

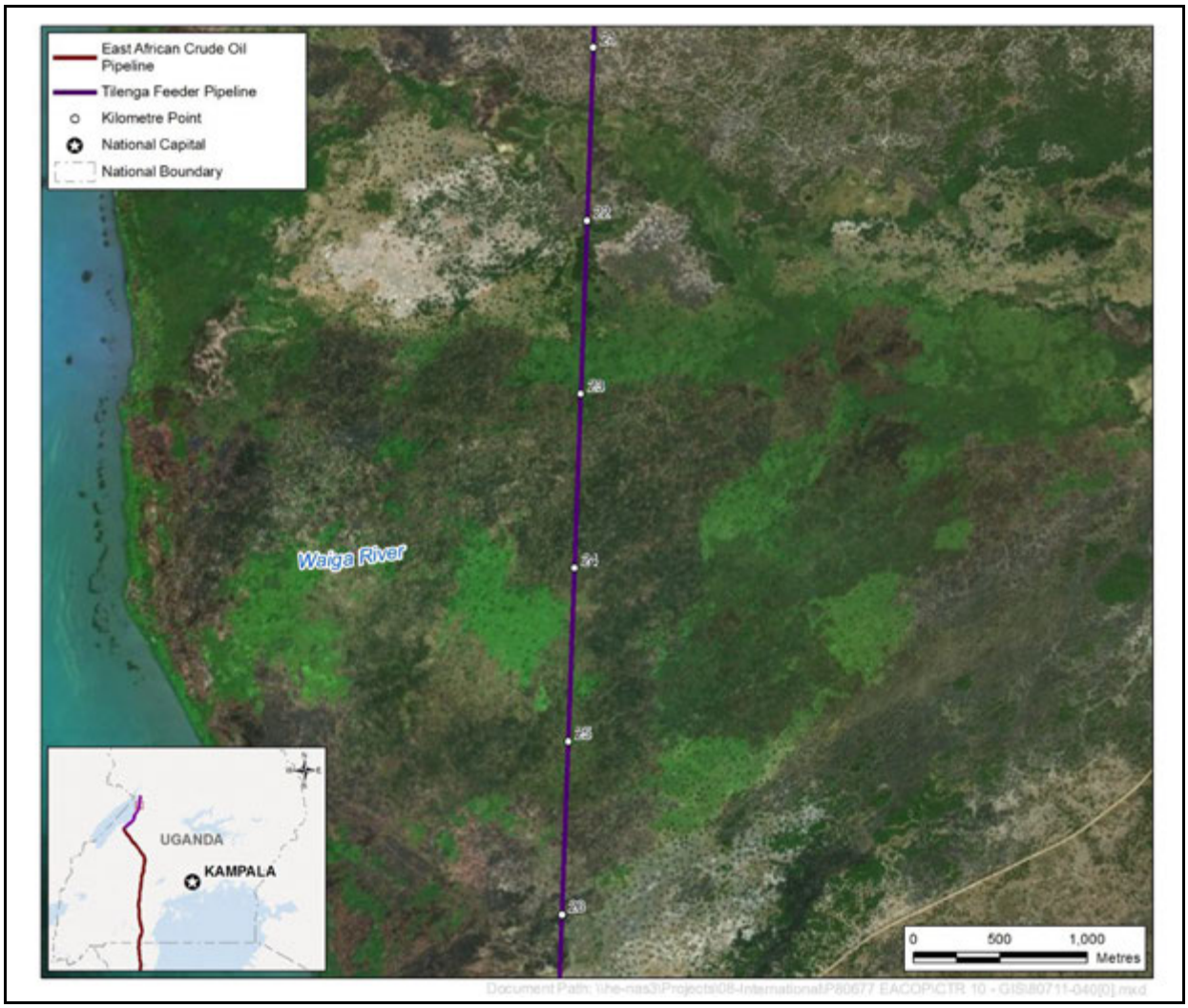

Figure Att6.3–2 Waiga River at KP21–25

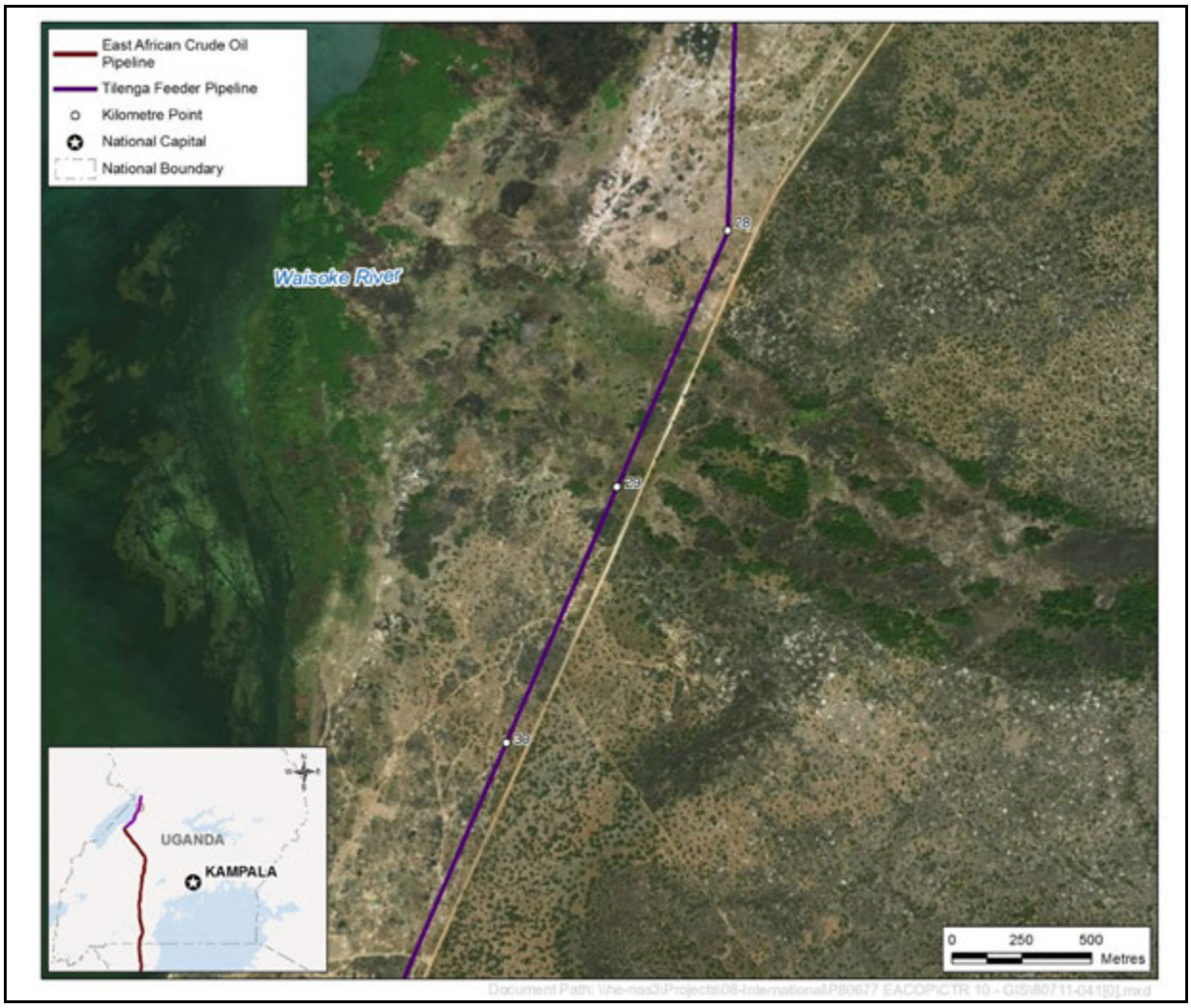

Figure Att6.3–3 Waisoke River at KP28–29

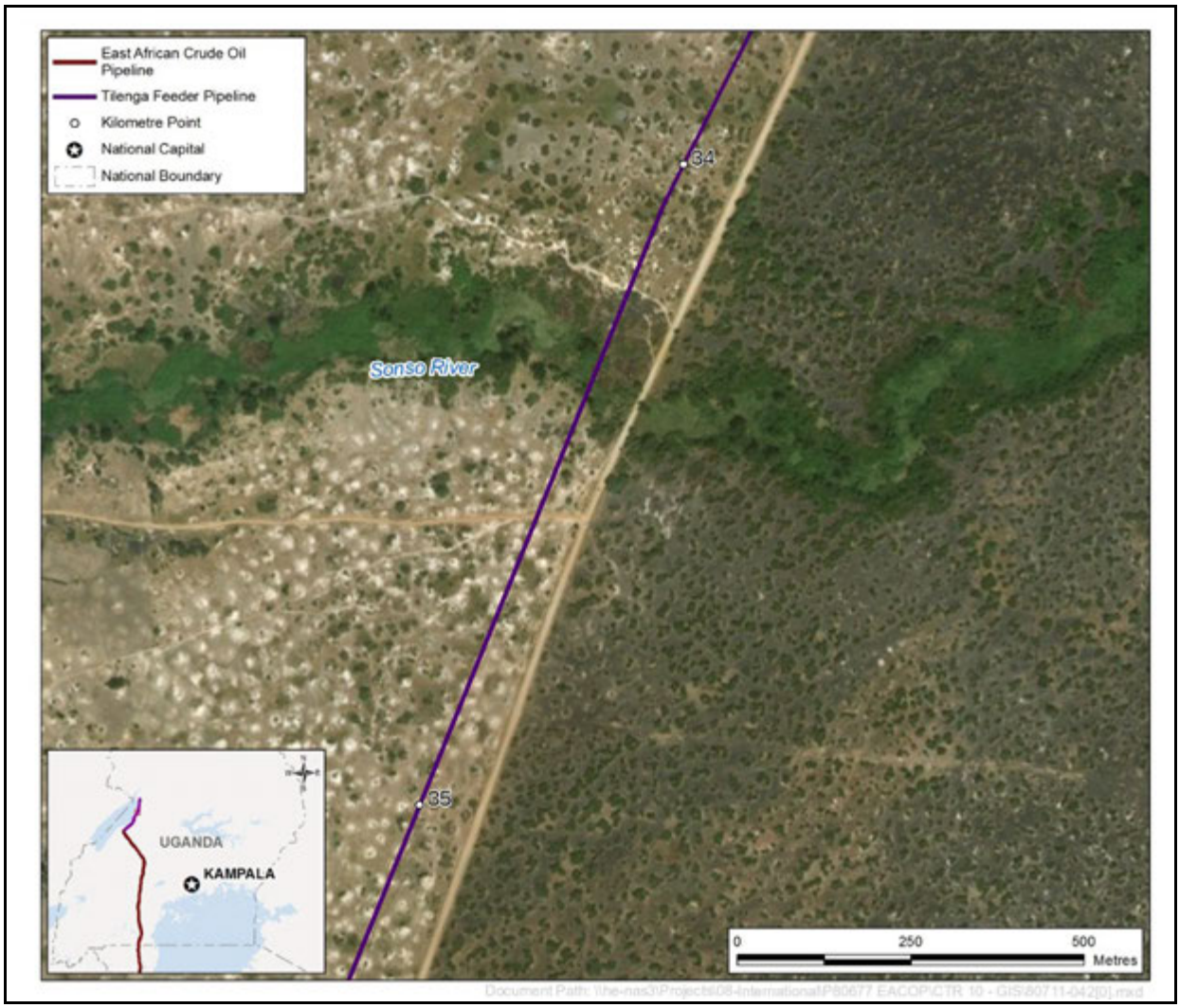

Figure Att6.3–4 Sonso River at KP34.3

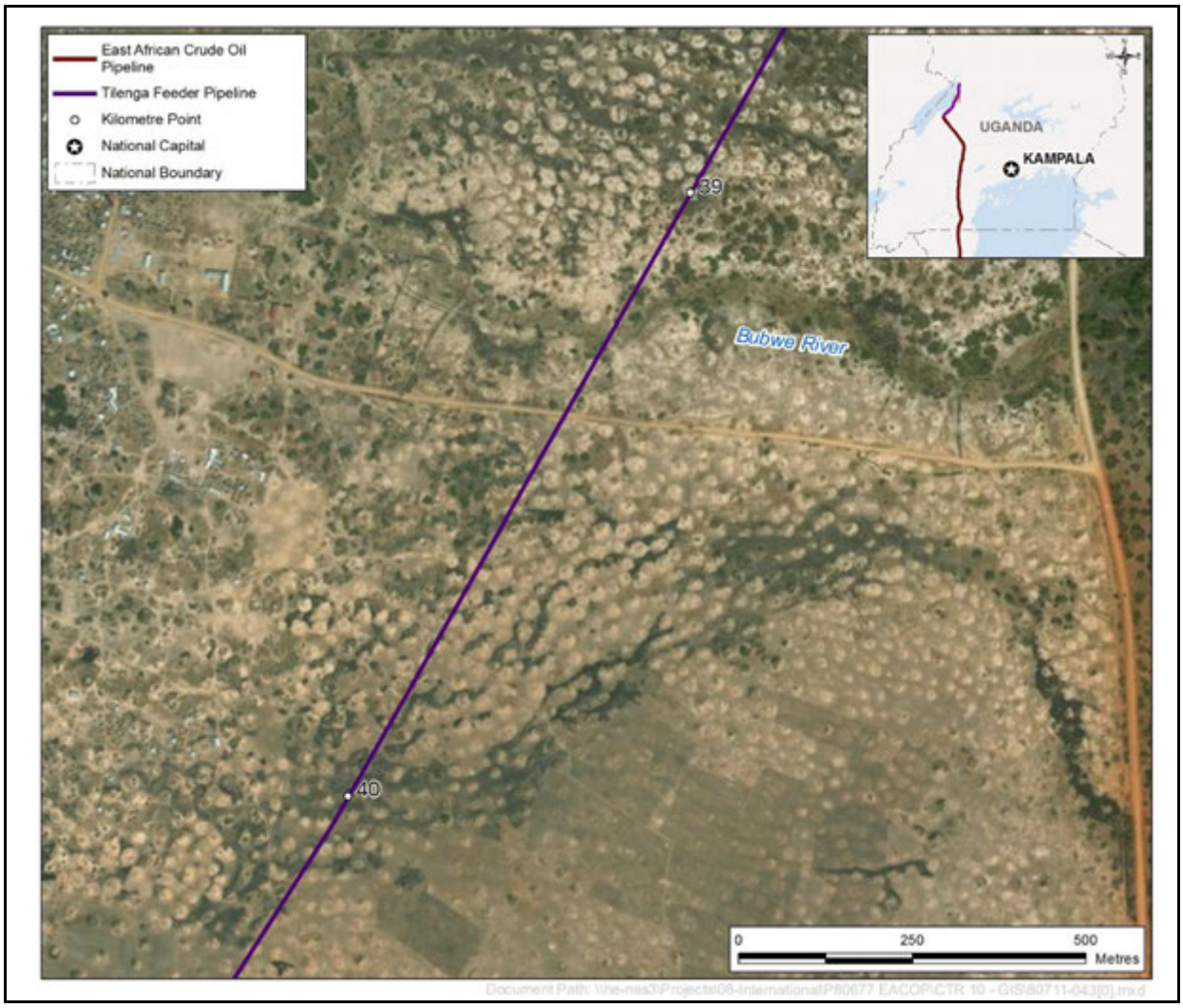

Figure Att6.3–5 Bubwe River at KP39

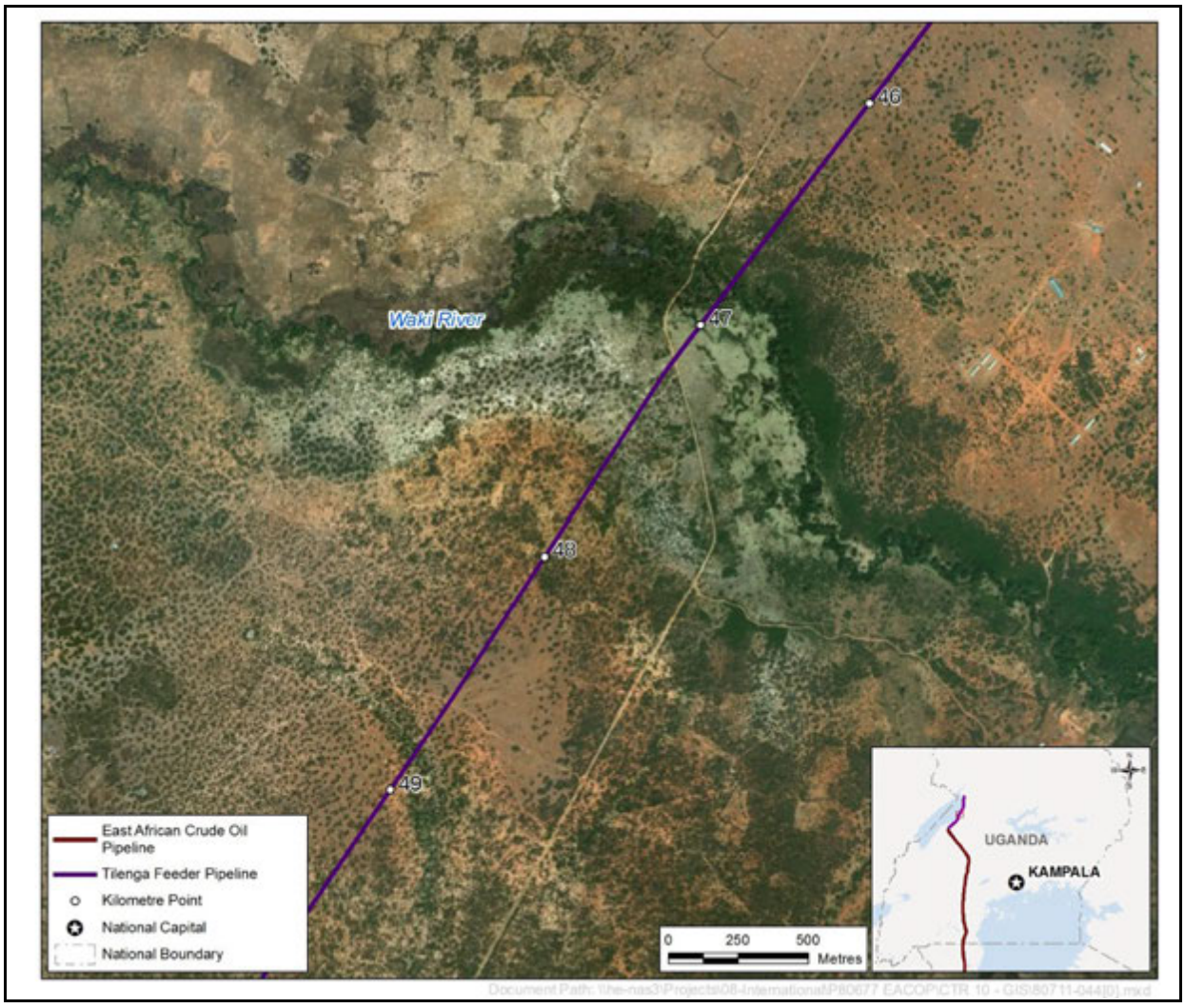

Figure Att6.3–6 Waki River at KP46.9

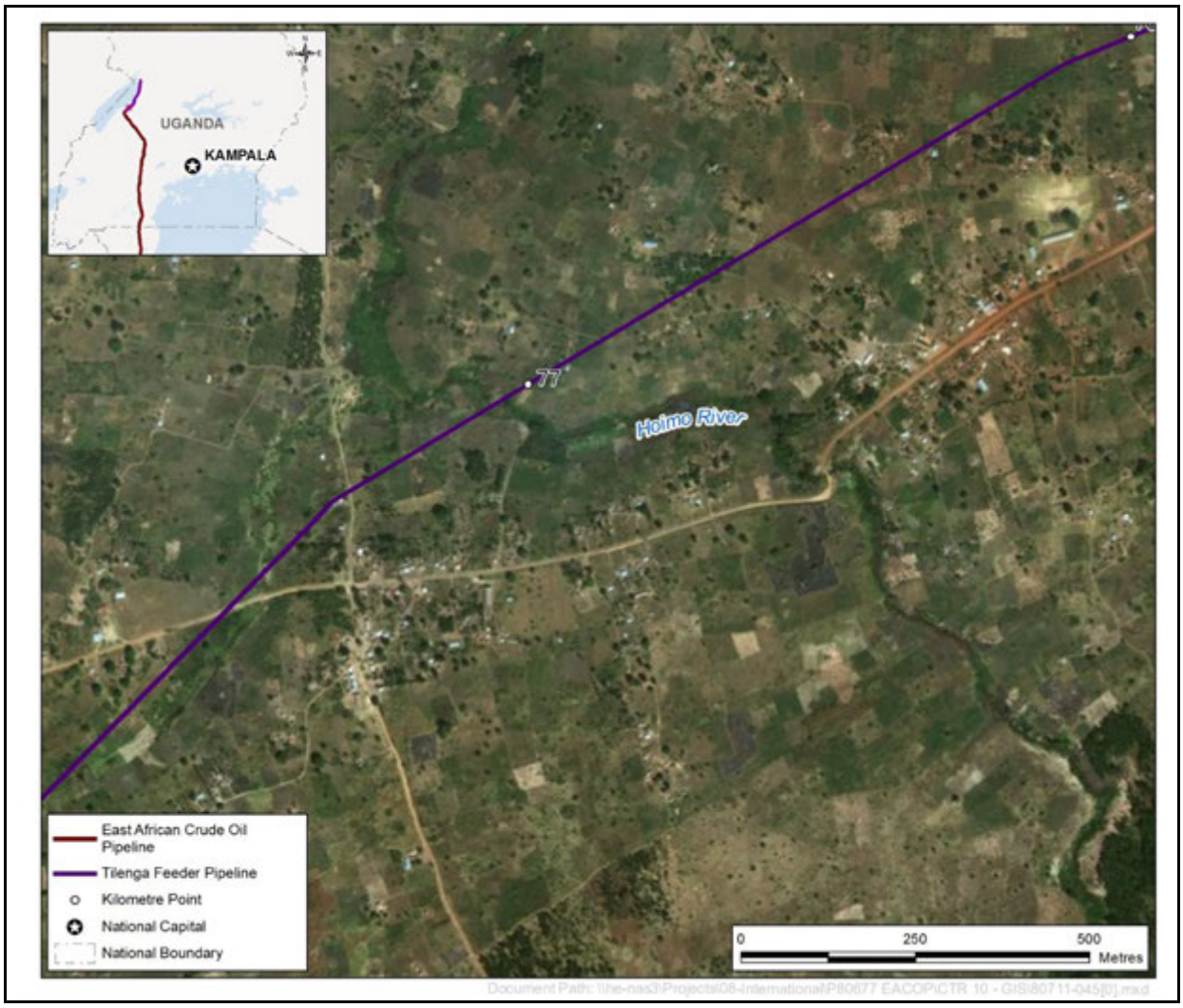

Figure Att6.3–7 Hoimo River at KP77

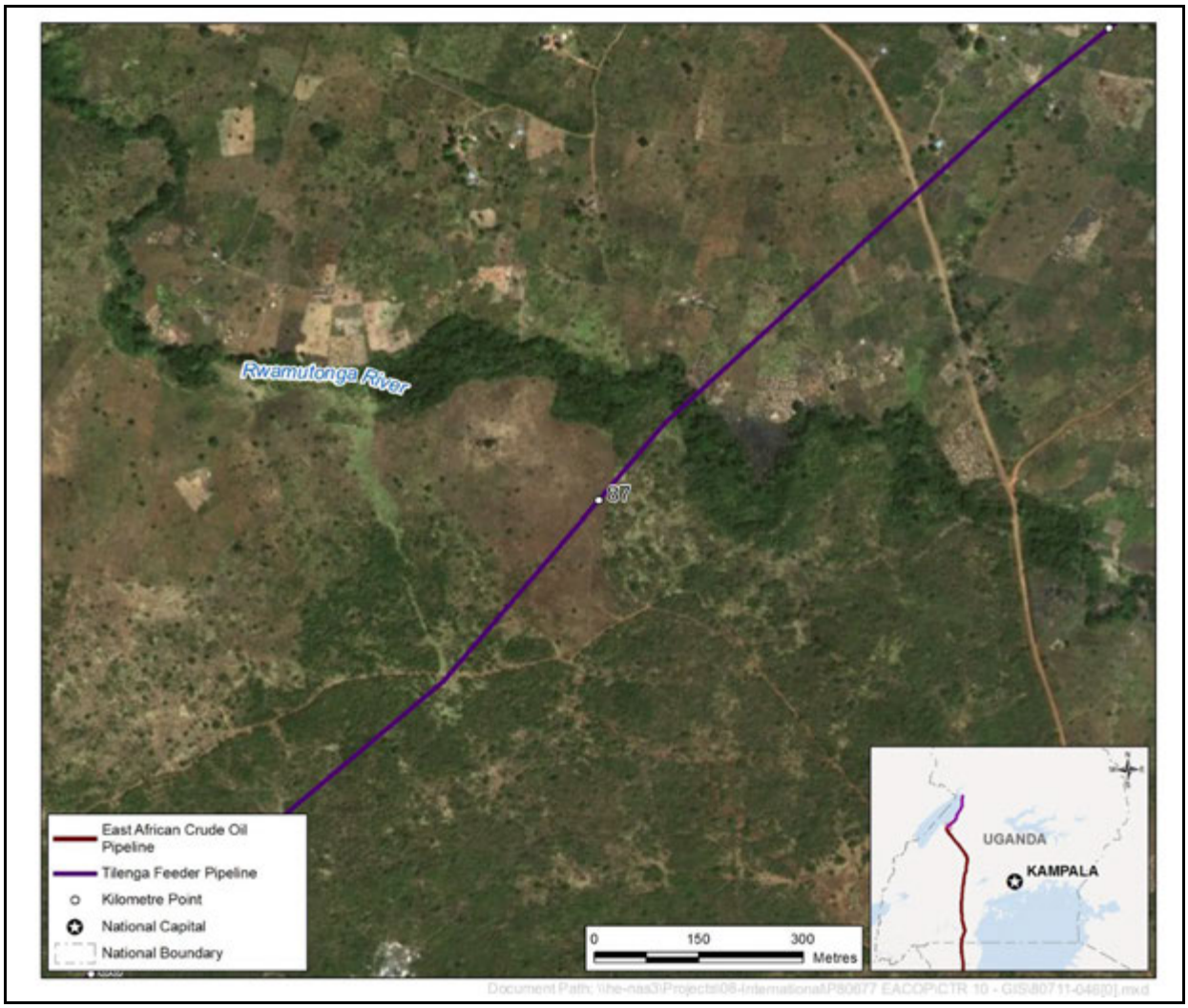

Figure Att6.3–8 Rwamutonga River at KP87

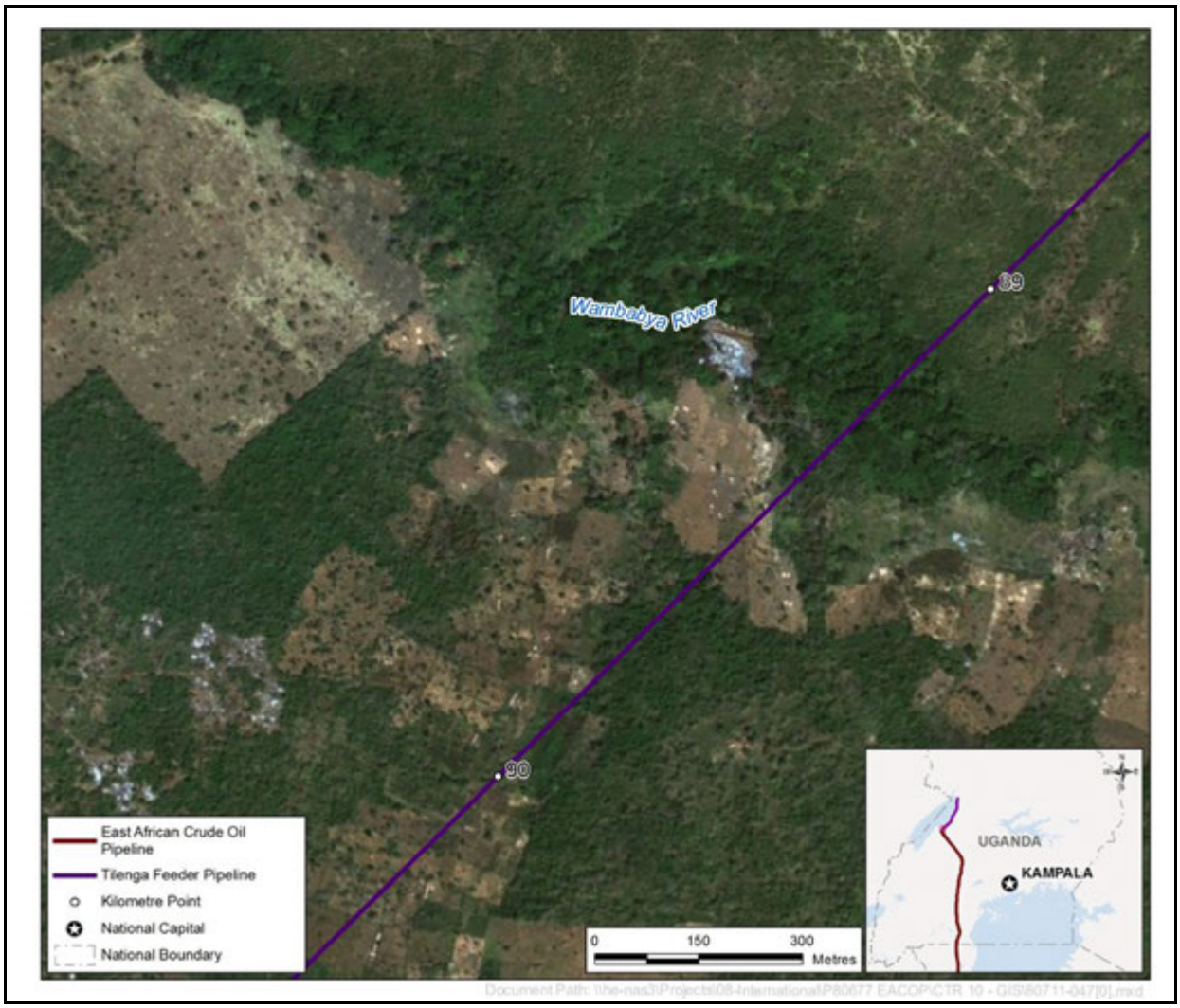

Figure Att6.3–9 Wambabya River at KP89.5

ATTACHMENT A6.4 MAPS OF WATERCOURSES AND COMMUNITY WATER SUPPLIES ALONG PROJECT ACCESS ROADS AND NEAR PROJECT FACILITIES

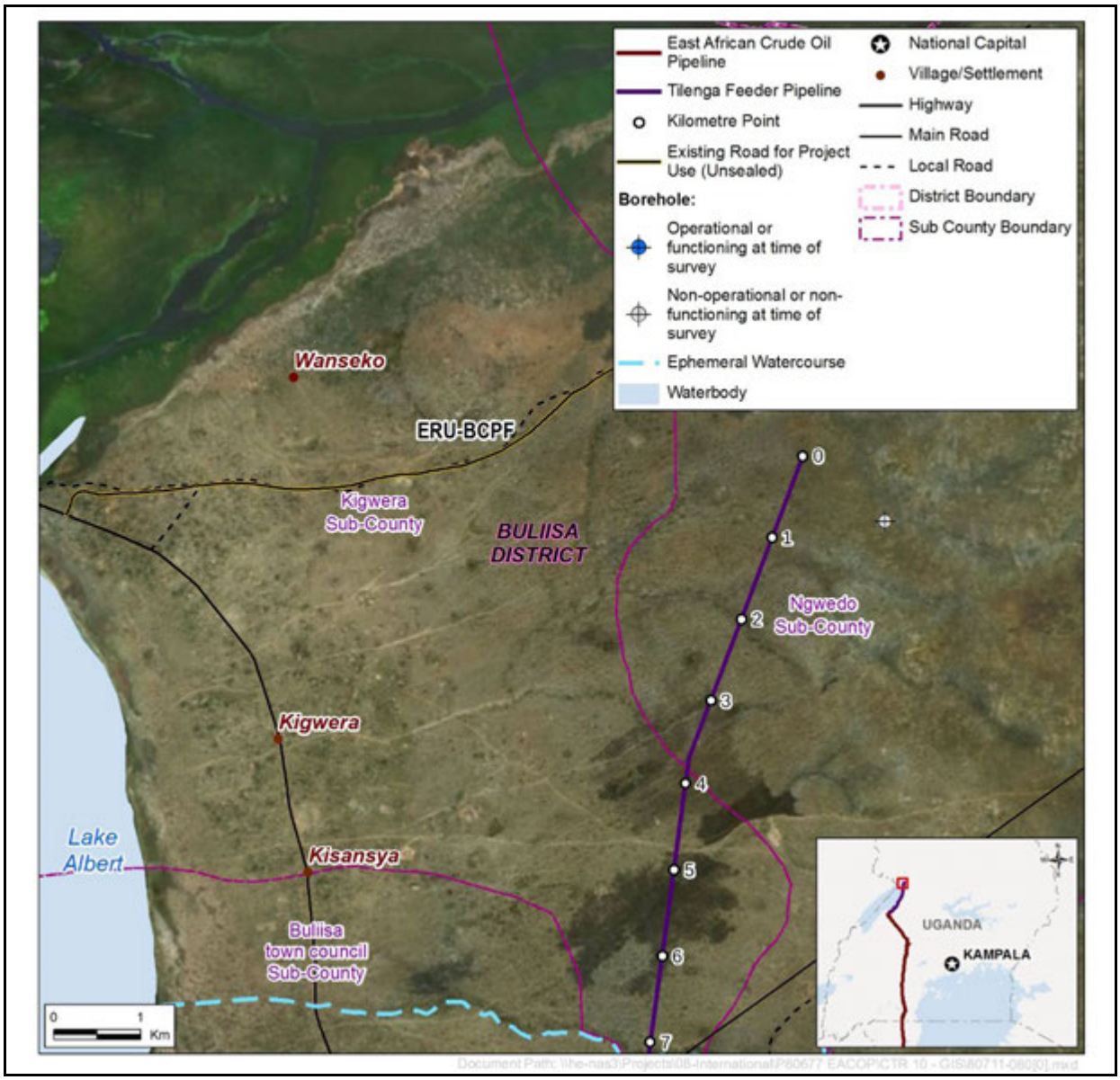

Figure Att6.4–1 Road ERU–BCPF at KP0

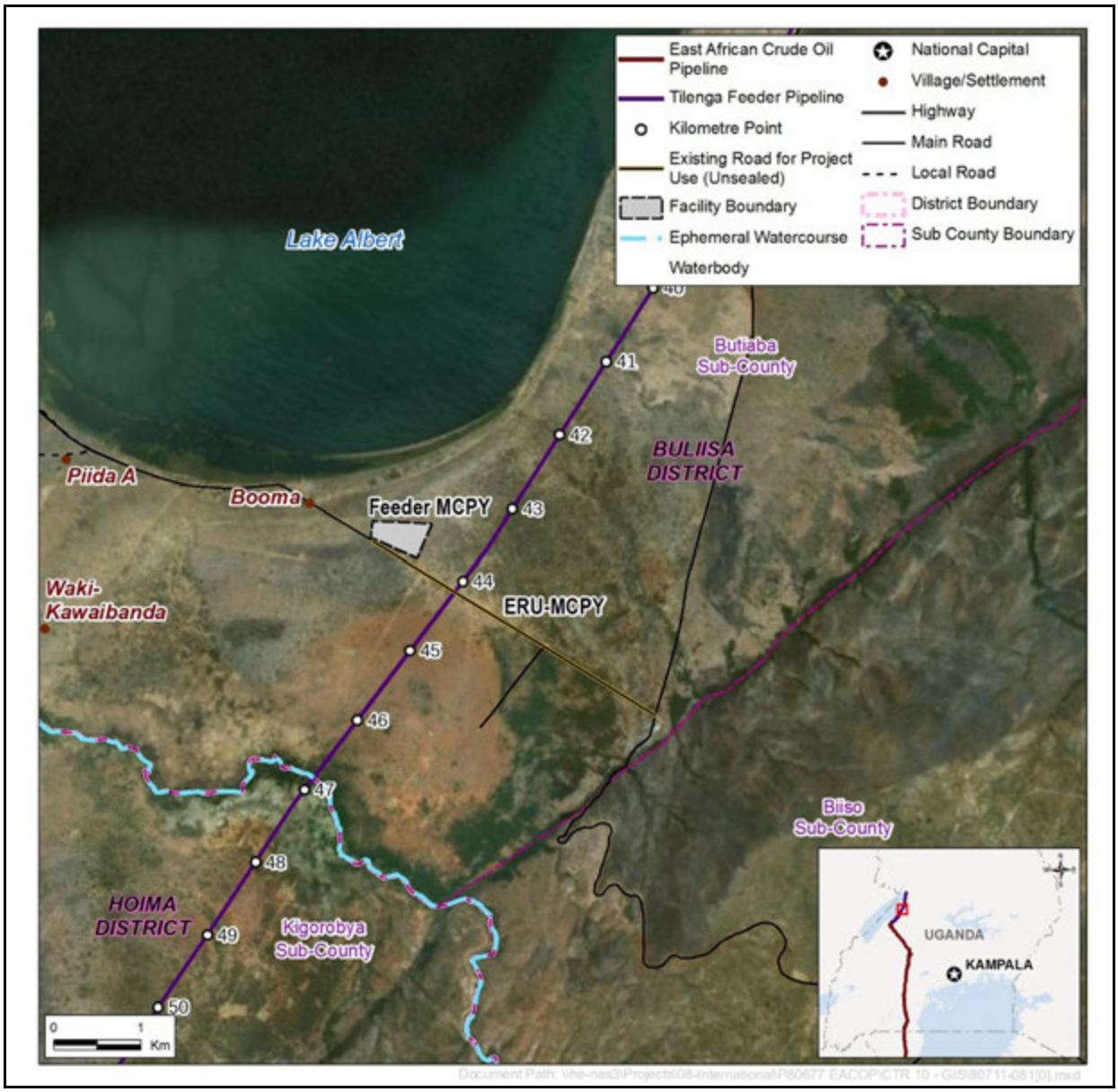

Figure Att6.4-2 Road ERU–MCPY and MCPY at KP44

ATTACHMENT A6.5 PHOTOGRAPHS OF SAMPLING SITES

Figure Att6.5–1 Waiga River KP22.5: View Upstream from the Sampling Site (Dry Season)

Figure Att6.5–2 Waiga River KP22.5: View Downstream from the Sampling Site (Dry Season)

Figure Att6.5–3 Waisoke River KP28.5: View Upstream from the Sampling Site (Dry Season)

Figure Att6.5–4 Waisoke River KP28.5: View Downstream from the Sampling Site (Dry Season)

Figure Att6.5–5 Sonso River KP34.3: View Upstream from the Sampling Site (Dry Season)

Figure Att6.5–6 Sonso River KP34.3: View Downstream from the Sampling Site (Dry Season)

Figure Att6.5–7 Waki River KP46.9: View Upstream from the Sampling Site (Dry Season)

Figure Att6.5–8 Waki River KP46.9: View Downstream from the Sampling Site (Dry Season)

ATTACHMENT A6.6 ESTIMATED RIVER CHANNEL DIMENSIONS AND FLOW CAPACITY AT BANKFULL LEVEL

KP	River	Estimated Bankfull Width (m)	Estimated Bankfull Depth (m)	Cross-Section Area A (m^2)	Wetted Perimeter P (m)	Hydraulic Radius R (A/P) (m)	Estimated Channel Slope (m/m)	Roughness Factor n	Estimated Bankfull Velocity (m/s)	Estimated Bankfull Flow (m^3/s)
7	Sambiye	59	1.5	88	96	0.9	0.0074	0.100[1]	0.8	70
21.3	Waiga	6	1	6	8	0.8	0.0023	0.035[2]	1.1	7
28.3	Waisoke	6	1	6	8	0.8	0.0022	0.035[2]	1.1	7
34.3	Sonso	9	1	9	11	0.8	0.0020	0.035[2]	1.1	10
39.3	Bubwe	3	1	3	5	0.6	0.0058	0.035[2]	1.5	5
46.9	Waki	9	1	9	11	0.8	0.0074	0.035[2]	2.2	19
77	Hoimo	7	0.5	3.5	8	0.4	0.0130	0.040[3]	1.6	6
87	Rwamutonga	8	0.5	4	9	0.4	0.0020	0.040[3]	0.7	3
89.5	Wambabya	10	1.5	15	13	1.2	0.0015	0.040[3]	1.1	16

NOTES: [1]Value of n given by Chow (1959) for floodplains with medium to dense brush in summer.

[2]Value of n given by Chow (1959) for minor streams on plain (top width <30 m); full stage, no riffles or deep pools, stones and weeds.

[3]Value of n given by Chow (1959) for minor mountain streams (top width <30 m), no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages. River bed: gravels, cobbles, and few boulders.

ATTACHMENT A6.7 ESTIMATION OF STREAM POWER AT MEAN ANNUAL FLOOD

River	KP	Mean Annual Flood (m^3/s)	Channel Slope (m/m)	Stream Power (W/m)
Sambiye River	7	4	0.0074	290
Waiga River	21–25	20	0.0023	451
Waisoke River	28–29	19	0.0022	410
Sonso River	34.3	13	0.002	255
Bubwe River	39	8	0.0058	455
Waki River	46.9	13	0.0074	944
Hoimo River	77	5	0.013	638
Rwamutongo River	87	4	0.002	78
Wambabya River	89.5	21	0.0015	309

ATTACHMENT A6.8 RESULTS OF ONSITE WATER QUALITY MEASUREMENTS AND OBSERVATIONS

Parameter	Uganda Standard Limit Level[1]		River							
	Treated	Natural	Waiga		Waisoke		Sonso		Waki	
KP			**KP22.5**		**KP28.5**		**KP34.3**		**KP46.9**	
Season			**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
Date, dd/mm/yy			**06/07/17**	**18/11/17**	**06/07/17**	**18/11/17**	**06/07/17**	**18/11/17**	**05/07/2017**	**18/11/17**
Time, hh:mm			**14:30**	**13:20**	**11:40**	**11:00**	**09:20**	**09:45**	**16:40**	**07:30**
Sample No.			**1008**	**1018**	**1007**	**1016**	**1006**	**1015**	**1005**	**1014**
Flow (est.)[2] m^3/s			0.2–0.4	4–6.8	3.4–4.2	7.9–12.6	0.36	0.6–3.0	12	16.3–19.5
Physical water quality										
Temperature, °C	-	-	22.9	23.3	22.0	23.7	22.4	22.7	22	21.5
Turbidity (NTU)	5	25	**71**	21	**85**	2.3	6	4.9	**43**	19
Chemical water quality										
pH	6.5–8.5	5.5–9.5	7.3	7.1	7.3	6.8	6.6	6.8	7.5	ND
EC (µS/cm)	1500	2500	216	136	187	118	135	185	148	117
TDS ** (mg/L)	500	1500	140	88	120	77	87	120	99	76
DO (mg/L)	-	-	5.2	4.8	6.0	6.9	4.4	2.1	7.5	7.9
DO (%)	-	-	66	61	74	88	54	26	92	96
Microbiological water quality										
Total Coliforms (sample/duplicate) (CFU/100 mL)	Absent	Absent	**160 / 216**	0, **10**	ND (turbidity interference)	**30 / 34**	**1056 / 816**	**14 / 12**	**128 / 196**	**30 / 20**
E. coli (sample / duplicate) (CFU/100 mL)	Absent	Absent	**688 / 912**	**10 / 60**	ND (turbidity interference)	**50 / 58**	**752 / 880**	**20 / 38**	**448 / 416**	**60 / 120**
Observations										
Odour	Odour-less	Odour-less	Present (organic)	ND	Present	Absent	Present (organic)	Absent	Present (organic)	Absent
Gas bubbles	-	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Algae	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Iridescence	-	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Bacterial aggregates	-	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Precipitates	-	-	Absent	NR	Absent	Absent	Absent	Absent	Absent	Absent
Colour (TCU)	15	50	ND	Light brown	ND	Light brown	ND	Grey	ND	Grey
Weather	-	-	Dry, warm, sunny	Sunny	Dry, warm, sunny	Sunny, clear sky	Dry, warm, sunny	Cloudy	Chilly, cool, dry	Cloudy
General	-	-	Water point for people and cattle	Water level higher	Community water and bathing point	Thick vegetation cover Newly formed floodplain	Vegetated river banks	Dense macrophyte cover. Slow moving water	Water point for cattle	Over-grown vegetation. Increased flow

NOTES: [1]Standards expressed as upper limit for treated and natural waters (Uganda Standard, US EAS 12: 2014, Potable water – Specification). The Uganda Standard has been incorporated into the project environmental standards.

[2]Flow was estimated by visually estimating the width (m), mean depth (m) and mean velocity (m/s) and calculating the flow using Flow = width x depth x velocity.

ND = no data.

ATTACHMENT A6.9 SGS' METHODS OF WATER ANALYSIS AND LIMITS OF DETECTION

Parameter	Analytical Method	Limit of Detection (mg/L)	Method Uncertainty (mg/L)
Total suspended solids TSS	EW APHA 2540D	1	±0.76
Chloride Cl	EW APHA 4500CL	0.2	±0.17
Sulphate SO_4	EW APHA 4500SO4E	0.02	±0.078
Calcium Ca	EW APHA 3111D CA ICP	0.01	±0.097
Biochemical Oxygen Demand BOD	EW APHA 5210B	0.1	-
Chemical Oxygen Demand COD	EW APHA 5220D COD	0.1	±0.024
Total Petroleum Hydrocarbons TPH	EW APHA 5520F	1	-
TPH speciated to aromatics and aliphatics	ISO 9377-2	0.1	±0.038
Total polycyclic aromatic hydrocarbons PAH	DIN 38407-39 HE	0.00001	-
Arsenic As dissolved (by Hydride)	EW APHA 3114B DHYD	0.001	±0.0008
Barium Ba dissolved	EW APHA 3111B DMET_I	0.002	±0.020
Cadmium Cd dissolved	EW APHA 3111B DMET I	0.001	±0.044
Chromium Cr dissolved	EW APHA 3111B DMET I	0.001	±0.027
Copper Cu dissolved	EW APHA 3111B DMET I	0.001	±0.016
Iron Fe dissolved	EW APHA 3111B DMET I	0.001	±0.050
Lead Pb dissolved	EW APHA 3111B DMET I	0.005	±0.012
Mercury Hg dissolved (by Cold Vapour)	EW APHA 3114B DHYD	0.001	±0.0015
Nickel Ni dissolved	EW APHA 3111B DMET I	0.004	±0.023
Silver Ag dissolved	EW APHA 3111B DMET	0.01	±0.001
Vanadium V dissolved	EW APHA 3111B DMET I	0.001	±0.026
Zinc Zn dissolved	EW APHA 3111B DMET I	0.001	±0.040

SOURCE: SGS

ATTACHMENT A6.10 RESULTS OF LABORATORY ANALYSES ON WATER SAMPLES

Parameter	Unit	Uganda Standard Limit Level[1]		River							
		Treated	Natural	Waiga		Waisoke		Sonso		Waki	
KP				KP22.5		KP28.5		KP34.3		KP46.9	
Season				Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Sample date (dd/mm/yy)				06/07/17	18/11/17	06/07/17	18/11/17	06/07/17	18/11/17	05/07/17	18/11/17
Time (hh:mm)				14:30	13:20	11:40	11:00	09:20	09:45	16:40	07:30
Sample no.				1008	1018	1007	1016	1006	1015	1005	1014
Physical water quality											
Total suspended solids TSS	mg/L	-	-	27.5	21.8	87.2	11.5	10.3	27.0	44.9	29.8
Chemical water quality											
Chloride Cl	mg/L	250	250	<0.20	3.5	5.9	69.9	4.1	4.0	2.3	3.7
Sulphate SO_4	mg/L	400	400	10.1	3.7	6.0	1.4	7.8	2.7	9.6	2.8
Calcium Ca	mg/L	150	150	9.6	7.3	10.1		5.8	8.9	6.2	7.2
Biochemical Oxygen Demand BOD	mg/L	-	-	1	13.0	3	12.0	1	20.0	2	14.0
Chemical Oxygen Demand COD	mg/L	-	-				26.8				
Total Petroleum Hydrocarbons TPH	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total hydrocarbons (C10–C40)	mg/L	-	-				<0.10				
Total polycyclic aromatic hydrocarbons PAH	mg/L	-	-				<0.00001				
Naphthalene (PAH)	mg/L	-	-				<0.00001				
Acenaphthylene (PAH)	mg/L	-	-				<0.00001				
Acenaphthene (PAH)	mg/L	-	-				<0.00001				
Fluorene (PAH)	mg/L	-	-				<0.00001				
Phenanthrene (PAH)	mg/L	-	-				<0.00001				
Anthracene (PAH)	mg/L						<0.00001				
Fluoranthene (PAH)	mg/L						<0.00001				
Pyrene (PAH)	mg/L						<0.00001				
Benz[a]anthracene (PAH)	mg/L						<0.00001				
Chrysene (PAH)	mg/L						<0.00001				
Benzo[b]fluoranthene (PAH)	mg/L						<0.00001				
Benzo[k]fluoranthene (PAH)	mg/L						<0.00001				
Benzo[a]pyrene (PAH)	mg/L	0.0007 [2]	0.0007 [2]				<0.00001				
Dibenz[a,h]anthracene (PAH)	mg/L						<0.00001				
Benzo(g,h,i)perylene (PAH)	mg/L						<0.00001				
Indeno(1,2,3-c,d)pyrene (PAH)	mg/L						<0.00001				
Arsenic As-dissolved	mg/L	0.01	0.01				<0.001				
Barium Ba-dissolved	mg/L	0.7	0.7				0.039				
Cadmium Cd-dissolved	mg/L	0.003	0.003				<0.001				
Chromium Cr-dissolved	mg/L	0.05	0.05				<0.001				
Copper Cu-dissolved	mg/L	1	1				<0.001				
Iron Fe-dissolved	mg/L	0.3	0.3				**0.76**				
Lead Pb-dissolved	mg/L	0.01	0.01				<0.005				

Parameter	Unit	Uganda Standard Limit Level[1]		River							
		Treated	Natural	Waiga		Waisoke		Sonso		Waki	
KP				**KP22.5**		**KP28.5**		**KP34.3**		**KP46.9**	
Season				**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
Sample date (dd/mm/yy)				**06/07/17**	**18/11/17**	**06/07/17**	**18/11/17**	**06/07/17**	**18/11/17**	**05/07/17**	**18/11/17**
Time (hh:mm)				**14:30**	**13:20**	**11:40**	**11:00**	**09:20**	**09:45**	**16:40**	**07:30**
Sample no.				**1008**	**1018**	**1007**	**1016**	**1006**	**1015**	**1005**	**1014**
Mercury Hg-dissolved	mg/L	0.001	0.001				<0.001				
Nickel Ni-dissolved	mg/L	0.02	0.02				<0.004				
Silver Ag-dissolved	mg/L						<0.01				
Vanadium V-dissolved	mg/L						<0.001				
Zinc Zn-dissolved	mg/L	5	5				0.031				

NOTES: – No standard available

[1]Standards expressed as upper limit for treated and natural waters (Uganda Standard, US EAS 12: 2014, Potable water – Specification). The Uganda Standard has been incorporated into the project environmental standards.

[2]0.0007 mg/L is equivalent to 0.7 µg/L as stated in Uganda Standard, US EAS 12: 2014, Potable water – Specification.

ATTACHMENT A6.11 JULY 2017 DRY SEASON WATER QUALITY SURVEY – LABORATORY REPORTS

SGS

sanas Testing Laboratory

T0337

Report number: EL170168

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Tim Newton
RSK Ltd
Spring lodge, 172Chester Road, Helsby,
Cheshire, WA6 OAR, UK

Lab Ref:	EL170168
Client Ref:	**P0269241**
Project:	
Received:	11/07/2017
Reported:	04/08/2017
Samples:	5
First Sample:	1005
Last Sample:	1008
Pages:	2

FINAL REPORT

Notes

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Authorised:

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Lab Ref EL170168
Client Ref **P0269241**
Project
Reported 04/08/2017
Status Final
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ANALYTICAL REPORT

Sample Ident	*Chloride*	*Sulphate*	*Ca*	*TSS*	*BOD**	*Total Petroleum Hydrocarbon**
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1005 Date(dd-mm-yy): 05/07/2017 Time(24hr): 16:40 Sample type:	2.3	9.6	6.2	44.9	2.0	<1.0
1006 Date(dd-mm-yy): 06/07/2017 Time(24hr): 09:20 Sample type:River water	4.1	7.8	5.8	10.3	1.0	<1.0
1007 Date(dd-mm-yy): 06/07/2017 Time(24hr): 11:40 Sample type:River water	5.9	6.0	10.1	87.2	3.0	<1.0
1008 Date(dd-mm-yy): 06/07/2017 Time(24hr): 14:30 Sample type:River water	<0.20	10.1	9.6	27.5	1.0	<1.0
Method	*Chloride*	*Sulphate*	*Cations*	*TSS*	*BOD*	*troleum Hydrocarbons*
Detection Limit	*0.20*	*0.02*	*0.01*	*1.0*	*0.10*	*1.0*
Method Uncertainity	*±0.17*	*±0.078*	*±0.097*	*±0.76*	-	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

END OF REPORT

ATTACHMENT A6.12 NOVEMBER 2017 WET SEASON WATER QUALITY SURVEY – LABORATORY REPORTS

SGS

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T0337

Report number: EL170288

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Lab Ref: EL170288
Client Ref: **PO272595**
Project:
Received: 23/11/2017
Reported: 17/01/2018

Samples: 6
First Sample: 1014 (Water) 18-Nov-17 07:00
Last Sample: 1019 (Water) 18-Nov-17 14:20
Pages: 8

FINAL REPORT

Notes

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Authorised:

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Bismark Sarkodie
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ANALYTICAL REPORT

Sample Ident	*Chloride*	*TSS*	*Sulphate*	*Ca*	*BOD**	*Total Petroleum Hydrocarbon**
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1014 (Water) 18-Nov-17 07:00	3.7	29.8	2.8	7.2	14.0	<1.0
1015 (Water) 18-Nov-17 09:45	4.0	27.0	2.7	8.9	20.0	<1.0
1016 (Water) 18-Nov-17 11:00	69.9	11.5	1.4	N.A	12.0	<1.0
1018 (Water) 18-Nov-17 13:20	3.5	21.8	3.7	7.3	13.0	<1.0
1019 (Water) 18-Nov-17 14:20	64.0	<1.0	2.6	0.093	2.0	<1.0

Method	*Chloride*	*TSS*	*Sulphate*	*Cations*	*BOD*	*troleum Hydrocarbons*
Detection Limit	*0.20*	*1.0*	*0.02*	*0.01*	*0.10*	*1.0*
Method Uncertainity	*±0.17*	*±0.76*	*±0.078*	*±0.097*	-	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	*COD*	*As*	*Hg*	*Ba*	*Cd*	*Cr*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1014 (Water) 18-Nov-17 07:00	N.A	N.A	N.A	N.A	N.A	N.A
1015 (Water) 18-Nov-17 09:45	N.A	N.A	N.A	N.A	N.A	N.A
1016 (Water) 18-Nov-17 11:00	26.8	<0.001	<0.001	0.039	<0.001	<0.001
1018 (Water) 18-Nov-17 13:20	N.A	N.A	N.A	N.A	N.A	N.A
1019 (Water) 18-Nov-17 14:20	N.A	N.A	N.A	N.A	N.A	N.A

Method	*COD*	*D_Hydrides*	*D_Hydrides*	*issolved Metal*	*issolved Metal*	*issolved Metals*
Detection Limit	*0.10*	*0.001*	*0.001*	*0.002*	*0.001*	*0.001*
Method Uncertainity	*±0.024*	*±0.0008*	*±0.0015*	*±0.020*	*±0.044*	*±0.027*

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	*Cu*	*Fe*	*Pb*	*Ni*	*Ag*	*V*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1014 (Water) 18-Nov-17 07:00	N.A	N.A	N.A	N.A	N.A	N.A
1015 (Water) 18-Nov-17 09:45	N.A	N.A	N.A	N.A	N.A	N.A
1016 (Water) 18-Nov-17 11:00	<0.001	0.76	<0.005	<0.004	<0.01	<0.001
1018 (Water) 18-Nov-17 13:20	N.A	N.A	N.A	N.A	N.A	N.A
1019 (Water) 18-Nov-17 14:20	N.A	N.A	N.A	N.A	N.A	N.A
Method	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metals*
Detection Limit	*0.001*	*0.001*	*0.005*	*0.004*	*0.01*	*0.001*
Method Uncertainity	*±0.016*	*±0.050*	*±0.012*	*±0.023*	*±0.001*	*±0.026*

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	*Zn*	*Polycyclic Aromatic Hydrocarbonms (PAH) #*				
		Naphthalene	*Acenaphthylene*	*Acenaphthene*	*Fluorene*	*Phenanthrene*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1014 (Water) 18-Nov-17 07:00	N.A	N.A	N.A	N.A	N.A	N.A
1015 (Water) 18-Nov-17 09:45	N.A	N.A	N.A	N.A	N.A	N.A
1016 (Water) 18-Nov-17 11:00	0.031	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
1018 (Water) 18-Nov-17 13:20	N.A	N.A	N.A	N.A	N.A	N.A
1019 (Water) 18-Nov-17 14:20	N.A	N.A	N.A	N.A	N.A	N.A
Method	*Dissolved Metal*	*HIN 38407-39*	*HIN 38407-39*	*HIN 38407-39*	*HIN 38407-39*	*HIN 38407-39 HE*
Detection Limit	*0.001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Method Uncertainity	*±0.040*	-	-	-	-	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	*Polycyclic Aromatic Hydrocarbonms (PAH) #*					
	Anthracene	*Fluoranthene*	*Pyrene*	*Benz(a)anthracene*	*Chrysene*	*Benzo(b)fluoranthene*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1014 (Water) 18-Nov-17 07:00	N.A	N.A	N.A	N.A	N.A	N.A
1015 (Water) 18-Nov-17 09:45	N.A	N.A	N.A	N.A	N.A	N.A
1016 (Water) 18-Nov-17 11:00	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
1018 (Water) 18-Nov-17 13:20	N.A	N.A	N.A	N.A	N.A	N.A
1019 (Water) 18-Nov-17 14:20	N.A	N.A	N.A	N.A	N.A	N.A
Method	*HN 38407-39*	*HN 38407-39*	*HN 38407-39*	*HN 38407-39*	*HN 38407-39*	*HN 38407-39 HE*
Detection Limit	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Method Uncertainity	-	-	-	-	-	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	*Polycyclic Aromatic Hydrocarbonms (PAH) #*					
	Benzo(k)fluoranthene	*Benzo(a)pyrene*	*Dibenzo(a,h)anthracene*	*Benzo(g,h,i)perylene*	*Indeno(1,2,3-c,d)pyrene*	*Total PAH*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
1014 (Water) 18-Nov-17 07:00	N.A	N.A	N.A	N.A	N.A	N.A
1015 (Water) 18-Nov-17 09:45	N.A	N.A	N.A	N.A	N.A	N.A
1016 (Water) 18-Nov-17 11:00	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
1018 (Water) 18-Nov-17 13:20	N.A	N.A	N.A	N.A	N.A	N.A
1019 (Water) 18-Nov-17 14:20	N.A	N.A	N.A	N.A	N.A	N.A
Method	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 HE*
Detection Limit	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Method Uncertainity	-	-	-	-	-	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited* *# - subcontracted* *TNTC - too numerous to count* *T.F. to follow*

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Lab Ref	EL170288
Client Ref	**PO272595**
Project	
Reported	17/01/2018
Status	Final
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ANALYTICAL REPORT

Sample Ident	*Total Hydrocarbons (C10-C40)#*
Units	*mg/l*
1014 (Water) 18-Nov-17 07:00	N.A
1015 (Water) 18-Nov-17 09:45	N.A
1016 (Water) 18-Nov-17 11:00	<0.10
1018 (Water) 18-Nov-17 13:20	N.A
1019 (Water) 18-Nov-17 14:20	N.A
Method	*EN ISO 9377-2 HE*
Detection Limit	*0.10*
Method Uncertainity	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

END OF REPORT

ATTACHMENT A6.13 SGS' METHODS OF SEDIMENT ANALYSIS AND LIMITS OF DETECTION

Parameter	Analytical Method	Limit of Detection (mg/kg)
pH	EW_APHA_4500H	-
Chloride Cl	EW_APHA_4500CL	0.2
Total Petroleum Hydrocarbons TPH	EW_APHA_5520F	1.0
Total Phenols	EW_APHA_5530C	0.002
Sulphides	EW_APHA_4500S_2F	0.1
Arsenic As (by Hydride)	EW_APHA_3114B_DHYD	0.001
Cadmium Cd	EW_APHA_3111B_DMET_I	0.001
Chromium Cr	EW_APHA_3111B_DMET_I	0.001
Copper Cu	EW_APHA_3111B_DMET_I	0.001
Lead Pb	EW_APHA_3111B_DMET_I	0.005
Mercury Hg (by Cold Vapour)	EW_APHA_3114B_DHYD	0.001
Nickel Ni	EW_APHA_3111B_DMET_I	0.004
Silver Ag	EW_APHA_3111B_DMET_I	0.01
Vanadium V	EW_APHA_3111B_DMET_I	0.001
Zinc Zn	EW_APHA_3111B_DMET_I	0.001

SOURCE: SGS

ATTACHMENT A6.14 RESULTS OF ONSITE OBSERVATIONS AND LABORATORY ANALYSES ON SEDIMENT SAMPLES

Parameter	**River**			
	Waiga	**Waisoke**	**Sonso**	**Waki**
KP	**KP22.5**	**KP28.5**	**KP34.3**	**KP46.9**
Sample date (dd/mm/yy)	**18/11/17**	**18/11/17**	**18/11/17**	**18/11/17**
Time (hh:mm)	**14:00**	**12:05**	**10:15**	**07:30**
Sample no.	**1018-SED**	**1016-SED**	**1015-SED**	**1014-SED**
Sample location	**Downstream of road bridge**	**Downstream of road culvert**	**Not recorded**	**Not recorded**
Observations				
Texture	Fine silt/sand	Gravel/coarse sand	Fine and coarse particles	Silty
Colour	Brown	Grey	Black	Brown
Odour	Soil odour	Soil/organic odour	Organic odour	Soil odour
Presence of biota	Not visible	Not visible	Not visible	Not visible
Presence of detritus	Not visible	Present	Present	Absent
Depth of sediment sampled (m)	0–0.5	0–0.5	0–0.3	0–0.5
Other	Possibly murram washed off road. Used shovel only	Thick vegetation cover. Newly formed floodplain. Used shovel only	Dense macrophyte growth. Slow moving water. Used shovel only	Cattle watering point. Used sample tube and shovel
Weather	Sunny	Sunny	Cloudy	Sunny
Analytical Results				
pH	7.5	7.1	7.2	7.7
Chloride Cl (mg/kg)	25.8	24.3	13.3	27.8
TPH (mg/ kg)	<1.0	<1.0	<1.0	<1.0
Total Phenols (mg/kg)	<0.002	<0.002	<0.002	<0.002
Sulphides (mg/kg)	<0.10	<0.10	<0.10	<0.10
Arsenic As by Hydride (mg/kg)	<0.001	<0.001	<0.001	<0.001

Parameter	**River**			
	Waiga	**Waisoke**	**Sonso**	**Waki**
KP	**KP22.5**	**KP28.5**	**KP34.3**	**KP46.9**
Sample date (dd/mm/yy)	**18/11/17**	**18/11/17**	**18/11/17**	**18/11/17**
Time (hh:mm)	**14:00**	**12:05**	**10:15**	**07:30**
Sample no.	**1018-SED**	**1016-SED**	**1015-SED**	**1014-SED**
Cadmium Cd (mg/kg)	<0.001	<0.001	<0.001	<0.001
Chromium Cr (mg/kg)	<0.001	<0.001	<0.001	<0.001
Copper Cu (mg/kg)	<0.001	<0.001	<0.001	<0.001
Lead Pb (mg/kg)	<0.005	<0.005	<0.005	<0.005
Mercury Hg by Cold Vapour (mg/kg)	<0.001	<0.001	<0.001	<0.001
Nickel Ni (mg/kg)	<0.004	<0.004	<0.004	<0.004
Silver Ag (mg/kg)	<0.01	<0.01	<0.01	<0.01
Vanadium V (mg/kg)	0.071	<0.001	<0.001	<0.001
Zinc Zn (mg/kg)	0.373	0.208	<0.001	0.459

ATTACHMENT A6.15 SEDIMENT QUALITY SURVEY: LABORATORY REPORTS

SGS

sanas testing Laboratory

T0337

Report number: EL170289

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Lab Ref: EL170289
Client Ref: **PO272595**
Project:
Received: 23/11/2017
Reported: 09/02/2018

Samples: 6
First Sample: 1014 (SED) 18-Nov-17 07:30
Last Sample: 1018 (SED) 18-Nov-17 14:00
Pages: 4

FINAL REPORT

Notes

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ANALYTICAL REPORT

Sample ident	*pH*	*Chloride*	*Total Petroleum Hydrocarbon**	*Total Phenols**	*Sulphide**	*As*
Units	*SU*	*mg/Kg*	*mg/Kg*	*mg/Kg*	*mg/Kg*	*mg/Kg*
1014 (SED) 18-Nov-17 07:30	7.7	27.8	<1.0	<0.002	<0.10	<0.001
1015 (SED) 18-Nov-17 10:15	7.2	13.3	<1.0	<0.002	<0.10	<0.001
1016 (SED) 18-Nov-17 12:05	7.1	24.3	<1.0	<0.002	<0.10	<0.001
1017 (SED) 18-Nov-17 12:05	7.3	20.0	<1.0	<0.002	<0.10	<0.001
1018 (SED) 18-Nov-17 14:00	7.5	25.8	<1.0	<0.002	<0.10	<0.001

Method	*pH in water*	*Chloride*	*ıtroleum Hydro*	*Phenols*	*Sulphide*	*D_Hydrides*
Detection Limit	-	*0.20*	*1.0*	*0.002*	*0.10*	*0.001*
Method Uncertainity	*±0.012*	*±0.17*	-	-	-	*±0.0008*

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited* *# - subcontracted* *TNTC - too numerous to count* *T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	Hg	Cd	Cr	Cu	Pb	Ni
Units	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
1014 (SED) 18-Nov-17 07:30	<0.001	<0.001	<0.001	<0.001	<0.005	<0.004
1015 (SED) 18-Nov-17 10:15	<0.001	<0.001	<0.001	<0.001	<0.005	<0.004
1016 (SED) 18-Nov-17 12:05	<0.001	<0.001	<0.001	<0.001	<0.005	<0.004
1017 (SED) 18-Nov-17 12:05	<0.001	<0.001	<0.001	<0.001	<0.005	<0.004
1018 (SED) 18-Nov-17 14:00	<0.001	<0.001	<0.001	<0.001	<0.005	<0.004
Method	D_Hydrides	issolved Metal	issolved Metal	issolved Metal	issolved Metal	issolved Metals
Detection Limit	0.001	0.001	0.001	0.001	0.005	0.004
Method Uncertainity	±0.0015	±0.044	±0.027	±0.016	±0.012	±0.023

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

*non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow

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Lab Ref	EL170289
Client Ref	**PO272595**
Project	
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ANALYTICAL REPORT

Sample Ident	*Ag*	*V*	*Zn*
Units	*mg/Kg*	*mg/Kg*	*mg/Kg*
1014 (SED) 18-Nov-17 07:30	<0.01	<0.001	0.46
1015 (SED) 18-Nov-17 10:15	<0.01	<0.001	<0.001
1016 (SED) 18-Nov-17 12:05	<0.01	<0.001	0.21
1017 (SED) 18-Nov-17 12:05	<0.01	0.015	<0.001
1018 (SED) 18-Nov-17 14:00	<0.01	0.071	0.37
Method	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metals*
Detection Limit	*0.01*	*0.001*	*0.001*
Method Uncertainity	*±0.001*	*±0.026*	*±0.040*

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

END OF REPORT

ATTACHMENT A6.16 QUALITY CONTROL PROCEDURES

Introduction

Several quality control procedures were implemented to ensure that accurate and reliable water and sediment quality data were collected. These included:

- blank water sample
- duplicate water and sediment samples
- daily calibration checks on the Aquaprobe multiparameter probe
- single-use bailer for water sampling
- nitrile gloves used while sampling water and sediment
- standard operating procedures.

Blank Water Sample

A single blank water sample of de-ionised water was taken to check the correct functioning of analytical equipment.

Duplicate Water and Sediment Samples

A single duplicate sediment sample was taken to check the reproducibility of the analytical results. Table Att6.15-1 lists the quality control samples taken.

Table Att6.15-1 Quality Control Samples

Sample Medium	Sample ID	Sample Type	Analysis Suite
Water	1019	Blank (de-ionised water)	Lab measurements: BOD, Cl, TPH, TSS
Sediment	1017-SED	Duplicate of sample 1016-SED	Lab measurements: pH, Cl, TPH, Total Phenols, Sulphides, Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Ag, V, Zn)

The results of the quality control samples are presented in Table Att6.15-2, with duplicate data presented along with those of the original sample allowing direct comparison.

Table Att6.15–2 Quality Control Data

Parameter	Unit	Water		Sediment	
		Blank	Original	Duplicate	Original
Sample date		**18/11/17**	**18/11/17**	**18/11/17**	**18/11/17**
Time		**13:20**	**13:20**	**12:05**	**12:05**
Sample no.		**1019**	**1018**	**1017-SED**	**1016-SED**
Sample location		**Waiga River KP22.5 Downstream of road bridge**		**Waisoke River KP28.5. Downstream of road culvert**	
Water					
Total suspended solids (TSS)	mg/L	<0.1	21.8		
Chloride Cl	mg/L	64	3.5		
Biochemical oxygen demand BOD	mg/L	2.0	13.0		
Total petroleum hydrocarbons TPH	mg/L	<1.0	<1.0		
Sediment					
pH				7.3	7.1
Chloride Cl	mg/L			20.0	24.3
Total Petroleum Hydrocarbons TPH	mg/L			<1.0	<1.0
Total Phenols	mg/L			<0.002	<0.002
Sulphide	mg/L			<0.10	<0.10
Arsenic As by Hydride	mg/L			<0.001	<0.001
Cadmium Cd	mg/L			<0.001	<0.001
Chromium Cr	mg/L			<0.001	<0.001
Copper Cu	mg/L			<0.001	<0.001
Lead Pb	mg/L			<0.005	<0.005
Mercury Hg by Cold Vapour	mg/L			<0.001	<0.001
Nickel Ni	mg/L			<0.004	<0.004
Silver Ag	mg/L			<0.01	<0.01
Vanadium V	mg/L			0.015	<0.001
Zinc Zn	mg/L			<0.001	0.21

With the exception of the BOD results for water, the results for the water and sediment duplicates show close agreement with those of the original samples. It is concluded that, with the exception of BOD, the laboratory results are reproducible. BOD analyses are prone to variation when there is an appreciable transit time to the laboratory, as is the case here: the samples are taken in Uganda and the laboratory is in Tanzania.

Daily Calibration Checks

The calibration of the multiparameter Aquaprobe was checked at the start of each sampling day to maximise the accuracy of results.

Single-Use Bailers

Use of single-use bailers prevents cross contamination of samples. Where possible, single-use bailers (clean 1-L sample bottles) were used to collect water from the river. These bottles were marked and not used again during the survey.

Where use of single use bailers was impractical, a bucket and rope were used for collecting water. Before sample collection, the bucket was thoroughly washed with the water to be sampled, minimising the risk of cross contamination.

Nitrile Gloves

The sampling team wore nitrile gloves during sampling, minimising the risk of contamination of samples. Gloves were discarded after use at each site.

Standard Operating Procedures

Standard operating procedures were provided for the samplers to following during training and during the survey:

- surface water hydrochemical sampling
- Aquaread multiparameter probe calibration
- surface water field parameters
- preparation of CHROMagar ECC broth (culture medium for microbiological testing)
- river sediment sampling.

The use of standard procedures ensured as far as possible uniformity in calibration, sampling and measurement, causing any differences in results to be due to the water or sediment sampled and not the sampling or measurement technique.

ATTACHMENT A6.17 SECONDARY RIVER WATER QUALITY DATA (SOURCE: SWS 2010)

Table Att6.16-1 Sampling Dates

SWS ID	Date Sampled
HR-09 River Waki	17/08/2010
HR-16 River Sonso	17/08/2010
HR-26 River Waisoke	17/08/2010
HR-31 River Waiga	17/08/2010
ZO-01 River Zolya	16/08/2010

Table Att6.16-2 Field Measurements

SWS Well ID	pH	Temp (°C)	EC (µS/cm @ 25°C)	DO (mg/L)	ORP (mV)	Colour (mg/L Pt)	Turbidity (NTU)	Total Alkalinity (mg/L as $CaCO_3$)	Nitrite (mg/L)	Faecal Coliform (CFU/100 mL)
HR-09 River Waiki	7.5	22.1	86.7	6.71	40	367	107	25	<0.05	300
HR-16 River Sonso	7.03	23.2	156	3.76	33	>1000	141	63	0.1	126
HR-26 River Waisoke	7.38	22.9	132	4.63	28	>1000	170	57	0.2	116
HR-31 River Waiga	7.16	22.8	131	3.73	20	388	56.8	52	0.1	67
ZO-01 River Zolya	6.28	37.8	242	0.82	-81	460	17.1	54	<0.05	50

Table Att6.16-3 Dissolved Metals

Sample Location	All µg/L																				
	Al	As	Ba	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Na	Sr	Sn	Zn
HR-09 River Waik	43	<0.8	28.8	<120	<0.6	6.23	0.9	<0.6	1	985	<5.0	3360	9.3	<0.1	<2	1.46	<1.6	4.4	39	<5	<3
HR-16 River Sonso	<32	<0.8	60.1	<120	<0.6	15.3	<0.7	3.5	<1	3100	<5.0	6310	1040	<0.1	3	3.6	<1.6	3.7	83	<5	<3
HR-26 River Waisoke	65	<0.8	35.4	<120	<0.6	10.4	<0.7	<0.6	2	567	<5.0	4100	20.7	<0.1	<2	2.11	<1.6	8.6	58	<5	<3
HR-31 River Waiga	64	<0.8	59.1	<120	<0.6	10.3	<0.7	0.7	2	1690	<5.0	4850	100	<0.1	4	2.79	<1.6	7.9	75	<5	<3
ZO-01 River Zolya	<32	<0.8	67.6	<120	<0.6	7.25	<0.7	1.2	<1	706	<5.0	3360	140	<0.1	5	3.3	<1.6	6.4	54	<5	<3

Table Att6.16-4 Total Metals

Sample Location	All µg/L																				
	Al	As	Ba	B	Cd	Ca	Cr	Cr (VI)	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Na	Sr	Sn	Zn
HR-09 River Waiki	487	<0.8	53	245	<0.6	9.22	1.2	<0.03	2.1	20	4580	6.4	3720	273	<0.1	<2	1.68	<1.6	9.94	58	<5	45
HR-16 River Sonso	84	1.1	98.3	216	<0.6	16.1	<0.7	<0.03	4.2	18	12500	11.1	6350	1110	<0.1	<2	4.04	<1.6	9.88	111	<5	15
HR-26 River Waisoke	1180	<0.8	67.4	236	<0.6	12.7	3.2	<0.03	2.3	21	4320	5.6	4780	111	<0.1	<2	2.62	<1.6	14.9	86	<5	25
HR-31 River Waiga	361	<0.8	101	235	<0.6	11.7	0.9	<0.03	1.6	21	4860	7.6	5040	208	<0.1	<2	3.16	<1.6	13.8	101	<5	9
ZO-01 River Zolya	147	<0.8	78.1	222	0.9	8.75	0.9	<0.03	2	27	2290	5.5	3520	150	<0.1	<2	3.72	<1.6	12.5	72	<5	<3

Table Att6.16-5 Anions and Nutrients

Sample Location	All mg/L													
	Chloride as Cl	Fluoride as F	Sulphate as SO_4	Bicarbonate Alkalinity (as $CaCO_3$)	Carbonate Alkalinity (as $CaCO_3$)	Hydroxyl Alkalinity (as $CaCO_3$)	Ammoniacal Nitrogen as N	Nitrate as N	Nitrite as N	Phosphate, Ortho as P, Filt.	Phosphate, Ortho as P	Nitrogen, Total as N	Sulphide as S	Cyanide, total as CN
HR-09 River Waiki	2.2	<0.1	<1.0	34.1	<2.2	<2.2	<0.19	0.64	<0.006	<0.08	<0.08	<0.9	0.03	<0.009
HR-16 River Sonso	3.9	0.1	<5.0	66.5	<2.2	<2.2	<0.19	0.32	<0.006	<0.08	<0.08	<0.9	0.27	<0.009
HR-26 (River Waisoke	5.2	0.1	5.61	54.9	<2.2	<2.2	<0.19	0.3	0.006	<0.08	<0.08	<0.9	<0.029	<0.009
HR-31 River Waiga	1.3	0.2	<5.0	60.1	<2.2	<2.2	<0.19	<0.29	<0.006	<0.08	<0.08	<0.9	<0.029	<0.009
ZO-01 River Zolya	<0.9	0.2	<5.0	47.3	<2.2	<2.2	<0.19	0.53	<0.006	<0.08	<0.08	<0.9	0.08	<0.009

Table Att6.16-6 Physico-Chemical and Miscellaneous Parameters

Sample Location	pH	Conductivity-Electrical @20°C (µS/cm)	Solids, Total Dissolved 180°C (mg/L)	COD (Total) (mg/L)	TOC as C (mg/L)	Detergents, non-ionic (mg/L)	Detergents, Anionic as NaLS (mg/L)	Phenols Mono (Phenol Index) (mg/L)
HR-09 River Waiki	6.8	83	87	51	6.3	<0.5	<0.21	<0.15
HR-16 River Sonso	6.6	130	133	46	13.4	0.9	<0.21	<0.15
HR-26 River Waisoke	6.9	120	119	50	10.4	0.9	<0.21	<0.15
HR-31 River Waiga	6.7	111	101	51	19.3	0.7	<0.21	<0.15
ZO-01 River Zolya	6.4	89	81	31	9.4	0.5	<0.21	<0.15

Table Att6.16-7 Total Petroleum Hydrocarbons

Sample Location	TPH >C6–C40 (µg/L)	TPH >C6–C8 (µg/L)	TPH >C8–C10 (µg/L)	TPH >C10–C16 (µg/L)	TPH >C16–C24 (µg/L)	TPH >C24–C40 (µg/L)
HR-09 River Waiki	<20	<20	<20	<20	<20	<20
HR-16 River Sonso	<40	<40	<40	<40	<40	<40
HR-26 River Waisoke	<20	<20	<20	<20	<20	<20
HR-31 River Waiga	<40	<40	<40	<40	<40	<40
ZO-01 River Zolya	<20	<20	<20	<20	<20	<20

Table Att6.16-8 Polycyclic Aromatic Hydrocarbons

Sample Location	Acenaphthene (µg/L)	Acenaphthylene (µg/L)	Anthracene (µg/L)	Benzo (a) anthracene (µg/L)	Benzo (g,h,i) perylene (µg/L)	Benzo (a) pyrene (µg/L)	Benzo (b) fluoranthene (µg/L)	Benzo (k) fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz (a,h) anthracene (µg/L)	Fluoranthene (µg/L)	Fluorene (µg/L)	Indeno (1,2,3) cd pyrene (µg/L)	Naphthalene (µg/L)	Phenanthrene (µg/L)	Pyrene (µg/L)	PAH, Total (µg/L)
HR-09 River Waiki	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
HR-16 River Sonso	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
HR-26 River Waisoke	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
HR-31 River Waiga	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
ZO-01 River Zolya	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Table Att6.16-9 Volatile Organic Compounds

Sample Location	Dichlorodifluoromethane	Chloromethane	Chloroethane	Bromomethane	Trichlorofluoromethane	1,1-Dichloroethene	Dichloromethane	1,1-Dichloroethane	Cis-1,2-dichloroethene	2,2-Dichloropropane	Chloroform	Bromochloromethane	1,1,1-Trichloroethane	1,1-Dichloropropene	1,2-Dichloroethane	Benzene	1,2-Dichloropropane	Trichloroethene	Bromodichloromethane	Dibromomethane	Cis-1,3-dichloropropene	Toluene	Trans-1,3-dichloropropene	1,1,2-trichloroethane	Carbon Tetrachloride	Vinyl Chloride	1,3-dichloropropane	Tetrachloroethene	Dibromochloromethane	1,2-dibromoethane
HR-09 River Waiki	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HR-16 River Sonso	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HR-26 River Waisoke	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
HR-31 River Waiga	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ZO-01 River Zolya	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

NOTE: All VOC concentrations are in µg/L

Table Att6.16-10 Volatile Organic Compounds (Continued)

Sample Location	Chlorobenzene	1,1,1,2-tetrachloroethane	Ethyl Benzene	m,p-xylene	o-xylene	Styrene	Bromoform	Isopropylbenzene	Trans-1,2-dichloroethene	1,1,2,2-tetrachloroethane	1,2,3-trichloropropane	n-propylbenzene	Bromobenzene	2-chlorotoluene	1,3,5-trimethylbenzene	4-chlorotoluene	tert-butylbenzene	1,2,4-trimethylbenzene	sec-butylbenzene	p-isopropyltoluene	1,3-dichlorobenzene	1,4-dichlorobenzene	n-butylbenzene	1,2-dichlorobenzene	1,2-dibromo-3-chloropropane	1,2,4-trichlorobenzene	Hexachlorobutadiene	Naphthalene	1,2,3-trichlorobenzene	MTBE
HR-09 River Waiki	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
HR-16 River Sonso	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
HR-26 River Waisoke	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
HR-31 River Waiga	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
ZO-01 River Zolya	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0

NOTE: All VOC concentrations are in µg/L

ATTACHMENT A6.18 SECONDARY RIVER WATER QUALITY DATA (SOURCE: AECOM 2017)

Parameter	Uganda Standard Limit Level[1]		River									
	Treated	Natural	Sambiye								Waiga	
Sampling location			SW4				SW5				SW12	
Sample point coordinate			Northing: 248373 Easting: 322373				Northing: 252769 Easting: 340647				Northing: 272082 Easting: 334126	
Sample Date (dd/mm/yy)			10/02/14	24/04/14	28/06/14	30/09/14	11/02/14	26/04/14	29/06/14	25/09/14	16/12/16	13/06/17
Season			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Dry
Physical Water Quality												
Temperature (°C)	–	–	29.29	28.71	30.52	29.02	26.48	28.83	28.74	29.11	ND	ND
Turbidity (NTU)	5	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	**35.9**
TSS (mg/L)	–	–	ND	ND	ND	ND	ND	ND	ND	ND	120	86
Chemical Water Quality												
pH	6.5–8.5	5.5–9.5	6.85	7.58	7.7	7.16	6.86	7.46	8.01	7.33	ND	ND
EC (µS/cm)	1500	2500	81	113	120.8	122.5	79	117.3	119	117	ND	ND
TDS (mg/L)	700	1500	40	73	79	80	40	76	77	76	ND	ND
DO (mg/L)	–	–	6.35	7.3	7.99	5.39	8.02	8.72	10.3	9.33	ND	ND
Bromide Br (mg/L)	–	–	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.05
Chloride Cl (mg/L)	250	250	5.7	5.0	5.0	5.5	5.6	5.0	4.9	4.8	0.89	0.28
Fluoride F (mg/L)	1.5	1.5	0.43	0.3	0.3	0.39	0.38	0.38	0.31	0.37	0.15	0.16
Sulphate SO_4 (mg/L)	400	400	0.71	1.7	2.9	1.3	0.9	1.9	1.3	1.5	0.89	1.4
Metals												
Aluminium Al (mg/L)	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	**0.22**	**0.31**
Arsenic As [2] (mg/L)	0.01	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium Ba [2] (mg/L)	0.7	0.7	<0.050	<0.050	<0.050	0.053	<0.050	<0.050	<0.050	<0.050	0.096	0.087
Cadmium Cd [2] (mg/L)	0.003	0.003	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Calcium Ca (mg/L)	150	150	7.5	7.6	9.4	8.6	8.3	8.8	9.4	8.3	ND	ND
Chromium Cr [2] (mg/L)	0.05	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt Co (µg/L)	–	–	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	4.3	3.3
Copper Cu [2] (mg/L)	1	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.027
Iron Fe (mg/L)	0.3	0.3	**0.44**	**0.55**	**0.41**	**1.1**	0.22	**0.59**	**0.53**	**0.56**	**9.6**	**5.8**
Lead Pb [2] (mg/L)	0.01	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium Mg (mg/L)	100	100	3.2	3.1	3.4	3.5	3.7	3.2	3.3	3.4	ND	ND
Manganese Mn (mg/L)	0.1	0.1	0.027	0.039	0.025	0.086	0.024	0.035	0.037	0.05	**0.6**	**0.39**
Mercury Hg [2] (mg/L)	0.001	0.001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel Ni [2] (mg/L)	0.02	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium K (mg/L)	–	–	3.3	3.7	3.8	3.8	3.9	3.8	3.7	3.4	ND	ND
Sodium Na (mg/L)	200	200	12	11	13	13	13	12	12	12	ND	ND
Uranium U (µg/L)	–	–	ND	<0.0002	<0.0002	<0.0002	ND	<0.0002	<0.0002	<0.0002	<5.0	<5.0
Zinc Zn [2] (mg/L)	5	5	<0.01	0.03	<0.01	<0.01	<0.01	0.056	<0.01	<0.01	<0.01	<0.005
Mono Aromatic Hydrocarbons												
Benzene (µg/L)	10	10	<0.20	<0.2	<0.2	<0.20	<0.20	<0.2	<0.2	<0.20	<0.2	<0.20
Toluene (µg/L)	700	700	<0.20	<0.2	<0.2	<0.20	<0.20	<0.2	<0.2	<0.20	<0.2	<0.20
Ethylbenzene (µg/L)	–	–	<0.20	<0.2	<0.2	<0.20	<0.20	<0.2	<0.2	<0.20	<0.2	0.72
o-Xylene (µg/L)	–	–	<0.20	<0.2	<0.2	<0.20	<0.20	<0.2	<0.2	<0.20	<0.2	<0.20
m,p-Xylene (µg/L)	–	–	<0.20	<0.2	<0.2	<0.20	<0.20	<0.2	<0.2	<0.20	<0.2	<0.20
Xylenes (sum) (µg/L)	500	500	<0.40	<0.4	<0.4	<0.40	<0.40	<0.4	<0.4	<0.40	<0.4	<0.40
BTEX (sum) (µg/L)	–	–	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1.0
Petroleum Hydrocarbons												
TPH (C10–C12) (µg/L)	–	–	<4.0	<4	<4	<4.0	5.4	<4	<4	<4.0	<10	<10

Parameter	Uganda Standard Limit Level[1]		River									
	Treated	Natural	Sambiye								Waiga	
Sampling location			SW4				SW5				SW12	
Sample point coordinate			Northing: 248373 Easting: 322373				Northing: 252769 Easting: 340647				Northing: 272082 Easting: 334126	
Sample Date (dd/mm/yy)			10/02/14	24/04/14	28/06/14	30/09/14	11/02/14	26/04/14	29/06/14	25/09/14	16/12/16	13/06/17
Season			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Dry
TPH (C12–C16) (µg/L)	–	–	<5.0	<5	<5	6.8	<5.0	<5	<5	<5.0	<10	<10
TPH (C16–C21) (µg/L)	–	–	<6.0	8.9	6.9	<6.0	<6.0	<6	<6	<6.0	<10	<10
TPH (C21–C30) (µg/L)	–	–	<10	13	<10	<10	13	<10	<10	<10	<15	<15
TPH (C30–C35) (µg/L)	–	–	<5	<5	<5	<5	8.3	5.1	<5	<5	<10	<10
TPH (C35–C40) (µg/L)	–	–	<8	<8	<8	<8	<8	<8	<8	<8	<10	<10
TPH Sum (C10–C40) (µg/L)	–	–	<38	<38	<38	<38	<38	<38	<38	<38	<38	<38
Nutrients												
Ortho-phosphate PO_4-P (mg/L)	–	–	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.33	0.082
Ortho-phosphate PO_4 (mg/L)	2.2	2.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.11	0.25
Nitrate NO_3-N (mg/L)	–	–	1.2	1.1	0.93	<0.9	1.6	1.1	1.3	1.4	<0.2	<0.2
Nitrate NO_3 (mg/L)	45	45	<0.01	<0.01	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.9	<0.9
Nitrite NO_2-N (mg/L)	–	–	0.28	0.26	0.21	<0.20	0.37	0.25	0.28	0.31	<0.01	<0.01
Nitrite NO_2 (mg/L)	0.003	0.003	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Ammonium NH_4-N (mg/L)	–	–	<0.05	<0.05	0.082	<0.05	<0.05	<0.05	<0.05	<0.05	ND	ND
Ammonia NH_3 (mg/L)	0.5	0.5	<0.065	<0.065	0.11	<0.065	<0.065	<0.065	<0.065	<0.065	ND	ND

NOTES: – No standard available

[1]Standards expressed as upper limit for treated and natural waters (Uganda Standard, US EAS 12: 2014, Potable water – Specification). The Uganda Standard has been incorporated into the project environmental standards

[2]Results converted from µg/L to mg/L

ATTACHMENT A6.19 PIPELINE WATERCOURSE CROSSINGS: AN ASSESSMENT OF EXISTING CONTAMINATION AND SENSITIVITY TO POTENTIAL CHANGE IN WATER QUALITY

KP	Watercourse at Pipeline Crossing	Flow Regime (Permanent or Ephemeral)	Protected Status of Catchment Area	Land Cover or Use	Wetlands	Settlement	Use of Watercourse Upstream of Crossing	Users or VECs at Crossing and Downstream	Assessment of Existing Contamination Concerns	Baseline Sensitivity of Watercourse to Change in Water Quality	Rationale for Ranking
7	Sambiye River	Ephemeral	Headwater area has protected status	Wooded grassland in headwaters. Rainfed cultivation in mid-catchment. Rangeland in lower catchment	None	Dispersed settlement in mid-catchment.	Livestock watering and domestic use (at times of flow).	Livestock watering. Fishing village in floodplain on shore of Lake Albert 5.6 km downstream of crossing.	Elevated iron. Elevated total coliforms and *E. coli*.	Moderate (3)	The mid catchment is densely settled with subsistence agriculture and livestock rearing. Water quality at times of flow is likely to be good.
21.3–26.3	Waiga River floodplain	Permanent	Catchment has protected status.	Predominantly woody vegetation.	Seasonal wetland along floodplain.	None	None	Occasional homesteads. Lake Albert 1.5 km downstream of crossing.	Elevated iron. Elevated total coliforms and *E. coli*.	Very high (5)	Catchment is a natural protected area with no settlement. Water quality is likely to be natural.
28.3–29	Waisoke River floodplain	Permanent	Catchment has protected status.	Predominantly woody vegetation. Forested headwaters on rift plateau.	Seasonal wetland along floodplain of lower river.	None	None	Occasional homesteads on shore of Lake Albert 1.5 km downstream of crossing.	Elevated iron. Elevated total coliforms and *E. coli*.	Very high (5)	Catchment is a natural protected area with no settlement. Water quality is likely to be natural.
34.3	Sonso River floodplain	Permanent	Catchment has protected status.	Predominantly woody vegetation. Forested headwaters on rift plateau.	Seasonal wetland along floodplain of lower river.	None	None	Fishing village at mouth of watercourse on lakeshore 1.3 km downstream of crossing.	Elevated iron. Elevated total coliforms and *E. coli*.	Very high (5)	Catchment is a natural protected area with no settlement. Water quality is likely to be natural.
39	Bubwe	Permanent	Catchment largely has protected status.	Predominantly woody vegetation. Headwaters on rift plateau partly cultivated.	Limited seasonal wetland on floodplain of lower river	Dispersed homesteads in headwater area.	Livestock watering and domestic use.	Fishing village at mouth of watercourse on lakeshore 1.0 km downstream of crossing.	Elevated total coliforms and *E. coli*.	High (4)	Catchment is sparsely settled with subsistence agriculture and livestock rearing. Water quality is likely to be very good.
46.9	Waki River	Permanent	None	Densely settled plateau with rainfed cultivation and plantations in headwaters and lower catchment. Forest reserve in mid catchment.	Limited seasonal wetland on floodplain of lower river	Moderately densely settled plateau except for forest reserve.	Livestock watering and domestic use.	Waki hydropower project proposed on escarpment. Fishing village at adjacent to mouth of river on lakeshore 4 km downstream of crossing.	Elevated iron. Elevated total coliforms and *E. coli*.	Moderate (3)	Headwaters are densely settled with rainfed and plantation agriculture. Natural forest cover in mid catchment. Sparsely settled with subsistence agriculture and livestock rearing in the lower catchment. Water quality is likely to be good.

KP	Watercourse at Pipeline Crossing	Flow Regime (Permanent or Ephemeral)	Protected Status of Catchment Area	Land Cover or Use	Wetlands	Settlement	Use of Watercourse Upstream of Crossing	Users or VECs at Crossing and Downstream	Assessment of Existing Contamination Concerns	Baseline Sensitivity of Watercourse to Change in Water Quality	Rationale for Ranking
77	Hoimo River	Permanent	None	Densely settled plateau with rainfed cultivation.	Some wetland vegetation along river	Moderately densely settled.	Livestock watering and domestic use.	Proposed Orio hydropower plant on escarpment. Fishing village on lakeshore 6 km downstream of crossing point.	Elevated total coliforms and *E. coli*.	Moderate (3)	Catchment is densely settled with subsistence agriculture and livestock rearing. Water quality is likely to be good.
87	Rwamutonga River (tributary of Wambabya River)	Permanent	None	Densely settled plateau with rainfed cultivation.	Some wetland vegetation along river	Moderately densely settled.	Livestock watering and domestic use.	Orio hydropower project proposed on escarpment. Fishing village on lakeshore 6 km downstream of crossing point.	Elevated total coliforms and *E. coli*.	Moderate (3)	Catchment is densely settled with subsistence agriculture and livestock rearing. Water quality is likely to be good.
89.5	Wambabya River	Permanent	None	Densely settled plateau with rainfed cultivation and plantations in headwaters. Forest reserve in mid-lower catchment. Dense riparian vegetation along watercourses including in plantation.	Permanent wetlands along courses of tributaries on plateau.	Moderately densely settled.	Livestock watering and domestic use.	Existing Kabalega hydropower scheme 7 km downstream of pipeline crossing. Kaiso Tonya fishing village at mouth of river on lake shore 10 km downstream of crossing.	Elevated total coliforms and *E. coli*.	Moderate (3)	Catchment is densely settled with subsistence and plantation agriculture and livestock rearing. Water quality is likely to be good.

ATTACHMENT A6.20 PROJECT CONSTRUCTION FACILITIES: AN ASSESSMENT OF EXISTING CONTAMINATION IN NEARBY WATERCOURSES AND SENSITIVITY TO POTENTIAL CHANGE IN WATER QUALITY

Pipeline KP	Project Facility	Watercourse/Distance from Facility (m)	Protected Status of Catchment Area	Land Cover or Use	Wetlands	Settlement	Use of Watercourse Upstream of Site	Users or VECs of Watercourse Downstream of Site Drainage	Assessment of Existing Contamination Concerns	Baseline Sensitivity of Watercourse to Change in Water Quality	Rationale for Ranking
44	MCPY	Ephemeral wetland (150 m north of site)	Unprotected	Grassland	Ephemeral wetland	Sparse dispersed rural settlement	None	Rural communities and livestock	Elevated total coliforms and *E. coli*	High (4)	Rural catchment, sparsely settled with livestock rearing. Water quality likely to be very good during periods of surface water occurrence.

ATTACHMENT A6.21 ASSESSMENT OF RELATIVE WATER SCARCITY FOR COMMUNITIES ALONG THE PIPELINE

KP	Community Name	Settlement Pattern (Nucleated/ Dispersed)[2]	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater/ Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns and Observations	Relative Water Scarcity (Low, Moderate, High)
0–4.5	Largely uninhabited												
0.3	Kayese village, 0.8 km southeast of pipeline. (Ngwedo subcounty, Buliisa district)	Dispersed	No	Livestock farming	Domestic Livestock watering	Groundwater Surface water	Borehole with handpump Water holes. Lake Albert	ND ND 9 km	Reliable Unreliable Reliable	None? Microbiological. None.	High Low Moderate	Handpump was not operating at time of visit	High
4.5–6.5	ND	Dispersed	No	Livestock farming	Domestic Livestock watering	Groundwater Surface water	Boreholes with handpump at Kikorwe KP7.5 and Kijangi KP8 Lake Albert Water holes. Sambiye River Lake Albert	2.6 km 2.0 km 6 km ND 1.5 km 6 km	Reliable Reliable Reliable Unreliable Unreliable Reliable	None? None? Microbiological. Microbiological. Microbiological. Microbiological.	High High Moderate Low Moderate Moderate	Handpump at Kijangi was not operating at time of visit Handpump at Kikorwe was operating at time of visit	High
6.5–9.5	ND	Dispersed	No	Livestock farming	Domestic Livestock watering	Groundwater Surface water	Boreholes with handpump at Kikorwe KP7.5 and Kijangi KP8 Lake Albert Water holes. Sambiye River Lake Albert	1.5 km 1.0 km 6 km ND 0–1.5 km 6 km	Reliable Reliable Reliable Unreliable Unreliable Reliable	None? None? Microbiological. Microbiological. Microbiological. Microbiological.	High High Moderate Low Moderate Moderate	Handpump at Kijangi was not operating at time of visit Handpump at Kikorwe was operating at time of visit	High

KP	Community Name	Settlement Pattern (Nucleated/ Dispersed)[2]	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater/ Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns and Observations	Relative Water Scarcity (Low, Moderate, High)
7.7	Kijangi village, 0.8 km east of pipeline route (Buliisa Subcounty, Buliisa district)	Dispersed	No	Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	Boreholes with handpump at Kikorwe KP7.5 and Kijangi KP8 Lake Albert Water holes. Sambiye River Lake Albert.	1.2 km 0.5 km 6 km ND 1.5 km 6 km	Reliable Reliable Reliable Unreliable Unreliable Reliable	None? None? Microbiological. Microbiological. Microbiological. Microbiological.	High High Moderate Moderate Moderate Moderate	Handpump at Kijangi was not operating at time of visit Handpump at Kikorwe was operating at time of visit	High
9.5–12.5	ND	Dispersed, mainly on west side of pipeline route	No	Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	Boreholes with handpump at Kikorwe KP7.5 and Kijangi KP8 Lake Albert Water holes. Sambiye River Lake Albert.	2.5–5 km 2–4.5 km 4 km ND 2–5 km 4 km	Reliable Reliable Reliable Unreliable Unreliable Reliable	None? None? Microbiological. Microbiological. Microbiological. Microbiological.	High High Moderate Low Moderate Moderate	Handpump at Kijangi was not operating at time of visit Handpump at Kikorwe was operating at time of visit	High
12.5–20.5	ND	Dispersed, mainly on west side of pipeline route	No	Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	Boreholes with handpump at Kyogolyeki Kigoya KP17 Kabolwa KP17 and 18.5 Lake Albert Water holes. Lake Albert.	0–4 km 0–3.5 km 0–3.5 km 1–3 km ND 1.5–3 km	Reliable Reliable Reliable Reliable Unreliable Reliable	None? None? Salty Microbiological. Microbiological. Microbiological.	High High High Moderate Low Moderate	Handpump at Kyogolyeki Kigoya KP17 was operating at time of visit Two handpumps at Kabolwa were not operating at time of visit Kabolwa KP18.5 reported to be salty	High
20.5–28	Largely uninhabited												
28–30.5	ND	Dispersed	No	Rainfed cultivation Fishing Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	Borehole at Bugoigo. Waisoke River Lake Albert Waisoke River Lake Albert	3.5 0.1 km 1.5 km 0.1 km 1.5 km	Reliable Unreliable Reliable Unreliable Reliable	None? Microbiological, Turbidity Microbiological. Turbidity.	High Moderate Moderate Moderate Moderate	Borehole at Bugoigo not found	Moderate

KP	Community Name	Settlement Pattern (Nucleated/ Dispersed)[2]	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater/ Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns and Observations	Relative Water Scarcity (Low, Moderate, High)
30.5–32	Bugoiga/ Serule B, 0.5 km west of pipeline route (Butiaba subcounty, Buliisa district)	Nucleated, along shore of Lake Albert	Yes	Rainfed cultivation Fishing Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	Borehole at Bugoigo. Waisoke River Lake Albert Waisoke River Lake Albert	1.5 1.5 km 0.2–0.6 km 1.5 km 0.2–0.6 km	Reliable Unreliable Reliable Unreliable Reliable	None? Microbiological, Turbidity Microbiological. Turbidity.	High Moderate Moderate Moderate Moderate	No information available on borehole at Bugoigo Bottled water used by some people for drinking	Moderate
32–42.5	ND	Dispersed along shore of Lake Albert	No	Rainfed cultivation Fishing Livestock farming	Domestic Livestock watering	Surface water	Sonso River Bubwe River Lake Albert	0.1–2 km 1.5 km 0.1–0.4 km	Unreliable Unreliable Reliable	Microbiological, Turbidity	Moderate Moderate Moderate	No boreholes in this zone. Surface water is only option	Moderate
42.5–46.5	ND	Dispersed	No	Fishing Livestock farming	Domestic Livestock watering	Surface water	Lake Albert Waki River	0.2–1.5 km 0.2–1.5 km	Reliable Reliable	Microbiological Turbidity	Moderate Moderate	ND	Moderate
44	Booma village, 1.8 km west of pipeline route (Butiaba subcounty, Buliisa district)	Nucleated	Yes	Fishing Livestock farming	Domestic Livestock watering	Groundwater Surface water	Piped groundwater supply Lake Albert Waki River	0–0.5 km 0.2 km 0.2–1.5 km	Reliable Reliable Reliable	None? Microbiological Turbidity	High Moderate Moderate	Water from the gravity flow scheme is constant and the communities also have access to water from Lake Albert.	Low
46.5–51.5	Largely uninhabited												
51.5–52	ND	Nucleated, along shore of Lake Albert	No	Fishing Livestock farming	Domestic Livestock watering	Surface water	Lake Albert	0.2–1.5 km	Reliable	Microbiological	Moderate	ND	Moderate
51.5–54	Largely uninhabited												
54–54.5	ND	Nucleated, along shore of Lake Albert	No	Fishing Livestock farming	Domestic Livestock watering	Surface water	Lake Albert	0.2–1.5 km	Reliable	Microbiological	Moderate	ND	Moderate
54.5–56	Largely uninhabited												
56–62.5	ND	Dispersed	No	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water	Shallow wells Springs, Watercourses.	0–1 km 0–1 km	Variable Variable	Microbiological, Turbidity	Moderate/High Moderate	Presence of shallow wells, springs and watercourses is inferred from density of settlement.	Moderate
62.5–65.5	Largely uninhabited												

KP	Community Name	Settlement Pattern (Nucleated/ Dispersed)[2]	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater/ Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns and Observations	Relative Water Scarcity (Low, Moderate, High)
65.5–89	ND	Dispersed, with nucleated villages	No	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water	Boreholes: Nyakabingo KP79, Karamwanga KP79.5. Springs, Watercourses.	ND ND 0–1 km	Reliable Reliable Unreliable	None? None? Microbiological Turbidity	High High Moderate	ND	Moderate
75	Wayayo village, 0.4 km west of pipeline (Kigorobya subcounty, Hoima district)	Nucleated	Yes	Commercial Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water	4 shallow wells, 1 handpump 1 ephemeral stream.	ND ND 1.5 km	Variable Variable Unreliable	Microbiological None? Microbiological Turbidity	Moderate High Moderate	“It [the ephemeral stream] sometimes dries up during dry season. If that happens they have to walk further to the Hoima River to collect water.”	Low
79–79.5	Nyakabingo village Karamwanga village	Nucleated	No	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water	Borehole at Nyakabingo , Borehole at Karamwanga Ephemeral stream	ND ND 1.5 km	Variable Variable ND	None? None? ND	High High Moderate	Both boreholes are operating in Nyakabingo village.	Low
86	Rwamutonga village, 0.7 km west of pipeline route (Busuruka subcounty, Hoima district)	Nucleated	Yes	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	Over 8 shallow wells (no handpumps) 2 private boreholes Rwamutonga river Rwamutonga river Wambabya river Luzira river. Luzira wetland.	0–0.5 km ND 0.5 0.2–1 km 1.5–3 km ND ND	Variable Reliable Reliable Reliable Reliable ND ND	None? None? Microbiological Microbiological Turbidity	Moderate High Moderate Moderate Moderate Moderate Moderate	Quality of surface water used for drinking “not good” Water sources are “sufficient but very far.” Some people use bottled water for drinking. This is considered “good”, but “unreliable.”	Low
89–92	Largely uninhabited												
92–92.5	ND	Dispersed	No	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water	ND Wambabya River	ND 0–1 km	ND Reliable	ND Microbiological Turbidity	ND Moderate	ND	Moderate
92.5–93.5	Largely uninhabited												

KP	Community Name	Settlement Pattern (Nucleated/ Dispersed)[2]	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater/ Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns and Observations	Relative Water Scarcity (Low, Moderate, High)
93.5–94.5	Katooke village, 1.9 km east of pipeline route (Buseruka subcounty, Hoima district)	Nucleated	Yes	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	4 Shallow wells. 1 Public borehole. Wambabya River Wambabya River	0–1 km 0.1 km 2.5 km 2.5 km	Reliable Reliable Reliable	None None Microbiological Turbidity	High High Moderate	Water sources are “sufficient to meet local demand.”	Low
94.5–95	Kayere village, 0.2 km west of pipeline route (Buseruka subcounty, Hoima district)	Nucleated	Yes	Rainfed cultivation Livestock farming	Domestic Livestock watering	Groundwater Surface water Surface water	2 Boreholes (not functioning). Wambabya River Wambabya River	ND 1.3 km 1.3 km	Unreliable Reliable Reliable	None Microbiological Turbidity Microbiological Turbidity	High Moderate Moderate	Both boreholes are not functioning. One of the boreholes had not functioned for seven years. “It [water] is sufficient…they have made a dam (a hole in the ground next to the river). However, cattle also drink from the river so they get illnesses such as worms from the water.”	Moderate

ATTACHMENT A6.22 ASSESSMENT OF RELATIVE WATER SCARCITY FOR COMMUNITIES ALONG PROJECT ROADS

Pipeline KP or Project Road ID	Community Name[1]	Settlement Pattern (Nucleated or Dispersed)	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater or Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns and Observations	Relative Water Scarcity (Low, Moderate, High)
ERU–BCPF	Kasinyi village at entrance to CPF at eastern end of ERU–BCPF (Ngwedo subcounty, Buliisa district)	Dispersed	No	Livestock farming.	Domestic Livestock watering	Groundwater Surface water	6 boreholes with handpumps Water holes. Nile River. Lake Albert.	1 km ND 3 km 9 km	Unreliable Unreliable Reliable Reliable	None? Microbiological Microbiological Microbiological	High Low Low Low	Of the six boreholes, four were functional at the time of 2015 survey.[1] In time of insufficient water, people walk to the River Nile or Lake Albert to get water.[1]	Low
	Katanga village at western end of ERU–BCPF (Kigwera subcounty, Buliisa district)	Nucleated	Yes	Fishing. Livestock farming.	Domestic Livestock watering	Groundwater Surface water	Piped water scheme in Wanseko[1] 2 public boreholes with handpumps 2 seasonal wells Water holes. Nile River. Lake Albert	0.5 km 0.3 km 0.3 km ND 1 km 1 km	Variable Variable Unreliable Unreliable Reliable Reliable	None? None? Microbiological Microbiological Microbiological Microbiological	High High Moderate Low Low Low	ND	Low
ERU–MCPY	Booma village, 1.8 km west of ERU–MCPY (Butiaba subcounty, Buliisa district)	Nucleated	Yes	Fishing. Livestock farming.	Domestic Livestock watering	Groundwater Surface water	Piped groundwater supply Lake Albert Waki River	0–0.5 km 0.2 km 0.2–1.5 km	Reliable Reliable Reliable	None? Microbiological Turbidity	High Moderate Moderate	Water from the gravity flow scheme is constant and the communities also have access to water from Lake Albert.	Low

NOTES: [1]SOURCE: Artelia Eau et Environnement (2015)

ATTACHMENT A6.23 ASSESSMENT OF RELATIVE WATER SCARCITY FOR COMMUNITIES NEAR PROJECT CONSTRUCTION FACILITIES

Pipeline KP or Facility	Community Name[1]	Settlement Pattern (Nucleated or Dispersed)[2]	Social Baseline Survey?	Main Livelihood Activities	Water Uses	Groundwater or Surface Water	Possible Sources of Water	Average Distance to Water Source	Potential Reliability of Source	Likely Existing Contamination Concerns	Sensitivity to Contamination (Low, Moderate, High)	Water-Related Concerns or Observations	Relative Water Scarcity (Low, Moderate, High)
KP44 MCPY	Booma village, 0.8 km west of MCPY (Butiaba subcounty, Buliisa district)	Nucleated	Yes	Fishing. Livestock farming.	Domestic Livestock watering	Groundwater Surface water	Piped groundwater supply Lake Albert Waki River	0–0.5 km 0.2 km 0.2–1.5 km	Reliable Reliable Reliable	None? Microbiological Turbidity	High Moderate Moderate	Water from the gravity flow scheme is constant and the communities also have access to water from Lake Albert.	Low

Appendix A7: Groundwater Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

Symbols and units	
CFU/100 mL	colony forming units (unit of measurement of abundance of coliform bacteria) per 100 millilitres
µg/L	micrograms per litre (1 mg/L = 1000 µg/L)
µS/cm	microsiemens per centimetre: a unit of electrical conductivity
m^3	cubic metres
mbgl	metre below ground level
mg/L	milligrams per litre
A	
aquifer	stratum or zone below the earth's surface capable of producing water for human use
B	
BOD	biochemical oxygen demand
C	
COD	chemical oxygen demand
D	
DO	dissolved oxygen
DWD	Directorate of Water Development
DWRM	Directorate of Water Resources Management
E	
EC	electrical conductivity
F	
fault	fracture or fracture zone along which there has been displacement of the sides relative to another parallel to the fracture
fractures	breaks in rocks due to intense folding or faulting
M	
mbgl	metre below ground level
mbd	metre below datum
mg/L	milligrams per litre
MWE	Ministry of Water and Environment, Uganda
N	
NTU	nephelometric turbidity units

P	
PAH	polycyclic aromatic hydrocarbon
pH	numeric scale used to specify the acidity or basicity of an aqueous solution: pH1 is extremely acidic, pH14 is extremely alkaline and pH7 is neutral
T	
TDS	total dissolved solids
TSS	total suspended solids.
turbidity	the measure of relative clarity of a liquid. It is an optical characteristic of water and an expression of the amount of light that is scattered by material in the water when a light is shined through the water sample.
W	
WGS84	World Geodetic System, established in 1984. It is currently the reference system being used by global positioning systems.

A7 GROUNDWATER BASELINE REPORT

A7.1 Purpose and Scope of Report

This baseline report describes the groundwater:

- area of influence (AOI) and broader region
- methods
- baseline conditions:
  - trend in condition and sensitivity to change
  - ecosystem services provided
- key considerations.

A7.2 Area of Influence and Study Area Boundaries

A7.2.1 Area of Influence Boundary

The groundwater AOI during the project construction and operational phase will encompass aquifers:

- that will be used for project groundwater abstraction
- that may be affected by planned discharges of treated water and accidental spills, leaks of fuels and chemicals.

During construction, the AOI will include aquifers crossed by the right-of-way and used by the MCPY. During the operational phase, the AOI will only include aquifers crossed by the right-of-way.

A7.2.2 Study Area Boundaries

The study area and AOI boundaries are the same. The field baseline survey included sampling of existing water supply boreholes and wells within a 5-km corridor on either side of the pipeline, a sufficient distance for assessing baseline groundwater quality.

A7.3 Methods

A7.3.1 Secondary Data

The groundwater baseline data included a review of secondary data sources from:

- the Ministry of Water and Environment (MWE)
- national hydrocensus database
- Directorate of Water Resources Management (DWRM) national database
- geological maps and reports
- published scientific papers.

Meetings and discussions were also held with local consultants and DWRM in Entebbe to obtain information on groundwater use and aquifer conditions.

The review provided the foundation for field survey design and identified aquifer characteristics, listed below:

- depth to the water table
- aquifer systems (location, thickness, aquifer conditions, sources of recharge, flow direction)
- aquifer vulnerability and sensitivity, existing contamination, number and type of users and abstraction points. This was evaluated by collecting data on the depth to the water table, the permeability of the soil or rock above the water table and the quality of groundwater in the aquifer(s).
- groundwater–surface water interaction, specific to sensitive surface waterbodies that rely on groundwater such as shallow unconsolidated aquifers. This was achieved by studying hydrogeology maps, collecting data on surface water bodies (depth, flow) and interpreting data to identify losing or gaining[1] streams.

The following baseline studies were also reviewed:

- the socio-economic and health baseline study (see Appendix A9) provided information on access to drinking water and water supply infrastructure that was used to inform the assessment of trend and sensitivity below.
- the surface water baseline study (see Appendix A6) provided information on surface water and wetlands that was used to evaluate potential surface water and groundwater interactions. This study also includes an assessment of water scarcity.
- soil and geology baseline study provided information on soil characteristics and geological formations that was used for determining aquifer lithology and aquifer vulnerability.

A7.3.2 Field Survey

The groundwater baseline survey was conducted during November 2017 to characterise the baseline groundwater quality by sampling existing abstraction boreholes and wells within a 5-km corridor on either side of the pipeline.

Abstraction boreholes were identified from the DWRM national database and visited for sampling. Where boreholes were found abandoned (see Attachment 7.2), local authorities were consulted to enquire about alternative boreholes were asked for permission to sample. The existing local boreholes were fitted with pumps, which could not be removed, to collect data on borehole depth and static water level.

Five operating abstraction boreholes were identified within the study area and sampled using the hand pump in place. Table A7.3-1 lists the boreholes visited and indicates which were sampled and why. Figure A7.3-1 maps the locations of boreholes sampled.

[1]A losing stream is a stream or river that loses water as it flows downstream. The water infiltrates the ground recharging the local groundwater, because the water table is below the bottom of the stream channel. A gaining stream increases in water volume further downstream as it gains water from the local aquifer.

Table A7.3-1 Boreholes Included in the Field Survey

BH or Well ID, No. or Name	Sampling Date	Closest KP Along Pipeline	District	Sampling Location (WGS84 TM35E_S)		Borehole or Well Type	Current Use of Borehole or Well	Sample Number
				Easting	Northing			
Kayese DWD 25901	No sample collected	KP0.5	Buliisa	329451	240726	Not operating	Domestic use	No sample collected
Kijanji Primary School DWD 33439	No sample collected	KP08	Buliisa	327418	233838	Not operating	Domestic use	No sample collected
Kijanji CD 2235	No sample collected	KP08	Buliisa	327418	233838	Not operating	Domestic use	No sample collected
Kikorwe DWD 53247	21.11.17	KP08	Buliisa	328593	233818	Drinking well	Domestic use	GWU-001
Kibukwa-Barwogeza DWD53493	21.11.17	KP08	Buliisa	328787	234044	Drinking well	Domestic use	GWU-002
Kabolwa DWD 33442	No sample collected	KP17	Buliisa	324560	224769	Not operating	Domestic use	No sample collected
Kyogolyeki Kigoya	22.11.17	KP17	Buliisa	324183	225755	Drinking well	Domestic use	GWU-003
Kabolwa	No sample collected	KP18.5	Buliisa	324507	223205	Not operating	Domestic use	No sample collected
Songambe DWD 52052	No sample collected	KP70	Buliisa	298783	172586	Not operating	Domestic use	No sample collected
Nyakabingo	23.11.17	KP79	Hoima	298781	172583	Drinking well	Domestic use	GWU-004 and duplicate GWU-005
Karamwanga DWD33659	23.11.17	KP79	Hoima	298420	172184	Drinking well	Domestic use	GWU 006

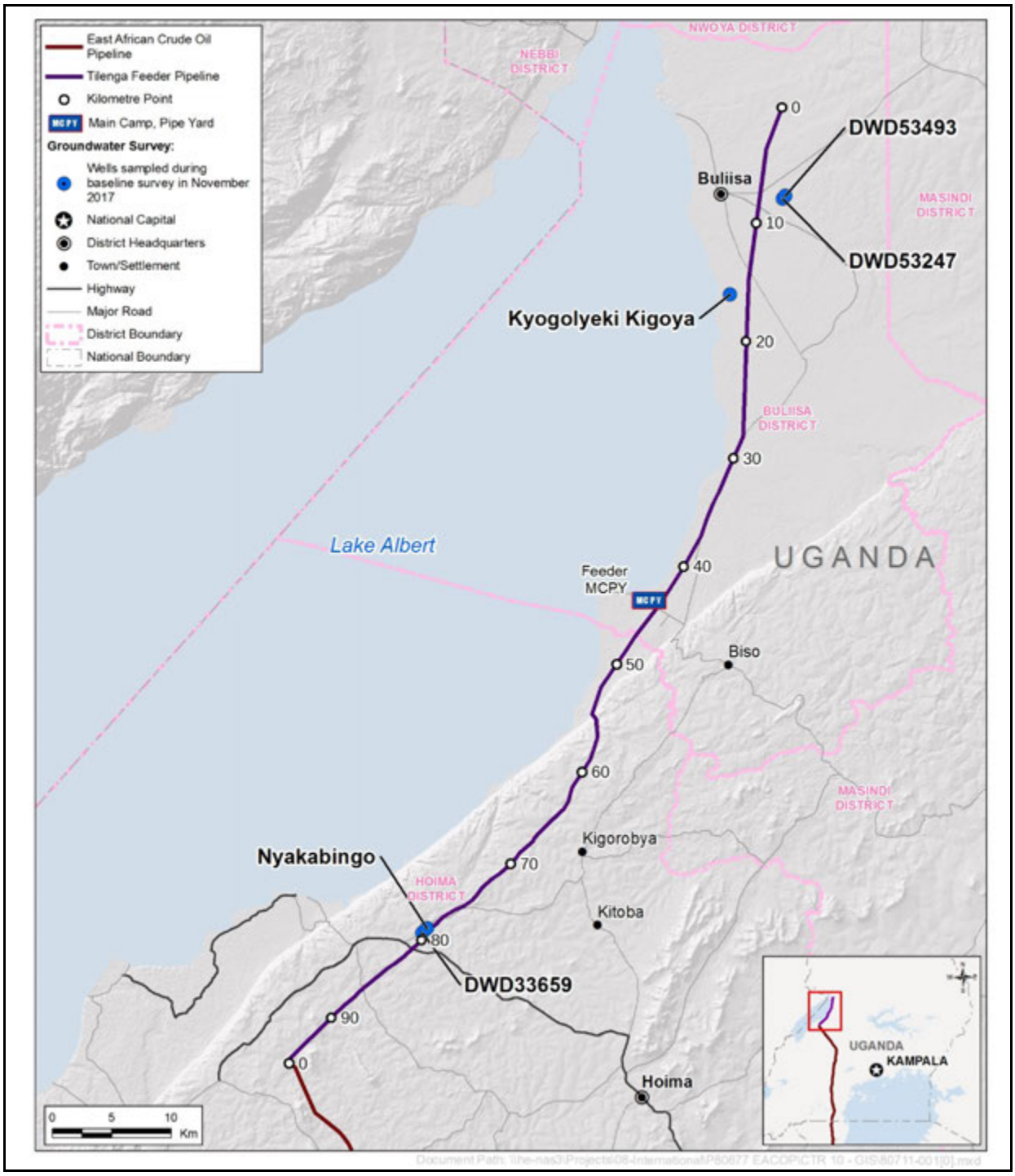

Figure A7.3-1 Boreholes and Wells Sampled During the Field Survey

The sampling methodology was in accordance with industry best practice (ISO 5667-11:2009 Water quality – Sampling – Part 11: Guidance on sampling of groundwaters). GPS coordinates of the sampling locations were recorded. Samples were packed securely in cool boxes with ice packs and kept dark before being despatched with a sample chain of custody form to the SGS laboratory with ISO 17025 accreditation in Mwanza.

Attachment A7.1 describes the detailed survey methodology.

A7.3.3 Data Collection and Analysis

A7.3.3.1 Water Quality

The survey comprised onsite water-quality measurements and observations, and sample collection for laboratory analysis.

At all sites, a calibrated portable digital multiparameter water quality sonde (Aquaprobe) was used to measure:

- water temperature (°C)
- electrical conductivity (EC)
- total dissolved solids (TDS)
- pH
- dissolved oxygen (DO)
- turbidity.

Field tests for total coliforms and *E. coli* were undertaken at all sites using a portable DelAgua single incubator water-testing kit. Samples were incubated on CHROMagar ECC broth for 24 hours at 44°C.[2] Observations were made at all sites of water odour, iridescence, precipitates and colour.

The samples were tested at the laboratory for the following parameters:

- total petroleum hydrocarbons (TPH)
- polycyclic aromatic hydrocarbons (PAH)
- dissolved metals (arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, vanadium, zinc)
- total suspended solids (TSS)
- chemical oxygen demand (COD)
- biochemical oxygen demand (BOD)
- sulphates, calcium, chloride

Section A7.4.1.2 describes the test results.

A7.3.3.2 Sensitivity Ranking

Groundwater sensitivity has been ranked according to the groundwater section of the sensitivity table in Appendix D of the environmental and social impact assessment (ESIA).

A7.3.4 Data Considerations

Most borehole locations in the DWRM national database were found to be either not operating or abandoned. However, as noted in Section A7.3.2, this was

[2] Using the CHROMagar ECC broth enabled the simultaneous analysis of total coliforms and *E. coli*. The prescribed incubation temperature for both types of bacteria is 37°C. However, it was not possible to adjust the incubation temperature of the particular test kit used in this survey. Incubation at 44°C favours the growth of *E. coli* relative to total coliforms. As the presence of *E. coli* is an indicator of faecal contamination and total coliform bacteria are ubiquitous in natural waters, this was not considered to affect the conclusions reached.

addressed by identifying other boreholes in the area with the assistance of the local authorities.

Through the identification of alternative sampling locations (Section A7.3.2) the collected data are sufficient to describe groundwater conditions in the AOI.

A7.4 Baseline Conditions

A7.4.1 Baseline Condition

A7.4.1.1 Aquifers

The AOI traverses areas that are characterised by unconsolidated fluvial, sedimentary and basement aquifers.

Unconsolidated and Sedimentary Aquifers

Unconsolidated aquifers are typically Quaternary or Tertiary in age and are generally found along existing river channels or palaeochannels in which fluvial gravel, sand and silt have been deposited. Unconsolidated aquifers can be unconfined or semiconfined (leaky) and more than 50 m thick where there are significant palaeochannel deposits. Associated borehole depths are variable but may be up to 60 m when drilled into palaeochannels (BGS 2017). The fluvial deposits provide significant yields as shown in Table A7.4-2.

The interaction between groundwater and surface water occurs mainly in the fluvial deposits. The surface water baseline report (Appendix A6) describes the catchments in greater detail but in summary, there are wetlands in the uplands and the lowlands, and both are filled with papyrus. The channels in the uplands and lowlands are incised to the extent that they can be fed by groundwater. The wetlands also receive surface inflows from upstream. Watercourses supported by groundwater may be permanent or ephemeral. The surface water baseline report indicates that all rivers crossed by the route, with the exception of the Sambiye, are likely to be fed by groundwater. In dry periods, watercourses dry up and switch from being gaining streams to losing streams.

Basement Aquifers

The basement complex generally forms discrete aquifers of limited spatial extent. They occur in the unconsolidated weathered regolith (saprolite) or underlying fissured bedrock (saprock). Bedrock permeability is greatest close to the saprock–saprolite interface and may increase with the presence of fractures before eventually decreasing with depth. The number, distribution and connectivity of fissures and fractures control it. The permeability of the saprolite is highly variable but is an important source of groundwater storage.

The basement aquifers are generally semi-confined or leaky and typically between 20 and 45 m thick. Associated boreholes are generally drilled to depths of 45–70 m (BGS 2017).

Table A7.4-1 summarises the hydrogeological conditions of the main aquifers traversed by the Tilenga feeder pipeline. Yield values have been categorised by MacDonald et al. (2010) as defined in the table below.

Table A7.4-1 Aquifer Productivity

Aquifer Productivity	Yield Range (m^3/h)
Very high	>72
High	18–72
Moderate	7.2–18
Low to moderate	1.8–7.2
Low	0.36–1.8
Very low	<0.36

Table A7.4-2 Summary of Aquifer Geology Characteristics

District, Approximate KP range and Project Facilities	Aquifer Lithology and Geological Formations	Soil Description[1]	Main Water Strike (mbgl) (Average)[2]	Static Water Level (mbgl) (Mean Value)[3]	Vulnerability[4]	Yield (m^3/h) and Recharge[5]
Buliisa (KP0–48) MCPY near KP44	Tertiary–Quaternary sediments within the Rift Valley system, predominantly sandstones, siltstones, claystones and shales	Loamy sand; sandy clay (Arenosols and Ferralsols or Calcisols)	42	29	High	Yield: 7.1 Recharged by rainfall
	Precambrian basement: undifferentiated gneisses and granulite facies rocks		57	23		Yield: 7.3 Recharged by rainfall
Hoima (KP48–90)	Regolith and fluvial sediments (paleochannels); Tertiary–Quaternary sediments within the Rift Valley system, predominantly sandstones, siltstones, claystones and shales	Sandy clay or clay loam	52	17	High	Yield: 6.3 Recharged by rainfall
	Precambrian basement (weathered and fractured crystalline bedrock): shales, arkoses and quartzites; undifferentiated gneisses and granulite facies rocks		43	19		Yield: 4.1 Recharged by rainfall

SOURCE: From district groundwater reports provided by DWRM (2012a, 2012b).

NOTES: [1]Based on field observations during the groundwater baseline survey for the project in November 2017. [2]Main water strike is the level at which groundwater is first encountered during drilling. [3]Static water level refers to the level of water in a well under normal, undisturbed, no-pumping conditions. [4]Sensitivity of a valued environmental and social component (VEC) as a function of the vulnerability based on the ground conditions (permeability) and depth to the water table. [5]Recharge information is from BGS (2017) data; average airlift yields from district groundwater reports provided DWRM (2012a, 2012b).

A7.4.1.2 Groundwater Quality

A review of MWE published data (2012a, 2012b) indicates that groundwater quality is generally good in both Buliisa and Hoima. In Buliisa district, there are some reported concerns related to sulphate, hardness and TDS levels in boreholes installed in the Rift Valley sediments. In Hoima district, there is no evidence of any water quality concerns.

Field Sampling Results

The field sampling results are presented in detail in Attachment A7.2. Table A7.4-3 summarises the data and indicates the following:

- EC values were relatively high, ranging from 541 to 2769 µS/cm. All EC values were within the national water quality standards for natural water.
- pH values were circumneutral, ranging from 6.49 to 6.98. All pH values were within the national water standard for natural water range for pH (5.5–8.5).
- DO concentrations were relatively low at the time of sampling the boreholes and wells along the Tilenga feeder pipeline route, ranging from 2.24 to 3.35 mg/L (31.5–48.1% saturation). There are no national standards for DO.
- Turbidity ranged from 0.2 to 48.9 NTU. In samples GWU003, 004 and 006, turbidity values exceeded the treated and natural national water standard range for turbidity (0–5 NTU and 0–10 NTU).
- Total coliform counts (indicative of contamination by general bacteria) ranged from 04 CFU/100 mL to 06 CFU/100 mL. *E. coli* counts (indicative of faecal bacteria contamination) ranged from 00 CFU/100 mL to 02 CFU/100 mL. The national water standards for potable water state that all coliforms should be absent.
- Zinc was found to exceed the national water standard for natural water (5.0 mg/L) at one location (17.0 mg/L in sample GWU-002 at Kibukwa-Barwogeza DWD53493); no other exceedances of the national water quality standards for the parameters tested in the laboratory were identified (see parameter list in Section A7.3.3.1). The reason for the exceedance is not known.

Table A7.4-3 Summary of Field Measurements

Parameter	Maximum	Minimum
Temp (°C)	30.4	25.2
EC (µS/cm)	2769	541
TDS (mg/L)	1800	351
pH	6.98	6.49
DO (mg/L)	3.35	2.24
DO (% saturation)	48.1	31.5
Turbidity (NTU)	48.9	0.2
Coliform (CFU/100 mL)	06	00
E. coli	02	00

A7.4.1.3 Laboratory Analyses

All the laboratory results are presented in Attachment A7.1 in tables that include the Ugandan and project standards for drinking water quality.

No concentrations above the laboratory detection limits (LDL) were detected for the following parameters:

- acenaphthene
- acenaphthylene
- anthracene
- benz(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- benzo(g,h,i)perylene
- benzo(k)fluoranthene
- chromium (Cr)
- Chrysene
- copper (Cu)
- dibenzo(a,h)anthracene#
- fluorene
- indeno(1,2,3-c,d)pyrene#
- mercury (Hg)
- silver (Ag)
- TPH.

A7.4.1.4 Groundwater Use

In both Buliisa and Hoima districts, groundwater is the most important source of water supply for domestic use. Table A7.4-4 presents the available data on groundwater use (MWE 2017).

Table A7.4-4 Groundwater Use and Quality

District	Wells and Boreholes as Source of Water for Population (%)	Groundwater Quality
Buliisa	78	Generally meets national potable water standards
Hoima	68	Generally meets national potable water standards

SOURCE: From district groundwater reports

A7.4.1.5 Groundwater Scarcity

An assessment of relative water scarcity for communities along the pipeline route is included in the surface water baseline study (see Appendix A6). A summary is shown in Table A7.4-5.

Table A7.4-5 Summary of Water Scarcity Along the Route

KP	Relative Water Scarcity (Low, Moderate, High)
0.3–20.5	High
28–43.5	Moderate
44	Low
44.5–74	Moderate
75–86	Low
89–92.5	Moderate
93.5–94.5	Low
94.5–95	Moderate

NOTE: KP gaps indicate uninhabited areas

A7.4.2 Trend in Condition and Sensitivity to Change

Groundwater will continue to be a primary source of water for the population in both districts. Population growth is likely to increase the reliance of local communities on groundwater for domestic use. Data on past groundwater quality and water levels was not available to undertake an accurate assessment of trends; however, the available information was sufficient to support the assessment that groundwater in both the sedimentary and basement aquifers is considered highly sensitive to change based on the above data on trend and increase due to demand.

A7.4.3 Ecosystem Services Provided

Groundwater within the AOI provides a range of ecosystem services as set out below.

Provisioning services:

- groundwater supplying freshwater for community use: Shallow wells and boreholes are the primary water source for 78% of the population in Buliisa district and 68% in Hoima district. The importance of groundwater as an ecosystem service is likely to increase in the future in both districts. Population growth is likely to increase the reliance of local communities on groundwater for domestic use. Groundwater in both the sedimentary as a result of population growth.

Regulating services:

- groundwater supporting aquatic and riparian habitats and wildlife, both directly (where groundwater feeds wetlands) and indirectly (where groundwater maintains surface water flows).

A7.4.4 Sensitivity Ranking

Table A7.4-6 summarises the sensitivity ranking for groundwater.

Table A7.4-6 Groundwater Receptor Sensitivity Ranking

District	Groundwater Receptor	Sensitivity Ranking	Rationale for Ranking
Buliisa (KP0–48)	Aquifers: Rift Valley sediments	High (4)	Good quality water used for drinking and other domestic uses
Hoima (KP48–90)	Aquifers: basement	High (4)	Good quality water used for drinking and other domestic uses

A7.5 Key Considerations

Key considerations are:

- the sensitivity rankings of groundwater VECs are very high
- groundwater is an important ecosystem service.

A7.6 References

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ATTACHMENT A7.1 GROUNDWATER QUALITY RESULTS

Table Att7.1-1 Results of Groundwater Laboratory Tests: GWU-001–GWU-003 Samples

Parameter	Ugandan Standard Limit Level		WHO Standard	Project Standard	Limit of Detection	Units	Sample Number, Date and Location		
	Treated	Natural					GWU001 21-Nov-17 Kikorwe DWD 53247	GWU002 21-Nov-17 Kibukwa-Barwogeza DWD53493	GWU003 22-Nov-17 Kyogolyeki Kigoya
Chloride	250	250	-	-	0.20	mg/L	38.5	41.3	228
Ca	150	150	-	100	0.01	mg/L	15.3	14.6	134
TSS	-	-	-	-	1.0	mg/L	<1.0	<1.0	7.6
BOD	-	-	-	6	0.10	mg/L	5.0	<0.10	<0.10
COD	-	-	-	-	0.10	mg/L	14.5	1.2	<0.10
Sulphate	400	400	-	400	0.02	mg/L	15.9	10.3	250
Total petroleum hydrocarbons	-	-	-	-	1.0	mg/L	<1.0	<1.0	<1.0
As	0.01	0.01	0.01	0.01	0.001	mg/L	<0.001	<0.001	<0.001
Hg	0.001	0.001	0.006	0.001	0.001	mg/L	<0.001	<0.001	<0.001
Cd	0.003	0.003	0.003	0.003	0.001	mg/L	<0.001	<0.001	<0.001
Cr	0.05	0.05	0.05	0.05	0.001	mg/L	<0.001	<0.001	<0.001
Cu	1	1	2	1	0.001	mg/L	<0.001	<0.001	<0.001
Pb	0.01	0.01	0.01	0.01	0.005	mg/L	<0.005	<0.005	<0.005
Ni	0.02	0.02	0.07	0.02	0.004	mg/L	<0.004	<0.004	<0.004

Table Att7.1-1 Results of Groundwater Laboratory Tests: GWU-001–GWU-003 Samples

Parameter	Ugandan Standard Limit Level		WHO Standard	Project Standard	Limit of Detection	Units	Sample Number, Date and Location		
	Treated	Natural					GWU001 21-Nov-17 Kikorwe DWD 53247	GWU002 21-Nov-17 Kibukwa-Barwogeza DWD53493	GWU003 22-Nov-17 Kyogolyeki Kigoya
Ag	-	-	-	-	0.01	mg/L	<0.01	<0.01	<0.01
V	-	-	-	-	0.001	mg/L	<0.001	<0.001	<0.001
Zn	5	5	-	5	0.001	mg/L	1.7	17.0	0.13
Ba	0.7	0.7	-	0.7	0.002	mg/L	0.055	0.021	0.035
Fe	0.3	0.3	-	0.3	0.001	mg/L	4.9	0.091	0.19
Naphthalene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	0.00002
Acenaphthylene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Acenaphthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Fluorene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Phenanthrene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Anthracene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Fluoranthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Pyrene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benz(a)anthracene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Chrysene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(b)fluoranthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(k)fluoranthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001

Table Att7.1-1 Results of Groundwater Laboratory Tests: GWU-001–GWU-003 Samples

Parameter	Ugandan Standard Limit Level		WHO Standard	Project Standard	Limit of Detection	Units	Sample Number, Date and Location		
	Treated	Natural					GWU001 21-Nov-17 Kikorwe DWD 53247	GWU002 21-Nov-17 Kibukwa-Barwogeza DWD53493	GWU003 22-Nov-17 Kyogolyeki Kigoya
Benzo(a)pyrene	0.7 µg/L[1]	0.7 µg/L[1]	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Dibenzo(a,h)anthracene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(g,h,i)perylene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Indeno(1,2,3-c,d)pyrene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Total polycyclic aromatic hydrocarbons (PAH)	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	0.00002

NOTES: Source of standards: Uganda Standard – Potable Water (2014)

- no standards

[1]Unspecified polynuclear aromatic hydrocarbon

Table Att7.1-2 Results of Groundwater Laboratory Tests: GWU-004–GWU-006 Samples

Parameter	Ugandan Standard Limit Level		WHO Standard	Project Standard	Limit of Detection	Units	Sample Number, Date and Location		
	Treated	Natural					GWU004 23-Nov-17 Nyakabingo	GWU005 23-Nov-17 Duplicate of GWU004	GWU006 23-Nov-17 Karamwanga DWD33659
Chloride	250	250	-	-	0.20	mg/L	284	286	63.4
Ca	150	150	-	100	0.01	mg/L	513[2]	363[2]	154[2]
TSS	-	-	-	-	1.0	mg/L	1.0	<0.10	<0.10
BOD	-	-	-	6	0.10	mg/L	3.7	<0.10	<0.10
COD	-	-	-	-	0.10	mg/L	<1.0	<1.0	<1.0
Sulphate	400	400	-	400	0.02	mg/L	<0.001	<0.001	<0.001
Total petroleum hydrocarbons	-	-	-	-	1.0	mg/L	<0.001	<0.001	<0.001
As	0.01	0.01	0.01	0.01	0.001	mg/L	0.022[2]	<0.001	<0.001
Hg	0.001	0.001	0.006	0.001	0.001	mg/L	<0.005	<0.005	<0.005
Cd	0.003	0.003	0.003	0.003	0.001	mg/L	0.073[2]	0.040[2]	<0.004
Cr	0.05	0.05	0.05	0.05	0.001	mg/L	<0.01	<0.01	<0.01
Cu	1	1	2	1	0.001	mg/L	<0.001	<0.001	<0.001
Pb	0.01	0.01	0.01	0.01	0.005	mg/L	0.035[2]	<0.001	0.1
Ni	0.02	0.02	0.07	0.02	0.004	mg/L	0.38[2]	0.16[2]	<0.001
Ag	-	-	-	-	0.01	mg/L	<0.002	<0.002	<0.002
V	-	-	-	-	0.001	mg/L	167[2]	166[2]	64.4[2]
Zn	5	5	-	5	0.001	mg/L	<0.001	<0.001	<0.001

Table Att7.1-2 Results of Groundwater Laboratory Tests: GWU-004–GWU-006 Samples

Parameter	Ugandan Standard Limit Level		WHO Standard	Project Standard	Limit of Detection	Units	Sample Number, Date and Location		
	Treated	Natural					GWU004 23-Nov-17 Nyakabingo	GWU005 23-Nov-17 Duplicate of GWU004	GWU006 23-Nov-17 Karamwanga DWD33659
Ba	0.7	0.7	-	0.7	0.002	mg/L	<0.001	<0.001	<0.001
Fe	0.3	0.3	-	0.3	0.001	mg/L	28.9[2]	24.9[2]	35.4[2]
Naphthalene	-	-	-	-	0.00001	mg/L	0.00003	<0.00001	0.00001
Acenaphthylene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Acenaphthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Fluorene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Phenanthrene	-	-	-	-	0.00001	mg/L	0.00002	<0.00001	0.00001
Anthracene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Fluoranthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Pyrene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benz(a)anthracene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Chrysene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(b)fluoranthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(k)fluoranthene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(a)pyrene	0.7 µg/L[1]	0.7 µg/L[1]	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Dibenzo(a,h)anthracene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Benzo(g,h,i)perylene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001
Indeno(1,2,3-c,d)pyrene	-	-	-	-	0.00001	mg/L	<0.00001	<0.00001	<0.00001

Table Att7.1-2 Results of Groundwater Laboratory Tests: GWU-004–GWU-006 Samples

Parameter	Ugandan Standard Limit Level		WHO Standard	Project Standard	Limit of Detection	Units	Sample Number, Date and Location		
	Treated	Natural					GWU004 23-Nov-17 Nyakabingo	GWU005 23-Nov-17 Duplicate of GWU004	GWU006 23-Nov-17 Karamwanga DWD33659
Total PAH	-	-	-	-	0.00001	mg/L	0.00005	<0.00001	0.00002

NOTES: Source of standards: Uganda Standard – Potable Water (2014).

- no standards

[1]Unspecified polynuclear aromatic hydrocarbon; [2]Values are not reliable owing to long standing time

ATTACHMENT A7.2 FIELD SURVEY REPORT

Introduction

A baseline water quality sampling survey was undertaken along the Tilenga feeder pipeline in Uganda. The survey ran from 21 to 24 November 2017. The survey was undertaken by Robert Naguyo and Mark Olokotum, consultants employed by ECO & Partner in Kampala. The objective of the survey was to characterise the quality of groundwater and to identify any contamination.

Sampling Sites

The sampling sites were determined before the field work and aimed to sample existing drinking water wells based on locations listed in a DWRM database. Several of these wells were found to be either not used or not operating for other reasons. Table Att7.2-1 lists all the locations visited with notes on wells that were not operating. Photographs taken at sampling sites are presented below.

Table Att7.2-1 Boreholes Sampled

Well ID (Name and DWRM National Database Number)	Nearest Approx. KP	District	Sampling Location (WGS84 TM35E_S)		Observations and Sample Number
			Easting	Northing	
Kayese DWD 25901	KP0.5	Buliisa	329451	240726	Borehole broken and not operating; no water sample taken.
Kijanji Primary School DWD 33439	KP08		327418	233838	Borehole not operating; no water sample taken; has not been operating for the past 60 days.
Kijanji CD 2235	KP08		327389	233600	Borehole installed with heavy duty hand pump but not operating; no water sample taken.
Kikorwe DWD 53247	KP08 Alternative		328593	233818	Operating borehole for domestic use, locked by community member; access was provided; water sample collected GWU 001.
Kibukwa-Barwogeza DWD53493	KP08 Alternative B		328787	234044	Newly constructed operating borehole for domestic use; water sample GWU 002.

Table Att7.2-1 Boreholes Sampled

Well ID (Name and DWRM National Database Number)	Nearest Approx. KP	District	Sampling Location (WGS84 TM35E_S)		Observations and Sample Number
			Easting	Northing	
Kabolwa DWD 33442	KP17		324560	224769	Borehole not operating; no water sample taken; abandoned.
Kyogolyeki Kigoya	KP17		324183	225755	Operating borehole for domestic use; water sample: GWU 003.
Kabolwa	KP18.5		324507	223205	Borehole not operating; no water sample taken; locals reported the water to be salty.
Songambe DWD 52052	KP70		298783	172586	Borehole not operating; no water sample taken.
Nyakabingo	KP79	Hoima	298781	172583	Operating borehole for domestic use; water sample GWU 004; duplicate sample GWU 005 taken from this well.
Karamwanga DWD33659	KP79 Alternative		298420	172184	Operating borehole for domestic use; water sample GWU 006.

Survey Methodology

Onsite measurements of water temperature, EC, TDS[3], pH, DO and turbidity were made using a calibrated portable digital multiparameter water quality sonde (Aquaprobe).

Field tests for total coliforms and *E. coli* were undertaken at all sites using a portable DelAgua single incubator water-testing kit. Samples were incubated on CHROMagar ECC broth for 24 hours at 44°C.[4] Observations of water odour, iridescence, precipitates and colour were made at all sites.

The laboratory samples were tested for the following parameters:

- total petroleum hydrocarbons
- polycyclic aromatic hydrocarbons
- dissolved metals (arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, vanadium, zinc)

[3] TDS was calculated internally by the Aquaprobe based on the equation TDS = EC·0.65.

[4] Using the CHROMagar ECC broth enabled the simultaneous analysis of total coliforms and *E. coli*. The prescribed incubation temperature for both types of bacteria is 37°C. However, it was not possible to adjust the incubation temperature of the particular test kit used in this survey. Incubation at 44°C favours the growth of *E. coli* relative to total coliforms. As the presence of *E. coli* is an indicator of faecal contamination and total coliform bacteria are ubiquitous in natural waters, this was not considered to affect the conclusions reached.

- TSS
- COD
- BOD
- sulphates, calcium, chloride

The sampling methodology was in accordance with industry best practice (ISO 5667-11:2009 Water quality – Sampling – Part 11: Guidance on sampling of groundwaters). GPS coordinates of the sampling locations were recorded. All samples were collected using the existing hand pump installed at each well. Samples were packed securely in cool boxes with ice packs and kept in the dark before being despatched to the laboratory with a sample chain of custody form. The samples were sent to SGS, a laboratory in Mwanza, Tanzania that has ISO 17025 laboratory accreditation.

Analytical methods used by SGS were those specified by:

- Standard Methods for Examination of Water and Wastewater (APHA 2012)
- German Institute for Standardisation (DIN).

Table Att7.2-2 lists SGS' analysis methods and limits of detection.

Table Att7.2-2 SGS Methods of Analysis and Limits of Detection

Parameter	Analytical Method	Limit of Detection (mg/L)	Method Uncertainty (mg/L)
TSS	EW_APHA_2540D	1	±0.76
Chloride Cl	EW_APHA_4500CL	0.2	±0.17
Sulphate SO_4	EW_APHA_4500SO4E	0.02	±0.078
Calcium Ca	EW_APHA_3111D_CA_ICP	0.01	±0.097
BOD	EW_APHA_5210B	0.1	-
COD	EW_APHA_5220D_COD	0.1	±0.024
Total Petroleum Hydrocarbons	EW_APHA_5520F	1	-
Total PAH	DIN 38407-39 HE	0.00001	-
Arsenic As-dissolved by Hydride	EW_APHA_3114B_DHYD	0.001	±0.0008
Barium Ba-dissolved	EW_APHA_3111B_DMET_I	0.002	±0.020
Cadmium Cd-dissolved	EW_APHA_3111B_DMET_I	0.001	±0.044
Chromium Cr-dissolved	EW_APHA_3111B_DMET_I	0.001	±0.027
Copper Cu-dissolved	EW_APHA_3111B_DMET_I	0.001	±0.016
Iron Fe-dissolved	EW_APHA_3111B_DMET_I	0.001	±0.050
Lead Pb-dissolved	EW_APHA_3111B_DMET_I	0.005	±0.012

Table Att7.2-2 SGS Methods of Analysis and Limits of Detection

Parameter	Analytical Method	Limit of Detection (mg/L)	Method Uncertainty (mg/L)
Mercury Hg-dissolved by Cold Vapour	EW_APHA_3114B_DHYD	0.001	±0.0015
Nickel Ni-dissolved	EW_APHA_3111B_DMET_I	0.004	±0.023
Silver Ag-dissolved	EW_APHA_3111B_DMET	0.01	±0.001
Vanadium V-dissolved	EW_APHA_3111B_DMET_I	0.001	±0.026
Zinc Zn-dissolved	EW_APHA_3111B_DMET_I	0.001	±0.040

The above analyses were performed at each sampling location.

Survey Results

Table Att7.2-3 presents the results of the onsite measurements, micro-biological analyses and observations in relation to national drinking water standards. Results exceeding national drinking water standards are printed in bold.

Table Att7.2-3 Results of Onsite Measurements and Observations

Closest KP	Sample No.	Date	Temp (°C)	EC (µS/cm)	TDS * (mg/L)	pH	DO (mg/L)	DO (%)	Turbidity (NTU)	Total Coliforms Duplicate 1/ Duplicate 2 (CFU/100 mL)	*E. coli* Duplicate 1/ Duplicate 2 (CFU/100 mL)	Odour
National drinking water standards		Treated	-	1500	500	5.5–8.5	-	-	5	Absent	Absent	Odourless
		Natural	-	2500	1500	6.5–8.5	-	-	25			
Project Standards			-	-	-	6.5–8.5	-	-	5	Absent	Absent	Odourless
KP08	GWU001	21/11/17	29.2	581	377	6.51	3.11	43.7	8.7	00	00	No odour
KP08-B	GWU002	21/11/17	30.4	541	351	6.49	2.44	35.3	0.2	00	00	No odour
KP17	GWU003	22/11/17	29.1	**2769**	**1800**	6.88	2.24	31.5	**30.1**	00	00	No odour
KP79	GWU004	23/11/17	25.2	**2200**	**1431**	6.55	2.43	37.5	**48.9**	00	00	No odour
KP79-B	GWU006	23/11/17	25.5	1450	**941**	6.98	3.35	48.1	**32.8**	04 06 04	00 00 02	No odour

NOTE: * Observations of TDS (mg/L) is calculated using the formula TDS = EC x 0.65.

NR – Not recorded

Quality Control Procedures

Introduction

Several quality control procedures were implemented to ensure that accurate and reliable data were collected. These included:

- blank and duplicate samples
- detailed standard operating procedures
- daily calibration checks on the AquaProbe multi-parameter probe.

Blank and Duplicate Samples

Blank and duplicate samples were taken. Table Att7.2-4 lists the quality control samples taken on the survey.

Table Att7.2-4 Quality Control Samples

Sample ID	Sample type	Analysis suite
GWU005	Duplicate of sample GWU004	Lab measurements: Cl, SO_4, Ca, TSS, BOD, COD, PAHs, total petroleum hydrocarbons and dissolved metals

Blank and duplicate samples were given unique identifiers that would not indicate their nature as a sample blank or as a duplicate. The duplicate samples were taken immediately after the respective original sample. The duplicate samples are a measure of the reproducibility of the sampling. The results of the quality control samples are presented in the baseline report, with duplicate data presented along with those of the original sample allowing direct comparison. Overall, the quality control analysis shows that the data collected are sufficiently accurate to enable a reliable assessment of water quality at the time of sampling and for the parameters analysed and can be used to inform the impact assessment.

Standard Operating Procedures

Standard operating procedures (SOP) were provided for the samplers to following during training and during the survey:

- groundwater hydrochemical sampling
- Aquaread multi-parameter probe calibration
- preparation of CHROMagar ECC broth (culture medium for microbiological testing).

The use of standard procedures ensured uniformity in calibration, sampling and measurement, causing any differences in results to be due to the water sampled and not the sampling or measurement technique.

Daily Calibration Checks

The calibration of the AquaRead multi-parameter Aquaprobe was checked at the start of each day to maximise the accuracy of results.

Onsite Observations

The results of the onsite observations indicate:

- There were both functional and nonfunctional boreholes along the Tilenga feeder pipeline.
- The nonfunctional boreholes were sometimes abandoned by the community owing to “bad water quality” i.e., salty water or water that was very brown and “iron” in colour. In case of mechanical failure of the boreholes, the community repairs it.
- Almost all the deep boreholes (more than 50 m) along the pipeline had very mild microbial contamination.
- The occurrence of broken down boreholes resulting from installing pumps at great depths rendered sampling from these boreholes using the hand pumps impossible. Most of the communities have resorted to local sources such as water holes as alternative sources due to poorly performing and broken-down boreholes.
- Hydrocensus data referred to for the survey lacked coordinates rendering it difficult to trace some of the existing sources along the pipeline despite efforts made to contact local communities and their leaders.
- As observed during the field survey, Hoima district generally has good groundwater potential in terms of quantity and quality. Shallow groundwater potential is also common in these areas rendering them vulnerable to contamination.
- Salinity is significant along the shores of Lake Albert, which leads to corroded pipes and frequent breakdowns of boreholes and in some instances, abandonment. However, this is not always the case, with some boreholes within short distances having lower salinity.

ATTACHMENT A7.3 FIELD SURVEY PHOTOGRAPHS

Date	Well Location	KP Number	BH No.	
11/21/2017	KAYESE	KP0.5	DWD 25901	
11/21/2017	KIJANJI PRIMARY SCHOOL	KP0.8	DWD 33439	

Date	Well Location	KP Number	BH No.	
11/21/2017	KIJANJI	KP08	CD 2235	
11/21/2017	KIKORWE	KP08-ALT	DWD 53247	

Date	Well Location	KP Number	BH No.	

Date	Well Location	KP Number	BH No.	
11/21/2017	KIBUKWA-BARWOGEZA	KP08-ALT B	DWD53493	
11/22/2017	KABOLWA	KP17	DWD 33442	
11/22/2017	KYOGOLYEKI KIGOYA	KP17	NO NUMBER	
11/22/2017	KABOLWA	KP18.5-ALT	NO NUMBER	
11/23/2017	SONGAMBE	KP70	DWD 52052	
11/23/2017	NYAKABINGO	KP79	NO NUMBER	

Date	Well Location	KP Number	BH No.	
11/23/2017	KARAMWANGA	KP79-B	DWD33659	

ATTACHMENT A7.4 LABORATORY REPORTS

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ilac-MRA CALA
Testing
Accreditation No. A 4114

Report number: EL180073

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Tim Newton
RSK Ltd
Spring lodge, 172 Chester Road, Helsby,
Cheshire, WA6 OAR, UK

Lab Ref: EL180073
Client Ref: **P.O. 275206**
Project:
Received: 07/04/2018
Reported: 07/05/2018

Samples: 9
First Sample: GWU-004 (Water) 23/11/2017 23:20
Last Sample: GWU-012 (Water) 25/11/2017 16:40
Pages: 7

FINAL REPORT

Notes

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Lab Ref EL180073
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Project
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ANALYTICAL REPORT

Sample Ident	*Chloride*	*Sulphate*	*BOD**	*COD*	*Total Petroleum Hydrocarbon**	*Cd*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
GWU-004 (Water) 23/11/2017 23:20	284	513	1.0	3.7	<1.0	<0.001
GWU-005 (Water) 23/11/2017 23:20	286	363	<0.10	<0.10	<1.0	<0.001
GWU-006 (Water) 23/11/2017 13:30	63.4	154	<0.10	<0.10	<1.0	<0.001
Method	*Chloride*	*Sulphate*	*BOD*	*COD*	*troleum Hydro*	*issolved Metals*
Detection Limit	*0.20*	*0.02*	*0.10*	*0.10*	*1.0*	*0.001*
Method Uncertainity	*±0.17*	*±0.078*	-	*±0.024*	-	*±0.044*

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

**non-accredited # - subcontracted TNTC - too numerous to count T.F. to follow*

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ANALYTICAL REPORT

Sample Ident	*Cr*	*Cu*	*Pb*	*Ni*	*Ag*	*V*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
GWU-004 (Water) 23/11/2017 23:20	<0.001	0.022	<0.005	0.073	<0.01	<0.001
GWU-005 (Water) 23/11/2017 23:20	<0.001	<0.001	<0.005	0.040	<0.01	<0.001
GWU-006 (Water) 23/11/2017 13:30	<0.001	<0.001	<0.005	<0.004	<0.01	<0.001
Method	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Dissolved Metals*
Detection Limit	*0.001*	*0.001*	*0.005*	*0.004*	*0.01*	*0.001*
Method Uncertainity	*±0.027*	*±0.016*	*±0.012*	*±0.023*	*±0.001*	*±0.026*

NA - not analysed | – element not determined | I.S. insufficient sample | L.N.R. listed not received

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Sample Ident	*Zn*	*Fe*	*Ba*	*Ca*	*As*	*Hg*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
GWU-004 (Water) 23/11/2017 23:20	0.035	0.38	<0.002	167	<0.001	<0.001
GWU-005 (Water) 23/11/2017 23:20	<0.001	0.16	<0.002	166	<0.001	<0.001
GWU-006 (Water) 23/11/2017 13:30	0.10	<0.001	<0.002	64.4	<0.001	<0.001
Method	*issolved Metal*	*Dissolved Metal*	*Dissolved Metal*	*Cations*	*D_Hydrides*	*D_Hydrides*
Detection Limit	*0.001*	*0.001*	*0.002*	*0.01*	*0.001*	*0.001*
Method Uncertainity	*±0.040*	*±0.050*	*±0.020*	*±0.097*	*±0.0008*	*±0.0015*

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

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ANALYTICAL REPORT

Sample Ident	*TSS*	*Polycyclic Aromatic Hydrocarbonms (PAHs) #*				
		Naphthalene	*Acenaphthylene*	*Acenaphthene*	*Fluorene*	*Phenanthrene*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
GWU-004 (Water) 23/11/2017 23:20	28.9	0.00003	<0.00001	<0.00001	<0.00001	0.00002
GWU-005 (Water) 23/11/2017 23:20	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
GWU-006 (Water) 23/11/2017 13:30	35.4	0.00001	<0.00001	<0.00001	<0.00001	0.00001
Method	*TSS*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 HE*
Detection Limit	*1.0*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Method Uncertainity	*±0.76*	-	-	-	-	-

NA - not analysed | -- element not determined | I.S. insufficient sample | L.N.R. listed not received

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Sample Ident	*Polycyclic Aromatic Hydrocarbonms (PAHs) #*					
	Anthracene	*Fluoranthene*	*Pyrene*	*Benz(a)anthracene*	*Chrysene*	*Benzo(b)fluoranthene*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
GWU-004 (Water) 23/11/2017 23:20	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
GWU-005 (Water) 23/11/2017 23:20	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
GWU-006 (Water) 23/11/2017 13:30	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Method	IN 38407-39 H	IN 38407-39 H	IN 38407-39 H	IN 38407-39 H	IN 38407-39 H	IN 38407-39 HE
Detection Limit	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Method Uncertainity	-	-	-	-	-	-

NA - not analysed | *-- element not determined* | *I.S. insufficient sample* | *L.N.R. listed not received*

**non-accredited* *# - subcontracted* *TNTC - too numerous to count* *T.F. to follow*

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Sample Ident	*Polycyclic Aromatic Hydrocarbonms (PAHs) #*					
	Benzo(k)fluoranthene	*Benzo(a)pyrene*	*Dibenzo(a,h)anthracene*	*Benzo(g,h,i)perylene*	*Indeno(1,2,3-c,d)pyrene*	*Total PAH*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*
GWU-004 (Water) 23/11/2017 23:20	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00005
GWU-005 (Water) 23/11/2017 23:20	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
GWU-006 (Water) 23/11/2017 13:30	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002
Method	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 H*	*IN 38407-39 HE*
Detection Limit	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Method Uncertainity	-	-	-	-	-	-

NA - not analysed | *-- element not determined* | *I.S. insufficient sample* | *L.N.R. listed not received*

**non-accredited* *# - subcontracted* *TNTC - too numerous to count* *T.F. to follow*

END OF REPORT

Appendix A8: Acoustics Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

Symbols	
$L_{eq(T)}$	sound level in decibels equivalent to the total sound energy measured over a stated period of time
$L_{90(T)}$	noise level exceeded for 90% of the time of the measurement duration. Often taken to represent the ambient or background noise level.
$L_{10(T)}$	noise level exceeded for 10% of the time of the measurement duration. Often taken to represent traffic-related noise
L_{max}	RMS (root mean squared) maximum level of a noise source or given environment
A	
AGI	aboveground installation
AOI	area of influence
B	
bomas	livestock enclosure
D	
dB	decibel
dB(A)	A-weighted decibel
H	
h	hour
K	
km	kilometre
M	
m	metre
masl	metres above sea level
min	minute
R	
RoW	right-of-way
V	
VEC	valued environmental (and social) component

Please note all times are provided in 24 h format.

A8 ACOUSTIC BASELINE REPORT

A8.1 Introduction

This baseline report describes the acoustics:

- area of influence (AOI) and study area boundaries
- methods
- baseline conditions:
  - trend in condition and sensitivity to change
  - ecosystem services provided
- key considerations.

A8.2 Area of Influence and Study Area Boundaries

A8.2.1 Area of Influence Boundary

AOI boundaries have been applied to existing and planned new and upgraded construction access roads, the main camp and pipe yard (MCPY) and the right-of-way (RoW).

The AOI was set at a 500-m radius, based on a review of engineering information and satellite images, and taking into consideration likely noise emission levels. It has been used to identify the location of potential receptors.

The temporal AOI for the pipeline will be approximately 25 years. For the temporary construction access roads and MCPY, the temporal AOI is the period of construction.

A8.2.2 Study Area Boundary

The study area boundary is the same as the AOI boundary for construction access roads, the MCPY and the RoW as the potential acoustic impacts will be negligible beyond the 500-m AOI.

Figure A8.2-1 shows the baseline noise monitoring locations.

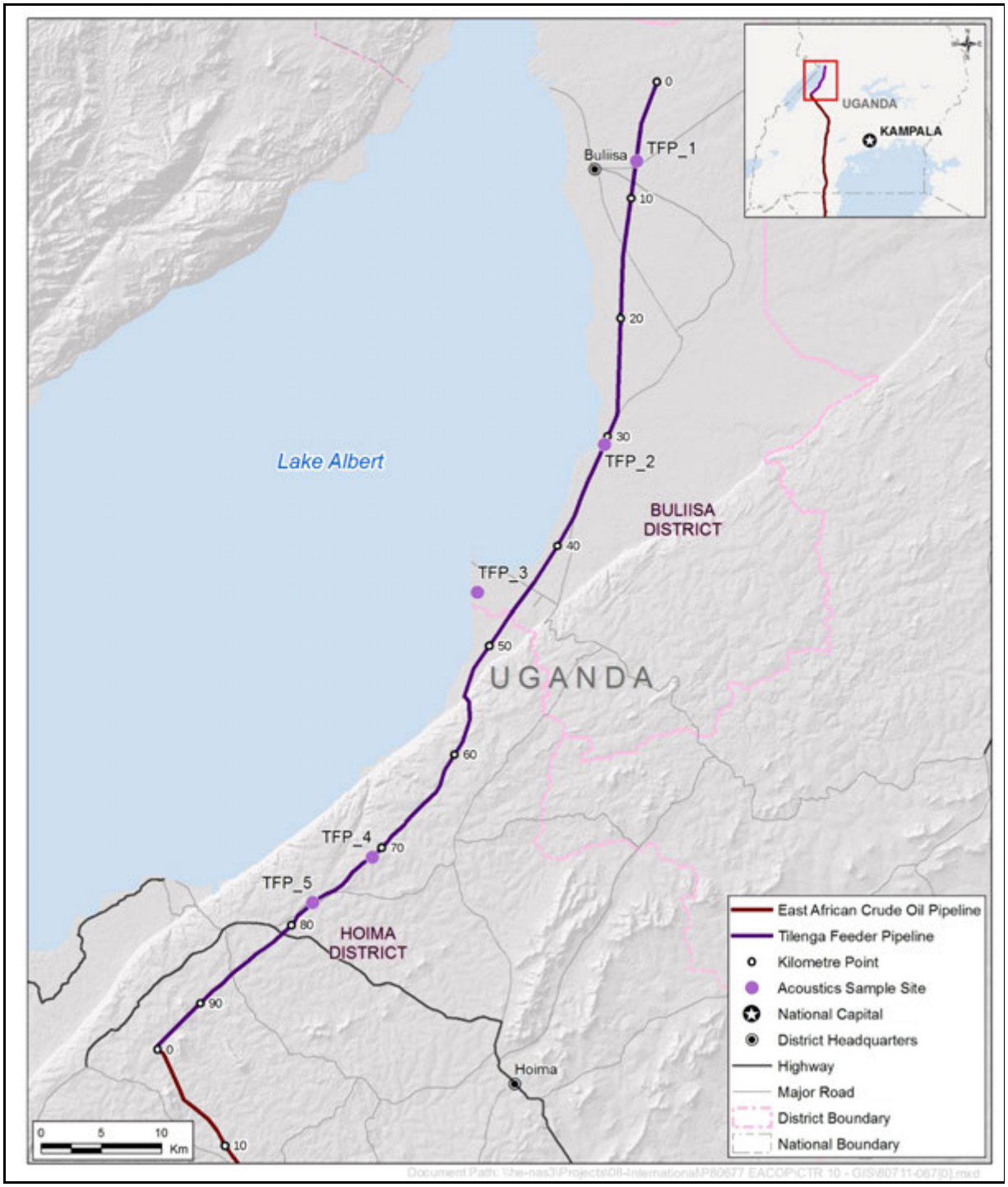

Figure A8.2-1 Location of Baseline Noise Monitoring

A8.3 Methods

A8.3.1 Secondary Data

Land cover maps and satellite images was initially used to identify noise and vibration sensitive receptors near project components during construction and operation. The information was also used to identify monitoring locations from

which data representative of the existing noise environment across the AOI could be collected.

A8.3.2 Field Survey

The noise field survey was conducted between Tuesday 6 February and Thursday 8 February 2018 using field survey data sheets developed during the desktop review. The survey objectives were to:

- Identify potential sensitive receptors around the MCPY
- characterise the baseline acoustic environment in the AOI
- quantify the noise environment during the day (the MCPY is not expected to operate at night)
- quantify the likely baseline noise environment throughout the AOI
- consider potential trends affecting the acoustic environment throughout the AOI.

In the absence of national guidelines on monitoring methods, the survey was undertaken in accordance with *British Standard BS 7455-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures'.*

A8.3.2.1 Equipment

In the absence of national guidelines, the equipment used for the survey consisted of Class 1 sound level meters and a field calibrator (Table A8.3-1). The equipment used conformed to the requirements of *British Standard BS EN 61672:-1:2003 'Electroacoustics. Sound level meters. Specifications'.*

Table A8.3-1 Noise Monitoring Equipment

Type	Model	Serial No	Calibration Date*
Class 1 sound level meter	Rion NL-32	01013661	12/06/2017
Field calibrator	Rion NC-74	34378202	24/11/2017

NOTE: *The equipment used has a calibration history that is traceable to a certified calibration institution. Under British Standard BS EN 61672-1, sound level meters require calibration every two years, with acoustic calibrators requiring calibration annually.

A8.3.2.2 Macro-Siting

Monitoring locations were chosen throughout the AOI to provide a general understanding of the noise environment across different types of land use and are therefore suitable for assessing both fauna and human impacts.

Owing to the length of the RoW and the temporary nature of construction noise emissions, which may be experienced along the RoW, it is considered appropriate to undertake monitoring at locations representative of a wider receiver area. Data has therefore been collected from areas directly around the monitoring point and from other areas along the RoW which are considered to have a similar noise environment (as inferred by proximity to similar noise sources and presence of similar vegetation).

Monitoring was undertaken at five locations along the RoW, labelled TFP1–5 (Figure A8.2-1).

All the monitoring locations are representative of the noise environment across the AOI for the RoW and construction access roads.

The noise data collected at TFP3 is representative of the noise environment surrounding the MCPY.

A8.3.2.3 Micro-Siting

Although the monitoring sites were chosen from aerial imagery and other secondary and field data, the final siting of each microphone was chosen while onsite to be as close as practically possible location chosen during the macro-siting process while avoiding locations where local factors would adversely affect the results. Final locations were:

- close to habitation to gather data representative of human receptors
- 1.2–1.5 m aboveground
- a minimum of 3 m away from any vertical surfaces (e.g., buildings, walls and other structures)
- away from dominant plant (i.e., generators, pumps or air handling units)
- away from dominant vehicles (i.e., idling traffic or cattle trucks)
- away from dominant watercourses
- away from vegetation likely to cause substantial noise under moderate wind speeds
- away from abnormal or ad-hoc events such as markets, festivals or sporting events.

At each location, a record of the site position and conditions was made, which included photographs of the noise meter in situ. These records are contained in Attachment A8.1.

A8.3.2.4 Monitoring Parameters and Durations

Across all positions, broadband acoustic indices were recorded. This included $L_{eq,T}$, $L_{90,T}$, L_{max} and $L_{10,T}$, with all data recorded under A-weighting.

At all locations, the monitoring duration was a minimum of 1 h during daytime periods (06:00 to 22:00).

A8.3.3 Data Analysis

The acoustic sensitivity of the landscape has been ranked according to the table for acoustic receptor sensitivity in Section 8 of the environmental and social impact assessment (ESIA).

A8.3.4 Data Considerations

The desk-based assessment, field survey and social and biodiversity surveys provided sufficient information to accurately describe the acoustic landscape, and identify and characterise receptors within the acoustic AOI.

A8.3.5 Vibration

The baseline environment for vibration is rarely quantified at ESIA stage unless there are substantial terrestrial vibration sources identified during the scoping exercise.

The scoping exercise did not identify any terrestrial vibration source in the study area with a potential to be discernible above natural background vibration levels. Significant vibration sources are typically heavy mining activities, localised industrial operation (with heavy reciprocating or percussive plant) or heavy construction activities (piling, high-impact compaction or drilling). In addition, vibration is usually assessed in line with absolute thresholds rather than by comparison to a baseline.

Therefore, vibration has not been further considered as part of this baseline report.

A8.4 Noise Baseline Conditions

The baseline condition of the AOI is described in terms of:

- observed noise character
- measured noise levels.

The term ‘noise’ is used rather than ‘acoustic’ as the following sections purely focus on noise rather than acoustics (noise and vibration). Vibration is discussed in Section A8.3.5.

A8.4.1 Baseline Condition of the Noise Environment

Section A8.4.1.1 describes the baseline condition of the RoW and construction access roads.

The field survey sheets containing data on each noise monitoring location are presented in Attachment A8.1.

A8.4.1.1 Main Camp and Pipe Yard

Noise has been measured at the closest sensitive receptors to the MCPY. Daytime measurements have been recorded as these facilities are expected to operate only during the day through the construction phase.

Measurement location TFP3 is less than 1.5 km to the southwest of MCPY.

At the MCPY, the terrain is varied with vegetation consisting of localised banana and maize plantations. Less than 1 km to the north is Lake Albert. There are small isolated habitations in the area immediately surrounding the MCPY.

Most of the landscape within the MCPY AOI has been modified by human activity and has lost of its natural vegetation.

The dominant noise sources in the AOI are limited to farming (mainly manual labour farming), shoreline activity (boat movement and repairs), wind through vegetation, bird song and occasional localised vehicle movements (with a high percentage of small-engine motorbikes). No industrial or commercial noise sources were observed during the field noise survey. Neither the field survey nor other data sources suggest the presence of industrial or commercial noise sources.

Table A8.4-1 shows quantitative data describing the noise environment in the MCPY AOI.

Table A8.4-1 Main Camp and Pipe Yard Daytime Noise Monitoring Data, TFP3

Location	Date	Start and End Time	$L_{eq,1hr}$, dB(A)	$L_{90,1hr}$, dB(A)	$L_{10,1hr}$, dB(A)	L_{max}, dB(A)
TFP3	Thursday 8 February 2018	06:30–07:30	43.2	25.1	37.2	84.1

The noise environment around the MCPY is consistent with what would be expected in an environment away from major industrial noise sources.

A8.4.1.2 Right-of-Way and Construction Access Roads

Within the RoW AOI, background noise measurements were made at five locations (TFP1–5) .

The noise data represent baseline conditions in the RoW and construction access road AOI, and are presented in this section. They provide a general indication of the background noise environment across the entire project AOI.

Anecdotal information from local consultants, stakeholders and other field surveys supports the observations made during the noise monitoring that the range of noise sources is relatively consistent across the RoW and access road AOI. Typical background noise sources are:

- road traffic (with a high proportion of small-engine motorbikes, particularly across unsealed roads, and truck movements across sealed roads). Traffic flows, even across sealed roads, are relatively low.
- human interactions. This includes domestic and low-level commercial farming, mainly with manual labour, community events, school noise, manual brick-making and general talking and play.
- fauna (bird song, local mammal movements, and amphibian and insect calls) and domestic animals (livestock and dogs)
- local plant (mechanical pumps and generators)
- local and short-term construction noise (mostly manual labour, but some plant including road upgrade plant)
- wind through vegetation.

Given the above and considering the large AOI, the noise levels recorded at the five monitoring locations are considered together to indicate the range of noise levels for the baseline environment rather than a specific value per location. This is considered valid due to the presence of similar noise sources throughout, and the short-term nature of the measurements.

Table A8.4-2 summarises the daytime noise data. Attachment A8.1 includes the field survey sheets which have information on the characteristics of the site which may affect the measured noise environment.

Table A8.4-2 Daytime Noise Monitoring Data, TFP1 to TFP5

Location	Date	Start and End Time	Leq,1hr, dB(A)	L90,1hr, dB(A)	L10,1hr, dB(A)	Lmax, dB(A)
TFP1 [1]	Wednesday 7 February 2018	22:40–23:40	38.0	24.3	39.4	58.5
TFP2	Wednesday 7 February 2018	08:30–09:30	47.5	33.1	47.8	75.1
TFP3	Thursday 8 February 2018	06:30–07:30	43.2	25.1	37.2	84.1
TFP4	Tuesday 6 February 2018	13:12–14:12	41.9	32.7	43.5	73.3
TFP5	Tuesday 6 February 2018	11:15–12:15	55.2	46.7	62.2	62.4
Highest Recorded Hour			55.2	46.7	62.2	84.1
Lowest Recorded Hour			38.0	24.3	37.2	58.5
Mean			45.2	32.4	46.0	70.7
Range			38.0–55.2	24.3–46.7	37.2–62.2	58.5–84.1

NOTES: [1]Measurement recorded during day/night transition period but treated as a daytime value for analytical purposes.

The daytime data presented across the noise RoW and access road AOI shows a spread of 17–22 dB for indices normally used to represent ambient and baseline noise environments (L_{eq} and L_{90}). This is as would be expected throughout the daytime and therefore gives confidence that the data range is representative of the wider AOI.

A8.4.2 Trend in Condition and Sensitivity to Change

A8.4.2.1 Right-of-Way, Main Camp and Pipe Yard and Construction Access Road Areas of Influence

The noise environment throughout the AOI, particularly around human habitations and settlements, has been exposed to road construction using heavy machinery and although vehicle movements have the potential to increase, the character of the noise source is not new to most of the areas. Sensitivity will be greater where new roads are created to access project facilities, compared with the use of existing roads.

Therefore, given the temporary nature of the noise emissions associated with the wider acoustic AOI, and the experience of similar noise emissions, the tolerance to change is considered relatively high. This will depend on actual magnitude of emissions.

A8.4.3 Ecosystem Services Provided

This VEC does not have any ecosystem services associated with it.

A8.4.4 Sensitivity Rankings

Based on the survey, stakeholder engagement, trend in condition and sensitivity to change, the sensitivity of the acoustic environment for the RoW and access roads across the AOI has been ranked (Table A8.4-3). The sensitivity ranking is reasonably generic across the AOI.

Table A8.4-3 Acoustic Receptor Sensitivity Ranking – Presence in Area of Influence

Project Component	Receptor				
	Very Low	Low	Moderate	High	Very High
RoW	X	X	X	X	X*
Construction access roads	X	X	X	X	-
MCPY	X	X	X	X	-

NOTES: *Very high for some biodiversity-related VECs (not for human receptors)
Very low – No human receptors other than project workforce and visitors to the project. Area is not considered frequented or used by fauna.
Low – Locations used for recreation and industrial activities, such as industrial units and workshops. Workers outside the project site or not engaged in project work (i.e., not part of the project workforce). Fauna have the potential to pass through the area but not a common occurrence. Area not known to be used for breeding, feeding, habitation or migration of fauna
Moderate – Locations used for work requiring concentration, such as offices. Area known to be used regularly by local fauna for regular movement.
High – Locations used for rest and sleep such as residential properties. Educational establishments and places of worship. Area known to be used for regular feeding or migration of local fauna.
Very High – Locations used by vulnerable people such as hospitals and homes for the elderly. Area known to be used for fauna habitation and breeding.

A8.5 Key Considerations

The acoustic baseline study did not identify sensitive receptors classed as very high anywhere in the acoustic AOI, although very low to high sensitivity receptors were identified across the RoW and MCPY AOI.

The noise environment across the majority of the AOI is dominated by human induced sources such as road traffic, farming and general human interactions. There is an absence of industrial and commercial noise throughout the RoW and MCPY AOIs.

A8.6 References

British Standard BS 7455-1:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures',*

British Standard BS EN 61672:-1:2003 '*Electroacoustics. Sound level meters. Specifications'.*

Total East Africa Midstream BV. 2017. EACOP Environmental and Social Impact Assessment Scoping Report for Approval. Submitted to National Environment Management Authority, July.

ATTACHMENT A8.1 FIELD SURVEY DATA

Project Name	East African Crude Oil Pipe Line				
Project No.	80711	**Pipeline**	Tilenga Feeder Pipeline (Uganda)		
Day of Week	Wed	**Date**	7 /2/ 2018	**Location**	TFP_1
Co-ordinates:	2°07'18.2"N 31°26'41.3"E				
Monitoring Personnel	Abraham Ochola				

Photos

North

East

South

West

Period	File Ref:	Start Time	End Time	$L_{eq,1hr}$, dB(A)	$L_{90,1hr}$, dB(A)	$L_{10,1hr}$, dB(A)	L_{max}, dB(A)	Notes/sources
Day	0025	22:40	23:40	38.0	24.3	39.4	58.5	Wind, cattle, birds

Additional Notes:

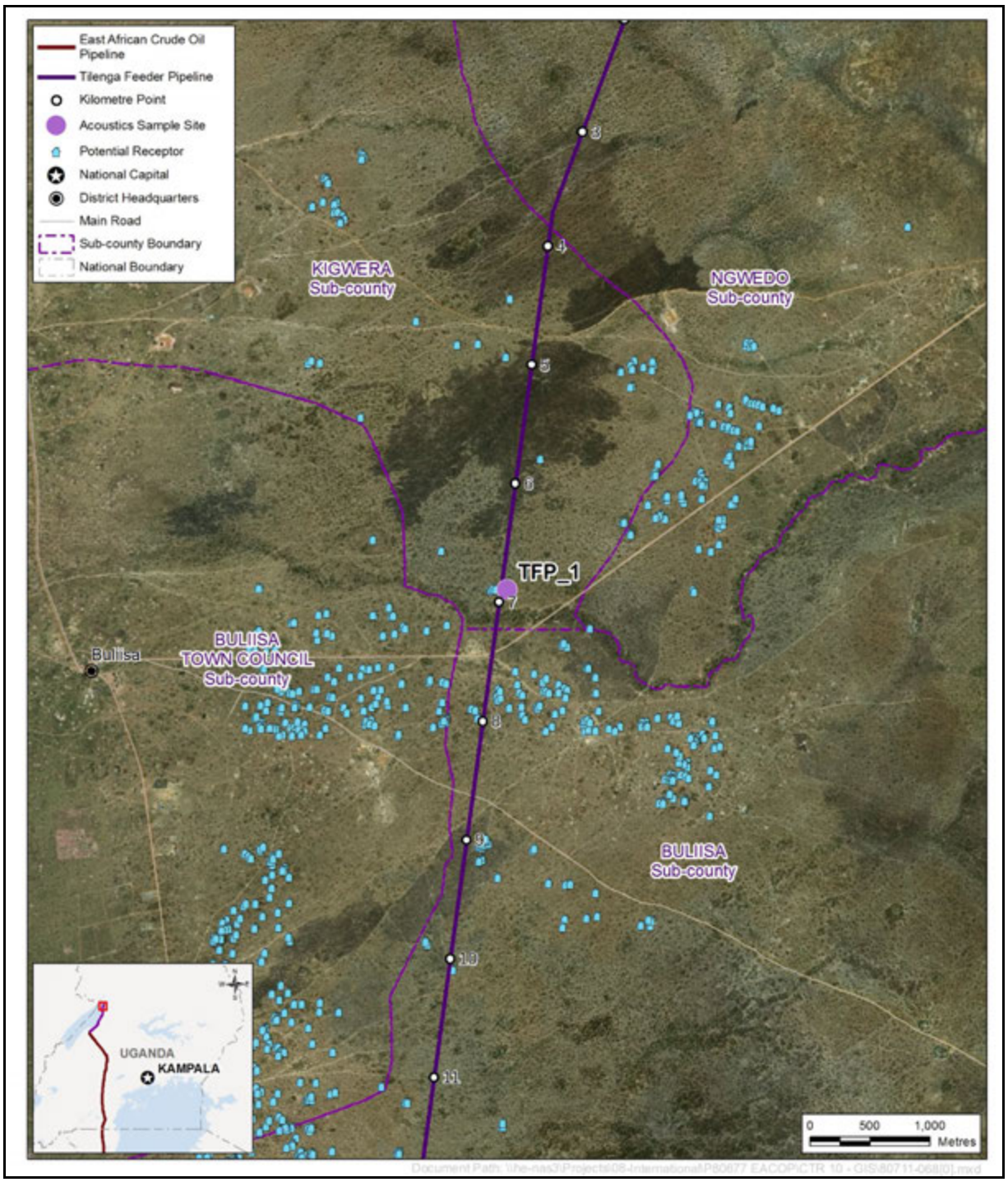

Figure Att8.1-1 Monitoring Site TFP_1

Project Name	East African Crude Oil Pipe Line				
Project No.	80711	**Pipeline**	Tilenga Feeder Pipeline (Uganda)		
Day of Week	Wed	**Date**	7/2/2018	**Location**	TFP_2
Co-ordinates:	324207, 211394				
Monitoring Personnel	Abraham Ochola				

Photos

North

East

South

West

Period	File Ref:	Start Time	End Time	$L_{eq,1hr}$, dB(A)	$L_{90,1hr}$, dB(A)	$L_{10,1hr}$, dB(A)	L_{max}, dB(A)	Notes/ sources
Day	0024	08:30	09:30	47.5	33.1	47.8	75.1	Aeroplane, cattle grazing, people, occasional motorists

Additional Notes:

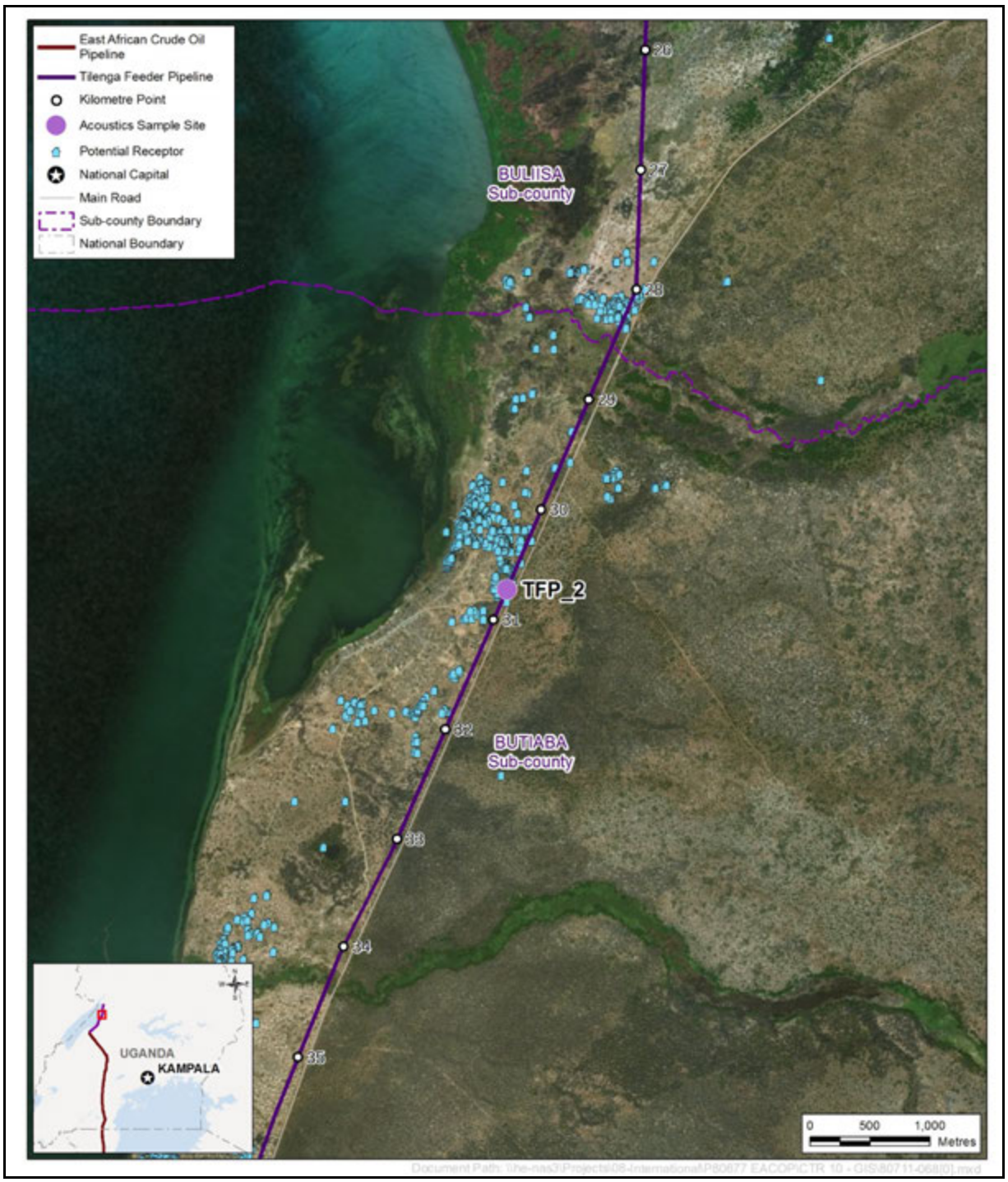

Figure Att8.1-2 Monitoring Site TFP_2

Project Name	East African Crude Oil Pipe Line				
Project No.	80711	**Pipeline**	Tilenga Feeder Pipeline (Uganda)		
Day of Week	Thurs	**Date**	8 /2/ 2018	**Location**	TFP_3
Co-ordinates:	313699,199120				
Monitoring Personnel	Abraham Ochola				

Photos

North

East

South

West

Period	File Ref:	Start Time	End Time	$L_{eq,1hr}$, dB(A)	$L_{90,1hr}$, dB(A)	$L_{10,1hr}$, dB(A)	L_{max}, dB(A)	Notes/sources
Day	0027	06:30	07:30	43.2	25.1	37.2	84.1	Occasional motorists, cattle grazing, engine boats along the lake shores

Additional Notes:

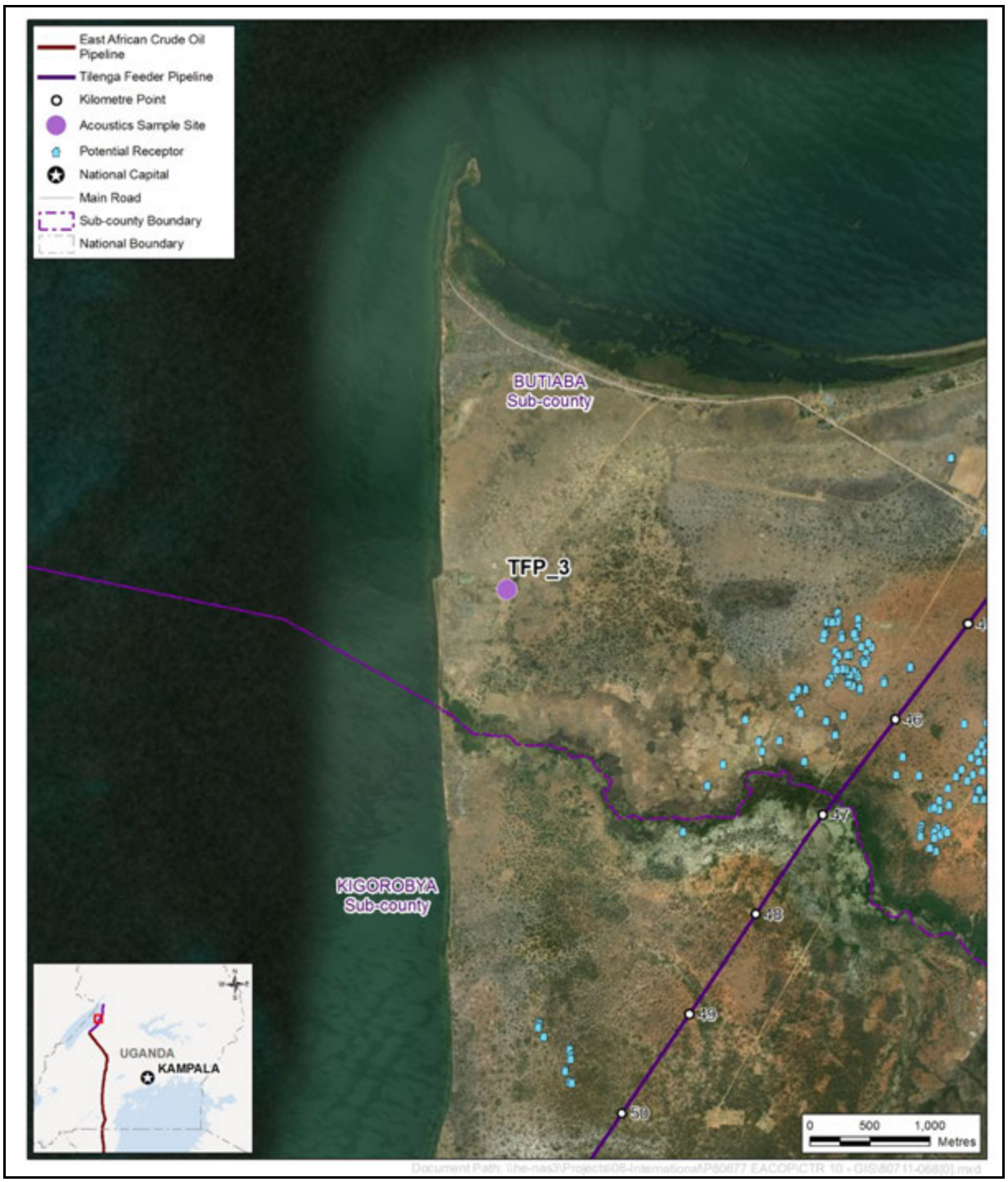

Figure Att8.1-3 Monitoring Site TFP_3

Project Name	East African Crude Oil Pipe Line				
Project No.	80711	**Pipeline**	Tilenga Feeder Pipeline (Uganda)		
Day of Week	Tues	**Date**	6/2/2018	**Location**	TFP_4
Co-ordinates:	304675,176864				
Monitoring Personnel	Abraham Ochola				

Photos

North

East

South

West

Period	File Ref:	Start Time	End Time	$L_{eq,1hr}$, dB(A)	$L_{90,1hr}$, dB(A)	$L_{10,1hr}$, dB(A)	L_{max}, dB(A)	Notes/sources
Day	0023	13:12	14:12	41.9	32.7	43.5	73.3	Wind, School children talking, Occasional motorists

Additional Notes:

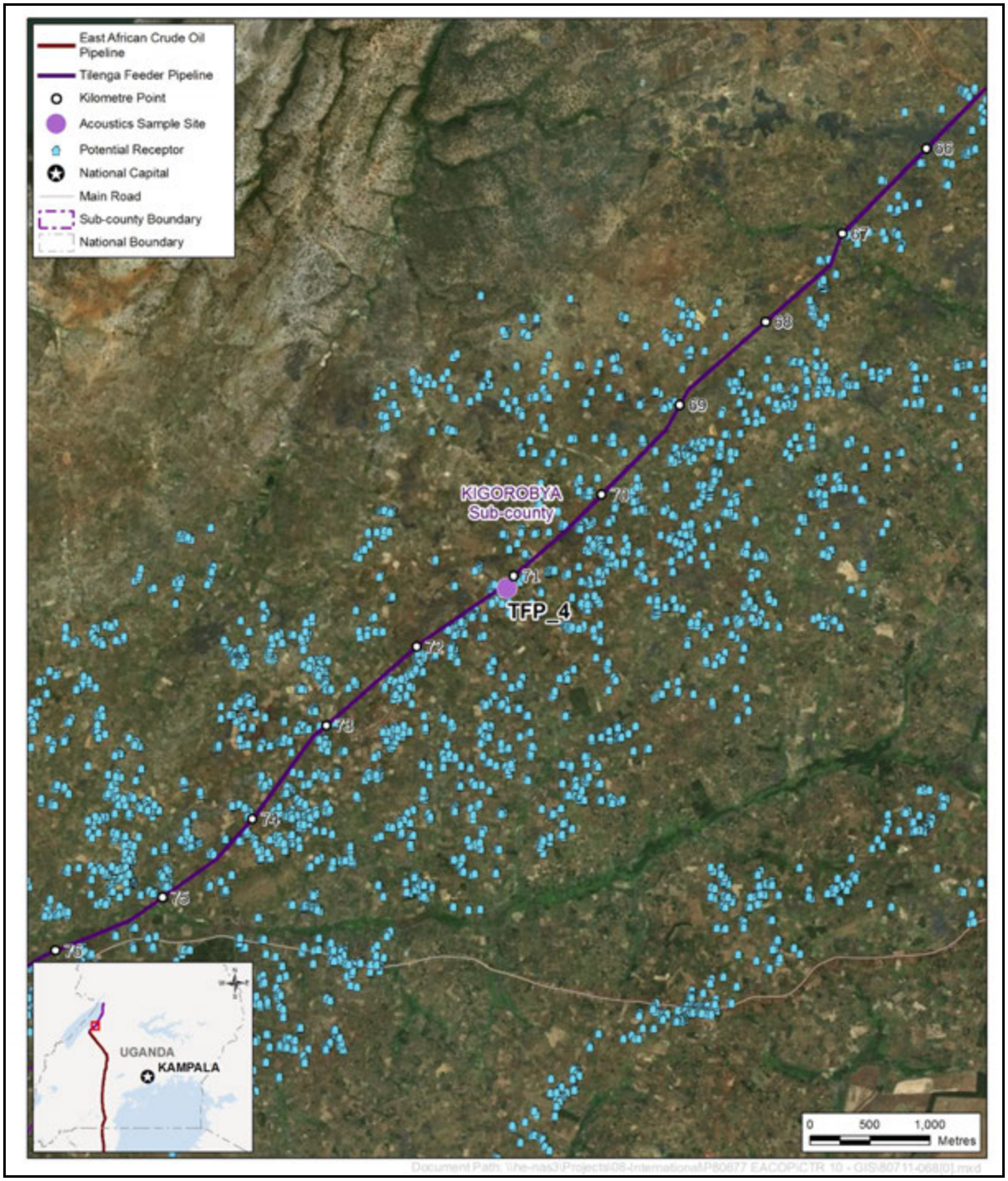

Figure Att8.1-4 Monitoring Site TFP_4

Project Name	East African Crude Oil Pipe Line				
Project No.	80711	**Pipeline**	Tilenga Feeder Pipeline (Uganda)		
Day of Week	Tue	**Date**	6/2/2018	**Location**	TFP_5
Co-ordinates:	300120, 173461				
Monitoring Personnel	Abraham Ochola				

Photos

North

East

South

West

Period	File Ref:	Start Time	End Time	$L_{eq,1hr}$, dB(A)	$L_{90,1hr}$, dB(A)	$L_{10,1hr}$, dB(A)	L_{max}, dB(A)	Notes/ sources
Day	0022	11:15	12:15	55.2	46.7	62.2	62.4	Cattle, music, people talking, occasional motorists, Leaf rustles

Additional Notes:

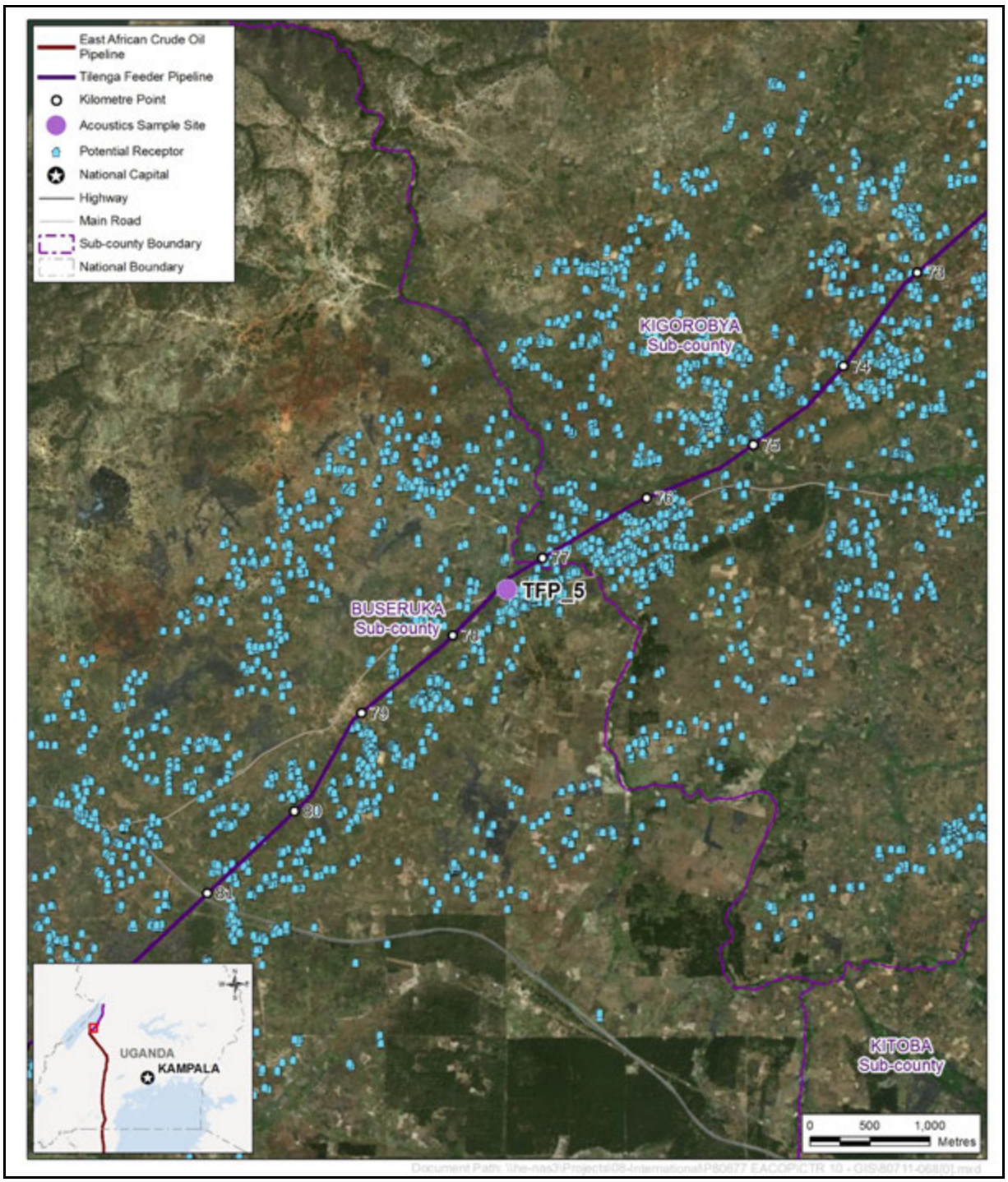

Figure Att8.1-5 Monitoring Site TFP_5

Appendix A9: Socio-economic and Health Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

A	
AGI	aboveground installation
AIDS	acquired immune deficiency syndrome
AOI	area of influence
ACEMP	African Centre for Energy and Mineral Policy
ACODE	Advocates Coalition on Development and Environment
ANARDE	Advocates for Natural Resources and Development
ARI	acute respiratory infection
ASM	artisanal and small-scale mining
B	
BBL/D	barrels per day
BCG	Bacillus Calmette-Guerin
BID	background information document
BMU	beach management unit
BOD	burden of disease
BTVET	business, technical and vocational education and training
BLB	Buganda Land Board
C	
CAO	chief administrative officer
CBOs	community-based organisations
CCO	Certificate of Customary Ownership
CDO	community development officer
CLA	Communal Land Association
CLTS	community-led total sanitation
CNOOC	China National Offshore Oil Corporation
COCTIP	Coordination Office to Combat Trafficking in Persons
COFTU	Central Organisation of Free Trade Unions
COMESA	Common Market for Eastern and Southern Africa
CSCO	Civil Society Coalition for Oil and Gas
CVD	cardiovascular disease

D	
DDP	district development plan
DGSM	Directorate of Geological Survey and Mines
DHMT	district health management team
DHO	district health officer
DLB	district land board
DLO	district land office
DOSH	Department of Occupational Safety and Health
DRC	Democratic Republic of Congo
E	
EAC	East African Community
EACOP	East African Crude Oil Pipeline
ECO	Ecological Christian Organisation
EHA	environmental health area
ESIA	environmental and social impact assessment
F	
FGD	focus group discussion
FDI	foreign direct investment
G	
GBV	gender-based violence
GDP	gross domestic product
GH	general hospital
GOU	Government of Uganda
H	
HAT	human African trypanosomiaisis
HC	health centre
HH	household
HHI	household interview
HIA	health impact assessment
HIPC	heavily indebted poor countries
HIV	human immunodeficiency virus
HMIS	health management and information system
HODIFA	Hoima District Farmers Association
HPP	hydropower plant
HRT	human rights team
HSB	health-seeking behaviour

I	
IAP	International Accountability Project
IFC	International Finance Corporation
ILO	International Labour Organisation
ITN	insecticide treated bed net
K	
KET	key employment terms
KII	key informant interview
KP	kilometre point
L	
LGDPs	local government development plans
M	
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MMR	maternal mortality rate
MDA	ministries, departments and agencies
MDRI	Multilateral Debt Relief Initiative
MEMD	Ministry of Energy and Minerals Development
MGLSD	Ministry of Gender, Labour and Social Development
MLHUD	Ministry of Land, Housing and Urban Development
MoU	Memorandum of Understanding
MTWA	Ministry of Tourism, Wildlife and Antiquities
MDR-TB	multidrug-resistant tuberculosis
MWE	Ministry of Water and Environment
N	
NAADS	National Agricultural Advisory Services
NAP	national action plan
NAPE	National Association of Professional Environmentalists
NCD	noncommunicable disease
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGO	nongovernmental organisation
NDP	National Development Plan
NDPII	Second National Development Plan
NSSF	National Social Security Fund
NMCP	National Malaria Control Programme
NOTU	National Organisation of Trade Unions
NRH	national referral hospital

O	
OPM	Office of Prime Minister
OSH	occupational safety and health
P	
PACs	potentially affected communities
PAU	Petroleum Authority of Uganda
PFM	public financial management
PFP	private-for-profit
PNFP	private-not-for-profit
PPE	personal protective equipment
PPG	public and publicly guaranteed
PSA	Production Sharing Agreement
PSPS	public service pension schemes
R	
RAP	resettlement action plan
RDC	resident district commissioner
REA	Rural Electrification Agency
RESP-2	rural electrification strategy and plan
RoW	right-of-way
RRH	regional referral hospitals
S	
SC	subcounty
SGI	small group interviews
SIP	sector investment plans
SSA	Sub-Saharan Africa
STI	sexually transmitted infection
T	
TB	tuberculosis
TEPU	Total E&P Uganda
TIs	tertiary institutions
TM	traditional medicine
TC	town council
U	
UAE	United Arab Emirates
UBOS	Uganda Bureau of Statistics
UBC	Uganda Broadcasting Corporation
UEDCL	Uganda Electricity Distribution Company Limited

UEGCL	Uganda Electricity Generation Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UDHS	Ugandan Demographic Health Survey
UNRA	Uganda National Roads Authority
UGX	Ugandan shilling
UNDSS	United Nations Department for Safety and Security
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNOC	Ugandan National Oil Company
USD	US dollar
UWA	Uganda Wildlife Authority
UWEP	Uganda Women Entrepreneurship Programme
V	
VAT	value added tax
VEC	valued environmental component
VHF	viral haemorrhagic fever
VHT	village health team
W	
WHO	World Health Organization
Y	
YLP	Youth Livelihood Programme
YF	yellow fever

A9 SOCIO-ECONOMIC AND HEALTH BASELINE REPORT

A9.1 Purpose and Scope of Report

This baseline report describes the social:

- area of influence (AOI) and study area boundaries
- method
- baseline conditions:
- trend in condition and sensitivity to change
- ecosystem services provided
- sensitivity ranking
- key considerations.

Baseline conditions are described for the following valued environmental (and social) components VECs:

- economy
- local economy (nonland-based livelihoods)
- land-based livelihoods
- river and lake-based livelihoods
- land and property
- workers' health, safety and welfare
- social infrastructure and services
- community health
- community safety, security and welfare.

The report also includes an overview of governance, demography and education.

A9.2 Area of Influence and Study Area Boundaries

A9.2.1 Area of Influence Boundary

The spatial AOI for the construction, operation and decommissioning phases of the project is identified at three levels:

- national (includes the entire country)
- district (including the subdivisions of districts: county, subcounty and parish) through which the pipeline passes, in which project facilities are located or which could be associated with other project activities such as transportation
- potentially affected communities (PACs). PACs include hamlets, villages, trading centres and towns within a geographical boundary defined by project land take requirements, construction and operation activities. Based on the adopted methodology of purposive sampling (see Section A9.3 and A9.3.2.2), the geographical boundary was determined as approximately 4 km on either side of the pipeline where PACs were identified to potentially experience a

range of direct and indirect impacts, such as air and noise pollution, land take and influx.

There are two districts (Buliisa and Hoima), 11 parishes, five subcounties, two town councils (TCs) and an estimated 38 villages and hamlets traversed and passed by the project.

The AOI for the PACs is dependent on the VEC, see Table A9.2-1.

Table A9.2-1 Area of Influence for the VECs at Potentially Affected Community Level

VEC	AOI for the VEC at PAC Level
National economy	**Construction, operation and decommissioning phases**[1] This is not assessed at PAC level.
Local economy (nonland-based livelihoods)	**Construction, operation and decommissioning phases** Hamlets, villages, trading centres and towns on or within approximately 4 km from access roads which may benefit from employment, local purchasing and use of services
Land-based livelihoods	**Construction, operation and decommissioning phases** Households, hamlets and villages directly and indirectly affected by the land acquisition for the project, which includes the RoW and the adjacent area, pastoralists traversing the project area
River and lake-based livelihoods	**Construction and construction decommissioning phases** Hamlets, villages and towns using rivers and lakes for fishing directly or indirectly affected by the project construction activities **Operation and decommissioning phases** Not applicable
Land and property	**Construction, operation and decommissioning phases** Households, hamlets and villages directly or indirectly affected by project land acquisition, including the RoW
Workers' health, safety and welfare	**Construction, operation and decommissioning phases** Tilenga feeder pipeline project and project contractor employees, including in the primary supply chain
Social infrastructure and services	**Construction phase** Hamlets, villages, trading centres and towns within approximately 4 km from project RoW and access roads **Operation phase** Hamlets, villages, trading centres and towns within approximately 4 km from project permanent access roads **Construction decommissioning phase**

[1] Decommissioning phases refers to both the construction facilities and project decommissioning phases unless otherwise indicated.

Table A9.2-1 Area of Influence for the VECs at Potentially Affected Community Level

VEC	AOI for the VEC at PAC Level
	Hamlets, villages, trading centres and towns within approximately 4 km from project RoW and associated roads
Community health	**Construction and construction decommissioning phase** Hamlets, villages, trading centres and towns within approximately 4 km from the RoW and access routes **Operations and decommissioning phase** Hamlets, villages, trading centres and towns within approximately 4 km from the RoW and access routes
Community safety security and welfare	**Construction and construction decommissioning phase** Hamlets, villages, trading centres and towns within approximately 4 km from the RoW and access routes **Operation and decommissioning phases** Hamlets, villages, trading centres and towns within approximately 4 km from access roads

A9.2.2 Study Area Boundary

The national level study boundaries are Uganda's borders.

The district level study boundaries are all the districts, including counties and subcounties, traversed by the AOI (see Figure A9.2-1).

The PAC level study boundary is approximately 4 km either side of the pipeline.

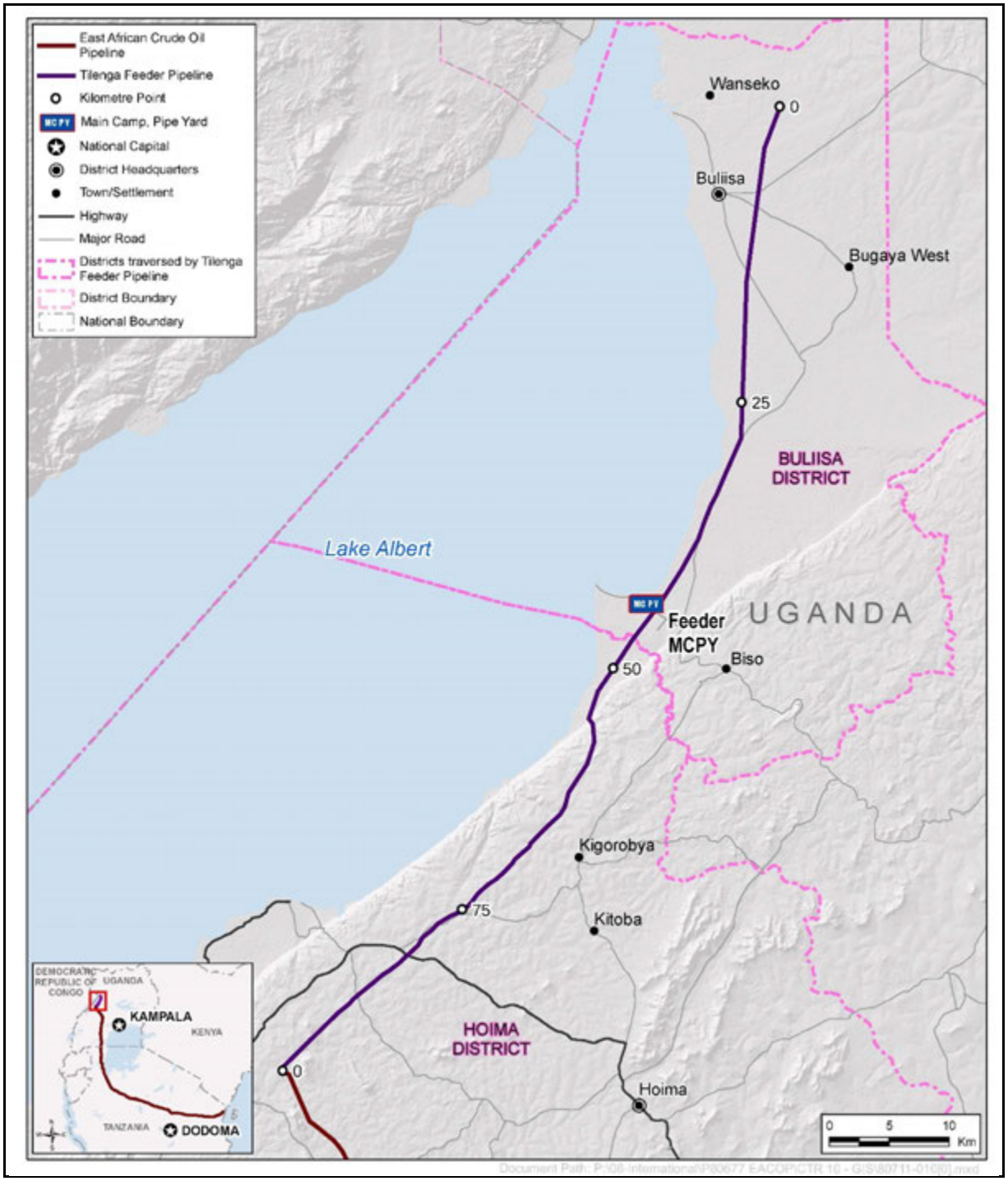

Figure A9.2-1 District Level Study Area Boundary

A9.3 Methods

Three teams performed the study – a social team, a health team and a human rights team –and collaborated to develop the socio-economic and health baseline.

The screening report and scoping stakeholder engagement report conducted by the social and health teams between 19 April and 1 June 2017 at national, district and PAC levels provided primary and secondary data on the main socio-economic and health characteristics relevant to the project and enabled the identification and initial description of the VECs (see scoping report for details on the stakeholder engagement). During the scoping phase, 25 meetings were held.

Further secondary and primary data were collected at national and district levels by the social, health and human rights teams during the baseline studies undertaken 4–14 December 2018. This enabled further descriptions of the VECs.

Based on this data, PACs were identified that were deemed representative of the range of socio-economic and health baseline conditions in the AOI (see Section A9.3.2.2 for selection criteria for PACs).

In-depth data collected at PAC level were embedded in the district and national context to ensure both depth and breadth. The PAC data provided qualitative and quantitative elaborations on the district data.

A purposive sampling strategy (selecting PACs based on their socio-economic characteristics) was used to select the PACs. This ensured that information was collected on the range of socio-economic and health concerns and covered all the affected districts.

This methodology was adopted because a statistical random sampling approach was not appropriate because of the initial lack of reliable data on the number and location of PACs in the AOI and the linear nature of the project (95 km). In addition, statistical sampling could have led to a sample of PACs that did not necessarily include all socio-economic characteristics.

The social team collected socio-economic data at national, district and PAC levels. The human rights team collected human rights data at a national level. The health team conducted meetings with the district health management teams and assessed district health facilities.

A9.3.1 Secondary Data

The social and health teams undertook a review of the following sources:

- annual reports from the district health management teams (DHMTs)
- district development plans (DDPs)
- subcounty development plans
- national population and housing census reports by Uganda Bureau of Statistics (UBOS)
- study reports related to the Albertine Graben, including environmental and social impact statements by oil and gas operators and the Albertine Graben Sensitivity Atlas
- annual health sector performance reports

- National Development Plan 2015/16–2019/20 (NDPII)
- The Uganda Poverty Assessment Report 2016
- World Bank, World Health Organization (WHO) and nongovernmental organisation (NGO) reports.

A9.3.2 Field Surveys

Primary data were collected from individuals and small groups from all three levels of the AOI between 26 October and 15 December 2017.

A9.3.2.1 National and District Level

Key informant interviews (KIIs) were held by the social and human rights teams[2] at national level with:

- international NGOs:
- Action Aid Uganda (HRT)
- Minority Rights Group International (HRT)
- International Accountability Project (IAP) (HRT)
- national NGOs:
- Advocates for Natural Resources and Development (ANARDE) (HRT)
- Civil Society Coalition for Oil and Gas (CSCO) (HRT)
- Global Rights Alert (HRT)
- Ecological Christian Organisation (ECO) (HRT)
- National Association of Professional Environmentalists (NAPE) (HRT)
- National Association of Women Organisations in Uganda (HRT)
- Green Watch Uganda (HRT)
- national government:
- Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)
- Ministry of Gender, Labour and Social Development (MGLSD)
- Ministry of Lands, Housing and Urban Development (MLHUD)
- Ministry of Tourism, Wildlife and Antiquities (MTWA)
- Ministry of Water and Environment (MWE)
- National Environment Management Authority (NEMA)
- National Forestry Authority (NFA)
- Office of the Prime Minister (OPM)
- Petroleum Authority of Uganda (PAU)
- Ministry of Energy and Minerals Development (MEMD)
- Uganda Electricity Transmission Company Limited (UETCL)
- Uganda National Oil Company (UNOC)
- Uganda National Roads Authority (UNRA)
- Uganda Wildlife Authority (UWA)
- Uganda Chamber of Mines and Petroleum

[2] Meetings held by the human rights team are indicated with (HRT).

- Uganda Human Rights Commission (UHCR) (HRT).
- other:
- Advocates Coalition on Development and Environment (ACODE) (HRT)
- African Centre for Energy and Mineral Policy (ACEMP) (HRT)
- Makerere University School of Law (HRT)
- Uganda Consortium on Corporate Accountability (HRT)
- United Nations Department for Safety and Security (UNDSS).

The social team held KIIs and small group interviews (SGIs) at district level with:

- district technical planning committees
- chief administrative officers (CAO) and deputy chief administrative officers
- district community development officers
- district education officers
- district police commanders and internal security officials
- district economists
- district labour officers
- district planners
- district land experts
- district land boards
- district environmental officers
- district natural resource officers
- district entomology officers
- district agriculture experts and officers
- district livestock experts
- district fisheries officers and experts
- district veterinary officers
- kingdom representatives
- health service providers
- NGOs.

The health team conducted two SGIs with health service providers, including the district health management teams, across the districts traversed by the AOI (see Table A9.3-1 and Figure A9.3-1 for health sample sites). The aim was to access quantitative and qualitative data on the main health concerns in the district, and to assess the capacity of district health facilities. The guide used for the interviews was based on the health management and information system (HMIS) and ensured that the environmental health areas (EHA) framework required by the IFC performance standards was followed. In addition, three district health services were assessed using the service availability and readiness assessment (SARA) tool. The SARA results are in Attachment A9.3.

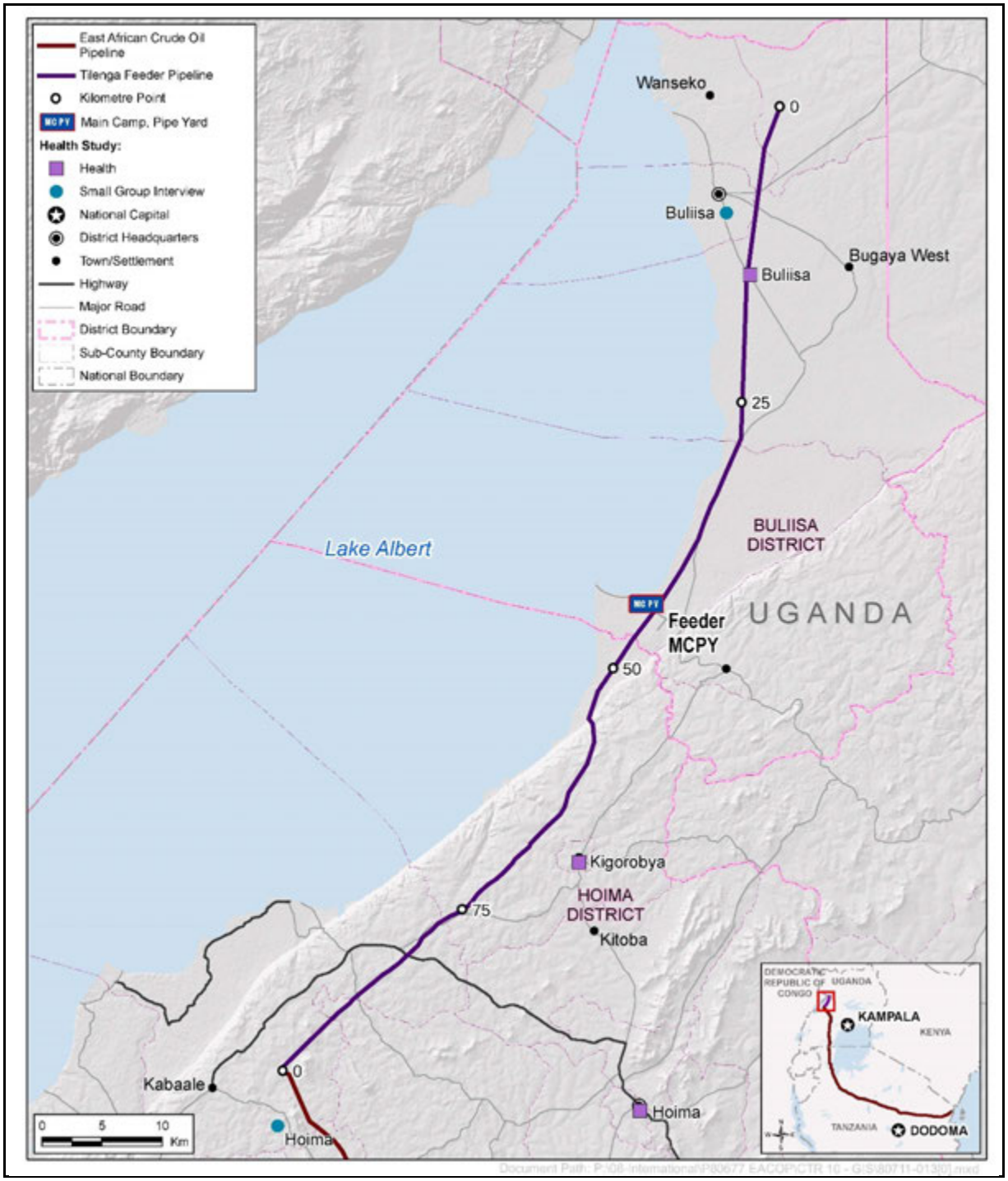

Figure A9.3-1 Health Study

A9.3.2.2 Potentially Affected Community Level

To develop a sample of PACs for inclusion in the social study, the following process was undertaken.

Sites (areas) surrounding construction facilities, the pipeline route and access roads were identified using a purposive sampling strategy. The following criteria were used to identify the sites:

- In each district and subcounty traversed by the AOI, at least one site was identified.
- Sites within 4 km of planned Tilenga facilities and activities were included.
- Sites representing all the characteristics listed below were included:
  - different levels of urbanisation: urban (town), rural (village, hamlet, trading centre)
  - different levels of isolation (remote and well connected)
  - different density of agricultural land parcels (dense and dispersed parcels)
  - presence of grazing land
  - presence of tourism facilities
  - presence of mining activities
  - presence of fishing activities (lake, river)
  - natural habitats (protected and designated areas).

Six sites were identified, which formed the sample sites for the data collection. In each of those sites, the PACs were identified. One to three PACs were selected per site[3] based on the above-mentioned criteria.

Figure A9.3-2 shows the sample sites and sample PACs for the social study.

[3] Secondary data were relied upon for the following PACs: Avogera, Kasinyi, Kisomere (KP0), Katanga and Kigwera (KP4), Kibambura (KP5), Kisansya (KP6), Buliisa and Kijangi (KP8). This is because a substantial number of studies, including household interviews for the CPF, had already been undertaken at PAC level. To avoid consultation fatigue, the secondary data were reviewed and detailed in this baseline study.

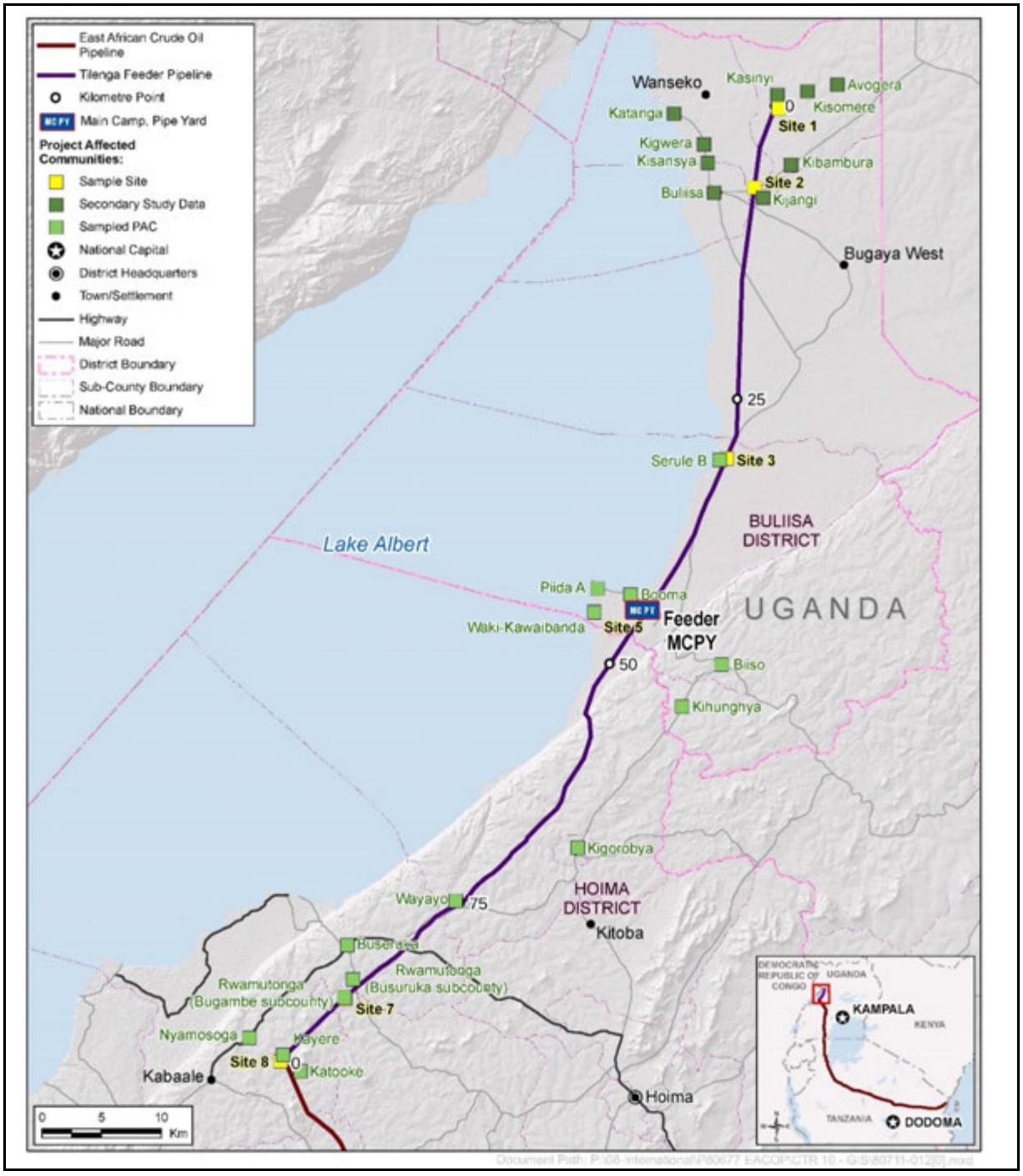

Figure A9.3-2 Sample Sites and Potentially Affected Communities

Primary data collection at sample site and sample PAC level included various steps, outlined below.

Step 1: Compilation of Factsheets

Based on satellite imagery, a factsheet was created for each sample site that provided initial information on the site. It shows the project components relevant to the sample site, the administrative entities in which it is located, the main socio-economic features of the project footprint, the PAC in the sample site, initial secondary data available for the sample site and a preliminary indication of the data collection tools to be used for baseline data collection.

Step 2: Reconnaissance Site Visits

Reconnaissance site visits were conducted to the sample sites and PACs during 26 October–21 November 2017 that included:

- a meeting with the village leaders, parish leaders and villagers to inform them about the ESIA and social baseline study. Posters and background information documents (BID) were used to explain the project and the ESIA study (see Attachment A9.1). Stakeholder concerns and questions were recorded and, where possible, responses provided. This is reported in Section 7 (Stakeholder Engagement) of the ESIA.
- verifying and enhancing the data from the factsheet and developing a better understanding of the site and the PACs
- conducting a transect walk on the project footprint to document land use features
- compiling a community socio-economic resources inventory through discussion with village leaders and field observation
- arranging the focus group discussions (FGD), SGIs, KIIs and household interviews (HHI) to be conducted during the social baseline survey

The information obtained was used to update the factsheets.

Step 3: Main Baseline Survey

The main survey, which was conducted between 2 November and 7 December 2017, included:

- FGDs, which were open discussions based on discussion guides with village community leaders, women and youth to obtain group knowledge, perceptions and attitudes about village livelihoods and to identify vulnerable groups in the community. The women's groups included widows, single mothers and women engaged in business activities. Based on the discussions, PAC profiles were developed (see Attachment A9.2). Figure A9.3-3 shows a photograph of an FGD. Two FGDs were organised in each sample PAC: one with women and one with community leaders (which also included some women).
- participatory mapping with the village community leaders and women's focus group participants, which involved drawing a map of infrastructure and land use in and around their village. The mapping facilitated discussion of village activities, local decision making and local community concerns.
- drawing a historical timeline of the important events in the village and discussing the changes these have brought about in the village over the years. The timelines are included in the PAC profiles.

- KIIs, which included interviews with informants with particular expertise or knowledge. These included:
  - business owners
  - community health practitioners
  - commercial and subsistence farmers
  - health workers
  - kingdom representatives
  - traditional healers (herbalists)
  - representatives of micro-finance providers
  - military personnel
  - commercial motorcyclists
  - guest houses and hotels
  - nongovernmental organisations (NGOs)
  - community-based organisations (CBOs)
  - religious leaders
  - sex workers
  - commuter taxi drivers
  - Local Council II (LC2)
  - vulnerable groups, including widows and personnel at orphanage centres
- SGIs to understand different livelihood strategies with:
  - crop farmers
  - fisherfolk
  - natural resource users (beekeepers, sand miners and shell collectors)
  - pastoralists.

Additional SGIs and KIIs were conducted in the PACs for additional social data when considered necessary. Baseline information was also collected from:

- a community observation walk along a predetermined route, accompanied by community leaders, to gather information on community life, community infrastructure, land use types and patterns, and natural resources use
- HHIs to provide information on household-level socio-economic features. A purposive sampling strategy was used to ensure inclusion of households with different livelihood strategies and vulnerable households, including pastoralists, the very poor, widows, elderly and people with disabilities. Forty-two HHIs were held across the different PACs. No statistical validity was attempted, as the resettlement action plan (RAP) team will conduct a full household survey. The HHIs served to enhance understanding of concerns related to vulnerable households and specific livelihoods.

Figure A9.3-3 Focus Group Discussions and Participatory Mapping with Women in Waki-Kawaibanda, Buliisa District (KP47)

Figure A9.3-4 shows the number of different data collection tools used in the PACs and the districts by the teams.

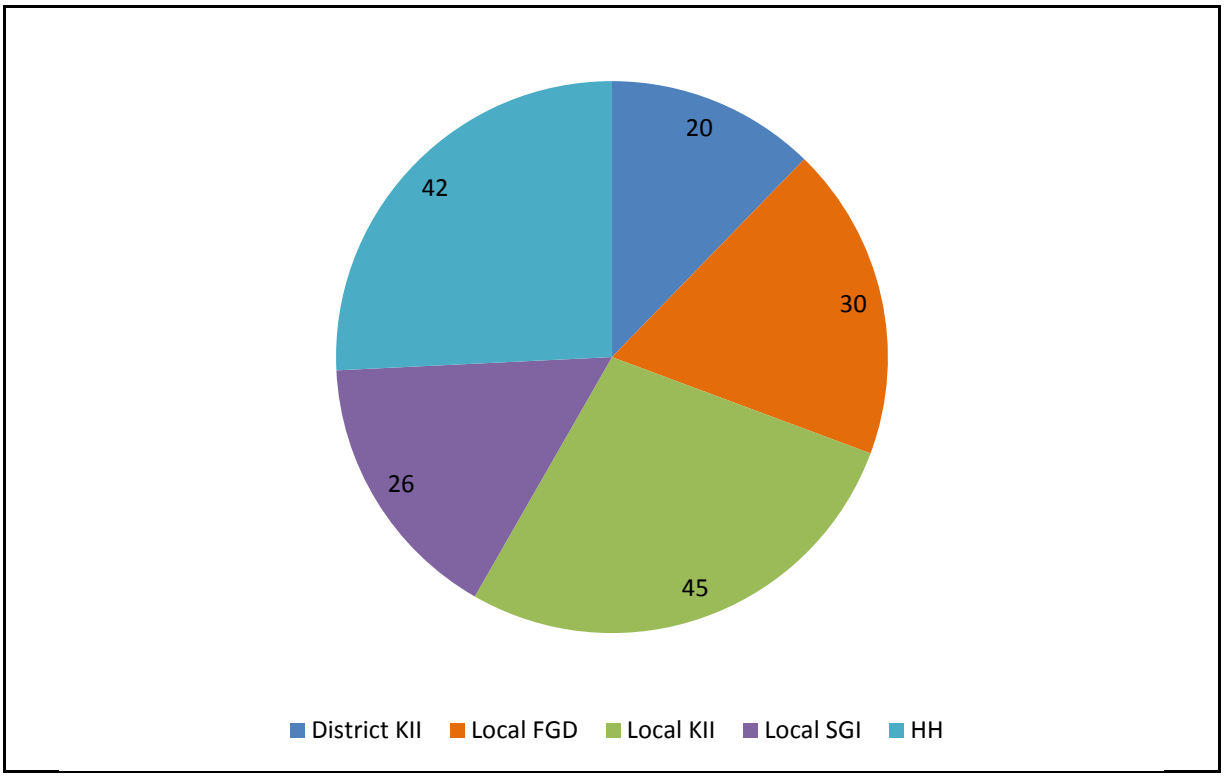

Figure A9.3-4 Data Collection at District and Potentially Affected Community Level

The number of people included in the baseline data collection by the social team was approximately 540. This included:

- 183 people in FGDs with PAC leaders (local)
- 172 people in FGDs with PAC women (local)
- 83 people in PAC SGIs (local)
- 41 people in PAC KIIs (local)
- 19 people in KIIs and SGIs (district level)
- 42 people in HHIs (local).

Attachment A9.3 includes the data collection tools (FGD, KII, SGI and HHI guides) used for data collection.

Table A9.3-1 and Table A9.3-2 provide details of the number of data collection activities (per data collection tool) executed at the different districts during the baseline phase. The meetings held during the scoping phase are not included here; these were reported in the scoping report.

Table A9.3-1 Data Collection at District Level

District	KIIs (Social Team)	SGIs (Health Team)	Health Facility Assessment (Health Team)
Buliisa	9	1	1
Hoima	11	1	2

Table A9.3-2 provides details of the number of data collection activities (per data collection tool) undertaken at the PAC level.

Table A9.3-2 Data Collection at Potentially Affected Community Level[4]

Subcounty	Nearest KP	PAC Name	FGDs (ST)	KIIs (ST)	SGIs (ST)	HHIs (ST)
Buliisa District						
Butiaba	30.5	Serule B	2	1	2	0
Biiso	44.5	Biiso	2	2	1	3
Butiaba	44.5	Booma	2	3	2	4
Butiaba	45.5	Piida A	2	1	0	4
Butiaba	47	Waki-Kawaibanda	2	1	1	3
Kihungya	49.5	Kihungya	2	0	1	4
Hoima District						
Buseruka	95	Katooke	2	5	3	10
Kigorobya TC	64.5	Kigorobya	2	5	1	4

[4] Secondary data were relied upon for the following PACs: Avogera, Kasinyi, Kisomere (KP0), Katanga and Kigwera (KP4), Kibambura (KP5), Kisansya (KP6), Buliisa and Kijangi (KP8).

Table A9.3-2 Data Collection at Potentially Affected Community Level[4]

Subcounty	Nearest KP	PAC Name	FGDs (ST)	KIIs (ST)	SGIs (ST)	HHIs (ST)
Kahoora Division	74.5	Hoima municipality	0	9	0	0
Kigorobya	75	Wayoyo	2	2	1	0
Buseruka	84.5	Buseruka	2	4	3	0
Buseruka	86	Rwamutonga	2	1	1	0
Bugambe	87.5	Rwamutonga	2	3	0	0
Kayere	94.5	Kayere	2	1	3	0
Nyamasoga	95	Nyamasoga	2	2	1	10

A9.3.3 Data Capture

Table A9.3-3 describes the data collection tools used in the study.

Table A9.3-3 Data Capture Tools

Data Collection Method	Data Capture Tool
Transect walk Community observation walk	GIS co-ordinates, photographs of socio-economic features and notes entered into tablets with collector mobile application
Household survey	Responses entered into tablets and subsequently entered into a database
Community meeting, FGDs KIIs (local, district and national) SGIs	Fieldnotes entered into an electronic template and subsequently entered into a database
Participatory mapping Timeline	Drawn on paper and captured on tablets with collector mobile application

A9.3.4 Data Analysis

The following data analysis was conducted:

- Data collected through KIIs, FGDs and SGIs were collated, tabulated, compared and triangulated for each VEC.
- Quantitative secondary and primary data were submitted to descriptive statistical analysis including averages and percentages.
- Historical data and data at the time of writing were compared with future projections to identify trends.

Main VECs were identified and their sensitivity ranked in accordance with the sensitivity tables for the socio-economic VECs in Appendix D.

The following were prepared:

- sample site profiles and sample PAC profiles (see Attachment A9.2)

- maps showing locations of the VECs which are described in the text.

A9.3.5 Data Considerations

Several data considerations, many of them common to social baseline surveys, were encountered and managed.

- Data provided by informants may be affected by translation. Triangulation was used to reduce this potential problem.
- The baseline is compiled from a multitude of sources collected by a large team of researchers using a diversity of tools. There is a risk of disparities in interpretations between team members and data loss in the data processing. The team was trained before the field visit. A rigorous data management process, using databases, team meetings and multiple verification exercises, was used to avoid disparities, data loss and variations in interpretation.
- Secondary data were relied upon for the following PACs: Avogera, Kasinyi, Kisomere (KP0), Katanga and Kigwera (KP4), Kibambura (KP5), Kisansya (KP6), Buliisa and Kijangi (KP8). This is because a substantial number of studies, including household interviews for the CPF, had already been undertaken at PAC level. To avoid consultation fatigue, the secondary data were reviewed and detailed in this baseline study. KIIs at district level with pastoralists, butchers, milk coolers (dairy) and livestock specialists were undertaken.
- Data collected may not capture seasonal changes. Interviewers were aware of this and aimed to cover the full range of seasonal changes when holding interviews and FGDs.
- Vulnerable groups were addressed in the KIIs, SGIs, FGDs and HHIs, but it is possible that some groups were not captured. Identification of vulnerable groups is ongoing through the RAP process.
- Data received from the national Health Management and Information System (HMIS) may not accurately determine the actual burden of disease (BOD) in the sample PACs due to challenges associated with system utilisation and data management. The data are, however, considered sufficiently accurate in tracking disease trends at a district and health facility level.
- Community level data for livestock markets was not obtained owing to a livestock movement prohibition imposed by the MAAIF that was in place during the field surveys. Data relating to markets were therefore collected at district level.
- The spelling of some village and town names differed according to information sources. Names identified during fieldwork have been used in the baseline.
- The boundaries of administrative entities are inconsistent between information sources, possibly because of a recent re-organisation of district boundaries. Where this was encountered, the ambiguity is highlighted in the text.
- The most recent agricultural and livestock census coordinated by UBOS and the MAAIF is 2008. Supplementary information was therefore sought from district veterinary officers.

The data considerations have not materially affected the baseline data gathered, which has provided sufficient information to describe and characterise the socio-economic and health conditions and assess their sensitivity.

A9.4 Socio-economic and Health Baseline Conditions

A9.4.1 Governance and Administration

The President of the Republic of Uganda is both Head of State and Head of Government.

The Government of Uganda (GOU) has three branches:

- the executive, comprising the President, Vice President, Prime Minister and Cabinet. The President is responsible for implementing and enforcing the laws written by Parliament and appoints the Cabinet.
- the legislative, comprising Parliament that passes laws and reviews government policy and administration
- the judiciary, comprising the Magistrates' Courts, High Court, Court of Appeals (Constitutional Court) and the Supreme Court. The role of the judiciary is to administer justice by resolving disputes between citizens and between the State and citizens, contribute to the enforcement of law and order, and protect the human rights of individuals and groups.

The government structure of Uganda consists of six levels, see Figure A9.4-1. Through this structure, power and decision-making at the national level is decentralised.

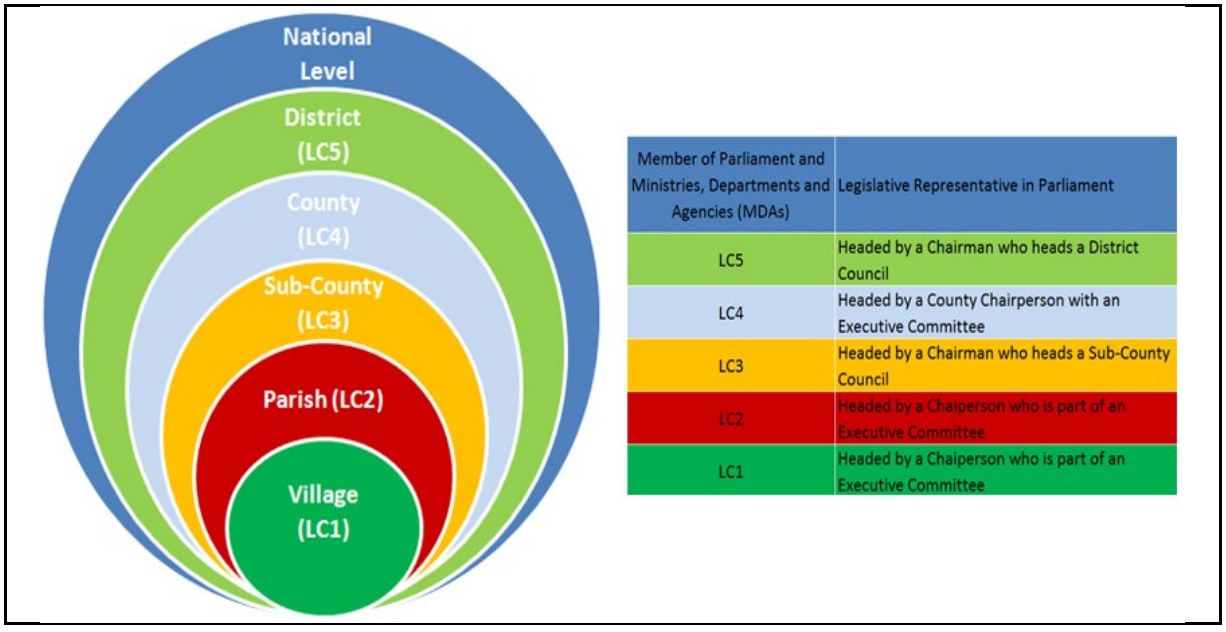

Figure A9.4-1 Government Structure of Uganda

SOURCE: Modified from Total E&P Uganda (2014)

A9.4.1.1 District and Subcounty Government

The structure of local government differs between urban and rural settings. In urban settings, there are cities, municipal divisions or towns, wards and cell councils (CLGF 2016). In rural settings, there are district councils (Local Council (LC)5) which are subdivided into counties, subcounty councils, parish councils and village councils (MOLG 2017). The role of the local government agencies is to implement

and monitor government programmes and resolve disputes at the respective levels (UBOS 2016a).

In each district, there is a resident district commissioner (RDC) appointed by the President. The office of the RDC received its mandate as stipulated by the Constitution and the Local Governments Act 1997. Article 203 of the 1995 Constitution provides for the establishment of the office of the RDC and the roles include monitoring the implementation of central and local government services in the district, to act as chairperson of the district security committee and to perform other functions as may be assigned by the President or prescribed by Parliament (GOU 1995). The RDC is the main contact between the local and central government systems (CLGF 2016).

Every district has an elected chairperson who is supported by a district council consisting of technical personnel and subcounty representatives. In every district council, at least one of the secretaries and one third of all councillors must be female (CLGF 2016). The district council is the planning authority of the district that prepares a comprehensive and integrated development plan, incorporating plans of lower level local governments, for submission to the national planning authority (GOU 1997).

A District Technical Planning Committee chaired by the CAO includes heads of departments of that district, including:

- a District Natural Resource Officer mandated to promote and ensure sustainable natural resource use and management. The natural resources include land, water or wetlands, savannah woodland and plantation and forest in specific reserves.
- a District Environmental Officer, responsible for environmental matters including monitoring and review of the ESIA process at the district level
- a District Lands Management Officer, who provides technical services to the district administration and district land board
- a DHMT, led by a District Health Officer (DHO), responsible for planning and implementing health programmes and overseeing service delivery
- a District Community Development Officer, responsible for planning and implementing community projects, stakeholder engagement and community sensitisation.

There are 1403 subcounties (LC3) in Uganda (Electoral Commission 2016, Internet site). Subcounty governments are led by subcounty councils (headed by elected chairmen) and are responsible for service delivery and local economic development within their areas. Like the district administration, a team of technical personnel coordinates the activities and functions of the subcounty. Service departments include health, works and technical services, production and marketing, education, gender and community services, finance and natural resources.

A9.4.1.2 Local Governance and Decision-Making

Each subcounty comprises parishes, which divide further into villages. Parish councils have elected executive committees comprising a chairperson, vice-chairperson, general secretary and secretaries for information, education, security,

finance, production and environmental protection. At the village level, all village citizens aged 18 years and above are members of the council.

Community Governance

Ancient traditional kingdoms, also known as cultural institutions, are a key feature of Ugandan society. Within the project area, there is one cultural institution:

- the Bunyoro-Kitara Kingdom.

Cultural institutions are not mandated to engage directly in the administrative roles of the local or central governments but can be instrumental in ensuring that government programmes succeed at the local level (John Paul II Justice and Peace Centre 2013). Representatives of cultural institutions play an active role in local communities by:

- assisting with the development of community infrastructure
- generating business opportunities (KIIs with kingdom representatives)
- undertaking community sensitisation and awareness campaigns (KIIs with kingdom representatives)
- preserving history (crafts, sites), cultural norms and identity.

Community Leaders

Governance in the sample PACs is based on inclusive community participation, with matters addressed in a consultative process, often without involving formal authorities other than those within the community. The village council (LC1), which consists of the village chairperson, the vice chairperson, secretary and other prominent leaders such as village elders and elected leaders representing youth, women and religious leaders, are pivotal in making decisions at community level. An elected chairperson and vice chairperson head village councils. The responsibilities of chairperson and vice chairperson are to:

- represent the village at the subcounty level
- organise and chair village meetings
- make decisions on behalf of the community
- ensure village security and safety of residents
- resolve disputes between village members; disputes that cannot be resolved by village chairmen are referred to higher levels of government (i.e., the subcounty and district).

Table A9.4-1 describes the various community leaders and their specific roles.

Table A9.4-1 Community Governance

Community Leader	Role of Leader in the Community
Village chairperson, vice-chairperson and secretary (LC1)	Representing village at subcounty level Public administration of village Organising, chairing and recording village meetings Mobilising residents Providing advice to community members Decision-making on behalf of community Resolving conflicts between community members Ensuring village security and safety of residents Overseeing civil matters within the community
Elders	Resolving conflicts, particularly over land Providing advice and other forms of support to community members, including the village chairperson and vice-chairperson Calling village meetings
Religious leaders	Providing advice and other forms of support to the community Organising and leading religious services and ceremonies Resolving conflicts between religious groups and community members Spiritual mentoring and counselling Community sensitisation, i.e., preventing the spread of HIV and AIDS, and gender-based violence
Agricultural leaders	Representing farmers and pastoralists at village meetings Presenting interests and needs of farmers and pastoralists to the village council Mobilising farmers and pastoralists for meetings Providing advice and other forms of support to farmers and pastoralists, (i.e., on veterinary services in local area and how to increase crop yield Resolving conflicts, i.e., between farmers and pastoralists
Women's leaders	Representing women at village meetings Presenting women's interests and needs to the village council Mobilising women for meetings Providing advice and other forms of support to women, i.e., regarding healthcare and education of children Resolving conflicts between women and other family members, i.e., spouses, or community members
Youth leaders	Representing young people at village meetings Presenting youths' interests and needs to the village council Mobilising youths for meetings Providing advice and other forms of support to young people, i.e., on training and employment opportunities Resolving conflicts between young people and other youths or community members

Table A9.4-1 Community Governance

Community Leader	Role of Leader in the Community
Disability leaders	Representing disabled people at village meetings Presenting disabled peoples' interests and needs to the village council Mobilising disabled people for meetings Providing advice and other forms of support to disabled people, i.e., on specific services available to them Resolving conflicts involving disabled people and other family or community members
Community members	Participating in decision-making Attending village meetings Providing support to fellow community members Reporting problems to the village council

SOURCE: FGDs with community leaders

A9.4.2 Demographics

A9.4.2.1 Baseline Condition of Demographics

National Level

The population of Uganda grew by 3% annually between 2002 and 2014, reaching 34.6 million in 2014 (UBOS 2016a). The population size projection for 2018 is approximately 38.8 million (UBOS 2016b). Females and males represent 51% (17.7 million) and 49% (16.9 million) of the population, respectively.

Figure A9.4-2 shows the age structure of the population in Uganda.

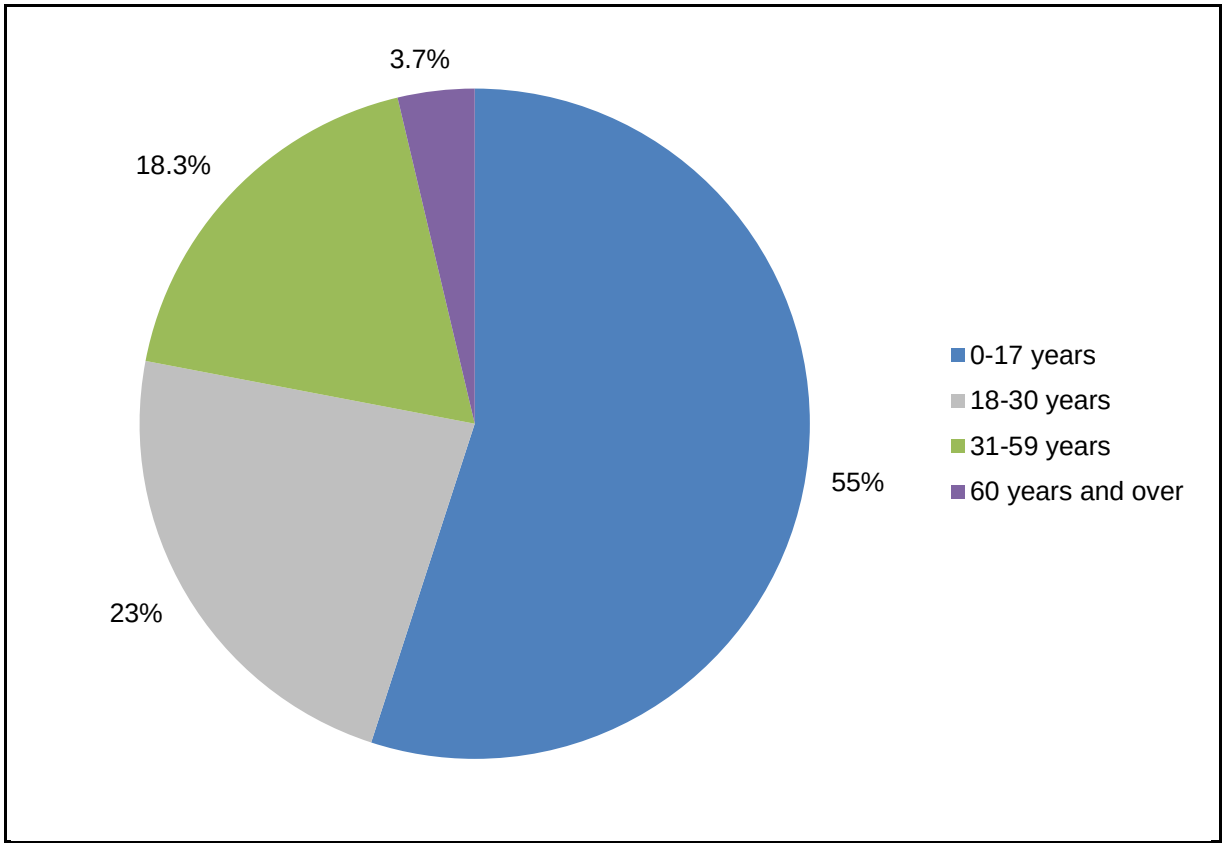

Figure A9.4-2 Age Profile of Uganda

SOURCE: UBOS (2016a)

As shown in the figure, Uganda's population is predominantly young, with 0–17-year-olds constituting more than half of the total population.

Uganda's population is predominantly rural, representing 79% of the overall population (MOLG 2017). However, the urban population has increased by 23% since the 2010 census (UBOS 2016a). This trend has been driven largely by rural–urban migration (World Bank 2015a, Internet site).

In 2014, the population density was 173 persons per km^2 and the national average household size was 4.7 persons.

Uganda consists of more than 40 different ethnic groups and languages, each with their own cultural identity and customs. The largest ethnic group are the Baganda which consists of 16.9% of the population, followed by Banyankole (9.5%), Basoga (8.4%), Bakiga (6.9%), Iteso (6.4%), Langi (6.1%), Acholi (4.7%), Bagisu (4.6%) and Lugbara (4.2%). Those identified as others account for 32.3% (World Atlas 2018, Internet site).

While there is great ethnic and linguistic diversity, intermarriage, rural–urban migration and other migratory movements including transborder migration has meant that the different ethnicities, along with their cultural traditions, have intermingled to create a mixed multicultural nation.

There are at least 40 native languages in Uganda, grouped into three main language families: Bantu, Central Sudanic and Nilotic. English was adopted during

colonisation as the common language and remains an official language. Swahili, which has regional significance, is also an official language, and Luganda is a commonly spoken language of a large proportion of the Ugandan population, particularly in the central region.

The wide variety of languages spoken in Uganda creates challenges for everyday communication and information exchange. Teachers face challenges when teaching children from other language groups; similarly, traders face challenges when selling goods to customers from other districts (KIIs with teachers and business owners). In the spirit of regional integration, Swahili is being promoted and recently became a compulsory subject in secondary schools (The Africa Report 2016, Internet site).

International Migration

Uganda experiences both in and out migration. Migration to Uganda has been driven by civil war and political instability in the Democratic Republic of Congo (DRC), Rwanda and South Sudan (Danish Refugee Council 2016). At the time of writing, more than 800,000 refugees and asylum seekers are accommodated in the country's northern, southern and southwestern regions (Refuge & Hope International 2017, Internet site). Since the beginning of 2018, roughly 34,000 Congolese refugees have crossed Lake Albert to Uganda, driven by renewed violence in the DRC (UNHCR 2018, Internet site). Most refugees have entered Uganda through Kaiso and Sebagoro landing sites on the shores of Lake Albert in Hoima district (ReliefWeb 2018, Internet site).

It is common for Ugandan doctors and nurses to emigrate to North African countries, the Middle East and the Caribbean, which has generated personnel shortages in local healthcare services (United Nations 2017, Internet site).

Internal Migration

Internal migration has occurred throughout Uganda's history and is driven mainly by employment. Internal movements are mostly toward urban centres or regions of high economic activity, such as plantation areas (IOM 2015) or locations where transient employment opportunities are available such as infrastructure developments. Evidence of migration for family and marital reasons has also been found in some regions and is more common among females (Nakiganda 2013).

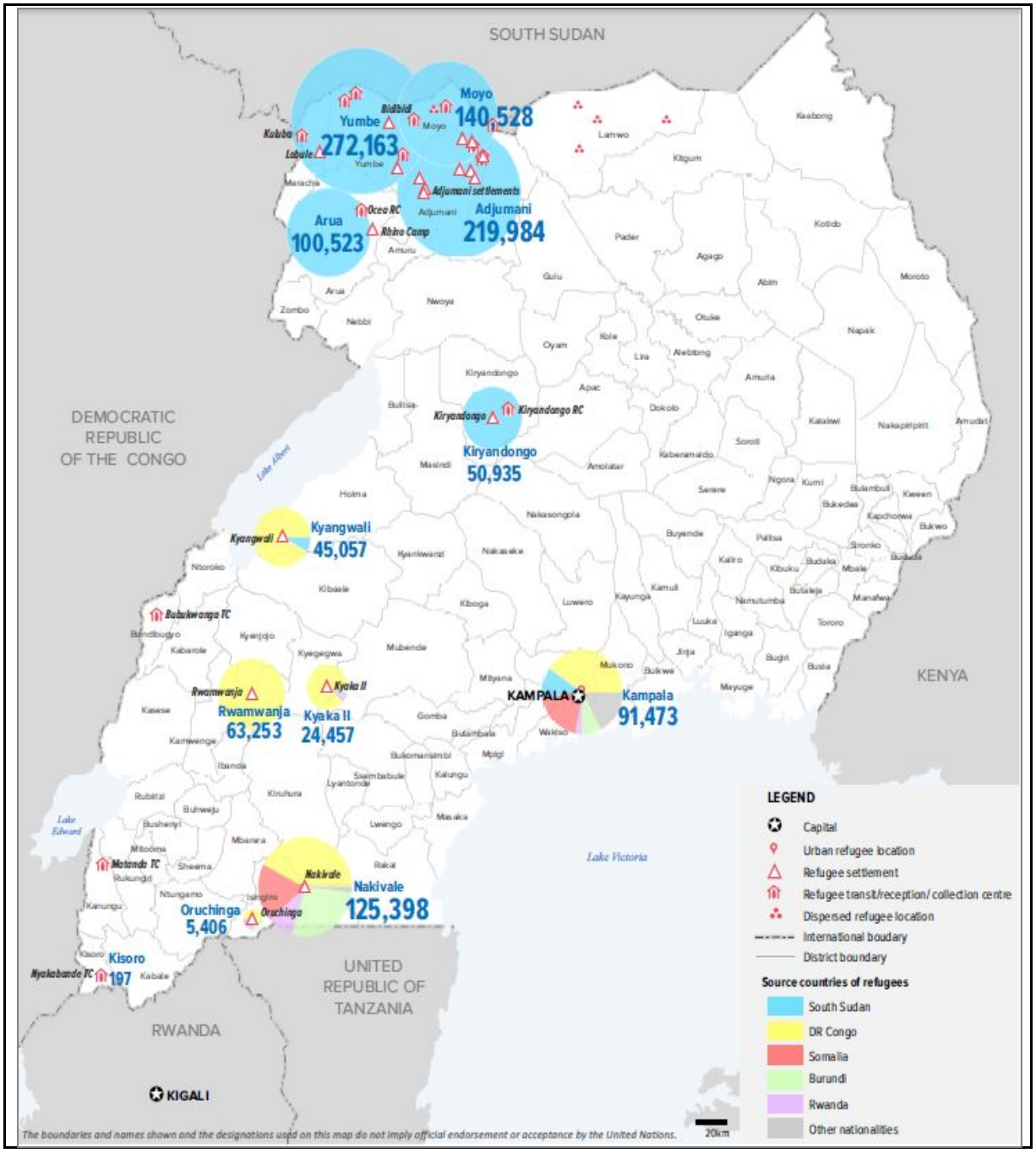

Figure A9.4-3 Refugee Settlements in Uganda

SOURCE: UNHCR (2017)

District Level

Table A9.4-2 provides the demographic characteristics of the districts traversed by the AOI.

High fertility rates, improved health services and in-migration (due to employment opportunities) were identified as the main reasons behind population growth in the districts (KIIs with district officials).

Table A9.4-2 Demographic Data, 2014

District	Population Size			Population Density (/km^2)	Population Growth (%/year)	Average Household Size
	Total	Male (%)	Female (%)			
Buliisa	115,506	51.3	48.7	36	4.9	5.3
Hoima	573,903	49.9	50.1	158.9	4.3	4.5

SOURCE: DDPs for 2015/16–2019/20

From the table it can be seen that:

- in Buliisa district the male population is larger than the female population, which is inconsistent with the national average
- population density is considerably lower in Buliisa than Hoima
- the rate of population growth in both districts is considerably higher than the national average.

Figure A9.4-4 shows the age composition of the districts traversed by the AOI.

The figure shows that the districts traversed by the AOI have young populations with over half of the population below the age of 17.

The population in the districts traversed by the AOI is predominantly rural: 97% of people in Buliisa and 90% of people in Hoima live in rural areas (DDPs 2015). However, consistent with national trends, the districts experience urbanisation: Hoima municipality grew by 10.7% between 2002 and 2014 (Hoima DDP 2015).

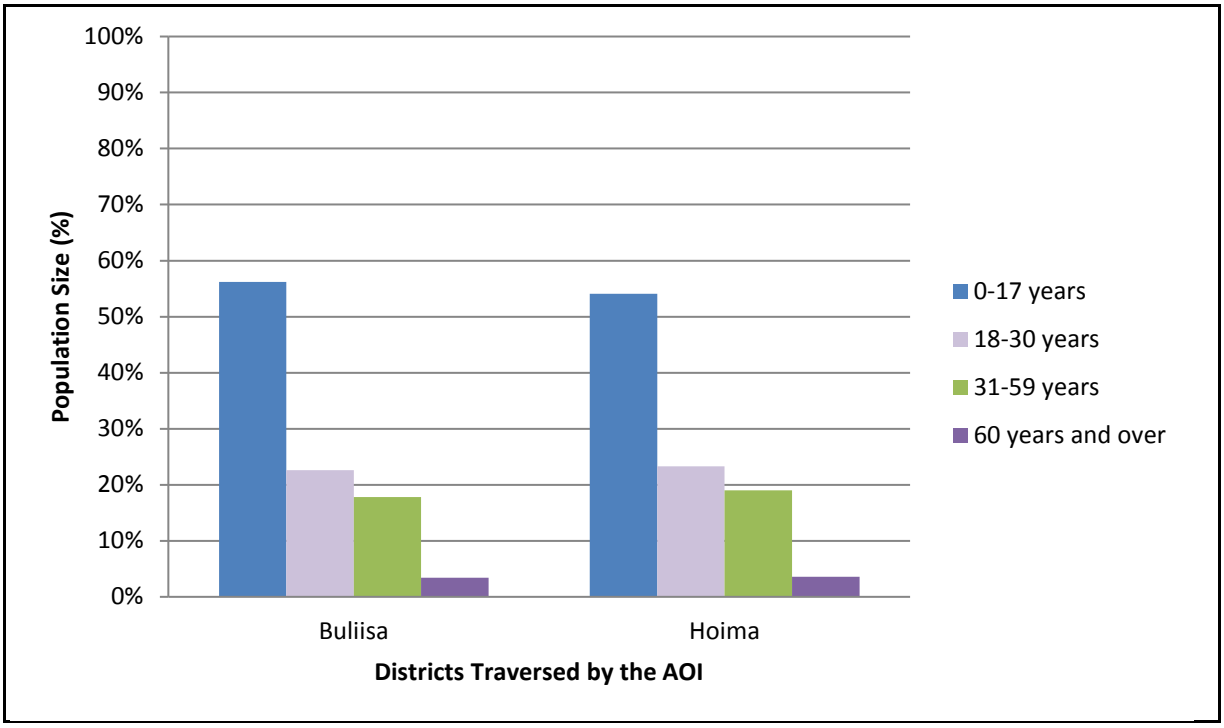

Figure A9.4-4 Age Profile of Districts Traversed by the Area of Influence, 2014

SOURCE: UBOS (2016a)

Ethnicity

Table A9.4-3 shows the main ethnic groups in the districts traversed by the AOI.

Table A9.4-3 Main Ethnic Groups by District

District	Main Ethnic Groups
Buliisa	Alur
	Bagungu
Hoima	Banyoro

SOURCE: Hoima DDP 2015, Artelia 2015a

Indigenous People

According to International Finance Corporation (IFC) Performance Standard 7 (IFC 2012), the term 'indigenous people' refers to a distinct social and cultural group with the following characteristics in varying degrees:

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others
- collective attachment, i.e., whose identity as a group or community is linked, to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories
- customary cultural, economic, social or political institutions that are separate from those of the dominant society or culture
- an indigenous language, often different from the official language of the country or region in which they reside.

IFC Performance Standard 7 recognises that indigenous peoples may be more vulnerable to the adverse impacts of a project than other communities (or non-indigenous communities). Ethnic groups in Uganda that may fulfil international definitions for indigenous peoples include the traditional hunter–gatherer Batwa and Benet communities, the Basongora and Banyabindi and pastoralist groups such as the Ik and Karamojong. These ethnic groups are not within the AOI. The project does not traverse lands traditionally owned by, or under the customary use of, any of these ethnic groups. Furthermore, the government does not officially recognise these groups as indigenous (ILO 2009). The Uganda Constitution refers to indigenous groups as vulnerable and marginalised, adopting the term "Vulnerable and Marginalised Groups" in place of "Indigenous Peoples" (GOU 2015).

Local Level

The population in the sample PACs varies in terms of size and gender composition (see Table A9.4-2).

The household survey conducted in the sample PACs revealed substantial variation in household size ranging from 5 to 9 in Buliisa and from 3 to 14 in Hoima.

Evidence of migration can be observed in some of the sample PACs:

- Katanga village (KP4) has experienced in-migration from Masindi, Kampala and Hoima in search of jobs in the oil and gas industry. In-migrants may stay for

only 3 to 4 weeks or may permanently settle in the hope of gaining further formal employment opportunities (Artelia 2015b).

- Booma (KP44.5) and Piida A (KP45.5) have experienced over the years migration from people from the DRC, either escaping conflict or pursuing economic opportunities. These migrants travel back and forth between Uganda and the DRC to trade fish and other goods.

In Buliisa district, the highest population densities can be found in sample PACs along the lakeshore including Serule B (KP30.5) and Piida A (KP45.5). This can be generalised to all lakeshore communities in Buliisa (Artelia 2015a). The lowest population densities can be found in sample PACs with large grazing areas like Kibambura (KP5) (Artelia 2015a). In Hoima district, the population density is greater in centres like Hoima municipality (KP74.5) and sparser on the lakeshore (NomoGaia 2012). Data on the population size of the sample PACs in Hoima district is not available. Secondary data sources suggest that the number of people per village in the district varies similar to Buliisa. Approximately 400 people reside in villages across Bugambe subcounty (DDP 2015; LCMT 2018, Internet site). In contrast, there are over 100,000 people in Hoima municipality (Kahoora Division) alone (KP74.5) (UBOS 2016c).

A survey of 624 households in Buliisa villages, including Kasinyi (KP0), found that males and females accounted for 51% and 49% of the population respectively (Atacama Consulting 2017). This is consistent with data reported at the district level. Table A9.4-2 presents the average proportion of males and females in villages throughout Hoima district.

From Table A9.4-2, it can be observed that the average proportion of males and females in the districts traversed by the AOI is broadly consistent with data reported at the national and district level.

Ethnicity and Religion

A range of ethnic groups is present in the sample PACs.

Table A9.4-4 shows the range of ethnicities identified in the sample sites based on HHIs.

Table A9.4-4 Ethnicities in the Sample Potentially Affected Communities

Sample Site	Ethnicity of Household Heads Interviewed in Household Survey
Kisomere, Kigwera, Katanga, Avogera, Kasinyi KP0	Acholi, Alur, Ateso, Bagungu, Banyankole, Karamojo, Langi
Kisanya, Kijangi, Kibambura, Buliisa KP6–KP8	Alur, Bagungu, Banyankole
Kihunghya, Biiso, Booma, Piida A, Waki-Kawaibanda, Kigorobya KP49.5–KP64.5	Alur, Mugungu, Munyankole, Munyoro

Table A9.4-4 Ethnicities in the Sample Potentially Affected Communities

Sample Site	Ethnicity of Household Heads Interviewed in Household Survey
Katoke, Nyamasoga, Kayere KP95 PS1	Acholi, Alur, Bafumbira, Baganada, Bagisu, Bakiiga, Banyankole, Banyarwanda, Banyoro, Basoga, Iuo, Karamojo, Lendu, Lugbaras

SOURCE: FGDs with leaders and females

The main ethnic groups in the PACs are the:

- Bagungu
- Banyoro
- Alur.

The main languages spoken among the PACs are:

- Alur
- Lugungu
- Runyoro.

The following languages are also spoken, but to a lesser extent:

- Lugbara
- Madi
- Runyankore-Rukiga
- Swahili.

Religion is important in the sample PACs. HHIs and KIIs with religious leaders indicated that:

- Christianity is the predominant religion in the study area, followed by Islam
- traditional beliefs are also practiced, often in combination with Christianity and Islam.

Trend in Condition and Sensitivity to Change

Demographic trends are important as a context for understanding trends in the VECs. Demographic trends are as follows:

- Uganda's population is growing rapidly and is projected to reach 130 million by 2050 (World Watch Institute 2018, Internet site). Population growth rates in the districts traversed by the AOI are 4.5–5.3% per year, above the world average of 1.2% (DDPs 2015).
- Uganda's population is predominantly rural, but the prevailing trend is urbanisation. Growth in urban areas may accelerate in line with the national vision to transform Uganda from a peasant to modern and prosperous society within 30 years (GOU 2013a). Under this vision, planned improvements in urban infrastructure and public service facilities may strengthen the appeal of towns and cities (GOU 2013a). Job opportunities in urban areas may also increase as industry and services become more prominent economic sectors.

- Uganda remains an important host country for refugees from neighbouring countries. Conflict and instability, if unresolved, may sustain the in-migration of large numbers into the country. The 2006 Refugee Act, one of the most progressive and generous in the world (World Bank 2016a, Internet site), supports the entry of refugees into Uganda.

A9.4.2.2 Key Considerations

Key considerations are:

- there is a large young labour pool
- PIIM may cause added stress to infrastructure and social services
- migrants often stay in locations they have moved to for work opportunities in the hope of further work opportunities rather than returning to an agricultural income.

A9.4.3 Education

A9.4.3.1 Baseline Condition of Education

National Level

Education is a right enshrined in the constitution of the Republic of Uganda and is compulsory for 6–13-year-olds (NUFFIC 2016). The education system comprises three years of nursery school, seven years of primary school, six years of secondary school and at least three years of higher education.

National school attendance at primary and secondary level is 81% and 17%, respectively (DHS 2011). The disparity in school attendance between males and females at the primary level is minimal in most regions. At secondary school level, the disparity (fewer females than males) widens in the north and Kampala regions (DHS 2011).

The Annual School Census 2015 found that Uganda has 18,889 primary schools and 2685 secondary schools (Ministry of Education and Sports 2015), of which 63.8% of primary schools and 38.1% of secondary schools are government funded; the remainder are privately owned (Ministry of Education and Sports 2015).

Figure A9.4-5 presents national literacy rates.

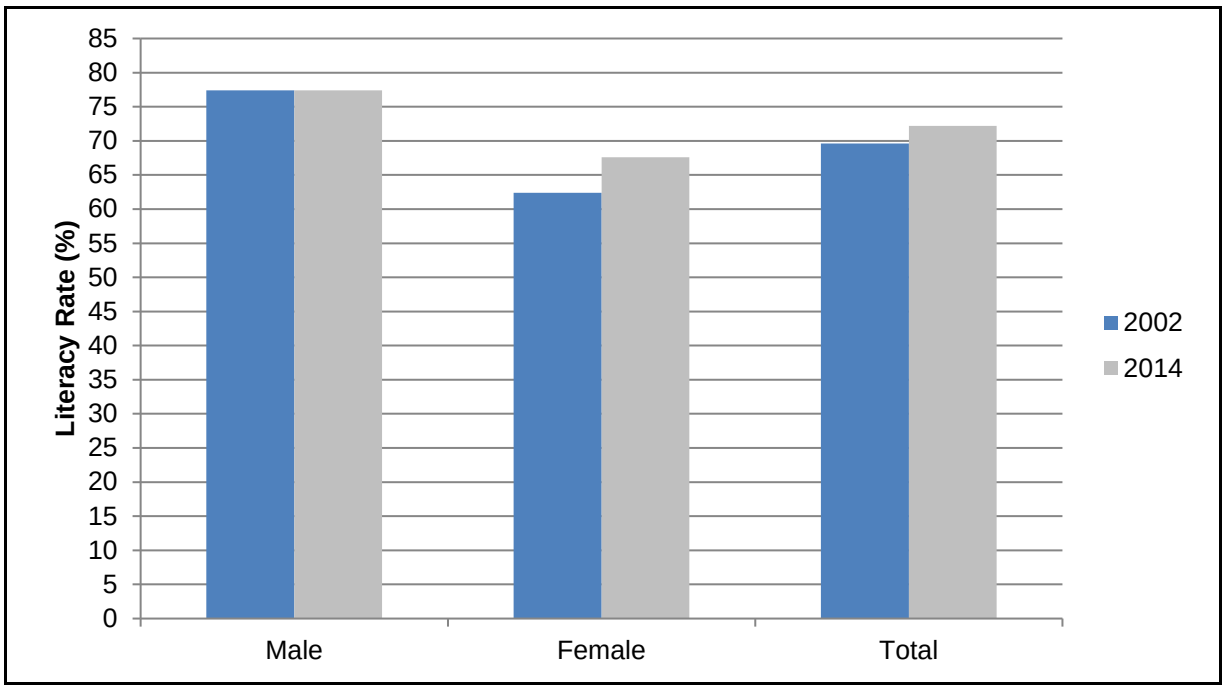

Figure A9.4-5 Literacy Rates for Persons Aged 10 Years and Above, 2002–2014

SOURCE: UBOS (2016a)

There are three categories of tertiary institutions (TIs) in Uganda:

- universities
- other degree-awarding institutions
- other tertiary institutions (Uganda Higher Education Council 2014).

Figure A9.4-6 presents the prominence of these institutions as a percentage of overall tertiary student enrolment.

In 2016, a total of 186,412 students were enrolled at university; 56% were male and 44% were female (UBOS 2017a). There are 40 universities in Uganda; over half of these (56%) are in the central region followed by 19% in the western region. The Uganda Higher Education Council (2014) reports that most students (66%) study arts and humanities courses with fewer students (34%) studying science and technology.

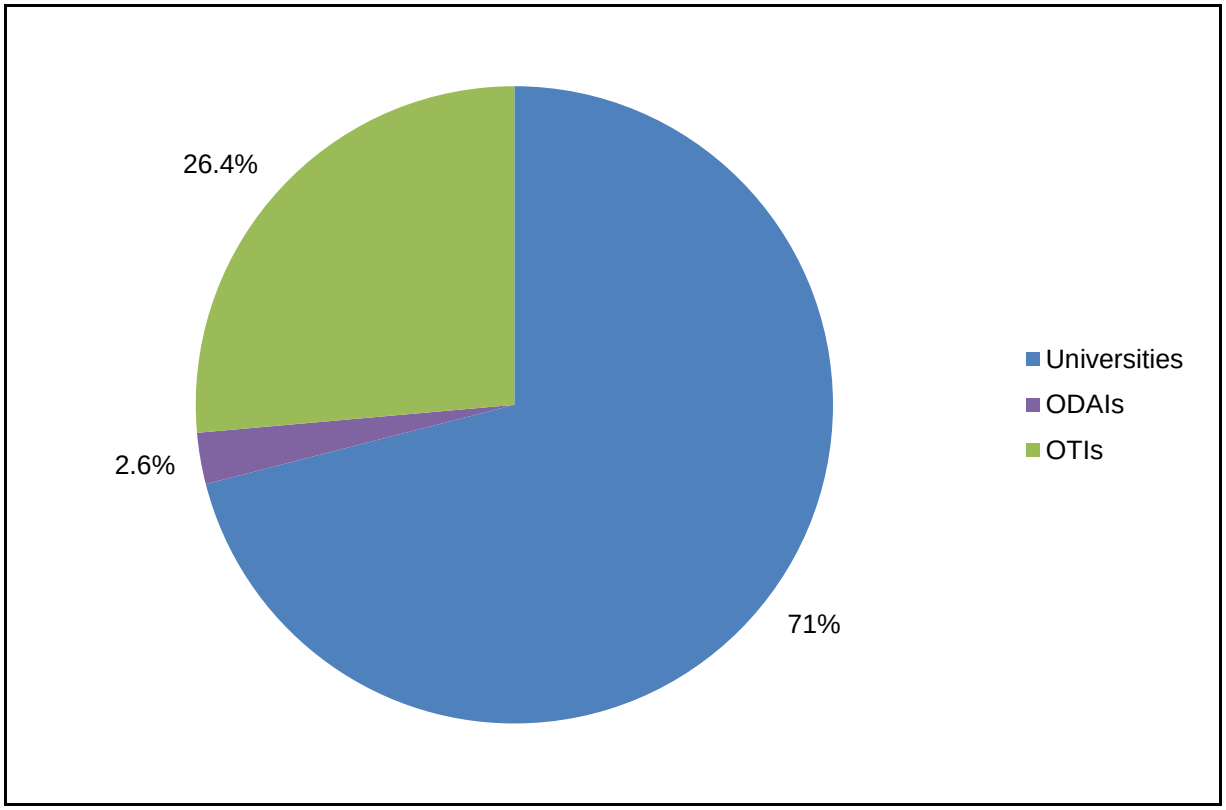

Figure A9.4-6 Higher Education Institutions as a Percentage of Overall Students Enrolled

SOURCE: Uganda Higher Education Council (2014)

There is a shortage of appropriately skilled and qualified workers in Uganda, particularly in sectors such as construction (Ministry of Education and Sports 2013). The mismatch between existing graduate qualifications and the skills required by industry results in high graduate unemployment and high levels of personnel turnover and retraining costs for companies. The business, technical and vocational education and training (BTVET) sector aims to address the technical skills gap in the country. There are 129 BTVET institutions in which 63,209 students are enrolled (UBOS 2017a).

The central government has recently invested in education infrastructure (Ministry of Education and Sports 2015). Despite government efforts, 31% of schools lack access to safe drinking water, emphasising the need for continued investment (Ministry of Education and Sports 2015).

District Level

Figure A9.4-7 shows adult literacy rates for persons 18 and above in the districts traversed by the AOI with literacy rates ranging between 54.6% and 68.1%.

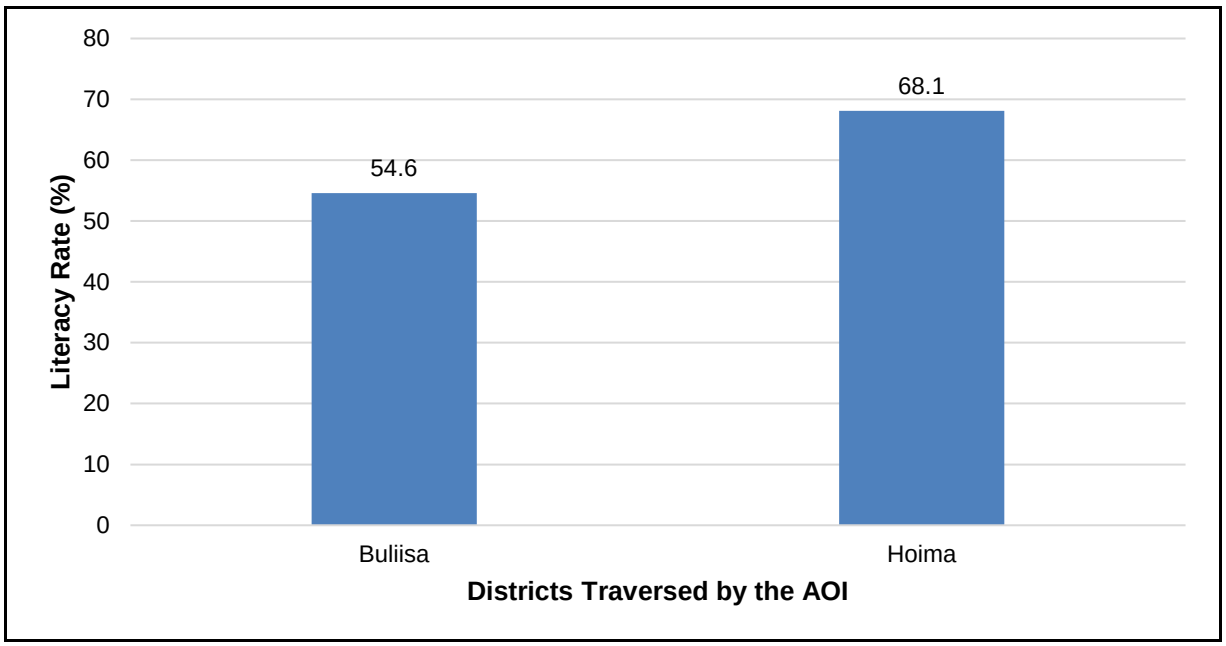

Figure A9.4-7 Literacy Rates for Persons Aged 18 Years and Above, 2014

SOURCE: DDPs for 2015/16–2019/20

Table A9.4-5 shows the school attendance rates in the districts traversed by the AOI. Key points include:

- primary school attendance ranges between 79.4% and 79.6%
- secondary school attendance ranges from 22% to 26.2%
- boys have slightly higher attendance rates compared to girls at primary school level.

Table A9.4-5 School Attendance Rates in the Districts, 2014

District	Attending Primary School (6–12 Years) (%)			Attending Secondary School (13–18 Years) (%)		
	Total	Male	Female	Total	Male	Female
Buliisa	79.6	79.9	79.2	22.0	26.7	17.4
Hoima	79.4	79.2	79.6	26.2	26.3	26.0

SOURCE: UBOS (2016b)

Consistent with the national level, substantial skills gaps are present in the districts traversed by the AOI. Recognising the importance of human capital development, the DDPs place emphasis on increasing the skill level and productivity of the workforce through vocational training programmes (DDPs 2015).

The DDPs highlight challenges for district education departments including:

- personnel shortages
- high drop-out rates among girls due to early marriages, teenage pregnancies and domestic chores (Hoima and Buliisa DDPs 2015).

Tertiary Education

Hoima has two technical institutes: the Buhimba Technical Institute and the Kitakara Institute of Commerce, Media and Vocational Studies. These institutes offer courses in business administration, health care, information and communication technology, carpentry, welding and metal fabrication, plumbing and petroleum technology (BTVET-Uganda 2018).

In addition, students from Hoima and Buliisa districts attend technical institutes in Gulu (St Daniel Comboni, Gulu district), Masindi (St Kizito Vocational Centre, Masindi Vocational Training Institute and Kyema technical college; Masindi district) and Hoima districts (St Simon Peters Vocational Institute and Nile Vocational Training Institute) (Artelia 2015a).

The Ministry of Education and Sports, in partnership with the Uganda Petroleum Institute Kigumba (UPIK) and Uganda Technical College Kichwamba (UTCK), executed a skills access and upgrading project in 2016, the objective of which was to upgrade BTVET quality in oil and gas sector, to meet private sector demand (Ministry of Education and Sports. 2017. Internet site).

PAC Level

The literacy rate of the population in the PACs varies. Interviews with PAC teachers reported literacy rates ranging from 0 to 45% in sample PACs such as Buseruka (KP84.5) and Katooke villages (KP95) in Hoima district and in Biiso village (KP44.5) in Buliisa district. High literacy rates of 80% were reported in Wayoyo (KP75) and Hoima villages (KP74.5) in Hoima district and Kihunghya village (KP75) in Buliisa district.

Female literacy rates in the PACs were mostly estimated to be below 40% (women FGDs). These low literacy rates were attributed to the historical preference of parents educating boys over girls and early marriage. Figure A9.4-8 shows the percentage of children attending primary school in sample PACs.

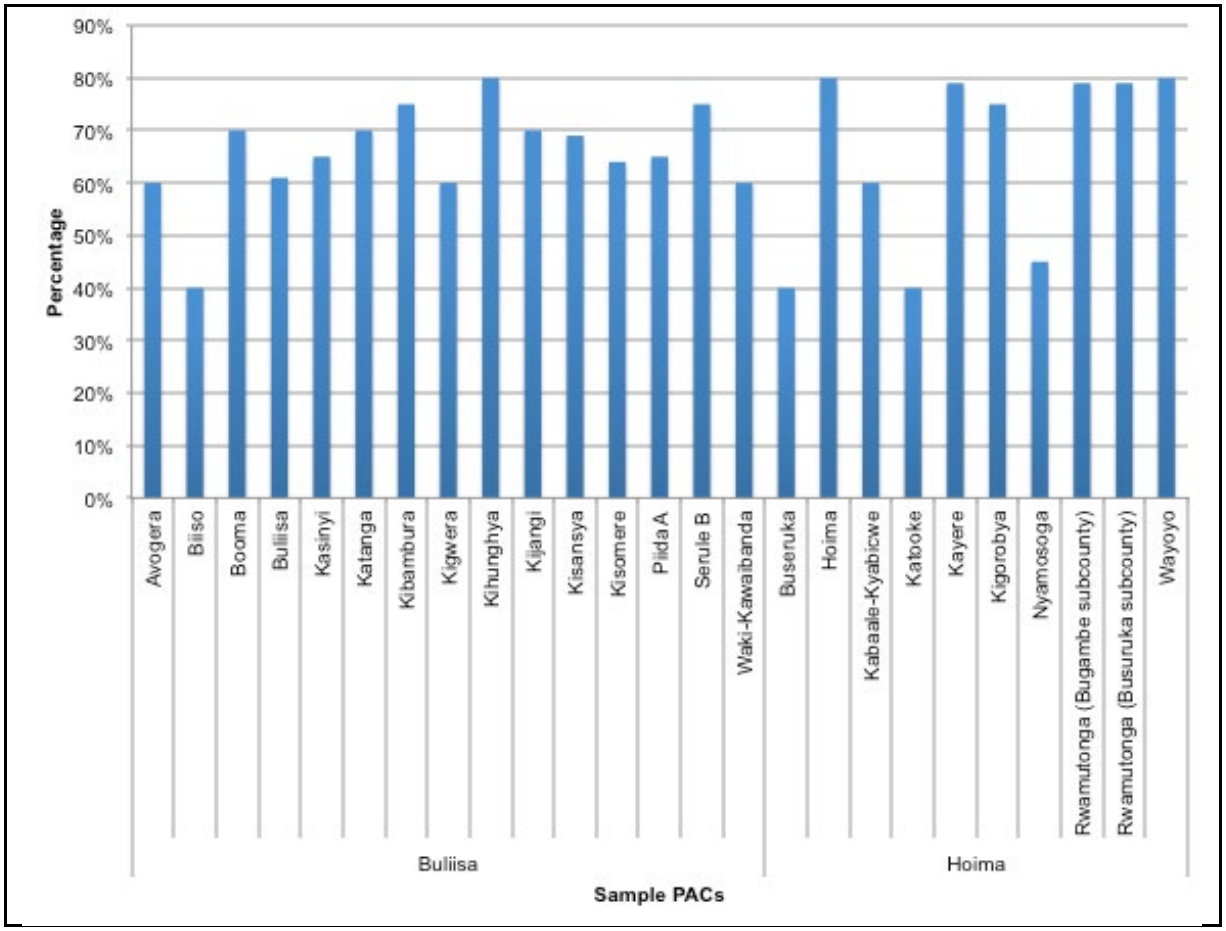

Figure A9.4-8 Percentage of Children Attending Primary School in Sample Sites and Potentially Affected Communities

SOURCE: KIIs with primary school teachers, FGDs with women, Artelia (2015b)

Figure A9.4-8 shows that the percentage of children estimated to be attending primary school ranges from 40% to 80%.

KIIs with teachers reported domestic chores, long travel distances from home to school, low value attributed to education by children and parents, and household income earning commitments as reasons for low attendance rates.

Atacama et al. (2017) indicate that costs associated with education were often unaffordable for PACs, especially for orphaned children living with relatives (one in every six pupils is an orphan). Many pupils in the PACs in Buliisa district regularly change schools because households are transient, with multiple homes either in Uganda's West Nile region or across Lake Albert in Congo (Artelia 2015a: 97).

In some sample PACs, attendance rates were found to be lower for boys than girls. This was attributed to peer pressure and engagement of boys in income-generating activities. For example, most boys in Booma village (KP44.5) are involved in fishing activities, and in Kayere village (KP94.5) boys are involved with cattle herding; both negatively affect school attendance. In the majority of PACs, however, attendance rates were found to be lower among girls. This is corroborated in studies undertaken of the upstream PACs KP0–8 (Atacama et al. 2017). Reasons reported for low school attendance by girls include:

- lack of sanitary pads during menstrual periods
- bullying and sexual abuse
- household's inability to afford school fees
- distances needed to travel to access schools
- lack of security of schools (no fences around peripheries)
- teenage pregnancy
- early marriage.

Consistent with district level data, concerns about the quality of education in the sample PACs are widespread. Most teachers interviewed reported that their classrooms were not adequately equipped, lacking desks, science kits and text books to support the numbers of pupils accessing education. Other concerns include low wages for teachers relative to the cost of living, high pupil–teacher ratios per class, lack of accommodation for teachers and lack of food for teachers and students during the school day.

Human Rights

The following human rights laws apply to education:

- Universal Declaration of Human Rights, article 26; International Covenant on Economic, Social and Cultural Rights, article 13; Convention on the Rights of the Child, article 28: Right to education.

Uganda has ratified all these declarations.

Trend in Condition and Sensitivity to Change

Education trends are as follows:

- Education remains a key development priority in Uganda, and the districts traversed by the AOI make provisions for investment in education infrastructure and resources in the DDPs. However, the extent of improvements at the district level will be influenced by the financial and human resources available.
- High graduate unemployment and complaints from the private sector have increased the attention paid to Uganda's skills gap. At the national level, the Business Technical Vocational Education Training Strategic Plan 2011–2020 seeks to create employable skills and competencies relevant to the job market. At the district level, some DDPs outline plans to increase enrolment in tertiary institutions and offer vocational training programmes to citizens (Hoima DDP 2015).
- Uganda's oil reserves are mainly situated in Buliisa, Hoima and Nwoya districts. The discoveries have raised high expectations among the communities with regards to job creation. At the district level, the DDPs outline plans to increase enrolment in tertiary institutions and offer vocational training programmes to local people to ensure that they take advantage of the employment opportunities emerging in the districts (Buliisa and Hoima DDPs 2015).

Sensitivity Rating

Table A9.4-6 presents the sensitive VECs for education identified during the social baseline study.

Table A9.4-6 Education VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Unemployed graduates	Positive	Unemployed graduates may benefit from the training opportunities and work experience with the project.
Children of primary and secondary school age	Moderate (3)	Attendance rates of children may fall due to jobs or opportunities indirectly created by the project.

A9.4.3.2 Key Considerations

Key considerations are:

- Uganda lacks skills in particular sectors, i.e., construction, and enrolment in science and technology programmes. Labour recruited for pipeline construction is likely to require considerable training and capacity building.
- TIs in the districts traversed by the AOI may be a potential source of construction labour for pipeline construction
- opportunities such as temporary work on construction sites and informal service industry (roadside shops and kiosks) may reduce school attendance by both girls and boys, affecting their human right to education.

A9.4.4 Economy

A9.4.4.1 Baseline Condition of the Economy

East African Regional Level

East Africa is the fastest growing economic region in Africa with recorded regional growth estimated at 6–7% for 2016 and 2017. Growth has been primarily driven by the service, construction and industry sectors as well as public investment programmes and agriculture. The region also benefits from large foreign direct investment (FDI) inflows (AfDB et al. 2016).

While inflation has been higher in East Africa (12–19% in 2007–2014) than in other African regions, it is expected to reduce to the African average of 7–8% in the upcoming years. Before 2016, the East African region ran persistent fiscal and current account deficits. However, predicted East African fiscal deficits of around 4% of gross domestic product (GDP) and current account deficits of around 7% in 2016 and 2017 are similar to African average deficits (AfDB et al. 2016).

Uganda, as a member of the East African Community (EAC) since 2010, shares a common market with Kenya, Tanzania, Burundi and Rwanda. Uganda's GDP is approximately 60% of Kenya's GDP (the largest economy in the EAC), placing it behind Tanzania and just ahead of Rwanda (AfDB et al. 2016). The EAC is economically more diverse than other regional African communities because it is less dependent on extractive industries.

Trade within the EAC, as a percentage of total trade, increased from 17.7% in 2000 to 18.6% in 2010, after which it fluctuated slightly to 18.4% in 2014. The EAC market remains constrained by nontariff barriers (IMF 2016, Internet site). However, the EAC is in the process of implementing a single customs territory system. The

objective of this system is to harmonise and electronically connect members' customs clearance systems to reduce clearance delays at borders, thereby reducing business costs (IMF 2017a, Internet site).

National Level

Gross Domestic Product

Uganda's economy experienced strong growth between 1962 and 1970 but collapsed during the 1970s and 1980s due to political uncertainty and ongoing civil war (Byrnes 1990). Since then, the government has acted to rehabilitate the economy and economic reforms have ushered in a period of solid economic growth and lower inflation. Nevertheless, overall productivity remains hampered by supply-side constraints including underinvestment and high production costs in the agricultural sector (CIA 2017, Internet site).

Average annual growth slowed to 4.5% from 2010–2011 to 2015–2016, compared to the 7% achieved during the 1990s and early 2000s. Growth was initially driven by a rapidly expanding urban population (with increased participation in the formal economy). The economic slowdown starting in 2010 was driven by several factors including adverse weather affecting agriculture, unrest in South Sudan and private-sector credit constraints. Uganda is considered one of the poorest nations in the world (IFAD 2012, Internet site).

Economic Structure and Sector Contribution

The Ugandan economy is characterised by formal and informal economic activity with the informal sector accounting for approximately 45% of all economic activity (UBOS 2016a). The informal economy refers to a diverse set of economic activities, enterprises, jobs and workers that are not regulated or protected by the state.

The service industry typically contributes most to the formal economy and comprises 54.5% of GDP in 2016 (CIA 2017, Internet site), up from 38% in the early 1990s (Wiegratz 2009).

Community services, wholesale and retail trade (predominantly at micro-scale) were the most important service subsectors, followed by transport and communication (Wiegratz 2009). Services sector growth in Uganda is dominated by telecommunications, tourism and financial services (UN 2011).

Tourism is one of the fastest growing service sectors in the Ugandan economy and is the largest foreign exchange earner. Tourism contributes approximately 9% to GDP and employs around 8% of the national workforce (Deloitte 2016).

Agriculture has traditionally been a major economic activity comprising 24.5% of GDP in 2016 (CIA 2017, Internet site) down from 48.6% in the early 1990s (Wiegratz 2009).[5] The decreased contribution to GDP is primarily because of growth in other sectors such as manufacturing. Major crops include coffee, tea,

[5] NOTE: Deloitte (2016) notes that the agricultural sector contributes 5.5% to the formal and 47% to the informal economy.

cotton, tobacco, cassava, potatoes, maize, millet and pulses (CIA 2017, Internet site).

The industrial sector is relatively small but has recorded high growth rates over the past three decades. It accounted for 21% of GDP in 2016 (CIA 2017, Internet site), up from 13.4% in the early 1990s (Wiegratz 2009). The sector is dominated by manufacturing and construction, while electricity production and supply, water supply and mining also contribute to GDP (Wiegratz 2009).

However, the industrial sector is dependent on imported equipment and energy (oil) and is constrained by poor infrastructure, high energy costs and low levels of private investment.

Table A9.4-7 presents the formal economic sector contribution and growth.

Table A9.4-7 Economic Sector Contribution and Growth

Sector	1990, 1991–1994 and 1995	1995–2000	2000, 2001–2004 and 2005	2015 and 2016*
Average Share of GDP (%)				
Agriculture	48.6	42.3	38.7	24.5
Industry	13.4	17.8	18.2	21.0
Services	38.0	39.9	40.2	54.5
Average Annual Growth (%)				
Agriculture	4.0	3.8	2.9	n/a
Industry	11.4	11.2	7.9	n/a
Services	8.2	7.0	7.0	n/a

SOURCE: Wiegratz (2009), CIA (2017, Internet site)

Oil and Gas Sector

Uganda's first major oil discoveries were confirmed in 2006. In 2007, the government placed a moratorium on further licensing in order to develop a regulatory and fiscal framework. The National Oil and Gas Policy was established in 2008, and the Petroleum Exploration, Development and Production Act (replacing the Petroleum Exploration and Production Act of 1985), and the Petroleum Refining, Conversion, Transmission and Midstream Storage Act were promulgated in 2013. In February 2015, the moratorium was lifted with the announcement of Uganda's first competitive licensing round for six blocks (IMF 2017b, Internet site).

At the time of writing, Uganda estimates overall crude reserves discovered in the Albertine Graben at 6.5 billion barrels, while recoverable reserves are estimated at between 1.4 and 1.7 billion barrels (IMF 2017b, Internet site). The recorded rate of exploration success has been extraordinarily high at more than 85% (the Ministry of Energy and Minerals Development reports that hydrocarbons were encountered in 102 of 116 deep wells drilled in the Albertine Graben by 2015) (IMF 2017b, Internet site).

In 2014, the GOU identified three major commercialisation processes, formalised in a Memorandum of Understanding (MoU) with licensed upstream oil companies in Uganda (Tullow Oil, TEPU and CNOOC) (MEMD 2017a, Internet site), namely:

- production of crude oil and gas for power generation in the short to medium term
- establishment of a 60,000-barrels-per-day (bbl/d) refinery
- export of crude oil through a pipeline or any other viable option.

In 2015, the Petroleum Regulatory Authority was established to oversee the oil sector. The Public Financial Management (PFM) Act of 2015 requires all oil revenue to be deposited in a Petroleum Fund (IMF 2017a, Internet site). The Minister of Finance, Planning and Economic Development is responsible for the overall management of the Petroleum Fund and oversees all transfers into and disbursements from the fund. Withdrawals from the fund can be made to the Consolidated Fund to support the annual budget or to the Petroleum Revenue Investment Reserve for Investments (Bank of Uganda 2016, Internet site).

Production sharing agreements (PSAs) govern tax arrangements for upstream oil production between the government and joint venture partners that provide for royalties, distribution of 'profit oil'[6] between the government and the joint venture partners, corporate income tax (30%) and state participation (IMF 2017a, Internet site).

Inflation

Uganda has experienced generally low and stable inflationary rates since the late 1990s, despite several shocks such as an inflation spike from 4% in 2010 to 18.7% in 2011 (Mawejje and Lwanga 2015).

More recently, despite the considerable 2015 exchange rate depreciation that led to an interest rate increase from 11% to 17% (CIA 2017, Internet site), inflation has remained in single digits, averaging 6.7% in the fiscal period 2015–2016.

Food price inflation has increased from 5% in September 2016 to 23.1% in May 2017 due to a drought in the Horn of Africa, while core inflation[7] increased to 7.2%. However, food price inflation dropped to 11.8% by August 2017 (Bank of Uganda 2017) and core inflation remained at 5.1% in May 2017, close to the Bank of Uganda's 5% target (IMF 2017a, Internet site).

Exchange Rate

Between 2012 and May 2018, Uganda's exchange rate declined from UGX 2591: USD 1 to UGX 3740: USD 1 (IMF 2017a, Internet site; Bank of Uganda 2018, Internet site).

[6]Surplus of oil over the amount needed to cover the royalty and other costs

[7]Core inflation (underlying inflation) measures total inflation within an economy, excluding commodities such as food and energy prices, which tend to be much more volatile and prone to inflationary spikes.

Government Finances

Total government revenue, including taxes and grants, in 2015–2016 was projected at USD 3.75 billion (UGX 14 trillion[8]) (15.2% of GDP), with projected expenditure of USD 5.41 billion (UGX 20.3 trillion) (20.1% of GDP) (CIA 2017, Internet site; IMF 2017a, Internet site).

Figure A9.4-9 presents government revenue from income tax, value added tax (VAT), excise duties and international trade taxes.

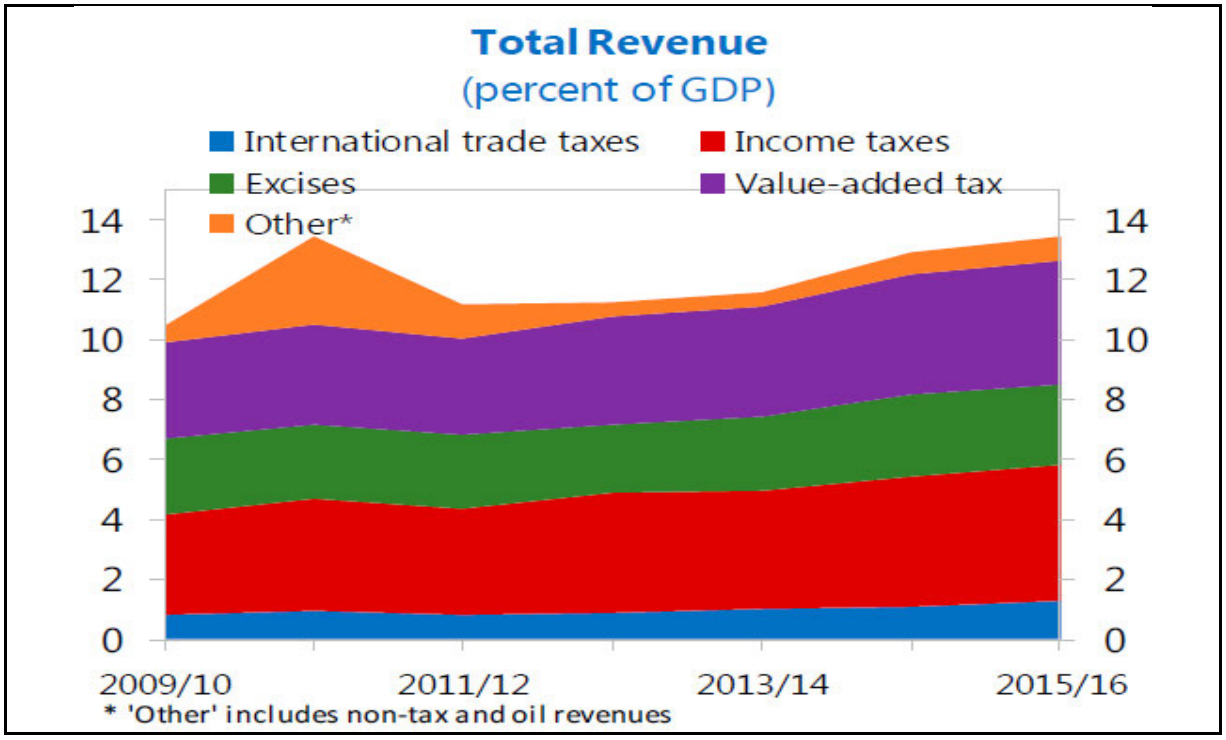

Figure A9.4-9 Government Revenue

SOURCE: IMF 2017c, Internet site

Foreign grants are relatively low for Uganda compared to the East African region:

- about 2% of GDP in 2009–2010
- about 1% of GDP in 2013–2014
- about 1.5% of GDP in 2015–2016 (IMF 2017c, Internet site).

Between 2012 and 2015, state expenditure exceeded income; by 2015–2016, the fiscal deficit had increased to about 5.3% of GDP at more than UGX 4393 billion (USD 1.2 million).

The recent 2015–2016 budget focused on energy and road projects.

Debt

Uganda received debt relief on seven occasions between 1982 and 2006. In 1998, Uganda became the first country to receive debt relief (USD 650 million) (UGX 2.4

[8] Conversions based on exchange rate on 24 August 2018. Source: https://www.xe.com/currencyconverter/

trillion) under the IMF and World Bank Initiative for Heavily Indebted Poor Countries (HIPC). Under the Multilateral Debt Relief Initiative (MDRI) in the mid-2000s, the debt was further relieved by USD 3.6 billion (UGX 13.5 trillion). As a result, Uganda's total outstanding external debt declined from a 1992 peak of 102% of GDP to 12% of GDP in 2007 (Romero-Barrutieta et al. 2015) (see Figure A9.4-10).

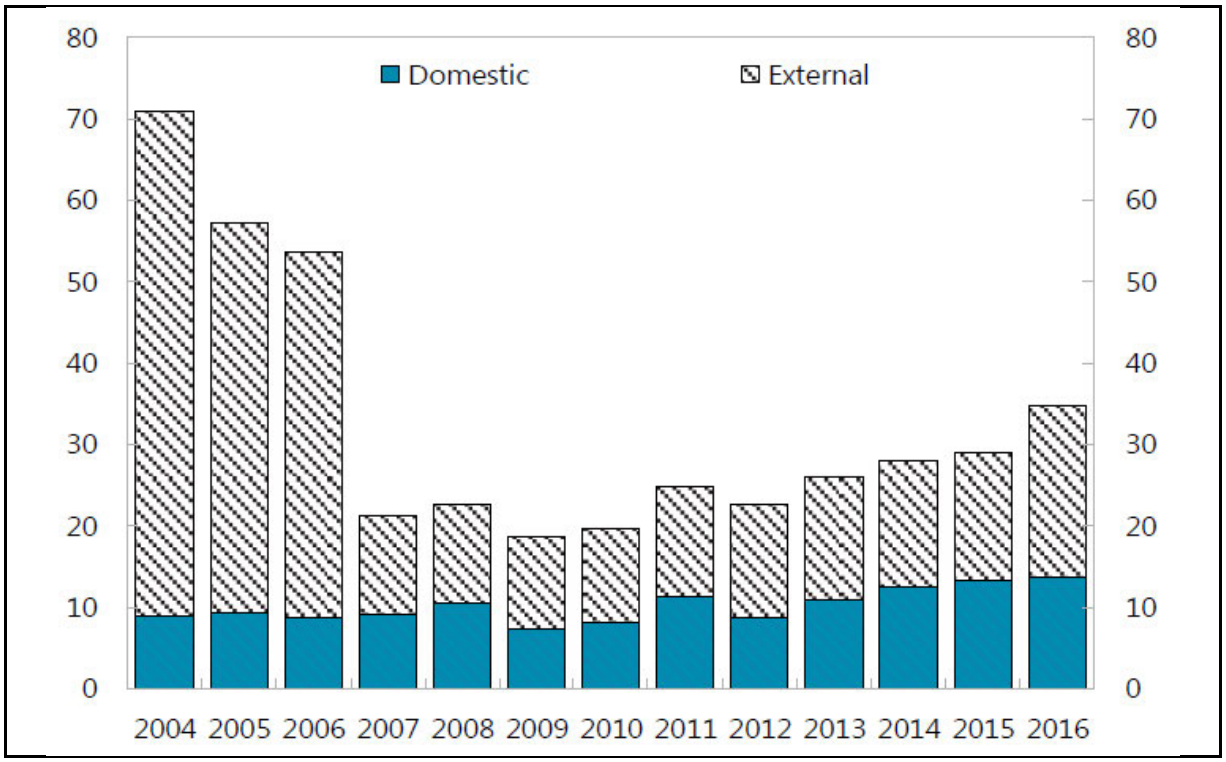

Figure A9.4-10 Public Debt as Percentage of Gross Domestic Product

SOURCE: IMF (2017c, Internet site)

Public and publicly guaranteed debt in Uganda increased from 26.1% of GDP in 2012 to 35.7% of GDP in 2015 (IMF 2017a, Internet site) due to national fronting of large infrastructure projects meant to be financed by external sources (UNDP 2016, Internet site). Approximately 61% of debt is external, with the remainder domestic debt (IMF 2017a, Internet site).

Public debt is considered sustainable and the risk of debt distress is considered low provided planned investments in energy and transport infrastructure raise growth and revenue (UNDP 2016, Internet site, IMF 2017a, Internet site).

All sovereign eurobonds[9] in Africa are denominated in USD hence considerable depreciation of the UGX affects the local currency value of debt service payments. Debt service costs for Uganda rose in 2015 by 2.5 percentage points of GDP and by 27% in local currency terms (AfDB et al. 2016).

[9] A eurobond, also referred to as sovereign bond, is a debt security issued by a national government and is denominated in a foreign currency, usually dollars rather than the euro that its name implies (Quartz Africa 2017, Internet site)

Trade

Agriculture accounts for the majority of Ugandan exports; substantial exports in 2014 include coffee (14.9%), sesame seeds (6.3%) and cement (5.5%) (AfDB et al. 2016, IMF 2017a, Internet site).

Uganda's export base is relatively diversified, and the top five export destinations accounted for less than half of exports in 2015 (CIA 2017, Internet site):

- Rwanda (11%)
- United Arab Emirates (UAE) (10%)
- DRC (10%)
- Kenya (10%)
- Italy (6%).

Figure A9.4-11 shows that neighbouring African countries, and the COMESA[10] region in general, are the most important export markets for Uganda but the conflict in South Sudan has affected exports to that country (AfDB et al. 2016, Leading Edge 2017, Internet site).

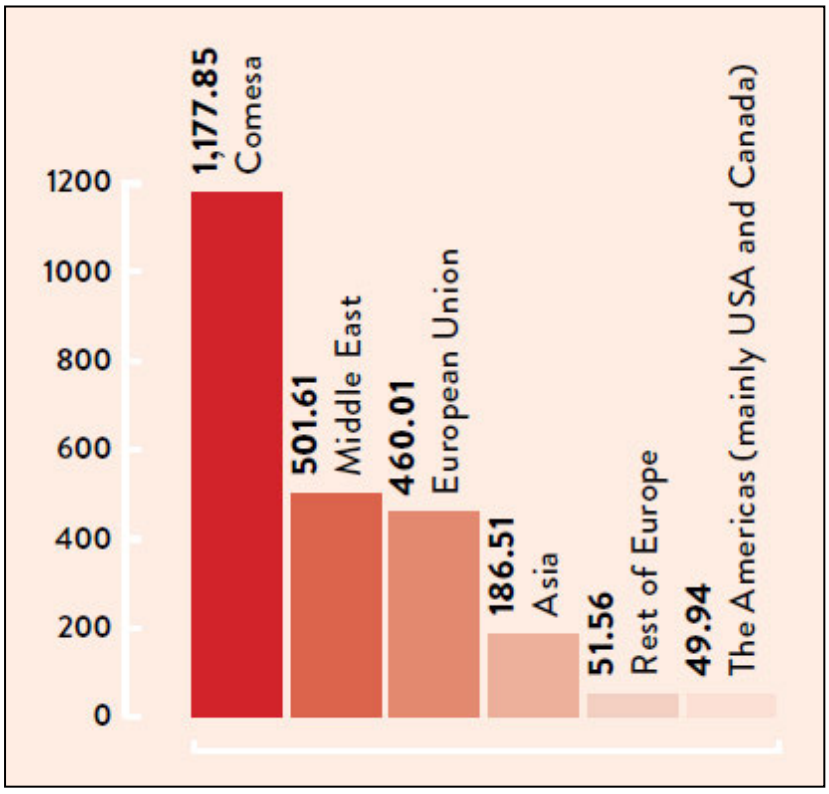

Figure A9.4-11 Main Export Regions, 2016

SOURCE: Leading Edge (2017, Internet site)

NOTE: Values in USD million

[10] The Common Market for Eastern and Southern Africa (COMESA) region consists of Burundi, Comoros, DRC, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe.

Uganda's main imports are vehicles, petroleum, medical supplies and cereals (CIA 2017, Internet site). Oil accounts for 14% of import value, down from 20% in 2012 and 2013 as a result of lower oil prices.

Figure A9.4-12 shows that Uganda's top import partners in 2015 were Kenya (16% of import value), UAE (16%), India (13%) and China (13%) (CIA 2017, Internet site). Though Kenya is in the top three partners that account for nearly half of imports, most imports originate outside Africa.

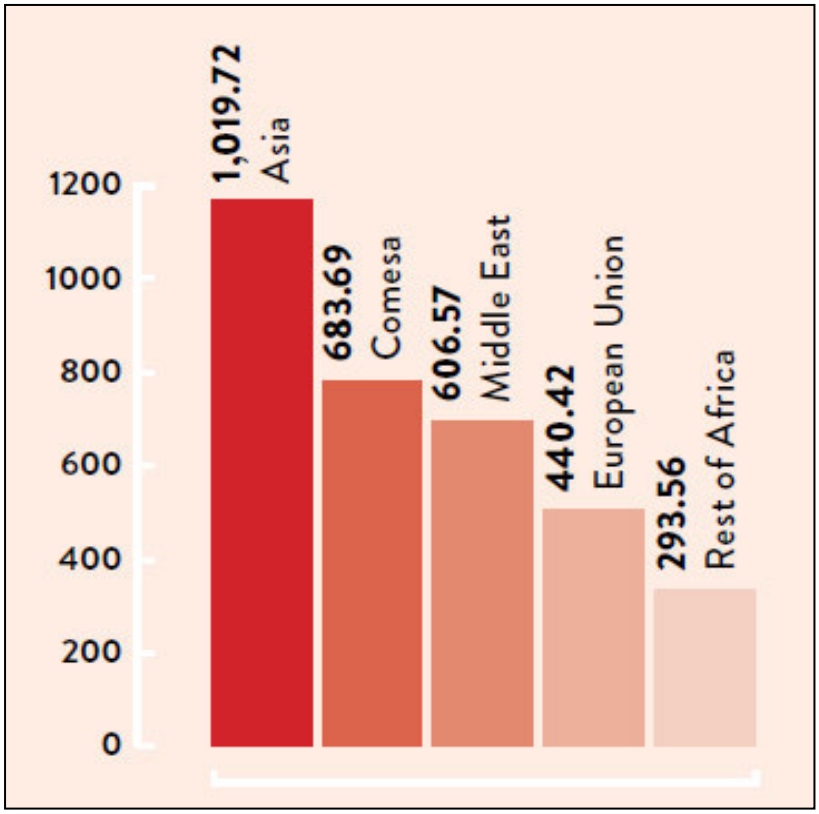

Figure A9.4-12 Main Import Regions, 2016

SOURCE: Leading Edge (2017, Internet site)

NOTE: Values in USD million

Table A9.4-8 shows the trade balance for Uganda between 2012 and 2016. From the table it can be seen that imports have consistently exceeded exports, resulting in a negative trade balance. However, a decline in the cost of imports, due to lower oil prices and delayed investments, outweighed a drop in exports, due to lower global and regional demand including from South Sudan, and narrowed the trade deficit during 2015–2016.

Table A9.4-8 Trade Balance

	2012–2013	2013–2014	2014–2015	2015–2016
Exports of goods (USD million/UGX trillion)	2912/11	2706/10.2	2738/10.3	2688/10.1
Export growth (%)		-7.1	1.2	-1.8
Coffee (% of export value)	14.5	14.9	14.6	13.1
Imports of foods (USD million/UGX trillion)	-5035/-18.9	-5074/-19.1	-4988/-18.8	-4574/-17.2
Import growth (%)		0.8	-1.7	-8.3
Oil (% of import value)	20.4	21.5	18.7	14.1
Trade balance (USD million/UGX trillion)	-2123/-8	-2368/-8.9	-2250/-8.5	-1886/-7.1
Trade balance (% of GDP)	-8.5	-8.5	-8.3	-7.8

SOURCE: IMF (2017a, Internet site)

Employment

The following characterise the state of employment in Uganda from available information sources:

- The labour force participation rate in 2016 was 70.1% (ILO 2017, Internet site).
- The size of the labour force in 2016 was estimated to be 19 million (CIA 2017, Internet site).
- The unemployment rate in 2013 was 9.4% (CIA 2017, Internet site).
- Youth unemployment in 2014 was estimated at 13.3% (Byamugisha et al. 2014).
- In 2016, 93.5% of the workforce was in the informal sector (World Bank 2017a, Internet site).
- Employment in both the formal and informal labour markets is increasing (CIA 2017, Internet site; World Bank 2017a, Internet site). This is largely attributed to urbanisation (World Bank 2017a, Internet site).
- Growth in the informal labour market seems to be more rapid than growth in the formal labour market as a result of:
  - rapid growth in construction jobs spurred by urbanisation (AfDB et al. 2016)
  - weak performance of the manufacturing and service sectors, generating fewer wage-paying jobs (Spence et al. 2009: 26–27, cited in AfDB et al. 2016).

Table A9.4-9 presents sectoral employment numbers.

Table A9.4-9 Sectoral Employment as Reported by Different Sources

Sector	Employment, %	
	CIA[1]	World Bank[2]
Agriculture	40.0	71.9
Industry	10.0	4.4
Services	50.0	20.2

NOTES: [1] CIA (2017, Internet site). [2] World Bank (2017a, Internet site)
Uganda has a low Human Development Index (0.483 in 2014), a small improvement over 0.478 in 2013, but still below the 0.502 average for the world's least developed countries and the 0.518 average for sub-Saharan Africa (AfDB et al. 2016).

The agricultural sector generally absorbs lower-skilled workers, while services, particularly in business, tourism and construction provide opportunities for semi-skilled workers. The public sector, such as government administration, education and health, generally provides most opportunities for highly skilled workers (Mendez-Parra 2015).

Poverty

Uganda has achieved the second-fastest reduction in poverty in sub-Saharan Africa and met the Millennium Development Goals Target 1a of halving poverty by 2015. The proportion of people living below the international poverty line (USD 1.90 per day) (UGX 7150 per day) has reduced by 2.7% per year since 2003 (World Bank 2017b, Internet site).

However, even after two decades of progress, poverty is still widespread. Approximately 35% of the population (about 11 million people) were below the international poverty line in 2013, down from 62% in 2002 and 2003 and 68% in 1993. Agricultural households account for up to 79% of poverty reduction during this period. This is attributed to good farming conditions and favourable prices for agricultural products in regional and international markets which helped to increased income from crops.

Uganda's Gini-coefficient[11] was 0.39 in 2013 having dropped from 0.46 in 2002, indicating increasing equality. The country ranks 66th in the world in terms of income inequality. The wealthiest 10% of households accounted for 33.9% of consumption in 2012, while the poorest 10% accounted for 2.4% (AfDB et al. 2016, CIA 2017, Internet site).

The AOI will traverse the western region, which is briefly described below, largely based on information provided by UBOS (2010a, 2011a) and presented in Table A9.4-10.

[11] The Gini-coefficient is a measurement of the income distribution of a country's residents. This number, which ranges between 0 and 1 and is based on residents' net income, helps define the gap between the rich and the poor, with 0 representing perfect equality and 1 representing perfect inequality.

Table A9.4-10 Economic Statistics for Western and Central Regions, 2010–2011

Indicator	Western Region (% of Total)	Central Region (Including Kampala) (% of Total)
Regional GDP (2009/10)*	18.7	51.7
Employment	16.0	61.3
Total businesses	18.0	59.2
Business per Sector		
Agriculture	43.4	14.5
Mining	40.8	44.2
Manufacturing	17.2	59.1
Construction	6.4	83.1
Trade	18.2	58.4
Transport	6.9	68.5
Accommodation and food	20.5	58.1
Information and communications	12.0	65.3
Finance and insurance	24.4	47.9
Real estate and business services	13.5	71.5
Health and social works	16.3	61.3
Recreation and personal services	16.3	66.2
Education	16.5	56.4

SOURCE: UBOS (2010a, 2011a)

Western Region

Farming, followed by fishing and animal husbandry, are the most important agricultural activities in the western region. Subsistence farming remains widespread in the region (Compassion 2015, Internet site).

The western region is also home to more than half of the world's mountain gorillas and numerous national parks that attract tourists (Leading Edge 2017, Internet site).

The western region experienced one of the fastest poverty reduction rates of all regions in Uganda. Poverty reduced by an annual average of 7.9% between 2006 and 2013. Only 10% of the country's poor lived in the western region in 2013 (compared to 21% in 2010) (World Bank 2016b, Internet site).

Central Region

The central region includes Kampala, which is the capital and economic hub of Uganda. The central region accounted for 51.7% of the GDP, 59.2% of all businesses and 61.3% of employment in 2010–2011 (see Table A9.4-10).

Fishing is most important in the central region because of its location on the shore of Lake Victoria; this sector employs marginally more people than farming (UBOS 2011a). Soils and climate are also well suited to farming, especially along the shore of Lake Victoria where food crops, coffee and cotton are grown (Compassion 2015, Internet site).

The central region has also experienced one of the fastest poverty reduction rates of all regions in Uganda. Poverty reduced by an annual average of 7.4% between 2006 and 2013. Only 6% of the country's poor lived in the central region in 2013 compared to 15% in 2006 (World Bank 2016b, Internet site).

District Level

Despite the declining contribution of agriculture to national GDP, agriculture plays a pivotal role in the economies of the districts traversed by the AOI.

Fishing is a major economic activity in:

- Buliisa, particularly on major landing sites including Butiaba, Walukuba, Bugoigo and Wanseko
- Hoima: In this district, fishing is done mostly on Lake Albert. The lake covers roughly 38% of the district.

The depletion of fish stocks due to unsustainable fishing practices is one of the major challenges for fisherfolk in Hoima and Buliisa (DDPs 2015).

Large-scale tea and sugar plantations are a key agricultural feature in Hoima district and employ many people in Hoima either directly or as out-growers.

Other important livelihoods in the districts traversed by the AOI include small-scale agricultural processing, trade in retail and agricultural goods, and provision of services (including tourism). Further information about these activities can be found in Section A9.4.5 on local economy (nonland-based livelihoods).

A9.4.4.2 Trend in Condition and Sensitivity to Change

Economic Outlook

Uganda's economic outlook is considered favourable. Economic growth may exceed 5% in 2017–2018, provided weather conditions stabilise (global warming making seasons unpredictable), FDI flows accelerate, the banking system stabilises and budgeted capital spending is executed without delays. FDI in the oil sector could also help support the recovery of growth, following the issuance of exploration permits (World Bank 2017a, Internet site).

Factors that continue to affect economic growth negatively are low business confidence, the ongoing conflict in South Sudan (affecting exports) and high credit costs that continue to hamper domestic private investment.

Over the medium term, infrastructure and oil sector investments could yield growth rates of 6% to 6.5% (IMF 2017a, Internet site).

Growth is expected to be driven mainly by strong performances in the industrial sector and investment in large infrastructure projects that will boost manufacturing and services. Increasing private consumption will also drive growth.

Core inflation is projected to stay close to the 5% target. With the planned infrastructure investments, public debt would increase but remain manageable, assuming the investments lead to higher growth and increased revenue collection. Risks to economic growth include (possible) weak implementation of public investments, adverse weather and regional developments (IMF 2017a, Internet site).

Uganda is in the process of implementing the second National Development Plan (NDPII), the objective of which is to propel the country toward middle-income status by 2020. The NDPs are implemented through sector investment plans (SIPs), local government development plans (LGDPs), annual work plans, and budgets of ministries, departments and agencies (MDAs). The NDPII also seeks to leverage the international and regional frameworks such as Africa Agenda 2063 and the Post 2015 Development Agenda to exploit growth opportunities (UBOS 2016a).

The Ugandan economy is vulnerable to the following key factors:

- Large FDI flows can cause currency appreciation, which decreases price competitiveness of exports.
- Regional conflicts in South Sudan, the DRC and Somalia could weigh on exports and growth, while an increase in refugee movements could exert budgetary pressure (IMF 2017c, Internet Site, Bank of Uganda 2017).
- Uncertainties about global economic growth, tightening of global financial conditions and increasing protectionism could result in reversal of capital flow out of emerging economies, higher financing costs of (increasing) government debt and reduction in exports. Dependency on economic growth in Europe and conflict in the Middle East could affect remittances.
- Depreciation of the exchange rate (due to increasing demand for foreign currency and global uncertainty), leading to an outflow of capital coupled with rising debt levels, would increase debt service costs but make exports more competitive.
- Delays in the completion of public investment programmes (such as road and energy infrastructure, including the Karuma and Isimba hydropower projects, strategic roads, an oil refinery and a standard gauge railway) would prevent the productivity that could be gained from enhanced infrastructure (IMF 2017c, Internet site).
- Cuts in aid would undermine the sustainability of spending, particularly in the social sector.

A9.4.4.3 Ecosystem Services Provided

The Ugandan economy is heavily dependent on agriculture, fishing, mining and tourism, all provisioning services. These ecosystem services are described in more detail in Sections A9.4.5 (local economy – nonland-based livelihoods), A9.4.6 (land-based livelihoods) and A9.4.7 (river- and lake-based livelihoods).

A9.4.4.4 Sensitivity Ranking

Sensitivity ranking is covered in sections discussing specific livelihood activities including crop farming (Section A9.4.6.1), livestock rearing (Section A9.4.6.3), mining (Section A9.4.6.4) and local economy (nonland-based livelihoods) (Section A9.4.5).

A9.4.4.5 Key Considerations

Key considerations are:

- FDI associated with major projects may have effects on the capital account
- major project investments may have effects on the exchange rate and national inflation and earnings
- major projects create employment opportunities
- synergistic effects can result from different planned developments
- international projects may provide training and capacity building of the Ugandan workforce and local companies to satisfy Uganda's local content policy.

A9.4.5 Local Economy (Nonland-Based Livelihoods)

A9.4.5.1 Baseline Condition of Local Economy (Nonland-Based Livelihoods)

This section reports local economic (nonland-based livelihoods) activities at district and PAC level.

District Level

Although agriculture and fishing are the most important livelihoods in the districts traversed by the AOI, the following economic activities are also important (Atacama Consulting 2017):

- small-scale processing of agricultural and fish products
- small-scale trade in retail merchandise and agricultural produce
- provision of services including tourism and transport.

Local economic activities are predominantly informal, meaning that they are neither taxed nor regulated by the state and offer little social protection to workers (WIEGO 2018, Internet site).

Small-Scale Processing

Large-scale industrial activity is limited in the districts traversed by the AOI (NomoGaia 2012).

Artisanal fish processing (e.g., drying, smoking) takes place in Buliisa district with fish-handling facilities at Wanseko and Katala/Katolo landing sites on the shores of Lake Albert. Although a fish factory in Butiaba was closed down owing to low fish stocks, the DDP states a need for more fish-processing facilities at landing sites (Buliisa DDP 2015). Women play an important role in fish processing, particularly fish drying at landing sides (IISD 2015).

Agro-processing facilities such as cassava and millet grinding mills were found in Avogera (KP0) and Kigwera (KP4) in Buliisa district (Artelia 2015c).

Hoima district boasts several tea, coffee and tobacco estates with small-scale processing factories (NomoGaia 2012). These are mostly in urban areas, i.e., surrounding Hoima municipality (KP74.5). Examples of such facilities are Alasco grain millers, Alliance One Uganda and Bugambe Tea Estate (KIIs with business owners; Ramboll 2016).

Agro-processing is undertaken mainly by women (DDP 2015).

The development of small-scale processing in the districts traversed by the AOI is limited by inadequate financial and technical capacity to process products (Fortune of Africa 2013a, Internet site).

Trade in Retail Merchandise and Agricultural Produce

Small-scale trade occurs in the districts traversed by the AOI. The sale of retail goods and agricultural produce by micro-enterprises predominantly occurs on roadsides and at markets in trading centres, towns and cities owing to ease of access to customers. In Uganda, a micro-enterprise is an enterprise employing up to four people with an annual sales turnover or total assets not exceeding UGX 10 million (USD 2657) (Uganda Investment Authority 2018, Internet site).

There are 58 functioning markets in Hoima, including 25 in the subcounties traversed by the AOI (Buseruka, Kigorobya, Bugambe and Buhimba) (DDP 2015). Figure A9.4-13 shows an example market.

Figure A9.4-13 Market in Kibambura (KP5), Buliisa District

Small-scale enterprises may rent shop premises, street stands or trade with customers from the privacy of their own homes. The types of merchandise sold include agricultural products and general merchandise (i.e., clothes, manufactured goods, airtime, fuel wood) (Hoima DDP 2015). Traders travel to large urban settlements to source merchandise for their shops.

The proximity of the districts to international borders has created great potential for import and export trade. KIIs with Congolese migrants found that they often move back and forth between Uganda and the DRC to trade fish and other products. Markets in Buseruka (Hoima district) and Wanseko (Buliisa district) trade with regional traders in South Sudan (Artelia 2015a; Hoima DDP 2015).

The percentage of households with at least one family member engaged in a non-agricultural household-based enterprise in the districts traversed by the AOI is presented in Figure A9.4-14.

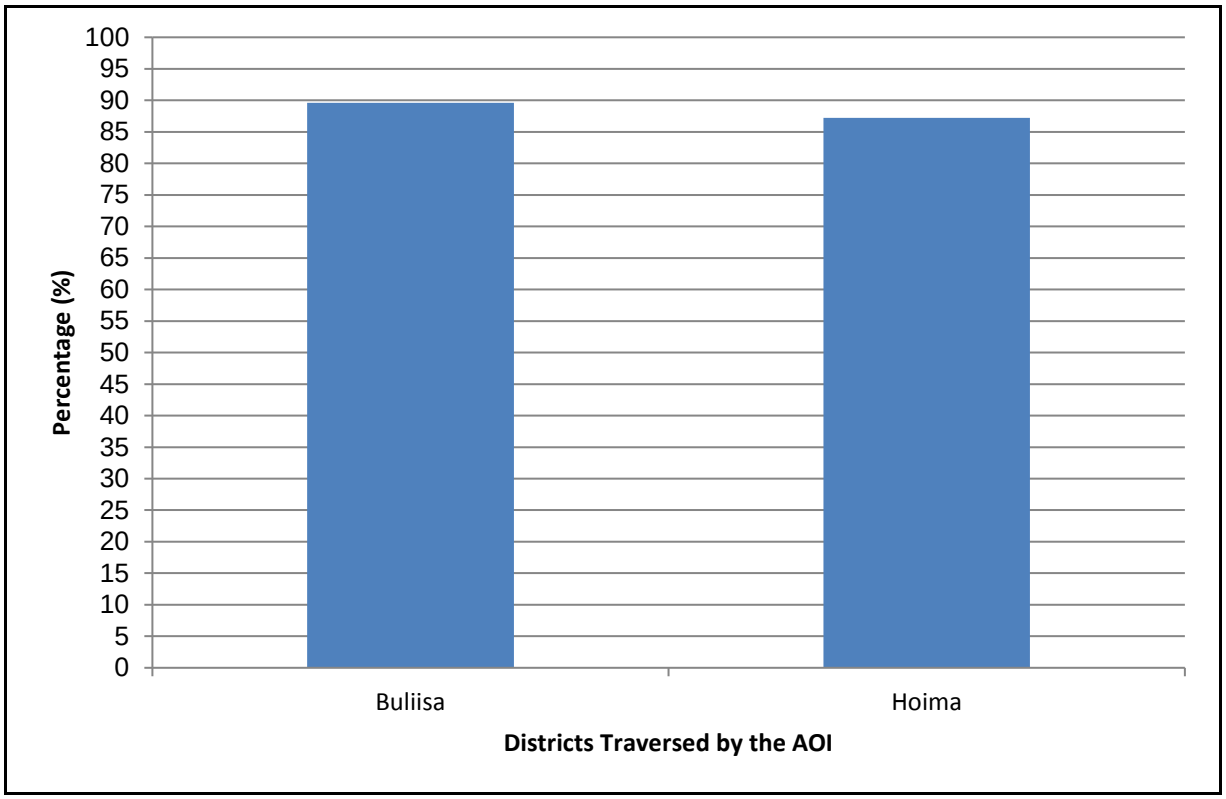

Figure A9.4-14 Percentage of Households with at Least One Member Engaged in a Non-Agricultural Household-Based Enterprise

SOURCE: UBOS (2016c)

Figure A9.4-14 shows that most households have at least one family member engaged in some form of household-based enterprise such as petty trade or selling homemade food items. Atacama Consulting (2017) and KIIs found that trade in basic goods and services are undertaken concurrently with agricultural and fishing activities to supplement income. Women practice livelihoods peripheral to artisanal food processing such as operating restaurants and bars (IISD 2015). The monthly incomes of small businesses in the districts traversed by the AOI fluctuate considerably.

Trade in retail merchandise and agricultural produce is important to the districts. Constraints to the growth of micro-enterprises are:

- lack of electricity, lack of start-up capital and credit access, and lack of enterprise management expertise (Artelia 2015a)

- poor road access between traders and producers (Hoima DDP 2015).

Tourism

Tourism-based livelihoods are particularly important in the districts traversed by the AOI. Buliisa and Hoima districts are within the Albertine Graben region, which accounts for over 70% of Uganda's tourism revenue (Total E&P Uganda and Tullow Oil 2016). The main attractions in Buliisa are the Murchison Falls National Park (MFNP), River Nile and forest reserves (i.e., Budongo, Bugungu) (DDP 2015). Visitors are attracted to Hoima by the abundance of wildlife species and geographical features (e.g., hot springs, salt pans) along the Albertine Rift (DDP 2015). Figure A9.4-15 shows the main tourism sites in relation to the AOI.

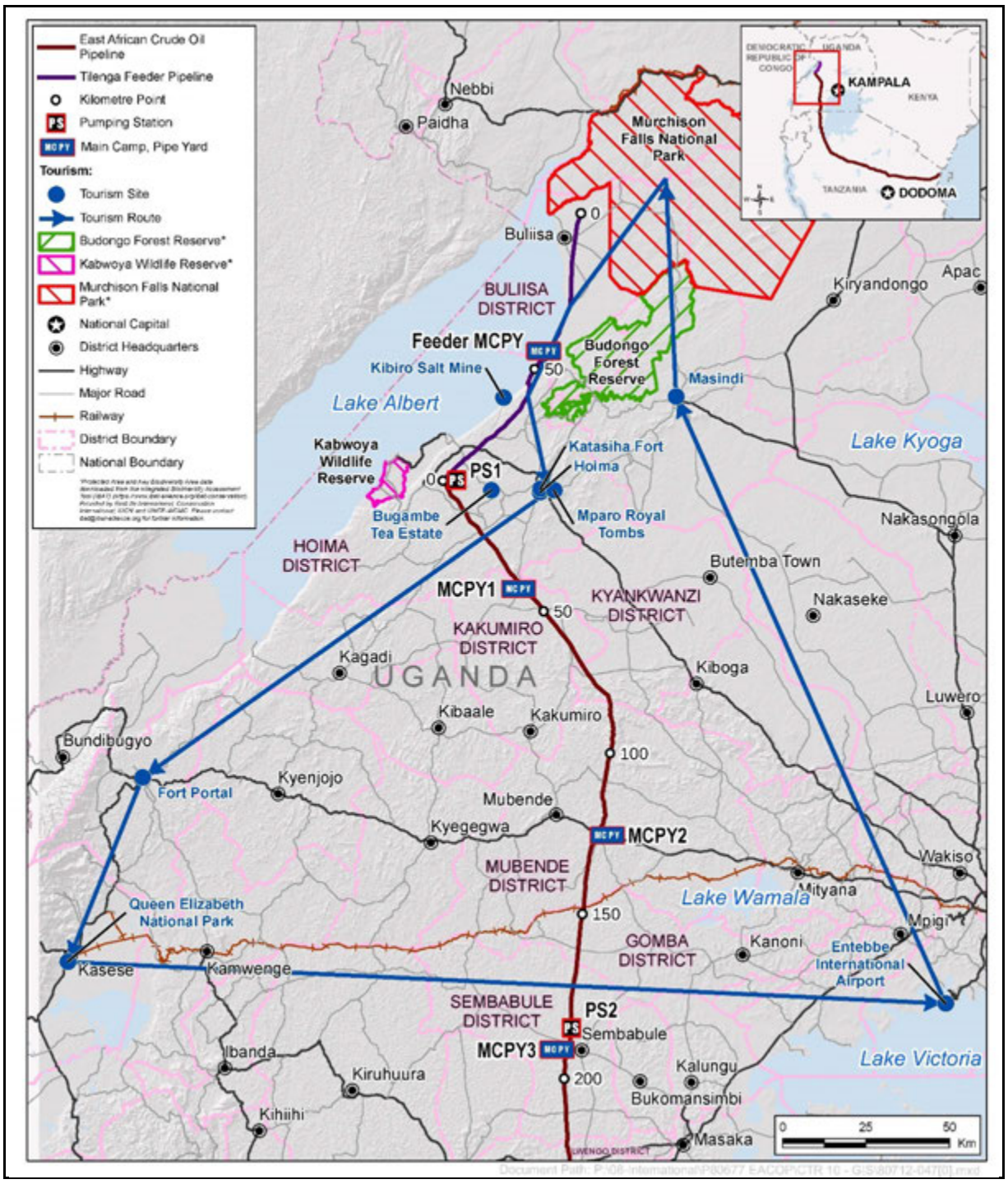

Figure A9.4-15 Tourist Sites

MFNP is one of the top wildlife-watching destinations in the country and 30–40% of visitors to Uganda visit the park (Advisian 2015). Murchison Falls brings major revenue to Buliisa district; in 2014/15, the Uganda Wildlife Authority (UWA) disbursed UGX 635.4 million (USD 168,853) to the district as part of its revenue sharing scheme, representing 5% of the total revenue received by Buliisa that year (Artelia 2015b). Locally raised revenues come from service tax, hotel tax, park fees and business licences and are mainly used to fund social service projects (Artelia

2015b). Locally raised revenues may increase following the completion of plans to promote eco-tourism and protect established eco-tourism sites (Buliisa DDP 2015). The Bagungu Heritage and Information Centre was recently launched to promote cultural tourism activities in the district (Buliisa DDP 2015).

Figure A9.4-16 A Sign at Murchison Falls to indicate the Scenic Tourist Route

Hoima district is a hub for tourists travelling from Murchison Falls to Queen Elizabeth National Park. Hoima has hotels and guesthouses that have invested in facility upgrades to meet increasing tourist and oil industry requirements.

Tourist sites including the Mparo Tombs (the burial place Bunyoro kings), the 805 ha Bugambe Tea estate and Kibiro salt mine (a UNESCO World Heritage site) are major tourist attractions for both international and national visitors.

Plans are underway to construct the Kabaale International Airport in Hoima district which is intended to serve as a regional airport to cater for travel to the DRC, South Sudan, Rwanda and Burundi as well as serving regional tourist sites in Uganda.

Despite the potential of the tourism sector, several challenges remain. Consistent with national concerns, human activities have led to serious biodiversity loss and environmental degradation in Hoima (DDP 2015). In Buliisa, communities lack the skills and understanding required to effectively run tourism-based enterprises (Artelia 2015b). There are few local permanent employees in tourist lodges with most coming from Kampala and the southern part of Uganda (Artelia 2015b).

PAC Level

Trade in retail merchandise and agricultural products and provision of services are livelihood strategies present in the sample PACs, particularly among women.

Based on KIIs with business owners, the main items sold are:

- maize, beans, rice and other agricultural produce
- beef, milk (raw and boiled) and other livestock produce
- toiletries and cosmetics (e.g., soaps, toothpaste, shampoo)
- general dry foodstuffs (e.g., bread, sweets, cereal) and drinks (e.g., sodas, beers, water)
- stationery and school materials
- clothing and shoes
- airtime credit for mobile phones
- fuel (e.g., petrol)
- drugs and medicines (e.g., malaria tablets, acne cream, cough syrups).

Shops in the sample PACs are run by individuals or families (ERM 2008). The businesses interviewed, employ an average of 1–8 people (source: KIIs with business owners). Figure A9.4-17 shows an example of a small business enterprise.

Figure A9.4-17 A Small Business Enterprise in Kigorobya (KP64.5), Hoima District

A variety of local services is available in the sample PACs (see Figure A9.4-18):

- entertainment, including video halls
- construction, including metal welding, brick-laying and carpentry

- hospitality, including restaurants, bars, guesthouses and hotels
- utilities, including plumbers and electricians
- beauty, including hairdressers and barbers.

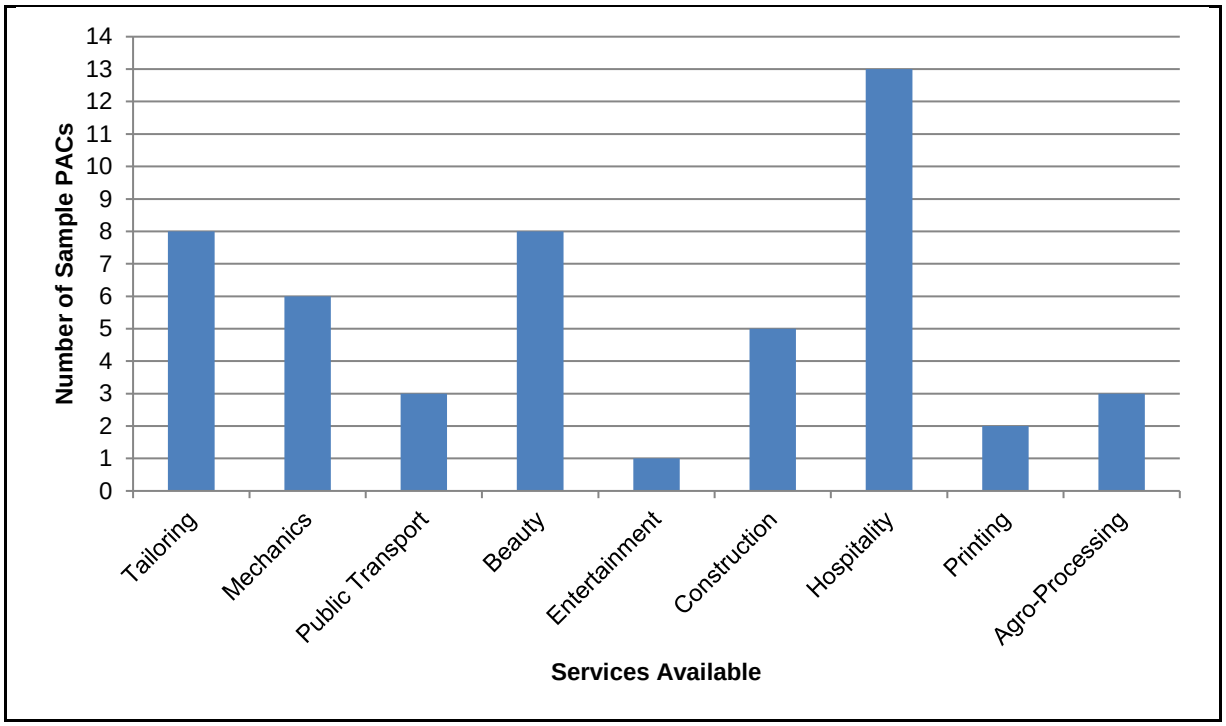

Figure A9.4-18 Services Available in the Sample Potentially Affected Communities

SOURCE: KII traders

From Figure A9.4-18, it can be observed that construction, tailoring, beauty and hospitality services are available in over half of the sample PACs where data were available. Mechanics, construction and public transport services are present to a lesser extent.

In the past decade, the motorbike (boda boda) taxi business has attracted an increasing number of local residents in Buliisa, especially young people (Artelia 2015a; CNOOC et al. 2016).

Provision of services for visitors to the area for business and tourism was said to be increasing. Interviews with three hoteliers in Hoima municipality (KP74.5) reported that their main guests are tourists travelling on an established route from Queen Elizabeth National Park to MFNP, businesspersons and charity workers. These hotels generate job opportunities, employing between 36 and 64 individuals, many of whom are local to the area.

Figure A9.4-19 shows the skills base as identified by community leaders and Figure A9.4-20 shows the skills base as identified by women during FGDs. The PAC profiles in Attachment A9.2 provide further data on skills in the sample PACs.

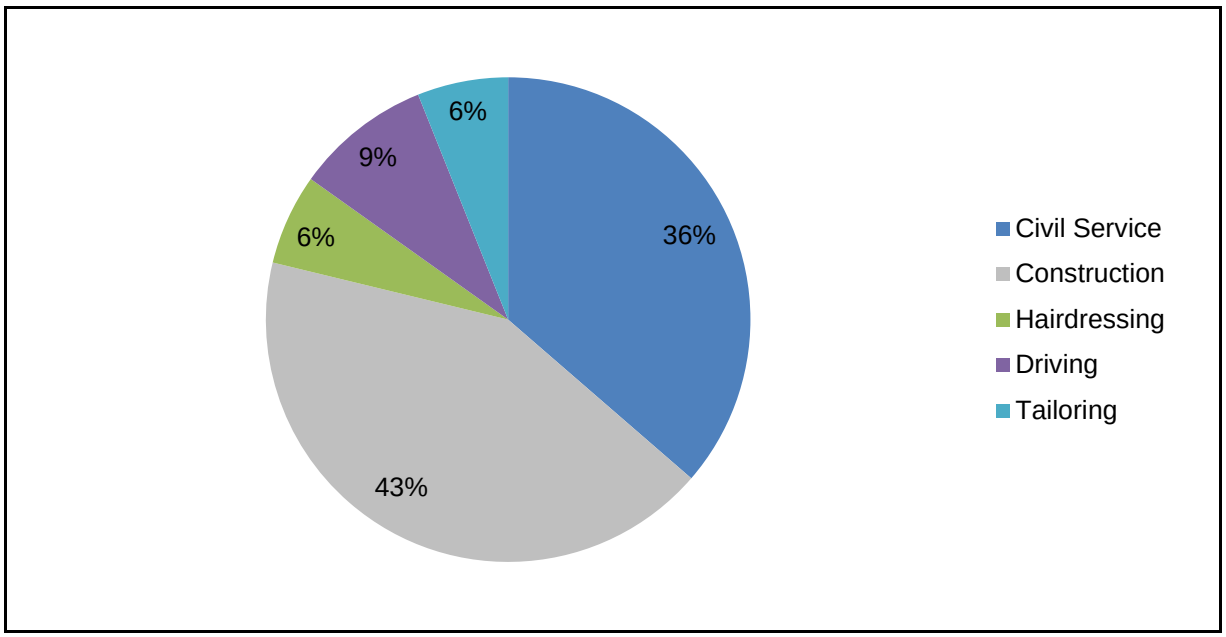

Figure A9.4-19 Skills at Potentially Affected Community Level Cited by Community Leaders

SOURCE: FGDs with community leaders

NOTE: Civil service skills include engineering, teaching, health and social work, administration and accounting. Construction skills include brick-laying, carpentry and welding.

Figure A9.4-19 shows that construction is the most prevalent skill. This is inconsistent with reports of labour shortages in the construction sector at the national and district level. Figure A9.4-20 shows that weaving is the most prevalent skill.

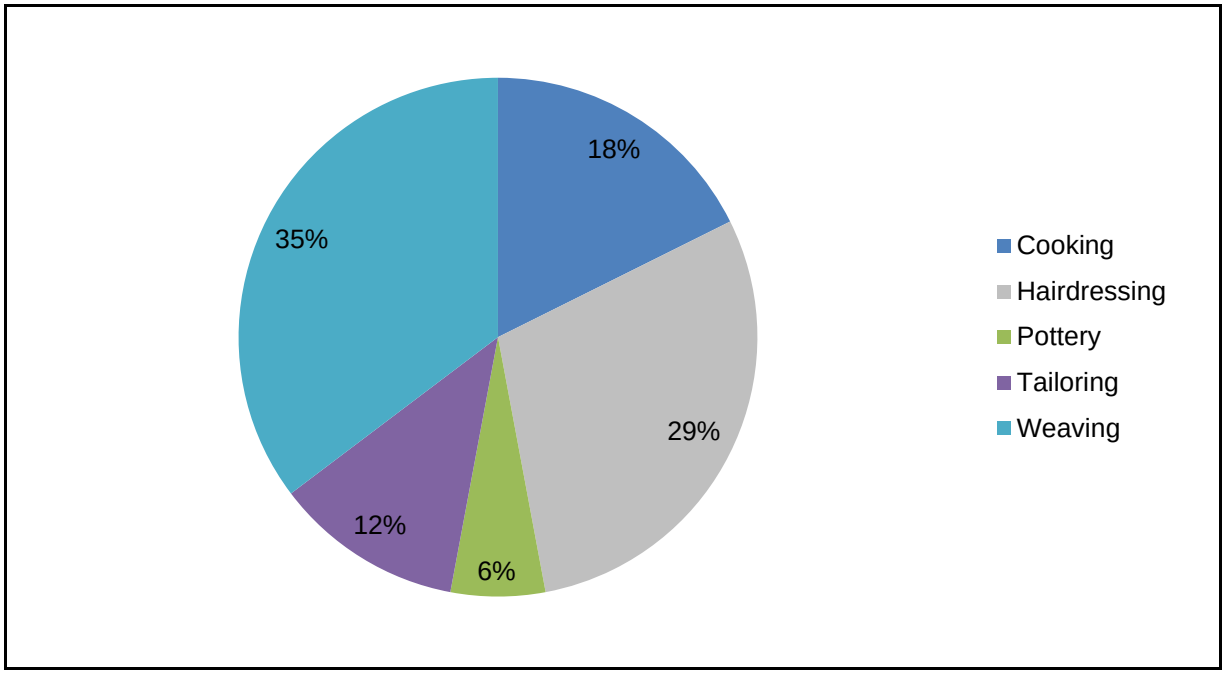

Figure A9.4-20 Skills at Potentially Affected Community Level Cited by Women

SOURCE: FGDs with women

Table A9.4-11 shows the income earnings of six local small enterprises in the sample PACs. However, these data need to be read with caution, as they are based on a limited number of KIIs.

Table A9.4-11 Income Earnings of Micro-Enterprises in a High and Low Month

District	Subcounty	Settlement	KP	Business Type	Income (High Month) (UGX/USD)	Income (Low Month) (UGX/USD)
Buliisa	Ngwedo	Kisomere	0	Retail (livestock produce)	3,400,000/903.524	1,500,000/ 398.610
Hoima	Kigorobya	Kigorobya Town Council	64.5	Retail (agricultural produce)	850,000/225.87	300,000/79.72

SOURCE: KII with business owners

Attachment A9.2 details the type and number of small local enterprises and services in all sample PACs.

Programmes such as the Uganda Women Entrepreneurship Programme (UWEP) and the Youth Livelihood Programme (YLP) aim to facilitate the start-up of businesses for women and youth by providing them with zero- to low-interest government loans (KIIs with CDOs). The level of interest paid on the loans depends on the speed of repayment and may be zero if the loan is repaid within the first year or 5% interest if it is repaid within the second year.

Institutions such as Enterprise Uganda have been established to promote the growth of small enterprises by offering:

- training workshops
- assistance with preparation of business plans
- skills development (Fortune of Africa 2013, Internet site).

Business owners in the sample PACs did not refer to the UWEP, YLP and Enterprise Uganda, suggesting that such programmes may not have reached the sample PACs.

KIIs and FGDs with sample PAC members whose livelihoods are based on trade in goods and services revealed the following challenges:

- poor road network rendering transport of goods difficult
- lack of sufficient access to credit to buy bulk supplies and start up enterprises
- customers buying on credit and not paying when due
- fluctuating market prices for agricultural produce
- lack of affordability of electricity and piped water.

Focus groups with women and community leaders found that sex work takes place in several sample PACs including Hoima municipality (KP74.5) and the number of sex workers is increasing.

Sex workers, who are predominantly aged between 19 and 45 years, reported that:

- they mostly come from outside the area. In seven out of ten sample PACs, sex workers travel from other districts in Uganda to Buliisa and Hoima.
- they work alone, mostly in bars and rent rooms
- they have no alternative means of earning income
- their main customers include fisherfolk, boda boda drivers, businessmen and construction workers
- earnings per day are UGX 10,000 and 30,000 (USD 2.66 and 7.97).

Vocational risks include communicable diseases (e.g., HIV and AIDS) and gender-based violence (GBV) from customers. As such, in some of Buliisa district's lakeshore communities, HIV infection rates are much higher than the national average (Artelia 2015a).

Human Rights

The following human rights laws apply to local economy (nonland-based livelihoods):

- Universal Declaration of Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples' Rights, article 21: Right to an adequate standard of living. Uganda has ratified all these declarations.
- Universal Declaration of Human Rights, articles 1, 2 and 23(2); International Covenant on Civil and Political Rights, articles 2 and 3; International Covenant on Economic, Social and Cultural Rights, articles 2 and 3; ILO Convention 111 on Discrimination (Employment and Occupation); Convention on the Elimination of All Forms of Discrimination Against Women; UN Women's Empowerment Principles (2010); African Charter on Human and Peoples' Rights, articles 2, 3,

15 and 19; Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa: Women's rights. Uganda has ratified all these declarations.

Trends and Sensitivity to Change

Trends with regards to the local economy (nonland-based livelihoods) are as follows:

- Livelihoods based on small-scale agro-processing may benefit from the national calls for more foreign investment in this area (Export Gov 2017a, Internet site). Foreign investment, if attracted, may enable people to participate in more sophisticated post-harvest activities (i.e., packaging), thereby increasing the value they capture from the overall product.
- Value-adding activities to fish and agricultural products are widely promoted in the DDPs. In the next five years, support to the private sector includes the provision of technical and advisory services in Buliisa (DDP 2015). Agro-processing will be expanded in Hoima with the procurement of 10 new fruit-processing machines (DDP 2015).
- Infrastructure development is a priority at the national and district level (DDPs 2015 and State House of Uganda 2018, Internet site). Investment in Uganda's road network could lead to lower transportation costs, thereby improving market access for livelihoods based on the trade of retail goods and agricultural products.
- Women and youth engagement in business may intensify as the UWEP and YLP continue to be administered at district and local levels. With support, women and young people may be more empowered to start businesses.
- District governments view tourism as an important growth opportunity and have designated potential sites for future development (DDPs 2015). The development of tourism sites in the districts traversed by the AOI may contribute to the growth of tourism at the district level, increasing the number of job opportunities and income generated. However, funding shortages are a challenge often reported by district governments.
- Sex work in urban areas has increased with women travelling from other districts in Uganda to urban hubs such as Buliisa municipality (KP8) and Hoima municipality (KP74.5). Ongoing urbanisation may sustain increasing demand for sex work in these settlements.

Ecosystem Services Provided

Local economy (nonland-based livelihoods) does not provide ecosystem services. It does, however, rely on the ecosystem services described in Section A9.4.6 (land-based livelihoods).

Sensitivity Ranking

Table A9.4-12 presents the sensitive VECs with regards to the local economy (nonland-based livelihoods) identified during the social baseline study.

Table A9.4-12 Local Economy (Nonland-Based Livelihoods) VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Small business owners	Potentially positive	Potential increase in number of businesses and business activity
Employees in informal businesses	Potentially positive	Potential increase in number of businesses and business activity
Sex workers	High (4)	Vulnerable to physical abuse and communicable diseases. Sex workers are increasingly active in the districts traversed by the AOI.

A9.4.5.2 Key Considerations

Key considerations are:

- for small local companies to benefit from major projects, they need to meet standards which are often absent. This may lead to business and trade opportunities being usurped by outsiders.
- women and young people seem to have fewer paid work opportunities and so the lack of start-up capital for the small business entrepreneur is more keenly felt by women and young people
- good road connections between rural communities and urban centres are crucial for business owners to source supplies and market their goods.

A9.4.6 Land-Based Livelihoods

Land-based livelihoods include:

- crop farming
- livestock rearing
- mining
- natural resources use.

A9.4.6.1 Baseline Condition of Crop Farming

National Level

Uganda is an agriculture-based economy. About 72% of the working population is engaged in agricultural activities (World Bank 2017a, Internet site). Census data indicates that, of the population engaged in subsistence agricultural activities, there is a higher proportion of females (49%) compared to males (37%) (UBOS 2012a: 30).

Households engaged in agriculture tend to undertake mixed farming activities to prevent shocks, such as drought or pest infestations, affecting household income. According to UBOS (2016a), 75% of agricultural households are engaged in crop growing, 58% in livestock farming and 69% are involved in both crop farming and livestock rearing.

The commercial agricultural sector remains small; however, NDPII sets out the intention to transform the sector from subsistence to commercial production (GOU 2013a).

Major Crops

The main cash crops grown are coffee, cotton, tea, tobacco and sugar cane.

Maize, beans, plantain, cassava and sweet potato are grown by most of the agricultural households. Of these crops, maize has the highest uptake with 1.5 million households growing the crop (UBOS 2010b).

Commercial tree planting is increasingly important partially due to increasing construction industry, charcoal and firewood demand. Commercial forestry plantations make up approximately 50,000 ha.

Labour

Agricultural production is predominantly at household level with household members, including children, assisting after school and during weekends. To transform Uganda from a subsistence agricultural economy to a commercial agricultural economy, a major increase in training and mechanisation will be required.

Farming Inputs

Agriculture is characterised by traditional farming methods. Inputs such as improved seed or seedling varieties, fertilisers, pest control measures, irrigation, machinery and equipment are not accessible to most farmers.

According to the World Bank (2016c, Internet site), only one in four farmers used fertiliser, one in ten used pesticides and fewer than 12% of farmers received extension services.

Irrigation

Crops are mainly rain fed. According to the Uganda Census of Agriculture (UCA) 2008–2009, fewer than 1% of agricultural households used any form of irrigation. There are two rainy seasons (March–May and October–November) in the central and southwestern regions of Uganda, and rain harvesting is essential (UBOS 2010c). The Uganda National Meteorological Authority stated that Uganda is currently experiencing the worst drought in the country's history (The Ugandan 2018, Internet site).

Marketing

Commercialisation of agricultural produce is limited primarily by remote farms lacking access to local and regional markets (UBOS 2011b). Figure A9.4-21 shows a typical local market.

Figure A9.4-21 Buliisa Monthly Market, Buliisa District

Agro Processing

The MAAIF Agricultural Sector Strategic Plan (2016) recognises the importance of agro processing and adding value to agricultural produce, and has highlighted several processing options for Uganda's strategic commodities (MAAIF 2016), including:

- coffee roasting and grinding plants and instant coffee processing
- tea processing
- grain processing
- fish and beef canning
- fruit juice extraction
- natural fibre processing
- butter, cheese, yoghurt, milk curds and UHT milk production
- hides and skin processing
- honey processing, including use of beeswax
- cooking oil pressing from nuts and maize
- production of animal feeds and fertilisers.

Farmer Groups

Farmer groups are the main organisations through which the government supports household agricultural production and marketing services.

However, Uganda Cooperative Alliance 2008–2009 found that only 16% of the 3.95 million respondents were members of farmer groups, of which 51% were male and 49% were female (UBOS 2011b). The census also found that only a relatively small percentage (35%) of the farmer groups was active.

Role of Women in Agriculture

Figure A9.4-22 sets out the percentage of economically active people involved in agricultural activities. The figure shows that higher numbers of women are involved in crop production (54%), growing vegetables (58%), and fruit cultivation (56%) activities than men.

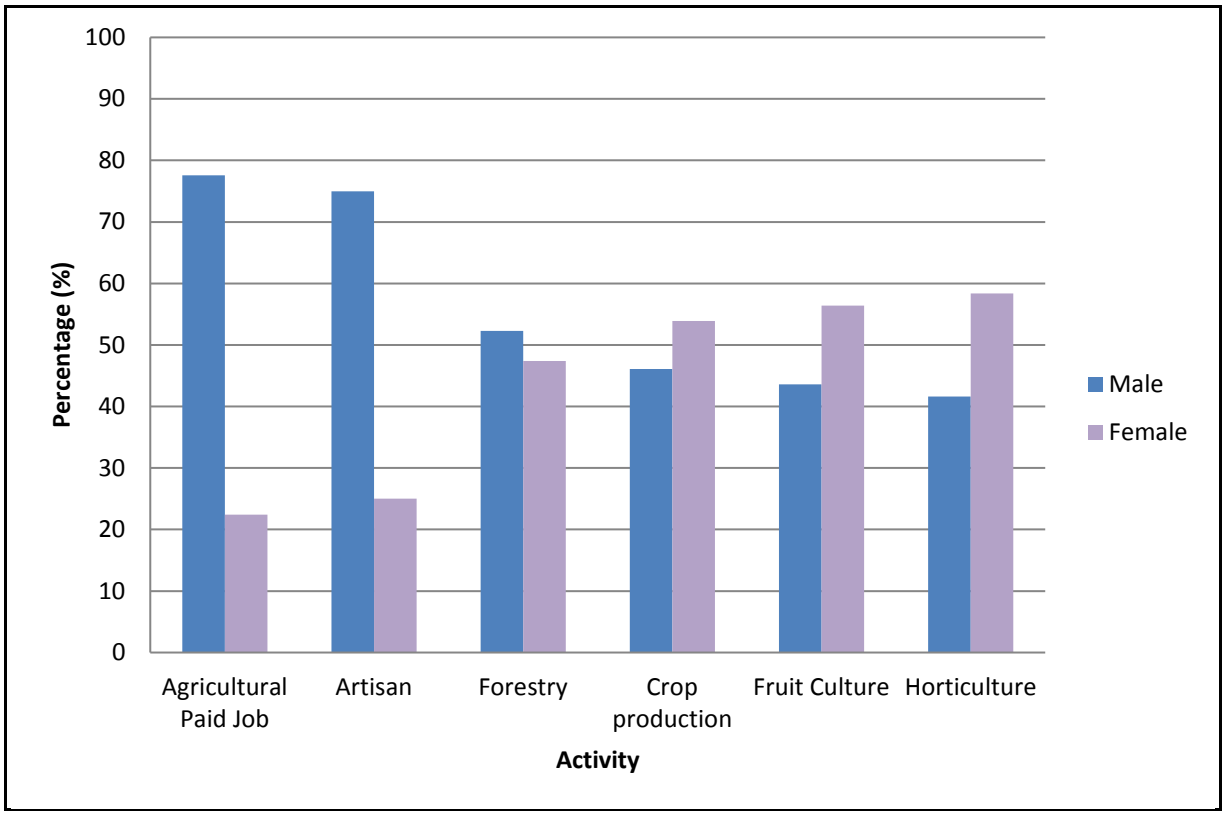

Figure A9.4-22 Economically Active Population (14–64 Years) Involved in Different Agricultural Activities, Disaggregated by Gender

SOURCE: UBOS (2012a)

A World Bank study (2015b) found that male-managed plots were 60% larger than those managed by females and were more likely to be planted with cash crops. The UCA of 2008–2009 found that female farm labourers earned lower wages compared to their male counterparts for the same type of employment.

Major Constraints

Although crop farming is a core sector of Uganda's agricultural economy and the largest employer, major constraints are hindering this sector (New Agriculturalist 2012, Internet site; Export Gov 2017a). These include:

- crop farming operating at a low level of intensity which results in low productivity
- crop failure as a consequence of environmental factors such as unpredictable weather patterns, plant disease or pests
- limited access to finance
- high costs of farm inputs such as hybrid seeds

- limited access to extension activities
- limited farm labour
- inadequate transport networks, especially in rural areas, and limited means of transportation of agricultural goods to market
- insufficient market information
- weak value chain linkages
- a complex land tenure system.

District and PAC Level

Both Buliisa and Hoima are rural districts, with households dependent on land- (and water) based livelihoods for income, nutrition and subsistence.

Buliisa DDP states that 45% of the population are dependent on subsistence agro pastoralist activities (crop farming and livestock rearing). Hoima DDP estimates that 85% of the population are subsistence farmers focusing more on crop farming.

In Buliisa, crop farming is mainly undertaken in Ngwedo subcounty on the Albertine plain and Kihunghya and Biiso subcounties above the rift escarpment where the soils and climatic conditions are more conducive to productive farming. This is the case in Hoima where most productive crop farming is undertaken on the escarpment above the rift, noting that the subcounties of Buseruka and Kigorobya extend from above the escarpment to the lakeshore.

Although most farming is subsistence, some large-scale commercial farming enterprises were identified in Hoima:

- tobacco (Alliance One Tobacco, Uganda Tobacco Services Ltd, Premier Leaf Tobacco, Continental Tobacco Uganda Ltd) in Hoima district
- tea (Bugambe Tea Estate), Bugambe subcounty, Hoima district
- sugar (Hoima Sugar Limited).

The number of larger commercial farms is increasing, particularly in Hoima district.

Sugar cultivation in Hoima is based on an out-grower model providing growers access to credit and inputs such as technical advice, hybrid seeds, pesticide and machinery.

Commercial forestry is not common in the areas the AOI traverses, despite government encouragement to promote tree planting. However, household smallholder plantations exist to a minor degree.

Agricultural activities are based on low-input, low-output family farming activities with trading of surplus crops.

Farming is undertaken on plots that are locally called ‘gardens’. The average size of agricultural plots is 1 to 5 acres in Buliisa district and 6 acres in Hoima district (Artelia 2015: 130) (Hoima DDP).

Major Crops

Climatic conditions (a bi-modal rainfall pattern that is becoming increasingly unpredictable because of climate change) and lateritic sandy soils restrict the

diversity of crops grown along the shore of Lake Albert in Buliisa and Hoima districts.

Crop farming in Buliisa district focuses on cassava (bitter and sweet) as the primary crop, followed by cotton and maize (Atacama et al. 2017; Artelia 2015a). Other crops include tobacco, sesame, sweet potatoes, potatoes, beans, groundnuts, matooke, cow-peas, sorghum and pumpkin (Buliisa DDP).

Cotton used to be an important cash crop in Buliisa and continues to be grown in several villages in the district. However, fluctuating cotton prices have caused farmers to change to food crop production (Artelia 2015a).

In Hoima district, the main crops grown are tobacco, rice, cotton, coffee, maize, beans, sugar, bananas and tea.

Crops are grown for both income generation and domestic consumption in both districts. Major cash crops are sugar, tea and cotton (Hoima DDP). However, both DDPs specify that all food crops including traditional subsistence crops are increasingly being sold and provide a major contribution to the household income.

Figure A9.4-23 presents the seasonal calendar for the farming of crops.

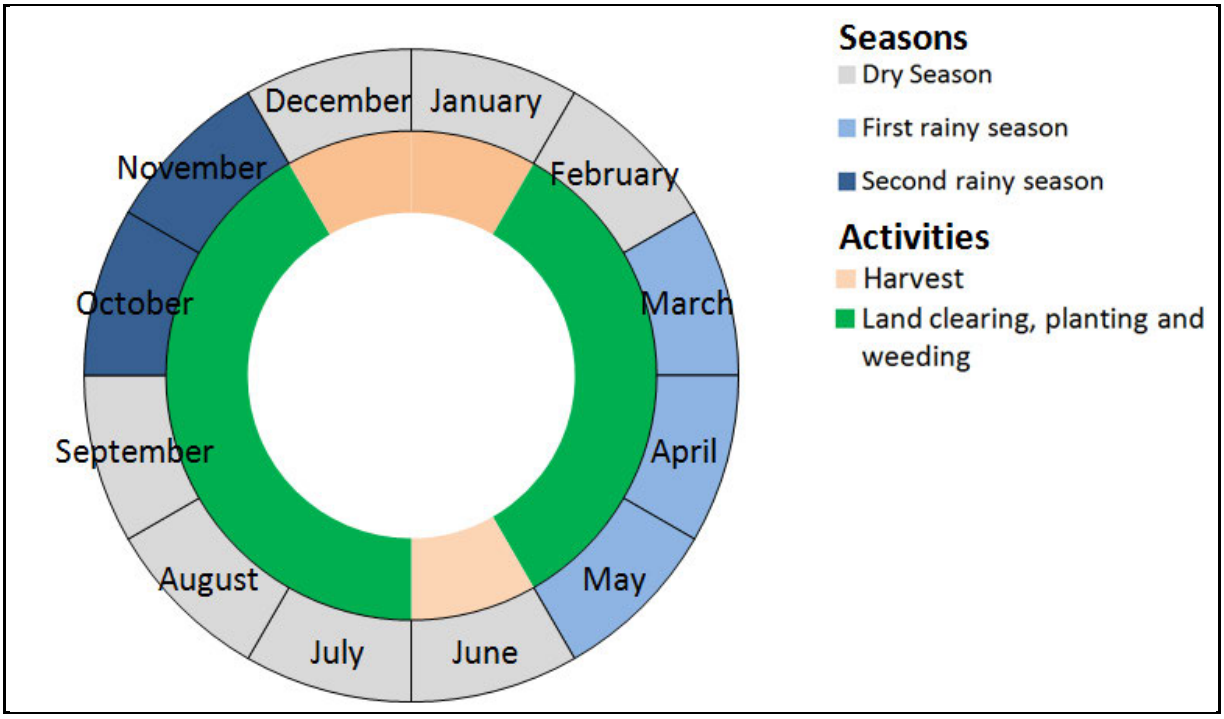

Figure A9.4-23 Seasonal Calendar for Main Crops

SOURCE: SGIs with crop farmers, KIIs with district production officers

Mixed crop farming is undertaken to provide resilience from crop diseases, pest infestations, theft and poor harvests. The primary crops grown at sample PACs at KP0–8 are mainly cassava and maize and, to a lesser extent cotton, sweet potato, Irish potato, beans, groundnuts, plantain, cow peas, sorghum, pumpkin, sim sim and aloe (Atacama et al. 2017). At Biiso village (KP44.5), Kihungya village (KP49.5), Kigorobya village (KP64.5), Rwamatonga village (Bugambe subcounty) (KP47), Rwamatonga village (Buseruka subcounty (KP86), Wayao village (KP75),

Kayere village (KP94.5), Katoke village (KP95) and Nyamasoga village (KP95), KII and HH surveys found that the main crops grown are beans, cassava, maize and sweet potato and, to a lesser extent, groundnut, Irish potato, matoke (plantain), sim sim, onions and tomatoes. Sugar cane was found to be grown only at UG8-3 and tobacco at Rwamatonga village (Buseruka subcounty) (KP86), Buseruka village (KP86) Wayayao village (KP75) and Kayere village (KP94.5). Few crops are grown at Serule B village (KP30.5), Piida A village (KP45.5), Booma village (KP44.5) and Waki Kawabanda village (KP47), as they are predominantly fishing communities and the climate, lack of water and poor soil fertility, according to key informants, are not conducive to crop farming. Laurent's (2013) studies found that in some communities in Buseruka subcounty (KP86–96) those fisherfolk that could afford to do so have purchased pieces of land to undertake crop farming alongside fishing on a part-time basis.

Sample PACs repetitively stressed the value of trees to households. Households generally grow a small number of trees as a fruit crop, firewood, lumber, seeds and traditional medicine as well as for shade of crops. Tree products are sourced from communal lands or land allocated to households. Trees are usually interspersed with crops or near dwellings. The production of fruit is seasonal and used for household consumption as well as surplus being sold for income. Wood products are used for home consumption as well as surplus sold. Few trees grow along the shores of Lake Albert KP0–47 except acacia. The fruit tree holdings of PACs at KP0–8 are mainly mango and orange (Atacama et al. 2017). On top of the escarpment PACs of Biiso village (KP44.5), Kihungya (KP49.5), Kigorobya (KP64.5), Rwamatonga (Bugambe subcounty) (KP47), Rwamatonga (Buseruka subcounty (KP86), Wayao (KP75), Kayere (KP94.5), Katoke (KP95) and Nyamasoga (KP95), observational analysis found that more trees grow on land holdings with avocado, mango, pawpaw, guava, citrus and, to a lesser extent, eucalyptus and pine trees.

Farming Inputs

District agricultural officers have informed that agricultural activities remain dependent on rudimentary hand tools. Nevertheless, the use of tractors particularly associated with cash crops such as tobacco is growing (Hoima district). Tractor rental is available in Buliisa from independent companies, but the high prices associated discourages crop farmers from using the facility (Artelia 2015a). A KII with a district agricultural officer in Hoima revealed that to avoid costs associated with tractor usage, farmers practiced zero tillage after harvesting. Although reliant on pesticides, the method is beneficial to the soil structure and avoids the necessity to plough the land.

Application of commercial pesticides was found in Hoima and Buliisa districts. With increasing numbers of pests such as army worm, locusts, aphids, banana weevils, maize stock borer and termites, and crop diseases such as banana bacterial wilt and cassava mosaic, pesticides have reportedly become a necessity. Yet costs associated with pesticides prevent most farmers in the PACs from using them.

SGIs with farmers at PAC level confirmed the necessity of applying pesticides due to the increasing amounts of pests and plant disease. Alternative techniques such

as pruning, digging up or burning infected plants were undertaken to avoid the costs associated with application of pesticides.

Application of chemical fertilisers is not common among PACs owing to their cost. Instead livestock manure, urea and other organic matter are applied with agricultural practices such as crop rotation and planting of multipurpose trees to promote nitrogen in soils to prevent depletion of soil nutrients.

Soil fertility of agricultural plots was reported to be declining owing to intensive farming practices. This was particularly reiterated in Kihunghya (KP49.5), Kigorobya (KP64.5) and Katooke (KP95). However, chemical fertilisers were not commonly used because of the cost; instead, the practice of crop rotation, leaving plots fallow and mulching is reported. Some agro pastoralists applied organic matter, but this was a minority. KII found that Hoima District Farmers Association (HODIFA) had undertaken extension activities relating to chemical fertilisers and provided samples to members. However, it was reported that farmers experienced the results of application to be good but were not convinced enough to use it, thus indicating that farmers continue to depend on traditional practices.

In Buliisa and Hoima districts, seeds and seedlings were distributed by the National Agricultural Advisory Services (NAADS) in the past. This practice has now become sporadic and targets poorer farming households.

A portion of seeds and tubers are put aside after harvests for the following growing season. Improved varieties of plants and trees are not commonly planted, and the farmers interviewed rarely revealed a desire for improved varieties. This possibly shows the limited extension activities in sample PACs (Artelia 2015a).

Storage of agricultural goods is critical for sample PACs, and it was reported that, produce often spoils or needs to be sold in a hurry because of a lack of storage facilities in the household. The latter exposes households to receiving low market prices for their produce. Studies did not find that people had dedicated storage facilities in sample PACs, and Atacama et al. (2017) found that households at KP0–8 store their produce inside their dwelling in sacks or woven baskets, or outside uncovered in piles.

Labour

Farming in PACs is predominantly household based, with household members, including children, undertaking agricultural tasks such as tilling, planting, weeding and harvesting. Households who have small plots or no land holdings provide labour (paid or in-kind payments) to other farmers. Where labour is not affordable, traditional collective labour is used whereby households work on each other's plots on a rotational basis, or labour is paid in kind and community members are hired as labourers and served a meal in payment. Hiring labour is a necessity, although scarcity of casual labour was often cited as an increasing challenge.

Migrant labour moves to the districts during the rainy season to assist and prepare the land. In Buliisa, it was reported that people travel from Nebbi and the DRC to labour on farms. Where labour was not affordable, the Artelia (2015a: 134) studies found several ways in which agricultural households assist each other:

- traditional collective labour (dici in Alur language): Different families collaborate and work together on a rotational basis. One family will work in another's field for a certain time and the service will be returned to them when needed by the other families
- labour paid in-kind (koya in Alur language): Community members are hired as labourers and served a meal made of chicken or goat meat (Artelia 2015a: 134).

Farmer Groups

The DDPs recognise the importance of farmer groups. The NAADS was prevalent in all districts traversed by the AOI.

Many PAC farmers interviewed are supported by either the NAADS through various programmes such as operation wealth creation, or support is provided via a registered farmer group. Many registered farmer groups were set up by NGOs, e.g., Ugandan Social Action Fund (USAF) and NAADS or they were self-made by community members in response to potential initiatives. Government programmes require that before disseminating in-kind grants (livestock, seeds, fertilisers) or extension activities that local communities be organised into formally registered groups via the district community development officer (Artelia 2015a). Types of assistance provided cited by PACs were seeds, seedlings, extension activities and livestock.

Farmers associations identified include:

- Hoima District Farmers Association (HODIFA)
- agricultural technology training (crops, fruit, livestock, vegetables, honey, timber, fruit, fuelwood and environment) provided by Community Integrated Development Initiatives and World Vision, supported by NAADS/Operation Wealth Creation and district government extension (Atacama et al. 2017)
- Buliisa Initiative for Rural Development Organisation (BIRUDO), Mungu Miyo and Malaika (for honey)
- Latoro Business Farmer's Cooperative
- Kityanga Women's Group
- Butiaba Fishers and Farmers Development Association (BUFITA).

(Atacama et al. 2017)

The level and commitment of support provided by these organisations varies. However, PAC members interviewed valued being part of an organisation. Nearly all farmers belonged to SACCOs run in their community to access credit facilities.

Irrigation

Crop production across the districts traversed by the AOI is predominantly rain fed.

KIIs with agricultural officers and crop specialists stressed the need for appropriate small-scale technologies such as foot treadle pumps for household level irrigation to assist agricultural production. The Hoima DDP asserts that delayed or early rains have more impact on crop yields than the total amount of rain over the course of the year. With increasingly unpredictable wet seasons and erratic rainfall, the need for irrigation is becoming increasingly important.

In two sample PACs, Avogera village (KP0) and Kayere village (KP94.5), crops were watered from available water in streams, wells, boreholes using jerry cans or plastic bottles punctured with holes to drip irrigate newly planted seedlings or seeds (Artelia 2015b). However, it was reported that water sources were prone to drying up in the dry seasons, in such cases crop farmers at Avogera village (KP0) dug holes in their plots and filled them with water to act as a water dam. These irrigation methods were said to be time consuming and required substantial human labour to carry the water. This was particularly the case at Kayere village (KP94.5) where crops were said to be a considerable distance from the water source.

Commercial operations such as Bugambe Tea Estate and out-growers of sugar and tobacco tend not to invest in irrigation infrastructure.

Agricultural Processing

Across the districts, value chain linkages between production, processing and marketing are weak, which results in most agricultural produce being sold unprocessed at the farm gate. Nevertheless, maize milling, and fruit processing facilities were found in larger towns such as Hoima and Buliisa and in Kigorobya village.

Produce is supplied to processing entities by intermediaries from farm gate sales. In addition, Artelia (2015a) found that mechanic grinding mills for processing cassava, as fixed structures were relatively common in PACs in Buliisa. Larger mobile grinding machines are commonly transported to the districts from main towns such as Hoima and Masindi; they are run by young men who are charged by the owner of the machine to run their business.

With regards to cotton, intermediaries purchase cotton at the farm gate. However, as prices are low, some farmers in Buliisa rent trucks to take the harvested cotton directly to ginneries in Hoima and Masindi (Artelia 2015a).

Promotion of technologies for primary agro-processing and value additions priorities are cited as a priority in both DDPs.

Role of Women in Agriculture

Women and men are involved in all aspects of agricultural activities, such as tilling, sowing and harvesting. The Hoima DDP (2015) recognises that in rural agricultural households, women's workloads exceed those of men by several hours a day. It states that women are involved in crop production and are often responsible for post-harvest processing and storage, marketing of produce, processing staples such as maize and rice for consumption as well as being responsible for household tasks. However, women have limited access to land and productive assets, and there is a discrepancy between women's contribution to crop production and their control over crop marketing and decisions on the use of household funds.

At PAC level, there are minimal divisions of labour in crop farming, except for the high-value cash crops such as tobacco and sugar for which men take charge.

Key challenges for women engaging in crop farming are similar to those stated at district level. However, women are vulnerable, as they predominantly grow crops on land that they do not own, with only a small minority having claims to land.

Marketing

With the absence of agricultural marketing cooperatives, individual farmers undertake their own marketing. Towns in the two districts hold a weekly market and district level markets are held in Buliisa and Hoima town.

Farm gate sales of crops to intermediaries for cash crops such as sim sim, cotton and maize are the most common way to market produce. Tobacco is purchased directly by the tobacco companies such as Alliance in Hoima, and sugarcane is purchased by sugar processing companies such as Hoima Sugar Limited.

Nearly all KII in the sample PACs showed that they sell surplus crops, such as avocados, onions and Irish potatoes, to neighbours or in local markets near to their homes. Monthly markets are held in Hoima town (KP74.5) and Ngwedo (KP0). During field studies, other weekly markets were found at Buliisa Town Council (KP4), Biiso (KP44.5), Kigorobya (KP64.5) and Rwamatonga (Buseruka subcounty (KP86). Other important markets reported were Panyimur market, which is reached by ferry across the River Nile, and Wanseko market, which acts as a trading centre for goods being sold on to markets in Nebbi district, Masindi, the northern region of Uganda and beyond the borders with DRC and South Sudan (Artelia 2015a).

Table A9.4-13 sets out prices for agricultural produce as obtained through KII at sample PAC and district level. Prices vary according to supply and demand, and season. Prices were similar across all sample PACs.

Table A9.4-13 Prices of Agricultural Produce by District

Produce	Price or Price Ranges Quoted, UGX/USD	Unit
Beans	30,000/7.97	Per basins
Cassava	2,222–50,000/0.59–13.29	Per bag
Cotton	1,500/0.40	Per kg
Eucalyptus trees	150,000/39.9 Large	Per tree, depending on size
Groundnuts	2,222/0.59	Per kg (depending on being hulled or not)
Irish potato	12,000/3.2	Per sack
Maize	750–1,000/0.20-–.27	Per kg
Rice	1,000–2,500/0.27–0.66	Per kg
Sim sim	2,500/0.66	Per cup
Sorghum	1,000/0.27	Per kg
Sugar cane	120,000/31.9	Per 20 L jerry can (juice)
Sweet potato	80,000/21.3	Per sack
Tobacco	6,300–7,200/1.68–1.91	Per kg (depending on grade)
Tomatoes	30,000/7.98	Per basin
Matoke	10,000/2.66	Per bunch

SOURCE: KIIs with agricultural specialists and district agricultural officers, SGIs with crop farmers

Table A9.4-14 provides examples of gross earnings for different crops. While these prices were quoted during the field studies, the price will fluctuate according to demand, season and availability of the produce.

Table A9.4-14 Annual Earnings from Crops across Sample Potentially Affected Communities

Produce	Earnings for 1 Year Per Acre (UGX/USD)
Cassava	1,500,000–3,000,000/398.73–797.479
Groundnuts	960,000/255.19
Irish potato	144,000/38.28
Maize	1,200,000/319.00
Sorghum	800,000/212.634
Sugar cane	4,800,000/1,275.81
Matoke	6,400,000/1,701.08
Tomatoes	4,000,000/1,063.07
Tobacco	10,000,000/2,657.7
Beans	1,500,000/398.65

SOURCE: SGDs with crop farmers

Marketing of produce is cited by sample PACs as being a major challenge to agricultural livelihoods. The main challenges specified by KIIs at district level are:

- inadequate road infrastructure
- high transportation costs, which negatively affects produce prices
- lack of market price information from surrounding districts, preventing farmers from negotiating prices
- market gluts.

Human Rights

The following human rights apply to crop farming:

- the right to an adequate standard of living. Universal Declaration on Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples' Rights, article 21.
- women's rights and children's rights as they are particularly vulnerable to losing land and family crops. Universal Declaration on Human Rights, articles 1, 2 and 23(2); International Covenant on Civil and Political Rights, articles 2 and 3; International Covenant on Economic Social and Cultural Rights, articles 2 and 3; ILO Convention 111 on Discrimination (Employment and Occupation); Convention on the Elimination of All Forms of Discrimination Against Women; UN Women's Empowerment Principles (2010); African Charter on Human and Peoples' Rights, articles 2, 3, 15 and 18; Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa.

Trend in Condition and Sensitivity to Change

Crop farming trends are as follows:

- The GOU has a five-year Development Strategy and Investment Plan to steer public actions and investments in the agriculture sector. The four key programmes of the plan are enhancing production and productivity; improving access to markets and value addition; creating an enabling environment; and institutional strengthening of the sector.
- Crop farmers, particularly tobacco and sugar farmers, are becoming more commercially orientated and are increasingly renting land to enlarge their plot size. These farmers tend to receive assistance from commodity buyers and processors.
- Crop farming is rain fed, low input and low output, therefore harvests are vulnerable to the effects of pests, diseases and climate variability. It is common for a crop to be spoilt, thereby threatening household food security and ability to pay for school fees and health services.
- Available labour for farming activities is in decline because young people are migrating to urban areas.

Ecosystem Services Provided

The land-based livelihoods (crop farming) described herein provide the following ecosystem services.

Provisioning services:

- food for basic survival of the population
- income from selling surplus crops to pay for education, clothes and health-related items as well as other basic needs
- jobs for farm labourers
- products for agro-processing activities.

Crop farming is undertaken throughout the AOI PACs, sometimes being their only source of food.

In the sample PACs, most farming is subsistence and the agricultural produce is consumed within the family with a small portion being sold at the local market.

Sensitivity Ranking

Table A9.4-15 presents the sensitive VECs with regards to crop farming identified during the social baseline study.

Table A9.4-15 Crop Farming VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Agro pastoralists	Moderate (3)	Agro pastoralists have diversified income streams across crop faming and livestock rearing, therefore they are more resilient to external shocks such as pest infestations, animal diseases and climate change.
Commercial farmers (large scale) (tea, tobacco and crops)	Moderate (3)	Impacts to commercial farming could indirectly affect the livelihoods of the farm workers; however, commercial farmers would be more resilient to adverse conditions than subsistence farmers because of greater access to farming inputs, credit and land.
Intermediaries buying goods at farm gates	Moderate (3)	Road access is critical for movement of goods to markets in a timely manner before they spoil. Roads are often in bad condition.
Crop buyers and agro processing	Moderate (3)	Crop buyers, including intermediaries and agro processors, are dependent on the supply of crops, vegetables and fruits to process and sell on. Without the supply of produce, processing will stop. Buyers are dependent on one income stream, but they are likely to have access to credit facilities based on their business.
Crop farming households engaged in subsistence and commercial crop farming activities	Very high (5)	Crop farming activities are mostly conducted without inputs and are rain-fed. Subsistence farmers have limited access to alternative sources of income due to rural location, lack of education, skills and experience. There is low resilience to external shocks such as crop failure. This can impact on food/nutritional status as well as cash for cost of education and health care.
Landless farm labourers on subsistence farms	Very high (5)	Landless farm labourers are particularly vulnerable; without income potential impacts will be felt on household food and nutritional status as well as income for living, education and health care.
Crop farming female headed households	Very high (5)	Women have limited access to improved farming inputs, have access to smaller sized plots to grow crops and are more likely to receive lower wages as farm labourers than men due to cultural norms. They are mainly confined to subsistence farming. Impacts on their crop farming will be felt in their food and nutritional status as well as on their budget for education and health care.

A9.4.6.2 Key Considerations

Key considerations are:

- crop farming in the sample PACs is mostly undertaken on household allocated land holdings. The impacts of failed crops or loss of land can last for several

years, as seedlings and seeds are produced each season for the subsequent season

- crop farming in the sample PACs is generally rain fed, low input and low output, therefore harvests are vulnerable to pests, diseases and climatic variability. It is not uncommon for entire crops to be spoilt, thus making households vulnerable in terms of food security and the ability to pay for school fees and health services.
- farmer groups have relatively low participation but are the government's preferred means of contact
- labour shortages may affect household agricultural capability; children are required to complete farm work and miss school when labour is required. This situation may be exacerbated if household members are drawn away to temporary construction jobs.
- access to markets is a major challenge for crop farmers in rural areas. With poor road conditions and limited market information, farmers are dependent on selling goods in a timely manner locally or to middlemen buying at the farm gate. Any interruptions in the supply chain will affect their ability to market goods and receive a cash income.
- women are notably disadvantaged in crop farming with limited access to land holdings, capital to improve farming activities and constraints with household duties. With limited education and no other prospects of livelihood opportunities, they are reliant on crops farming as a main stay livelihood
- human rights to adequate food and standard of living are sustained.

A9.4.6.3 Baseline Condition of Livestock Rearing

International standards for responsible business provide that individuals should receive adequate compensation when deprived of their means of livelihood[12]. Adequate compensation requires that displaced persons are provided with compensation for loss of assets at full replacement cost and other assistance to help them improve or at least restore their standards of living or livelihoods[13]. Groups showing strong cultural ties to a lifestyle and livelihood such as pastoralists also have cultural rights that need to be protected.

National Level

Livestock rearing is an important economic activity at household level. However, it does not feature prominently in the macro economics of the country (Artelia 2015a).

Domestic consumption of livestock products (meat and milk) is low compared to the country's neighbours with an average of 11 kg of meat and 23 L of milk per capita per year for all Ugandans compared to 41 kg meat and 26 L of milk in Sudan and 15 kg of meat and 198 L of milk per person in Kenya (ICPALD 2013). Figure A9.4-24 presents a national livestock inventory for 2009.

[12] IFC Performance Standards on Social and Environmental Sustainability, Performance Standard #5 Land Acquisition and Involuntary Resettlement, paras 1, 2, Objectives, Requirement 9 (Compensation and Benefits for Displaced Persons); OECD Guidelines for Multinational Enterprises, Chapter II, General Policies, Recommendations 2, 10, 11 and 12.

[13] IFC Performance Standards on Social and Environmental Sustainability, Performance Standard #5 Land Acquisition and Involuntary Resettlement, Objectives, Requirement 9 (Compensation and Benefits for Displaced Persons).

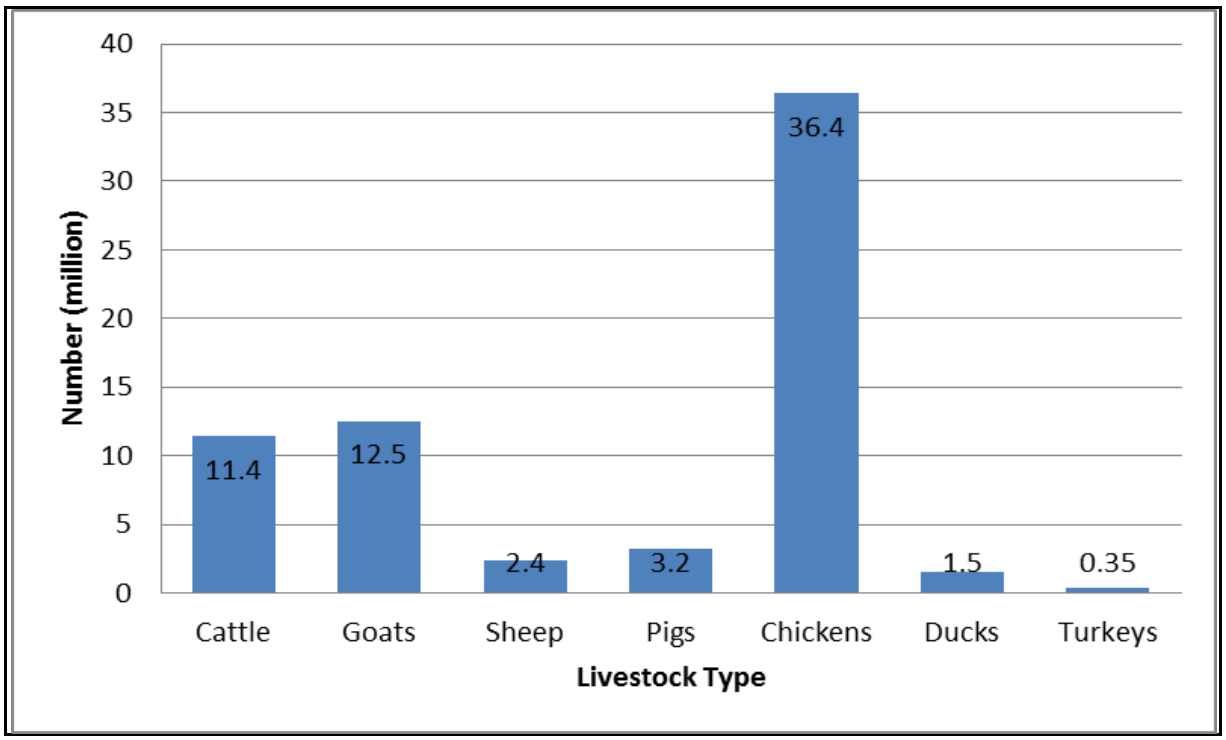

Figure A9.4-24 Livestock Numbers per Species

SOURCE: UBOS (2009a)

Livestock regulations and policies are under the responsibility of the MAAIF. Policies established to organise and manage the sector are as follows (Artelia. 2015b):

- national animal breeding policy (1997)
- dairy policies: dairy sector policy (1993), dairy industry act (1998)
- animal health policies: policy on delivery of veterinary services (2001), national veterinary drug policy (2002)
- meat policy (2003)
- national animal feeds policy (2005)
- draft rangeland management policy (2012).

Management and implementation of these policies is undertaken at district level.

Livestock Rearing Practices

Livestock are reared on a commercial basis but also at household level for both cultural and economic reasons, including:

- prestige to illustrate family wealth
- investment and a means of savings
- cultural for payments of dowries
- income to pay for school fees and health services
- source of food (eggs, milk and meat)
- source of hide
- source of manure for crops.

Livestock rearing takes place under four types of livestock production systems: agro pastoral, semi-intensive, commercial ranching and pastoral (FAO 2018).

Agro-pastoralists undertake livestock rearing alongside crop farming. A small number of animals are kept. Pasture lands, either in 'paddocked' areas (Boma) with informal hedging or fencing on privately owned land or on communal village land, are used to graze livestock.

Semi-intensive production systems are where livestock including fowl are kept in confined spaces and provided fodder, feeds and crop residues. These farming entities are mainly in the central and southwestern subregions and in peri-urban areas.

Commercial ranching production systems consist of large herds of animals, particularly cattle, which are grazed on expansive hectares of fenced private lands and provided with supplementary feed inputs. Commercial ranching accounts for 10% of the national herd and this system is mainly found in the central and southwestern regions within the cattle corridor. Production is for beef and milk. Herd sizes can be as large as 10,000 heads of cattle and in the case of goats over 600. Within the system of commercial ranching, large herds of cattle, goats and sheep are tended by a herder, sometimes a family member, or herders are sought from pastoralist tribes such as the Karamojong from northeast Uganda or the Banyarwanda from southwest Uganda or Rwanda.

The fourth system, nomadic pastoral production, which is less common and remains in northeast Uganda, is a system where livestock are moved from one place to another in search of pastures and water on communal lands. Nomadic pastoralist practices have largely disappeared in Uganda owing to factors such as:

- government policies that prioritise modern livestock development
- climate change resulting in prolonged droughts
- land tenure matters.

Livestock breeding of goats, sheep and cattle is concentrated in the northeast and along the cattle corridor (UBOS 2009a) which stretches from the temperate southwest of Uganda, across the central sub-humid rangelands and up to the northeast arid or semi-arid rangeland. This corridor used to be the traditional migratory route to pastures throughout the seasons. As livestock rearing has become a more sedentary activity, this corridor has become the densest livestock (cattle and goats) production area in Uganda. The cattle corridor is characterised by pastoral system in the northeast of the corridor, large commercial ranches concentrated in the central region and semi-intensive and commercial systems in southwest Uganda where dairy farming is predominant.

Localised nomadism is still practiced. This involves movements of livestock herds, usually cattle, between villages within district borders and occasionally between districts during the dry seasons. Localised nomadism, which enables pastoralists (agro-pastoralists and commercial ranching) to survive the increasingly unpredictable seasons, is undertaken in an organised manner with host pastures being rented. Herders, often family members, move the animals by road or by trucks to the pastures and remain with their herd for the duration of their stay in the

host pasture. Livestock movements, however, are prohibited during disease quarantines.

Breeds of livestock remain principally indigenous despite government initiatives to encourage livestock farmers to replace local breeds with high-yielding introduced breeds (Kabi et al. 2016). Cattle keepers in Uganda have bred indigenous cattle suited to their agro-ecological zones. The zebu, East African shorthorn zebu and their crossbreeds represent 93.3% of the Ugandan herd and are favoured by agro pastoralist and pastoralist production systems. Commercial ranches manage herds of a mixture of indigenous and cross breeds, but introduction of exotic and improved breeds is becoming more common. Other breeds, including exotic breeds, are Nganda, Boran, Sahiwal, Angus, Holstein Friesian and Bosmara.

The main goat breeds reared are small East African breeds. However, exotic meat goats, mainly Boer crosses, alpine and savannah, are being introduced.

Sheep breeds favoured are indigenous Ankole fat tailed and Dorset horned breed cross.

Marketing

Trading of livestock is undertaken at regional and district markets or farm gate sales with intermediaries buying live animals for onward sale to abattoirs or to private buyers.

District and PAC Level

The main livestock species in the districts traversed by the AOI are cattle, goats, pigs, donkeys, poultry, sheep and dogs. The most common livestock production system is agro pastoralism performed on a subsistence basis by the majority of households. To a lesser extent, but growing in popularity, semi-intensive production systems for chicken and pigs are put in place. Cattle rearing is recognised as being the most economically important in both Hoima and Buliisa. Larger scale commercial herds of cattle up to 600 were encountered at Kijangi (KP8) and Kayere (KP94.5).

Livestock rearing is an important livelihood activity for many households. Five percent of the population of Buliisa depend on livestock as a main source of livelihood and a proportion of crop farmers also raise livestock as agro pastoralist (Buliisa DDP 2015). In Hoima, 62.7% of households are engaged in livestock rearing (UBOS 2017a).

Figure A9.4-25 shows the distribution of livestock among the households surveyed. Livestock are acquired through purchases, grants or commonly through inheritance. They are essential to a household's finance as they are a means of saving, provide a source of income, are used to pay for school fees and are a means of food security. In addition, livestock are core to the Banyoro and Bagungu identity and culture, for example, livestock are used as payments for dowries, goats are gifted when a child is born and cattle are slaughtered for weddings and funerals.

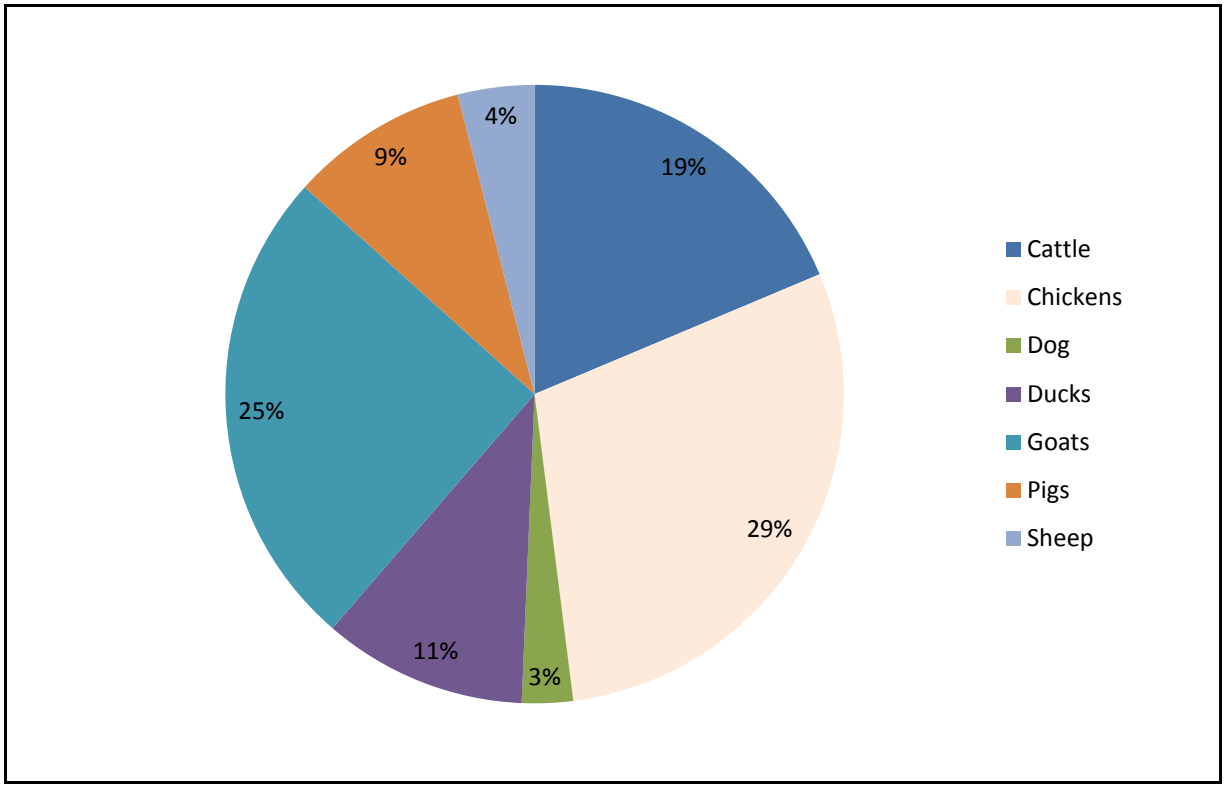

Figure A9.4-25 Livestock and Poultry Kept by Potentially Affected Community Households

SOURCE: HH survey

The figure shows that poultry is the most common type of livestock kept by households followed by goat, cattle and ducks.

Indigenous species of goats were predominant in PACs. However, KII with district production officers found that programmes are trying to introduce more exotic species such as Boer. The average size of goat herds was seven (Atacama et al. 2017). However, KII with livestock owners found that there existed in the PACs larger herds of 200 at Kisomere village (KP0) and 150 at Booma village (KP44.5).

Cattle are particularly important to the livelihoods of households of the Bagungu majority villages of Kasinyi (KP0), Kigwera, (KP4), Kibambura (KP5) and Kibaambura (KP8) whereby cattle are the main livelihood activity, whereas the Alur are agro pastoralists undertaking a combination of crop farming and livestock rearing. FGDs and KIIs found cattle rearing also important in Buseruka village (KP84.5), Rwamutonga village, Bugambe subcounty (KP87.5), Kayere (KP94.5) and Katooke and Nyamasoga villages (KP95). Herd sizes are large across the PACs and KIIs found that the sizes ranged from 80 to 1000. Artelia (2015c) found that average herd sizes were between 30 and 130. KIIs found that the larger herds (up to 1000) are in Kibambura village (KP5), Buseruka village (KP84.5) and Kayere village (KP94.5). but these are exceptions. Laurent's (2013) studies in Hoima found that several investors in cattle purchased land in Buseruka subcounty (which had previously been dedicated to cotton growing, but the global downturn had made the crop unviable), which may account for the larger herd sizes. In addition, fishing boat

owners who rent boats out to fisherfolk on the shores of Lake Albert were found to have diversified and bought land in Buseruka subcounty for cattle rearing.

Sheep are not common in PACs, although studies found some households that raised them at Avogera village (KP0), Booma village (KP44.5), Kigorobya village (KP64.5), Buseruka village (KP84.5) and Kayere village (KP95). The largest herd recorded was 300 head of sheep at Buseruka village (KP84.5). The smaller herds ranged from 5 to 50.

In Hoima, pig rearing as a semi-intensive system and commercial poultry farming are growing agricultural activities. In Buliisa district, pigs are not traditionally reared, but they have been introduced through government programmes (e.g., NAADS) and NGOs. Two examples exist of youth groups at Kigwera village (KP4) whereby rearing pigs has been introduced through external programmes (Artelia 2015a). Pig farming was found at Kigwera (KP4), Kibambura (KP5), Kisansya (KP6), Kihungya (KP49.5), Kigorobya (KP64.5), Nyamasoga and Katooke villages (KP95). Herd sizes were reported to be small, with up to 10 animals.

Labour

Households commonly employ herders to assist in the livestock rearing. In Buliisa, the herders are called Balaalo. The herdsmen often come from traditional livestock herding tribes in Uganda or Rwanda such as Karamojong or Banyakole, Bahima and Banyarwanda ethnic groups. They migrate to the area looking for work as herders during the rainy season when the pastures are good and the cattle are producing milk. KIIs found that they mostly leave their families behind and do not stay long, often one season at a time. Laurent's (2013) studies found that some herders remain with the cattle owner's herd; those who do so are able to build their own herd up with remuneration. This was corroborated during field studies with livestock owners at Kasinyi (KP0), Buseruka (KP84.5) and Kayere (KP94.5) villages. They are paid either in kind via a proportion of the milk, provided a head of livestock or provided a wage or a combination of such (Laurent 2013; Artelia 2015c). KIIs found that the Banyankole herders were often marginalised. They never intermarry with other tribes and do not assimilate to the traditions in which they are living. KIIs and FGDs found they were blamed for stealing cattle from owners for whom they are working.

Herders encountered during the field studies were either elderly or young. In the morning, livestock are taken from the kraal, an enclosed area made of wood and fencing, to communal grazing pastures assigned to households. In the middle of the day, the animals are taken to water sources such as the lakeshore (Laurent 2013). To access water sources, the herdsman or the livestock owners sometimes traverse land not assigned to them. When this is the case, permission is sought and a fee is paid, on occasion. The animals are returned to the kraal in the evening.

The task of caring for livestock is shared by males, females and children (Figure A9.4-26). Women's involvement in livestock rearing is generally restricted to lesser activities such as cleaning out livestock kraals, caring for calves and milking. Discussions with district veterinary officers revealed that some females acquire and manage cattle herds, but no evidence was found of this during field studies. Children are also relied upon to assist with livestock care.

Figure A9.4-26 A Mixed Herd of Cattle in Serule B, Buliisa District

Activities related to the livestock rearing are presented in Table A9.4-16.

Table A9.4-16 Livestock Rearing Responsibilities by Household Member

Task	Responsibility
Administer medicine	Men
All tasks relating to livestock	Men Herdsmen Children
Caring for calves and young livestock	Women Children
Buying livestock	Men
Cleaning livestock and Kraals	Women Children Herdsmen
Cooking and domestic work	Women
Grazing and searching for watering points	Men Herdsmen Children
Milking	Men Women
Marketing dairy products	Women

Grazing and Localised Nomadism

Nomadic pastoralism was not reported in the districts. Instead, livestock rearing is undertaken as part of sedentary farming activity, predominantly alongside crop farming or other income-earning activities.

Grazing takes place as a free-range system on communal lands with open access to the resources grassland and water or the animal is tethered at the household dwelling (Artelia 2015c). Grazing of larger herds is principally undertaken on the plains of the shores of Lake Albert as a free-range system. The livestock's main source of food is derived from grazing. Manufactured animal feed was reported to be expensive, so few livestock holders provided inputs apart from salt. Pigs are reared on maize, cassava and sweet potato. Poultry are free range with no inputs provided.

Behind the shores particularly in Ngwedo, Kigorobya and Buseruka subcounties, a belt can be observed where both cropping and livestock rearing (sheep, goats, pigs and poultry) takes place. The top of the escarpment marks a belt where crop farming is more intensive. However, in Bugambe and Buseruka subcounties where the escarpment is more gradual, there is a belt dedicated to livestock rearing, particularly cattle rearing at the top of the escarpment (KP86–96) (Laurent 2013). Where livestock rearing is undertaken alongside crop farming, the free-range system is problematic, as livestock enter areas where crops are grown and so are either tethered or ad hoc fencing is used.

Animals are taken daily by herdsmen to grazing pastures and water sources, such as the Waiga River, and in the evening the animals are returned to the kraal as part of a sedentary lifestyle of settled pastoralists. Occasionally, a temporary camp is made by herdsmen or family members tending the livestock near the grazing pastures or watering point if the location is far from the household (Artelia 2015c). This is generally undertaken during the drier months when pastures close by are depleted and water sources dry up. These movements are considered localised nomadism. KIIs with livestock owners found that with increasingly unpredictable rains and extended dry seasons, finding pastures and water points that have not dried up makes the distances travelled a lot further. Furthermore, it aggravates conflicts between crop farmers and pastoralists when crops are destroyed by moving herds; sometimes this is intentional, as specified in KII (Kisomere, KP0, and Kayere, KP94.5).

During the dry seasons, KIIs with the district veterinary officers, pastoralists and a UWA officer found that cattle are taken to the peripheries of Murchison Falls, Budongo (Buliisa district) and Kaiso Tonya, Kyakaboga, Bujawe and Kahara Forest Reserves (Hoima district) by herders for grazing. At opportune moments, the livestock herds, predominantly cattle, are reportedly pushed in to the parks illegally. This creates a conflict between the park wardens and the pastoralists within local communities. Lake Albert is used to water the livestock. However, large distances are covered in the dry season and, in the process, it was reported that animals get injured falling into, for example, abandoned sand mining pits. These movements take place from as early as November to April; however, it depends on the arrival of rains, which is reportedly becoming less predictable. In 2017, the dry season extended until September which particularly affected the cattle owners' abilities to

find sufficient food and water and extended the localised nomadism period. When the rains arrive, livestock are taken back to the homestead permanent grazing areas.

A KII with Buliisa district veterinary officer also revealed that when there are extended droughts, herds are moved from Hoima, Kyankwanzi, Kiboga and Nakasongola districts to the shores of Lake Albert and protected areas in Buliisa. This often creates conflict between local livestock owners, crop farmers and the UWA.

At PAC sample sites in Hoima, there is less or no communal land available, particularly in Buseruka subcounty. Changes in land ownership patterns (individualisation), land use (expansion of cultivation) and population pressure (especially at Lake Albert shores) or population movement (due to the war) have affected livestock management practices. Livestock owners are restricted to the lands owned by the household or permission to graze or to seek water on someone else's land must be sought from the landowners or land holders. With extended dry seasons, this restricts accessing grazing and water, therefore organised movements of cattle are undertaken as set out in Figure A9.4-27. Formal arrangements are made between the pasture owner and the livestock owner. This may be paying pasture land rent or exchanging animals (see below).

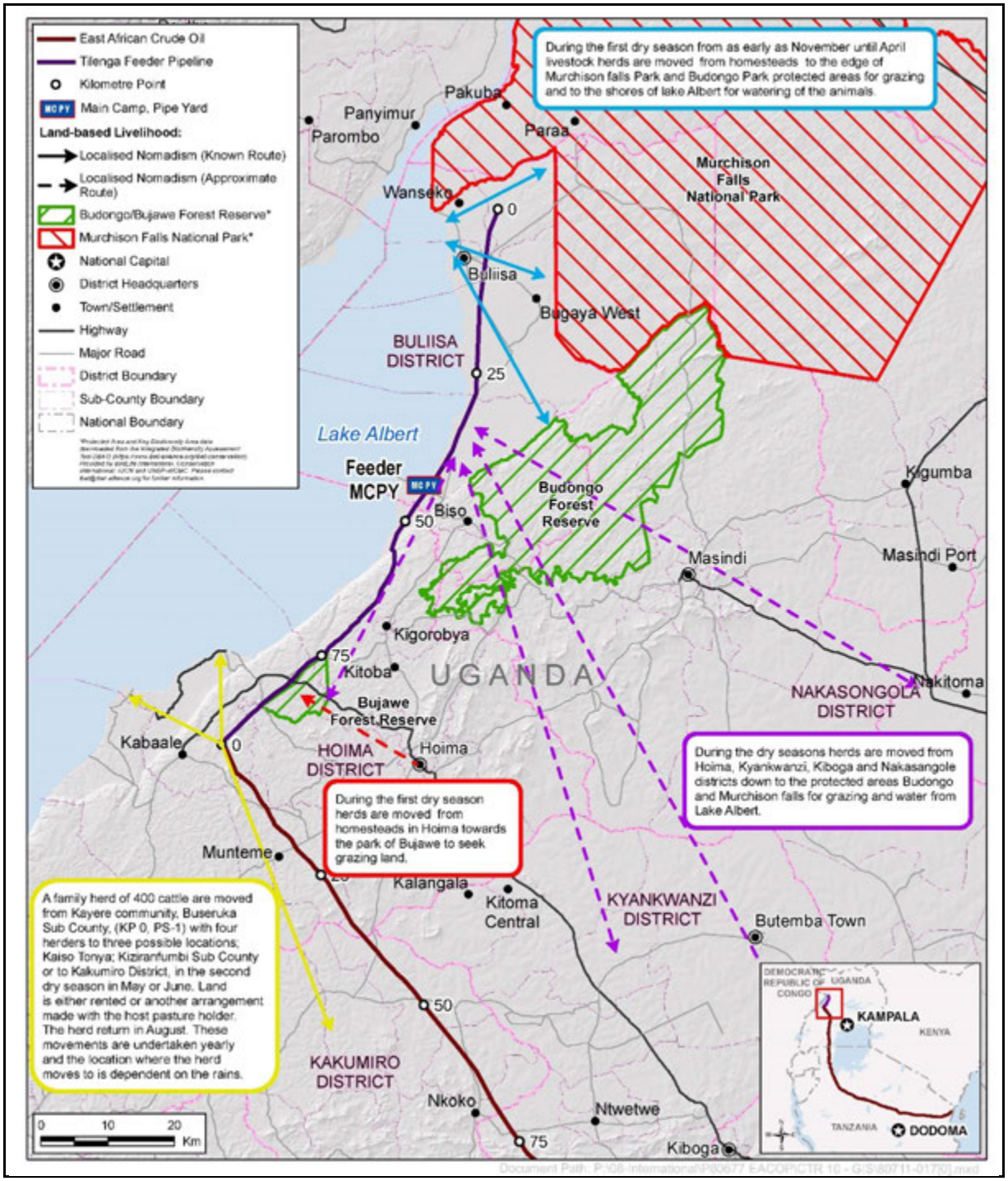

Figure A9.4-27 Localised Nomadic Movements

SOURCE: KII livestock owners and KII district agricultural officers

Marketing

SGIs with pastoralists found that most households keep livestock for both subsistence and sale. Marketing of livestock takes places at mixed markets (agricultural produce such as vegetables and fruit; livestock and poultry and general merchandise of manufactured goods and clothes) at district level on a monthly basis (Buliisa Town Council, KP11; Hoima municipality, KP74.5) or locally on a

more frequent basis such as at Buseruka town (KP84.5), Kigorobya village (KP64.5) and further afield in Masindi town (Masindi district).

Livestock markets are privately run under a tender allocated by the government. They are tightly regulated with payment dues of up to UGX 15,000 (USD 4.01) for selling or purchasing animals. Animals cannot be loaded until dues are paid and a letter issued by the district veterinary officer. Vendors of livestock must produce a letter from their community LC1 to prove livestock ownership. Farm gate sales were commonly reported with intermediaries purchasing animals to sell on to buyers. In addition to these marketing channels, commercial ranches reportedly sell live animals directly to abattoirs and street butchers (FAO 2018).

The major determinants of sale price paid for live animals cited by KIIs are the live body weight, breed, age, reproductive stage and sex. Table A9.4-17 presents prices ranges for livestock species. Prices paid for livestock vary across the two districts.

Table A9.4-17 Prices Quoted for Livestock across Districts Traversed by the Area of Influence

Livestock Species	Price Range UGX/USD/Per Head Live Animal
Cattle (indigenous species) Bulls	0.25–2.5 million/66.89–668.89
Bulls	<250 kg 0.25 million/66.89 250 kg 1.2 million/321.05
Heifer	0.45–0.5 million/120.40–133.70
Cattle(exotic)	1.8–4 million/481.61–1069.53
Goat	0.1–0.25 million/26.74–66.8
Sheep	0.08–0.12 million/21.40–32.11
Pig Piglet	0.5–0.7 million/133.70–187.26 0.04–0.05 million/10.70–13.38
Chicken	0.001–0.035 million/0.27–0.94

SOURCE: KII with district agricultural officers

In addition, livestock owners were disinclined to provide typical annual income earned from livestock owing to the variation year on year in numbers, breed and gender of animals sold and other driving factors that determine whether livestock are sold. In addition, during fieldwork, a quarantine on all livestock movements was in place, which affected the marketing of all ruminant livestock.

District agricultural officers were unable to specify production costs of livestock because animals were kept under an open grazing system and farmers were not accustomed to keeping records such as veterinary costs, additional feed and water.

Livestock and livestock byproducts are used for both subsistence and sale. Livestock byproducts such as milk, yoghurt, skins and meat are sold to various entities. Women sell milk and milk products such as yoghurt and ghee. They are either farm gate sales or taken to dairies locally known as coolers. Field studies found coolers in Hoima municipality and Buliisa town. The price of milk fluctuates

according to the season. During the rainy season when milk is plentiful owing to good grazing, the price is lower but in the dry season the price is higher.

Animal hides are salted and dried before they are sold by the men in households.

There is no dedicated abattoir in Buliisa or Hoima. However, animals must be slaughtered in allocated places called slaughter sheds or slaughter slabs, where the veterinary officer inspects the animal and a slaughter fee is paid. The butchers sell meat at the weekly or monthly markets, directly to consumers at the point of slaughter, to street vendors or restaurants.

Table A9.4-18 sets out the prices of animal products, as indicated by key informants.

Table A9.4-18 Average Price for Livestock Products

Product	Price Range Paid (UGX/USD)	Per Unit Sold
Yoghurt	1,000/0.27	litre
Cheese	12,000–30,000/3.21–8.02	kg
Ghee	10,000–11,000/2.67–2.94	kg
Milk	600–1,100/0.16–0.29	litre
Hides	700–7,000/0.19–1.87	kg
Meat (species not specified)	10,000/2.68	kg

SOURCE: FGD leaders and women, SGD and KII pastoralists

Veterinary Services

The range of veterinary services available in the districts includes:

- extension activities incorporating training and demonstrations
- veterinary treatment and disease control, surveillance, clinical treatment, vaccinations and artificial insemination
- regulatory services including meat hygiene, inspection verification, control of movement and quality control.

Table A9.4-19 sets out livestock diseases reported in the districts traversed by the AOI.

Table A9.4-19 Main Livestock Diseases According to Species, District and Last Recorded Case

Livestock	Disease	Last Recorded Case	District Reported
Cattle	Tick-borne diseases	2017	Hoima/Buliisa
	Foot and mouth	2017	Hoima/Buliisa
	Trypanosomiasis	2017	Hoima
	Tsetse flies	2017	Buliisa Hoima
	Worms	2017	Hoima

Table A9.4-19 Main Livestock Diseases According to Species, District and Last Recorded Case

Livestock	Disease	Last Recorded Case	District Reported
Pigs	African swine fever	2014	Hoima/Buliisa
	Piglet anaemia	2015	Hoima
	Mange	2017	Hoima/Buliisa
	Worms	2017	Hoima/Buliisa
Goats	Tick-borne diseases	2015	Hoima/Buliisa
	Trypanosomiasis	2017	Hoima
	Clostridial diseases	-	Hoima
	Tsetse flies	2017	Hoima/Buliisa
	Mange		Hoima
Poultry	New castle disease	2017	Hoima/Buliisa
	Fowl pox	2017	Hoima/Buliisa
	Fowl typhoid	2017	Hoima/Buliisa
	Fowl cholera	2017	Hoima/Buliisa

SOURCE: KII Veterinary officers; KII livestock specialists; SGD farmers

KIIs with livestock specialists at the district level indicated that livestock diseases were increasing, and it is recognised that this trend is a major constraint for the commercialisation of the sector. Some of the reasons cited for the increase in diseases are:

- counterfeit veterinary drugs
- farmers failing to consult veterinary doctors on how to treat diseases and parasites that affect their livestock
- absence of communal dips and sprays
- government initiatives that promote exotic breeds, which are less resistant to disease
- the absence of animal checkpoints on roads to enforce compliance with regulations governing movement of animals
- movement of livestock across international borders.

Veterinary officers and livestock specialists reported livestock injuries, through:

- mishandling by traders during transportation and at markets
- falling in to excavations made for ASM extraction, in particular for sand
- poor shelter
- poor feeding and access to water especially during drier months.

Challenges Facing Livestock Rearing

The following challenges to livestock rearing were cited across sample PACs:

- prevalence of diseases. Veterinary services were reported as unaffordable by livestock owners interviewed.
- quarantines enforced by the MAAIF. This has resulted in the closure of livestock markets, which has left livestock owners unable to market their animals and without access to cash.
- climate variability, which has lengthened the dry seasons, making access to water sources and pastures difficult
- livestock theft, especially of cattle, which is increasing owing to a population rise. Cattle are branded to identify livestock, but this does not act as a deterrent with many thefts never being reported or recovered. Cattle theft was occasionally blamed on herders or unemployed youth.
- absence of government support for livestock owners
- lack of available land to make livestock rearing commercially viable
- threats from animals such as snakes and baboons, as cited by interviewed livestock owners. Baboons were said to be a problem in Buseruka subcounty.
- increasing livestock injuries, including falling into excavations related to informal ASM, when moving animals to pastures and water sources
- fluctuating prices of livestock and their products as a result of the sellers' need for cash and condition of the animals
- conflict as a result of damage to crops when herds stray into farmland
- competition for resources such as water and land between pastoralists and host communities.

Human Rights

The following human rights apply to livestock rearing as a land-based livelihood:

- the right to an adequate standard of living: Universal Declaration on Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples' Rights, article 21
- the right to water, as this is one of the communities' main concern regarding livestock rearing
- Groups showing strong cultural ties to a lifestyle and livelihood (for example pastoralists) also have cultural rights. Universal Declaration of Human Rights, article 27; International Covenant on Economic, Social and Cultural Rights, article 15; UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage; African Charter on Human and Peoples' Rights, article 17.
- International standards for responsible business also provide that individuals should receive adequate compensation when deprived of their means of livelihood. IFC Performance Standards on Social and Environmental Sustainability, Performance Standard #5 Land Acquisition and Involuntary Resettlement, paras 1, 2, Objectives, Requirement 9 (Compensation and Benefits for Displaced Persons); OECD Guidelines for Multinational Enterprises, Chapter II, General Policies, Recommendations 2, 10, 11 and 12.
- Adequate compensation requires that displaced persons are provided with compensation for loss of assets at full replacement cost and other assistance to

help them improve or at least restore their standards of living or livelihoods. IFC Performance Standards on Social and Environmental Sustainability, Performance Standard 5 Land Acquisition and Involuntary Resettlement, Objectives, Requirement 9 (Compensation and Benefits for Displaced Persons).

Trends in Condition and Sensitivity to Change

Trends in condition for livestock are as follows:

- Long-distance movements (more than 20 km) in search of water and pasture are no longer undertaken. Localised pastoralism is common with organised movements of livestock to host pastures.
- Livestock owners with large herds of cattle are increasingly reliant on pasture rental agreements and, in the dry season, scarce water sources.
- Government initiatives promote the introduction of exotic livestock breeds; however, livestock owners are slow to engage with these initiatives and the new breeds are less disease resistant.
- Despite an increased prevalence of livestock diseases, livestock owners lack access to veterinary services. During the survey, a foot and mouth disease quarantine prevented any livestock movements.
- Rural households invest in livestock as a means of saving for dowries, school fees and health treatment.
- Access to grazing land and watering points is decreasing because of increased use of land by activities including crop farming and building or improving roads and dwellings.
- Ongoing conflicts between farmers and livestock owners over land access is likely to worsen because of the growing population and changing weather patterns.
- Settlements that are better connected to markets have seen increased incomes from selling milk and animals.

Ecosystem Services Provided

The land-based livelihoods (livestock rearing) described herein provide the following ecosystem services:

Provisioning services:

- rural income from selling livestock
- food security for families and future generations (if managed in a sustainable manner)
- financial security (livestock rearing is part of a diversification strategy to ensure some cash will be available when other means of income fail).

Cultural services:

- preservation of cultural heritage and traditional knowledge where livestock rearing is inter-generational.

Key points to note are that within the districts traversed by the AOI, livestock are used for both subsistence and sale. Livestock rearing in the sample PACs is predominantly sedentary with grazing on owned or rented land.

Land provides a provisioning service as a resource for livestock keeping. It provides grazing resources, water sources, ground for movement and habitation of livestock herds, and trees for shelter and medicinal herbs.

Sensitivity Rating

Table A9.4-20 presents the sensitive VECs in relation to livestock rearing identified during the social baseline study.

Table A9.4-20 Livestock Rearing VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Livestock owners with large herds (commercial production)	Moderate (3)	Livestock owners with large herds own large tracts of land and rear livestock commercially assisted by production inputs. As operations are large scale, they are more resilient to external shocks except for disease, climatic change and labour shortages (e.g., herdsmen and other farm workers).
Livestock keepers and their families including women, children and elderly, undertaking crop farming (agro pastoralism incorporating small-scale livestock production)	Moderate (3)	Livestock keepers, who are also crop growers, are vulnerable to loss of livestock but less vulnerable than those who rely solely on livestock rearing.
Livestock owners and their families including women, children and elderly with herds, not undertaking crop farming in conjunction with livestock keeping	Very high (5)	Without free movements of large herds (cattle), animals may not have sufficient pasture and water sources. Herd owners are less resilient to external shocks as their main dependency is on their herd.
Hired herdsmen (often of Karamojong, Bunyarawanda ethnicity or non-Ugandan nationals)	Very high (5)	Herdsmen, employed by cattle owners, have low or no education and some are without identity cards. They have no alternative livelihood means and are more vulnerable to external shocks.

Key Considerations

Key considerations are:

- livestock rearing activities in the sample PACs are under pressure owing to shortages of land and water resources
- livestock diseases are common, and increased movements of vehicles and people could increase the spread of diseases
- owners of large herds in the sample PACs often do not have diversified income
- human rights of access to food and a decent standard of living should be maintained.

A9.4.6.4 Baseline Condition of Artisanal and Small-Scale Mining

National Level

The Directorate of Geological Survey and Mines (DGSM) in the Ministry of Energy and Mineral Development is the regulatory authority for mining and artisanal and small-scale mining (ASM) activities.

Deposits of gold, tin, tungsten, niobium, coloured gemstones, limestone, marble, kaolin, clay, granites, rock salt and sand are present in Uganda, see Figure A9.4-28. In addition, construction materials such as sand, clay, lateritic soils (murram), limestones, marble, kaolin and stone aggregates are quarried.

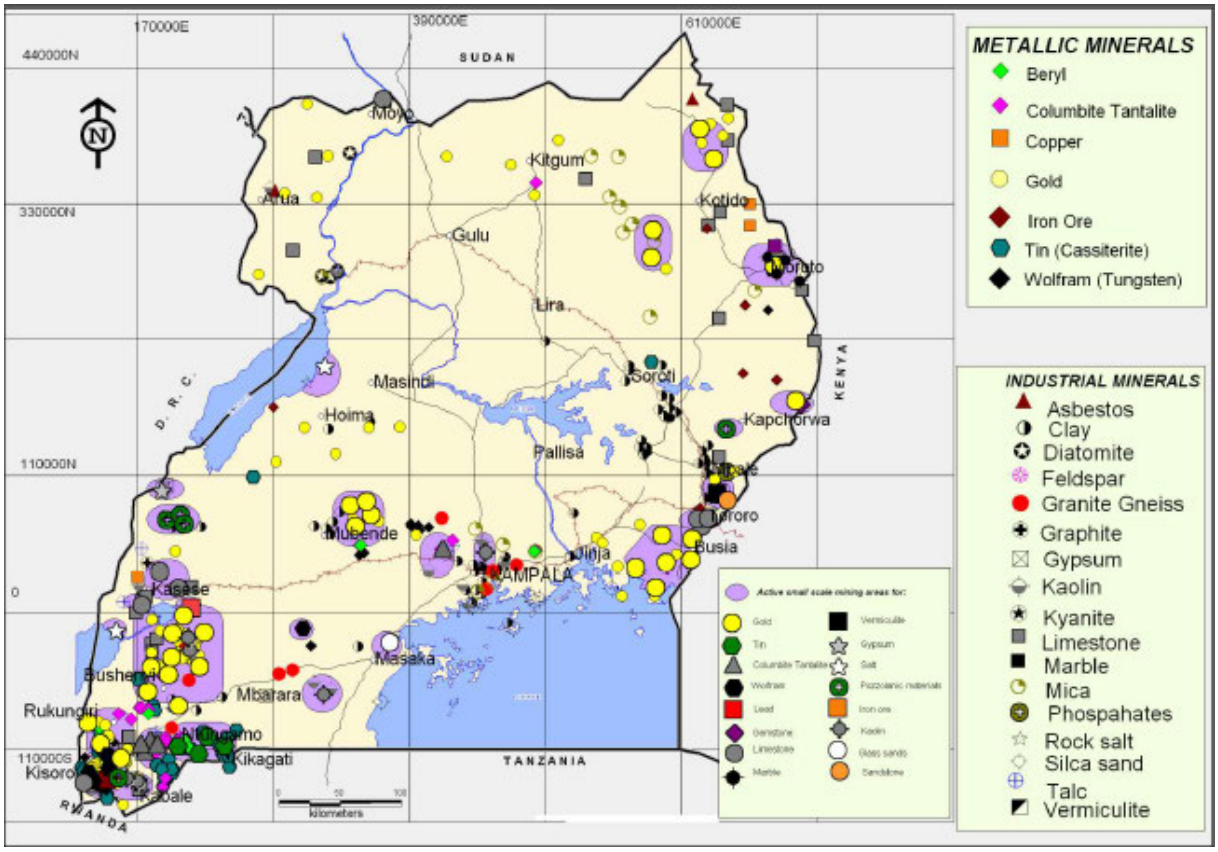

Figure A9.4-28 Metallic and Industrial Minerals

SOURCE: MEMD 2017, Internet site

The Geological Survey of Uganda was set up in 1919. Between the 1950s and the 1970s, mining expanded and became more formalised with copper, phosphates, limestone, tungsten, coloured gemstones, niobium, tantalum, gold and tin being exploited. During the civil unrest of the 1970s, the mining sector collapsed and stimulated an environment for the development of unlicensed ASM activities, with retrenched employees of the formal sector setting up their own mining activities, particularly in the southwest and, to a degree, the east and northeast of the country. During the stability of the 1980s, gold discoveries by ASM miners created rush situations and introduced ASM to rural farming communities. Mining was not a priority during the nation building of the 1990s and continued on a small scale, with

medium-scale mining of construction materials and ASM of precious metals, base metals, construction aggregates and other minerals (Blacklock 2017).

To date, Uganda's mining sector is characterised by a combination of officially registered local and international mining companies, and ASM. The Energy and Mineral Sector Performance Report 2016–2017 reports a total of 692 licences, of which 150 are prospecting licences, 374 exploration licences, 49 location licences, 39 mining leases, and 76 mineral dealers' licences (Daily Monitor 2017, Internet site).

The Mining Act (2003) provides legislation for prospecting, exploration and mining (Alchetron 2017, Internet site). Two aspects of the act applicable to ASM are the:

- prospecting licence: a one-year, non-exclusive licence granted to the holder to prospect for minerals around the country
- exclusive prospecting licence: mineral specific and limited to an area of 20.48 km^2 (7.91 square miles).

ASM provides livelihoods for almost 200,000 women and men, and over a million Ugandans benefit indirectly (EARF 2018). It is estimated that ASM has grown by 40% since 2008 (Spiegel 2012). The sector provides an alternative to agricultural subsistence farming and offers employment where there are few other livelihood alternatives. It also reduces rural–urban migration.

However, ASM is associated with illicit activities, environmental degradation, exposure to occupational hazards and other serious health and safety concerns for miners and their communities, displacement of people and in-migration of prospectors.

Construction Materials

EARF highlights that 'Article 244 of the Constitution of Uganda (1995) states that clay, murram, sand, or any stone commonly used for building or similar purposes are not considered minerals, resulting in their exclusion from previous mining law' (2018: 10). Yet, at 6% growth per annum, the construction sector is strong, and the current market demand is the main driver, especially with the large number of current and imminent infrastructure projects in the country. For example, the cement industry is preparing to double in-country production by developing new limestone mines with large-scale companies such as Hima Cement Ltd, Kampala Cement Ltd and Tororo Cement Ltd, thus driving the exploitation of limestone (UNDP 2018).

District and PAC Level

Full-scale geological studies have not been undertaken to determine the presence of minerals across the districts traversed by the AOI, and the mineral status of these districts is largely unknown. Known deposits are largely unexploited. Hoima DDP identifies the presence of gold.

Construction materials such as sand, stone for aggregates, laterite soils (murram) for road and brick making are the main product of mining and quarrying in the districts. Atacama et al. (2017) found that 31.3% of households make a living from

sand and clay extraction as specified in the RAP studies for the proposed Kabaale Industrial Park and N1 access road.

Sand mining occurs in both districts, particularly in wetlands. It takes place year-round but increases in the dry season. For the majority of existing sand pits, permission is sought from landowners and a fee paid. Shovels and spades are used, as mechanised equipment is unaffordable for most people. Sand sources were said to be decreasing owing to an increasing number of people seeking to make a living from this resource. Sand is sold at the extraction site to buyers who collect the material with trucks. The monthly income of a sand miner, generating sand from a quarry, was said to be UGX 150,000–400,000 (USD 40.13–107.03). Sand mining is performed alongside crop farming or fishing activities within a household and is a major source of income.

Processing stone for aggregates was undertaken to a lesser extent in both districts. District natural resource officers reported 10 aggregate extraction sites in Hoima and 25 in Buliisa (see Table A9.4-21). Permission from landowners is sought to extract the rock before it is processed in to small pieces manually with a hammer. It is undertaken year-round as a daily activity, accumulating the processed aggregate which is then sold to buyers who come directly to the site to collect it.

Extraction of red lateritic soils (murram) is undertaken in Hoima and Buliisa. Murram is used for road construction and borrow pits near to roads are made and the murram is extracted with a caterpillar machine. Contracting companies renovate the roads under the Uganda National Roads Authority's (UNRA) supervision, and the pits are exploited with permission from district authorities in a planned manner (Artelia 2015d). Buliisa district's natural resource officer informed that there were 15 murram borrow pits in Ngwedo subcounty (KP0–4).

Salt is extracted at Kibiro fishing village on the shores of Lake Albert in Kigorobya subcounty, Hoima (approximately KP60). Women solely undertake the activity and are dependent on salt extraction as an income, as the sandy soils on the immediate lakeshore are not conducive to crop farming. Salt is traded in nearby markets and used for livestock and domestic consumption. The salt is considered superior to industrial salt and is of cultural significance to the Bonyoro ethnic group. There is also a hot spring at Kibiro salt gardens and the entire site is an important archaeological and cultural heritage site recognised by UNESCO (UNESCO 2015, Internet site; East Africa Travel Guide 2015, Internet site).

Although Hoima DDP states that gold deposits are present in Hoima, field studies did not encounter any ASM activities nor where they mentioned by Hoima district natural resource officer.

The Buliisa district natural resource officer mentioned that there were several calcium activities in the district. Studies did not reveal any further information.

Table A9.4-21 sets out known mineral deposits in Hoima and Buliisa districts.

Table A9.4-21 Mineral Deposits by District

District	Site Name and Subcounty, Where Known	Mineral	Number of Sites
Buliisa	Butiaba subcounty	Sand	15
	Ngwedo subcounty	Calcium	2
	Buliisa subcounty	Murram	15
Hoima	In most wetlands around the district	Sand	40
	Kyedikyo, Hoima municipality	Stone aggregates	50

SOURCE: KIIs with district natural resource officers

NOTE: These figures may not be exhaustive of all the mining activities at present owing to the informal way in which it is undertaken making the ASM activities itinerant.

In most of the sample PACs, people were engaged in ASM of clay, sand, and gravel for domestic usage for dwellings and shelter as well as those who exploit the mineral for commercial usage. Some households undertaking it for commercial usage are solely dependent on the activity for an income. Based on KIIs, it is likely to be encountered in all PAC communities. Figure A9.4-29 shows the locations of ASM.

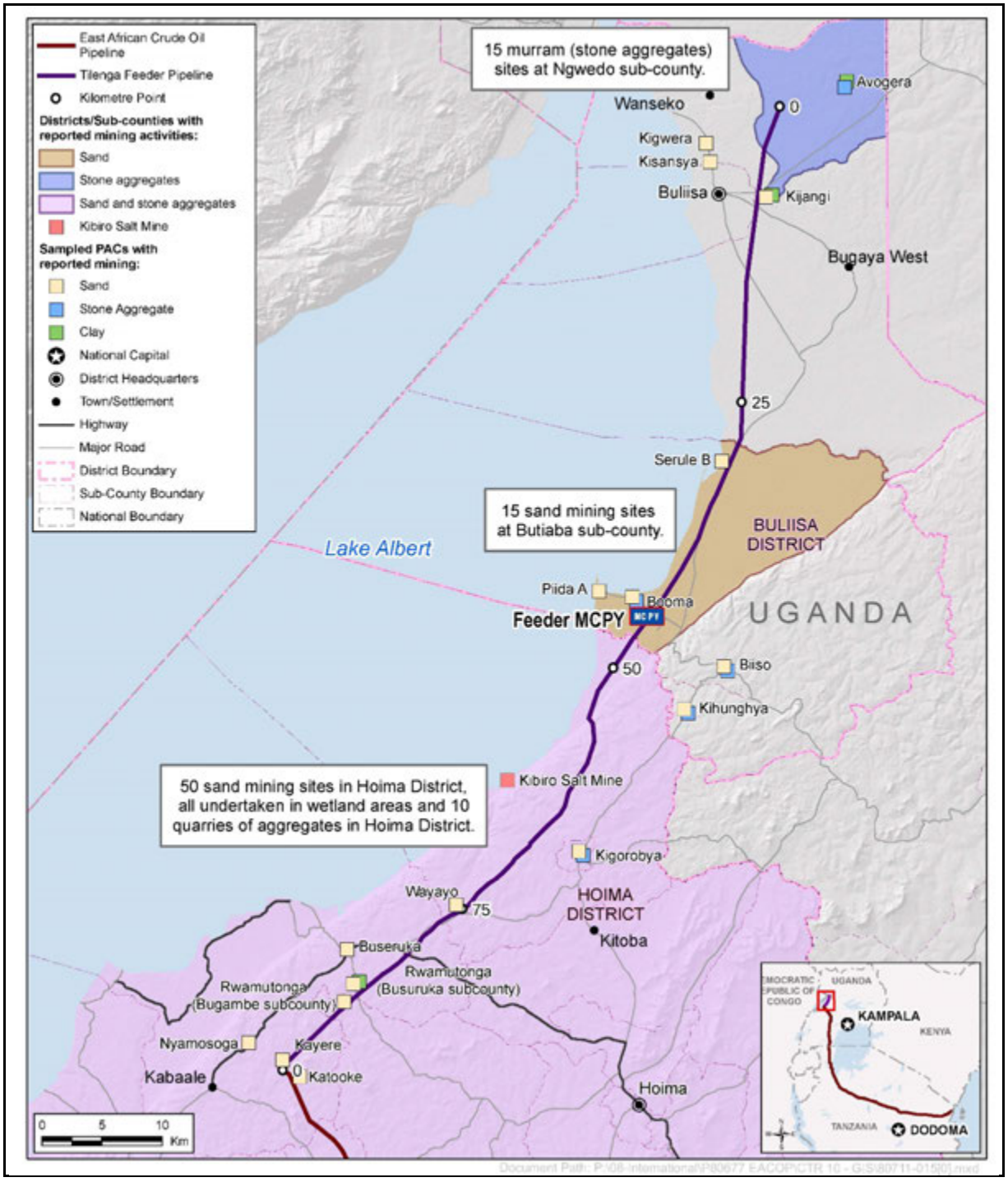

Figure A9.4-29 Artisanal and Small-Scale Mining in the Sample Potentially Affected Communities

Problems associated with artisanal mining as reported by district natural resource officers were:

- ASM being undertaken in an uncontrolled manner, without a licence, and often without the knowledge of the authorities

- environmental degradation. Open pits and uprooted trees can create drainage problems and stagnant water provides breeding grounds for mosquitoes. Open holes are dangerous for humans and animals.
- the low aesthetic value of abandoned or active mine sites
- safety matters
- women working in ASM obtaining fewer benefits than men
- prominent child labour, especially in extremely poor households in rural communities
- gaining access to the deposits creating conflicts and boundary disputes
- fluctuating demand for sand, clay and aggregate
- customers not always paying miners.

Human Rights

The following human rights apply to ASM:

- the right to an adequate standard of living
- the right to freedom from child labour and other children's rights because children often participate in the family work of mining, which can be harmful to them
- in the case of artisanal mining, the right to life is also at risk, and the related rights to liberty and security of the person and the right to be free from cruel, inhuman or degrading treatment.

Other relevant standards include:

- Voluntary Principles on Security and Human Rights.

Trend in Condition and Sensitivity to Change

ASM trends include:

- the government increasingly acknowledging the importance of ASM and moving toward formalisation of the sector
- increasing extraction of construction materials such as sand, clay for bricks and stone for aggregate owing to an expanding construction industry in Uganda
- ASM activities providing increasingly major benefits to households and create multiplier effects in local communities
- ASM activities slowing down urbanisation and creating downstream employment.

Ecosystem Services Provided

The land-based livelihoods (ASM) described herein provide the following ecosystem services.

Provisioning services:

- income from sale of minerals and construction materials (e.g., sand, clay, gravel)
- materials for dwellings and shelter
- salt for livestock and domestic consumption.

ASM is an abiotic provisioning ecosystem service undertaken throughout the AOI by sample PACs, primarily in the dry season.

Sensitivity Ranking

Table A9.4-22 presents the sensitive VECs with regards to ASM identified during the social baseline study.

Table A9.4-22 Artisanal and Small-Scale Mining VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Non-Ugandan nationals undertaking ASM activities informally	Very high (5)	This category of people will be highly vulnerable, as they hold no identity papers and have no legal standing in Uganda.
Artisanal and small-scale miners engaged as casual labour on an informal basis, pursuing mining as a sole occupation	Very high (5)	These VECs do not have access to land for farming or livestock as an alternative livelihood and therefore have very high vulnerability.
Child artisanal miners engaged as casual labour on an informal basis, pursuing mining as a part-time occupation	Very high (5)	Children encounter high safety risks and lack access to education as a result of their mining activities.

Key Considerations

Key considerations are:

- large construction projects may require substantial quantities of construction materials. This would increase the pressure on existing sources of supply with the following potential results:
- price increases for construction material with indirect effects felt through the construction industry and possibly making housing less affordable
- opening of new (licensed and unlicensed) borrow pits to meet increased demand
- a surplus of borrow material, fall in prices and fall in employment after the demand is closed once construction is completed.
- because of the informal and hence often covert nature of ASM activities, it is difficult to assess the precise location of ASM sites at any time
- PACs' human rights to a decent livelihood, safety and security.

A9.4.6.5 Baseline Condition of Natural Resources Use

National Level

Products such as biomass fuel (firewood and charcoal), wild foods (honey, insects, mushrooms and bush meat), timber (products made from trees harvested from forests, plantations and nonforest lands), medicinal plants and grasses play a vital part in the subsistence of rural communities in terms of energy for cooking, food

security, construction materials for shelter, medicine and income. With an increasing population and a high demand and reliance on natural resources, environmental management of these resources has become essential. This section should be read in conjunction with the biodiversity sections, which report on plant and animal species available to PACs.

Hunting occurs throughout rural areas in Uganda and requires a permit from the UWA under the Uganda Wildlife Act 1996. However, hunting often takes place without a permit.

Apiculture is a fast-growing industry. However, despite being only one of five countries in SSA licensed to export honey to the European Union, Uganda has been unable to meet national demands for honey, let alone export the produce. The Ugandan Beekeepers Association estimates that only 800–1200 metric tonnes of honey are produced per year which is 1% of a potential 500,000 tonnes of honey per year (Ghent University 2017, Internet site).

District and PAC Level

Forest, rangeland, lakeshore and wetland habitats characterise the districts traversed by the AOI. Local communities harvest natural resources in these habitats for subsistence or for cash income.

Dependency on natural resources is related to the economic status of households who source them. Baseline studies found that the poorer households were more dependent on natural resources for energy to cook food, food security and income generation. These income generation activities form part of a multiple livelihood strategy of households that runs parallel to crop farming, livestock rearing or fishing activities. Seasonal availability of natural resources determines when they are collected. Seasonal downtime from other income-generating activities also determines whether natural resources are collected.

Figure A9.4-30 presents the natural resources use in the sample PACs.

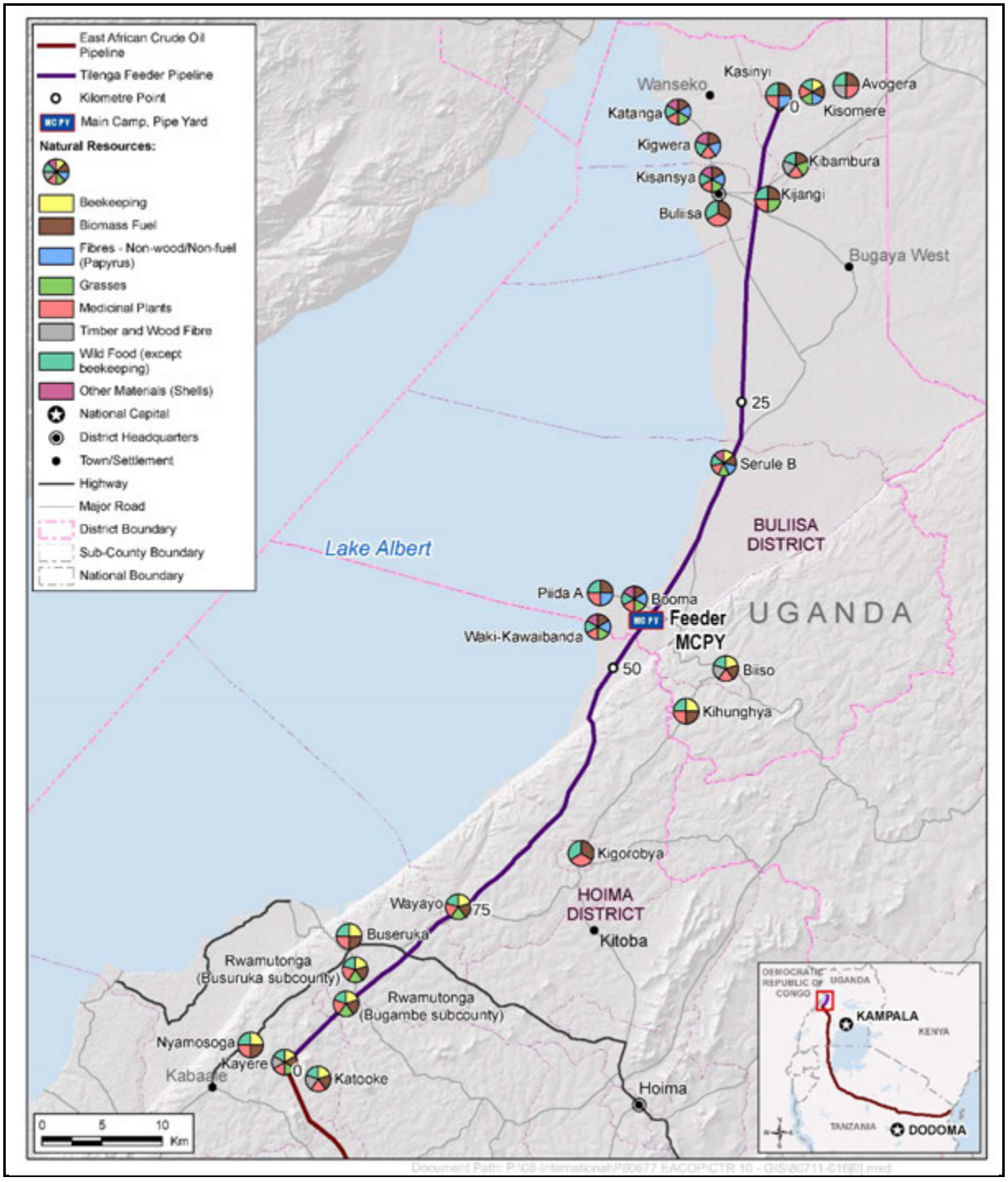

Figure A9.4-30 Natural Resources Harvested in the Sample Potentially Affected Communities

The various natural resources used are discussed below.

Timber and Wood Fibres

Timber is used for crafting household furniture, kitchen utensils, poultry cages and shelter.

Trees, mainly lira and acacia trees (in Buliisa) and eucalyptus and pine in both districts, are used for dwelling construction (poles for scaffolding or joists and uprights in houses and planks for walls). Wood for construction is collected by specialised wood merchants for sale and by households for construction and repair of their own dwellings. Observations in the field found that wood merchants generally sell timber by the roadside (Kayere, KP94.5). The trees are grown on household farm plots or sourced from private land in areas adjacent to communities with permission sought from the landowner. Small eucalyptus plantations were found at Kigorobya (KP64.5), Kihunghya (KP49.5), Katooke (KP95) and Nayamasoga and Katoke villages (KP95). Few plantations were found in Buliisa district.

Biomass Fuel[14]

Firewood, an important source of cooking fuel, is collected on communal land by communities in the districts traversed by the AOI. In Buliisa, it is collected in the communal lands in the central zone of rangeland. On the Rift Valley escarpment, where crop farming is undertaken, households collect wood from beyond the boundaries of the villages in communal areas or use household trees on the edge of plots.

Firewood is collected daily by women in all sample PACs. Distances travelled to find firewood have reportedly increased owing to diminishing sources. Permission is sought from land holders and firewood is sometimes collected from the protected areas (Wambabya, Budongo, Bugungu and Murchison Falls) on approval and, in such cases, wardens accompany the collectors. Stakeholder engagement also found that wood is taken illegally.

Wood collected includes that from acacia, lira, eucalyptus, fruit trees and, to a small extent, pine. Artelia studies found that at some Lake Albert shoreline villages in Buliisa, firewood is not easily accessible because the area has many settlements and tree cover is sparse (2015d) so communities buy firewood from retailers. In villages such as Serule B (KP30.5) and Piida A (KP45.5), specialised merchants trade firewood collected from rural areas.

Charcoal use is popular in the districts traversed by the AOI (Figure A9.4-31) The national charcoal survey undertaken in 2015 found that the major tree and shrubs species used for charcoal making are *Acacia hockii*, *Ficus natalensis*, *Albizia coriaria*, *Eucalyptus grandis*, *Combretum molle*, *Maesopsis eminii*, *Mangifera indica* and *Milicia excelsa*.

[14] Biological material derived from living or recently living organisms, both plant and animal, that serves as an energy source.

Figure A9.4-31 Charcoal Sacks in Kayere, Hoima District (KP94.5)

The harvested wood is converted to charcoal in earth or mound kilns. The wood can be put in the kiln immediately after harvesting but for increased efficiency it is often dried for 2 to 14 days. The wood is left in the kiln for up to a week. The charcoal is then cooled using water, damp soil or sand, or by leaving the hot coals spread out on the earth in the open air. Charcoal production is generally undertaken in the wet season because of its water requirements.

Charcoal processing is found in a small number of sample PACs, and this is corroborated in Artelia studies (2015d) which specify that charcoal is produced on a small scale in Buliisa district. A few households within sample PACs undertake the process. Wood is collected from farming areas, plantations near communities or private land. In the latter case, permission is required. In some cases, charcoal producers are given free access to wood in return for clearing land for crop growing or making a payment to the land holder. Charcoal is predominantly being produced for marketing, with small amounts for household use. Women package the final product in 50-kg bags, which are sold along main roads for an average price of UGX 22,000 (USD 5.89). Charcoal dealers or private buyers purchase the charcoal for sale in urban centres. The average monthly income of a full-time charcoal producer is estimated at UGX 317,000 (USD 84.83) with UGX 170,000 for a part-time charcoal maker (USD 45.50) (MEMD 2015).

The Artelia (2015d: 70) natural resource studies identify that with the increased population in the area and improved road connectivity, this could increase demand for charcoal. Therefore, more suppliers undertaking charcoal production will emerge in the area.

Fibres (Nonwood, Nonfuel)

Papyrus *Cyperus papyrus* grows in abundance in wetland areas in both districts. The papyrus is cut and dried to make sleeping mats, flooring and screens. Both men and women engage in mat weaving. Mats take approximately three hours to make and are sold for UGX 5000–10,000 (USD 1.34–2.67) by the roadside or at local markets.

PACs collect papyrus near wetland ecosystems on riverbanks or river mouths in slow-moving water, including Waiga River (KP23), Waisoke River (KP28), Sonso River (KP34), Waki River (KP47), Wambabye River (KP89) and lakeshores. It was reported to be collected on an as-needed-basis and was said to be in plentiful supply in wetland areas. Artelia studies found that at Katanga village (KP4) local women who work on mat production depend heavily on papyrus cutting.

Sisal is grown and processed into ropes for land demarcation.

Jatropha is used for land demarcation, livestock fodder and seeds which are pressed and made in to oil.

Shells

Shells are collected for lime production from the shores of Lake Albert and behind the shoreline. KIIs with shell collectors found women and a small number of men undertake this activity, deemed by community members within which the activity is undertaken as the poorest. The shells are collected by hand or are dug out of the sand. In Waki Kawaibunda (KP47), holes dug by the shell collectors create hazards for cattle and this was sometimes a source of conflict. Shells are stockpiled and sold to intermediaries who grind them down for chicken feed as a source of calcium. One sack of shells is sold for UGX 30,000 (USD 8.02). Shell collectors in Serule B (KP30.5) mentioned that there are 60 people undertaking the activity in the immediate cluster of nearby villages and availability of shells is reducing because of the increase in population to the lakeshores.

Grasses

Women and men collect elephant grass and spear grass mostly on village land. These grasses have several uses (Artelia 2015d) including:

- thatching for roofs. Grass for thatch is harvested on a regular basis during the rainy season in a small number of sample PACs in Hoima district.
- animal fodder, which is gaining importance owing to ongoing depletion of communal grazing areas and the shortage of pasture land during the dry season
- making brooms, which is a seasonal activity; brooms are generally sold at local markets.

The grass is cut by specialised collectors with a scythe and bundled for sale by the roadside. In the case of Kayere, Nyamasoga (KP0) and Katooke villages (KP1.5),

the grass is sold to the lakeshore populations, where most houses have thatch roofs but there is no suitable grass available. A bundle of grass is sold for UGX 2000–4000 (USD 0.53–1.07). Prices vary according to the season, abundance and distance from the source at which it is sold.

Medicinal Plants

Leaves, stems, bark and roots from various plants, shrubs, herbs and trees are used for medicinal purposes (human and animal), such as atropha plant, tamarind and eucalyptus leaves (see Appendix A1 Botany Biodiversity Baseline Report).

FGDs revealed a substantial reliance on locally sourced medicinal plants for common illnesses. People use both medicinal plants and modern medicine to treat illnesses. However, use of local medicinal plants is more prevalent in remote rural areas. This is possibly because of the lack of adequate medical facilities such as clinics and pharmacies. Both men and women collect plants for traditional medicine, which are found in crop farming areas, open bush and forests.

Wild Food

All sample PACs harvest wild fruit and vegetables for household consumption, with surplus occasionally sold in local markets or within the community.

Edible wild plants are collected throughout the year from the peripheries of cleared land where crop farming is undertaken and tree-covered areas and are used to supplement the diet. Women and children mainly collect wild foods.

Mushrooms are harvested March–May and August–October from open rangeland or forest and groves near communities. Women and children mainly conduct mushroom picking to supplement the household's diet but sometimes surplus is sold.

Men, women and children harvest grasshoppers to supplement the diet. Grasshoppers are caught in open areas using a light placed in a large drum to attract the insects at night or they are caught by hand. Grasshoppers are only available between November and December.

Ants are collected February–April and March–June. Collection of ants involves smoking out ants nesting underground or from ant hills in open areas.

Both grasshoppers and ants are harvested for home consumption and excess is sold 'fresh or fried' in local markets or by the roadside.

Hunting

Hunting of wild animals was reported to occur on an infrequent basis in both Buliisa and Hoima districts. Key informants were reluctant to disclose if they engaged in hunting, as it is considered poaching with a heavy penalty. Where it was disclosed, it was often qualified as being near agricultural plots or communal lands. However, field studies and Artelia studies found that hunting is also undertaken in protected areas, such as Bugungu, Budongo, Wambabya and Kabywoya Wildlife and Forest Reserve areas.

Animals hunted include buffalo, Ugandan kob, baboons, bush pig, monkey, rabbits; hippopotamus and wild rats (Artelia 2015d). Hunting is undertaken by men in the

dry season. Hunting commonly uses nets, dogs (with a bell attached to the collar), bow and arrow, and spears. Nets are laid across expected escape routes held at either end. The animals are then driven into the nets and killed with a spear. Hunters consume the meat within the household either fresh or smoked. Only a small percentage of catches are traded in nearby markets. Hunters stated that there is a considerable decrease in the wild animal population due to over hunting in the past, clearing of forest and grassland areas for agriculture, increased grazing areas and rain shortages.

Figure A9.4-32 A Hunter with a Bow and Arrow in Kayere, Hoima District (KP94.5)

Apiculture

Apiculture is a livelihood activity in both Buliisa and Hoima districts. Beekeeping is undertaken in some sample PACs. Communities typically have one or two beekeepers. Honey is harvested twice a year between March and June and August

and October. Other bee products such as brood comb and bee bread are harvested on a small scale (New Agriculturalist 2018, Internet site).

Traditional hives are made from timber, bamboo, borassus palm or woven from forest climbers. Hives are placed in farm plots or in tree-covered areas inside or outside community land. Permission to place the hives is not always sought from land holders. The number of hives for a beekeeper ranges between 5 and 18. Men traditionally tend the hives and women assist in honey processing, hive cleaning and selling the products.

Apiculture is considered profitable with 1 kg of honey sold for UGX 5000 (USD 1.34). The honey is sold in the local communities and local markets or to wholesale buyers (including a supermarket) in Hoima district. Most bee keepers reported that although business was good, the number of bee colonies had declined over the years.

AECOM studies[15] found that training had been made available in Buliisa district from Masindi D Farmers Association (MADFA) and Loving Heart, and there are two active beekeeping groups called URIBO and Albertine Honey.

Challenges and Constraints

- A growing population, particularly around the lakeshore, has put pressure on the natural resources owing to encroachment on wetlands and forest areas for dwellings, farming and grazing.
- Many timber and charcoal dealers are unlicensed, which makes regulation by the districts difficult.
- The high cost of alternative sources of energy for cooking and lighting (gas, solar and electricity) forces people to use wood and charcoal.
- The rate of tree cutting is much higher than the rate of reforestation.
- Honey production is inefficient. Traditional beehives and rudimentary equipment can contaminate the processed honey. Honey fermentation is common owing to a lack of appropriate equipment and storage facilities. Potentially valuable byproducts such as wax and propolis are discarded. To increase production, beekeepers need more support in terms of equipment and ongoing practical training.
- The bee population is decreasing because:
  - hives are usually destroyed and colonies often killed when collecting honey
  - non-organic pesticides kill bees
  - there is habitat pressure for bees due to population increase
  - honey bee pests and predators affect traditional beehives.

Human Rights

The following human rights apply to natural resources use:

- the right to an adequate standard of living
- the right to health, as communities use some plants for medicinal purposes.

[15] FGD undertaken by AECOM with Buliisa bee keepers on 28.11.2016

Trend in Condition and Sensitivity to Change

Trends in natural resources use includes:

- Natural forest and scrubland is diminishing, and women need to travel increasing distances to collect wood. With few affordable alternatives to firewood and charcoal, the long-term sustainability of existing sources of biomass fuel is uncertain.
- Medicinal plants are widely used for human and animal illnesses; more so in remote rural areas owing to the inaccessibility of medical facilities. However, increased clearance for farming and infrastructure may threaten availability.
- Although hunting is only permitted with a licence, illegal hunting is practiced on a small scale. Hunting has, however, diminished because there is a decrease in game populations due to over-hunting, clearing of forests and scrubland areas for agriculture, and increased livestock grazing.

Ecosystem Services Provided

The land-based livelihoods (natural resources use) described herein provide the following ecosystem services:

Provisioning services:

- energy for cooking and food security
- construction materials for shelter
- income from selling natural resources
- traditional medicine.

The natural resources included in this section are obtained from a variety of ecosystems within or near the PACs including forests, wetlands and pasture rangelands. As such, these natural resources play a vital role in subsistence of rural communities. With an increasing population and a high demand and reliance on natural resources, continued protection of and access to these resources is essential.

Sensitivity Rating

Table A9.4-23 presents the sensitive natural resources use VECs identified during the social baseline study.

Table A9.4-23 Natural Resources Use and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Beekeepers	Low (1)	Beekeepers are more resilient to external shocks because beekeeping activities supplement farming activities.
Hunters	Low (1)	Hunters are generally not reliant on the bush animals they catch for food or as a main income.

Table A9.4-23 Natural Resources Use and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Fibres and grass collectors	Moderate (3)	Access to fibres and grass, which is culturally important, may be reduced.
Medicinal plant users	Moderate (3)	Without access to medicinal plants, there may be limited means to treat illnesses in an affordable manner.
Wild food users	High (4)	Plants supplement diets and are used in 'hungry months' when households may not have sufficient access to food.
Firewood collectors (women)	High (4)	With limited access to firewood, household meals cannot be cooked, affecting the health of family members. Access to firewood is already diminishing and women must walk long distances.
Shell collectors	Very high (5)	Deemed the poorest in communities and mostly undertaken by women, shell collecting is the only means of income. Without such, the collectors will be more vulnerable than most.

Key Considerations

Key considerations are:

- communities, especially poorer households, are dependent on natural resources for providing wild food, traditional medicine and firewood for cooking
- a growing population and urban demand for firewood and charcoal has reduced their availability in the AOI
- a decline in bee population due to habitat destruction in favour of crop farming and animal grazing. Additional removal of land cover may affect the bee population further.
- PACs' human rights to a decent livelihood and food security.

A9.4.7 River- and Lake-Based Livelihoods

A9.4.7.1 Baseline Condition of River- and Lake-Based Livelihoods

National Level

The fisheries sector provides a livelihood to fisherfolk and those engaged in the supply chain which includes small-scale and industrial fish processing, fish trading, boat-building, net making, trading in fishing equipment and extension activities provided by the government. The current annual production from fisheries is about 461,000 tonnes and from aquaculture 111,000 tonnes (ACME 2017, Internet site).

Fisheries activities are mainly undertaken in open water such as major and minor lakes, rivers and wetlands.

The MAAIF provides oversight of all aspect of fisheries in the country under the following departments:

- production and marketing
- fisheries resources and development
- fisheries regulation control and quality assurance
- aquaculture management and development.

The National Fisheries Policy (2004) forms the legislative framework for fisheries activities. The policy aims to ensure sustainable fish production and utilisation by properly managing capture fisheries, promoting aquaculture and reducing post-harvest losses. It has 13 policy areas, each with objectives and strategies. To achieve the objectives, decentralised co-management practices are promoted, including beach management units (BMUs).

A major challenge facing lake fisheries is illegal fishing with use of indiscriminate fishing gear such as fine-mesh-gill and seine nets. This is particularly problematic in Lakes Albert and Victoria, and the Government makes attempts to address the problem through patrol activities, registration, and licensing of fisherfolk and vessels (Nakkazi 2017, Internet site).

The Government is supporting the emergence of pond, dam and cage-based aquaculture. The sector is dominated by subsistence production with little or no technical inputs or management. However, there is an increase in commercialisation of the sector and cage culture, larger ponds and better-quality fish seed (fertilised fish eggs) and feed are being introduced. There are an estimated 12,000 farmers involved in aquaculture in the country at the time of writing (FAO 2018, Internet site).

District and PAC Level

The district production coordinator is the technical head of the fisheries sector and coordinates the functions and activities of the district fisheries.

Figure A9.4-33 shows the water catchment and river areas accessible to the sample PACs.

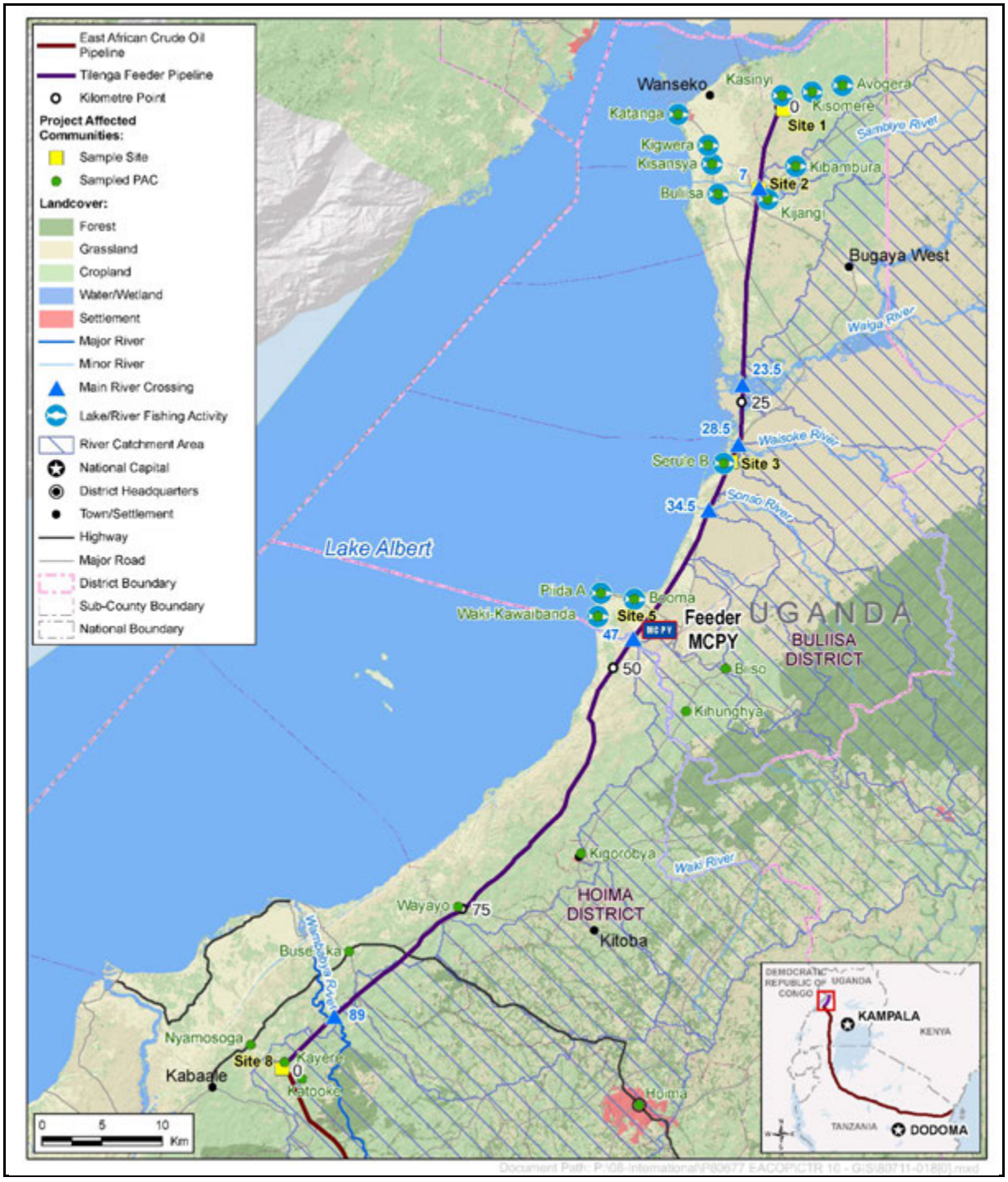

Figure A9.4-33 Land Cover, Water Catchments and River Areas in the Sample PACs

River, Stream, and Wetland Fishing

The AOI crosses the Waiga River (KP23), Waisoke River (KP28), Sonso River (KP34), Waki River (KP47) and the Wambabya River (KP89) near to PS1. These main rivers, as well as a series of minor rivers, streams and wetland areas, provide the fishing grounds for local communities (Figure A9.4-33).

Fishing on rivers streams and wetlands can be undertaken all year round, although the dry season causes some tributaries and wetland areas to dry up thereby reducing fishing grounds. Species found in these rivers are *Protopterus aethiopicus*, *Schilbe intermedius*, *Labeo* sp., small mormyrids and macroinvertebrate such as chironomids (see Appendix A2 Aquatic Biodiversity Baseline Report). KIIs found that fishing in the lake is favoured over fishing in rivers, as catches are more plentiful from the lake. Landless fishing households, or those with small agricultural plots, fishing in rivers are more dependent on fishing activities as a source of protein and to derive an income.

Gear

FGDs and KIIs with district fisheries officers found that the following gear is used:

- gill nets (see earlier in this section)
- fish traps or baskets (see earlier in this section)
- spear fishing (fisherfolk scan the water for fish to spear).

Marketing

Fish caught in rivers and wetlands are mainly consumed by the household. Surplus is processed and marketed by women.

Freshwater Fishing Challenges

FGDs and KIIs with district production officers and fisherfolk found the following challenges associated with freshwater fishing:

- basic fishing techniques used by fisherfolk in rivers and wetlands have low returns
- seasonal watercourses drying during the dry season reduce fishing opportunities for a large part of the year
- increased conversion of wetland areas for agricultural activities reduces fishing opportunities.

Lake Fishing

Lake Albert provide freshwater fishing grounds. Distributed along the shoreline are fish landing sites where boats and nets are stored, fish processing is undertaken, food stalls and traders operate and BMUs are established (Hoima DDP 2015; Uganda Nile Discourse Forum 2013, Internet site).

Fish-landing-site communities in both districts have expanded substantially in recent years. Fisheries act as a pull factor particularly to unemployed youth from inland as well as transborder from the DRC. Improved road networks associated with oil developments have facilitated movement to these areas that were previously difficult to access via roads (Oil in Uganda 2013, Internet site). The Artelia (2015a and b) studies found that as there is limited availability of land to buy or rent in Buliisa district, migrants to the area tend to settle within 200 m of the lakeshore, an area where land cannot be privately owned, yet this is tolerated by the local authorities. Landless fishing households, or those with small agricultural plots, are more dependent on fishing activities as a source of protein and to derive

an income. Landing sites have also been linked with relatively high levels of social ills such as alcoholism and HIV and AIDS (see Section A9.4.11).

Younger males dominate fishing (Hoima DDP). However, women are involved in the processing and marketing part of the fish supply chain. Studies found that some women had been able to invest in vessels through participating in saving circles (Artelia 2015a, 2015b). Diverse ethnic groups, including the Bagungu, Alur, Banyoro and Lugbar, engage in fishing activities with the Bugungu and Alur dominating. In some of the fishing communities in Buliisa, 80% of the population were migrants (Artelia 2015a).

The Alur constitutes a large proportion of immigrants because many (both Congolese and Ugandan) migrated to landing sites in the districts in the 1940s and are now well established, with some reportedly owning vessels. These migratory movements continue because of conflict in DRC. Most come on their own initially with their family joining them once they are settled and established in the community. KIIs with the Buliisa production officer found that there has been an increase in the number of families joining their family members in Buliisa district. This is possibly attributable to expectations of potential employment opportunities associated with oil exploration.

Lake fishing is predominantly a full-time occupation and most fishing households are therefore solely dependent on this income source. These communities are toward the edge of the Lake Albert shore at PAC landing sites in Katanga (KP4), Kigwera North East and Kigwera North West (KP4), Serule A and B (KP30.5), Booma, Piida A, (KP45.5) and Waki Kawaibanda (KP47). A small proportion of those who fish do so on a part-time basis, sharing their time with other income-earning opportunities such as crop farming, livestock rearing or trading. Part-time fisherfolk travel to the lakes from inland villages when they deem fish prices to be profitable, during the seasonal downtime of the agricultural activities or when the household needs immediate cash to pay for school fees, funeral costs or other emergency expense. In addition, during the rainy season when fishing is more fruitful between March and June, temporary migrants come to the lakeshore in search of income earning opportunities surrounding fishing activities. Men, especially youth, from inland areas of Buliisa and Hoima or neighbouring districts temporarily move to landing sites such as Butiaba, Kabolwa or Wanseko for a short period of time, from a few days to a couple of weeks. They undertake night fishing activities (Artelia 2015b). The following PACs were found to undertake fishing on a part-time basis: Kisomere (KP0), Kibambura (KP5), Kijangi (KP8), Kihunghya (KP49.5), Kigorobya (KP64.5), Buseruka KP84.5), Rwamatonga (Buseruka subcounty) (KP86) and Rwamatongoa (Bugambe subcounty) (KP87.5).

Lake fishing is undertaken from the shore or vessels. Boats are usually paddled, with only a minority having outboard engines. There are typically two people per vessel and no fish-cooling capacity.

Generally, offshore fishing trips are undertaken once a day, but a second trip may be made if the first catch is low. Fishermen usually leave in the evening (night fishing) or early morning to cast their nets and collect their catch the next morning. Studies undertaken by Advisian (2015: 42) found that some fishermen stay out on the lake for two to three weeks without landing. Gill nets are left in the water and

towed to landing sites without lifting the nets out of the water. This method avoids the need for cooling facilities because the fish are kept alive for the entire duration of the trip.

During the dry seasons, winds can pick up on the lakes and, without life jackets, fishing becomes hazardous. FGDs found that fishing communities experience high levels of mortality due to the changeable weather on the lake and absence of safety equipment.

Figure A9.4-34 Fishing Vessels in Piida A, Buliisa District (KP45.5)

Few fisherfolk own vessels, either because they fish part time or they cannot afford to buy a vessel. The vessel owners (men and women) are deemed the more affluent members, and observational analysis showed that they were often the older generation within communities. They do not fish themselves but rent out their boats. Rental prices of vessels are UGX 80,000–120,000 (USD 21.39–32.10) per month or UGX 2600–4000 (USD 0.70–1.07) per day (Artelia 2015a: 146). Some vessel and fishing gear owners also were found to undertake livestock rearing as well (Artelia 2015b; Laurent 2013). The less affluent full time or part-time fisherfolk use vessels and nets they have hired and share the daily catch as in-kind payment or other arrangements are made. Artelia (2015) studies found that there were various profit-sharing scenarios:

- 50% of the catch for the owner of the equipment (boat and net) or the person that rents it, and 50% for the fisherfolk crew (divided among themselves)

- 20% to the boat owner, 40% to net owner and 40% to the fisherfolk crew (divided among themselves).

The main fish caught in the lakes in the districts traversed by the AOI are Nile perch, tilapia, mud fish, *Clarias*, muziri, lung fish and *Bracynus nus* (see Appendix A2 Aquatic Biodiversity Baseline Report).

KIIs with district fisheries officers found that the following gear is used.

Gill Nets

Gill nets are the most popular fishing gear (Figure A9.4-35). The nets are made locally out of synthetic line which is traded in urban centres such as Hoima and at landing sites. The nets are normally set out at dusk and hauled in at dawn. Drift gillnetting is commonly practised on Lake Albert, but rarely on smaller waterbodies. The nets have different mesh sizes according to the type of fish targeted. Mesh below 100 mm is illegal but, according to KIIs with fisherfolk, finer mesh is used.

Figure A9.4-35 Fishers with Gill Nets in Piida A, Buliisa District (KP45.5)

Longline

This comprises a long length of line (100 to 300 m) carrying baited fishhooks. A longline is placed in the lake in the morning or afternoon and left to fish passively overnight.

Hooks

This method consists of hooks placed along a shore line. Bait is put on the hooks to attract the fish.

Silver Fish Fishery Mesh

Silver fish are caught at night using a net approximately 5 to 10 mm mesh and 40 ft long and paraffin lamps are lit to attract the fish (Figure A9.4-36). Silver fish are also fished from the shore. Women undertake the latter, often the poorest in the communities, such as widows whom have lost their husband on the lake.

Figure A9.4-36 Fishing Nets Used to Catch Silver Fish in Piida A, Buliisa District (KP45.5)

Cast Nets

A cast net is circular with weights around the circumference. When cast, the net opens and then closes after hitting the water trapping fish within the area it covers. Cast nets are used from vessels or from the shore in shallow waters. Cast net

fishing is mostly undertaken by men, but also on occasion by women from the shore, as disclosed at Waki Kawaibunda village (KP47).

Fish Traps or Baskets

Traps or baskets made from natural materials such as papyrus have a conical entrance to a capture chamber. These traps are strategically placed in areas where fish regularly pass or congregate, such as river mouths, fringes of papyrus wetland areas, main river channels and access channels to wetland areas. This method is not commonly used.

Marketing and Processing of Lake Fish

A small percentage of fish caught is kept for the household. In Hoima, fisherfolk consume 20 to 30% of the fish caught (Hoima DDP 2015). On average fish prices are high owing to the high demand and the short supply. High market prices encourage fisherfolk to sell rather than consume or share their catches in the local fishing community. This has, on occasion, threatened food security of the more vulnerable households. In Buseruka subcounty, fish prices range from UGX 2000 to UGX8000 (USD 0.53–2.14) per kg depending on the type of fish and whether it is fresh or processed. Prices vary according to the season, availability of fish in the market, size and species.

Marketing of fish is undertaken in the following manners:

- fresh or processed to local individuals in communities or in local markets such as Ngwedo town centre, Biiso and Wanseko, Kabolwa, Bugoigo or Hoima municipality, transported by bicycle
- fresh to buyers who come with refrigerated trucks from beyond the districts to sell to supplies in Kampala or other larger towns (reported at Katanga and Kigwera N/E (KP4) and Waki Kawaibunda (KP47)
- fresh or processed at regional markets such as Panyimur, which is then transported to North Uganda or the DRC.

FGDs found that profits are shared once the fish has been sold to the end user (Hoima DDP and Artelia 2015d). This type of transaction can reputedly cause conflict if the person who markets the fish does not share the profit fairly.

Fish processing is undertaken by sun drying the fish on makeshift dryers made from papyrus or by smoking the fish in mud ovens fuelled by firewood. Women undertake these fish processing activities. Salting, a male activity, is also undertaken to preserve and sell fish.

Figure A9.4-37 Fish Salting in Piida A, Buliisa District (KP45.5)

Lake Fishing Challenges

FGDs and KIIs with district production officers and fisherfolk identified the following challenges associated with lake fishing:

- There is an ongoing reduction in fish stock due to overfishing. Illegal fishing gear is used to boost catches such as beach seines, fine-meshed cast nets or small hooks, thereby exacerbating the problem.
- There is insufficient infrastructure at fish landing sites such as cold rooms, handling slabs and safe water for cleaning fish.
- In 2003, the MAAIF established BMUs for lakeshore fishing activities at district level to improve control and monitoring of fishing to prevent over-fishing and appropriate use of legal equipment.
- Competition for resources can become violent on the lake and the shore, as experienced in 2015 between Ugandan and Congolese fishermen in Kasinye East (KP0) (Artelia 2015a)

Aquaculture

Aquaculture undertaken in the districts consists of pond fisheries and cage fisheries in lake waters. Hoima DDP states that less than 1% of Hoima's population is engaged in aquaculture. It is predominantly a subsistence activity, undertaken in manmade ponds or dams up to 500 m^2 in size. Fish are reared intensively with the assistance of feed inputs, often prepared on site. Aquaculture is a year-round

activity, although other livelihood activities are usually undertaken alongside such as crop farming.

Despite Government initiatives to encourage aquaculture, it has not been taken up on a large scale, possibly owing to readily available lake fishing opportunities. MAAIF, in conjunction with FAO, has initiated pilot projects to promote cage fishing and fishponds in the districts. Target groups are youth, particularly those who do not own land. Under a cost-sharing basis, two groups (Butiaba Fishers and Farmers Development Association, BUFITA, and Butiaba Young Fishers and Traders Association, BUFIDA) of twenty members have been trained on cage fish farming and provided ten cages, fish fingerlings and feed as a startup for the first of four phases (FAO 2018 internet site).

Aquaculture Challenges

FGDs and KIIs with district production officers and fisherfolk identified the following challenges associated with aquaculture:

- Low inputs and the low quality of fish fry and feeds constrain aquaculture, resulting in poor productivity.
- Major diseases including fungal infection and stunted growth are experienced because of poor feeds.
- Predators such as monitor lizards, snakes and herons further reduce yields (UBOS 2009b).

Human Rights

The following human right applies to river and lake-based livelihoods:

- the right to an adequate standard of living. Universal Declaration on Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples' Rights, article 21.

Trend in Condition and Sensitivity to Change

The following trends were identified for river- and lake-based livelihoods:

- Lake fish stocks are decreasing due to overfishing, which encourages the use of illegal fishing gear (fine-meshed nets).
- Population growth is increasing pressure on natural resource use, including river fishing; additionally, this is causing more wetlands to be drained for agriculture and other land use thus further constraining fish availability.

Ecosystem Services Provided

The river- and lake-based livelihoods described herein provide the following ecosystem services.

Provisioning services:

- income from selling catch and fishing equipment
- food to supplement diets
- products for fish processing activities.

Fishing has been an important activity for generations and is a major part of the PACs' way of life, particularly for the lake fisherfolk.

Sensitivity Rating

The social baseline identified sensitive VECs for river and lake-based livelihoods. These are presented in Table A9.4-24.

Table A9.4-24 River and Lake-Based Livelihoods VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Lake fisherfolk who fish part time	Moderate (3)	This category of fisherfolk undertakes fishing activities alongside crop farming or informal trading activities. Therefore, they are less vulnerable to a reduction of one of their income streams.
River fisherfolk	Moderate (3)	River fishing is often undertaken alongside other income-generating activities. Therefore, river fisherfolk are less vulnerable to a change in status of one of the income streams.
Lake fisherfolk who fish full time	Very high (5)	This category of fisherfolk is dependent on fishing as a sole livelihood and subsistence activity. There are few other income-generating opportunities available and without land holdings they are particularly vulnerable.
Women who are dependent on lakeshore fishing	Very high (5)	Women fishing from lakeshores are considered highly vulnerable with low resilience to external shocks, as they have no alternative means of livelihood and are dependent on shore fishing for food security and income generation.
Women who process and market fish	Very high (5)	Women have limited income earning opportunities; however, fish processing and marketing provides a substantial income stream on which households depend.
Employed workers of aquaculture enterprises	Very high (5)	Often landless and exclusively dependent on their job

A9.4.7.2 Key Considerations

Key considerations are:

- lake fishing and aquaculture are small-scale subsistence activities
- those whose livelihoods are dependent on fishing are poor and do not have access to credit, and so their resilience is low
- there is pressure on the fisheries sector due to increasing crop failures caused by drought or floods forcing crop farmers to look for alternative means of generating an income
- young people are becoming more attracted to fishing activities as the size of farming plots for the younger generations is diminishing, rendering crop farming less profitable
- human right to access to food and an adequate standard of living for communities.

A9.4.8 Land and Property

A9.4.8.1 Baseline Condition of Land and Property

National and District Level

The Land Act (1998; 2010) identifies four forms of land tenure: customary, leasehold, freehold and mailo (see below) (MLHUD 2013). Most citizens hold their land under customary tenure, which applies to specific land areas that are governed by customary laws. Land under this tenure system is communally, jointly or individually owned, often without land titles and often presided over by elders, clan leaders or figureheads within communities. In the laws of Uganda, customary tenure is defined as, "A system of land tenure regulated by customary rules which are limited in their operation to a particular description or class of persons".

Over 60% of land is held under a customary tenure system, most of which is found in the northern, western and southern parts of the country and in Buliisa and Hoima. Key problems associated with this tenure include lack of security for landowners and disadvantages for women (MLHUD 2013).

The Land Act (1998; 2010) provides for two mechanisms in which rights held under customary tenure can be formally recognised:

- acquiring a certificate of customary ownership (CCO). Any person, family or community holding land under customary tenure on former public land may acquire a CCO. A CCO can be acquired through a tiered application process. The area land committee reviews applications, and the district land board eventually issues the certificates.
- forming a communal land association (CLA) by any group of persons under the Land Act for any purpose connected with the communal ownership and management of land, whether under customary law or otherwise (GOU 2013b).

Under the mailo tenure system, land is registered under the Registration of Titles Act, which grants the holder a land title and absolute ownership in perpetuity. This tenure system recognises occupancy by tenants (known as *Bibanja* holders), whose relationship with the landlords is governed and guided by the provisions of the Land Act (1998; 2010). Land held under mailo tenure (approximately 23,300 km^2) is confined to Buganda (central Uganda) and Bunyoro (western Uganda). At present, there are more than 250,000 mailo land title holders in Uganda (MLHUD 2013).

The mailo tenure also termed "native" freeholds separate the ownership of land from occupancy or ownership of developments by lawful occupants. This can cause conflicts of interest and overlaps in rights on the same piece of land. The Land (Amendment) Act of 2010 grants statutory protection to the lawful occupants against any arbitrary eviction as long as the prescribed nominal ground rent is paid (GOU 2010). However, the nominal ground rent provided for is mostly ignored creating a land use deadlock between tenants and registered landowners (CNOOC et al. 2016). This is a key feature of land ownership in the central region for land owned by Bunyoro-Kitara Kingdom and on which many Tilenga PAPs reside.

The third land tenure system (freehold) is similarly governed by the Registration of Titles Act. Under this system, a registration of title in perpetuity and conferment of

full powers of ownership is provided to the land holder, who may use the land for any legal purposes. Only national citizens are legally entitled to own land under the freehold system and there is little land held under freehold tenure. Where it is held, the majority has been issued to church missionaries, academic institutions and some individuals. This system is not common in Buliisa or Hoima districts (MLHUD 2013).

The leasehold land tenure system entails owning land for a set period, usually 49 or 99 years, with agreed conditions and a rental fee or premium.

Land conflicts form the highest percentage of disputes reported both in formal and informal dispute resolution systems in Uganda. Common concerns reported are landlord–tenant relations on mailo land, land tenure insecurity in post-conflict northern Uganda, disputes over land expropriation by the Government and the implications of oil exploration and mining for local land tenure systems and rights (MLHUD 2013).

Access to Land

The Land Act (1998; 2010) includes provisions to ensure access to land and enhance the security of tenure for all citizens, such as the legal recognition of customary ownership at the individual level. The legislation also recognises land held by a community to maintain access to community land, its use and the titling of communal land.

Communities, usually clan members, who share communal land and are seeking to formalise their ownership must arrange themselves into a CLA and register their interest with the district registrar of titles. Under the designation as a CLA, the association can obtain certificates of customary ownership and freehold titles. After the titles are obtained, the association can:

- transfer land they own under customary tenure or freehold to individual families, if they wish to do so
- set aside areas of common land use within the communally owned land and set up a common land management scheme (in particular, setting the prerequisites for natural resource takings).

The 1995 Constitution grants land ownership rights solely to citizens of Uganda. Foreigners cannot own freehold land, although they may obtain leases for 49 or 99 years. Foreign individual or corporate investors cannot acquire land for crop or animal production. Foreigners can either rent or lease land from citizens or the Government (Global Property Guide 2016, Internet site).

The Land Act seeks to protect equitable ownership of land for women and vulnerable persons through three dispositions:

- women and vulnerable persons cannot be excluded from customary ownership (all customs that exclude them are regarded as null by the law)
- land committees must protect the interests of women, children and disabled persons
- women must be represented in land committees, CLAs and tribunals.

Land Management

Lack of an established land legal framework exposed customary landowners to forceful evictions and land grabbing on a national and local scale. The Government has engaged in an ongoing reform process to tackle the root causes of these matters and to accommodate rapid changes in Ugandan society, particularly oil and gas discoveries.

The objectives of the National Land Policy (2013) are to:

- stimulate the contribution of the land sector to overall socio-economic development, wealth creation and poverty reduction in Uganda
- harmonise and streamline the complex tenure regimes in Uganda for equitable access to land and security of tenure
- clarify the complex constitutional and legal framework for sustainable management and stewardship of land resources
- redress historical injustices to protect the land rights of groups and communities marginalised in the past or based on gender, religion, ethnicity and other forms of vulnerability to achieve balanced growth and social equity
- ensure planned, affordable and orderly development of rural and urban settlements, including infrastructure development (GOU 2013b).

The MLHUD is responsible for formulating policy and overseeing the land sector nationally. The ministry is composed of three directorates, two of which are central in land management: the directorate of land management, and the directorate of physical planning and urban development. At the district level, land is administrated by the district land office, district land board and district tribunal (not functional). The district land management officer (DLO) provides technical services to the district administration and the district land board (DLB). The DLB is responsible for holding and allocating land in the district, facilitating the registration and transfer of interests in land and compiling and maintaining rates of compensation payable (i.e., crops and non-permanent buildings).

Buliisa does not have a fully functioning DLO; the district relies on a physical planner who also assumes the functions of the land officer and natural resources officer (Artelia 2015a). The Buliisa DLB was constituted in 2007 but remains challenged by a lack of human and financial resources (Artelia 2015a). Hoima district has a fully functioning DLB; strengthening the capacity of this body through better equipment and personnel training is an investment priority for the future (DDP 2015).

At the subcounty level, an area land committee and a recorder administrate land. In 2016, an online cadastre (register of land ownership) was launched for the mining sector, which aims to reduce conflicts between different landowners involved in mining activities.

Institutions like the church and kingdoms own large tracts of land that they lease out to individuals on a leasehold basis. Regional and field offices manage this land centrally and handle land matters on behalf of the responsible institution.

Challenges

Table A9.4-25 shows the problems that hamper land management.

Table A9.4-25 Land Management Challenges

Challenge	Description of Challenge
Land titling	Few land holdings are titled. This can be attributed to factors including the protracted process required to register land officially and the associated cost.
Speculation	Speculation is a common consequence of publicly disclosed land acquisition. Speculative behaviour is often initiated and may be funded by resourceful individuals with access to information on potential development areas (information which is otherwise not publicly available). Acting on such information, speculators extort land from desperate landowners (usually parcels held under customary tenure) often at below-market prices and without consent from family or clan members who have interest in the same land. In addition, due to the large number of unregistered land parcels in the area, land is often transferred and registered without consent or due process by individuals who do not share interests in the targeted land and who have access to the land administrative system. Legitimate landowners (with customary tenure rights) are thus deprived of their land rights, often without their knowledge.
Contested land ownership	Weaknesses in the land administrative system give rise to land ownership disputes, not least because of incomplete transactional processes, including title registrations.
Recognising and formalising rights under customary tenure	Customary tenure does not give clan leaders any land ownership rights; however, these institutions have the power to establish rules for people claiming their rights and interests on specific parcels of land. Increasingly, land is being parcelled into individual plots, even in clan-held areas, and there is therefore evidence of a move toward individual ownership. CCO linked to membership of a given clan may not be relied on as stable instruments because social migration and community dynamics change family and community composition.

SOURCE: Adapted from CNOOC et al. (2017: 23/24)

Land and Gender

Despite policy and legal safeguards, the head of the household, predominantly male, is usually perceived as the rightful owner and custodian of the land. In Uganda, women formally own 16–26% of the land, informal (customary) ownership is approximately 15% and conjugal ownership 3% (LANDac 2016). As the value of land is increasing, male dominance over land-related decisions is increasing.

Women and young men are dependent on the head of the household for their access to land. Teenage sons can participate in land management as heirs and are entitled to decide what to do with their inheritance. Women and girls do not typically participate in land-related decisions.

A considerable source of inequality of land rights is linked to the practice of customary marriages that are polygamous and not legally registered. At the end of a customary marriage (i.e., separation or widowhood), women may lose any land rights. This type of marriage does not protect women's land rights, leaving them vulnerable to loosing access to land.

Land Holdings

National data relating to average land holding size is scarce. However, UBOS (2009) states that the national holding size is 1.1 ha (equivalent to 2.7 acres). Average land holdings in the districts traversed by the AOI are small and fragmented, i.e., between 1 and 10 acres in Buliisa and roughly 6.2 acres in Hoima (DDPs 2015; KII with district land experts). Generally consistent with the national average, CNOOC et al. (2016) and Artelia (2015a) report that households in Buliisa and Hoima cultivate an average of 2 acres of land. The DDPs recognise that the small size of holdings constrains the agricultural sector and is attributable to a growing population, inheritance protocols (which divide land up between family members) and land shortages.

Land Conflicts

Land conflicts are the most common source of dispute, and are mainly due to:

- inheritance of land and land partitioning among the heirs
- nonconsented land sales within the family
- exclusion of women from land ownership
- fraud over land purchase or illegal land sales
- disputes over land boundaries
- expansion of settled and ranching farming, national parks, towns and settlements encroaching on village land
- land use plans that deny local communities access to land and natural resources needed for livelihoods
- village boundaries not being properly set
- land being acquired by the government for public purposes, but subsequently being used for other purposes, causing dissatisfaction with the original landowners.

The Land Act (1998; 2010) created a dedicated judiciary system to solve land conflicts through district land tribunals, although this resulted in numerous problems and the approach was abandoned in 2006. Land cases are handled by the judiciary system through civil magistrate courts. This often delays conflict resolution owing to work overload on these courts. For example, in 2013, 75% of the courts' case backlogs are related to land-related conflicts (MLHUD 2013).

PAC Level

From KIIs and HHI, the largest land holding in sample PACs reported was 162 ha in Booma (KP44.5). The smallest land holding was 0.4 ha in Biiso (KP44.5). Table A9.4-26 presents access to land, land tenure regimes and land conflicts in the sample PACs.

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
0	Buliisa	Ngwedo	Avogera	In Avogera boundary disputes, trespassing and multiple and fraudulent land sales are the main disputes relating to land, also history of conflict with the Balaalo herdsmen in Buliisa. Many parties are involved in resolving land disputes including the village council, elders, the subcounty ALC, the DLB, police, religious leaders, subcounty chief, magistrates court, parish chief, neighbours and the warring parties.	Common: customary
			Kasinyi	Land concerns in Kasinyi have increased because of population growth and the arrival of the oil industry. Conflicts mainly revolve around damages to crops by livestock, land ownership and land boundaries. The village council and clan leaders are the first parties involved in resolving the conflict.	Common: customary
			Kisomere	No conflicts reported. If they occur, village leaders are called upon to resolve disputes.	Common: customary (individual)
4		Kigwera	Katanga	Disputes over land boundaries are frequent in Katanga and mainly relate to the boundaries of new buyers in the area. There is a land issues committee, comprising four women and two men, which examines land concerns and, if necessary, refers cases to the village council and subcounty ALC.	Common: customary

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
			Kigwera	In Kigwera, recent cases have emerged of multiple land sales, resulting in conflict. Clan leaders resolve disputes surrounding land. If resolution at this level is unsuccessful, the dispute is escalated to higher authorities, i.e., village council and subcounty.	Common: customary
5		Ngwedo	Kibambura	In Kibambura, the arrival of oil companies has led to conflicts over land boundaries to the extent that the number of inter-clan marriages has fallen. Land conflicts in this sample PAC also occur historically and currently between herdsmen from inside and outside the area. Clan leaders resolve land disputes. If unsuccessful they are escalated to higher levels, i.e., village council and subcounty.	Common: customary (individual)
6		Buliisa Town Council	Kisansya	Land conflicts in Kisansya relate to land shortages and have intensified since oil activities began. The village tried to mobilise and develop a CLA but it was unsuccessful due to lack of funding. Clan leaders and the village council are the first points of contact for resolving conflicts.	Common: customary
8			Buliisa, Kijangi	In Kijangi, there have been boundary disputes and crop destruction. Illegal sales have occurred following the arrival of oil companies, with land disputes reported to LC1 or resolved through mediation by neighbours and previous landowners.	

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
30.5		Butiaba	Serule B	Land disputes in Serule B relate to land boundaries, livestock roaming, theft of natural resources and poaching. These disputes have worsened because of population growth and the resulting decline in land availability and increased competition for resources. Disputes are usually mediated by a third party (i.e., neighbours, elders, chairperson of village).	Common: customary (communal) (all land)
35		Buhimba	Kabaale-Kyabicwe	No data available	
44.5		Biiso	Biiso	In Biiso, land conflicts are very common and predominantly relate to disputes over land boundaries and land ownership. There have been cases where different people have provided evidence, i.e., papers, indicating that they are rightful owners of the same piece of land. Attempts to resolve land conflicts firstly occur at the family level. If conflict resolution is unsuccessful, the dispute is escalated to the village council and parish chief and eventually, if necessary, to the subcounty.	Common: customary (individual, communal)

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
44.5		Butiaba	Booma	Land disputes in Booma concern grazing areas. Banyankole pastoralists from outside the area travel to the village in search of land to graze their cattle. Banyankole pastoralists often use land without permission. In response, land associations have been formed to make land use agreements with non-Bagungu and non-Banyoro herdsmen. The discovery of oil in recent years has fuelled scrambles for land and land grabbing by people from outside the area. KII in Booma revealed that community members collecting grass for thatch often enter the Government land holding of the Uganda People's Defence Force's Wantembo military barracks, which does not have a periphery fence and is unguarded. This was said to be a source of conflict. The barracks intend to enlarge its capacity, which could result in further confrontations with nearby communities that are used to having access to the grass for thatching and grazing.	Common: customary Government land
45.5			Piida A	Land disputes in Piida A stem from population increases leading to land scarcity and conflicts over land access. The local council and subcounty council are consulted to resolve disputes regarding land access.	Common: freehold Uncommon: customary

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
47			Waki-Kawaibanda	Land disputes in Waki-Kawaibanda have stemmed from animals destroying crops. The village chairperson plays a key role in mediating between the farmers and pastoralists and resolving the conflict.	Common: customary
49.5		Kihunghya	Kihunghya	Land conflicts in Kihunghya relate to land boundaries, as people's land is not well demarcated. The local council, subcounty council and police are involved and mediate between the two parties concerned.	Common: customary (virtually all land)
64.5	Hoima	Kigorobya Town Council	Kigorobya	Conflicts over land in Kigorobya relate to livestock straying into crop farmers' fields. This problem has worsened in light of population growth and the resulting decline in land availability. Resolution is sought by sensitising livestock owners about the laws that govern animal grazing. Local council members and formal courts are sometimes involving in settling agreements.	Common: customary (individual) (all land)
74.5		Kahoora Division	Hoima municipality	No data available	
75		Kigorobya	Wayayo	No present disputes reported in Wayayo. In the event of a dispute, the community is called to come together and discuss the problem with the village chairperson. Depending on the size of the dispute, it may be elevated to higher levels, i.e., parish and subcounty.	Common: customary (communal) Uncommon: customary (individual)

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
84.5		Buseruka	Buseruka	In Buseruka, disputes are about damage to crops resulting from pastoralists allowing animals to graze on cultivated land. The conflict is exacerbated by population growth in the sample PAC, which has further reduced the availability of grazing areas. Pastoralists with grazing land have erected fencing, preventing access from landless pastoralists, turning them toward crop farmers' fields. Resolution has been sought by involving the local authorities. Crop farmers report that pastoralists are hesitant to respond to their complaints.	Common: customary (individual) Uncommon: customary (communal)
86			Rwamutonga	In Rwamutonga, conflicts occur between pastoralists and crop farmers over the destruction of crops by livestock. To mitigate the problem, livestock owners are encouraged to restrain their animals.	Common: customary (private) (all land)
87.5		Bugambe	Rwamutonga	In Rwamutonga, conflicts occur between land title owners and tenants. Local leaders are involved in resolving these conflicts.	Uncommon: customary (individual), leasehold

Table A9.4-26 Access to Land, Land Tenure and Land Conflicts in the Sample Potentially Affected Communities

KP	District	Subcounty	Settlements	Conflicts and Conflict Resolution Reported	Land Tenure Regimes
94.5–95 PS1		Buseruka	Kayere, Nyamasoga, Katooke	In Katooke and Kayere, disputes are caused by people grazing their animals on land under cultivation. Pastoralists and farmers often clash over this matter, with pastoralists claiming that farmers should erect fences to protect their crops from animals. However, some pastoralists have no access to grazing land, forcing them to move them toward cropland. Youth increasingly have no access to land because of inheritance protocols and the subdivision of family land through the generations. This makes the parcels of land progressively smaller each generation of inheritance, reducing the availability of productive land. Land speculation is prevalent. Reports of speculative behaviour such as forced eviction of rightful owners from below-market prices and often without consent from family.	Common: customary (individual), leasehold Uncommon: mailo (registered with title deeds), freehold

SOURCE: Interviews with community leadership (Artelia 2015b)

NOTES: Data for the following sample PACs came from Artelia (2015b): Avogera, Kasinyi, Kisomere, Katanga, Kigwera, Kibambura, Kisansya, Buliisa and Kijangi.

The PAC profiles (Attachment A9.2) and summary of important historical events (Attachment A9.5) provide details about past land conflicts in the sample PACs.

From the table the following can be concluded:

- There are land conflicts in most of the sample PACs. These relate to:
  - livestock encroaching on crop farming areas to find grazing land for their cattle. Population growth, resulting in reduced land availability, and the lack of implementation of land management plans exacerbate this problem.
  - the precise land boundaries between individual plots and villages
  - multiple and fraudulent sales of the same piece of land, leaving buyers without formal title deeds vulnerable
  - land speculation and land grabbing in sample PACs belonging to Buliisa district, i.e., Kibambura (KP5), Kijangi (KP8) and Booma (KP44.5), attributed to oil exploration and development.
- Consistent with national and district level data, customary land is the most common tenure regime in the study area. In most sample PACs, it is communally or individually owned.
- Clan leaders, elders and village councils play a key role in conflict resolution at the PAC level. Disputes which cannot be resolved by these individuals are often escalated to higher levels (i.e., subcounty ALCs and DLBs).

Settlements and Housing

In rural areas, most dwellings concentrate along national and secondary roads. Hamlets and villages often have a central trading place in which main business and social activities take place.

Two types of housing structures are common throughout the PACs: a traditional structure constructed using wood joists and uprights, with thatched roofing and adobe walls; and improved houses with brick walls, and zinc or fired-clay tiled roofs.

A9.4.8.2 Human Rights

The following human rights apply land and property:

- Universal Declaration of Human Rights, article 17; African Charter on Human and Peoples' Rights, article 14
- Universal Declaration on Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples' Rights, article 21
- Universal Declaration on Human Rights, articles 1, 2 and 23(2); International Covenant on Civil and Political Rights, articles 2 and 3; International Covenant on Economic Social and Cultural Rights, articles 2 and 3; ILO Convention 111 on Discrimination (Employment and Occupation); Convention on the Elimination of All Forms of Discrimination Against Women; UN Women's Empowerment Principles (2010); African Charter on Human and Peoples' Rights, articles 2, 3, 15 and 18; Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa
- Universal Declaration of Human Rights, articles 25.2 and 26; International Covenant on Civil and Political Rights, article 24; International Covenant on Economic, Social and Cultural Rights, articles 10, 12 and 13; Convention on the Rights of the Child; African Charter on Human and Peoples' Rights, article 18; African Charter on the Rights and Welfare of the Child.

Since the beginning of oil exploration, there have been concerns about the land acquisition and resettlement process in Buliisa district. Negative experiences with compensation rates and payments, alongside lack of participation, particularly by women, in the resettlement process, have been reported (UHRC 2013).

A9.4.8.3 Trend in Condition and Sensitivity to Change

The following trends and sensitivities were identified:

- An increase in population and in-migration in certain areas with accompanying purchase of land by migrants is increasing scarcity of land. The overall number of disputes involving land-related cases is growing.
- Long-standing discrimination that excludes women from owning, inheriting and controlling land is causing a high level of inequality. Furthermore, as the value of land increases, the male dominance over land-related decisions is likely to increase.
- Recognition of land value and the enactment of land legislation have increased the quantity of land being registered, sold and purchased. Consequently, there is less land being inherited and more land being sold.
- Land is often bought by outsiders of the village with higher purchasing power. During these transactions, there are an increasing number of fraud cases. The sale of land for private use is reducing the availability of communal village land, which was in the past used for grazing.

A9.4.8.4 Ecosystem Services Provided

The ecosystem services provided by land have been considered in Section A9.4.6, Land-Based Livelihoods.

A9.4.8.5 Sensitivity Ranking

The social baseline study has identified several sensitive VECs with regards to land and property. These are listed in Table A9.4-27.

Table A9.4-27 Land and Property VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Livestock rearers practicing localised nomadism	Moderate (3)	Without access to land or water, livestock quality and quantity will be adversely affected; localised nomadism has become increasingly important because of recent droughts and climate variability.
Landholders without title deeds (Kibanja or other)	High (4)	Without formal acknowledgement land holders will not have land ownership rights and will not be eligible to compensation, only for crops grown.
Youth	High (4)	Youth have limited access to land outside their customary rights as a member of a clan or family and inheritance protocols mean that parcels of land are becoming smaller and less viable.

Table A9.4-27 Land and Property VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Female headed households	Very high (5)	Without land ownership rights and long-standing discrimination that excludes women from owning, inheriting and controlling land causing a high level of inequality and without access to productive capital, women are particularly vulnerable.
Previously displaced/resettled HH/individuals	Very high (5)	Households or individuals who have undergone resettlement or compensation within the AOI will be particularly vulnerable to further change and have low resilience to additional shocks.

A9.4.8.6 Key Considerations

Key considerations are:

- the increasing scarcity of land because of a growing population
- the vulnerability of most landowners owing to a lack of formal title deeds
- women being disadvantaged in terms of access to land. Compensation for loss of land will mostly be paid to the head of household (men) without spousal consent leaving women vulnerable in terms of access to that compensation.
- the existence of numerous land conflicts exacerbated by land shortages
- the lack of land management plans, which impact on the distribution of land
- the existence of vulnerable groups in terms of land take, such as illegal users of the land, including hunters and natural resource collectors (see land-based livelihoods, Section A9.4.6)
- an increase in land-grabbing schemes used to obtain land unlawfully or under false pretexts, high amounts of land speculation and reports of speculators extorting land from people creates fear and insecurity
- resettlement activities have previously taken place in the study area associated with development activities undertaken by the Uganda National Roads Authority (UNRA), Uganda Electricity Transmission Company Limited (UETCL) and other government agencies (CNOOC et al. 2016). Legacy concerns associated with these resettlement activities may impede the resettlement process for the Tilenga feeder pipeline. If unavoidable, secondary displacement of some households may occur because of Tilenga feeder pipeline resettlement activities.
- the return of former assets to the Bunyoro-Kitara Kingdom by the GOU could render land acquisition in Buliisa and Hoima more complex (Artelia 2015a).

A9.4.9 Workers' Health Safety and Welfare

A9.4.9.1 Baseline Condition of Workers' Health Safety and Welfare

National Level

The majority of the International Labour Organisation (ILO) conventions have been incorporated into Ugandan national legislation. The Ministry of Gender, Labour and

Social Development (MGLSD), through the district administration, oversees workplace conditions and worker–employer relations. Labour officers are responsible for administering worker–employer relationships and registering and inspecting workplaces. However, there are restrictions on the capacity to undertake workplace inspections. Every employer is required to provide their employees with a written contract of employment from their first working day. However, in practice workers are not always provided with adequate information on their terms of employment and labour rights (DTCIDC 2016).

Employment Contracts

Uganda's labour market has been subjected to legal reforms since 2013 and, since 2016, all employers are required to issue itemised pay slips and key employment terms to employees covered under the Employment Act (2006). In practice, the majority (90%) of the labour force is not covered by legislation as they operate in the informal economy where workplace activities are largely unregulated (DTCIDC 2016). Informal workers are mostly concentrated in the agricultural sector.

Informal workers lack written employment contracts, and most are paid daily after the work is completed. Workers' entitlements to job security, sick pay, support in case of work injury, paid holidays, access to grievance mechanisms and regular working hours are largely absent. Basic rights, such as the right to paid leave, maternity leave (with 60 days leave at full wages) and safe working conditions, are often violated (ISER 2017).

A normal working week involves the completion of 48 hours with any additional hours paid as overtime. There is no limit on the amount of overtime that workers can complete.

The minimum wage (UGX 6000 per month) (USD 1.60 per month) was last increased in 1984. The Minimum Wages Advisory Board, set up in 2015, has suggested a new figure of UGX 136,000 (USD 36.38) but this is yet to be gazetted.

All workplace unions must be registered under the National Organisation of Trade Unions (NOTU) or the Central Organisation of Free Trade Unions (COFTU). As of 2016, 52 labour unions were registered covering 547,000 workers comprising 3.2% of the total labour force (DTCIDC 2016).

A culture of unionisation in the project area is largely non-existent. Some employers reportedly ignore legal requirements to enter collective bargaining agreements with registered unions. Some companies are believed to interfere to prevent their employees from joining unions or they avoid direct employment contracts through subcontracting, outsourcing services or providing temporary employment contracts thereby bypassing collective bargaining (The Danish Institute for Human Rights 2016). There are also concerns with unions not representing workers and employees being ill-informed of their rights (ISER 2017).

Workers have limited power to negotiate with their employers. This is exacerbated by poor awareness of labour rights among workers. High levels of illiteracy and the complexity of laws governing labour in Uganda makes it difficult for people to understand their rights, rendering them vulnerable (ISER 2017).

However, a system exists whereby complaints related to work place employer–employee disputes can be submitted to union leaders if they exist within the organisation or to the district labour office who forward complaints to the industrial court. The court, however, has a five-year back log of cases (The Danish Institute for Human Rights 2016).

Gender

Women's limited access to education and early marriage restrict them from obtaining equal pay within the formal and informal sectors of the economy. In 2013, the proportion of women recorded to be as owners of companies was lower than the average for SSA, as illustrated in Figure A9.4-38.

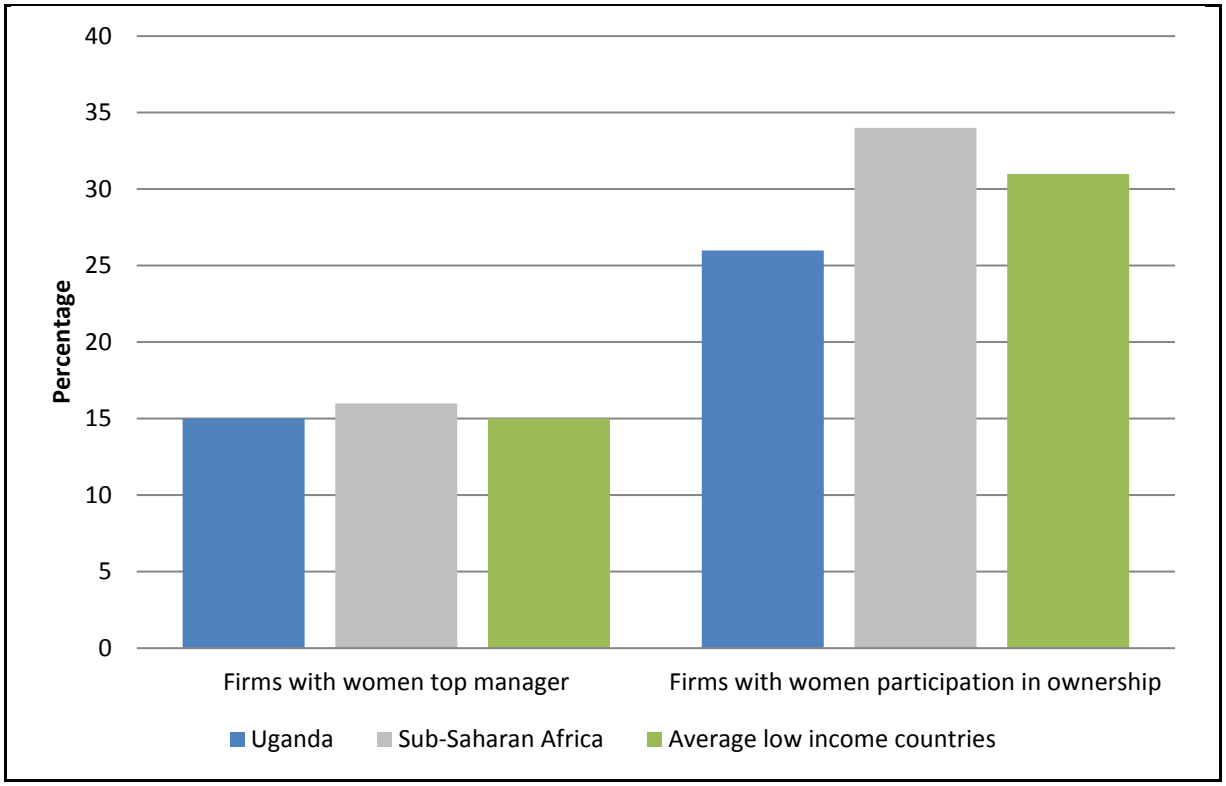

Figure A9.4-38 Proportion of Women in Management Positions and Participating in Ownership

SOURCE: World Bank and IFC 2013

Women face numerous challenges in the workplace, including sexual harassment, abuse and exploitation. Such challenges limit women's prospects and opportunities for advancement in the workplace (UHCHR 2016).

In addition to women, other groups, including those living with HIV/AIDS, casual or temporary workers and child-headed households, also experience workplace discrimination.

The Equal Opportunities Commission investigates cases reported by complainants and cases instigated by the commission itself (The Danish Institute for Human Rights 2016).

Social Security

Social security schemes consist of contributory and/or compulsory social insurance for formal workers. These are known as the National Social Security Fund (NSSF) and the Public Service Pension Schemes that cover all public servants and exclude people active in the informal sector (ILO 2018). The government is planning to introduce a nationwide social health insurance scheme, which would also cover workers from the informal economy.

The NSSF is the main contributory social protection scheme and provides support to workers engaged in the formal sector in the form of pensions, and benefits for disabilities following work injuries. The scheme is mandatory for businesses with more than five employees and voluntary for smaller firms. As of June 2011, the NSSF had a membership of equivalent to 1.3% of the population and has achieved limited success (DTCIDC 2016).

Micro-financed insurance schemes are an option for informal economy workers and are privately run through either micro-finance institutions or health-care providers. This type of scheme provides accident and health insurance, although these have had limited uptake owing to the cost of membership.

The proportion of the population covered by government or private social protection is estimated at 3.5%, which is lower than the 4.3% average across SSA. The proportion of people covered by health protection is 2%, compared with an average across Africa of 25%.

Occupational Health and Safety

The MGLSD, through the Department of Occupational Safety and Health (DOSH), is responsible for administering and enforcing the Occupational Safety and Health (OSH) Act 2006. Despite government efforts to improve the safety and health of all workers in the country, limited change has occurred owing to a lack of regulators enforcing the act.

Business owners and personnel supervisors do not prioritise managing OSH risks in the workplace, and Uganda's labour productivity is the lowest in East Africa owing to poor working conditions (Office of the Auditor General 2016). The Office of the Auditor General undertook a national audit of labour and working conditions in 2015, which contained the following key findings:

- Very few privately owned businesses were formally registered with the MGLSD, with 756 businesses holding registration certificates out of approximately 1 million entities. Despite a statutory requirement for businesses to register each year, only 5% of businesses had successfully re-registered for a second year. The lack of business registration means that most businesses are not known to the MGLSD and cannot be inspected for their OSH performance.
- In 2015, the DOSH had conducted inspections of just 139 businesses, and the department lacked the appropriate staffing, training and resources needed to conduct a greater number of inspections.
- The level of OSH awareness among the national workforce, supervisors and senior management is low. Workers are typically not aware of their legislative rights and are not consistently compensated for workplace injuries in accordance with national legislation (Office of the Auditor General 2016).

Recently, the informal mining sector has experienced considerable expansion and many mining sites are operated without OSH controls or adequate provision of worker welfare facilities. Informal mining operations are particularly hazardous due to the use of large excavated pits, basic machinery for digging and processing ore, and mercury for gold processing.

Workplace accidents that occur include fire, collapse of walls at construction sites, and illnesses related to exposure to noise, vibration and heat. The most recent government data available from the MGLSD indicated that 1520 people were injured at various workplaces between 2006 and 2008, and 856 workers contracted various occupational diseases and illnesses in 2007. From 2008 to 2009, over 40 buildings were recorded to have collapsed, killing and injuring many workers (Office of the Auditor General 2016).

Alinaitwe et al. (2007) investigated the frequency and type of accidents that occurred within the construction sector. The most common causes of accidents involved being hit by a falling object, limbs being caught in moving machinery and injuries involving vehicles. The research indicated that 15% of people involved in a workplace incident were killed and 37% experienced a permanent reduction in their ability to continue their main economic activity.

The Danish Institute for Human Rights reports that, in 2011, Uganda had the highest rate of construction incidents in the world, with 4200 major injuries taking place each year purportedly because of inadequate construction materials and high numbers of workers on sites (2016). Employers and employees do not consistently report workplace incidents, and workers do not commonly use legal processes to claim their entitlement for injury. Using legal processes to obtain compensation is problematic, as most workers are employed without a formal written contract.

Child Labour

The minimum age of employment is 14, although children aged 12 and 13 can engage in light work up to a maximum of 14 hours a week if it does not interfere with their schooling. Children between 14 and 17 must not work more than 43 hours per week and cannot work at night (7 p.m. to 7 a.m.) or undertake any hazardous work. These provisions are in line with international standards.

A national survey on child labour completed between 2011 and 2012 (ILO 2013) indicated that 39% of children were involved in an economic activity (93% in the agricultural sector); this is higher than the SSA average of 28%. Over the last ten years, the prevalence of child labour has decreased substantially and has been linked to higher school attendance at a national level. However, child labour in areas such as ASM and family work (i.e., crop farming, livestock rearing) is still prevalent. Many families have unstable livelihoods and need every family member to be earning an income. Ugandan children as young as seven are exploited in forced labour within the country in agriculture, fishing, forestry, cattle herding, mining, stone quarrying, brick making, car washing, scrap metal collection, street vending, bars, restaurants and the domestic service sector (United States Department of State 2014). An estimated two million children are still engaged in child labour across Uganda, 507,000 of whom are exposed to hazardous work, including sexual exploitation, mining, commercial agriculture, construction and

armed conflicts (OHCHR 2016). Children who are the sole heads of households are particularly vulnerable to child labour.

Human Trafficking

In 2009, the Prevention of Trafficking in Persons Act (2009) was enacted. Under Section 21, the designated office for Prevention of Trafficking in Persons is mandated to develop a National Action Plan on human trafficking. This National Action Plan was implemented in 2015 and the government has since trained over 1000 officers to reduce forced labour and human trafficking in the country.

According to the US Department of State (2017), the government of Uganda has shown increased efforts in investigating, prosecuting and achieving convictions in trafficking cases; initiated criminal prosecution of labour recruitment agencies for allegations of their involvement in trafficking; and promoted the Coordination Office to Combat Trafficking in Persons (COCTIP) to an official department. Insufficient funding, corruption and inconsistent victim assistance have hindered the effort. The government has not institutionalised anti-trafficking training among law enforcement and front-line officials, and it remains without an official lead agency with authority to manage, fund and drive the efforts of the national taskforce.

PAC Level

While there is no documented information available at a local level associated with worker safety and welfare, anecdotal information collected from KIIs indicates small business do not provide adequate welfare or OSH controls to the workforce in the sample PACs. For example, small vendors were observed repairing motorbikes in sample PACs using machinery without any OSH controls in place. Such small businesses typically provide almost no worker welfare facilities.

Human Rights

The following human rights apply to this VEC:

- right to nondiscrimination
- freedom from child labour
- freedom from forced labour
- freedom of association
- right to just and favourable working conditions
- right to work in a healthy and safe environment.

International standards for responsible business require that:

- organisations respect minimum labour standards
- supply chains must be considered in a company's effort to eradicate human rights risks in its activities.

Trend in Condition and Sensitivity to Change

The following trends could be identified:

- The ongoing expansion of the informal mining sector across the country is resulting in greater OSH risks, as this sector is largely unregulated and awareness of OSH among the workforce and employers is low.

- There is no culture of unionisation in Uganda; workers often do not have the power to negotiate with their employer.
- People work in unsafe and unhealthy conditions and often do not have access to personal protective equipment (PPE). Employers do not offer insurance or medical care in case of work-related injury or disease. There is no grievance mechanism for employees who have this type of claim.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table A9.4-28 provides the sensitivity ranking for the local workforce.

Table A9.4-28 Local Workforce Health and Safety and Welfare VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Local workforce health and safety and welfare	Very high (5)	The local workforce has a low occupational health and safety awareness.

A9.4.9.2 Key Considerations

Key considerations are:

- unscrupulous recruitment agencies exist in Uganda and potential workers may be asked to pay fees to 'register' their interest in being part of a workforce
- low level of awareness of health and safety and worker rights in the PACs
- low levels of understanding of a nondiscriminatory work culture such as with a mixed gender workforce in the PACs
- the human rights of workers with regards to health and safety.

A9.4.10 Social Infrastructure and Services

A9.4.10.1 Baseline Condition of Social Infrastructure and Services

National Level

Electricity

The liberalisation of Uganda's power sector in the late 1990s resulted in splitting the state-owned Uganda Electricity Board into three state companies: the Uganda Electricity Generation Company Limited (UEGCL), the Uganda Electricity Transmission Company Limited (UETCL) and the Uganda Electricity Distribution Company Limited (UEDCL) (Norton Rose Fulbright 2015, Internet site). UEGCL is responsible for the production and sale of electric power in Uganda. UETCL undertakes bulk power purchases and sales, import and export of energy and operation of grid assets above 33 kV (Norton Rose Fulbright 2015, Internet site). UEDCL's primary purpose is to distribute electric power to domestic and commercial end-users in Uganda, operating grid assets at and below 33 kV (New

Vision 2016b, Internet site). The Rural Electrification Agency (REA) was also established at this time to facilitate the government's goal of achieving universal access to electricity by 2035 (REA 2018, Internet site). The country generates its own electricity supply, predominantly from hydroelectric power stations (GOU 2018, Internet site). The country has 850 MW of installed capacity, the majority of which is hydro-generated capacity (see Figure A9.4-39).

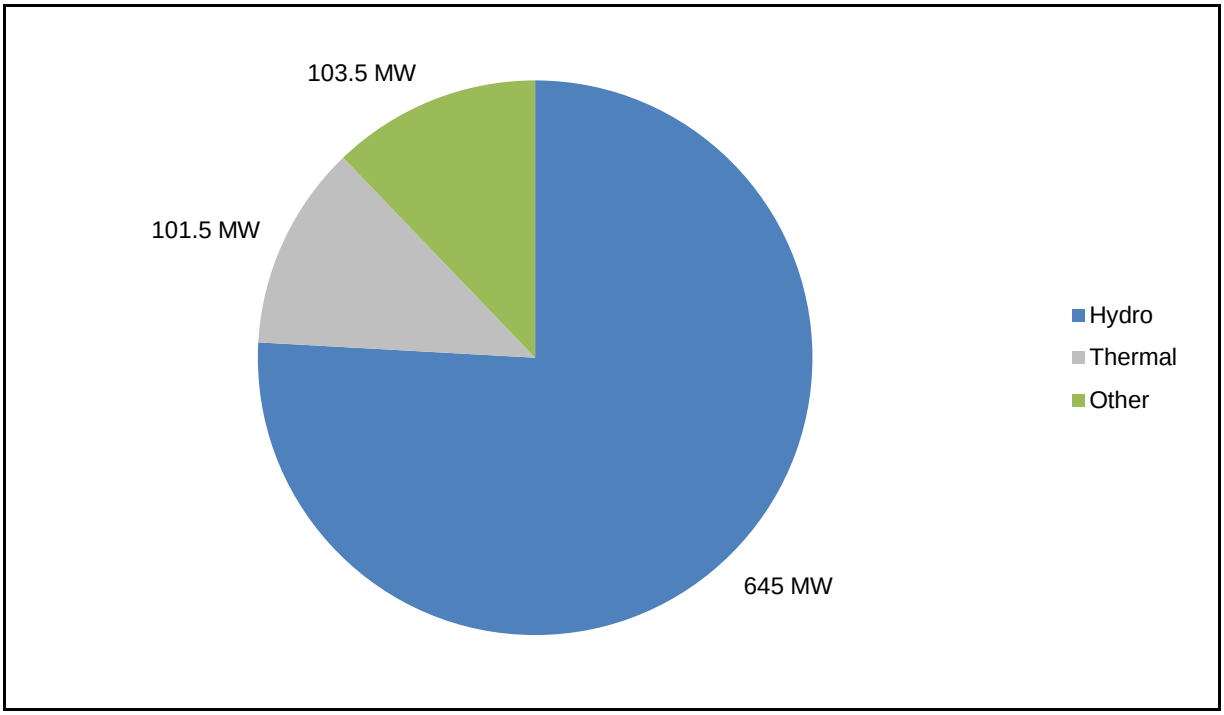

Figure A9.4-39 Electricity Capacity by Power Source

SOURCE: USAID (2017, Internet site)

The role of hydropower plants (HPP) in generating Uganda's electricity is likely to increase following the completion of the following large hydro facilities:

- Karuma HPP, Kiryandongo district, 600 MW capacity
- Isimba HPP, Jinja district, 183 MW capacity (UEGCL 2018, Internet site).

These power generation projects are a direct response to national development objectives and priorities, which includes providing electricity access to 80% of the population by 2040 (AfDB 2015).

A large proportion of Uganda's rural population does not have access to electricity (see Figure A9.4-40).

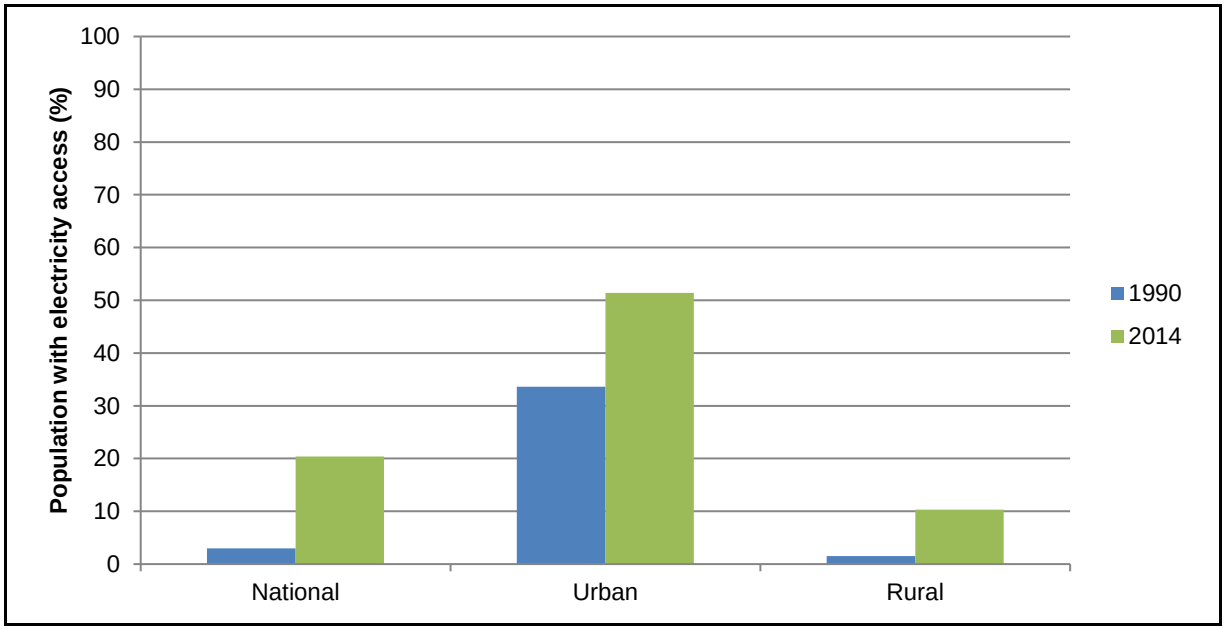

Figure A9.4-40 Proportion of the Population with Access to Electricity in 1990 and 2014

SOURCE: World Bank (2017c, Internet site)

To address the lack of electrical power in rural areas, the GOU approved the 10-year Rural Electrification Strategy and Plan (RESP-2) in 2013. With financial support from the African Development Bank and European Commission, the RESP-2 aims to increase electricity access in rural areas to 26% by 2022. The RESP-2 includes:

- the construction of 1147 km of medium voltage and 808 km of low-voltage distribution networks
- the provision of connections to the grid for 58,206 rural households, 5320 business centres and 1474 public institutions (European Commission 2018, Internet site).

In the absence of electricity, wood and charcoal provide almost all the energy required to meet the basic energy needs for cooking in rural areas and many urban households (UNDP 2014). In 2013, the use of firewood and charcoal in Uganda was estimated at 44 million tonnes per year. Out of this, only 26 million tonnes are reported to be sustainable, raising concerns about the availability and longevity of future supplies (UNDP 2014).

Solar energy is also being utilised, but on a much smaller scale. Over 30,000 solar photovoltaic systems have been installed in rural areas and two larger photovoltaic plants are at the planning stage (Africa-EU RECP 2018, Internet site). The DPPs suggest that solar power may play a more important role in electricity generation in the future.

Recognising the potential of solar power, the GOU has endeavoured to reduce the costs of producing solar, wind and geothermal energy by allowing VAT relief on business inputs purchased by producers (Lighting Africa 2018, Internet site).

Telecommunications

Uganda's communications sector is growing fast, driven by the rapid expansion of mobile telephony (ITU 2009, Internet site). There are more than 19 million mobile phone subscribers, equivalent to 50% of the population, with approximately 28 million mobile phone subscribers projected by the end of 2019 (Cartesian 2015). Figure A9.4-41 presents Uganda's main mobile network operators and their share of mobile subscriptions.

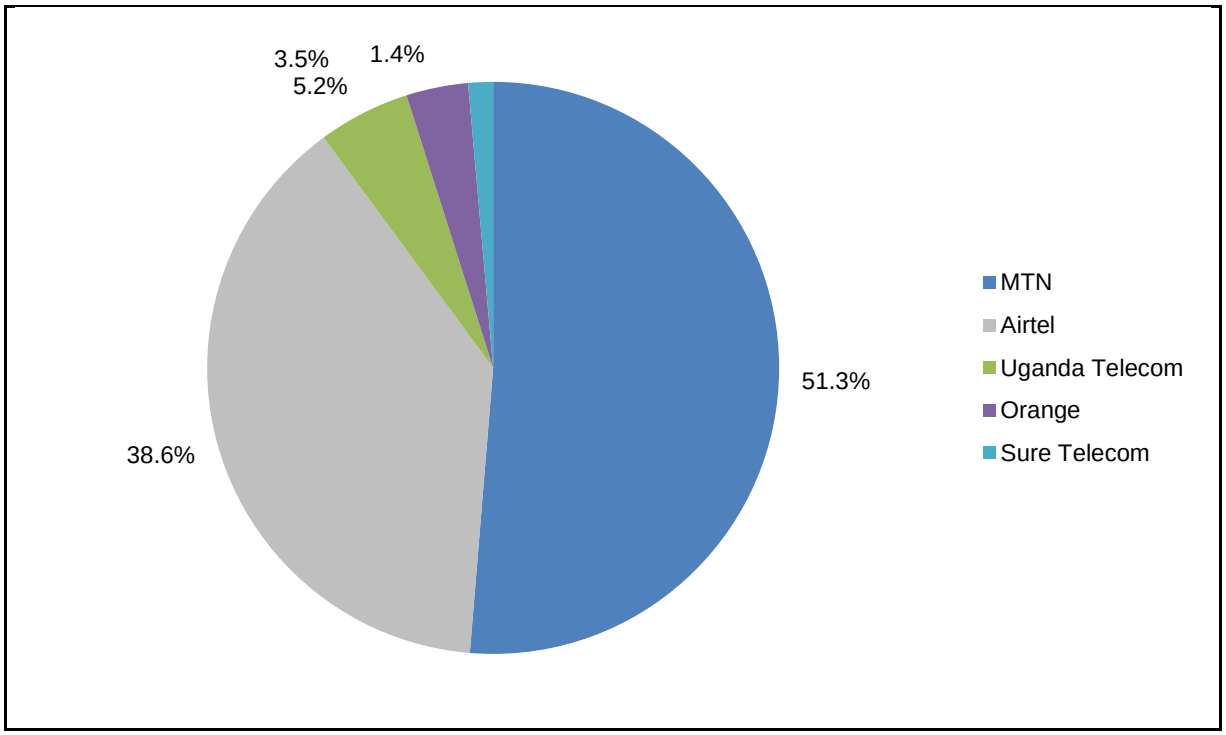

Figure A9.4-41 Main Mobile Operators and Proportion of Total Mobile Subscriptions

SOURCE: Cartesian (2015)

The projected number of mobile subscriptions will increase the demand for network, data transmission and fibre optic equipment in Uganda in the future (Export Gov 2017, Internet site).

A 3G mobile broadband service was launched in three major cities in March 2008 (ITU 2009, Internet site) and 3G is now available in most secondary urban areas. The installation of a 5000-km marine fibre-optic cable off the coast of East Africa in 2009 has improved the cost and performance of Uganda's internet service through cross-border connectivity arrangements (Teams 2014, Internet site). Nevertheless, the service remains slow and expensive by international standards (Export Gov 2017b, Internet site).

Figure A9.4-42 and Figure A9.4-43 show that the number of fixed and mobile Internet subscribers has increased steadily between 2012 and 2015.

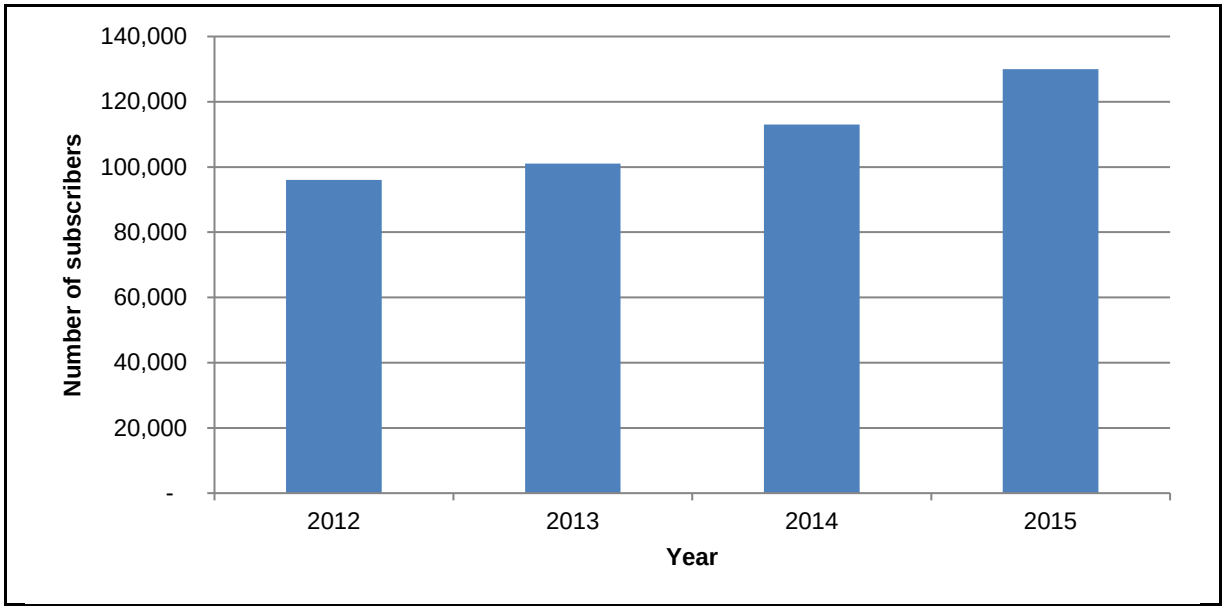

Figure A9.4-42 Fixed Internet Subscribers, 2012–2015

SOURCE: Export Gov (2017b, Internet site)

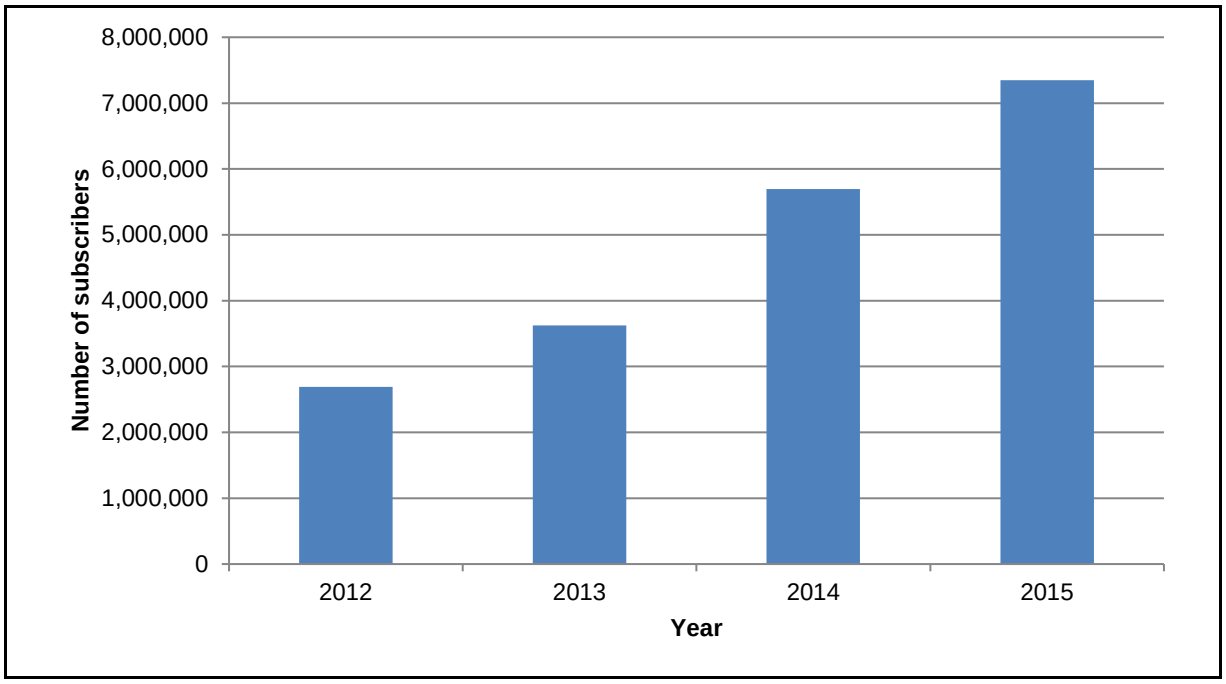

Figure A9.4-43 Mobile Internet Subscribers, 2012–2015

SOURCE: Export Gov (2017b, Internet site)

The number of people with mobile internet subscriptions is far greater than fixed Internet subscriptions. In 2015, there were over 7 million mobile Internet subscribers compared to 130,000 fixed Internet subscribers. Internet access has increased and become more affordable. However, Internet usage remains largely concentrated in urban areas where the infrastructure is available and there is a greater disposable income (Freedom House 2018, Internet site). The costs associated with Internet access remain expensive for many Ugandans, particularly

those living in rural parts of the country. Internet coverage and connectivity in remote areas is limited (Freedom House 2018, Internet site).

Mobile money services were first introduced in Uganda in March 2009 and have grown substantially since (Bank of Uganda 2016). A 2015 survey found that 43% of Ugandan adults have access to, and 26% actively use, mobile money accounts (CGAP 2015, Internet site). Figure A9.4-44 shows trends in the number of registered customers and transactions.

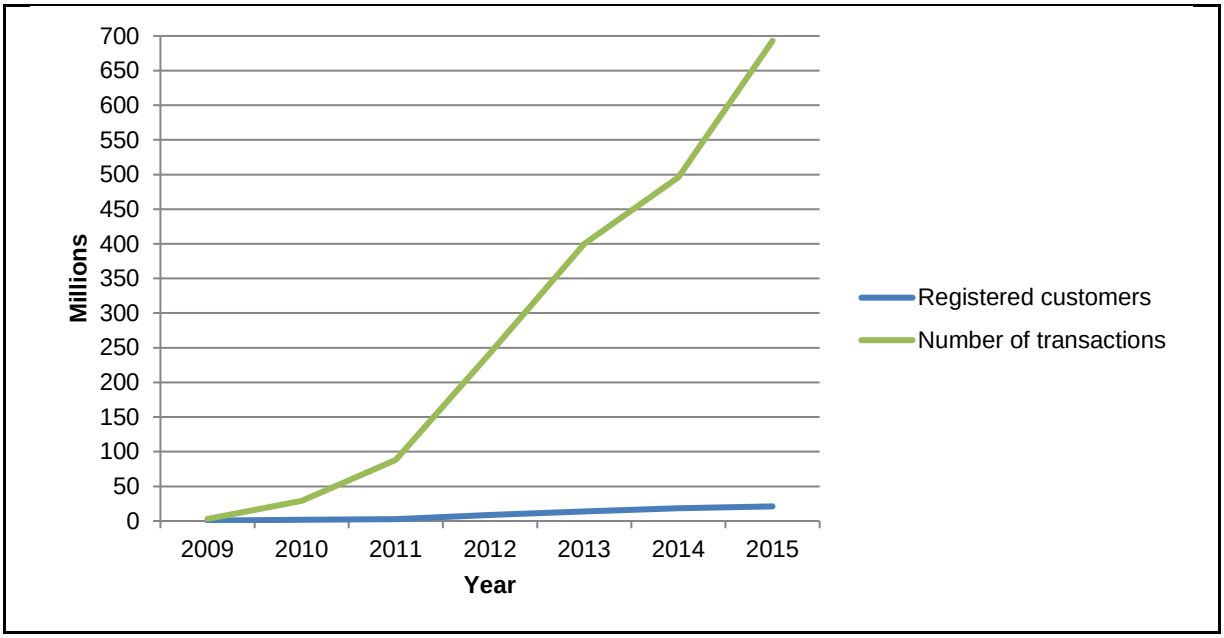

Figure A9.4-44 Number of Mobile Money Registered Customers and Number of Cumulative Transactions, 2009–2015

SOURCE: Bank of Uganda (2016)

Figure A9.4-44 shows that the number of registered customers and mobile money transactions increased between 2009 and 2015. The number of transactions has risen considerably since mobile money services were introduced (from 3 million to 693 million transactions).

Registered users can:

- load money into their accounts (cash-in). Users make cash deposits with mobile money agents who load their money for a transaction fee.
- make transfers to other users (registered or not) and buy airtime top-ups from mobile money agents
- withdraw money (cash-out). Users withdraw cash via mobile money agents for a transaction fee (Ndiwalana et al. 2012).

The benefits of mobile money in Uganda include:

- increased accessibility to financial services
- agricultural commercialisation, rural development and poverty reduction (Baganzi and Lau 2017).

Media

Newspapers

There are 24 daily and weekly newspapers in Uganda (Freedom House 2015, Internet site). The country's leading newspapers are the:

- New Vision
- Daily Monitor
- Bukedde.

The state-owned *New Vision* and independent *Daily Monitor*, printed in English, are the oldest and second oldest newspaper publications respectively (Freedom House 2015, Internet site). The government-owned *Bukedde* is printed in Luganda, one of the most widely spoken local languages in Uganda.

There has been a general decline in newspaper circulation in Uganda, partly resulting from the growing popularity of social media (e.g., Facebook, Twitter and YouTube) as a means of disseminating news and information.

Radio

Radio broadcasting, which began in 1952, is the most widely accessed news medium in Uganda (Freedom House 2015, Internet site). A study of over 2000 households, individuals, businesses and institutions found that 83.3% of respondents listen to the radio, mostly during the late afternoon and early evening (ACME 2015, Internet site). There has been tremendous growth in Uganda's radio industry since the liberalisation of broadcasting in the 1990s and over 180 private radio stations are now in operation (UNESCO 2015, Internet site). Popular radio stations include Radio Simba, a commercial private radio station which broadcasts in Luganda (Radio Simba 2018, Internet site). Community radio stations are also popular, particularly in rural areas where individuals have few media sources available (UNESCO 2018, Internet site). Community radio stations have played an important role in disseminating information for development purposes with a focus on health, education and sports (UNESCO 2015, Internet site). Community radio stations include Radio Apac, Mama FM and Speak FM (UNESCO 2018, Internet site).

Television

Similar to radio, there has been a substantial growth in Uganda's television industry since the 1990s. Television broadcasting started in 1963 and the state-owned Uganda Broadcasting Corporation (UBC) operates two television channels: UBC TV and Star TV (Zenith 2017, Internet site). There are several private television channels, mostly based in Uganda's cities, including East Africa TV and NTV Uganda (Zenith 2017, Internet site). The aforementioned study by ACME (2015, Internet site) examined television usage and found that the most popular time for television watching is 7.00–9.00 p.m. In urban areas, roughly 80% of the participants reported watching television at home; in rural areas, this figure dropped to 44.6% with 36.3% reporting that they watch TV in public places instead.

Waste Management

Local government authorities are responsible for providing waste management services according to the Local Government Act 1997 (Komakech 2014). Rapid population growth and higher levels of economic activity in urban areas has led to a substantial increase in waste generated. In Kampala, Ojok et al. (2012) report 900 tonnes of daily waste generated across the city. With reduced funding from central government, municipal authorities reportedly do not have the capacity to meet the demand. Inadequate waste collection and disposal in Uganda's major towns and cities has exacerbated many of the environmental hazards associated with urban areas and generated public health risks. In the absence of effective waste management services, some urban communities practice local waste management techniques such as recycling and composting (Okot-Okumu et al. 2011). Nevertheless, field studies found considerable amounts of waste dumped in open areas, streams and drainage canals, burnt near to homesteads or buried. This can contribute to environmental pollution, clogging of waterways and increases flood risks (DLCA 2015, Internet site).

Domestic liquid waste in Uganda is mainly disposed of in pit latrines. The percentage of the population with access to basic sanitation facilities has steadily increased and is estimated at approximately 80%. Nevertheless, the relatively high cost of constructing new latrines and poor health education limits the installation and use of improved toilet facilities in Uganda; this is discussed in the community health section (A9.4.11). Existing toilets, public and private, are often in poor condition and require maintenance, especially in high population density areas (Daily Monitor 2013, Internet site).

Transport

The baseline conditions for transport infrastructure in Uganda are described in the traffic baseline report (Appendix A10).

Water and Sanitation Services

The baseline conditions for water and sanitation services in Uganda are described in Section A9.4.11 on community health.

District and PAC Level

Electricity

Figure A9.4-45 shows the number of households with access to electricity in Buliisa and Hoima with 7.6% and 16.8%, respectively.

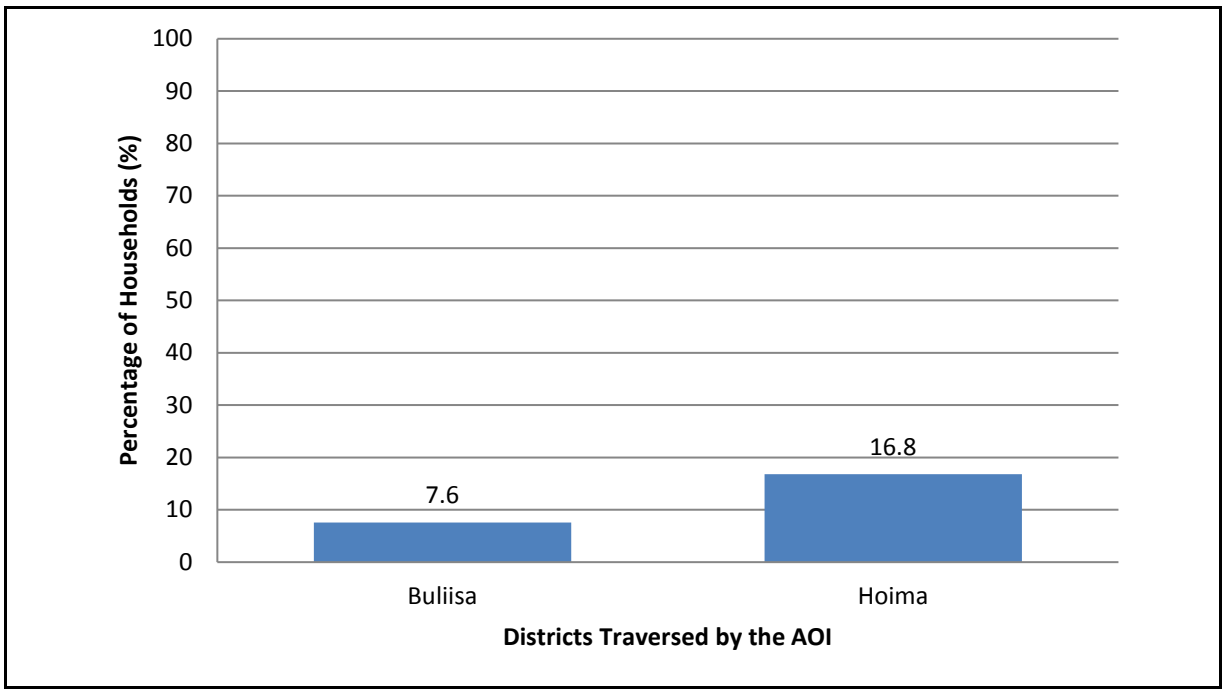

Figure A9.4-45 Percentage of Households with Access to Electricity by Districts

SOURCE: UBOS (2016c)

Figure A9.4-46 Power Cables in Buliisa, Buliisa District (KP8)

In the absence of electricity, people in the districts traversed by the AOI rely on alternative energy sources for lighting including fuel lamps, solar power, candles, batteries and torches (see Table A9.4-29).

Table A9.4-29 Main Lighting Source of Energy Used

District	Subcounty	Main Energy Source for Lighting
Buliisa	Buliisa	Fuel Lamp
	Butiaba	Fuel Lamp
	Kihungya	Fuel Lamp
Hoima	Bugambe	Fuel lamp
	Buhimba	Solar
	Buseruka	Solar
	Kiziranfumbi	Candle

SOURCE: FGD with women

Fuel and solar lamps can be purchased from retail outlets in trading centres, towns and cities. In some cases, solar lamps have been provided free as part of development efforts to reduce the reliance on fuel lamps in households.

The percentage of households using fuel lamps has declined nationwide whereas the use of solar power for lighting is expanding (Furukawa 2012). The local government for Hoima district plans to train more households in alternative energy sources including solar power (DDP 2015).

Telecommunications

The districts traversed by the AOI exhibit similar characteristics with regards to the proportion of the population who own a mobile phone and use the internet.

Figure A9.4-47 presents the percentage of the population aged 10 years and above (total, male and female) who own at least one mobile phone in the districts traversed by the AOI.

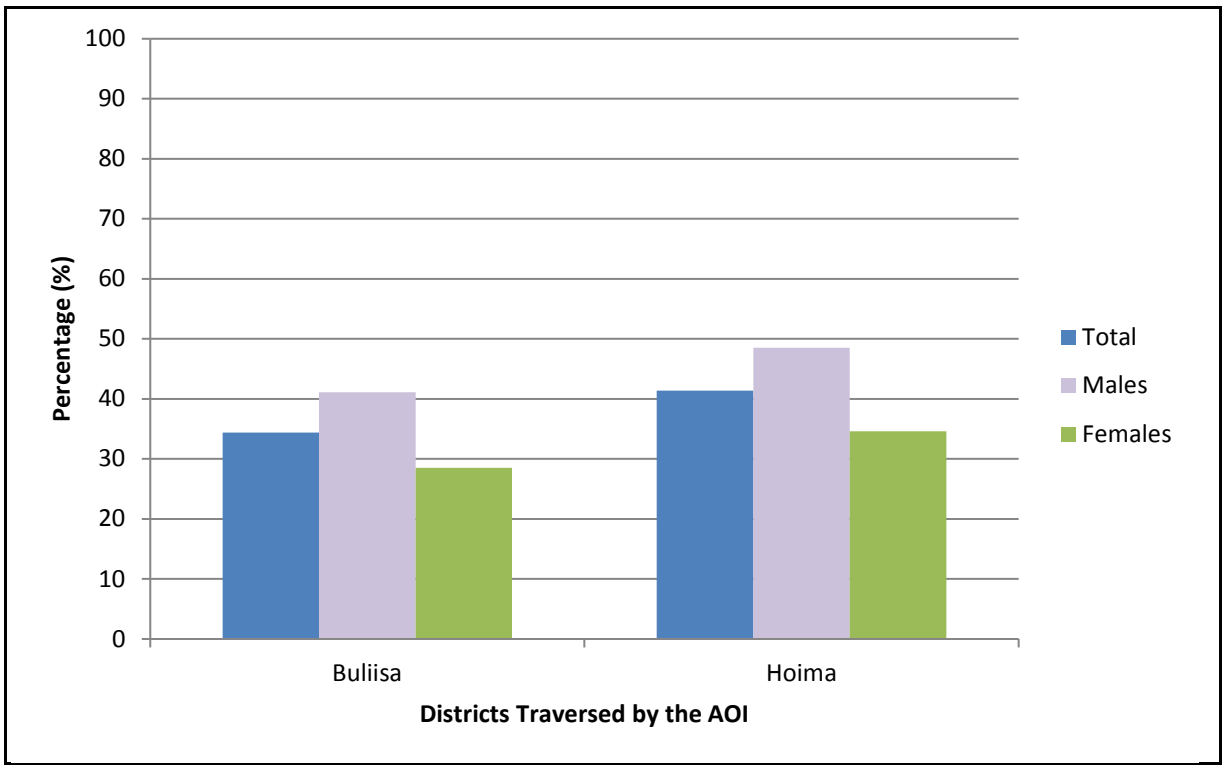

Figure A9.4-47 Mobile Phone Ownership in Buliisa and Hoima Districts
SOURCE: UBOS (2016c)

From Figure A9.4-47, the following observations can be made:

- the variation between districts in terms of mobile phone ownership is relatively small
- more males than females own mobile phones in the districts.

In addition, the household survey showed that 33 out of 42 households (nearly 70%) reported owning a mobile phone. It was reported that the male household heads more often own mobile phones than the women in the household. Mobile phones are used to call family members in urban areas, transfer money and negotiate market prices with buyers and intermediaries. Charge-up cards are bought in the local shops. These shops tend to have electricity and serve as mobile phones charging points.

Internet use in the sample PACs is considerably less common than mobile phone ownership. The percentage of the population (total, male and female) that use the Internet in the districts traversed by the AOI is shown in Figure A9.4-48.

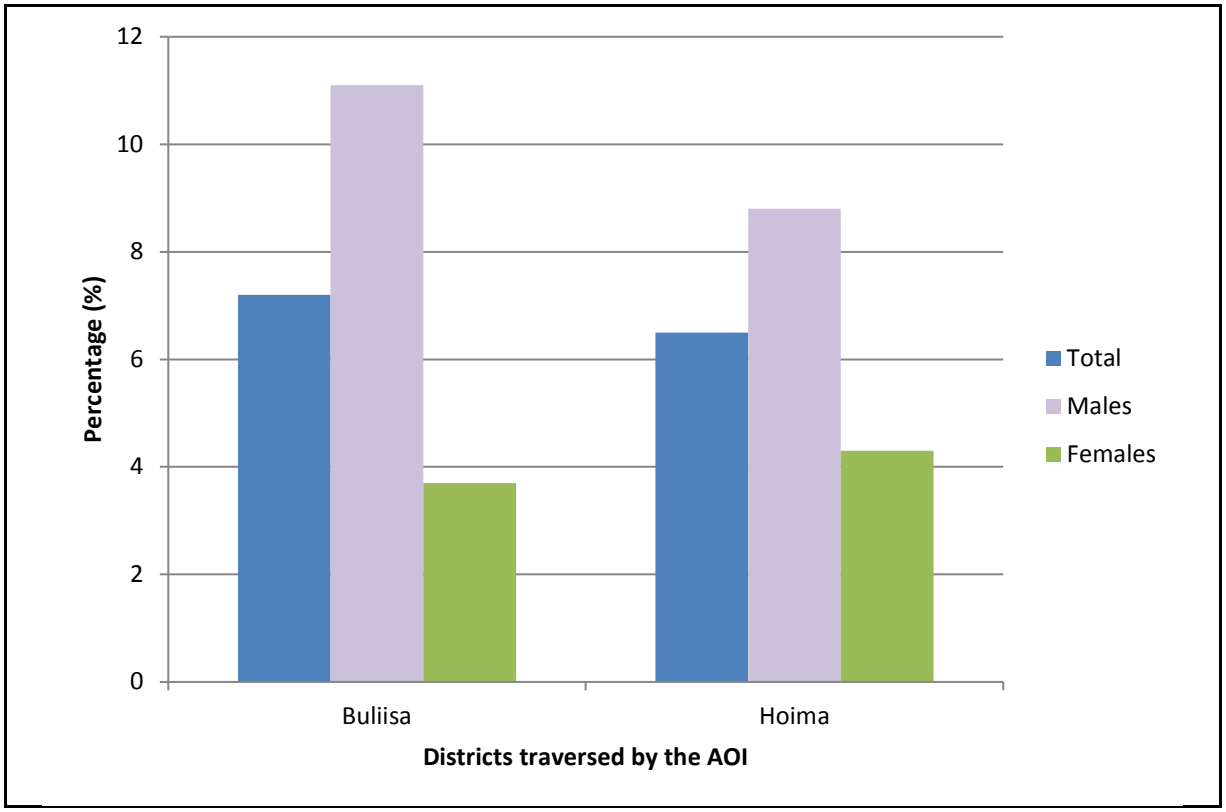

Figure A9.4-48 Internet Usage in the Districts Traversed by the Area of Influence

SOURCE: UBOS 2016c

From Figure A9.4-48, it can be observed that:

- Internet penetration in the districts remains low
- more males use the Internet than females in the districts; the most major difference is in Hoima district where 4.5% more males use the Internet than females.

Media

Leading national newspapers such as the *New Vision*, the *Daily Monitor* and the *Bukedde* are widely available in Buliisa and Hoima districts. Radio is the most widely used type of media in the districts traversed by the AOI and in the PACs.

The popularity of radios in the districts may reflect low literacy levels and limited disposable incomes; these factors may limit access to newspapers and television.

Radio is the commonest form of mass communication in Buliisa and 61% of households own radio. Radio coverage and access has improved but there is no FM radio station in the district. Most parts of Buliisa access FM radio waves from stations operating in the Bunyoro region, i.e., Kings Radio Masindi, Radio Kitara, Bunyoro Broadcasting Services, Radio Hoima and Spice Radio. Television coverage is poor; only a few households have digital TV (Buliisa District Government 2018).

Table A9.4-30 lists the radio and television stations based in the districts traversed by the AOI.

Table A9.4-30 Radio and Television Stations in the Districts Traversed by the Area of Influence, 2011

District	Radio Broadcasting Stations	Television Broadcasting Stations
Buliisa	No FM radio station in the district	Uganda Broadcasting Station (UBC) Wavah Broadcasting Service (WBS) TV
Hoima	Radio Hoima Liberty FM Spice Radio Radio Maria New Life Church Uganda Broadcasting Corporation (UBC)	Uganda Broadcasting Station (UBC) Wavah Broadcasting Service (WBS) TV

SOURCE: UCC (2011, Internet site)

Table A9.4-30 indicates that there are six radio stations and two television stations in the districts traversed by the AOI. This is only a small proportion of the nationally available stations.

Municipal Waste Management

Waste management in the districts traversed by the AOI is poor (DDPs 2015). Lack of effective waste management systems, designated dumping sites and low levels of waste collection are widely reported, particularly in town councils and trading centres. Littering and indiscriminate disposal of polythene bags and medical waste are environmental concerns in Hoima and Buliisa (DDPs 2015). Dumping of waste in wetlands and watercourses has created favourable conditions for disease in some districts with public health implications.

The proportion of the population in the districts traversed by the AOI with access to some form of sanitation facility fluctuates considerably, ranging from 68% in Buliisa to 91% in Hoima (see community health section, A9.4.11).

KIIs found that the sample PACs mainly burnt waste in the open air and buried waste in private pits near homesteads.

FGDs with women revealed that most PAC members have access to some form of pit latrine. Open defecation was also reported in some PACs. FGDs with women further revealed that community members do not regard their physical environment as clean.

Human Rights

The following human rights laws apply to social infrastructure and services:

- Universal Declaration of Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 12; African Charter on Human and Peoples' Rights, article 16: Right to health. Uganda has ratified all these declarations.

- Universal Declaration of Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples' Rights, article 21: Right to an adequate standard of living. Uganda has ratified all these declarations.
- Component of Universal Declaration of Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 12; African Charter on Human and Peoples' Rights, article 16: Right to water. Uganda has ratified all these declarations.

Trends and Sensitivity to Change

Trends for social infrastructure and services include the following:

- Under the efforts of the RESP-2, rural access to electricity may continue to improve. Uganda's overall electricity generation capacity will also likely improve once the construction of new HPPs in Kiryandongo district and Jinja district are complete.
- Renewables may play an increasingly important role in Uganda's energy sector as the national government continues to support renewable project developers. The share of the sector is projected to grow considerably as 157 MW of feed-in-tariff supported projects are expected to be commissioned by the end of 2018 (Climate Scope 2017, Internet site).
- Uganda's telecommunications infrastructure is rapidly expanding in line with growing demand for mobile and internet services nationwide. Mobile operators have installed 4G networks around Kampala and there are plans to make 4G available in other cities and urban settlements going forward (Export Gov 2017b, Internet site). Mobile phone and internet subscriptions are expected to reach 28.7 million and 11.9 million in 2021 respectively (Business Sweden 2017).
- The mobile money market in Uganda may grow with the rising number of internet subscriptions and mobile phone owners. Mobile money operators may also provide customers with new and diverse opportunities. Ugandans can now also pay for petrol, TV subscriptions, purchase airline tickets and play the lotto using mobile money.
- The use of social media in Uganda has proliferated in recent years in urban areas and among the youth. Internet use and penetration is still very low in rural areas. Popular platforms such as Facebook and Twitter are commonly used to access the latest news and communicate with others (Freedom House 2015, Internet site). The proliferation of social media is likely to be an ongoing trend, particularly if the number of mobile Internet subscriptions continues to rise (Uganda Business News 2017, Internet site).

Ecosystem Services Provided

The social infrastructure and services described herein provide the following ecosystem services.

Provisioning services:

- electricity from hydro, fossil fuels and solar energy
- cooking fuel from biomass and firewood (see Section A9.4.6.5 on natural resources use).

Sensitivity Ranking

Table A9.4-31 provides the sensitivity ranking for infrastructure and social services.

Table A9.4-31 Social Infrastructure and Social Services VECs and Sensitivity Rankings

VEC	Sensitivity Ranking	Rationale for Rating
PACs – media (radio, television, newspapers)	Low (1)	All households in the PACs have access to one or more media information source.
PACs – electricity	Moderate (3)	Most PACs do not have access to grid electricity and rely on other means of energy for cooking and lighting. Lack of grid electricity limits the PACs' economic development. Population growth and in-migration increase competition for the few available connections.
Households without mobile phone and Internet	Moderate (3)	These households may become increasingly vulnerable, as information is increasingly shared using these media.

A9.4.10.2 Key Considerations

Key considerations are:

- PACs rely on radio as a main means of receiving information
- mobile phone and Internet is becoming increasingly important to exchange information
- rural electrification is low, limiting general development.

A9.4.11 Community Health

The community health baseline section is based on the format presented in the IFC good practice note for health impact assessment (HIA). In accordance with this note, several environmental health areas (EHAs) are described:

- health system
- communicable diseases linked to the living environment (termed respiratory and housing issues under the EHAs)
- vector-related diseases
- soil-, water- and waste-related diseases
- sexually transmitted infections (STIs), including human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS)
- food and nutrition related concerns
- noncommunicable diseases
- accidents and injuries
- veterinary medicine and zoonotic diseases
- exposure to potentially hazardous materials, noise and offensive odours
- social determinants of health

- social cultural health practices.

Note that exposure to potentially hazardous materials, noise and offensive odours have not been considered in the baseline but are considered in the impact assessment.

A9.4.11.1 Baseline Condition of Health Systems

National Level

Health care in Uganda is delivered by both public sector (government) and private entities that include private-not-for-profit (PNFP) and private-for-profit (PFP) organisations, and complementary health service providers such as traditional healers. The government (MOH 2014) owns the majority of the health facilities in the country. The national target for access to services is that everyone should have a health facility within 5 km of their residence. Access measured against this indicator stood at 72% nationally in 2015 (MOH 2016).

A target of having a hospital or a level IV (see Table A9.4-32) primary care facility per 100,000 people was met in 2014, with a national census of health facilities recording 147 hospitals and 188 level IV primary care facilities (MOH 2014).

Provision of public health care has been decentralised with districts and subcounties having a key role in the planning, delivery and management of health services in their respective areas. The health service delivery structure is organised in tiers starting from the community level up to the national level, including the role of the Ministry of Health (MOH) as described below in Table A9.4-32.

Table A9.4-32 Health System Delivery Structure

Structure	Level	Description of Role Function in Structure
Village health teams (VHTs) or health centre (HC) I	Village Target population of 1,000 people	VHTs are the first level of health care delivery and mainly consist of volunteers in villages facilitating health promotion, service delivery, community participation and empowerment.
HCs II, III and IV	Village Target population of 5,000 people	This is the second level of service delivery. HC IIs provide a first level of interaction between the formal health sector and communities. They only provide health prevention and promotion services, community outreach services and links with VHTs. Curative services include outpatient care, emergency care and emergency deliveries.
	Village Target population of 20,000 people	HC IIIs provide basic preventive, health promotion and curative services, and support and supervision to lower level units. There are provisions for limited inpatient services, laboratory services for diagnosis, maternity care and first referral cover for the subcounty.
	Health subcounty	HC IVs provide the same broad level of care as HC III, with the addition of more advanced inpatient care, and blood transfusion, laboratory, emergency and other services. HC IVs were introduced in some areas as a strategy to address poor access to health care services.

Table A9.4-32 Health System Delivery Structure

Structure	Level	Description of Role Function in Structure
General hospitals (GHs)	Target population of 500,000 people	This includes all services offered at HC IV and other general services including surgery, imaging services and inpatient care. In-service training, consultation and research to community-based health care programmes also occurs at this level. The district government manages GHs.
Regional referral hospitals (RRHs)	Target population of 2,000,000 people	This level consists of more specialised clinical services in addition to services offered at GHs. Specialist services may include paediatrics, psychiatry, ophthalmology, dentistry, intensive care, radiology, pathology, and higher level surgical and medical services. These institutions are also generally involved in teaching and research. While RRHs are managed by the MOH, they manage and develop their own operating budgets. Each district has a designated RRH that provides services not available at the GH level.
National referral hospitals (NRHs)	Target population of 35,000.000 people	This is the highest level and provides the most comprehensive and specialised level of care level. They provide advanced tertiary services in addition to all the other clinical services, as well as providing teaching and research. These facilities are fully autonomous.
Health subcounty	Subcounty	Health subcounties are mandated with planning, organisation, budgeting and management of the HC III, II and I services and private providers.
District health systems	District	District health systems are responsible for delivering health services and the management of human resources, the development and passing of health-related bylaws and monitoring of sector performance. Local district governments manage public GHs and HCs, and supervise and monitor all health activities (including those in the private sector) in their respective areas. Health service delivery is decentralised at the district level, with the DHMT, led by a district heath officer, mandated to implement programmes and policy.
Ministry of Health	National	The MOH is responsible for: • policy analysis, formulation and dialogue • strategic planning and resource mobilisation • setting standards and quality assurance • advising other government departments and agencies on health concerns • capacity development, and technical support and supervision • provision of nationally coordinated services and coordination of research • monitoring and evaluation of the overall health sector performance.

All hospitals are expected to provide support supervision to lower levels and to maintain links with communities through community health departments. As of 2015, Uganda had 160 public hospitals: 2 NRHs, 14 RRHs and 144 GHs.

The country has an estimated 1.55 health workers per 1000 persons, which is below the WHO ratio of 2.28 per 1000 persons. Below this point, a country is considered to have a critical shortage of personnel. According to 2015 statistics, nurses and midwives are staffed to 83% and 76% respectively. Other staffing levels are also sub-optimal, notably pharmacists (8%), anaesthetic personnel (30%), health administrators (33%) and cold chain technicians (40%). Overall, staffing levels are skewed in favour of specialised health institutions and larger health facilities: RRH (81%), GH (69%), HC IV (85%), HC III (75%) and HC II (49%) (MOH 2014).

The reasons most commonly cited for not filling positions in the public sector include:

- inadequate and unpredictable wages
- difficult working conditions with inadequate number of support personnel, especially laboratory technicians and pharmacists
- inadequate accommodation and social amenities
- limited capacity to attract and retain personnel because of capacity constraints at district level.

Reproductive Health

Women in Uganda have an average of 5.4 children in their lifetime, a decline from a high of 7.4 children per woman in the 1980s. The fertility rate remains higher among women in rural compared to urban areas and decreases with increasing levels of education and household wealth (UBOS 2017b). Family planning is an essential component of reproductive health. Use of contraceptives among married women has increased at the national level from 26% in 2011 to 39% in 2016.

Maternal Health

Maternal health refers to the health of women during pregnancy, childbirth and the postpartum period (the first six weeks after birth). This is an important measure of health system functionality. Key indicators for maternal health are maternal mortality and access to antenatal and delivery care. Maternal and perinatal conditions account for approximately 20% of the total disease burden in Uganda. The maternal mortality rate was estimated to be 336 per 100,000 live births in 2016, decreasing from a high of 600 per 100,000 in the 1990s (UBOS 2017b). The main causes of maternal deaths in the country are haemorrhage, eclampsia, birth complications, unsafe abortion and sepsis (WHO and UNICEF 2012).

Access to skilled antenatal care is nearly universal in Uganda (at 96%). Three-quarters (74%) of child births occur at a health facility under the care of skilled personnel, increasing from 58% in 2011 (UBOS 2017b).

Child Health

Uganda has made substantial progress in child survival, from an under-five mortality rate of 178 per 1000 live births in 1990 to 64 per 1000 live births in 2016 (Figure A9.4-49) (UBOS 2017b). Figures indicate that one in every 23 Ugandan children dies before their first birthday (i.e., 43 per 1000 live births), and one in every 17 children dies before the fifth birthday (UBOS 2017b). The leading causes

of child deaths are respiratory infections, malaria, prematurity, birth asphyxia and diarrhoea (WHO 2015a). Data on child mortality rates in the project districts were not conclusive because of gaps in the HMIS.

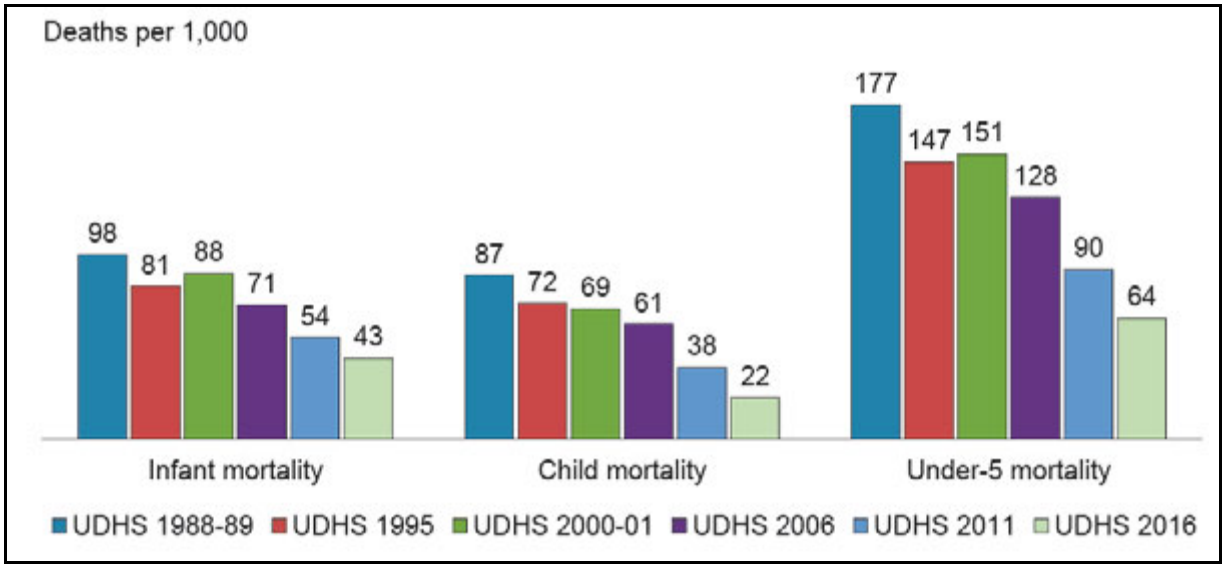

Figure A9.4-49 Trend in Child Mortality Rates
SOURCE: UBOS (2017b)

Immunisation

Uganda's childhood immunisation package is closely aligned with the WHO and UNICEF guidelines. The desired goal is 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 (WHO 2009).

District and PAC Level

The distribution and types of health facilities available in the project districts are included in Table A9.4-33 and Figure A9.4-50.

The government owns 52% of health facilities at national level, 51% of health facilities in Hoima and 83% of health facilities in Buliisa district.

A comprehensive services and readiness assessment (SARA) of health facilities close to the proposed pipeline route and AGIs is available in Attachment A9.4.

The RRF in Hoima was mentioned as a hospital with a personnel shortage with only 59% of the positions filled.

Table A9.4-33 Distribution and Type of Health Facilities by District, 2017

Area	HCII	HCIII	HCIV	General Hospital	Regional Referral Hospital	National Referral Hospital	Total
National	3929	1446	203	154	14	7	5753
Western region	906	406	67	35	4	0	1418
Hoima district	14	27	2	0	1	0	44
Buliisa district	6	4	1	1	0	0	12
Buliisa TC	1	0	1	0	0	0	2
Buliisa SC	0	1	0	1	0	0	2
Ngwedo SC	1	1	0	0	0	0	2
Kigwera SC	1	0	0	0	0	0	1
Butiaba SC	2	1	0	0	0	0	3
Buseruka SC	1	2	0	0	0	0	3
Bugambe SC	1	3	0	0	0	0	4
Kigorobya SC	8	1	1	0	0	0	10

SOURCE: Uganda HMIS 2017[16]

[16] Only subcounties traversed by the AOI are represented in the data.

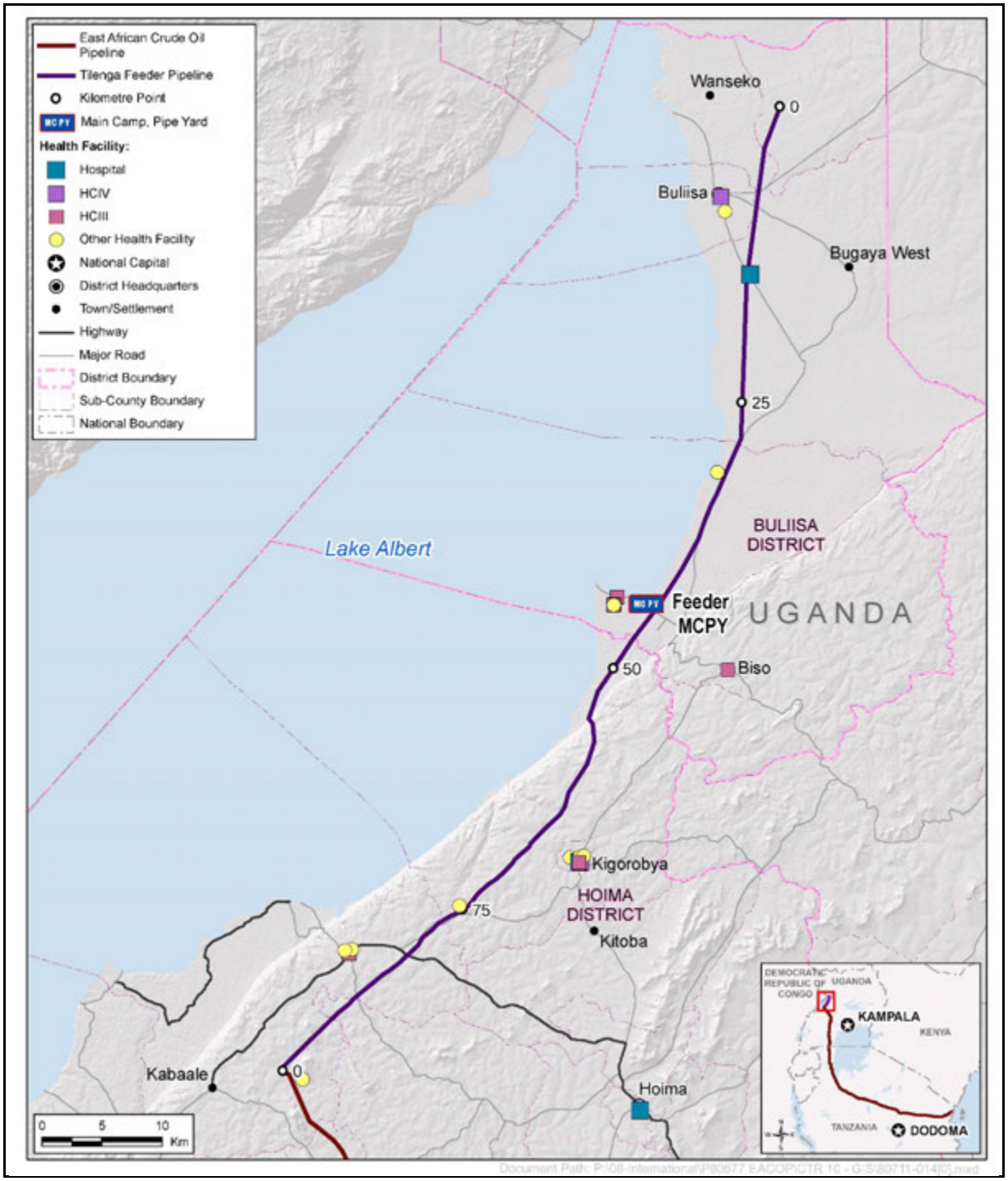

Figure A9.4-50 Health Facilities by District

Health System Challenges

The findings of the HIA baseline assessment identified the following health system challenges in the districts traversed by the AOI:

- shortage of skilled health personnel
- inadequate financial resources
- high burden of communicable and infectious diseases

- increasing burden of noncommunicable diseases
- inadequate and inequitable distribution of health facilities
- inadequate solid waste management facilities
- inadequate water and sanitation facilities
- shortage of medical supplies and equipment
- delay in seeking medical care
- inadequate emergency care services.

These challenges were common throughout the project districts.

Reproductive health services are generally available in all the districts traversed by the AOI and reports indicated an increase in the uptake of modern contraceptive methods and access to condoms.

Figure A9.4-51 shows the number of maternal deaths occurring in the districts traversed by the AOI in 2015–2017. Hoima recorded the highest number of maternal deaths in 2017 at 80. Some of these deaths were referrals from other districts to the regional hospital.

Baseline findings show that most women in the districts receive skilled antenatal care and most births occur at health facilities. However, home deliveries remain a challenge that continues to be addressed. Data on the coverage of institutional deliveries in the project districts were inconclusive because of gaps in the HMIS.

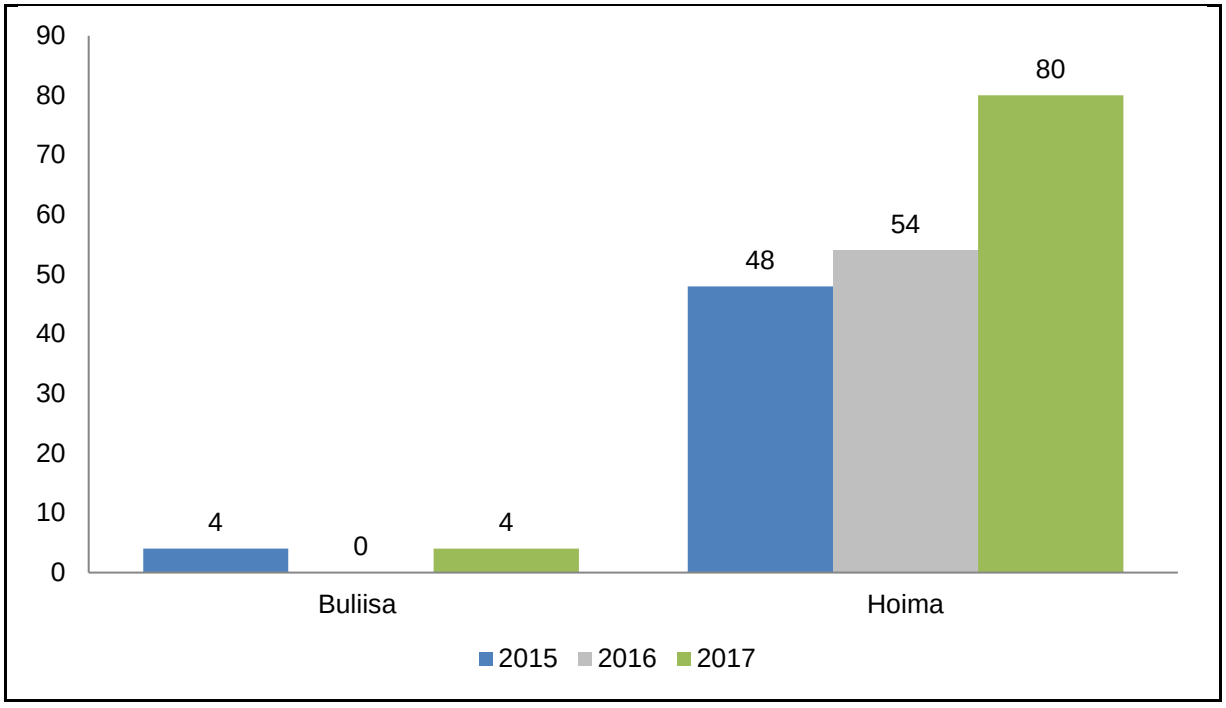

Figure A9.4-51 Maternal Deaths Occurring in Health Facilities by District, 2015–2017

SOURCE: Uganda HMIS 2017[17]

[17] Data does not include maternal deaths occurring in community.

Table A9.4-34 summarises immunisation coverage in the project districts.

Table A9.4-34 Immunisation Coverage Among One Year Olds by District, 2017

District	Measles	DPT-HepB-Hib-3
Buliisa	61%	80%
Hoima	95%	92%

SOURCE: Uganda HMIS 2017[18]

Large data gaps on immunisation coverage were noted. None of the districts had data available for BCG and polio coverage in 2016 and 2017, pointing to a weakness in the HMIS. Coverage of measles vaccinations is poor.

Human Rights

The following human rights apply to community health:

- Universal Declaration of Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 12; African Charter on Human and Peoples' Rights, article 16: Right to health. Uganda has ratified all these declarations.
- Universal Declaration of Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11, African Charter on Human and Peoples' Rights, article 21: Right to an adequate standard of living. Uganda has ratified all these declarations.
- Universal Declaration of Human Rights, articles 1, 2 and 23(2); International Covenant on Civil and Political Rights, articles 2 and 3; International Covenant on Economic, Social and Cultural Rights, articles 2 and 3; ILO Convention 111 on Discrimination (Employment and Occupation); Convention on the Elimination of All Forms of Discrimination Against Women; UN Women's Empowerment Principles (2010); African Charter on Human and Peoples' Rights, articles 2, 3, 15 and 18; Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa: Women's rights, which are relevant because women are particularly vulnerable to certain health risks related to Tilenga. Uganda has ratified all these declarations.
- Universal Declaration of Human Rights, articles 25.2 and 26; International Covenant on Civil and Political Rights, article 24; International Covenant on Economic, Social and Cultural Rights, articles 10, 12 and 13; Convention on the Rights of the Child; African Charter on Human and Peoples' Rights, article 18; African Charter on the Rights and Welfare of the Child: Children's rights, which are relevant because children are particularly vulnerable to certain health risks related to Tilenga. Uganda has ratified all these declarations.

Trends in Condition and Sensitivity to Change

- Maternal deaths in Uganda have decreased by almost half over the past two decades, from 600/100,000 live births in the 1990s to the current 336/100,000 live births (WHO 2015). The country has also made remarkable progress on

[18] Data on immunisation coverage for BCG and polio were not available. Coverage for the third dose of DPT-HepB-Hib was generally high and above threshold in all.

child survival, reducing by two-thirds the rate of child mortality over the past two and a half decades. Baseline findings show that maternal outcome and child survival in the project districts have generally improved because of increased access to comprehensive reproductive, maternal and child health services.

- Despite the improvement in some parameters, the sensitivity to change of the health systems in the project districts is considered high. The majority of the DHMT respondents noted that the existing structures and systems only managed to partially manage existing challenges and did not have the required capacity to meet any additional requirements brought about by project-associated changes. This includes short-term changes, for example, infective outbreaks, and longer-term impacts associated with chronic conditions.
- The VECs' ability to respond to the change would likely be insufficient, slow and compromised by the bureaucratic processes required to necessitate an adequate response. It is likely that external assistance would be required to effectively address any changes. The anticipated decrease in available services may have long-term impacts on general morbidity and mortality.
- Despite a high sensitivity to change, project-related activities are not expected to effect a substantial change to VECs owing to the relatively short temporal duration.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table A9.4-35 presents the sensitive health systems VECs.

Table A9.4-35 Sensitive VECs with Regards to Health System Facilities

VEC	Sensitivity Ranking	Rationale for Ranking
PACs in the districts of Hoima and Buliisa	High (4)	Difficult access to appropriate health care and services

Key Considerations

A key consideration is:

- population growth (natural and because of PIIM) may lead to local health care facilities being further over-stretched.

A9.4.11.2 Baseline Condition of Communicable Diseases Linked to the Living Environment

Communicable diseases, such as acute respiratory infections, pneumonia, tuberculosis, meningitis and leprosy, rely on fluid exchange, contaminated substances or close personal contact for them to travel from an infected carrier to a healthy individual. Therefore, they are directly linked to housing design, overcrowding, housing conditions and the general living conditions in a community.

Several communicable diseases linked to living conditions can be identified in the districts traversed by the AOI. These are outlined below.

Acute Respiratory Infections

National Level

Acute respiratory infections (ARI) were identified as the leading cause of disease burden in the districts traversed by the AOI and the country in general. Reports indicated an ARI prevalence of 9–12% in the central region and 17% in the western region (UBOS 2012b). Lower respiratory infections are the second leading cause of disease burden in Uganda, after HIV and AIDS, and are responsible for nearly 10% of all deaths (WHO 2015a).

District and PAC Level

ARI is a leading cause of disease burden in the districts traversed by the AOI. HMIS data (2017) show that ARI contributed 21% of outpatient load in Hoima district and 33% in Buliisa district with variation across subcounties (Figure A9.4-52). ARI featured consistently among the top-five diagnoses in the local health facilities and emerged among common diseases experienced by PACs based on findings from FGDs and KIIs.

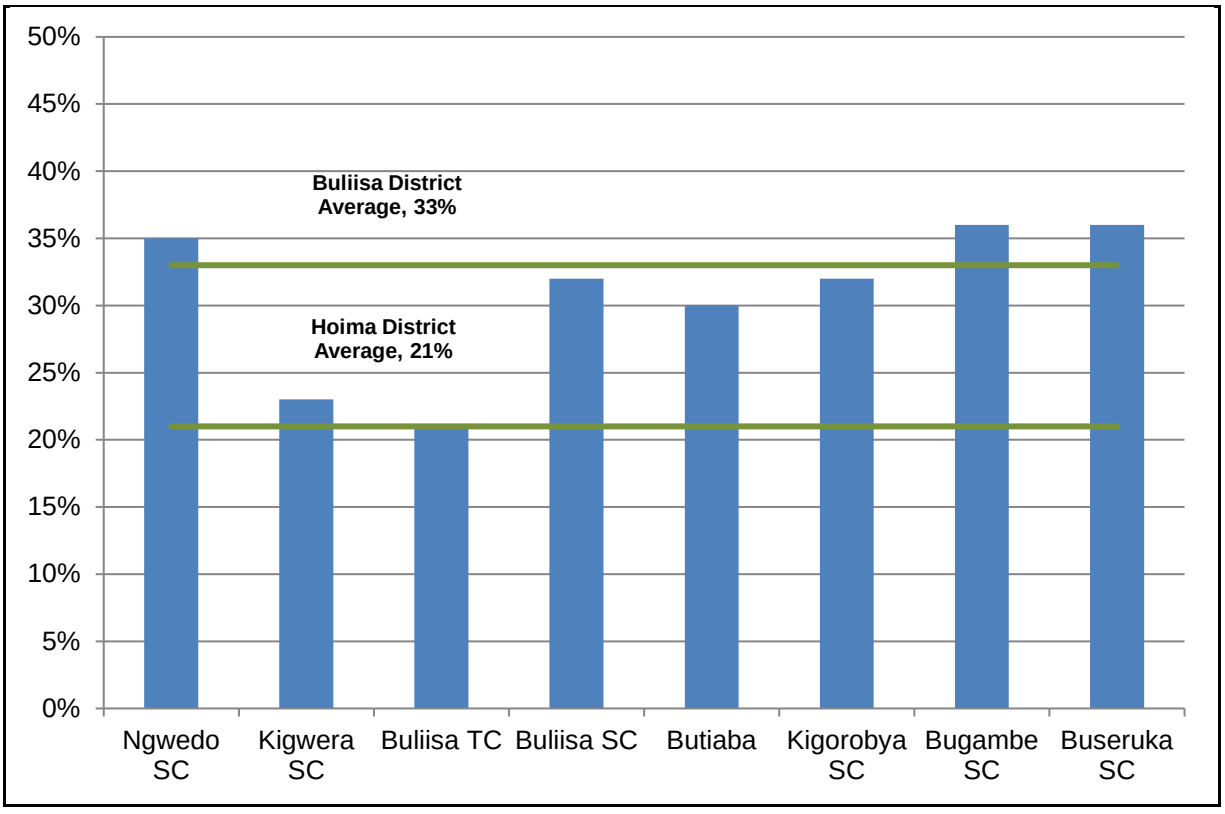

Figure A9.4-52 Acute Respiratory Infection Among Outpatients by District and Subcounty, 2017

SOURCE: HMIS (2017)

NOTE: SC = subcounty, TC = town council

Tuberculosis

Tuberculosis (TB) is an infectious bacterial disease caused by *Mycobacterium tuberculosis*, which most commonly affects the lungs. Individuals with active

pulmonary TB produce airborne droplet nuclei, containing infectious *M. tuberculosis* while speaking, sneezing and, particularly, coughing. Crowding, poor ventilation and duration of exposure increase the risk of transmission. People infected with TB bacilli will not necessarily become sick with the disease. The immune system 'walls off' the TB bacilli, which can lie dormant for years. Almost 10% of immune competent adults infected with *M. tuberculosis* ultimately develop active TB. When someone's immune system is weakened, the chances of becoming sick are increased. As such, HIV and poverty are important co-risk factors for development of active TB disease.

National Level

TB remains a major public health challenge in Uganda with an incidence rate of around 200 new cases per 100,000 (2015 estimate) (WHO 2016a). Like most countries in SSA, Uganda is battling with the dual epidemic of TB, and HIV and AIDS. It is estimated that approximately 42% of TB patients in the country are co-infected with HIV and AIDS (WHO 2015b, 2016a).

Multidrug resistant TB (MDR-TB) is also an emerging challenge at a prevalence of 1.6% for new cases and 12% of retreatment cases (WHO 2015). According to the 2016 global TB report, Uganda recorded relatively low rates of treatment success at 73%, below the recommended target of 85%, but did well to exceed the 90% target of enrolling HIV-positive TB patients on treatment (WHO 2015).

TB services in the country are integrated into the general health care system and are further decentralised to community level with a good coverage of directly observed treatment short-course strategies.

District and PAC Level

Baseline findings show that TB is endemic in the two project districts. HMIS data from 2017 show that Hoima district recorded a high number of 505 bacteriological confirmed TB cases compared to 55 cases in Buliisa district. It is important to note that part of the case load in Hoima stems from referrals from other districts to the regional referral hospital in Hoima municipality (KP74.5).

Hoima district recorded 20 MDR-TB cases in 2017, an increase from 12 in 2016. At subcounty level, Kigorobya recorded the highest number of TB cases, followed by Buseruka (at 99 and 37 confirmed cases, respectively) see Figure A9.4-53.

TB-HIV co-infection emerged as a challenge in both districts further complicating treatment compliance and outcomes.

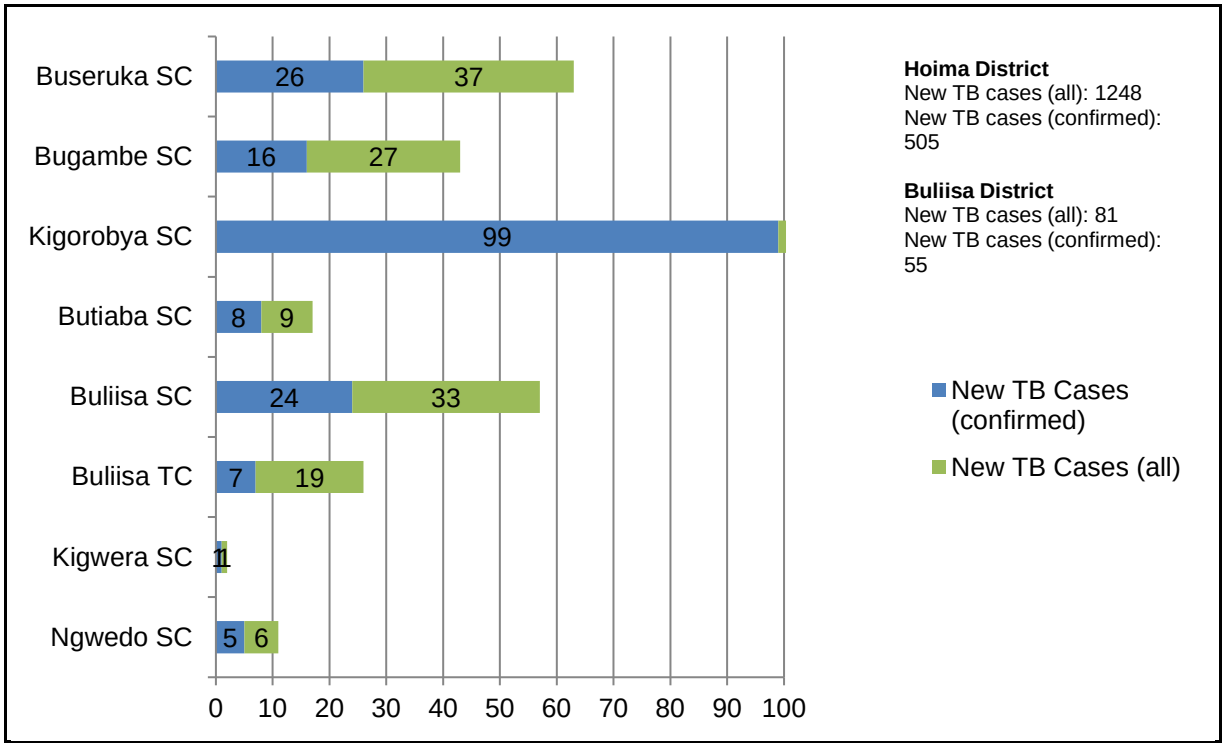

Figure A9.4-53 Distribution of Tuberculosis Cases by District and Subcounty, 2016

SOURCE: Uganda HMIS (2017)

Measles

Measles is a highly contagious, infectious disease caused by a paramyxovirus. Transmission follows inhalation of airborne respiratory droplets from an infected person's cough or sneeze. Unvaccinated children and those living in overcrowded or poor socio-economic conditions are at increased risk of measles. The disease is one of the leading causes of death among young children, even though a safe and cost-effective vaccine is available (WHO 2017).

National Level

The disease remains a public health challenge in all parts of Uganda, despite ongoing immunisation efforts. Latest statistics from the 2016 Ugandan Demographic and Health Survey (DHS) indicate the national measles vaccination coverage was estimated at 80%, lower than the 90% coverage target required for herd immunity (UBOS 2017b).

District and PAC Level

Baseline findings show that measles outbreaks occurred in Butiaba in 2017 (616 cases) and Kigorobya and Buseruka in 2016 (364 and 184 cases respectively). Overall, Hoima and Buliisa districts registered 2506 and 668 measles cases in 2017, respectively.

In FGDs conducted in communities in the project districts, women revealed that measles is common among children. Respondents from KIIs noted that one of the

key underlying factors for the frequent occurrence of measles cases, was the relatively low measles vaccine coverage in the two districts.

Meningitis

Meningitis is a viral or bacterial infection of the membrane covering the brain and spinal cord. Even when meningitis is diagnosed early and adequate therapy is available, 5–10% of patients die typically within 24–48 hours of experiencing the first symptoms. Many thousands of survivors are left with brain damage, hearing loss or learning disabilities. Transmission is through direct contact with respiratory droplets. Infections caused by *Haemophilus influenzae* type b (Hib), *Streptococus pneumoniae* and *Neisseria meningitidis* are responsible for high morbidity and mortality among children (Trotter 2007).

National Level

A section of northern Uganda lies within the African meningitis belt. These border areas and adjacent west Nile, northern and northeastern districts experience frequent outbreaks of meningococcal meningitis. The last outbreak was in 2016 in the Nakaseke district (Ainebyoona 2016, Internet site). The western and central regions are outside the meningitis belt and do not experience large outbreaks, but isolated cases of bacterial, viral or other forms of meningitis occur.

District and PAC Level

Analysis of HMIS data show that the bulk of the burden of disease is largely due to nonbacterial meningitis, estimated to be responsible for more than 99% of all diagnosed cases. In 2017, only 19 cases of bacterial meningitis were recorded in the project districts.

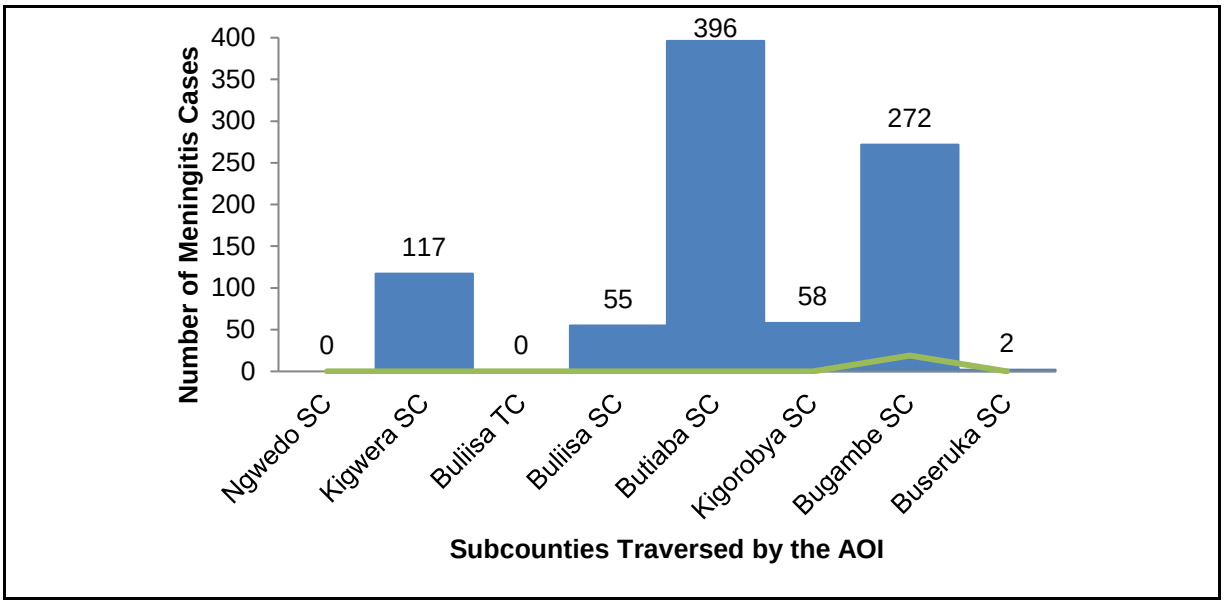

Figure A9.4-54 Distribution of Meningitis Cases by Subcounty, 2016

SOURCE: Uganda HMIS (2017)[19]

[19] Note: 99% of the cases are nonbacterial meningitis

Leprosy

Leprosy is closely associated with poverty and overcrowding. The disease is caused by the slow-growing bacillus *Mycobacterium leprae,* which is not highly infectious. The incubation period of the disease is about 5 years, but symptoms can take up to 20 years to appear (WHO 2012). Leprosy was not present in any of the PACs along the pipeline corridor, according to FGDs and KIIs.

National Level

There is a target to eliminate leprosy in all countries by 2020 (WHO 2012). Whereas Uganda has largely succeeded in eliminating leprosy as a public health problem, 300 new cases continue to be notified each year according to the National TB and Leprosy Programme. About two-thirds of these cases occur in 13 districts in the southeastern, north and northwestern regions of the country. New cases are unevenly distributed, which further complicates control efforts (MOH 2018, Internet site).

District and PAC Level

Baseline findings show that Buliisa district recorded just one new case of leprosy over the preceding three years (from 2015 to 2017) while Hoima district recorded 263 new leprosy cases over the same period. Again, it must be noted that the high case load in Hoima may be attributed to in-referral of cases from other districts in the catchment area. Among the subcounties, only Kigorobya recorded a single case of leprosy in the last three years.

Trend in Condition and Sensitivity to Change

The national trend in the annual incidence of TB has shown a progressive decline over the past 10 years.

The sensitivity to diseases related to living conditions in the districts traversed by the AOI varies from moderate to very high. These are based on the existing BOD in the districts, the available health services, trends in disease, stakeholder concerns and in-migration into high burden areas.

The sensitivity to change in both project districts is considered very high. These ratings were determined based on the existing BOD in the districts, the available health services, trends in disease, stakeholder concerns and population in-migration into high burden areas.

Should a change in the baseline status occur, it will likely manifest itself as an increase in disease burden which, in turn, will place additional pressure on and potentially overwhelm the capacity of the existing health system.

Sensitivity Ranking

Several sensitive VECs were identified for communicable diseases due to living conditions. These are presented in Table A9.4-36.

Table A9.4-36 Communicable Disease VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Households close to roads	Moderate (3)	Increased exposure to diesel particulate matter and other pollutants that have a detrimental effect on the respiratory system.
Children, especially under five years old	High (4)	Immature immune systems and low herd immunity
Elderly	High (4)	Lower immune response and greater risk for contracting communicable diseases
Households using biomass fuel for indoor cooking and lighting	High (4)	Poor indoor air quality associated with higher risk of ARIs
Individuals living in overcrowded areas associated with poor housing and low socio-economic standards	High (4)	Higher likelihood of disease spread and inadequate ventilation
Immuno-compromised individuals	Very high (5)	Poor immune response and clear link between TB and HIV

A9.4.11.3 Key Considerations

Key considerations are:

- interaction between PACs and an expatriate labour force may increase the risk of transmission of communicable diseases
- given the high incidence of communicable diseases and the poor health facilities, PIIM into the PACs will likely increase the prevalence of communicable diseases.

A9.4.11.4 Baseline Condition of Vector-Related Diseases

Malaria

Malaria is caused by parasites that are transmitted to people through the bites of an infected female *Anopheles* mosquito. Nearly half of the global population are at risk of malaria infection with most cases and deaths occurring in SSA. According to latest estimates from the WHO, released in December 2016, there were 212 million cases of malaria and 429,000 deaths in 2015 (WHO 2016b).

National Level

Malaria remains the leading cause of disease burden in Uganda and poses a substantial challenge to socio-economic development. The entire population is at risk of infection, though children under five years and pregnant women are particularly vulnerable (MOH 2014a, Internet site). Malaria transmission displays a stable, perennial pattern in 90–95% of the country. In the rest of the country, particularly the highland areas, there are areas of low and unstable transmission with the potential for epidemics. Transmission occurs year-round, but there is

seasonal variation in intensity with a peak at the end of the rainy seasons (UBOS 2015).

Plasmodium falciparum is the predominant parasite species, while the important anopheles mosquito species are *A. gambie* and *A. funestus*. Hospital records indicate that malaria is responsible for 30–50% of outpatient visits, 15–20% of admissions and up to 20% of inpatient mortality (UBOS 2015). Figure A9.4-55 shows the distribution of malaria in Uganda (MOH 2014a, Internet site). Hoima and Buliisa fall within very high malaria transmission areas.

The National Malaria Control Programme (NMCP) is tasked with implementing the Malaria Control Strategic Plan 2014–2015 to 2019–2020, which prioritises the following measures (UBOS 2015):

- use of long-lasting insecticidal nets or insecticide treated bed nets (ITN)
- indoor residual spraying
- environmental management (where feasible and effective)
- uncomplicated malaria case management with artemisinin-based combination therapy at the community level and in health units
- treatment and prevention of malaria during pregnancy, including intermittent preventive treatment in pregnancy
- early detection and response to malaria epidemics, monitoring and evaluation and operational research.

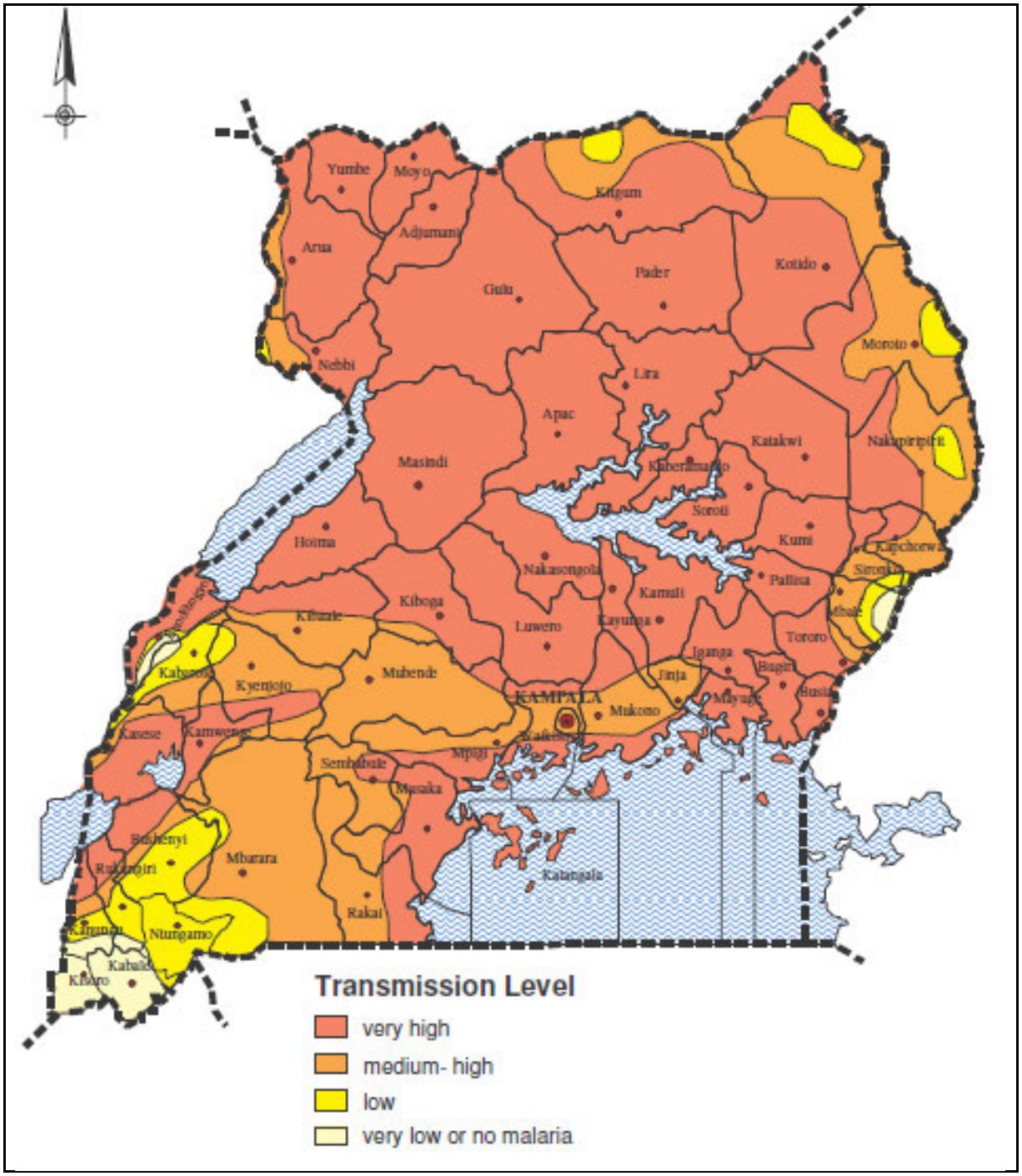

Figure A9.4-55 Distribution of Malaria Endemicity in Uganda

SOURCE: MOH (2014a, Internet site)

District and PAC Level

The districts of Hoima and Buliisa have a very high malaria transmission level and malaria cases account for 20–50% of outpatient cases at health facilities in the project districts. HMIS data from 2017 indicate that malaria case load, confirmed by rapid diagnostic tests, was highest in the subcounties of Kigwera, Ngwedo and Buseruka, constituting at least 40% of outpatient load (see Figure A9.4-56).

The total number of malaria cases diagnosed in 2017 was highest in Kigorobya, Bugambe and Buseruka and lowest in Buliisa town and Buliisa subcounty (see Figure A9.4-56). Findings from FGDs and household surveys also show that malaria was reported among the most common ailments experienced in sample PACs. This was further corroborated by findings from health facilities where malaria consistently ranked among the top five causes for morbidity. All the project districts benefit from periodic mass distribution of ITNs. They also received targeted distribution of ITNs to pregnant mothers and children under five years, and malaria prophylaxis in pregnancy. Malaria cases were managed with rapid diagnostic tests and artemisinin in combined therapy. Resources for the appropriate and timely management of malaria were routinely available in all health facilities within the project districts. Population coverage of ITN in the study area is reported to be above 82%. Indoor residual spraying is not implemented in any of the project districts.

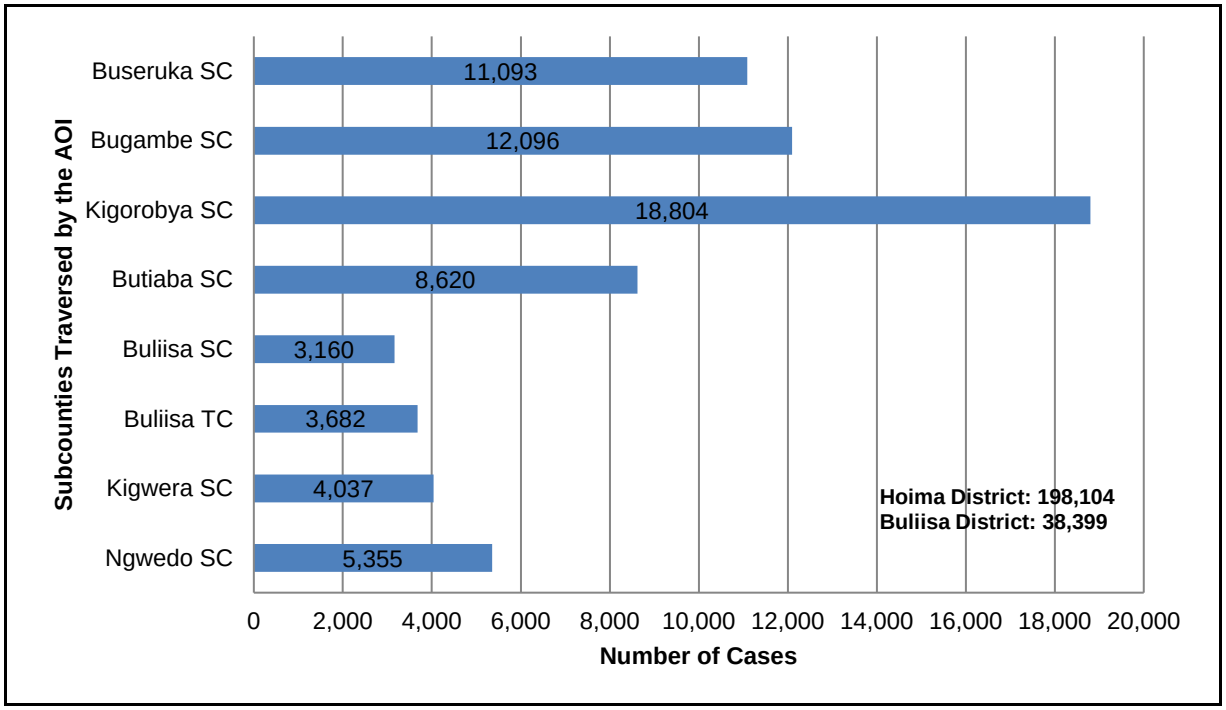

Figure A9.4-56 Malaria Cases by District and Subcounty, 2017

SOURCE: Uganda HMIS (2017)

Arboviral Diseases

Arboviral diseases, arthropod-borne viruses, that may occur in the project area are dengue and yellow fevers, while Rift Valley fever also a potential threat.

These acute viral fevers are transmitted by the day-biting *Aedes* mosquitoes which breed mainly in human-made containers. These diseases are often poorly documented and under-reported owing to limited awareness by health-care providers, lack of diagnostic capability and confounding clinical diagnoses from other febrile infections.

Dengue Fever

In recent years, the rapid spread of dengue fever has made it a global concern. The disease is widespread throughout the tropics, with local variations in risk influenced by rainfall, temperature and unplanned rapid urbanisation. Travel effectively sustains transmission. Dengue fever is likely to be under-recognised and under-reported in Africa because of low awareness by health-care providers, other prevalent febrile illnesses, and lack of diagnostic testing and systematic surveillance.

Dengue is endemic in Uganda. Early signs and symptoms of the disease are often similar to other viral fevers and febrile infections that confound clinical diagnosis (Amarasignhe et al. 2011). At the time of writing, insufficient data were available at a district level to describe the BOD.

Yellow Fever

Yellow fever (YF) is an acute viral haemorrhagic disease transmitted by *Aedes* mosquito bites. YF symptoms range from a mild influenza-like syndrome to a severe haemorrhagic fever. A small proportion of patients who contract the virus develop severe symptoms and approximately half of those die within 7–10 days.

YF surveillance is through border control and weekly reporting of suspected cases. Vaccination is not routinely provided in the country's childhood immunisation package, but reserved for outbreak events, thus immunisation coverage is generally low. HMIS data on YF were found to be insufficient in all project districts.

Human African Trypanosomiasis

Human African trypanosomiasis (HAT), commonly known as sleeping sickness, is endemic in parts of Uganda. Two forms of the parasite occur: *Trypanosoma brucei gambiense* is dominant in the northwest and *T. b. rhodesiense* in the southeast (Simarro et al. 2012). The rural populations whose livelihoods depend on agriculture, fishing, animal husbandry or hunting are at the highest of risk of exposure to the tsetse fly bites that transmit the parasite. Approximately 7% of the country, over two million people, is at risk of HAT. The districts traversed by the AOI are in a low-risk area for sleeping sickness transmission.

From 2016 to 2017, Hoima district recorded over 200 cases of sleeping sickness (including 7 cases from Buseruka) while Buliisa district recorded just one case (from Kigwera subcounty).

Onchocerciaisis

Onchocerciasis, commonly known as river blindness, is caused by the parasitic worm *Onchocerca volvulus*. It is transmitted to humans through exposure to repeated bites by infected blackflies of the genus *Simulium*. River blindness is found in discrete locations in the country, including Hoima, where 398 cases were recorded in 2016. The district implements an onchocerciasis elimination strategy, which includes biannual mass treatment with ivermectin and vector elimination measures.

Data obtained from the HMIS, show that Hoima recorded 245 cases of onchocerciasis in 2017 while Buliisa district recorded 73 cases. Both districts

implement an onchocerciasis elimination strategy, which includes biannual mass treatment with ivermectin. Results indicate that transmission of the disease has been interrupted.

Trend in Condition and Sensitivity to Change

Confirmed malaria cases increased in the project districts in 2016 when compared to statistics from 2015 (see Figure A9.4-57). The number of cases remained high in 2017, with minimal changes across all project districts. Other vector-related diseases generally show a decreasing trend indicating some gains from interventions.

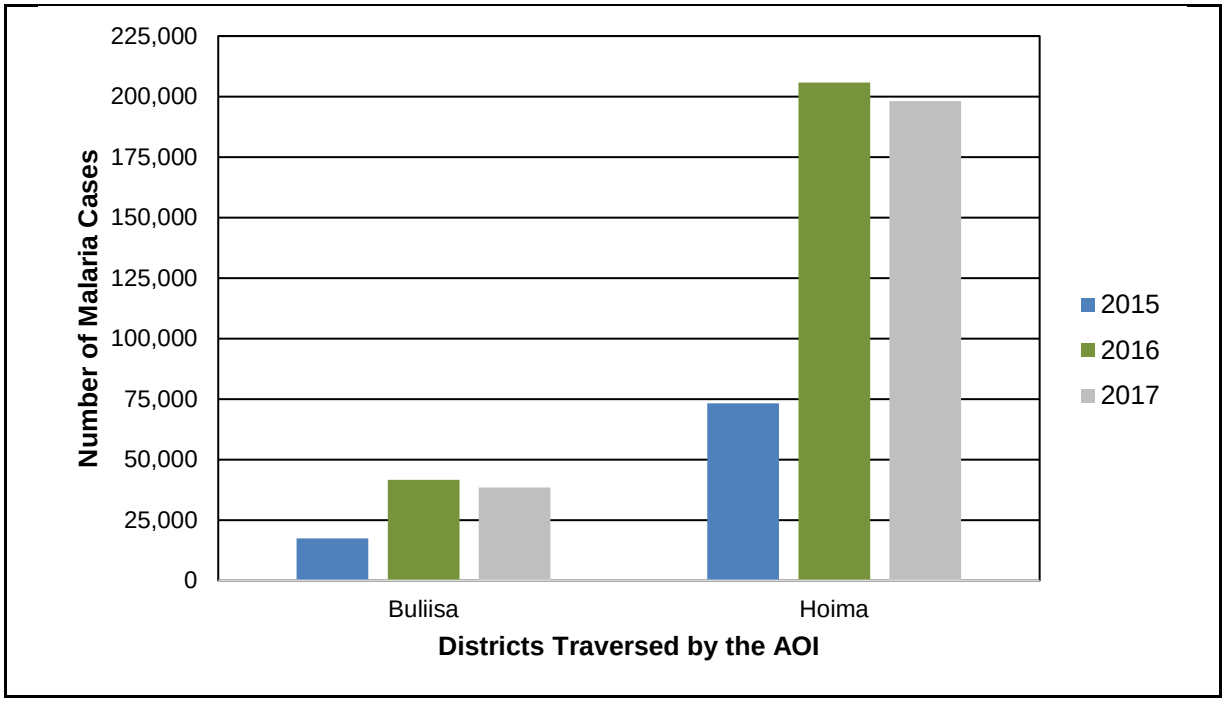

Figure A9.4-57 Trend in Malaria Cases by District, 2015–2017
SOURCE: Uganda HMIS (2017)

The sensitivity of the districts traversed by the AOI with regards to vector-related diseases varies from moderate to high. Owing to a high burden of disease in conjunction with an increase in disease trends, the districts of Buliisa and Hoima are considered highly sensitive to change. Table A9.4-37 details sensitive VECs in the AOI.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table A9.4-37 presents the sensitive VECs for vector-related diseases.

Table A9.4-37 Vector-Related Diseases and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Children (especially under five years of age)	High (4)	Immature immune systems
Pregnant women	High (4)	Potential of disease affecting unborn child
Individuals living in overcrowded areas associated with poor housing and poor sanitary conditions	High (4)	Higher likelihood of disease spread and increased mosquito densities
Rural populations	High (4)	Poorer access to medication and health facilities

Key Considerations

Key considerations are:

- construction activities may create standing water, in which malaria-spreading mosquitoes can breed
- vector management activities, if not aligned with national strategies, may increase vector resistance and compromise local authority interventions
- PIIM may promote vector breeding, disease transmission and an increased burden on health systems
- environmental sanitation, health care services and prophylaxis, vector control programmes and the management of PIIM are key for controlling malaria.

A9.4.11.5 Baseline Condition of Soil-, Water- and Waste-Related Diseases

The prevalence of soil-, water- and waste-related diseases is highly dependent on sanitation facilities and access to safe drinking water.

Access to Drinking Water and Sanitation

National Level

The latest WHO and UNICEF statistics show that 79% of the Ugandan population have access to safe drinking water, an increase from 40% in 1990. Access to adequate sanitation is generally poor at just 19% (29% in urban areas and 17% in rural areas) with limited progress in recent years (UNICEF 2015). Access to basic sanitation facilities is higher at an estimated 80% (MOH 2017a). The relative high cost of constructing latrines and poor health education were noted as factors limiting sanitation improvements (UBOS 2014).

An estimated 78% of households do not have functional hand-washing facilities, for after toilet use. Only 8% have access to water and soap. Functional hand-washing facilities were available in 30%, 26% and 14% of households in the central north, central south and Bunyoro regions respectively (UBOS 2014).

Waste disposal was generally poor. An estimated 44.2% of households (19.5% urban and 52.2% rural) dispose of waste in their gardens, with 22.5% burning and 8% burying waste. Only 7% of waste was disposed in a supervised dump (20.3% in urban areas) (UBOS 2014).

District and PAC Level

Figure A9.4-58 shows the proportion of households with access to safe drinking water and sanitation in both project districts. Access to safe drinking water was higher in Buliisa (71%) than in Hoima (58%) (Ministry of Water and Environment Sector Performance Report 2017). Baseline findings show that groundwater, in the form of boreholes or wells, is the most common water source for households. Others rely on surface water, in the form of Lake Albert, rivers and dams, for all their domestic needs. In general, the availability of water decreases during the dry season. Concerns relating to the reliability, quantity and affordability of water were reported in the FGDs. Nearly a third (32%) of households in Buliisa district have no access to sanitation facilities, compared to just 9% in Hoima.

In the absence of acceptable sanitation facilities, it is common for these households to practice open defecation.

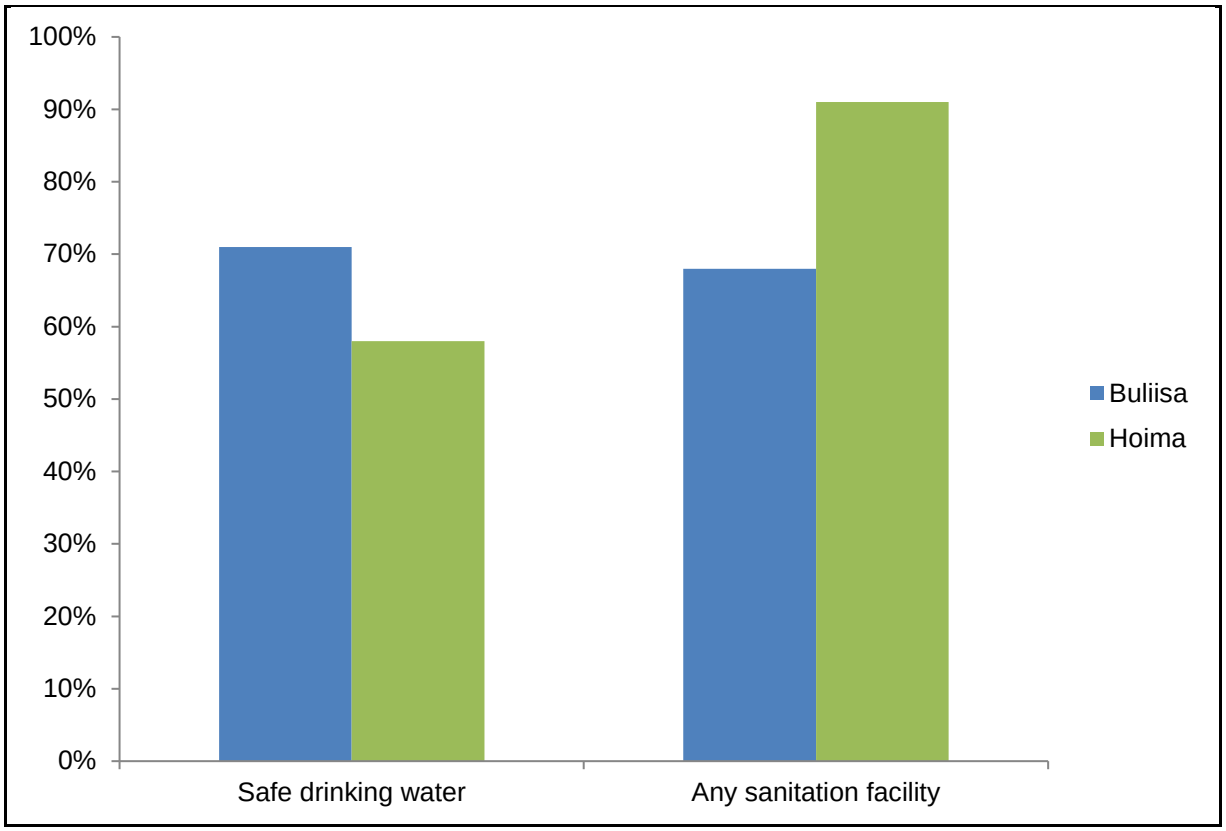

Figure A9.4-58 Access to Safe Drinking Water by Districts, 2016–2017

SOURCE: Ministry of Water and Environment – Sector Performance Report (2017)

Diarrhoeal Disease

National Level

Diarrhoeal disease is still a major public health concern in Uganda, although a considerable decline in this disease's share of the disease burden has been recorded. Diarrhoeal disease is estimated to be responsible for 5% of deaths in the country, a decline from 11% in 1990 (IHME 2013). However, among children under

five years, diarrhoea remains among the top causes of morbidity and mortality (WHO 2015a).

According to the 2011 UDHS, cases of diarrhoea among children were highest in the eastern region (32%) and lowest in the southwest region (14%). The western region recorded a 19% prevalence (UBOS 2017b).

District and PAC Level

Baseline findings show that diarrhoea is a common cause of morbidity in the project districts. According to district-level HMIS data, 3–4% of outpatient cases presented with diarrhoea (see Figure A9.4-59). The prevalence is much higher among young children. Butiaba subcounty contributed over a third (36%) of all the diarrhoeal cases in Buliisa district according to the HMIS data.

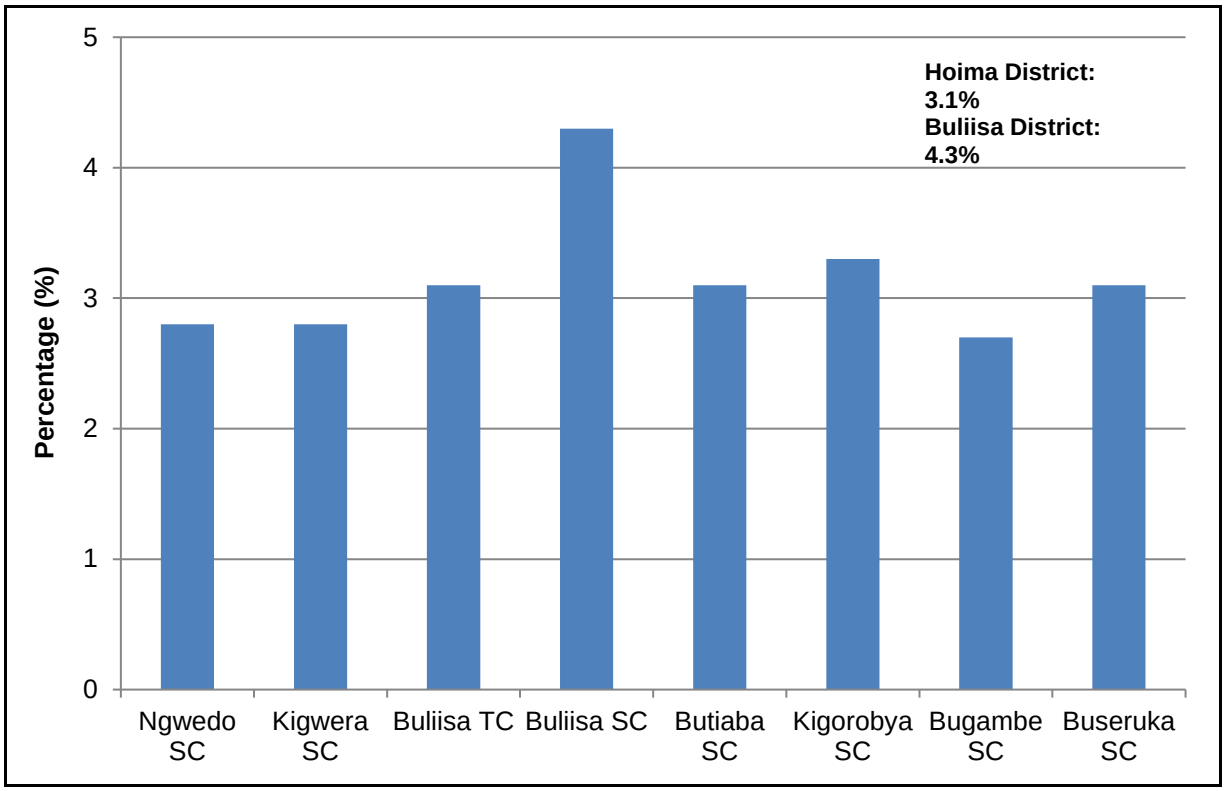

Figure A9.4-59 Diarrhoeal Disease Morbidity by District and Subcounty, 2017
SOURCE: Uganda HMIS (2017)

Cholera

Cholera is caused by the bacteria *Vibrio cholerae* and is the main cause of dehydrating diarrhoea in adults. Clinical episodes range from asymptomatic infection to acute fulminant watery diarrhoea which, if untreated, may be fatal (Sack et al. 2004). No cases of cholera were reported during the study in any of the PACs.

National Level

Uganda experiences frequent cholera outbreaks, with an estimated 11,000 cholera cases and 61–182 cholera-related deaths each year. Most cases (81%) occur in a relatively small number of districts comprising just 24% of the total population.

Cholera outbreaks are particularly common among fishing communities around the lakes. In 2015, an outbreak in Hoima district resulted in over 200 cases and 6 deaths (Mugwera 2015, Internet site; Bwire et al. 2017).

District and PAC Level

Cholera outbreaks are particularly common among fishing communities around the lakes and remains a major risk in the districts traversed by the AOI. In 2016, cholera outbreaks occurred in both Hoima and Buliisa districts, recording 202 and 97 cases, respectively. Outbreaks were noted to be more common in the Buseruka, Butiaba and Kigorobya subcounties (see Table A9.4-38).

The key underlying factors leading to higher vulnerability are:

- limited access to safe drinking water
- inadequate sanitation
- poor hygienic practices.

Table A9.4-38 Cholera Cases by District and Subcounty, 2015–2017

Project District	Cholera Cases		
	2015	2016	2017
Buliisa district	0	97	2
Buliisa subcounty	0	0	0
Buliisa Town Council	0	12	0
Butiaba subcounty	0	78	2
Kigwera subcounty	0	0	0
Ngwedo subcounty	0	0	0
Hoima district	263	202	43
Bugambe subcounty	7	0	0
Buseruka subcounty	30	119	0
Kigorobya subcounty	1	41	2

SOURCE: Uganda HMIS (2017)

NOTE: Only subcounties represented here are those traversed by the AOI.

Dysentery and Typhoid Fever

National Level

Typhoid fever, also called enteric fever, is a severe febrile illness that follows infection by a gram-negative bacillus, *Salmonella* spp. The disease continues to be a public health concern in many developing countries, including Uganda. Typhoid is commonly over-reported because of a lack of required diagnostic facilities. The techniques usually performed are very nonspecific and cross-react with other bacterial and parasitic diseases. Febrile illnesses such as malaria often confound the diagnosis of typhoid because of similarities in their general presentations.

District and PAC Level

HMIS data show that the districts traversed by the AOI record several cases annually (Figure A9.4-60). FGD participants in PACs consistently listed typhoid among common ailments in their community. These diseases are notifiable and surveillance is done through weekly reporting of cases.

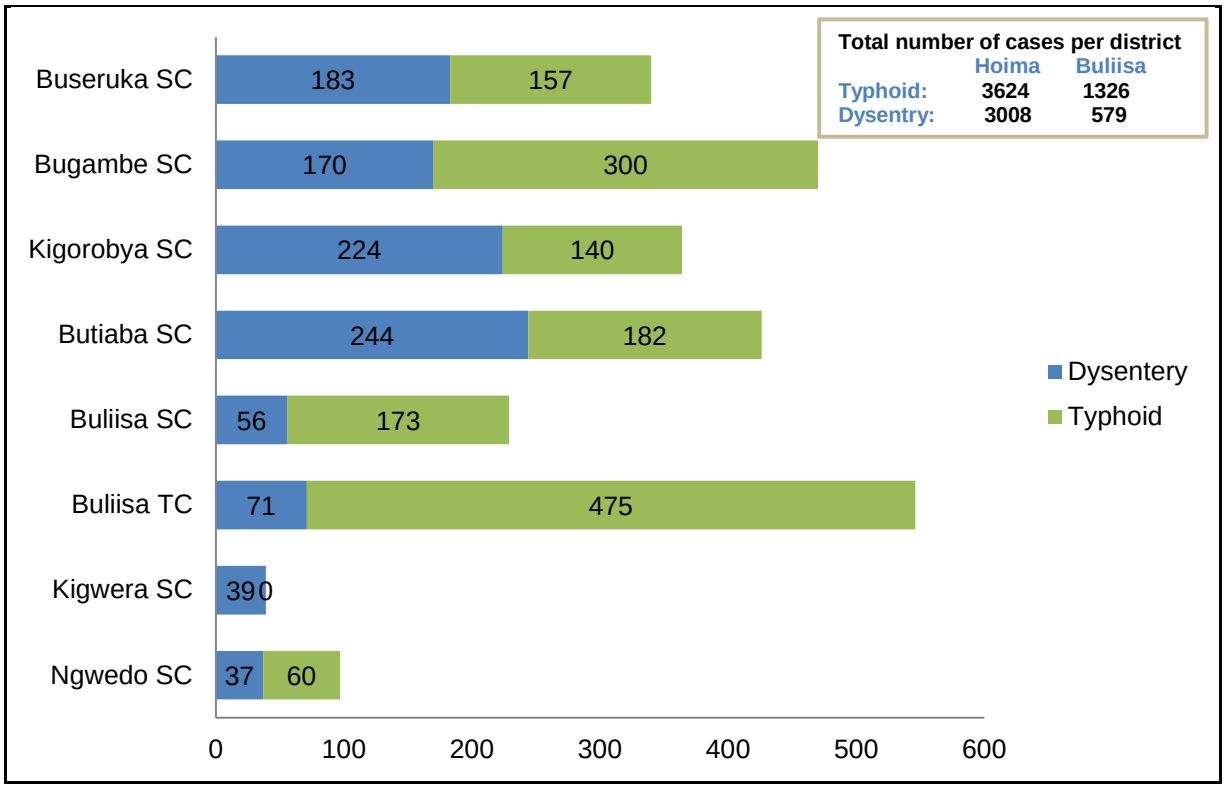

Figure A9.4-60 Typhoid and Dysentery Cases by District and Subcounty, 2017
SOURCE: Uganda HMIS (2017)

Schistosomiasis and Intestinal Worms

Schistosomiasis, also known as bilharzia, is a tropical disease caused by parasitic trematode worms of the genus *Schistosoma*. In Africa, the urogenital form, caused by *Schistosoma haematobium*, and the intestinal form, caused by *Schistosoma mansoni*, are common. Infection is prevalent in tropical and subtropical areas, especially in poor communities without potable water and adequate sanitation. Therefore, the prevalence of schistosomiasis is a good indicator of the level of sanitation in a potentially endemic area.

National Level

Schistosomiasis in Uganda is mainly caused by *S. mansoni* and affects more than 10% of the population. Research has shown high prevalence near lakeshores and along large rivers, with no transmission above 1400 m altitude or where total annual rainfall was less than 900 mm per year (Tukahebwa et al. 2013).

Intestinal worms are endemic throughout the country and their transmission is promoted by lack of adequate sanitation. Mass deworming of young children is implemented across the county to control the infection.

District and PAC Level

The Lake Albert area shows a very high prevalence of up to 80% (Kabatereine 2004). In 2017, Hoima and Buliisa recorded 197 and 196 schistosomiasis cases, respectively. The cases in Buliisa district came from just two subcounties: Butiaba (162 cases) and Buliisa (34 cases), while most cases in Hoima came from Kigorobya (150 cases). KIIs found that schistosomiasis was the main hazard for fisherfolk and shell collectors working in and on the shores of Lake Albert.

Trend in Condition and Sensitivity to Change

Trends with regards to soil-, water- and waste-related disease management include:

- access to safe drinking water and basic sanitation facilities is improving
- the districts traversed by the AOI reported a decrease in the burden of diarrhoeal diseases. This was partly attributed to improvements in hygiene behaviour. In addition, WASH programmes are coordinated and implemented by the Uganda Sanitation Fund. Most programmes focus on behaviour change communication programmes about open defecation. Programmes target approximately 5.6 million people in more than 9000 villages to live in open-defecation-free environments and to adopt good hygienic practices. A particularly effective initiative is community-led total sanitation.
- potential for cholera, dysentery and typhoid outbreaks remain high in all project districts because of underlying challenges in environmental health conditions.

Ecosystem Services Provided

Water-related diseases are linked to safe water, which provides the following ecosystem services.

Provisioning services:

- general health
- form of livelihood (see Section A9.4.7 on river- and lake-based livelihoods).

Sensitivity Ranking

Several sensitive VECs were identified in relation to soil-, water- and waste-related diseases (see Table A9.4-39).

Table A9.4-39 Soil-, Water- and Waste-Related Disease VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Children	High (4)	Undeveloped immune response and greater risk for contracting diseases
Elderly	High (4)	Compromised immune response
Immuno-compromised individuals	High (4)	Poor immune response
Communities with existing poor access to safe water and adequate sanitation	High (4)	High likelihood of infection

A9.4.11.6 Key Considerations

A key consideration is that:

- PIIM into PACs may influence the availability of water, exacerbate unsanitary conditions and increase disease spread and BOD.

A9.4.11.7 Baseline Condition of Sexually Transmitted Infections

HIV and AIDS

National Level

The HIV epidemic in Uganda continues to be generalised and stable, without a substantial change of pattern over the last decade. Uganda achieved impressive success in controlling HIV during the 1990s, bringing down the prevalence among adults 15–49 years from a high of 18.5% in 1992 to 6.4% in 2005 (MOH 2017b).

However, recent findings show an increase in HIV prevalence. In 2016, an estimated 52,000 new HIV infections were recorded and 28,000 people were estimated to have died from AIDS-related illnesses. While there have been increased efforts to scale up treatment initiatives, there are still many people living with HIV who are not treated, including possibly high-risk groups such as commercial sex workers. Punitive laws and stigmatising attitudes toward sex workers, people who inject drugs and gay men has meant that these people, who are most vulnerable to infection, are far less likely to engage with HIV services (AVERT 2017, Internet site).

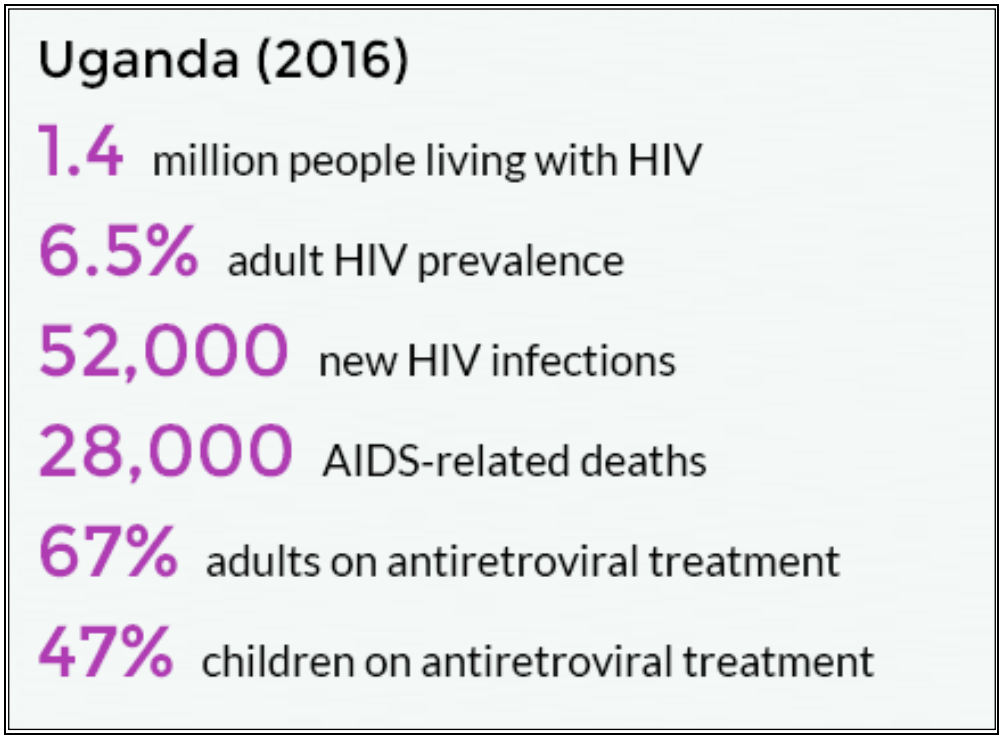

Figure A9.4-61 Key HIV Statistics for Uganda, 2016
SOURCE: UNAIDS 2016

The reported HIV prevalence is higher in urban areas (7.5%) than rural areas (5.8%) and higher among women (7.5%) compared to men (4.3%). The prevalence varies across regions, as shown in Figure A9.4-62.

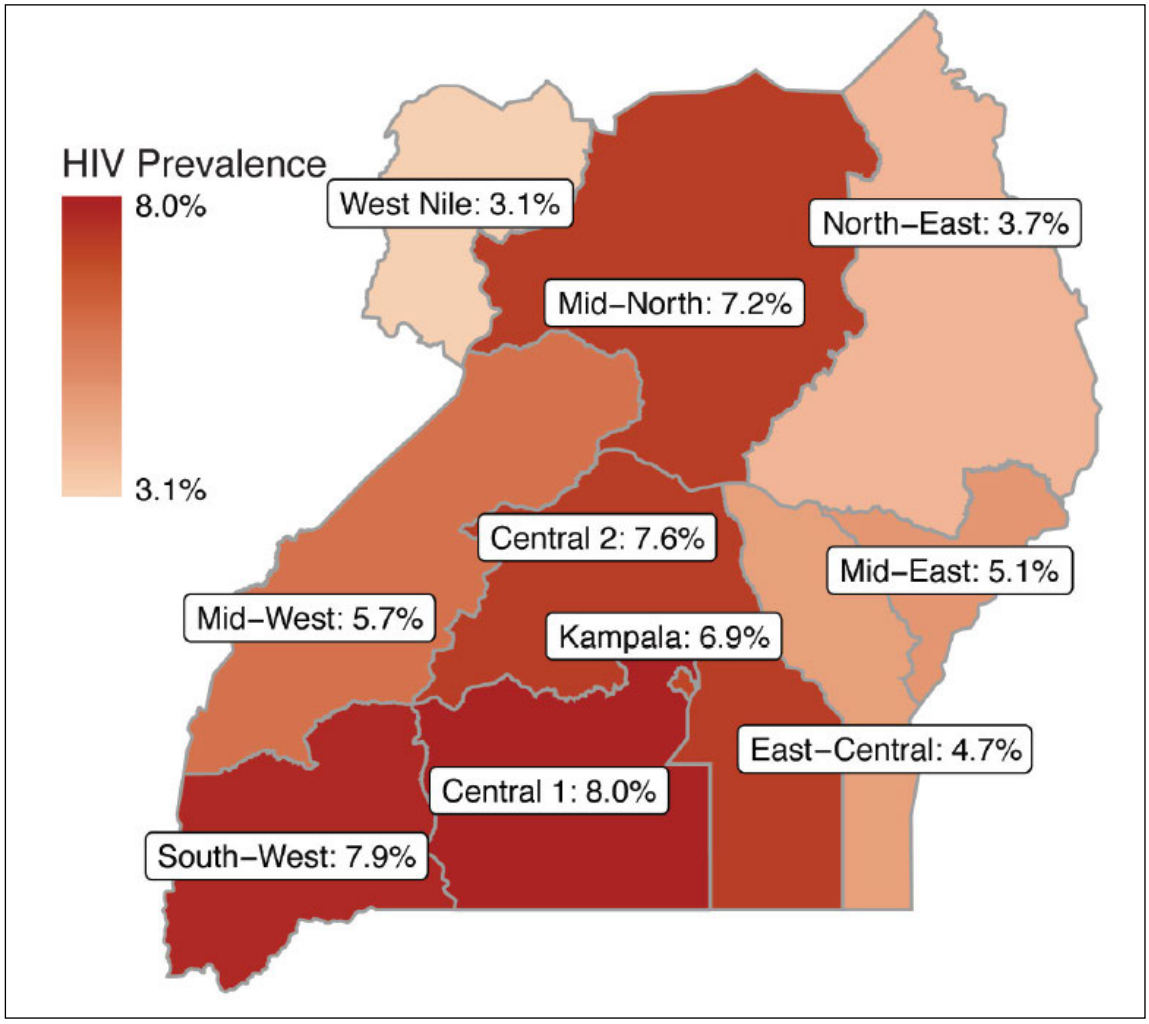

Figure A9.4-62 HIV Prevalence in Regions of Uganda, 2016–2017

SOURCE: MOH 2017b

District and PAC Level

Baseline findings indicated that the HIV prevalence in Hoima and Buliisa districts were estimated at 6.8% and 5.6% in 2016–17, respectively (see Figure A9.4-63). These rates have been inferred from programme data and weighted HIV prevalence among pregnant women visiting antenatal clinics and, therefore, may not necessarily reflect the true prevalence in the population. Butiaba subcounty recorded the highest HIV positivity rate in Buliisa district, with an estimated prevalence of 7.9% in 2015.

Fishing communities and trading centres were identified as the major hot spots for HIV transmission. The following determinants for HIV infection were identified by informants in the AOI:

- high population mobility
- location along major transport routes with rest stops for truck drivers

- fishing communities
- trade hubs
- existence of most-at-risk populations (most urban centres)
- cultural practices such as wife inheritance
- road construction that has increased in migration to the area
- high-risk sexual behaviour.

HIV care and treatment services were generally available and freely accessible. There were reports of shortages of first line drugs in some districts linked to supply chain inefficiencies.

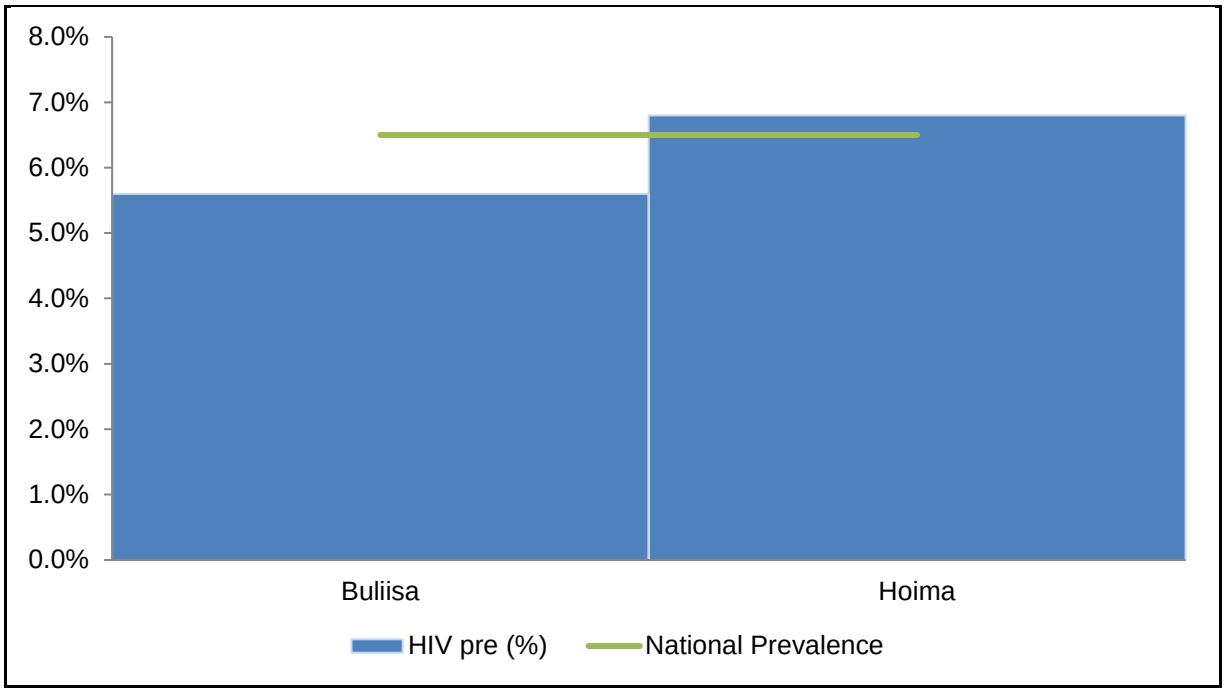

Figure A9.4-63 HIV Infection Rate by District, 2016

SOURCE: Uganda HMIS (2017)

Sexually Transmitted Infections

Sexually transmitted infections (STIs) such as gonorrhoea, syphilis and chlamydia are an important global health priority because of their devastating impact on women and infants. Moreover, STIs and HIV are linked by biological interactions and can occur in the same population cohorts. Infection with certain STIs can increase the risk of acquiring and transmitting HIV and can alter the course of HIV progression.

National Level

STIs are prevalent in Uganda with HMIS data recording over 73,000 cases of urethral discharge and 125,000 cases of genital ulcers in 2013. The data also indicated a syphilis prevalence of 2.0% among pregnant women (UNAIDS 2013). Prevalence remained at 2.0% in 2017 (MOH 2017b).

Studies have also documented the occurrence of herpes simplex virus-2, hepatitis B virus, gonorrhoea, chlamydia infection, bacterial vaginosis and other STIs. Alongside hepatitis A, C and E viruses, hepatitis B infection is highly endemic in Uganda, with transmission occurring in childhood and adulthood. A recent study indicates a seroprevalence of 10% in the general population. It is also estimated that more than 1.4 million Ugandans are chronic carriers of the virus. Since 2012, the country has included hepatitis B vaccine in its routine child vaccination programme (Bwogi 2009).

District and PAC Level

Baseline findings show that STIs are common in the districts traversed by the AOI. Hoima district recorded over 11,000 cases in 2017, while Buliisa recorded 1628 cases (see Figure A9.4-64). The subcounties of Kigorobya, Bugambe, Butiaba and Buseruka recorded the highest number of STI cases. Unsafe sex practices, especially among the youth and adolescent populations, were seen as the key underlying contributing factor to these high rates. Analysis of HMIS data showed that 6–11% of the STI cases stemmed from sexual violence, more especially in Butiaba and Buliisa subcounties.

Findings from KIIs and facility assessments indicated that STI services were free of charge and generally readily available in most of the public health facilities, although the continuity of effective stock management is a challenge.

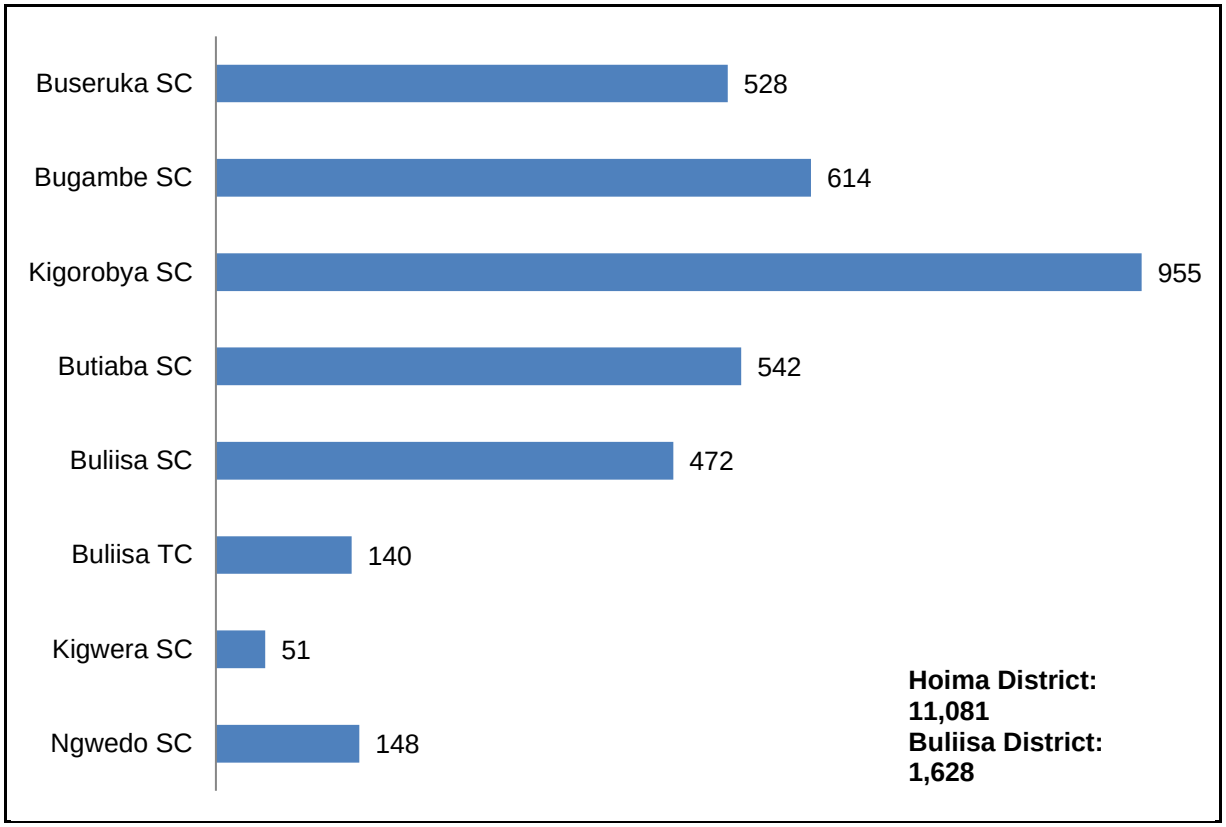

Figure A9.4-64 Sexually Transmitted Infections Cases by District and Subcounty, 2017

SOURCE: Uganda HMIS (2017)

Trend in Condition and Sensitivity to Change

The following trends were identified:

- The national trend in HIV prevalence showed a decrease over the previous two decades, from a high of >18% in the 1990s to a record low of 6.4% in 2005. The current picture, however, shows stagnation and pockets of increasing prevalence.
- Both Hoima and Buliisa districts reported a decrease in HIV prevalence over the past three years. This was attributed to scaling up interventions including health education, free condom distribution, safe male circumcision and increased availability and use of HIV care and treatment. It is important to note that there are challenges in determining the actual trend of HIV prevalence in the districts because of reliance on facility-based data which are less accurate compared to population-based surveys.
- Buliisa and Hoima are considered highly sensitive to change with regards to HIV, AIDS and other STIs. None of the receptors are considered resilient to change.
- Any project-related change may result in a substantial deviation from the baseline status, while the duration and associated challenges brought about by these changes are typically considered longer term. As with other EHAs, any substantial change has the potential to overwhelm the existing capacity of district health services and may result in a permanent negative change.
- As the potential project-related changes to incidences of HIV and STIs are typically observed in communities near project infrastructure, in larger trading centres and along project access roads, specific types of communities have been identified and, where possible, referenced to KPs.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline identified several sensitive VECs with regards to sexually transmitted diseases. These are presented in Table A9.4-40.

Table A9.4-40 Sexually Transmitted Disease VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Women and young girls	High (4)	High risk group for disease spread due to high level of GBV and rape
PACs along transport routes and access roads	High (4)	Truck driver stops linked to transactional sex
PACs close to artisanal mining activities	High (4)	Artisanal miners linked to transactional sex
Commercial sex workers	Very high (5)	High risk group for disease spread due to unsafe sex

A9.4.11.8 Key Considerations

A key consideration is:

- districts with a high prevalence of STDs, PIIM and a growing population are likely to have increased STI prevalence.

A9.4.11.9 Baseline Condition of Food and Nutrition Related Considerations

Uganda produces more food than it consumes. Yet, poverty still limits people's access to nutritious food, especially in the north and east of the country. Rapid population growth and the presence of a large refugee population pose further challenges to the country's food security. Inadequate diets are a root cause of persistent nutritional problems which undermine the health, growth and development of Ugandan children (WFP 2017, Internet site).

Food security is not a major concern in the districts traversed by the AOI with the both districts reporting sufficient food availability throughout the year.

Malnutrition and Anaemia

National Level

Even in the absence of a specific food crisis, many communities in Uganda struggle with chronic malnutrition, especially among young children. The immediate causes are high disease burden of communicable diseases such as malaria, diarrhoeal disease and respiratory infections, and inadequate calorie intake (UBOS 2012b).

Stunting affects 29% of children under five years of age, while anaemia rates stand at 53%. A mother's educational attainment makes a difference, with highest rates of malnutrition in uneducated mothers. Poverty plays a role in wasting and stunting with the poorest fifth of the population having double the malnutrition rates compared with the wealthier groups (UBOS 2017b).

District and PAC Level

Acute malnutrition is generally not regarded as a major public health concern in the districts traversed by the AOI, with clinical data reporting a prevalence among children under five of only 0.8% in the district of Buliisa and 1.2% in Hoima.

FGD participants reported reduced food availability in some months, especially in March and April. Findings from KIIs with district health authorities, indicated that cases of malnutrition do occur in the two districts, but these are generally confined to a few localities and are largely associated with poor feeding habits and other disease co-morbidities.

Chronic malnutrition, i.e., stunting or underweight, was reported as being more likely to occur, but this was not supported by data obtained from the district level HMIS. Anaemia contributed just 1–2% of overall outpatient morbidity according to 2017 data from the HMIS. It is likely that this is under-reported in this setting because of a lack of basic diagnostic capabilities in most primary health care facilities and a reliance on subjective clinical diagnosis that may not identify mild or moderate anaemia.

Trend in Condition and Sensitivity to Change

Available data shows that chronic malnutrition rates have decreased while acute malnutrition rates have generally remained low and stable at the district level. The 2016 UDHS shows that stunting prevalence has declined to 29% from 33% in 2011 and 46% in 1995. The proportion of underweight children has also declined to 11%, from 14% in 2011 and 21% in 1995. Acute malnutrition rates (wasting) have remained low at around 4–6%. There were concerns for future food insecurity related to weather patterns, especially drought, and rapid population growth in urban centres. Data on the trend of anaemia was inconclusive.

Ecosystem Services Provided

Ecosystem services related to food and nutrition are covered under land-based livelihoods, Section A9.4.6, and river- and lake-based livelihoods, Section A9.4.7.

Sensitivity Ranking

The social baseline identified VECs sensitive in relation to food and nutrition (see Table A9.4-41).

Table A9.4-41 Food and Nutrition Related VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Landless	Moderate (3)	May have less access to subsistence crops and wild foods
PAC households	Moderate (3)	Vulnerable to price inflation
Elderly	High (4)	Elevated level of vulnerability to food price inflation due to lower ability to bolster income
Women-headed households and children	High (4)	Elevated level of vulnerability related to income insecurity, land tenure and food price inflation
Hunter gatherers	High (4)	May have less access to wild foods due to reduced access to hunting and gathering areas

Key Considerations

Key considerations are:

- the majority of farmers in the AOI are subsistence farmers and any increase in external demand will need to be managed
- PIIM into the AOI may increase food prices and, as a result, affect food security of vulnerable groups.

A9.4.11.10 Baseline Condition of Noncommunicable Diseases

The BOD attributable to noncommunicable diseases (NCDs) is on the increase worldwide, with cardiovascular diseases (CVD), diabetes, cancer and chronic respiratory conditions responsible for most deaths. In SSA, it is predicted that NCDs and injuries may cause up to 60% of morbidity and 65% of mortality by 2020 (WHO

and AFRO 2011). The risk factors underlying the major chronic NCDs are unhealthy diet, physical inactivity, alcohol consumption and smoking (WHO and CDC 2010).

The demographic and nutritional transitions taking place in Uganda, as in other developing countries, are leading to accelerating growth of NCDs (Schwartz et al. 2014). This increasing burden threatens to overwhelm already over-stretched health services.

It is estimated that NCDs account for 27% of all deaths in the country, of which CVD contributes 9% (WHO 2014) (see Figure A9.4-65). Baseline findings show that NCDs are an emerging health concern in the project districts. The government is in the process of drafting a national policy that will guide monitoring and surveillance of NCDs (MOH 2017, Internet site).

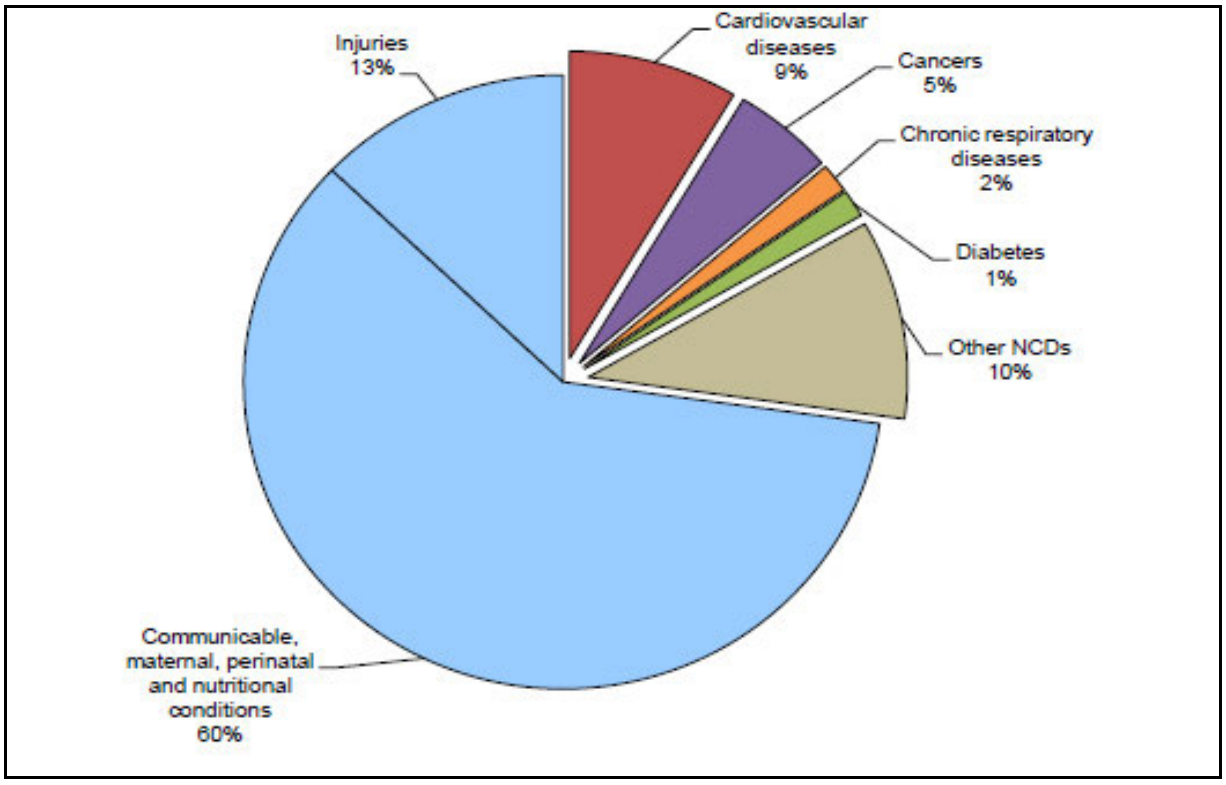

Figure A9.4-65 Distribution of Causes of Death in Uganda, 2012
SOURCE: WHO (2012)

Cardiovascular Disease and Hypertension

National Level

The Uganda Heart Institute reports a 500% increase in outpatient attendance because of heart-related conditions in 2002–2009 (MOH 2014b, Internet site). Hypertension is the leading risk factor for CVDs with a national prevalence of 43% among men and 39% among women, age over 25 years (WHO 2015a). Most hypertensive patients are not aware of their condition (Musinguzi and Nuwaha 2013).

District and PAC Level

In 2017, 11,691 cases of hypertension and 5586 cases of diabetes were recorded in Hoima district, while Buliisa district recorded 881 and 208, respectively. At subcounty level, Kigorobrya and Buliisa town recorded the highest number of hypertension and diabetes cases (see Figure A9.4-66).

Findings from KIIs with district health officials also indicated that obesity is an emerging concern, especially in urban areas. Care and treatment services for hypertension, diabetes and heart diseases were generally available in secondary or higher-level facilities but there were challenges of drug availability and access to specialised care.

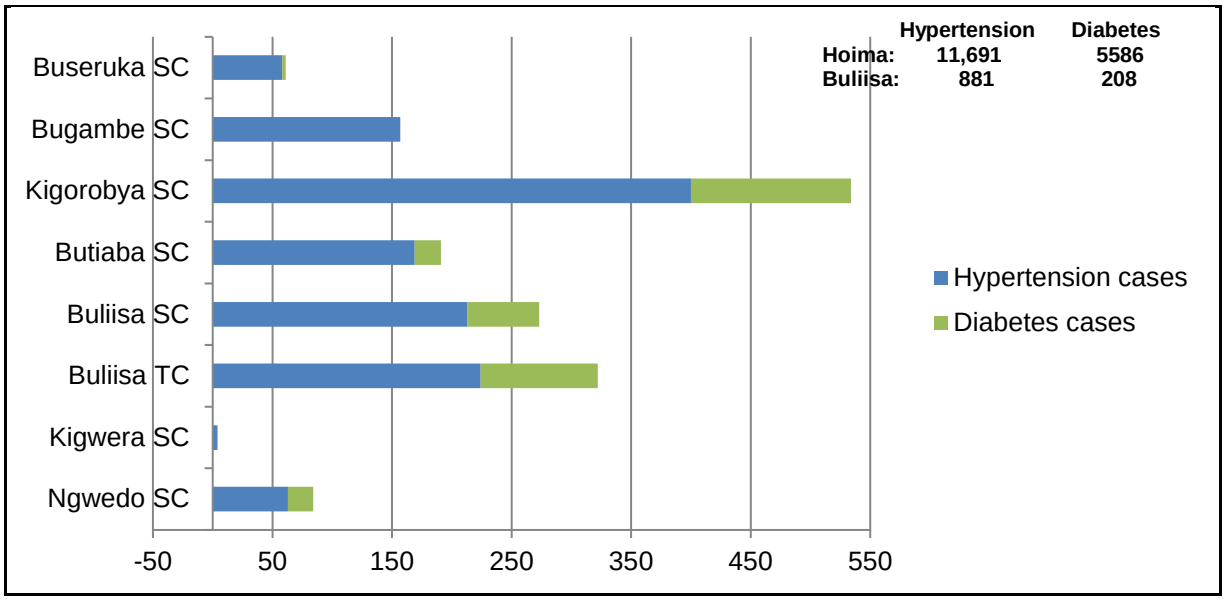

Figure A9.4-66 Hypertension and Diabetes Cases by District and Subcounty, 2017

SOURCE: Uganda HMIS (2017)

Diabetes

National Level

The prevalence of diabetes in Uganda ranges from 5% to 7% (Nyanzi 2014). Limited awareness and negative perceptions of the disease hinders its control. Only 34% of the population have adequate knowledge about lifestyle diseases (Mayega 2014).

District and PAC Level

The districts traversed by the AOI have recorded an increase in diabetes cases. HMIS data (2017) show less diabetes cases in the subcounties traversed by the AOI, compared to hypertension (see Figure A9.4-66). Diabetes care and treatment services were generally available at hospitals but very limited at lower level facilities.

Cancers

National Level

The Uganda Cancer Institute has reported an upward trend in cancer incidence in recent years (MOH 2014). Estimates suggest that cancers are responsible for at least 5% of deaths in the country (WHO 2014). The leading cancers among women were noted to be cervical, breast and oesophageal cancers, while the commonest among men are cancers of the prostate, oesophagus and Kaposi's sarcoma (GLOBOCAN 2012).

District and PAC Level

Analysis of district-level HMIS data show that several cases of cancers were recorded in the project districts. The diagnoses were limited to cervical and breast cancers in women and prostate cancer in men. Most of these suspected cancer cases were, however, referred to higher level facilities for further management, as local facilities did not have the necessary capabilities to treat these.

Chronic Respiratory Disease

The burden of chronic respiratory disease in Uganda is related to tobacco use and indoor air pollution (Schwartz et al. 2014). This disease group includes asthma, chronic obstructive pulmonary disease (COPD), occupational lung diseases and pulmonary hypertension.

National Level

The national prevalence of daily tobacco smoking is estimated to be 10% (16% among males and 3% among females) (WHO 2014). Most of the 16% of adults diagnosed with COPD were women. Though tobacco use was more common in men, daily exposure to poorly ventilated indoor smoke from cooking with biomass fuels was considerably higher in women. In some areas, chronic coughing that could be associated with TB was highly stigmatised (Schwartz et al. 2014).

District and PAC Level

HMIS data show that asthma is the commonest diagnosis related to chronic respiratory diseases (see Figure A9.4-67). Despite being the most common condition, only a relatively low number of cases have been recorded in 2017 with 90 cases diagnosed in Hoima and 14 cases diagnosed in Buliisa district during this period.

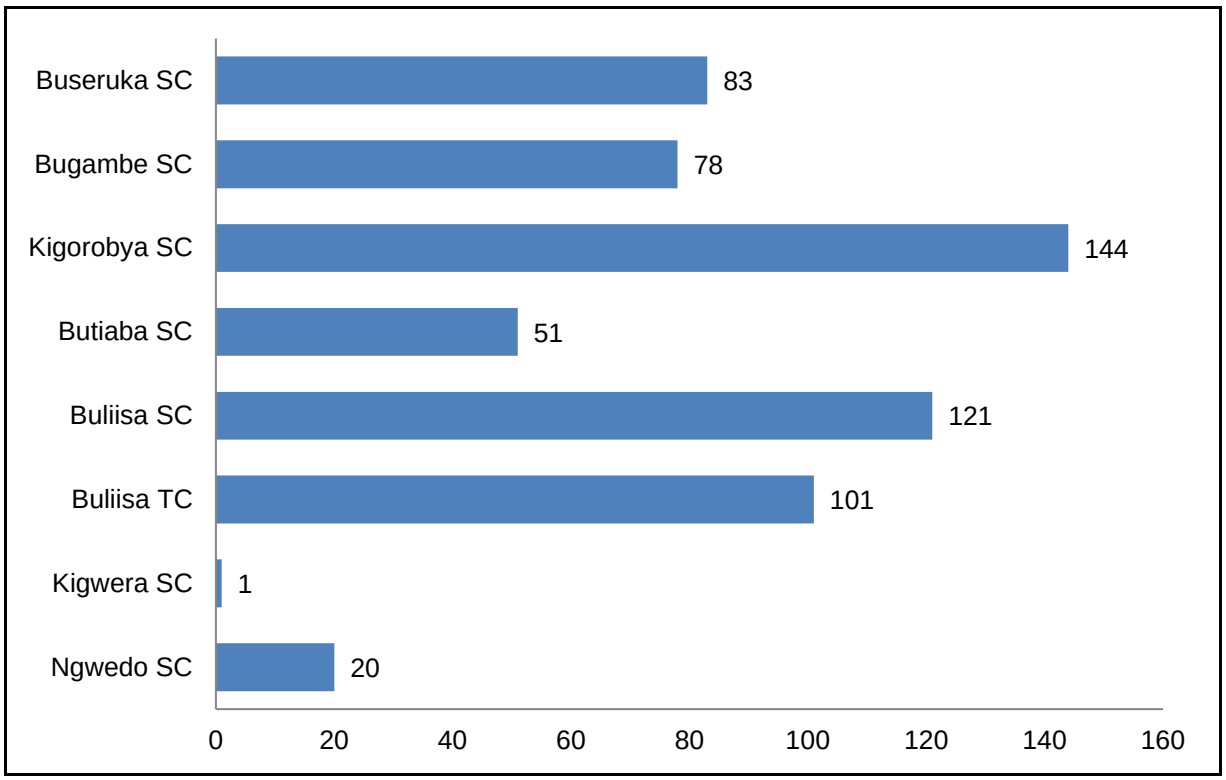

Figure A9.4-67 Asthma and Chronic Obstructive Pulmonary Disease, 2017
SOURCE: Uganda HMIS (2017)

Trend in Condition and Sensitivity to Change

NCDs, particularly heart disease, hypertension and diabetes, are showing an upward trend nationally and in the districts traversed by the AOI. This increase is largely attributed to urbanisation and changes in lifestyle.

While NCDs are considered an important risk factor with regards to community health, the sensitivity to change in all project districts is rated as moderate with little variation between districts.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline did not identify any sensitive NCD VECs.

Key Considerations

Unless there is a sustainable growth of the districts' economies, an increase in NCD is unlikely.

A9.4.11.11 Baseline Condition of Accidents and Injuries

Physical Assault and Domestic Violence

Domestic violence is widely acknowledged to be of great concern in Uganda, from human rights, economic and health perspectives. Baseline findings show that

gender-based violence (GBV) including physical and sexual assault is a common cause of injuries in the project districts. Substance (alcohol) abuse, social and economic challenges were identified as contributing factors.

In 2017, Hoima recorded 469 injuries from GBV while Buliisa district recorded 88 cases. At the local level, Butiaba and Bugambe subcounties recorded the highest number of injuries resulting from GBV. In addition, all sex workers interviewed reported that they had been subjected to GBV at some point. FGDs indicate that women generally do not have support networks for victims of domestic violence.

Accidents and Injuries

Road traffic and occupational accidents and injuries are an important consideration. Road accidents are covered in the traffic baseline report (see Appendix A10).

Hospital statistics from districts traversed by the AOI show that injuries were the leading cause of surgical emergencies and have become a major health burden.

Occupational Accidents and Injuries

This is discussed in Section A9.4.9.

Trend in Condition and Sensitivity to Change

Trends in traffic accidents are described in the traffic baseline report (see Appendix A10). Trends in workers' health are described in Section A9.4.9 (workers' health, safety and welfare).

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Sensitivity for traffic-related injuries are ranked in the traffic baseline report (see Appendix A10). Women, particularly sex workers, are considered highly vulnerable (4) in terms of GBV.

A9.4.11.12 Baseline Condition of 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 pandemic influenza (swine or avian influenza), viral haemorrhagic fevers (e.g., Ebola, Marburg, Rift Valley fever, rabies, brucellosis and leptospirosis). Emerging zoonotic diseases have potentially serious human health and economic impacts, and their current upward trend is cause for concern.

The most important zoonotic diseases to consider for the AOI are viral haemorrhagic fevers, pandemic influenza, brucellosis and rabies.

Viral Haemorrhagic Fever

National Level

Viral haemorrhagic fever (VHF) is a general term for a severe illness, sometimes associated with bleeding and that may be caused by different viruses especially

Lassa fever, Crimean-Congo, Marburg and Ebola viruses. Uganda has experienced repeated outbreaks of VHFs, particularly Ebola, Marburg and, more recently, Crimean-Congo viruses (Mbonye et al. 2012).

Ebola outbreaks have occurred in the districts of Gulu (2000), Bundibugyo (2007), Luwero (2011 and 2012) and Kibaale (2012) in western Uganda. The 2012 outbreak had a death rate of 57% (4 deaths out of 7 confirmed cases) (Mbonye et al. 2012).

District and PAC Level

In 2017, Hoima recorded 13 suspected cases of VHFs. Buliisa did not record any cases during the same period. Neither of the project districts have the capabilities to diagnose VHFs and relies on the national laboratory to confirm suspected cases.

Rabies

National Level

Rabies is a public health problem in many developing countries, although it is often under-reported because of limited awareness, public veterinary health services and diagnostic ability. Rabies is endemic throughout Uganda with transmission largely occurring from bites by infected domestic dogs (Fevre et al. 2005). Most domestic dogs are not vaccinated against rabies.

District and PAC Level

Many cases of dog bites are recorded in the local health facilities. These are often promptly managed with post-exposure prophylaxis to prevent progression to full-blown rabies, which is known to be 100% fatal.

Brucellosis

Brucellosis is common among pastoral communities in Uganda. Both districts traversed by the AOI recorded at least 100 cases of brucellosis in 2017. The mainstay of diagnosis is rapid serological tests that are mostly available at district and referral hospitals. Key informants reported that the disease is likely to be over-diagnosed because of inaccurate tests.

Pandemic influenza remains an important global threat because of increasing population mobility and mixing. Uganda had over 200 confirmed cases, but no deaths, during the 2009 swine flu pandemic caused by H1N1 influenza strain. Pandemic influenza therefore remains a relevant consideration.

Trend in Condition and Sensitivity to Change

Rabid dog bites have increased in the districts traversed by the AOI, leading to an increase in demand for post-exposure prophylaxis for rabies, with the vaccine often out of stock. The risk from VHFs remains high given their occurrence in the country and potential for spontaneous outbreaks.

Although the conditions are prevalent throughout the AOI, the estimated BOD remains low at the time of writing.

However, potential for outbreaks is a substantial challenge that imparts a measure of risk in the AOI. Owing to the low-grade re-occurrence of potential VHF cases in the AOI, both districts are considered to have a high sensitivity to change.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline identified that all PACs are equally sensitive VECs with regards to veterinary and zoonotic diseases.

Key Considerations

A key consideration is:

- VHFs and the associated outbreak potential remains a risk to PACs, particularly those that are impacted by PIIM.

A9.4.11.13 Baseline Condition of Social Determinant of Health

Social determinants of health are the conditions in which people are born, grow, live, work and age, including the health system. The distribution of money, power and resources typically shape these circumstances.

Mental Health

National Level

Uganda has recognised mental health as a serious public health concern and recently implemented reforms aimed at strengthening the country's mental health system. In 2010, only 1.8 beds per 100,000 people, were available in mental care hospitals (at the NRHs), 1.4 beds per 100,000 people in community-based psychiatric inpatient units and 0.4 beds per 100,000 people in forensic facilities. There is only one mental health worker per 100,000 people (Kigozi et al. 2010).

District and PAC Level

Although mental illness is recognised as a public health burden in all the project districts, reliable data are scarce. Baseline findings show that epilepsy, bipolar disorder and major depression are the most common mental disorders in the districts traversed by AOI. Substance use disorders, anxiety and psychotic disorders were also reported to be common. KIIs at PAC level found that mental illnesses are rarely openly spoken about, due to community perceptions of causes of illness, which included curses, satanic powers, bewitchment, as well as socio-economic causes such as poverty and familial discord.

Substance Abuse and Social Ills

National and Regional Level

Substance misuse is a growing public health concern in Uganda. A recent study found that at least 20% of high school students in the country have used drugs. It was reported that young people commonly abuse alcohol, tobacco (cigarettes,

shisha and kuber), marijuana and khat. Access to illicit drugs such as cocaine and heroin was also reported (Kidumu 2013, Internet site).

District and PAC Level

Findings from FGDs indicated that alcoholism, 'smoking drugs', prostitution, theft and gambling are among the social challenges in the project districts.

Commercial sex work was reported to be more common in urban centres and fishing communities in both districts. The presence of a military barracks in Butiaba was noted as contributing factor to commercial sex work in the area.

Gender-Based Violence

National Level

GBV creates both a health and psychological burden for women. It is also recognised that in many societies, women are socialised to accept, tolerate and even rationalise the practice. Women are more than twice as likely to experience sexual violence as men, with 22% of women aged 15–49 reporting that they had experienced sexual violence at some point, with 13% reporting this in the past 12 months. The experience is lowest in women with more than a secondary school education (UBOS 2017).

District and PAC Level

Baseline findings show that GBV is common in the study area. The highest number of cases were recorded in Butiaba, Bugambe and Kigorobya subcounties. Women in this setting are also marginalised in education, employment opportunities, decision-making and many other aspects.

Teenage Pregnancies and Early Marriages

Teenage pregnancy and early marriages are important on health and social grounds. Children born to very young mothers are at increased risk of sickness and death. Teenage mothers are more likely to experience adverse pregnancy outcomes and other socio-economic challenges. A recent national survey shows that 24% of 15–19-year-old girls in Uganda have given birth or are pregnant with their first child (UBOS 2017b). Baseline findings show that teenage pregnancies and early marriages are a concern in all project districts and are increasing.

Lack of formal education, cultural norms (acceptance in society, religious beliefs) and poverty (dowry and failure to pay for education) are some of the drivers of increase in teenage pregnancy. The government has identified this as a key challenge to Uganda's development. Several campaigns by government and other donor agencies toward preventing teenage pregnancy and abuse and educating female children are ongoing at most public and private media outlets.

Trend in Condition and Sensitivity to Change

Data on the trend of mental disorders were not conclusive, but the perception of health officials is that cases are increasing. Psychosocial stressors such as economic strife, poverty and other social challenges, and alcohol and drug abuse

were identified as contributing factors. In FGDs with health personnel, 48% felt that social problems have increased, particularly alcoholism and prostitution.

Based on the available data, the VECs' sensitivity to change as it relates to social ills is considered high in both Hoima and Buliisa districts. Based on feedback from stakeholders, the VECs' resilience to change was not considered high, increasing the risk for project-related changes. Any substantial changes from baseline activity will have a marked influence on population morbidity and mortality, and the duration of the impact will most likely be long term owing to the substantial overlaps between social ills and other conditions (e.g., HIV).

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline identified two sensitive VECs related to social determinants to health, as shown in Table A9.4-42.

Table A9.4-42 Socially Determined Diseases Related VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PACs employed by the project	High (4)	Disposable income increases alcohol, drug use and commercial sex work.
PACs where PIIM is expected	High (4)	Decrease in social structure and social cohesion

A9.4.11.14 Key Considerations

A key consideration is:

- PAC households that experience a sudden increase in disposable income may be affected by a loss of cohesion through increased use of substances such as alcohol and drugs, and sex workers.

A9.4.11.15 Baseline Condition of Social Cultural Health Practices

Health-Seeking Behaviour

The way people choose a health provider and at which stage of an illness they seek consultation depends on a variety of factors. Culture and spirituality may influence health-seeking behaviour (HSB) as well as the type and perceived severity of an illness.

National Level

The 2015–2016 Uganda health sector performance report shows that 50% of patients seek care from a public health facility when they first fall ill or suffer an injury. This is a considerable increase from 33% in 2004. The reported use of home remedies or self-medication has decreased from 10% in 2004 to the current 0.6%

and traditional medicine (TM), as a first source of treatment, has dropped from 1.1% in 2004 to 0.5% in 2015–2016 (MOH 2017a).

District and PAC Level

Baseline findings show that most of the population in the districts traversed by the AOI make use of formal health care services. However, self-medication and use of TM is used and can negatively affect treatment outcomes owing to the delay in treatment.

Traditional Medicine

National Level

TM is a routed practice in the districts traversed by the AOI and across Uganda. In contradiction with the national levels, nearly 60% of the population use TM for their primary health care, particularly herbal medicine. TM is used in the treatment of malaria, TB, HIV and AIDS, mental disorders and many other illnesses in Uganda (Tabuti et al. 2012; Lamorde et al. 2010).

District and PAC Level

Findings from baseline FGDs show that TM is most often used in the treatment of pregnancy complications, infertility, epilepsy and those who have been 'bewitched'. Traditional beliefs and practices, poor awareness of health matters as well as challenges in the health care system (e.g., accessibility, affordability and availability of services) were reported as key contributing factors.

Trend in Condition and Sensitivity to Change

The following trends were identified:

- HSB has improved and most of the population in the districts traversed by the AOI now use the formal health care system as well as TM. This was attributed to health education and system strengthening, including provision of outreach services.
- There is an increasing demand for services and high utilisation rates for maternal and child health services.
- Use of TM has generally decreased as people embrace modern health care.

Ecosystem Services Provided

Social cultural health practices are linked to the use of wild plants, which provides the following ecosystem services:

Provisioning services:

- ingredients for treatment of common illnesses (traditional medicine).

Sensitivity Ranking

The social baseline identified a sensitive VEC with regards to social cultural health practices, presented in Table A9.4-43.

Table A9.4-43 Social Cultural Health Practice Related VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PACs where PIIM is anticipated	Moderate (3)	Higher burden on health systems may lead to adverse HSB

A9.4.11.16 Key Considerations

A key consideration is:

- PIIM may lead to pressure on health care services.

A9.4.12 Community Safety, Security and Welfare

A9.4.12.1 Baseline Condition of Community Safety, Security and Welfare

Community Wellbeing

To understand a PAC's sense of wellbeing and sensitivity to change, it is important to understand how they perceive key events in their communal history. In FGDs, PACs identified the following important historical events (Attachment A9.5):

- New infrastructure and services are regarded as substantial positive events. PACs recalled the dates of construction of HCs, dams, tarmac roads, boreholes and vaccination campaigns.
- The discovery of oil and the potential development it would bring to the area.
- Health epidemics were remembered as key negative events. These included measles outbreaks, and the onset of HIV and AIDS and animal diseases such as foot and mouth disease.
- Major natural disasters, earthquakes and droughts also form a substantial part of communal history.

The PAC profiles in Attachment A9.2 provide additional information on PACs' historical timelines.

Community Aspirations

FGDs with PAC leaders and women's groups shared that the most often expressed aspirations were related to infrastructure and service improvement, for example, schools, health facilities, roads and electricity. This is in line with the data obtained for the historical events. Employment opportunities were not raised as often as other aspirations. This contrasts with the stakeholder engagement undertaken during the scoping phase during which employment aspiration were consistently raised, as this was the first time some stakeholders had been provided information about the project.

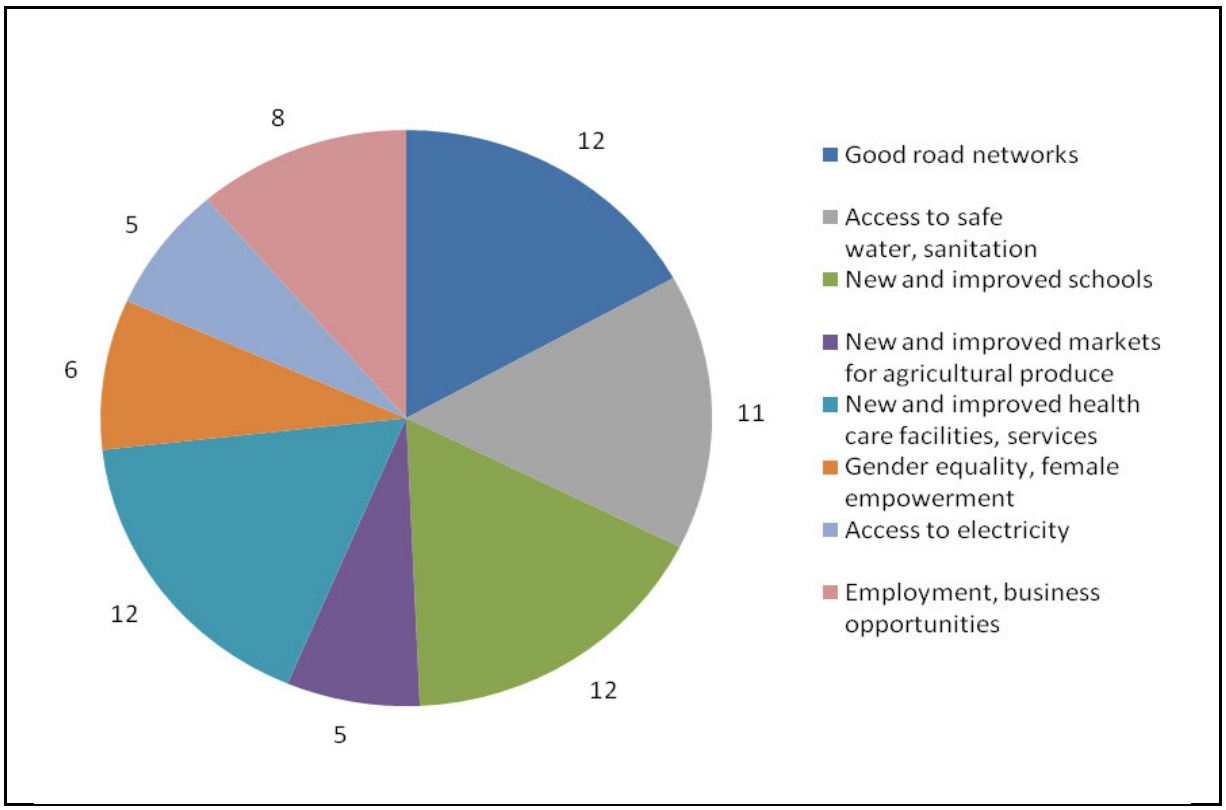

Figure A9.4-68 Potentially Affected Communities Aspirations

SOURCE: FGDs with community leaders and women

NOTE: Pie chart numbers refer to number of focus groups that expressed each aspiration

Community Cohesion and Social Support

Field survey data indicated a strong social fabric for all PACs with well-developed social networks and a sense of place.

In PAC households, bonds and commitment to support one another are strong. Households generally work as a unit on agricultural plots and ties to ancestral land are strong and traditional inheritance protocols for land allocation to family members maintain their connection. Unspoken kinship allegiances extend to patrilineal clans and tribal affiliations.

Maintaining the traditional relationship with land is becoming increasingly difficult, as plots are becoming too small to remain viable, forcing younger generations to migrate to urban areas. In addition, over recent years, mutual support in PACs appears to be decreasing, possibly because of migrations, emerging use of technology and intermarriage.

In multicultural Uganda with its diversity of tribes and religions, burial ceremonies are a ritual deeply rooted in cultural beliefs and traditions. With few public cemeteries, families of the deceased bury their dead in locations available to the household. This commonly is within the curtilage of the family's landholdings; however, some communities have allocated burial grounds such as Waki-Kawaibanda (KP47).

Little outside assistance from Government initiatives or NGOs was observed in the sample PACs. However, NGOs such as BIRUDO, Build Africa, World Vision, Hoima Catholic Development Organisation, Action AID and World Bank were mentioned during KIIs with CDOs and FGDs in PACs. These organisations have a wide remit, focusing on the environment, land matters, human rights, education, community sensitisation and livelihood support.

NGOs in Hoima play a particularly important role in supporting orphan and vulnerable children (OVC), accounting for 35% of service provision (DDP 2015). Other active NGOs in the district include Global Rights Alert, National Association of Women's Organisations in Uganda (NAWOU) and Hoima Caritas Development Organisation (HOCADEO) (KII with CDO). These organisations focus on several areas including livelihoods, female empowerment and environmental concerns.

Community-based organisations (CBOs) were prominent in all PACs. Savings and credit cooperative organisations, commonly referred to as 'savings circles', are prevalent CBOs. These self-help groups are owned, governed and managed by their members, and set up to provide loans and savings. Members agree to save money together and offer loans up to an agreed amount within the circle. Loans generally do not exceed the shares owned by the individual and are given at reasonable rates of interest (2.5–5.0% was quoted by members). Criteria for joining savings circles recorded in the sample PACs include being a village resident of Ugandan nationality, signing the constitution and agreeing to contribute an agreed sum of money on a weekly or monthly basis.

The existence and functioning of the savings and credit cooperative organisations in PACs shows the social capital of communities, and trust and mutual reciprocity. Savings circles generally have 15–50 members. Money is used for various purposes, particularly for crop growing and purchasing agricultural inputs such as pesticides, seeds, feed, veterinary drugs, livestock and animal feeds. Other uses cited were setting up a business, paying school fees, paying for a funeral and buying land. The main challenge reported was that members wanted to borrow more than was available. Drought conditions, leading to low yields and loss of livestock, regularly caused members to forfeit their repayments. Examples of these are provided in Table A9.4-44.

Table A9.4-44 Examples of Savings Circles in the Sample Potentially Affected Communities

Sample PAC	KP	Name	Activities	Number of Members
Serule B	30.5	Kwolonyo Women's Group	Savings and lending	12
Biiso	44.5	Biiso Agro Care Woman's Organisation	Savings and lending, tree planting	30
Booma	44.5	Bukedeya Women's Group	Savings and lending	15

Table A9.4-44 Examples of Savings Circles in the Sample Potentially Affected Communities

Sample PAC	KP	Name	Activities	Number of Members
Piida A	45.5	Booma Nigina Group	Savings and lending, helping one another through problems, gift giving	17
Kihunghya	49.5	Beclamat	Savings and lending, offering catering services	20
Buseruka	84.5	Kwataniza	Savings and lending, community sensitisation, encouraging good upbringing of children	40

SOURCE: FGDs with women

Safety and Security

The Uganda Police Force (UPF), established under Article 212 of the 1995 Constitution of the Republic of Uganda, is headed by the Inspector General of Police who provides oversight to regional and district commanders.

At community level, the rule of law is enforced by community leaders and by police officers at police stations or police posts (smallest unit). However, not all rural communities boast a police station. There are major police stations at Hoima and Buliisa municipalities.

In addition, the national approach to community policing includes establishing community 'crime preventers'. These individuals are proposed by local communities and their leaders to be trained in policing and assist the police force in maintaining law and order in the community.

There are 21 directorates charged with the management of specific aspects of policing via units within the UPF, engaging 37,400 police officers and 396 civilian personnel. Of relevance are:

- Directorate of Traffic and Road Safety:
  Established to enforce traffic and road safety laws
- Directorate of Police Fire Prevention and Rescue Services:
  The Directorate is charged with fire prevention and fire extinguishing and active participation in national disaster management activities with other strategic stakeholders (see Section 9 under unplanned events). However, there is no firefighting infrastructure in the sample PACs traversed by the AOI, except for in Hoima.
- Directorate of Criminal Investigation and Crime Intelligence (CID):
  The function of the Directorate is to ensure effective detection, investigation and prevention of crime.
- Directorate of Counter Terrorism:
  The counter terrorism directorate is charged with investigating and responding to terrorist incidents in the country.

- Oil and Gas Protection Directorate.

Recognising the importance of the oil and gas industry in Uganda, the Oil and Gas Police Protection Directorate was established and charged to maintain security of the routes, wells and any oil-related installations in the Albertine Graben area (UPF 2017, Internet site; Oil in Uganda 2013, Internet site).

Crime

The Uganda Annual Crime Report (2014) indicated that serious crime rates have increased by 13% since 2013. The most common serious crime was reported to be defilement, accounting for more than half of all serious crimes in 2014 (GOU 2014). The total number of cases that were investigated in 2014 represented an increase of 25.8%, while reported cases of rape increased by 5.4% since 2013.

The Overseas Security Advisory Council (OSAC) (2017) reports that organised crime syndicates operate on a small scale, carrying out robberies or roadside assaults, stealing valuables and attacking individuals. Gang crime is on the increase with groups such as the Kifeesi gang operating in Kampala and in other urban towns and trading centres. Gangs are popular among disengaged youth, and the number of the members is increasing despite Government arrests and crack downs on leaders and members.

National Security

A past insurgent war in the north of the country with the Lord's Resistance Army, which started in the mid-1990s and concluded over 12 years ago. Many IDPs were generated from this conflict and the displaced took shelter in IDP camps near Gulu municipality (approximately 150 km from Buliisa). When the warring parties signed an agreement to cease hostilities, UNHCR assisted those displaced to integrate in situ or to return home. Isolated instances of internal conflict have arisen in recent years, for example, violent clashes were reported in western Uganda in Bundibugyo and Kasese districts in 2014 and 2016 (FCO 2018, Internet site).

The Uganda National Action Plan (NAP) for Arms Management was launched in 2004 and its implementation is ongoing. Most illicit small arms in the region are old stocks that are passed from one conflict area to another. Established trade in small arms occurs along the gun corridor: Somalia, Southern Sudan, the DRC and Uganda. The emergence of modern terrorism (Al-Qaeda and Al-Shabaab), and pirates in the Indian Ocean, has supported the proliferation and circulation of illegal small arms. The threat of Al-Shabaab retaliatory attacks on Uganda People's Defence Forces' Operations in Somalia is still the biggest public security threat in Uganda, as witnessed by the suicide bombings in Kampala in 2010.

In Uganda, the activities of the Allied Defence Force have continued to escalate the small arms problem.

OSAC recognises that Uganda's extensive and porous borders, often too remote to police, enable a consistent flow of illicit trade and immigration (2017). Rebel groups operate freely in eastern DRC, which poses a potential risk along Uganda's western border (OSAC 2017, Internet site).

While there is relative stability and prosperity in the country, Uganda still has some underlying conditions that could result in internal conflict such as grievances over land and oil, and ethnic divisions (USAID 2018, Internet site).

The importance people attach to ethnic groups, area of origin, religious affiliations and cultural institutions often predominate over national identity. Youth particularly fall within this category (International Alert 2014).

Over the past 30 years, the GOU has instated a decentralised governance structure. This has assisted in reducing national-level conflict. However, it has incited local-level conflict through highly competitive races for district leadership positions and altering relations between local ethnic groups (Green 2015).

Road Safety

Despite the high rate of road traffic incidents in Uganda (see traffic baseline report Appendix A10), PACs did not perceive traffic accidents as a high risk.

Minor accidents occurring in the past six months were reported in Biiso (KP44.5), Kigorobya (KP64.5) and Nyamasoga (KP95), mainly involving motorcyclists. Major accidents resulting in loss of life were reported in Buseruka (KP84.5) and Kayere (KP94.5).

Conflict

Although communities are generally peaceful, conflicts were reported in KIIs and FGDs. Conflicts or disputes mentioned are related to:

- land concerns (trespassing, destruction of crops by livestock, land grabbing and boundary disputes)
- criminal acts (theft, defilement, rape and GBV).

The most often mentioned disputes related to theft and land. The latter is described in Section A9.4.8, Land and Property. Land conflicts are generally resolved with the assistance of the community leaders (see Section A9.4.1 on governance and administration). In the case of theft, defilement and rape, the police would occasionally be called. However, PAC members said that community leaders would initially endeavour to resolve any dispute or conflict.

Household domestic quarrels were mentioned often and reportedly resolved through family meetings supported by clan members. If the matter cannot be resolved, the village chairperson or another village leader relevant to the matter will get involved. Where resolution could not be reached at this level, the subcounty community development officer may be called upon to mediate, but this was not a frequent occurrence.

In Buliisa district, the historic discord against the herdsmen known as the Balaalo, associated with land grabs and the oil discoveries between the Bagungu and Banyoro, was rarely mentioned. The herdsmen were expelled from Buliisa by a Supreme Court ruling in 2010 that was over ruled in 2013 by the High Court in Masindi. The court ruling stated that Buliisa district authorities should compensate those herdsmen affected for the loss of their land assets, although the Court order prevented them settling back in Buliisa.

Gender

FGDs with women in the sample PACs revealed the task and role divisions between men and women. Only cooking and cleaning within the household are the sole responsibility of women; women and men share all other tasks. Women have the largest responsibility for child upbringing; collecting water, wood and wild plants and fruit; cultivating land; household budgeting; buying goods; and selling produce. Men mostly undertake tasks related to house construction, hunting and fishing. Males mostly inherit and own land. Women are mostly regarded as the protectors of the household. The above shows that women are important members of the household and wider community. They are highly entrepreneurial and their substantial contribution to the informal economy through labour, much of it unpaid, cannot be underestimated.

However, women are considered vulnerable in many ways:

- GBV against women is common in the districts traversed by the AOI. The highest number of cases was recorded in Hoima district. Substance abuse, especially alcohol, was seen as a major contributing factor.
- Women are also vulnerable in marriage. This vulnerability relates to the noncontractual nature of some types of marriage and the resulting inability to claim spousal rights in the event of mistreatment, divorce or abandonment.
- In Buliisa district, under customary law, it is assumed that the widows and their children will be taken care of by the kin of the deceased. The subordinate wife will be dispossessed of the family's assets and forced to return to her parents' or brother's home, or merely play a minor role in looking after the children. She would not be able make decisions regarding the future use of the deceased husband's land.

In many regions, a cultural ideal for men is to marry once they have finished school and have a job, and for girls to marry at a young age. By 18 years old, 78% had married and 10% of girls are married before the age of 15. The government launched the African Union Campaign to End Child Marriage and its National Strategy on Ending Child Marriage and Teenage Pregnancy (2014, 2015–2019 and 2020), which was developed in partnership with civil society organisations, including Girls Not Brides members in Uganda, and UN agencies. Led by the MGLSD, the strategy contains a multisectoral monitoring and evaluation framework, and an indicative budget for the implementation of the strategy.

The gender structure of land rights in Uganda varies across the country, but in general it is highly unequal, with women's rights restricted, while men are more likely to have ownership and control rights. This gender unequal tenure pattern reflects the system of patrilineal inheritance and patrilocal residence patterns that characterise much of Ugandan tenure relations. These systems imply that women's rights to land and property are less secure than men's. Particularly for rural women, this inequality of access to the key productive asset is a fundamental determinant of poverty and social disadvantage.

The low quality and accessibility of policing, health and education facilities in very poor areas exacerbate women's situation. The lack of police service resources acts as a constraint on women trying to extricate themselves from abusive situations.

The MGLSD is responsible for the development and implementation of national policies that work toward achieving gender equality in the public and private sector.

The Government is signatory to international, regional and has nation laws and policies that advance participation of women in public leadership. The development of a National Gender Policy in 1997, and its revision in 2007, confirms the GOU's commitment to take actions that will bring about more equal gender relations. During the 2017 parliamentary elections, 11% of elected MPs were female.

Female MPs have formed the Uganda Women Parliamentary Association as a forum to discuss, share experience and support activities that facilitate women's participation and leadership with the aim of ensuring gender responsive legislation processes. The women's movement has used the Uganda Women Parliamentary Association as a channel for advocacy at parliamentary level, as an opportunity to focus on matters as women, and a window to work with women's organisation to influence laws and policies. The Parliament of Uganda, under Speaker Rebecca Kadaga, has been commended for the actions taken to promote women and girls' rights in Uganda amid the challenges brought about by a reluctant Executive.

Other Vulnerable Groups

PAC members identified the following potential vulnerable groups.

Widow-Headed Households

Several widow-headed households were encountered in PACs. It was reported that widows find it difficult to meet basic needs to maintain a household. Elderly widows were said to be subject to theft of property and land from relatives and often found it difficult to obtain sufficient food because they could not tend to crops.

Children

Children are the single largest group (59%) of Ugandans living in absolute poverty. Children were deemed vulnerable, particularly those from poor households. Poor children were reported to be less likely to attend school.

AIDS orphans kept by guardians were regarded as particularly vulnerable, as they have limited opportunity to attend school or access health care and may be discriminated compared to the guardians' own children.

Children were also vulnerable to child labour, particularly in livestock-rearing households where it was traditionally seen as a child's role to tend to livestock.

Orphans were regarded as especially vulnerable, facing challenges such as lack of education and parental guidance, as stated during FGDs in Biiso (KP44.5), Piida A (KP45.5) and Rwamutonga (KP86).

Elderly

Elderly people are deemed vulnerable, as they are unable to work the land and dependent on remittances sent by family members.

Elderly women who are disabled suffer discrimination, poverty, stigma and isolation, and gender-based violence, and face obstacles in accessing justice. Their

economic situation is exacerbated by the burden of looking after orphans and other vulnerable children left by youth who died during the HIV and AIDS pandemic.

Youth

Youth were reported to be vulnerable, as they had limited access to productive assets, such as land or capital, and many lacked vocational skills. With few employment opportunities in rural PACs, it was common for youth to turn to alcohol and substance abuse.

People Living with Disabilities

People living with disabilities, including those living with mental, hearing and sight impairment, were said to be vulnerable. This was attributed to lack of ability to work the land effectively and reliance on other people for financial and food security.

People Living with Illnesses

People with illnesses such as epilepsy, TB, and HIV and AIDS were classified as vulnerable, as they were unable to work their land and relied on other people for financial and food security.

Land Users Who Have No Land Title

Land users who have no land title, no customary status or who have not yet acquired an ‘interest in the land’ were deemed vulnerable. This is reported under Section A9.4.8, land and property. In addition, PACs stressed that with inheritance protocols and the subdivision of land, it is increasingly difficult for households to survive off small plots of land. This has made more people dependent on natural resources to supplement their food consumption and to gain a living (see Section A9.4.6.5 natural resource use).

Ethnicities

FGD and KII in PACs found that the Alur population, particularly those non-Ugandans who had travelled from the DRC and settled in the districts, were not accorded the respect given to others in the community. This was also the case for herdsmen (Bahimba, Banyankole, Bunyarawanda and Karamajong). FGDs with PAC leaders found that individuals from these ethnicities were rarely encountered, which would indicate that they are prevented from leadership roles in communities and possibly marginalised within communities.

Human Rights

- Universal Declaration of Human Rights, article 3; International Covenant on Civil and Political Rights, article 6; African Charter on Human and Peoples' Rights, article 4
- Universal Declaration of Human Rights, article 3; International Covenant on Civil and Political Rights, article 9; African Charter on Human and Peoples' Rights, article 6
- Universal Declaration on Human Rights, article 25; International Covenant on Economic, Social and Cultural Rights, article 11; African Charter on Human and Peoples’ Rights, article 21

- International Covenant on Civil and Political Rights, article 7; African Charter on Human and Peoples' Rights, article 5
- International Covenant on Economic, Social and Cultural Rights, article 12; African Charter on Human and Peoples' Rights, article 16. The right to health is an international human rights law standard in itself and is also a component of the right to an adequate standard of living: Universal Declaration of Human Rights, article 25.
- Universal Declaration on Human Rights, articles 1, 2 and 23(2); International Covenant on Civil and Political Rights, articles 2 and 3; International Covenant on Economic. Social and Cultural Rights, articles 2 and 3; ILO Convention 111 on Discrimination (Employment and Occupation); Convention on the Elimination of All Forms of Discrimination Against Women, UN Women's Empowerment Principles (2010); African Charter on Human and Peoples' Rights, articles 2, 3, 15 and 18; Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa
- IFC Performance Standards on Social and Environmental Sustainability, Performance Standard # 4 Community Health, Safety and Security, para 1, Objectives, Requirement 5 (Community Health and Safety), Requirement 6 (Infrastructure and Equipment Design and Safety), Requirement 7 (Hazardous Materials Management and Safety); OECD Guidelines on Multinational Enterprises, Chapter II General Policies, Recommendations 2, 10, 11 and 12; Chapter IV Human Rights; Chapter VI Environment
- IFC Performance Standards on Social and Environmental Sustainability, Performance Standard # 1 Emergency Preparedness and Response, Objectives, Requirements 20–21 (Emergency Preparedness and Response)
- IFC Performance Standards on Social and Environmental Sustainability, Performance Standard # 4 Community Health, Safety and Security, Requirements 12–14 (Security Personnel)
- African Charter on Human and Peoples' Rights, article 24.

Trend in Condition and Sensitivity to Change

The following trends were observed:

- Communities consisting of mixed ethnicities and religions generally live in harmony. However, increasing migration and arrival of outsiders in PACs threatens this equilibrium. With improvements in infrastructure and increasing migration, communities will diversify.
- Traditions are gradually deceasing in prevalence. The Government is promoting traditions through the re-establishment of Kingdoms, encouraging people's valuation of cultural heritage.
- Savings circles are popular in rural PACs in the absence of banks and borrowing facilities. With improved infrastructure, micro-credit borrowing may be more accessible, thus the number of savings circles that also foster social cohesion and thus wellbeing may reduce.
- Despite Government policies and actions, gender inequality prevails in all aspects of life for women and girls, which continues to stymie the females in society.
- Despite Government efforts to combat discrimination against females, women still have a precarious legal status, lack political power and still suffer from 'overburden' of unpaid tasks and chores and high levels of sexual violence.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Rating

The social baseline study has identified sensitive VECs in relation to community safety, security and welfare. These are listed in Table A9.4-45.

Table A9.4-45 Community Safety, Security and Welfare VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Marginalised ethnicities (Alur, Bahimba, Banyankole, Bunyarawanda and Karamajong)	Moderate (3)	Marginalised from community decision making and access to information or support systems, marginalised groups are vulnerable to change.
Women	Very high (5)	Cultural attitudes toward women and their role within the household hinder many females in PACs. Disadvantaged through a lack of education and with limited access to land and support mechanisms such as access to credit facilities and agricultural inputs, women are deemed particularly sensitive to change.
Widow-headed households	Very high (5)	Widows are challenged to meet basic needs of the household in terms of food security, shelter, welfare and ability to pay for schooling and health care. The gender aspect compounds their situation. Elderly widows are reported as being subject to theft of property and land.
Children, particularly in poor households, AIDS orphans and boys from cattle keeping and plantation agriculture communities	Very high (5)	As minors in society, children are particularly vulnerable. Children from poor households will be less likely to attend school. They are more likely to be relied on to perform household tasks and generate income, exposing them to child labour which prevents them from accessing school.
Elderly (men and women)	Very high (5)	The elderly find it difficult to meet basic needs and afford health care. Unable to work the land, they depend on family to provide support and remittances, and exchange what little they own for food.
Youth	Very high (5)	Young people are particularly sensitive to change, as they have limited access to productive assets such as land or capital, they lack education and vocational skills and their situation is compounded by a lack of employment opportunities.
Disabled	Very high (5)	Disabled people find it difficult to meet basic needs and afford health care. Unable to work their land, they depend on family to provide support and remittances, and exchange what little they own for food.

Table A9.4-45 Community Safety, Security and Welfare VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
People living with illnesses	Very high (5)	People with illnesses such as epilepsy, TB, HIV and AIDS are unable to work their land and rely on other people for financial and food security.
Land users without land titles	Very high (5)	Land users who have no land title, without formal acknowledgement of land ownership, will not be eligible for compensation, only for crops grown.

A9.4.12.2 Key Considerations

Key considerations are:

- there are effective established mechanisms for conflict resolution and support groups at village level; however, lack of land and migrations, emerging use of technology and intermarriage are reducing their effectiveness
- although PACs are generally peaceful, conflicts arise because of changing demographics and decentralisation, underlining the requirement for effective stakeholder engagement
- there are vulnerable groups that will need special considerations.

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ATTACHMENT A9.1 BACKGROUND INFORMATION DOCUMENTS

THE EACOP PROJECT

In 2006, commercial quantities of oil were confirmed to exist in Lake Albert basin in Uganda. The Oil operators in Uganda; CNOOC LTD, TOTAL and TULLOW PLC finished the exploration phase and are now headed into development, which will consequently lead to the production of Uganda oil resources.

Once produced, the crude oil will be partly refined in Uganda to supply the local market and partly exported to the international market. The export to the international market will be through an export crude oil pipeline; The East Africa Crude Oil Export Pipeline (EACOP).

The EACOP is a 1,445km export pipeline that will transport Uganda's crude oil from Kabaale in Uganda to the Chongoleani peninsula near Tanga city port in Tanzania.

ESIA study for the EACOP

ESIA stands for Environmental & Social Impact Assessment. It is the process that defines and evaluates the potential social and environmental impacts of a given project and mitigation measures.

The ESIA studies for the EACOP will be conducted around the crude oil export pipeline route (from Kabaale in Uganda to Chongoleani peninsula, north to Tanga port in Tanzania) and the storage terminal (in Chongoleani). The studies will be conducted in accordance with the international guidelines, as well as laws of both the Ugandan and Tanzanian Governments.

The ESIA process

Scoping Phase
First look at the area to find any potential negative or positive impacts that will need to be further researched.

Specialist Studies:
This phase will involve various studies. As part of these studies, specialists from the UK (RSK) and Uganda (ECO Partners)/Tanzania (JSB & COWI) will visit some of the villages located near the proposed pipeline and the camps and the terminal to talk to local people to better understand village life and the natural surroundings.

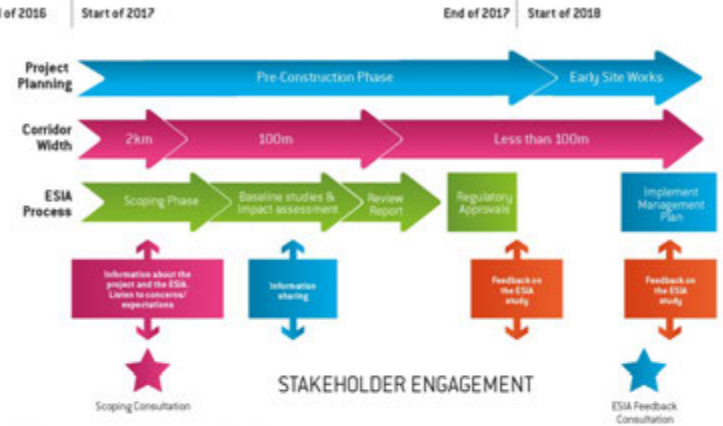
Impact Assessment Phase:
In this phase the researchers, with the help of the local population describe the potential impacts of the EACOP Project on the people's livelihoods, plants, animals, water air, soil, landscape, culture and health.

Development of Management plans:
In this phase plans are developed to avoid or manage impacts of the EACOP Project and also maximise positive impacts.

Regulatory Approvals:
Submission of the reports and approval by the governments of Uganda and Tanzania. Only after their approval can the project go ahead. All the management measures in the report will have to be implemented.

When is an ESIA done?

An ESIA should be done when the proposed project is still being formulated. It should take place before the project is implemented.



How will you be involved?

Scoping Consultation Meetings:

- The teams are currently holding meetings with the various government agencies, local communities and other stakeholders to share information about the project and the ESIA studies.
- You can ask questions and make comments during these meetings.
- All your comments will be written down and taken into account.

Specialist Studies:

- The teams will come to your villages to seek some information from you on the different social aspects of your livelihoods (agriculture, fishing, business, health, education, cultural heritage, etc).
- They will also conduct studies about biodiversity (plants, animals), soil, air quality, noise, road traffic, tourism.

Feedback Consultation Meetings:

- A series of meetings will be held with local communities, government bodies and NGOs once the specialist studies and impact assessment have been completed to discuss the results with you.
- Here again you will be able to ask questions and give comments which will be considered for the ESIA report,
- The reports will then be submitted to the governments of Uganda and Tanzania for their approval. Only after their approval can the Project go ahead. All the proposed management measures in the report will have to be executed.

Who conducts the ESIA?

The studies will be conducted by specialists from the UK (RSK) and partners in Ugandan (ECO & Partners) and in Tanzania (JSB & COWI).

Social and Environmental Studies to be conducted
PHYSICAL ENVIRONMENT
Surface Water
Underground Water
Soil
Air Quality
Noise
Landscape
SOCIO-ECONOMIC ENVIRONMENT
Socio-Economic
Community and Livestock Health
Traffic
Education
Culture and Archaeology
BIODIVERSITY
Protected Areas and Sensitive Habitats
Plants and Animals
Fish and Fisheries
The EACOP route from Kabaale (Uganda) to Chongoleani Tanga (Tanzania)
UNOC
TOTAL
TULLOW OIL
For more information please contact:
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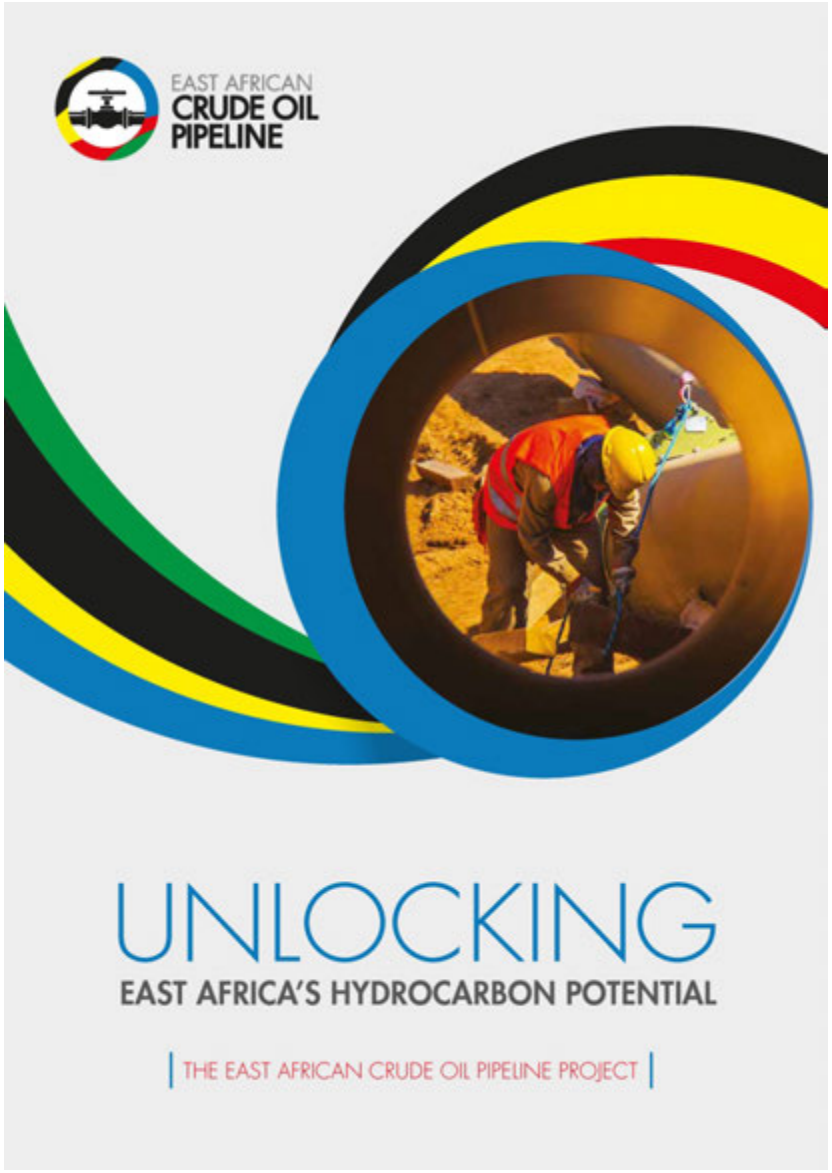
EAST AFRICAN CRUDE OIL PIPELINE
Environmental and Social Impact Study (ESIA)
The longest electrically heated pipeline in the world.


EAST AFRICAN
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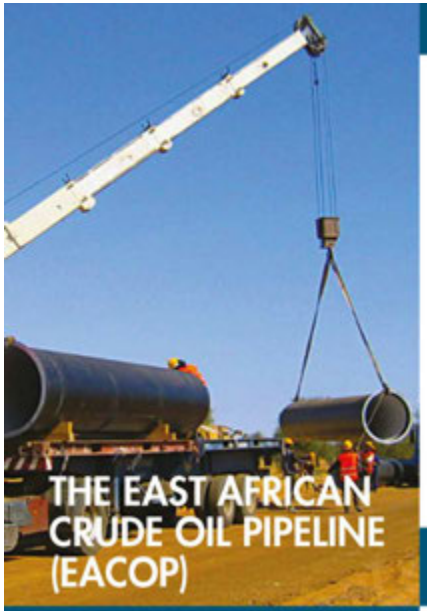
UNLOCKING
EAST AFRICA'S HYDROCARBON POTENTIAL
THE EAST AFRICAN CRUDE OIL PIPELINE PROJECT



THE EAST AFRICAN CRUDE OIL PIPELINE (EACOP)

In 2006, commercial quantities of oil were confirmed to exist in Lake Albert basin in Uganda. The Oil companies in Uganda; CNOOC LTD, TOTAL and TULLOW PLC finished the exploration phase and are now headed into development, which will consequently lead to the production of Uganda oil resources.

Once produced, the crude oil will be partly refined in Uganda to supply the local market and partly exported to the international market. The export to the international market will be through an export crude oil pipeline; The East Africa Crude Oil Export Pipeline (EACOP). This pipeline will be constructed and operated through a Pipeline Company with shareholding from the Uganda National Oil Company, the Tanzania Petroleum Development Corporation and the three oil companies, CNOOC, TOTAL and TULLOW.

The EACOP Project

The EACOP is a 1,445km crude oil export pipeline that will transport Uganda's crude oil from Kabaale in Uganda to the Chongoleani peninsula near Tanga port in Tanzania.

- The pipeline route was selected by the Government of Uganda as the least cost and most robust route.
- Due to the viscous and waxy nature of Uganda's crude oil, the pipeline will need to be heated along the entire route, making the EACOP the longest electrically heated pipeline in the world.
- The pipeline will be buried to minimize the impact on the environment.
- Some facilities will be above ground and will be designed to ensure minimal environmental and social impact.
- The project will be compliant with the Ugandan and Tanzanian national legislations and international requirements.
- The Marine Export Storage Terminal and the Load-Out Facility will be located north of Tanga port over the Chongoleani peninsula.

1,445km	1.2m	216Kbd	6	2	53
EXPORT PIPELINE	BURIED BELOW GROUND	EXPORT FLOW RATE BARRELS PER DAY	PUMPING STATIONS	PRESSURE REDUCTION STATIONS	BLOCK VALVE STATIONS

The Construction Phase

Once the Final Investment Decision (FID) is undertaken, the pipeline construction will start and last about 36 months.

The construction will comprise of:

1. Construction of the Pipeline

The construction will be undertaken as shown in the diagram below. Once ready, the pipeline is carefully placed in the pre-dug trench or, in some cases it will require to be bored under waterways or roads by using horizontal drilling.

2. Construction of the Temporary Facilities

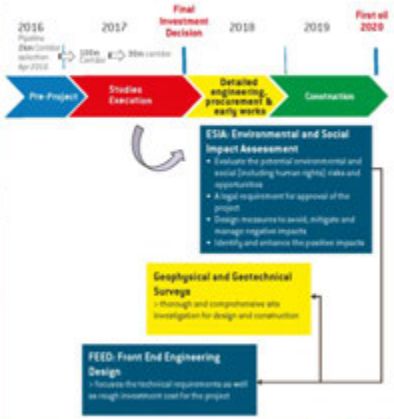
Other facilities will be built such as;

- Coating plants & Pipes Storage Yards
- Construction of additional Work space (Fuel, Helipad, Waste)
- Hydro-test dams, access roads, borrow pits.

3. Construction of the Marine Terminal and the Jetty

The crude oil, transported by the pipeline will be stored in the terminal located on Chongoleani in Tanga bay, before being shipped and sold in other countries. Vessels will be thus loaded with the crude oil at a sheltered deep-water site.

EACOP Schedule



Land Access

Land will be required to construct the EACOP and related facilities. This land will be acquired on either a temporary or permanent basis.

Temporary Access to Land

- within an approximately 30m wide right of way for construction.
- for temporary above ground facilities (like construction camps).
- Land required for temporary basis will be leased for approximately 1- 4 years and returned to owners in a fully reinstated condition.

Permanent Access to Land

- Land required on a permanent basis for above ground installations (Pumping Stations, Pressure Reduction Stations and the Marine Storage Terminal) and for the permanent Right of Way will be acquired.
- After construction, EACOP will need land easements along the pipeline corridor with some restrictions in safety zones.

The EACOP project is committed to:

- Compliance with applicable national legislation and international requirements.
- Ensuring that all landowners and users living along the pipeline corridor will be treated with respect and compensated fairly.
- Vulnerable people identified and assisted as necessary.
- Secure agreements with each affected household, deliver compensation and livelihood restoration programs and help households move out of the area (for those who choose in-kind compensation for resettlement, help them move into their new land).

CKING
CARBON POTENTIAL
E OIL PIPELINE PROJECT
Committed to the Protection of the Environment
The EACOP project will ensure that health, safety, security, social, economic and environment are addressed throughout the planning, construction, and operational phases of pipeline operations.
The pipeline's route has been selected to avoid the most environmentally sensitive areas like national parks and the high population density areas.
Facilities will be carefully located and operated to reduce any potential physical and ecological impacts.
We have developed a biodiversity charter which sets the principles of our work. According to this charter, we carry out all EACOP activities while:
• AVOIDING unnecessary impact to the ecosystem, the biodiversity and the local communities.
• MINIMIZING any unavoidable impact to the ecosystem, the biodiversity and the local communities.
• RESTORING: Rehabilitating the impacted areas and managing their restoration
• OFFSETTING any residual impact seeking a net positive gain
THE MITIGATION HIERARCHY
AVOID
MINIMISE
RESTORE
OFF SET
Committed to Socio-Economic Development
We consider national content as key for the success of our operations. We will therefore promote national participation by;
• Reinforcing the use of Ugandan and Tanzanian workforce and contractors through training programs and support to local companies
- strengthening of local skills and capacities
- creating direct and indirect employment
- supporting local content and local procurement
• Contributing to human development participating in local development programs (road safety, access to energy, capacity building...)
• Reinforcing infrastructures.
Employment Creation
The pipeline will create short term (2-3 years) employment for both highly skilled professionals, semi-skilled and casual labourers. It is expected that casual workers who will be involved in the construction phase of the proposed project will be sourced locally from each district and this will further promote the development of local capacity.
About 10,000 people will be employed during the construction phase.
Committed to Stakeholder Engagement
The EACOP Project is committed to meaningful engagement with all of its stakeholders based on the principles of participation, respect for human rights, non-discrimination, empowerment, transparency and accountability. Stakeholder engagement will therefore be conducted in order to:
• Establish lasting, positive relationships with stakeholders.
• Provide project information to enable stakeholders contribute meaningfully all along the process.
• Work co-operatively with stakeholders to understand their concerns and seek solutions.
• Commit towards the addressing of stakeholder concerns in a fair and effective manner.
• Pro-actively consult in an open based dialogue appropriate for the different stakeholders.
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EACOP PROJECT IN UGANDA
EACOP PROJECT IN TANZANIA
EAST AFRICAN
CRUDE OIL
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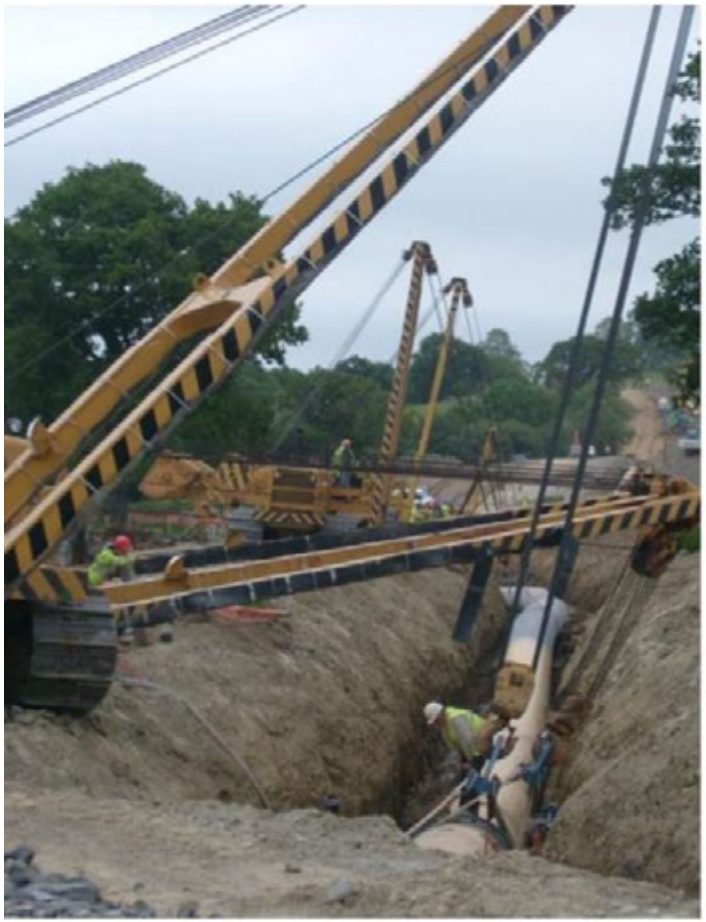
1

PIPELINE CONSTRUCTION



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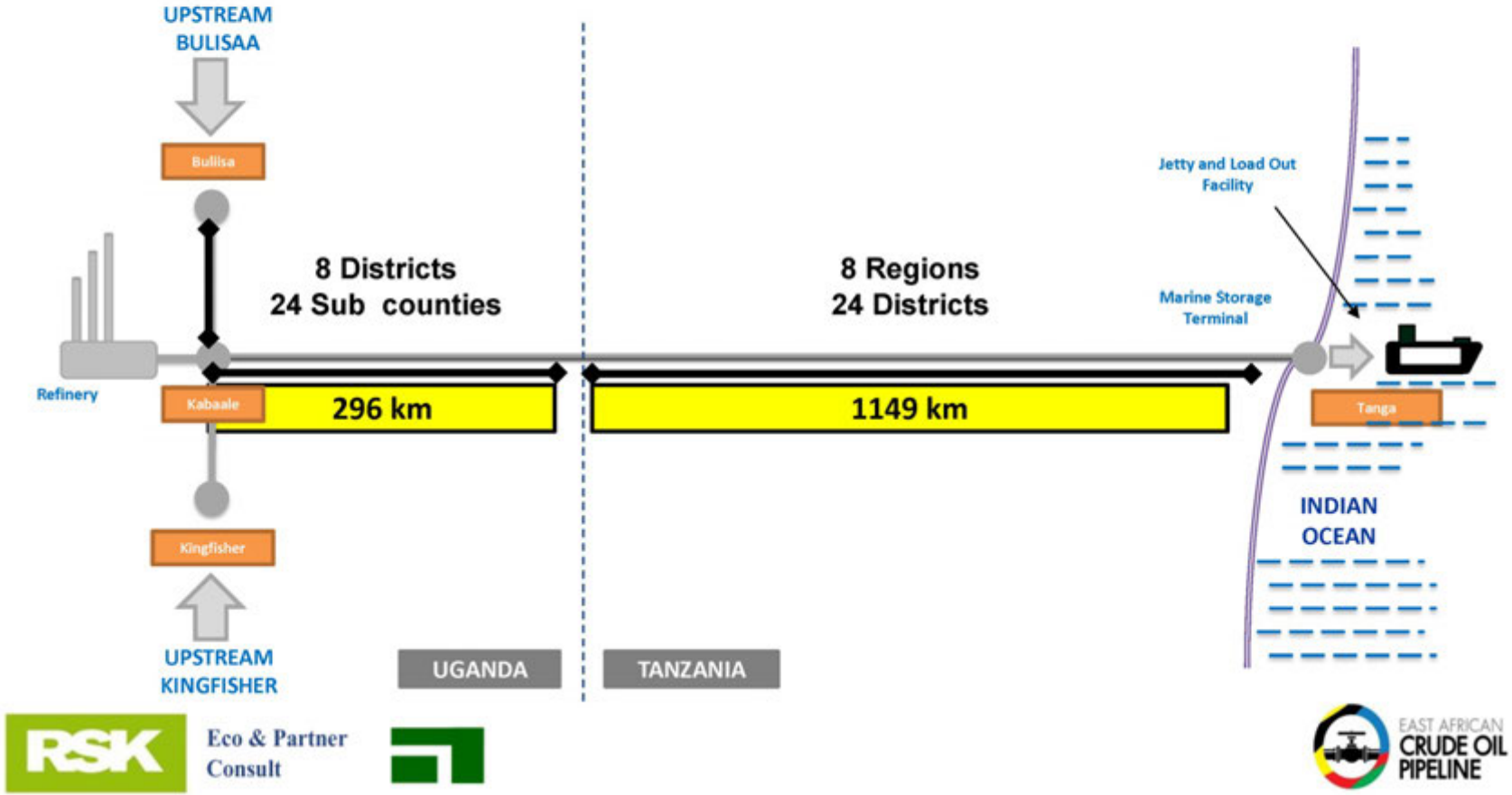
EAST AFRICAN CRUDE OIL PIPELINE

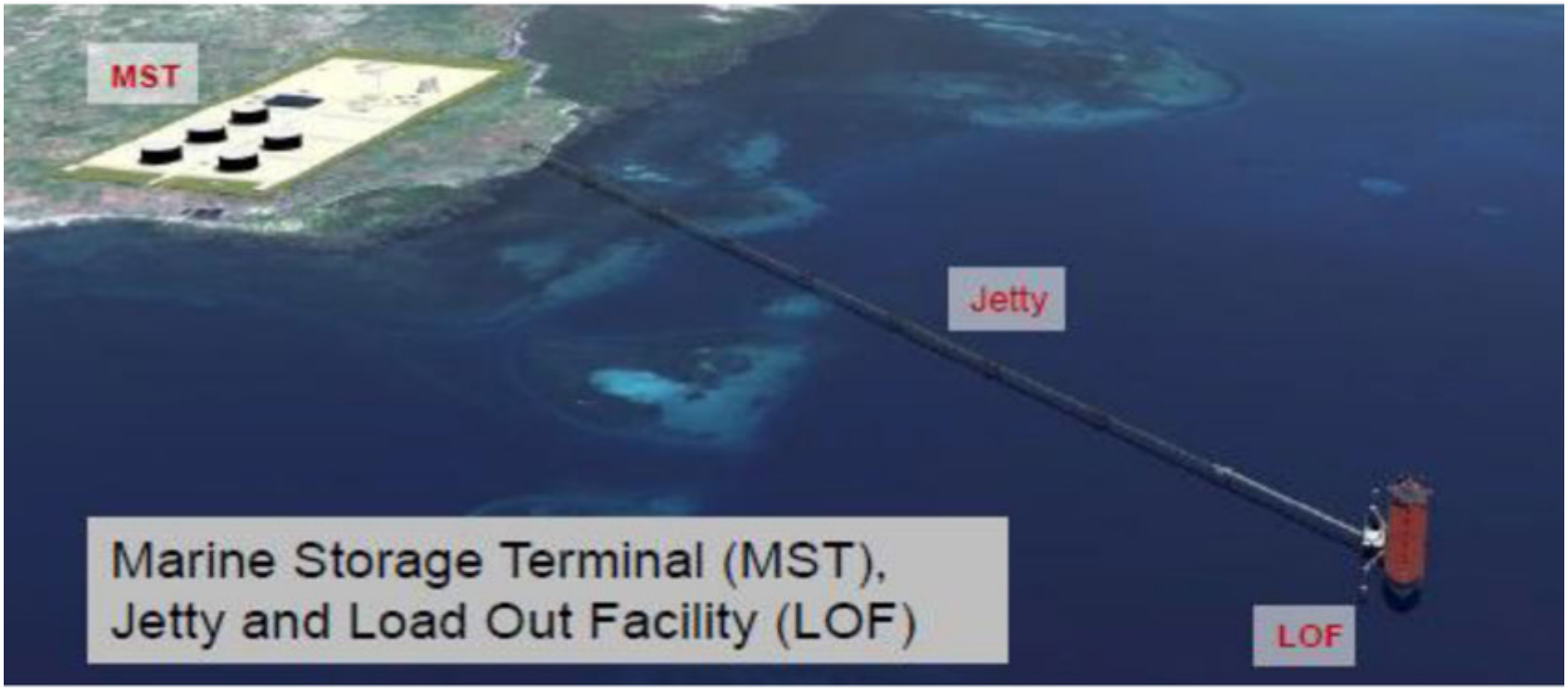
2

1445 KM LONG PIPELINE FROM THE LAKE ALBERT BASIN OIL FIELDS IN UGANDA TO THE INDIAN OCEAN COAST IN TANZANIA



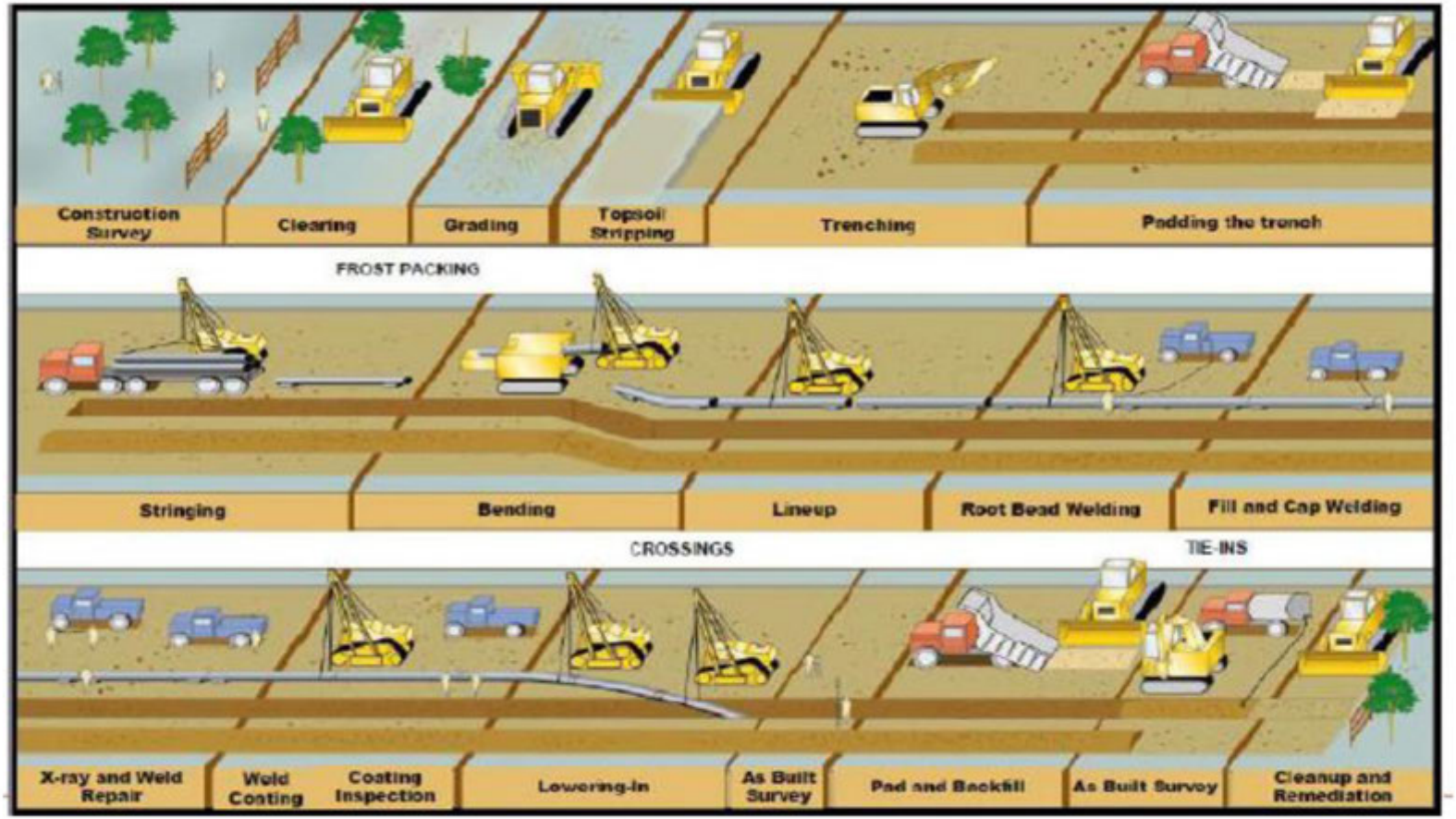
MARINE STORAGE TERMINAL (MST) AND LOAD-OUT FACILITY (LOF) LOCATED NORTH TO TANGA CITY PORT OVER THE CHONGOLEANI PENINSULA

3



4

STAGES OF CONSTRUCTION OF THE PIPELINE



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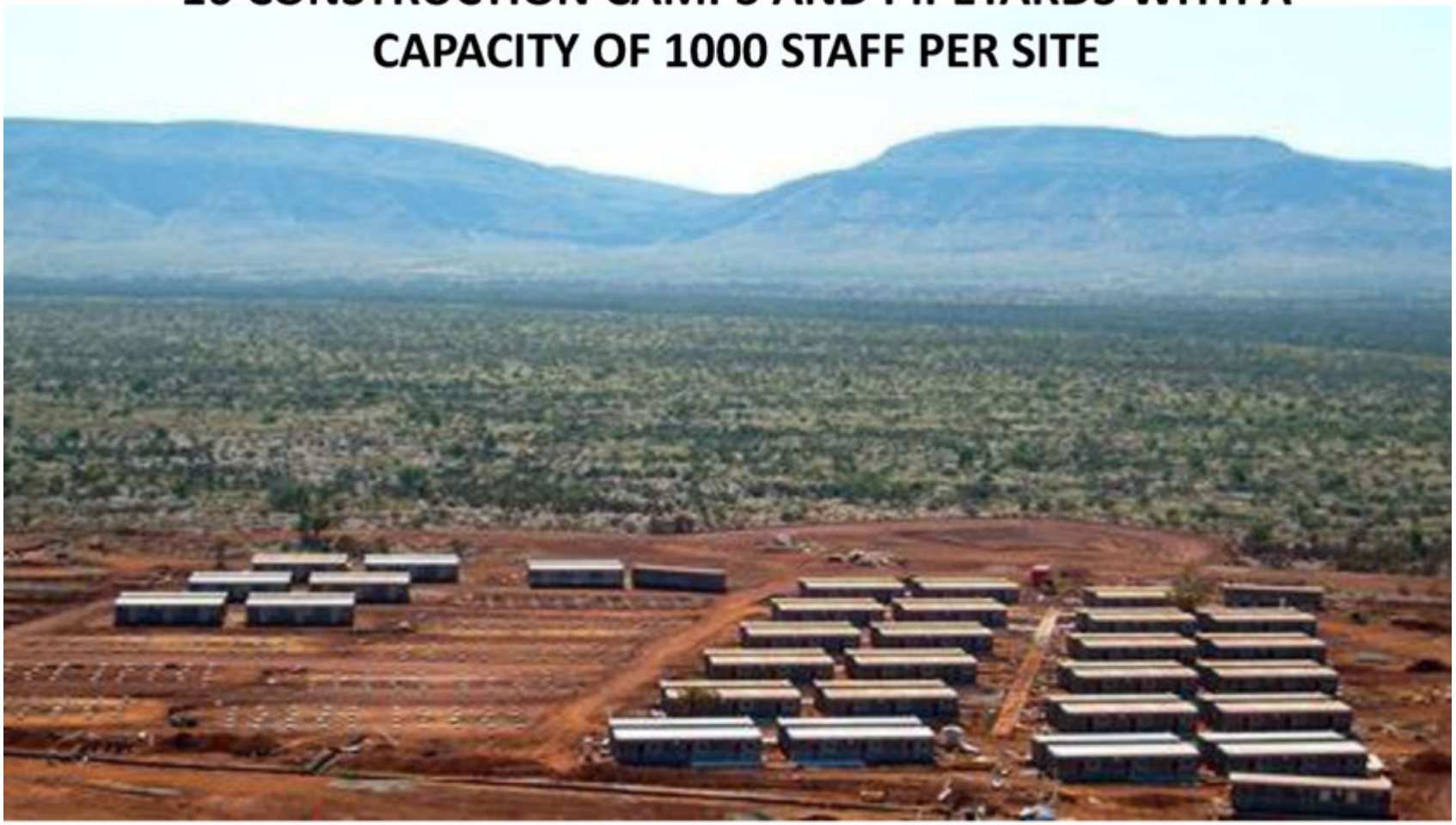
EAST AFRICAN CRUDE OIL PIPELINE

5

16 CONSTRUCTION CAMPS AND PIPEYARDS WITH A CAPACITY OF 1000 STAFF PER SITE



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EAST AFRICAN CRUDE OIL PIPELINE

PERMANENT ABOVE GROUND FACILITIES

Block Valve Stations

Pumping Stations

TEMPORARY ABOVE GROUND FACILITIES

Coating Plants

Construction Camps

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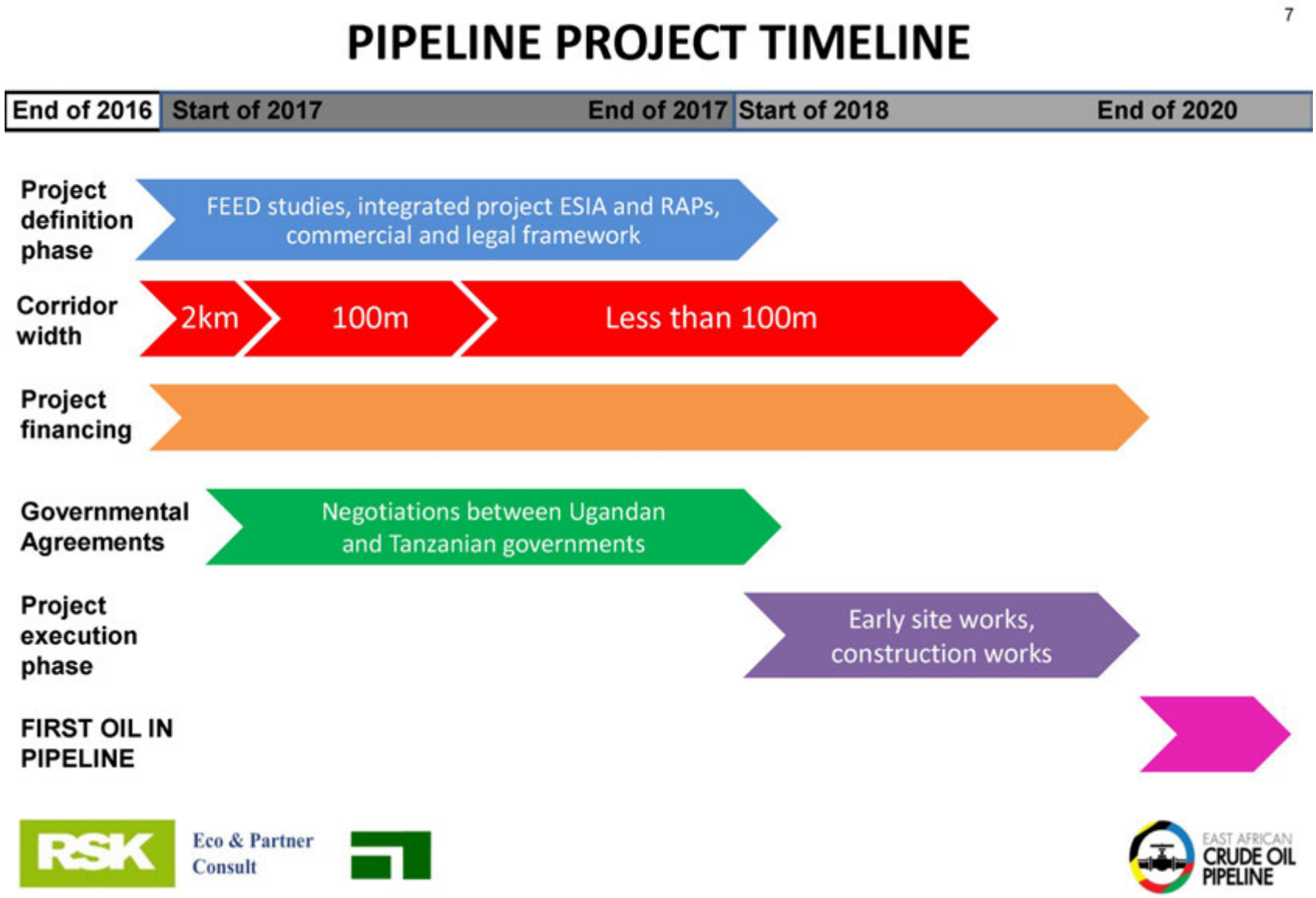
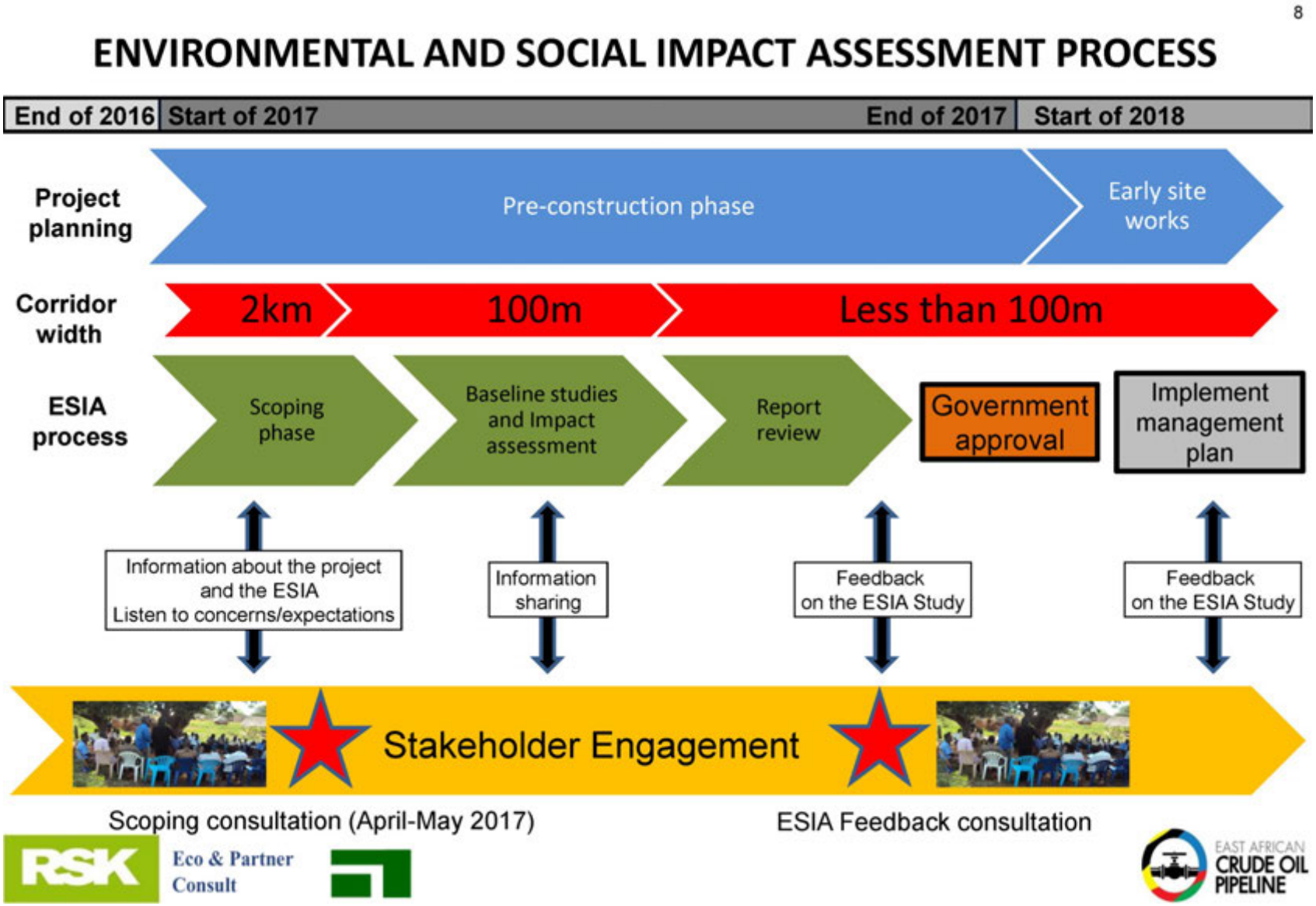
EAST AFRICAN CRUDE OIL PIPELINE


7
PIPELINE PROJECT TIMELINE
End of 2016
Start of 2017
End of 2017
Start of 2018
End of 2020
Project definition phase
FEED studies, integrated project ESIA and RAPs, commercial and legal framework
Corridor width
2km
100m
Less than 100m
Project financing
Governmental Agreements
Negotiations between Ugandan and Tanzanian governments
Project execution phase
Early site works, construction works
FIRST OIL IN PIPELINE
RSK
Eco & Partner Consult
EAST AFRICAN CRUDE OIL PIPELINE


8
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROCESS
End of 2016
Start of 2017
End of 2017
Start of 2018
Project planning
Pre-construction phase
Early site works
Corridor width
2km
100m
Less than 100m
ESIA process
Scoping phase
Baseline studies and Impact assessment
Report review
Government approval
Implement management plan
Information about the project and the ESIA
Listen to concerns/expectations
Information sharing
Feedback on the ESIA Study
Feedback on the ESIA Study
Stakeholder Engagement
Scoping consultation (April-May 2017)
ESIA Feedback consultation
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EAST AFRICAN CRUDE OIL PIPELINE

9

SOCIAL AND ENVIRONMENTAL STUDIES

Physical environment

- SURFACE WATER

- UNDERGROUND WATER
- SOIL

- AIR QUALITY
- NOISE
- LANDSCAPE

Socio-economic environment

- SOCIO-ECONOMIC

- COMMUNITY AND LIVESTOCK HEALTH

- TRAFFIC
- EDUCATION
- CULTURE AND ARCHAEOLOGY

Biodiversity

- PROTECTED AREAS AND SENSITIVE HABITATS
- PLANTS AND ANIMALS

- FISH AND FISHERIES

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10

POTENTIAL BENEFITS

Job opportunities

Economic development opportunities

Improvement of roads

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EAST AFRICAN CRUDE OIL PIPELINE

11

POTENTIAL NEGATIVE IMPACTS

Disturbance to wildlife and vegetation

Impact on land leading to potential economic displacement

Impact on health and well-being:
noise and traffic

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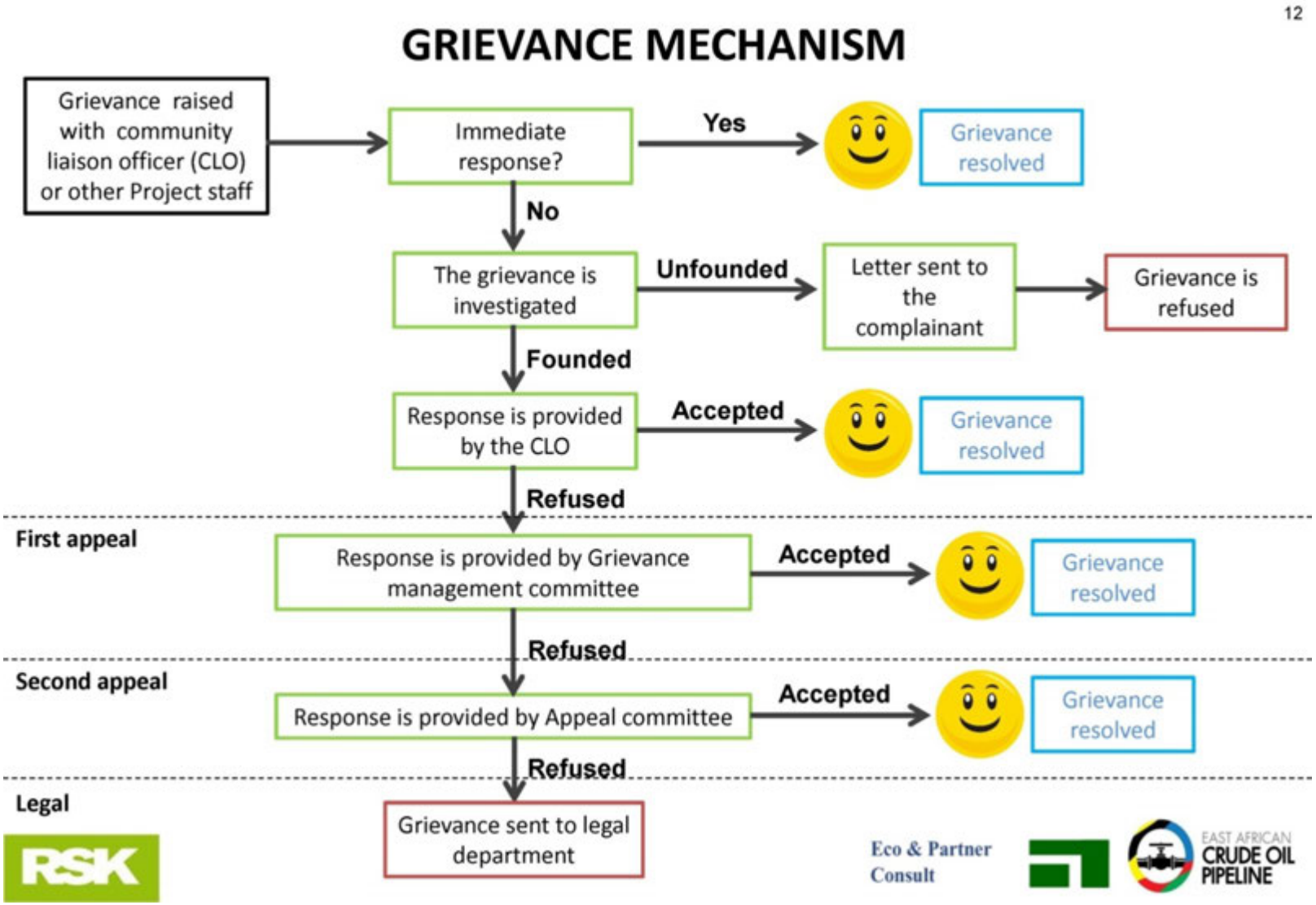
EAST AFRICAN CRUDE OIL PIPELINE

12


GRIEVANCE MECHANISM
Grievance raised with community liaison officer (CLO) or other Project staff
Immediate response?
Yes
Grievance resolved
No
The grievance is investigated
Unfounded
Letter sent to the complainant
Grievance is refused
Founded
Response is provided by the CLO
Accepted
Grievance resolved
Refused
First appeal
Response is provided by Grievance management committee
Accepted
Grievance resolved
Refused
Second appeal
Response is provided by Appeal committee
Accepted
Grievance resolved
Refused
Legal
Grievance sent to legal department
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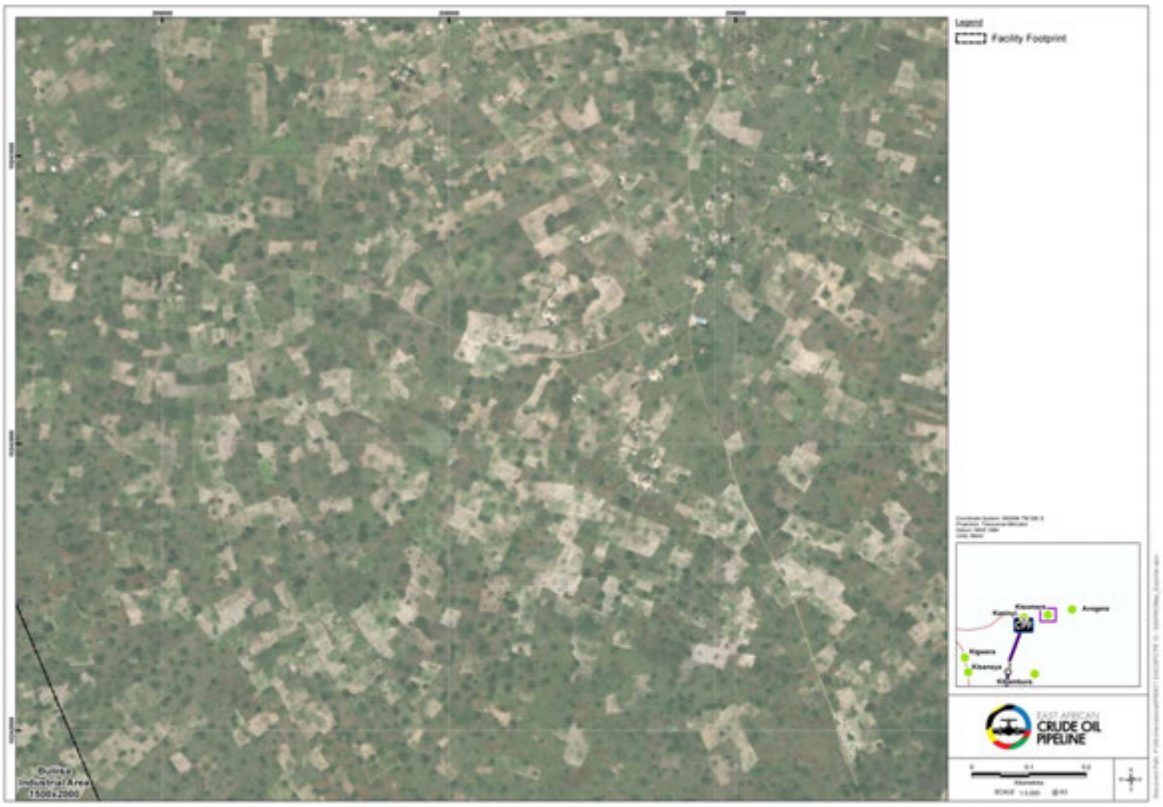
EAST AFRICAN CRUDE OIL PIPELINE

ATTACHMENT A9.2 SITE AND POTENTIALLY AFFECTED COMMUNITY PROFILES

PAC Profiles

Kisomere

PAC PROFILE KISOMERE – MAP



PAC PROFILE KISOMERE – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- 3 churches (Anglican, Catholic, Pentecostal)
- 1 mosque

Landfill:
- Household waste is piled and burned

Education

School:
- Kisomere parents school
- 1 nursery school

Cultural Heritage

Place of worship:
- 2 sacred trees

Health

- There is no health centre but the village has a private clinic.
- The nearest health centre is at Avogera- 3 km away.

Boreholes:
- 6

Seasonal wells:
- 6

Other:
- Clean latrines and rubbish pits

Commerce

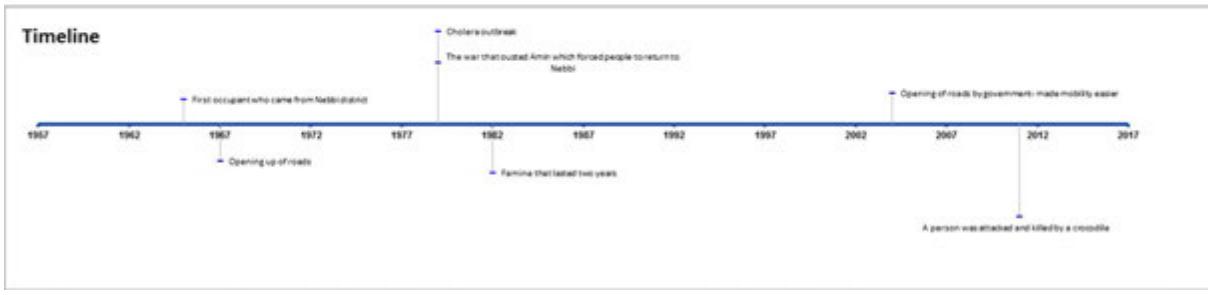
PAC PROFILE KISOMERE - DESCRIPTION

Kisomere village is located within Ngwedo subcounty in Buliisa district.

Land-based and water-based livelihood strategies:
The main crop types in the village include maize, cassava, cotton, beans, avocadoes, pineapples and groundnuts among others. Livestock rearing is undertaken in the village with the main kept animals being goats, sheep and poultry. Fishing is undertaken by youths along the Wanseko shoreline. Natural resources are collected in and around the village including grass for thatching and firewood. Charcoal burning is also present in the village. Some people are engaged in trading. Beekeeping is also practiced in the village.

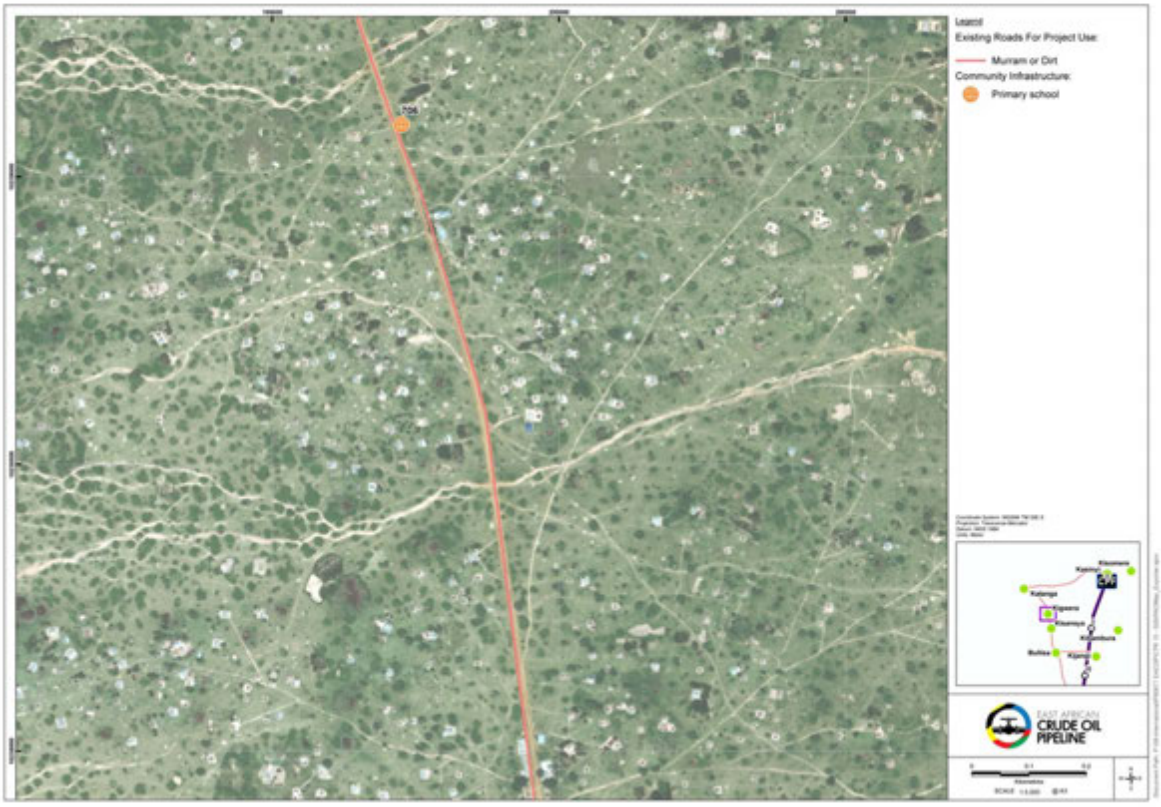
Main aspirations for the future:
Better development of the village
Improvement of the road networks
Compensation for destruction of crops

* Data adapted from Artelia 2015



Kigwera North East

PAC PROFILE KIGWERA NORTH EAST – MAP



PAC PROFILE KIGWERA NORTH EAST – COMMUNITY INFRASTRUCTURE

General

Education

School:
- 1 primary school

Cultural Heritage

Place of worship:
- There are many trees located around the village that are of importance for worship and rituals

Health

Health Centre:
- Kigwera Health Centre II
- Bulilisa Health Centre IV
- There are two Village Health Teams

River:
- River Nile

Borehole:
- 3 boreholes

Commerce

PAC PROFILE KIGWERA NORTH EAST - DESCRIPTION

Kigwera North East is located in the subcounty of Kigwera in Buliisa district.

Land-based and water-based livelihood strategies:
The main kept animals in the village include cattle, goats and sheep. Crop farming is also present on a small scale, with the main crops grown including cassava, maize sweet potatoes, groundnuts, peas, simsims and pumpkins. Fishing is undertaken in the community. Firewood collection is common in the village.

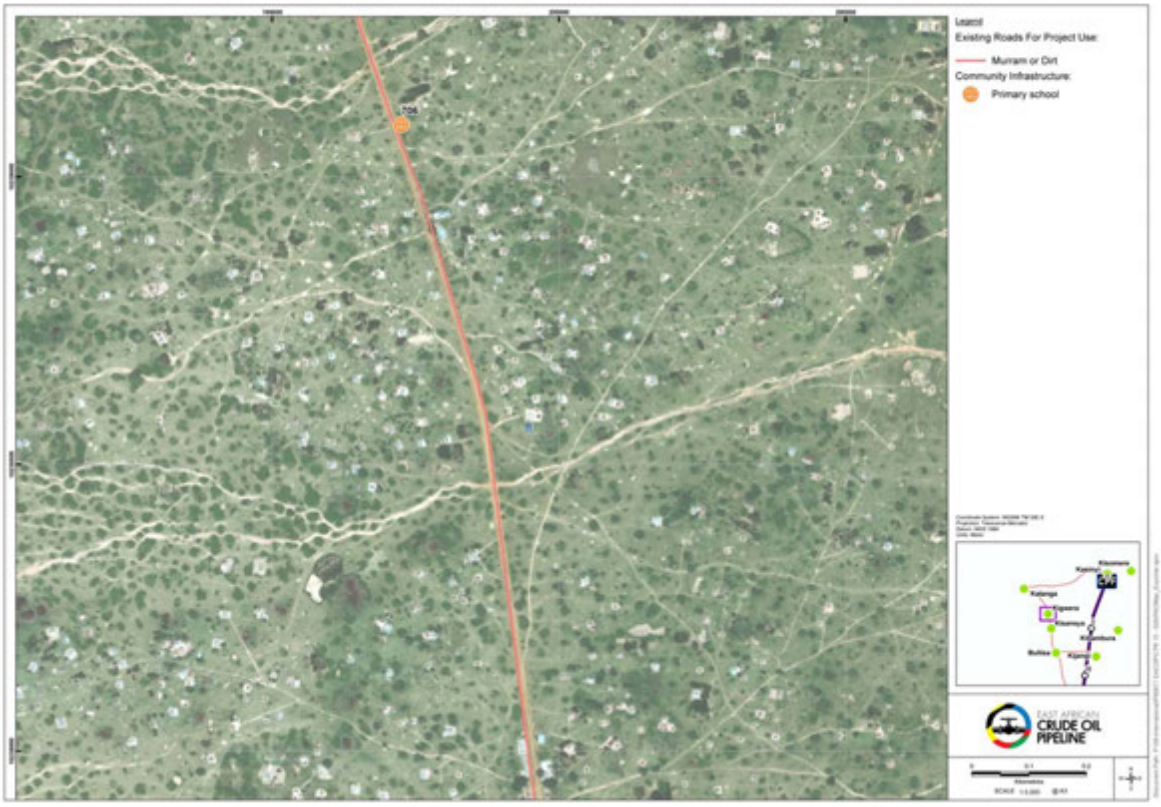
Main aspirations for the future:
- Development of the area
- New infrastructures (schools, health centres etc.)
- New jobs

* Data adapted from Artelia 2015

Timeline

Kigwera North West

PAC PROFILE KIGWERA NORTH WEST – MAP



PAC PROFILE KIGWERA NORTH WEST – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- Kigwera Miracle Centre
- Owobusobozi- Bisaka Church

Education

School:
- 1 primary school

Cultural Heritage

Place of worship:
- There are many trees located around the village that are of importance for worship and rituals

Health

Health Centre:
- Kigwera Health Centre II
- There are two Village Health Teams

Lake:
- Lake Albert

River:
- River Nile

Borehole:
- 3 boreholes

Commerce

PAC PROFILE KIGWERA NORTH WEST - DESCRIPTION

Kigwera North West is located in the subcounty of Kigwera in Buliisa district.

Land-based and water-based livelihood strategies:
The main kept animals in the village include cattle, goats and sheep. Crop farming is also present on a small scale, with the main crops grown including cassava, maize sweet potatoes and beans. Fishing is undertaken on a small scale at Lake Albert. Firewood collection and shell collection are common in the village. Sand mining is practiced for construction purposes.

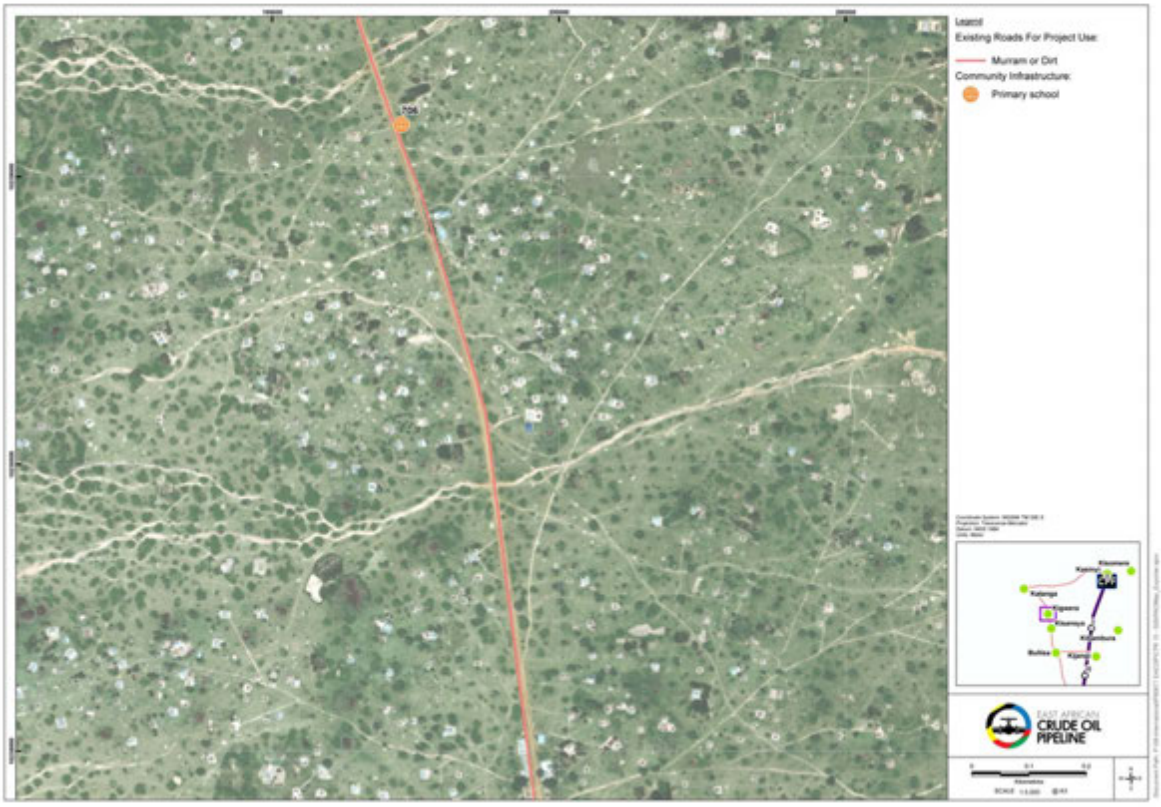
Main aspirations for the future:
- New social infrastructures
- New jobs
- New employment opportunities for women
- Market area to sell produce
- More support for fishing company and farmers

* Data adapted from Artelia 2015

Timeline

Kigwera South East

PAC PROFILE KIGWERA SOUTH EAST – MAP



PAC PROFILE KIGWERA SOUTH EAST – COMMUNITY INFRASTRUCTURE

General	Education	Health	Commerce
		Lake: ○ Lake Albert **Borehole:** ○ 1 borehole	

Cultural Heritage

PAC PROFILE KIGWERA SOUTH EAST - DESCRIPTION

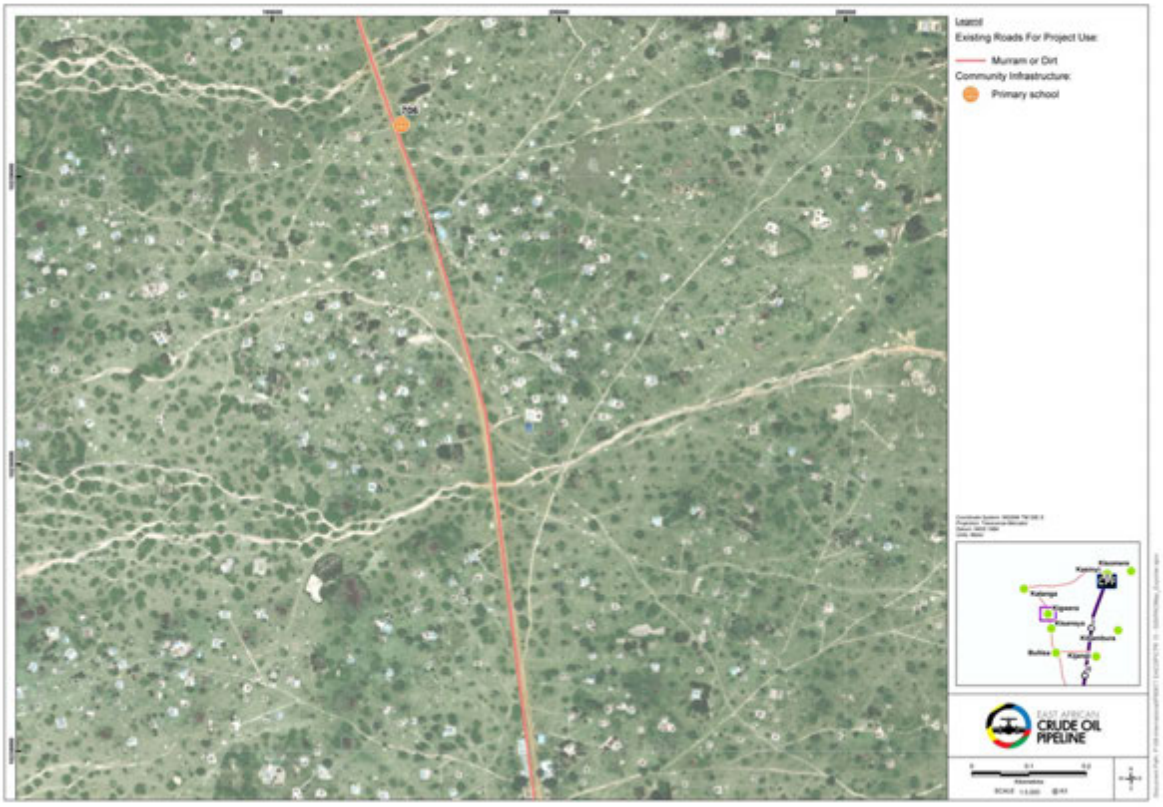
Kigwera South East is located in the subcounty of Kigwera in Buliisa district.

Land-based and water-based livelihood strategies:
The main kept animals in the village include cattle, goats and sheep. Crop farming is also present on a small scale. Fishing is undertaken at Lake Albert. Seashells are collected in the area. Sand mining is practiced for construction purposes.

* Data adapted from Artelia 2015

Kigwera South West

PAC PROFILE KIGWERA SOUTH WEST – MAP



PAC PROFILE KIGWERA SOUTH WEST – COMMUNITY INFRASTRUCTURE

General

Waste management:
- No system in place

Churches/ Mosques:
- 1 church

Education

School:
- 1 nursery and primary school

Cultural Heritage

Health

Lake:
- 1 lake

Borehole:
- 3 boreholes

Other:
- Homesteads use communal latrines

Commerce

Business:
- Kiosks
- Shops
- Carwash

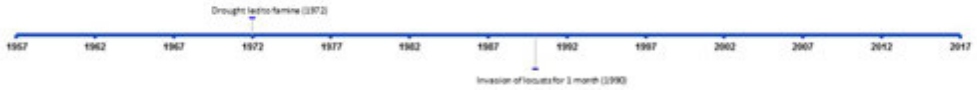
PAC PROFILE KIGWERA SOUTH WEST - DESCRIPTION

Kigwera South West is located in the subcounty of Buliisa in Buliisa district.

Land-based and water-based livelihood strategies:
Livestock rearing is the main livelihood activity in the community with the main kept animals including goats and sheep. Many residents are engaged in fishing activities in the area. Crop farming is not present in the area however most residents own land in Ngwedo and grow cassava and potatoes among others. Natural resources are collected and sand mining is practiced in the community.

* Data adapted from Artelia 2015

Timeline



Katanga

PAC PROFILE KATANGA – MAP

PAC PROFILE KATANGA – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- 5 churches
- 1 mosque

Waste management:
- None - village is extremely dirty with dry waste

Other:
- Police post considered as an asset for the village

Education

School:
- Good Hope Primary School
- 1 secondary school

Cultural Heritage

Other:
- There are many traditional healers located in the village

Health

- There is no health centre in the village- The closest is Kigwera Health Centre III.
- There is a functional VHT but no drugs are available.

Public boreholes:
- 2

Seasonal wells:
- 2

Commerce

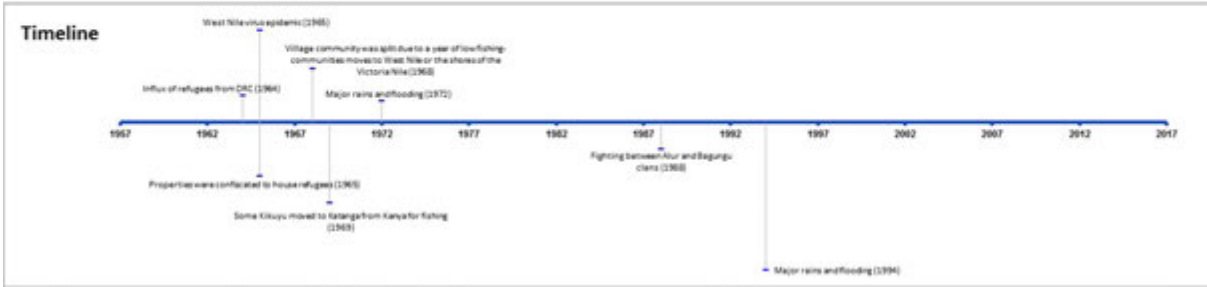
PAC PROFILE KATANGA - DESCRIPTION

Katanga village is located in the subcounty of Kigwera in Buliisa district.

Land-based and water-based livelihood strategies:
Fishing is the main livelihood activity in the village. Crop farming is practiced in the village with the main crops grown including fruit trees, cassava and beans. Livestock rearing is present in the village with the main kept livestock including cattle, goats and sheep. Firewood collection is common in the village. Charcoal burning is also undertaken.

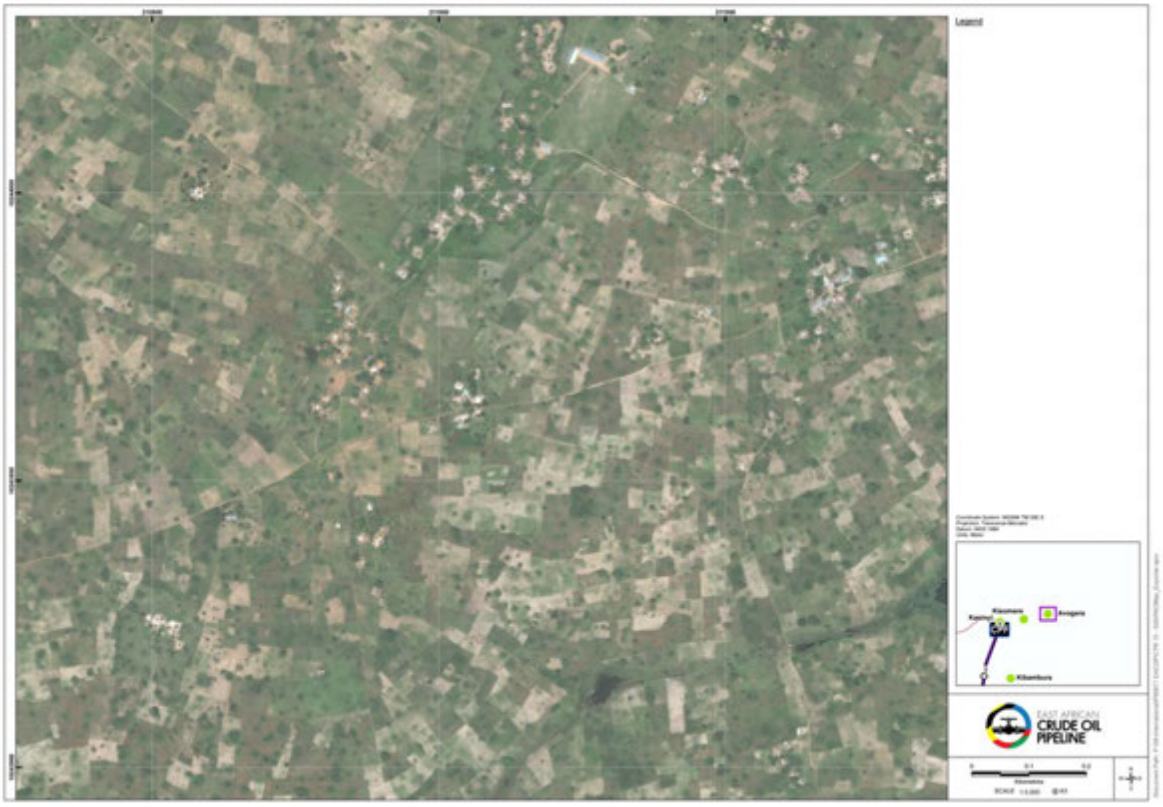
Main aspirations for the future:
- Improvements to infrastructure
- New employment opportunities

* Data adapted from Artelia 2015



Avogera

PAC PROFILE AVOGERA – MAP



PAC PROFILE AVOGERA – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- Avogera Catholic Church
- Avogera Church of Uganda
- Open Heaven Church
- The nearest mosque is located in Ngwedo

Other:
- Police post

Education

Schools:
- Avogera primary school

Cultural Heritage

Place of worship:
- There are 2 sacred trees (Simsim and Thembull) where clans practice rituals

Health

Health Centre:
- 1 health centre (HCII)

Boreholes:
- **2** functional boreholes- one constructed by the government, and the other by Heritage Oil

Commerce

Market:
- Open Monday and Thursday every week

Business:
- Tailors
- Bicycle repair
- Shops
- Mobile cassava and mullet grinders
- Carpenters
- Builders

PAC PROFILE AVOGERA - DESCRIPTION

Avogera is located in Ngwedo subcounty in Buliisa district.

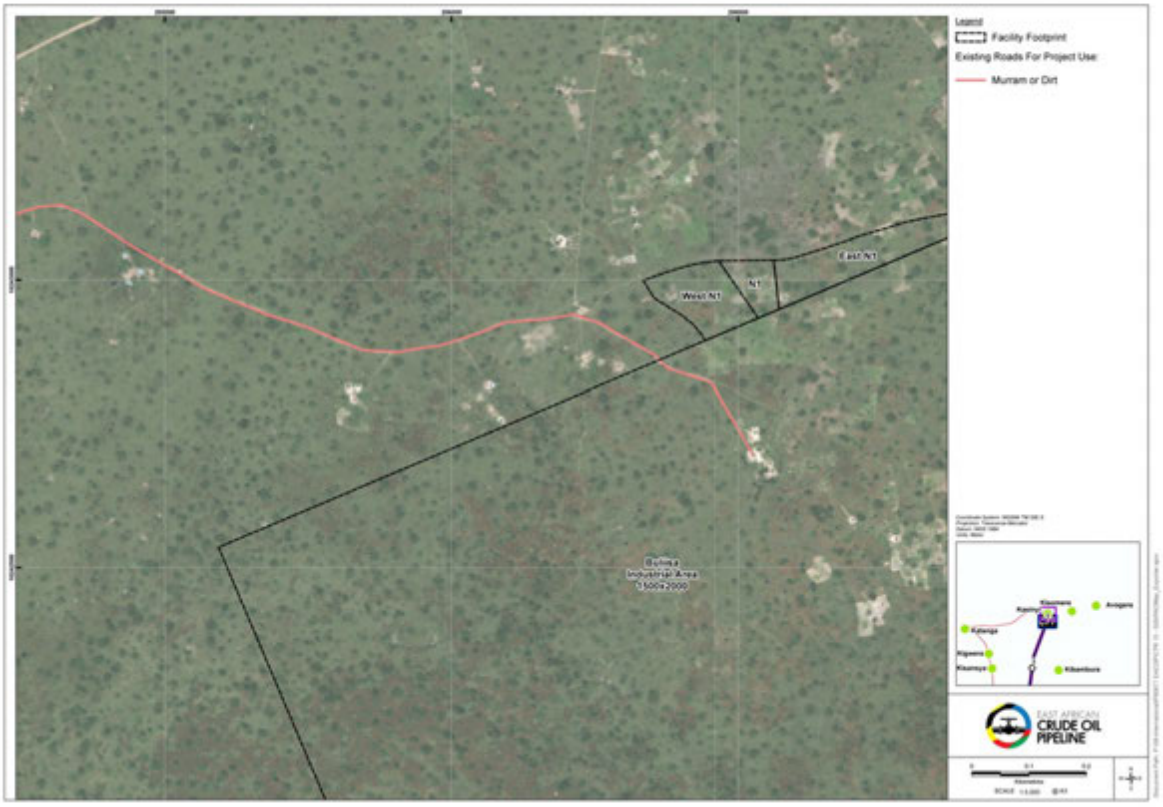
Land-based and water-based livelihood strategies:
The main livelihood within the community is crop farming. The main crops grown include cassava, maize, sesame, sweet potatoes, cotton and groundnuts among others. The main kept livestock include goats, chickens, pigs, sheep and guinea fowl. Youths undertake fishing in the area.

Main aspirations for the future:
- Improved yields from crops and livestock
- Investment in infrastructure (i.e., schools, health facilities etc.)

* Data adapted from Actelia 2015

Kasinyi

PAC PROFILE KASINYI – MAP



PAC PROFILE KASINYI – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- 2 Catholic churches
- 1 Protestant
- 1 Alleluia
- Muslims go to a mosque along the shores of Lake Albert

Education

School:
- 2 unregistered kindergarten in the village
- Nearest primary school is located in Kisomere- 2 hours away

Cultural Heritage

Other:
- Traditional healers are present in the village

Health

Health centre:
- The nearest is in Avongera- 8km away

Boreholes:
- 6 in the village- 4 of which are functional

Other:
- There is insufficient water, villagers use water from the lake and river

Commerce

PAC PROFILE KASINYI - DESCRIPTION

Kasinyi is located in the subcounty of Ngwedo in Buliisa district.

Land-based and water-based livelihood strategies:
The main livelihood strategy is livestock rearing, with the main kept livestock including cattle, sheep, goats and chickens. Crop farming is also undertaken in the community and the main crops grown include cassava, cotton, sesame, sorghum, sweet potatoes and maize. Fruit trees including mango, orange, jackfruit and watermelon are grown in plantations. Fishing is an important activity in the area. Hunting is undertaken at a small scale to catch small animals and wild pigs. Firewood collection is common in the village.

Main aspirations for the future:
- Scholarship programmes in the village
- Better infrastructures

* Data adapted from Artelia 2015

Kisanya East

PAC PROFILE KISANYA EAST – MAP

PAC PROFILE KISANYA EAST – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- 4 churches

Education

School:
- Kisansya Primary School
- Saint Damalie Private Nursery and Primary School

Cultural Heritage

Other:
- Traditional healers are located in the village

Cemetery/ graveyard:
- 5 cemeteries in the village
- Burials are also undertaken at household level

Health

Health Centre:
- Nearest is Ndandamire health centre- 3km away
- 2 Village health teams

Borehole:
- 1 functional borehole

Commerce

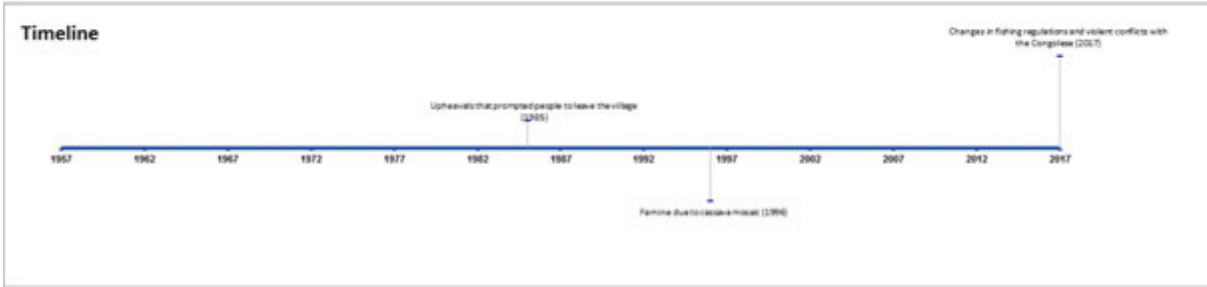
Business:
- Shops
- Lodges
- Tailors

PAC PROFILE KISANYA EAST - DESCRIPTION

Kisanya East is located in the subcounty of Buliisa TC in Buliisa district.

Land-based and water-based livelihood strategies:
The main crops grown in the village include cassava, pumpkins and watermelons. Livestock rearing is practiced, with the main kept animals including cattle, goats, chickens and pigs. Firewood collection is common in the community

* Data adapted from Artelia 2015



Kisanya West

PAC PROFILE KISANYA WEST – MAP

PAC PROFILE KISANYA WEST – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- 4 churches

Education

School:
- Nearest is located in Kigwera

Cultural Heritage

Health

Health Centre:
- Nearest is Kigwera Health Eentre II

Lake:
- 1 lake

Borehole:
- 1 functional borehole

Commerce

Business:
- Boda boda drivers

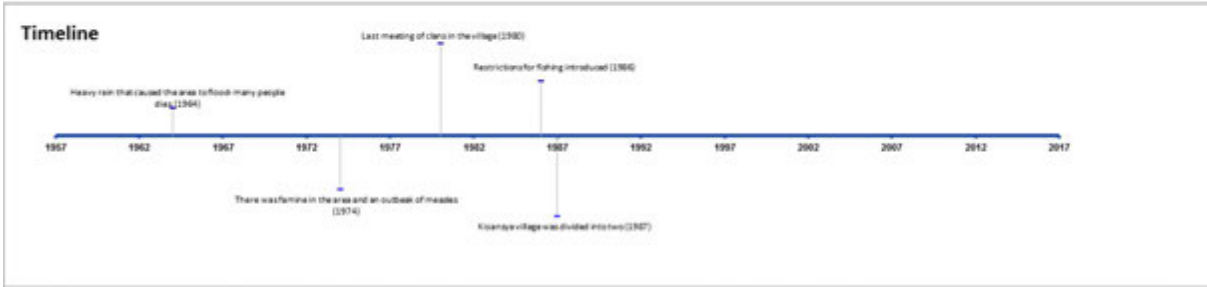
PAC PROFILE KISANYA WEST - DESCRIPTION

Kisanya West is located in the subcounty of Buliisa TC in Buliisa district.

Land-based and water-based livelihood strategies:
The main crops grown in the village include cassava, sisal, oranges and acacia. Livestock rearing is practiced, with the main kept animals including cattle, goats and sheep. Fishing is undertaken in the community however, due to restrictions, this activity is in decline. Firewood collection is common in the community. Sand mining is practiced for use in construction. Residents collect wild plants for medicinal purposes.

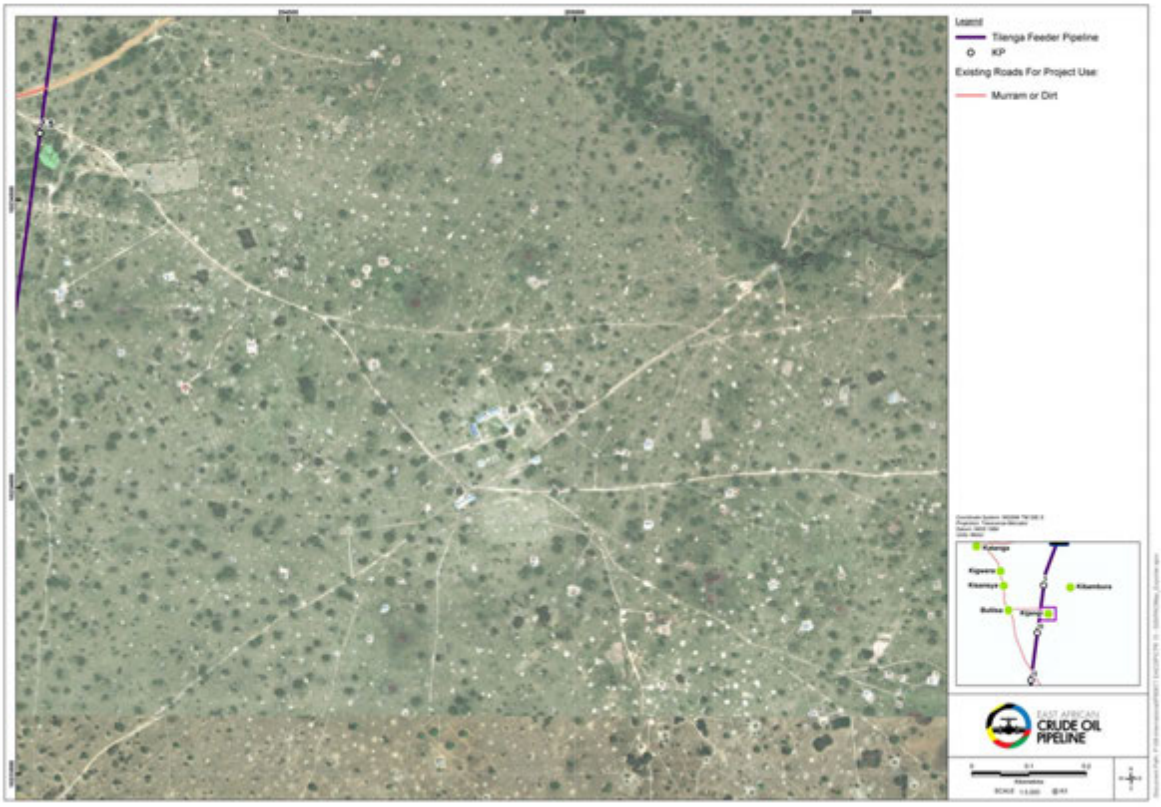
Main aspirations for the future:
- Support to vulnerable and poor groups

* Data adapted from Artelia 2015



Kijangi

PAC PROFILE KIJANGI – MAP



PAC PROFILE KIJANGI – COMMUNITY INFRASTRUCTURE

General	Education	Health	Commerce
Churches/ Mosques: o 3 churches	**School:** o Kijangi primary school	**Boreholes:** o 3 **Community wells:** o Hand dug wells o There is not enough water for all of the population.	
Cultural Heritage			

PAC PROFILE KIJANGI - DESCRIPTION

Kijangi is located in the subcounty of Buliisa in Buliisa district.

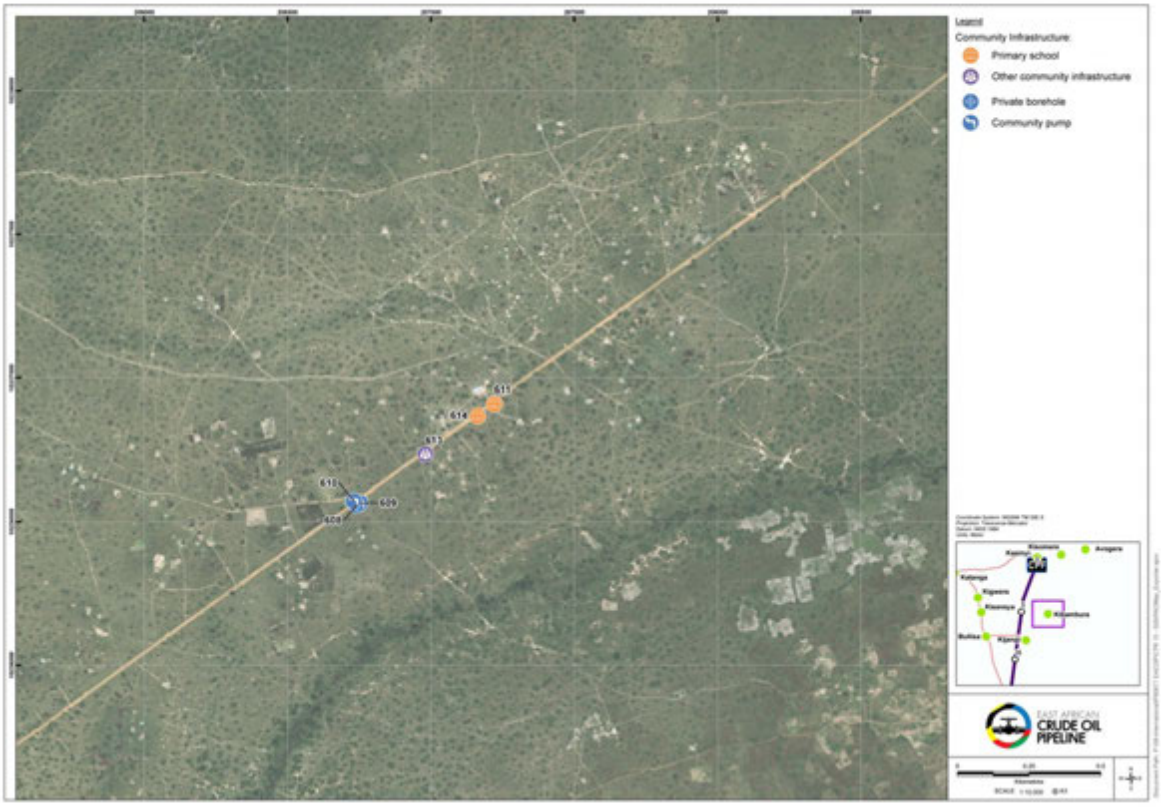
Land-based and water-based livelihood strategies:
The majority of households own livestock in the community, with the main kept livestock including cattle and goats. Main crops grown in the village include cassava, maize and potatoes. Fishing is undertaken by youths but at low levels. Firewood collection is common in the area. Charcoal burning is also present in the village. Sand mining is practiced.

Main aspirations for the future:
- Ambulance service
- New employment opportunities
- New infrastructure including schools
- Water dams for cows

* Data adapted from Artelia 2015

Kibambura

PAC PROFILE KIBAMBURA – MAP



PAC PROFILE KIBAMBURA – COMMUNITY INFRASTRUCTURE

General

Churches/ Mosques:
- The nearest churches and mosques are located in Ngwedo

Education

School:
- Kimbambura Primary school
- Nearest secondary school is located in Bulisa

Cultural Heritage

Place of worship:
- River Sambiye
- Yaya tree
- Nwinsizo main stream

Health

Health centre:
- There are no health centres, however there is a village health team.

Dispensary:
- The nearest is located in Ngwedo

River:
- Sambiye River

Boreholes:
- 5 boreholes- 3 are functional

Commerce

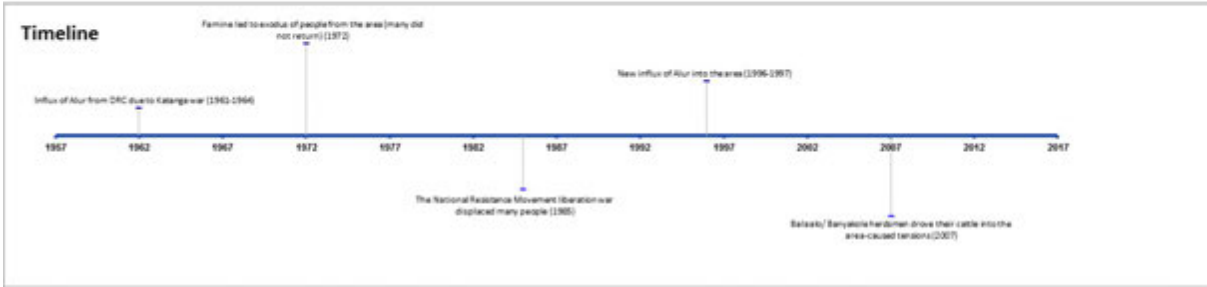
PAC PROFILE KIBAMBURA - DESCRIPTION

Kibambura is located in Ngwedo subcounty in Buliisa district.

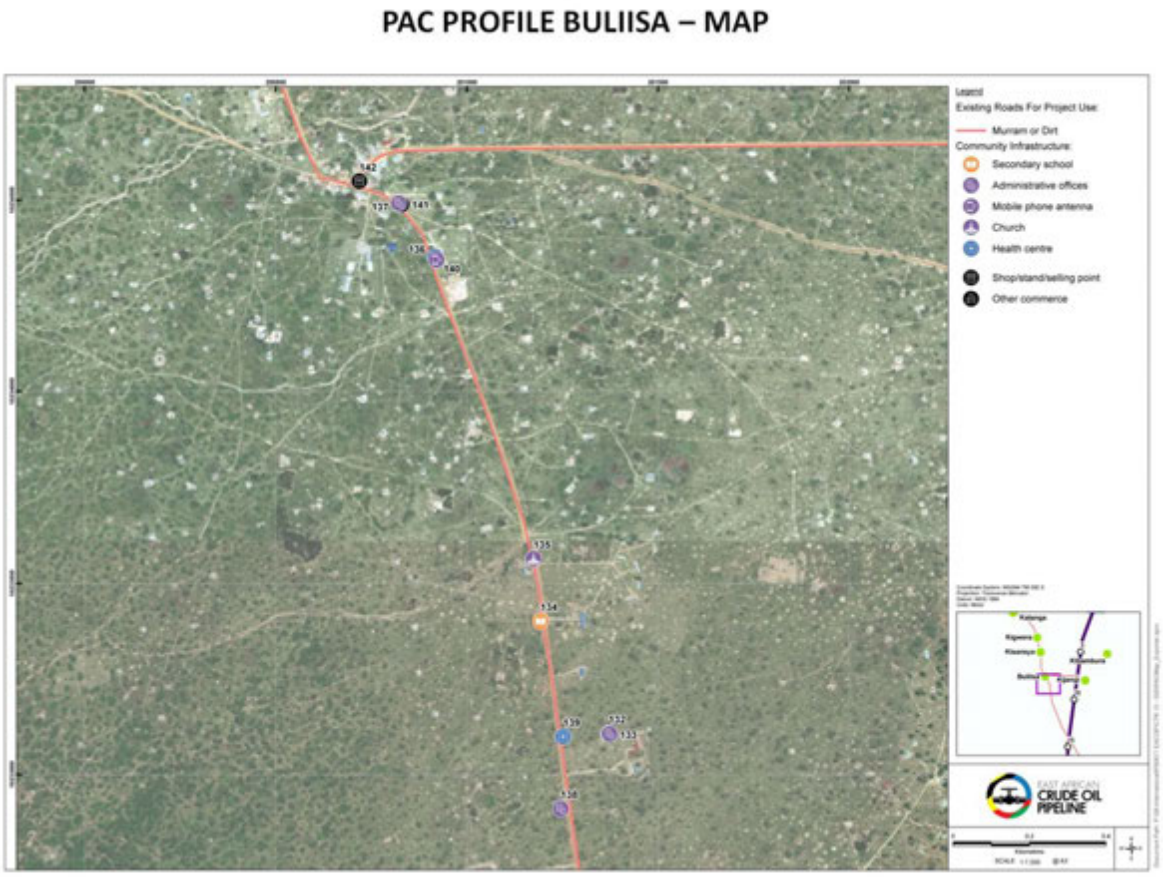
Land-based and water-based livelihood strategies:
The major livelihood is livestock rearing, with the main kept animal including cattle and goats. Crop farming is also practiced in the area with the main crops grown including cassava, maize, sweet potatoes, peas, pumpkins, bambara nuts and simsims. Fishing is practiced on a small scale due to government restrictions on the activity. Firewood is commonly collected in and around the area, as is the collection of grass cuttings and medicinal plants. Charcoal burning is undertaken on a small scale.

Main aspirations for the future:
- Women involved in more businesses
- New employment opportunities

* Data adapted from Artelia 2015

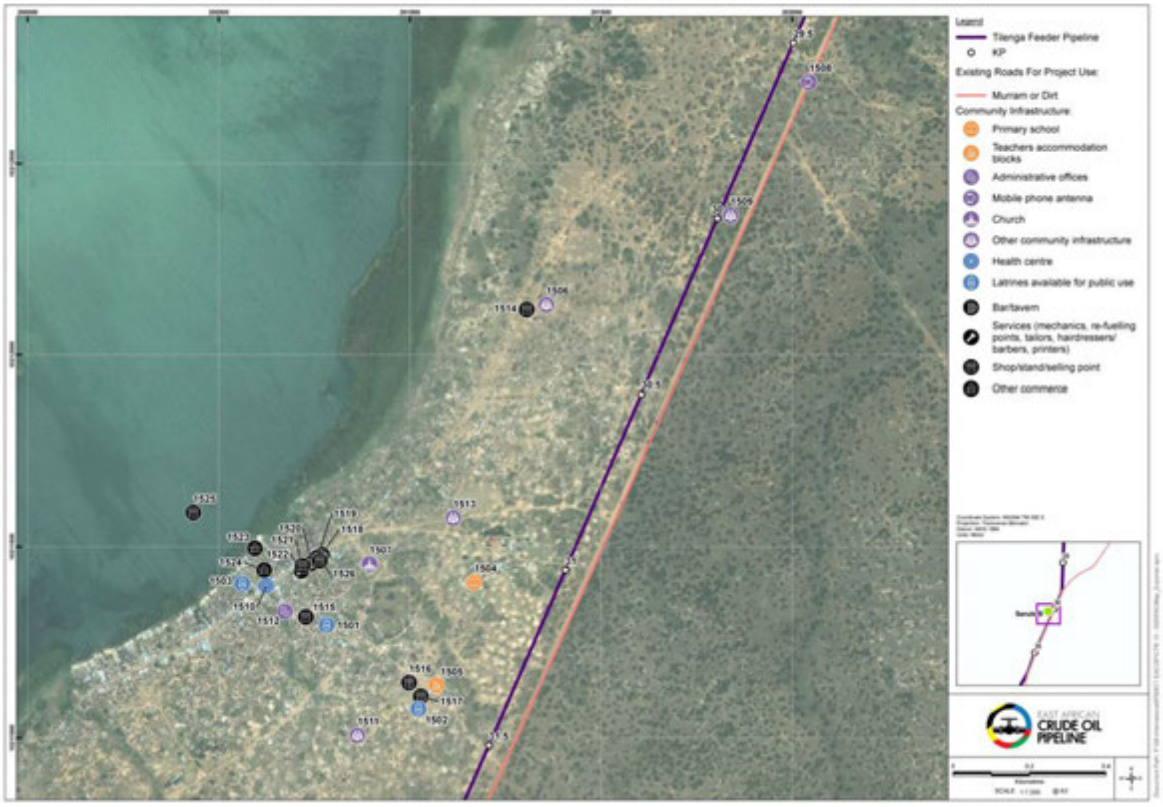


Buliisa


PAC PROFILE BULIISA – MAP
Legend
Existing Roads For Project Use:
Murram or Dirt
Community Infrastructure:
Secondary school
Administrative offices
Mobile phone antenna
Church
Health centre
Shop/stand/selling point
Other commerce
EAST AFRICAN CRUDE OIL PIPELINE

Serule

PAC PROFILE SERULE B-MAP



PAC PROFILE SERULE B- COMMUNITY INFRASTRUCTURE

General

Community gathering place:
- Mukonjos hall
- Mutoma Tree shade
- Bugoigo P/S

Churches/ Mosques:
- Bugoigo church of Uganda
- Bugoigo Christian Fellowship
- Church of Christ
- Bugoigo SDA

Electric lighting:
- There are some houses connected to hydroelectricity power in addition to the use of solar panels by other households

Power Cables :
- Masindi- Wanseko Power line

Mobile phone antenna:
- There are two antennas within the village

Communal roads:
- 1 trunk gravel road (Bugoigo-Waisoke road)
- Approximately 3 community roads
  - Bugoigo Main street
  - Bugoigo market street
  - Serule B –Dispensary road

General condition of roads within community:
- Motor able trunk roads

Level of traffic along main road:
- Medium mainly boda boda cyclists with a few vehicles

Recent history of accidents:
- No major accidents recorded in the previous 6 months

Education

Schools :
- St. Stephen Nursery and P/s
- Bugoigo Nursery and P/s (Government aided)
- Sunrise Nursery and P/s
- Nearest secondary school is located in Biiso sub-county
- Nearest tertiary school is located in Biiso sub-county

Teachers accommodation blocks:
- There is one house which houses three teachers at Bugoigo P/S

Cultural Heritage

Cemetery/ graveyard:
- There are graveyards in homesteads
- There is also a community burial ground.

People plant acacia trees around the graves, some have concrete headstones, some use a cross to mark graves.

There are two traditional healers.

Health

Health centres:
- The nearest health centre is in Kigungu Village (HC III)

Health Building (Clinic) :
- There are two privately owned clinics

River:
- Waisoke River which pours its water into Lake Albert. It also happens to be a water collection point for some communities

Marshes:
- At the edges of the lake shores

Lake:
- Lake Albert

Community pumps:
- One borehole at Bugoigo P/S

Public latrines:
- There are two latrines. One Bugoigo taxi stage the other at Bugoigo Market

Commerce

Market :
- Bugoigo Market which operates daily and commonly deals in general merchandise and food stuff

Business:
- There are some retail shops for general merchandise
- There are 3 alcohol selling shops
- There are two food selling areas
- There are 2 guest houses: Junakis Lodge,Bazale Lodge
- There are 2 boda boda repairing points.
- One welding workshop belonging to Kiiza Fred
- 3 saloons

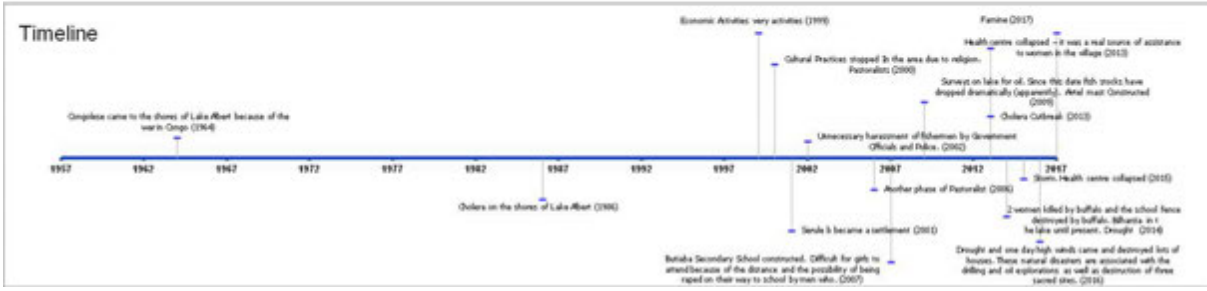
PAC PROFILE SERULE B- DESCRIPTION

Principal land-based and water-based livelihood strategies

Serule B is located in the sub-county of Butiaba within Buliisa district. Within the trading centre, the settlement is linear with houses built along the roadside. Further from the trading centre, the houses are scattered. A larger settlement is located just south of the village.

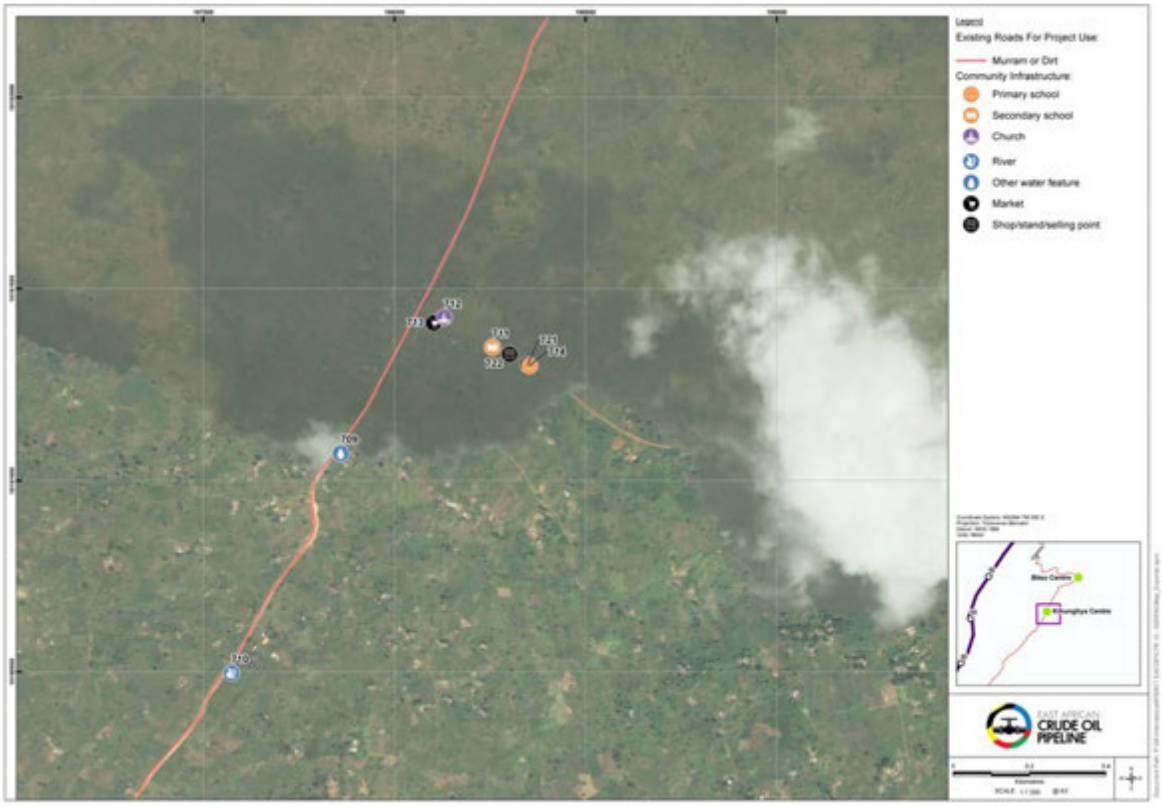
Land-based and water-based livelihood strategies:
The primary source of livelihoods within the village is fishing. This is conducted on and along the shores of Lake Albert. Within the village, the community does not engage in any form of farming with most of the food bought from Biiso sub-county. Very few engage in livestock rearing and keep cattle, goats and pigs but not in large numbers. Charcoal is ferried from Masindi and Kigorobya into the village. The gathering of natural resources is common in and around the game reserve, though illegal. There is mining of cowries shells at the shores of Lake Albert and sand mining is also undertaken.

Main aspirations for the future:
- Better schools and education for children
- Health centre
- Employment opportunities and jobs long term
- General improved lifestyle with oil
- Operating big businesses
- Having good road networks
- Having safe water
- Having a modern market



Kihunghya

PAC PROFILE KIHUNGHYA CENTRE- MAP



PAC PROFILE KIHUNGHYA CENTRE- DESCRIPTION

Principal land-based and water-based livelihood strategies

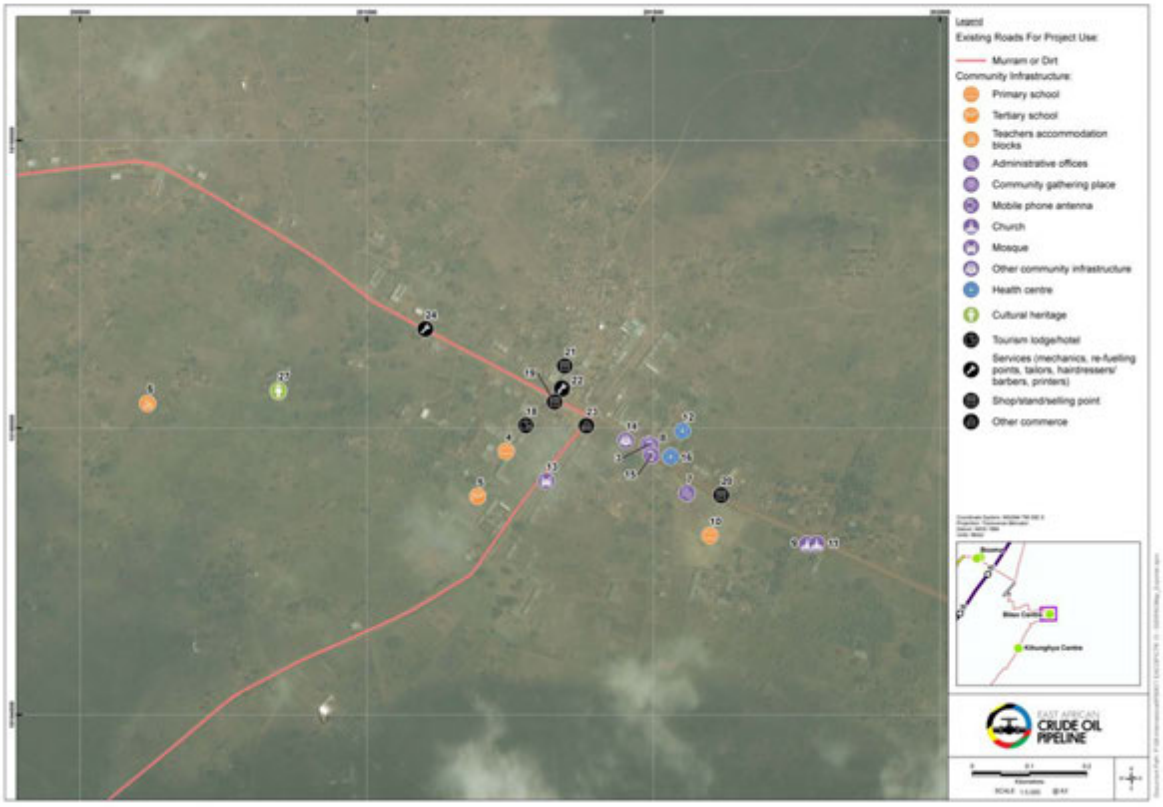
Kihungya centre is located in the sub-county of Kihungya within Buliisa district. The area is characterised with having swamps and rocks and is composed of a linear settlement built along the main road. The further from the trading centre, the more sparse the settlement.

Land-based and water-based livelihood strategies:
Within the trading centre, the soils are fertile and many practice mixed farming. Main kept animals include sheep, pigs, goats and cattle. Crops grown include cotton, cassava, maize, sweet potatoes, bananas, groundnuts. Sand mining is present along the shores of the lake. Fishing is undertaken especially in the ponds around the community. Firewood collection is common. Brick making is practiced in the trading centre.

Main aspirations for the future:
- Good infrastructure
- Increased access to social services
- Woman empowerment
- Business boom
- Girls education
- Good health services

Biiso

PAC PROFILE BIISO -MAP



PAC PROFILE BIISO - COMMUNITY INFRASTRUCTURE

General

Administrative Offices:
- There are 3 administrative units namely the Subcounty, the Uganda prisons and an NFA zonal office

Community gathering place:
- Biiso Community hall

Churches/ Mosques:
- 3: Biiso Church, Biiso Baptist Church, Biiso Miracle Church
- 1 mosque (Biiso Mosque)

Electric lighting:
- Several houses connected to hydroelectricity power

Power Cables:
- Masindi- Wanseko Powerline

Mobile phone antenna:
- There are 2 antennas within the trading centre.

Communal road:
- Hoima –Biiso road and Biiso-Masindi Road.
- There are several trunk earth roads as well as communal foot paths

General condition of roads within community:
- The roads are in poor state given the increased level of traffic

Level of traffic along main road:
- High level of traffic

Recent history of accidents:
- Minor accidents in the previous 3 months

Education

Schools:
- New Hope Nursery and Primary school
- Homeland Nursery and Primary school
- Biiso Primary School
- Biiso War Memorial Secondary school
- Muvaka's College
- Mukitale Foundation Secondary school
- Albertine Vocational institute (tertiary)

Teachers' accommodation blocks:
- Biiso War Memorial Secondary and Muvaka's College

Cultural Heritage

Cemetery/ graveyard:
- There are no burials held within the trading centre.
- Burials are conducted in the villages of the deceased.

To mark graves, some use stones, some place a cross, some use cement.

There are 2 traditional healers.

Health

Dispensary:
- The dispensary is within Biiso HC III

Health centre:
- There is 1health Centre (Biiso HC III)

Clinic:
- There are 7 privately owned clinics

Piped water from storage tanks:
- There are stand pipes with water being supplied by the sub-county water project

Private boreholes:
- There are 3including: Biiso Primary and Biiso Health Centre

Public latrines:
- There are 2 public latrines, 1 is at the market area

Commerce

Market:
- There is a daily market called Biiso Market

Business:
- There are many retail and whole sale shops for general merchandise
- There are 3 bars and over 10 alcohol selling places
- Daily food selling, especially in the morning and evening hours
- There are several restaurants
- There are several guest houses and a hotel but the prominent ones are Biiso Guesthouse and Albertine Nile Hotel among others
- There is one re-fuelling point along Biiso-Bulisa Road, several salons and 3 printers

PAC PROFILE BIISO - DESCRIPTION

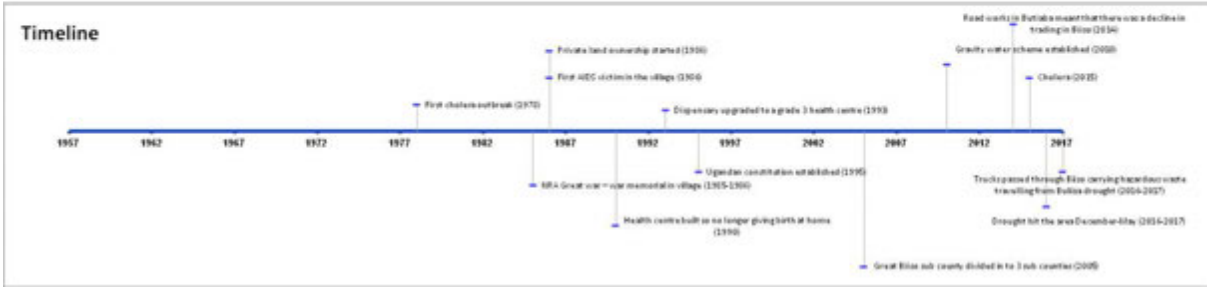
Principal land-based and water-based livelihood strategies

Biiso Centre is located in the subcounty of Biiso within Buliisa district. The major activities within the trading centre is trade; there are many retail and whole sale shops, a health centre, improved education facilities (including a tertiary institute), a prison post (Biiso Prisons) and several accommodation facilities.

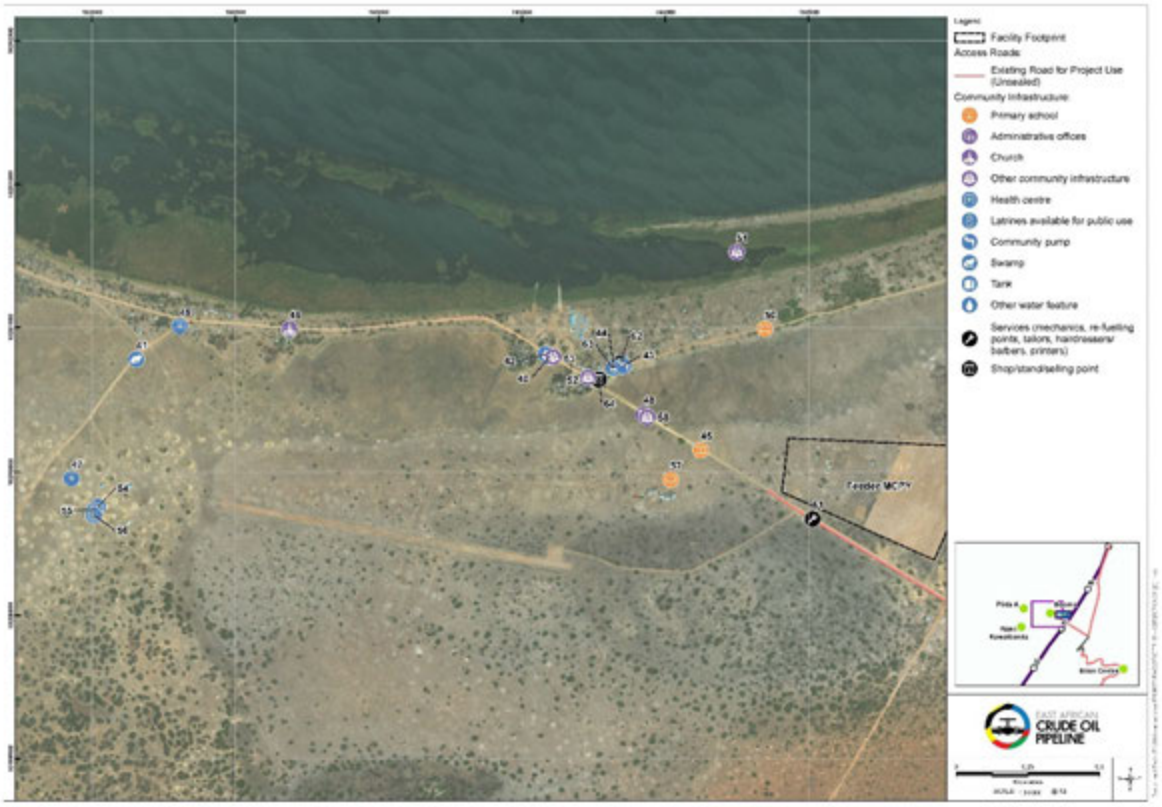
Land-based and water-based livelihood strategies:
The main kept livestock in the trading centre are cattle and goats. Crop farming is not present at all within the area as land is in short supply due to the many buildings constructed. Fishing is undertaken in Lake Albert and in one fish pond located in the trading centre. Firewood collection is common however charcoal is bought from neighbouring communities. There are also some beekeepers within the community.

Main aspirations for the future:
- Development of Biiso
- The town to become a agricultural trading centre (food processing, abattoir)
- Irrigation for the farms
- Modern health centre
- Tarmac road
- Tertiary education
- Tarmac road
- Market
- Health centre changed to hospital status
- Modern schools
- Ambulance
- More medicine for HIV/AIDS victims
- Women's equality

Timeline



Booma



PAC PROFILE BOOMA- COMMUNITY INFRASTRUCTURE

General

Administrative Offices:
- Offices in Booma parish and Piida parish

Community gathering place:
- Nyayo gardens, LC1's office

Churches/ Mosques:
- They have no specific local names for the worship places.
- There is Pentecostal Church of Uganda, Catholic, Church of Uganda, Baptist church.
- Butiaba Mosque

Electric lighting:
- There is electricity in the area and in particular yaka connection along the Trading Centre

Power cables:
- There are several small cables within the Trading Centre

Mobile phone antenna:
- There are 2 mobile antennas

Communal roads:
- Magali road which is a murram road.
- Several foot paths

General condition of roads within community:
- The roads are generally in poor condition

Level of traffic along main road:
- The traffic is minimal

Recent history of accidents:
- Low

Other:
- Few feeder roads

Education

Schools :
- Infant school and Else school
- Booma and Else primary schools
- Seed Secondary school.

Teachers' accommodation blocks:
- The accommodation blocks are only at Booma

Cultural Heritage

Place of worship:
- Nsonga cultural site where people go for traditional worship

Cemetery/ graveyard:
- The graveyards are homesteads

People mark graves by placing stones and bricks on the grave, and planting soonga trees around the burial ground.

Health

Dispensary:
- Butiaba dispensary

Health centre:
- Butiaba Health Centre II

Clinic:
- Various clinics in the area

River:
- River Waaki. This is characterised with poor hygiene, there are polythene bags and other waste littered around it

Lake :
- Lake Albert

Piped water from storage tanks:
- There is piped water. According to the community, the water is not treated

Public latrines:
- 1 public latrine, next to the Lake and Nyago gardens. It costs 300shs.

Communal washing areas :
- People normally wash from the Lake shores. Crocodile attacks are feared.

Commerce

Market :
- Butiaba market which has 3 days of active trading

Business:
- The shops are basically retail and wholesale. They operate on a daily basis.
- There are several bars.
- There is over drinking in this area.
- There are several food sellers though they operate in the night on a daily basis.
- There are several eating houses
- There are several lodges including Novel, Lunar B.K
- There are several saloons, tailors and a few mechanics

PAC PROFILE BOOMA- DESCRIPTION

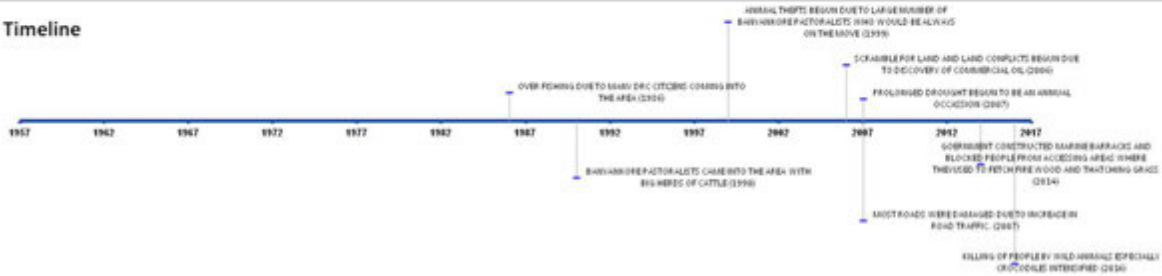
Principal land-based and water-based livelihood strategies

Booma is located in the subcounty of Butiaba within Buliisa district. The area is sparsely populated especially along the main road. Along the main road there are abandoned houses.

Land-based and water-based livelihood strategies:
Livestock keeping and crop farming are both undertaken in the village, with cattle goats and pigs being the main kept animals and cotton and maize being the most grown crops. Fishing is present in the village however, mainly of the methods used to fish are illegal. Hunting is not present within the village as a communal strategy was set up by the game park that rewarded the area with schools and other facilities in exchange for protecting the wildlife. This has also discouraged others from hunting in the area due to the fear of being caught. Firewood is collected in and around the village. Both sand and cowries shell mining take place at the lake shores though at low levels.

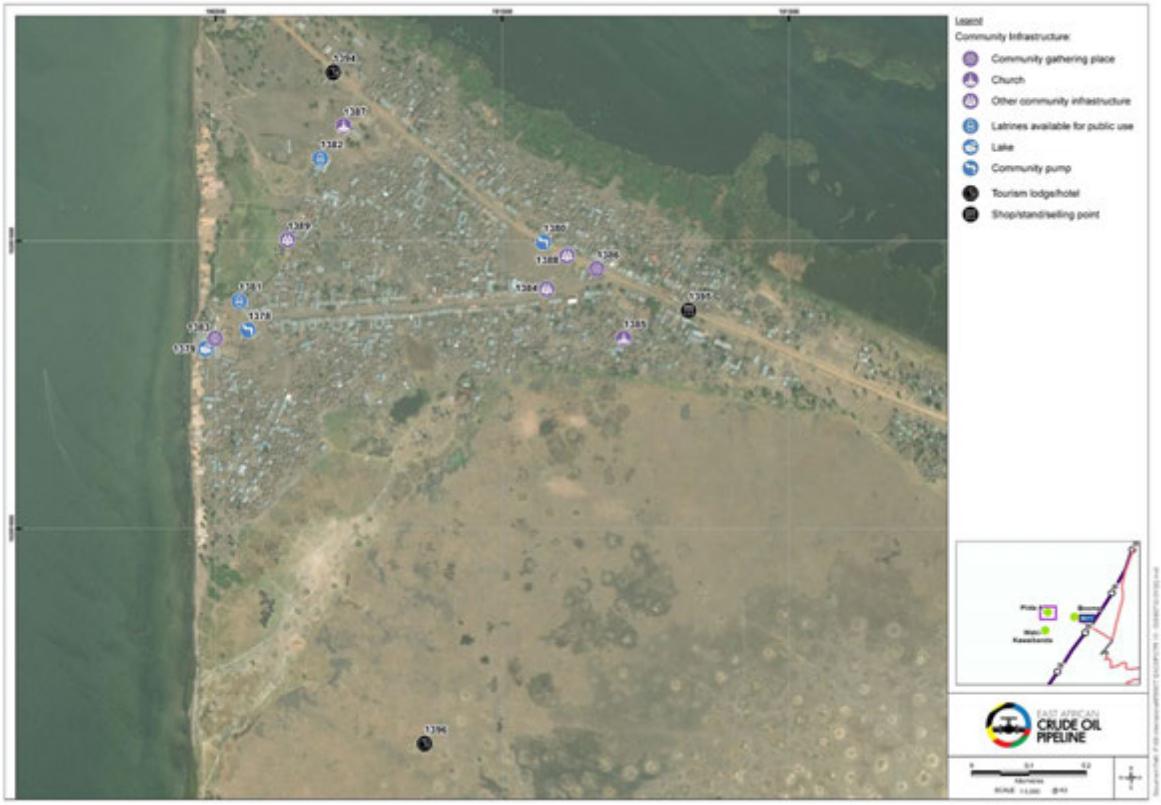
Main aspirations for the future:
- Employment opportunities for children
- Better social services infrastructure such as schools and hospitals
- School bursaries for children
- Support for women's groups
- Tarmac roads

Timeline



Piida A

PAC PROFILE PIIDA A -MAP



PAC PROFILE PIIDA A - COMMUNITY INFRASTRUCTURE

General

Administrative Offices:
- There are 2 including the LC1 and Beach
- Management Unit Office, which currently houses the fish cage association

Community gathering place:
- LC I offices
- Butiaba playground

Churches/ Mosques:
- They have no specific local names for the worship places.
- There is Pentecostal Church of Uganda, Catholic, Church of Uganda, Baptist Church.
- There is 1 mosque (Butiaba Mosque)

Electric lighting:
- There is electricity in the area

Power cables:
- There are several small cables within the Trading centre

Mobile phone antenna:
- There is 1 which hosts both MTN and Airtel network

Communal roads:
- 1 trunk earth road (Magali road) and several foot paths

General condition of roads within community:
- Motorable trunk roads

Level of traffic along main road:
- Medium mainly boda boda cyclists with a few vehicles

Recent history of accidents:
- No major accidents recorded in the previous 6 months

Education

Schools :
- Butiaba Infant school
- Butiaba Else Primary school
- Butiaba Infant school
- Booma Primary school
- Else Primary school
- Butiaba SEED Secondary school

Teachers' accommodation blocks:
- There are some teachers' houses at Booma Primary school

Cultural Heritage

Place of worship:
- Nsonga cultural site where people go for traditional worship

Cemetery/ graveyard:
- The graveyards are in homesteads

People mark graves by placing stones and bricks on the grave and planting soonga trees around the burial ground.

There are 2 traditional healers.

Health

Dispensary:
- Butiaba dispensary

Health centre:
- Butiaba Health Centre II

Clinic:
- 5 privately owned clinics

River:
- Waaki River

Marshes :
- At the edges of the Lake shores

Lake:
- Lake Albert

Community pumps:
- 1 borehole at Bugoigo Primary school

Piped water from storage tanks:
- There is piped water within the village that is supplied from Butiaba water gravity flow project though there are claims that the water is contaminated.

Public latrines:
- 1 public latrine next to the Lake and Nyago gardens

Communal washing areas:
- Washing areas are along the Lake shores.

Commerce

Market :
- Butiaba market which has 3 days of active trading

Business:
- There are retail and wholesale shops for general merchandise
- There are several alcohol selling places
- Daily food selling, especially in the morning and evening hours
- There are several food selling places
- There are several lodges including: Nouvel, Lunar B.K guest house
- There are several saloons, tailors and a few mechanics

PAC PROFILE PIIDA A - DESCRIPTION

Principal land-based and water-based livelihood strategies

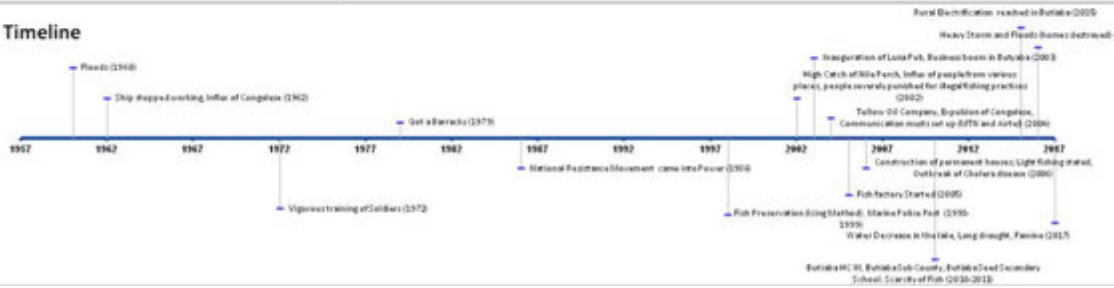
Piida A is located in the subcounty of Butiaba within Buliisa district. The village was previously a very busy trading centre until the landing site was moved. The village is densely populated within the trading centre and there are various ethnic tribes such as Bagungu, Alur, and Banyoro among others.

Land-based and water-based livelihood strategies:
The main livelihood is fishing for both commercial and subsistence purposes on Lake Albert. Main types of livestock keeping are cattle, goats and pigs, while crop farming and market gardening are not practised within the community. Firewood collected is common around the shrubs and sand and cowries shell mining are also present at the lake shore.

Main aspirations for the future:

- Fish factory
- Good health facilities
- Good schools
- Better road networks
- Street lights
- Legal entry of migrants
- Town council
- Markets
- Access to good social services
- Economic boom
- Operate big businesses
- Girls education
- Organised town

Timeline



Waki-Kawaibanda

PAC PROFILE WAKI-KAWAIBANDA -MAP

PAC PROFILE WAKI-KAWAIBANDA - COMMUNITY INFRASTRUCTURE

General

Community gathering place:
- Gatherings are done in the Centre in any of the houses. The hygiene of these places is worse it being a swampy area

Churches/ Mosques:
- Catholic, Protestant. These are all in bad condition.

Communal waste disposal:
- Butiaba- this is done along the shores of Lake Albert

General condition of roads within community:
- Kawaibanda has no roads within the community

Level of traffic along main road:
- Fairly good during dry seasons

Education

The children go to the next village to access education facilities.

Cultural Heritage

Cemetery/ graveyard:
- There are communal burial grounds and these are on a large scale

The symbols that represent graveyards in this area are hard-core stones.

Health

Health centre:
- Butiaba (HC III). This is in a fairly good state as response from the locals

River:
- Waaki River which connects to Lake Albert

Lake :
- Lake Albert

Communal washing areas:
- Washing is done at the shores of the Lake

Commerce

Market :
- Kawaibanda market. This sells only food stuffs and operates on a daily basis.

Business:
- There are some retail shops for general merchandise these are in a fairly good state.
- There are various alcohol selling points. The people of this area drink hours normally from 11am till the next morning as the order of the day.
- One house in the community that sells food. This is basically someone's house.

PAC PROFILE WAKI-KAWAIBANDA- DESCRIPTION

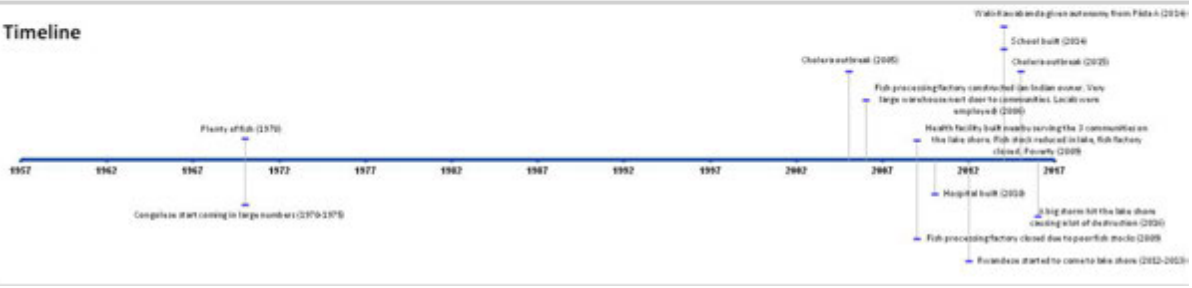
Principal land-based and water-based livelihood strategies

Waki-Kawaibanda is located in the subcounty of Butiaba within Buliisa district. The area is swampy and few activities take place. Within the village there is a lagoon. The village is named after the River Waki which flows into Lake Albert. The road to the village is not clear and in general the area of Kawaibanda is characterised to have poor sanitation.

Land-based and water-based livelihood strategies:
Livestock rearing of cattle and goats occurs in the village on a small scale. The main crop types farmed in the area are cotton, tobacco and trees. Fishing is practiced along the shores of Lake Albert with spear and net methods commonly used. There are also many illegal methods used when catching fish which is leading to the depletion of fish stock in the lake. Oranges are planted on a small scale. The collection of firewood is common, as is the use of solar power. Mining of cowries shells is also carried out along the shores of Lake Albert.

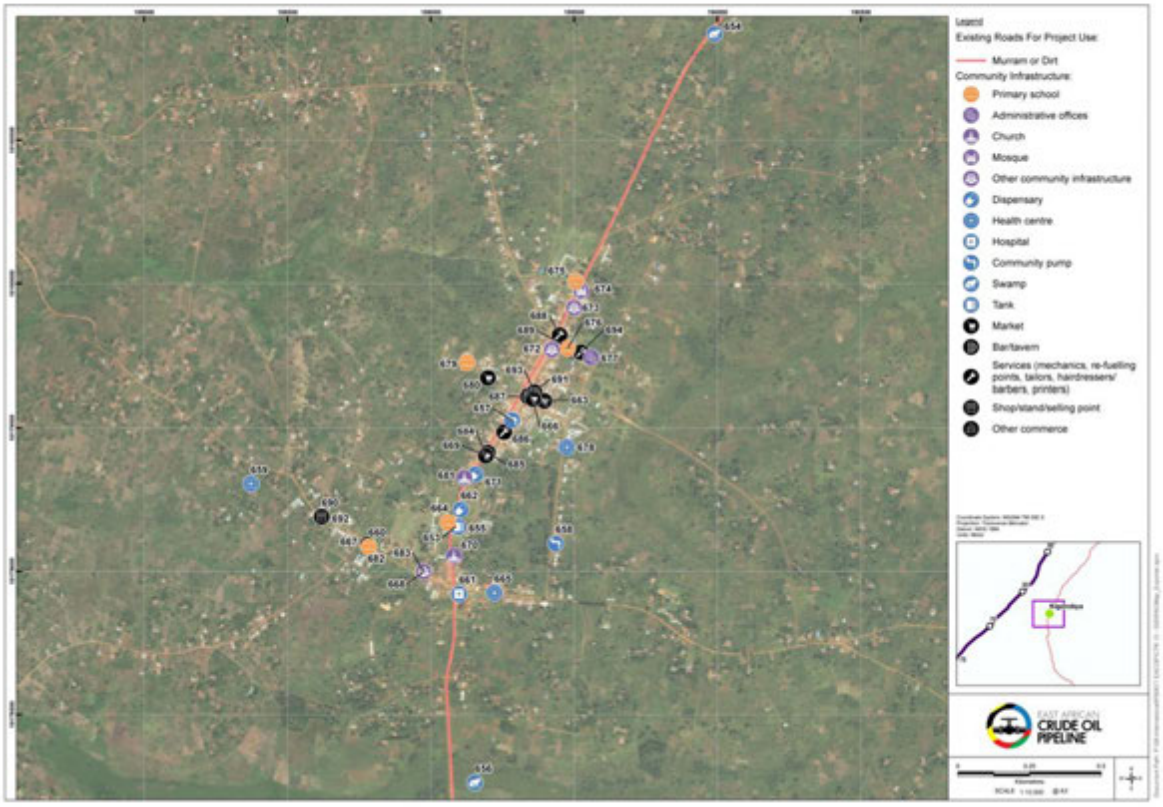
Main aspirations for the future:
- Water borehole
- Good roads
- Public latrines
- Better health facilities
- More fish
- Better fishing methods

Timeline



Kigorobya

PAC PROFILE KIGOROBYA -MAP



PAC PROFILE KIGOROBYA - COMMUNITY INFRASTRUCTURE

General

Administrative Offices:
- Kigorobya Subcounty offices
- Kigorobya Town Council offices

Community gathering place:
- Kigorobya Community hall and play ground

Churches/ Mosques:
- Kitana Catholic church and Kigorobya C.O.U
- Kigorobya Mosque

Electric lighting:
- There is hydro-electric power

Mobile phone antenna:
- 1 within the town

Communal roads:
- 1 trunk murram road (Hoima-Biiso Road)
- Several trunk earth roads including Kajura Road, Bisuha Road, Kikonkone Road, Rwanoiri Road
- Civic road and Reverend Tibenda Road.

General condition of roads within community:
- Poor

Level of traffic along main road:
- Medium

Recent history of accidents:
- Mainly as a result of boda boda cyclists

Education

Schools:
- St. Kizito Nursery school
- John Nursery school
- Sajabi Nursery school
- Kigorobya Nursery school
- God's Plan Nursery school
- St Ludovico's Primary school, Kitana
- Kigorobya Church of Uganda Primary school
- Kigorobya Muslim Primary school
- Highfield Primary school
- St. Thomas More Secondary school, Kitana
- Green Shoots Secondary school
- Kigorobya Public Secondary school
- Kigorobya Progressive Institute (tertiary)

Teachers' accommodation blocks:
- At St Ludovico's Primary school, Kitana and Kigorobya Church of Uganda Primary school

Cultural Heritage

Cemetery/ graveyard:
- Kigorobya C.O.U
- Kitana Catholic Church

People mark graves by placing concrete slabs, planting flowers and some trees.

Health

Dispensary:
- Kigorobya Dispensary

Health centre:
- Kigorobya Health Centre IV

Clinic:
- Approximately 10 private clinics

River:
- Nyabago River, Kacuuru River

Marshes:
- Papyrus along Nyabago River

Lake:
- Lake Albert

Community well:
- Several

Community pumps:
- 2

Piped water from storage tanks:
- There is 1 supplied by the sub county water project

Private boreholes:
- 1 at Green Shoots Secondary school

Public latrines:
- 3

Commerce

Market:
- Kigorobya Town market which operates on Saturday

Business:
- There are several shops both retail and wholesale
- There are several within the Town Council
- There are some along the road side.
- There are several eating places
- 5 lodges
- There are 3 re-fuelling points
- Several tailors
- 5 boda boda garages
- 4 grain mills

PAC PROFILE KIGOROBYA - DESCRIPTION

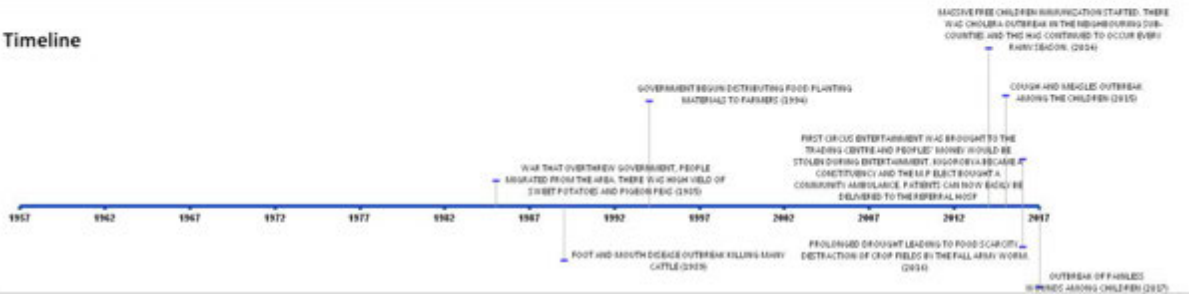
Principal land-based and water-based livelihood strategies

Kygorobya Town Council is located in the subcounty of Kigorobya TC within Hoima district. The town is situated along Biiso-Hoima road and is very busy. The town is characterised by a linear settlement along the road, comprising of mainly commercial buildings. There is piped water in the area and the most eye catching structure is Kitana Catholic church.

Land-based and water-based livelihood strategies:
Kigorobya Town Council borders Lake Albert, with several people involved in fishing. The main kept livestock in the area are cattle and goats and subsistence farming is undertaken. Market gardening is fairly practised in the area whilst hunting is no longer practised. There are a few in the town who have tree plantations. Charcoal is mainly bought from the neighbouring communities. Firewood collection is common within the bushy areas within the community. Salt mining and sand mining is conducted at Kibiro near to Lake Albert.

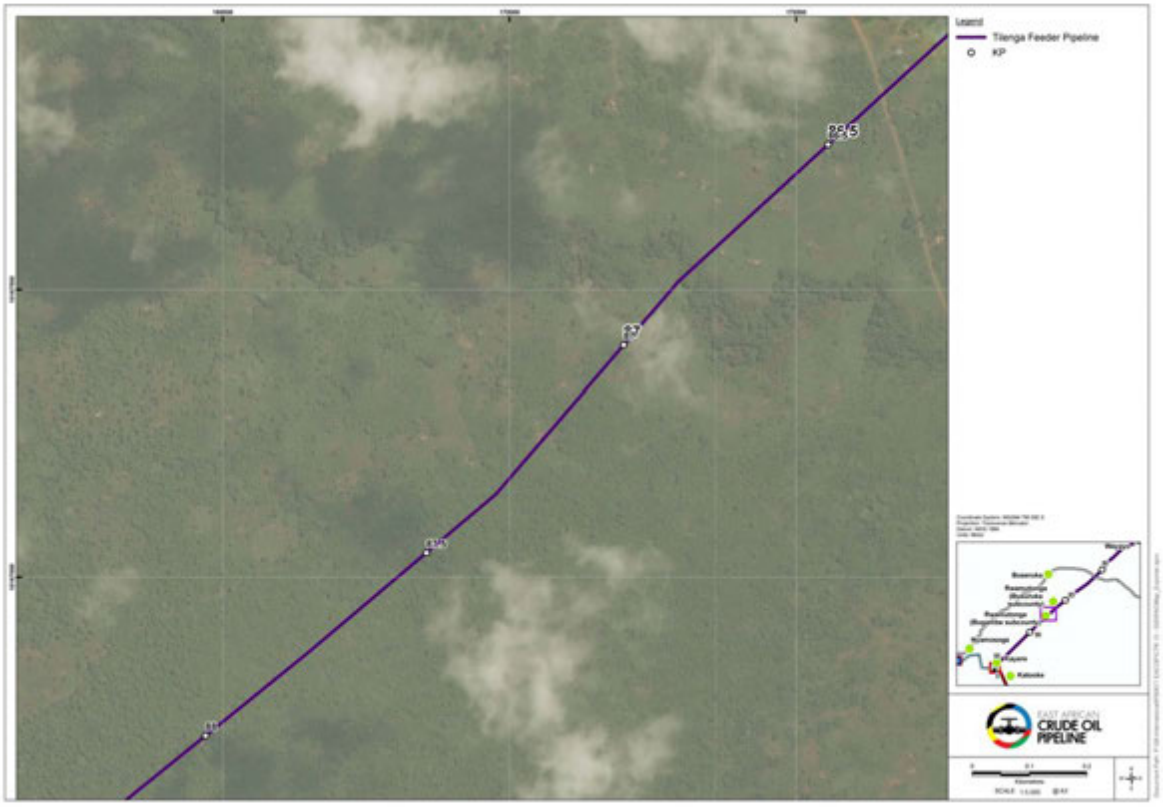
Main aspirations for the future:
- Street lighting
- Tarmac roads
- Evenly distributed electricity
- Safe piped water
- Functional hospital
- Upgrading of town to become municipality
- Market for products
- Health services
- NGO's supporting women

Timeline



Rwamutonga (Bugambe Subcounty)

PAC PROFILE RWAMUTONGA (BUGAMBE SUBCOUNTY)-MAP



PAC PROFILE RWAMUTONGA (BUGAMBE SUBCOUNTY)- COMMUNITY INFRASTRUCTURE

General

Administrative Offices:
- Subcounty offices.

Community gathering place:
- Kipenda centre
- At the market under a mango tree.

Churches/ Mosques:
- Rwamutonga Church of Uganda
- Rwamutonga Catholic Church
- Full Gospel Church.
- 1 mosque

Mobile phone antenna:
- Not in this village. The nearest is in Buseruka subcounty and Nyamulima village.

Communal road:
- Buseruka- Bugambe road (Rwamutonga). This is a fairly good murram road.

General condition of roads within community:
- Not good enough

Level of traffic along main road:
- Relatively minimal

Education

Schools :
- Wanainch Nursery and Primary school
- Ebeneza Nursery and Primary school
- Katanga Primary school
- Bugambe Secondary school

Cultural Heritage

Place of worship:
- In small houses, trees

Cemetery/ graveyard:
- Graves are within homesteads

Trees are planted around graveyards and graves are marked with cement.

Health

Health centre:
- The nearby is at the subcounty and it is HC III. There is 1 at the tea plantation.

Clinic:
- 3 clinics in Rwamutonga village

River:
- Rwamutonga River
- Wambabya River
- Luzira River

Marshes:
- Luzira River

Community well :
- More than 8 community wells, including: Vungale well, Lionale well, Darlison shallow well, Mungu biconi well.

Private boreholes:
- There are 2 and found in Rwamutonga centre and Vungale village.

Communal washing areas:
- Along river banks

Commerce

Market :
- 1 at the Trading Centre which operates on a daily basis.
- Rwamutonga market which operates only on Saturday.

Business:
- Restaurants: 3
- Bars: 20
- Lodges: 2
- Carpentry: 3

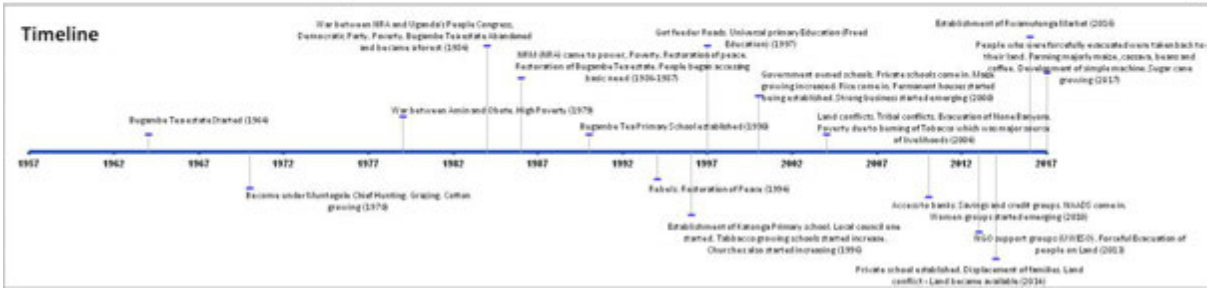
PAC PROFILE RWAMUTONGA (BURGAMBE SUBCOUNTY) - DESCRIPTION

Principal land-based and water-based livelihood strategies

Rwamutonga is located in the subcounty of Bugambe within Hoima district. The village is a densely populated area especially at Kipenda trading centre, characterised with various economic activities. Different infrastructures are present including roads, schools and hotels among others.

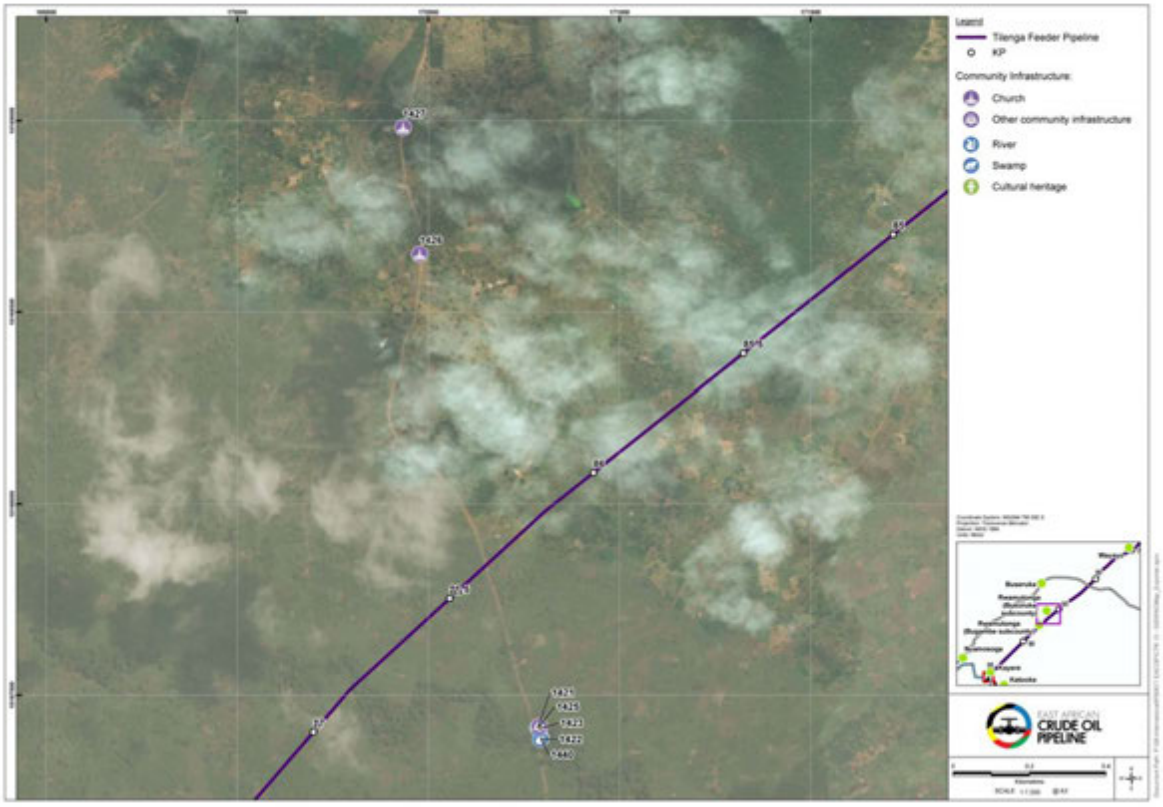
Land-based and water-based livelihood strategies:
Livestock keeping is undertaken in the village with cattle, goats, pigs and sheep present. Poultry is also kept in various homesteads. The area has very fertile soil which allows crop farming to be present. The main types of crops grown are maize, cassava, groundnuts, sweet potatoes, vegetables and beans. Fishing is also undertaken in the village at local ponds and the hunting of squirrels is present but on a low scale. There are several plantations in the community which contain jack fruits, sweet bananas, oranges and mangoes. Most people in Rwamutonga use firewood as well as other forms of electricity. Sand mining is also present and there are 2 beehives used for both commercial and subsistence purposes.

Main aspirations for the future:
- Having a more civilised society, which is well educated and informed
- Infrastructure development
- Improved access to social services like schools and health facilities
- Modernisation of agriculture
- Urbanisation in local village
- Factories
- Adult education
- Better roads
- New employment opportunities
- Upgrading to parish level
- More water services
- Electricity



Rwamutonga (Buseruka Subcounty)

PAC PROFILE RWAMUTONGA (BUSERUKA SUBCOUNTY) -MAP



PAC PROFILE RWAMUTONGA (BUSERUKA SUBCOUNTY) - COMMUNITY INFRASTRCTURE

General

Administrative Offices:
- Subcounty offices.

Community gathering place:
- Kipenda centre
- At the market under a mango tree.

Churches/ Mosques:
- Rwamutonga Church of Uganda
- Rwamutonga Catholic Church
- Full Gospel Church.
- 1 mosque

Mobile phone antenna:
- Not in this village. The nearest is in Buseruka subcounty and Nyamulima village.

Communal road:
- Buseruka- Bugambe road (Rwamutonga). This is a fairly good murram road.

General condition of roads within community:
- Not good enough

Level of traffic along main road:
- Relatively minimal

Education

Schools :
- Wanainch Nursery and Primary school
- Ebeneza Nursery and Primary school
- Wanainch Primary school
- Katanga Primary school
- Bugambe Secondary school

Cultural Heritage

Place of worship:
- In small houses, trees

Cemetery/ graveyard:
- Graves are within homesteads

Trees are planted around graveyards and graves are marked with cement.

Health

Health centre:
- The nearest is at the subcounty and it is HC III. There is 1 at the tea plantation.

Clinic:
- 3 clinics in Rwamutonga village

River:
- Rwamutonga River
- Wambabya River
- Luzira River

Marshes:
- Luzira River

Community well :
- More than 8 community wells, including Vungale well, Lionale well, Daelison shallow well, Mungu biconi well.

Private boreholes:
- 2, 1 in Rwamutonga centre and 1 in Vungale village.

Communal washing areas:
- Along river banks

Commerce

Market :
- 1 at the Trading centre, which operates on a daily basis.
- Rwamutonga market which operates only on Saturday.

Business:
- Restaurants: 3
- Bars: 20
- Lodges: 2
- Carpentry: 3

PAC PROFILE RWAMUTONGA (BUSERUKA SUBCOUNTY) - DESCRIPTION

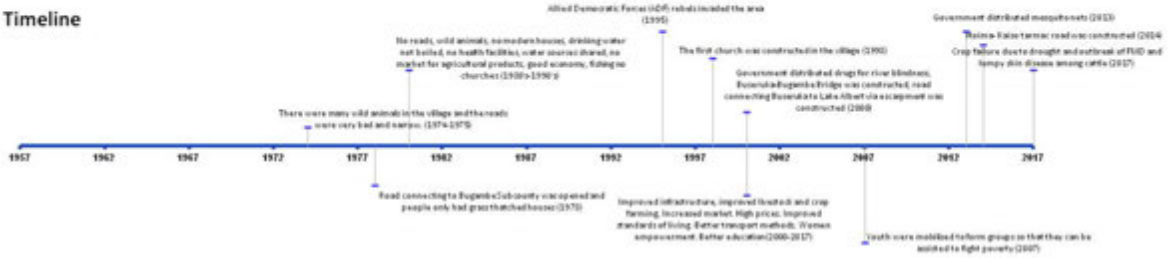
Principal land-based and water-based livelihood strategies

Rwamutonga is located in the subcounty of Buseruka within Hoima district. The village is sparsely populated and there is no common trading centre. House types comprise of both semi-permanent and permanent houses.

Land-based and water-based livelihood strategies:
The main activity in the village is agriculture for both subsistence and commercial purposes and livestock rearing. The main kept livestock includes cattle, goats, pigs and sheep present. Poultry is also kept in various homesteads. The main types of crops grown are maize, cassava, groundnuts, sweet potatoes, vegetables and beans. There are several plantations in the community which contain jack fruits, sweet bananas, oranges and mangoes. Fishing is also undertaken in the village at local ponds and the hunting of squirrels is practiced on a low scale. Firewood collection is common in the community. Sand mining is also present and beehives are used for both commercial and subsistence purposes.

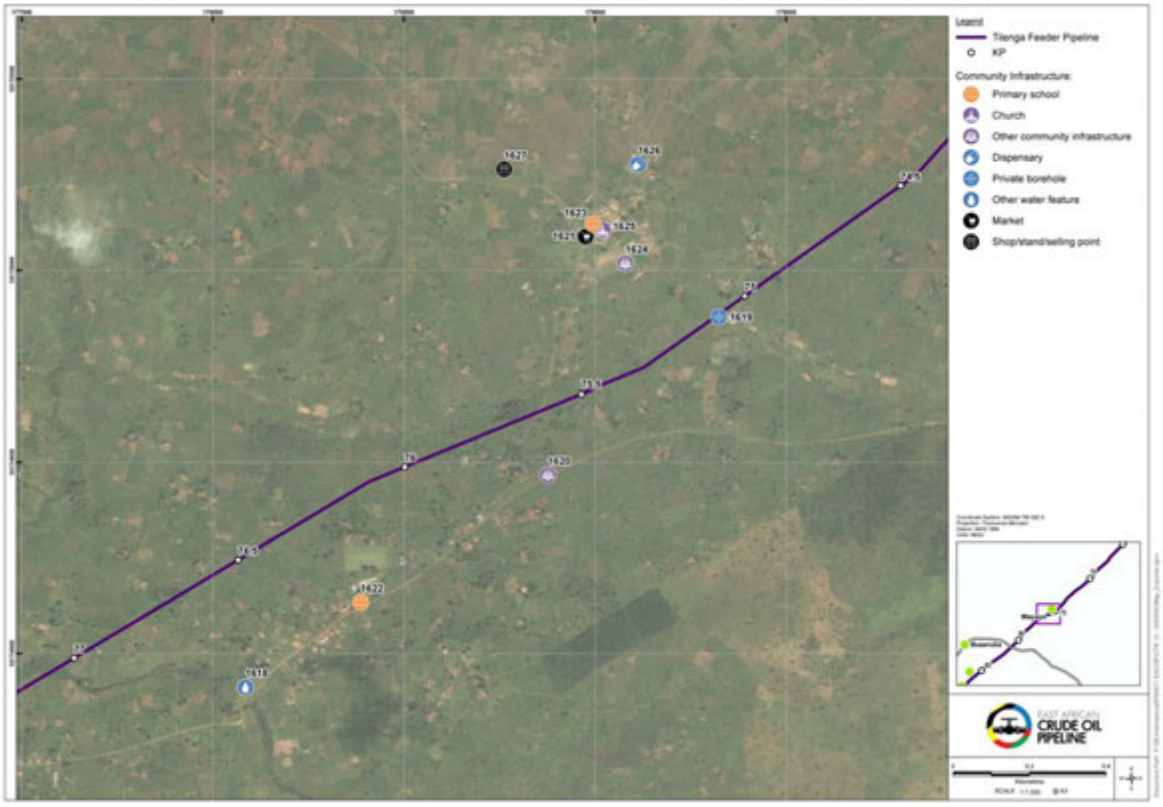
Main aspirations for the future:
- Construction of Health centres
- Women support organisations
- Employing women on the pipeline project
- Constructing for us a market here in our village
- Get electricity
- Motor able feeder roads
- Distribution of tree seedlings
- Portable water
- Micro-finance institutions
- Primary, secondary, technical and adult schools

Timeline



Wayoyo

PAC PROFILE WAYOYO -MAP



PAC PROFILE WAYOYO - COMMUNITY INFRASTRUCTURE

General

Community gathering place:
- Under a backcloth tree

Churches/ Mosques:
- Pentecostal Alleluia Church

Communal road:
- Buhirigi – Hanga road: a murram road

General condition of roads within community:
- Poor condition

Level of traffic along main road:
- Average

Recent history of accidents:
- Motor accident, a young kid sustained a fracture of the foot after being knocked by a motorcyclist.

Education

Schools :
- Pre-school and primary school
- Private school.

Cultural Heritage

Graves are marked by heaped soil.

Health

Dispensary:
- 2 drug stores

River:
- 1 seasonal stream - Nyakasandara

Community well :
- 4

Community pumps:
- 1 in place provided by Uganda Redcross Society

Commerce

Business:
- Bars: 1
- Trading shops: 3
- Barber shop: 1
- Drug store: 2

PAC PROFILE WAYOYO IN BUHIRIGI- DESCRIPTION

Principal land-based and water-based livelihood strategies

Wayayo in Buhirigi is located in the subcounty of Kigorobya within Hoima district. The village is characterised of sparse population and a scattered settlement. The area has limited infrastructure, especially in terms of access to roads, no health centres and no electricity.

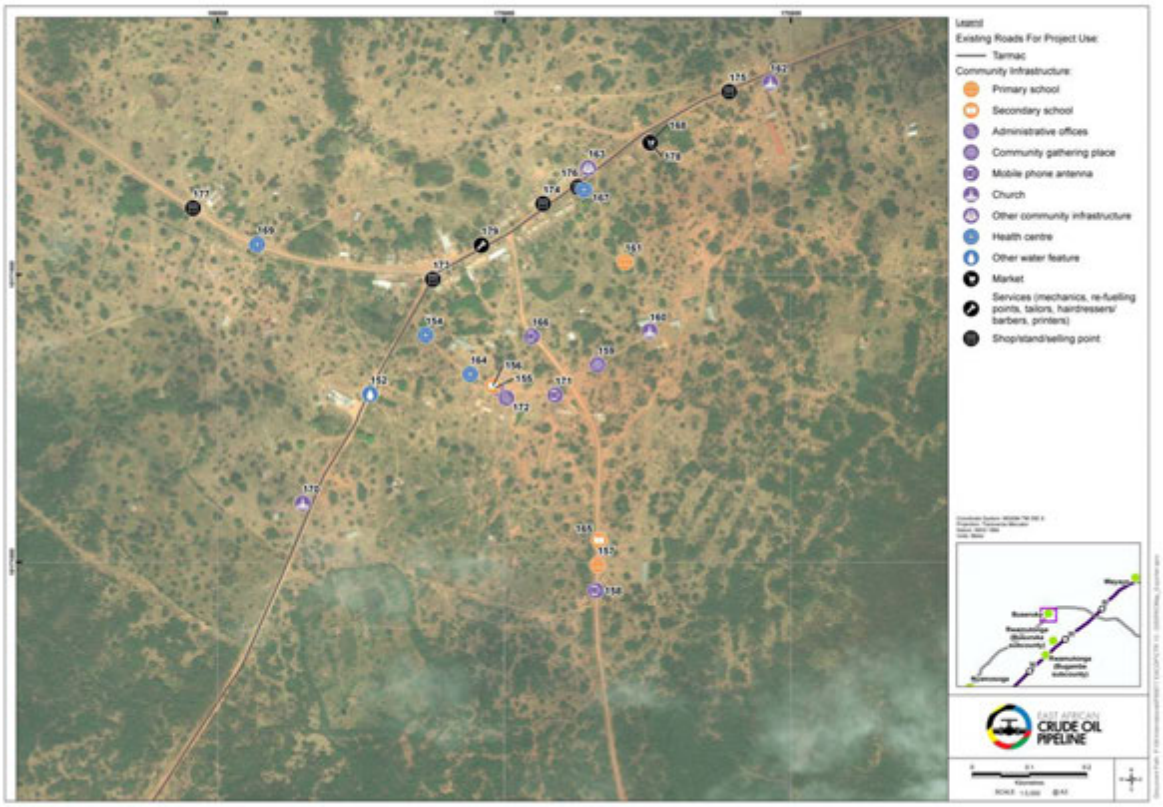
Land-based and water-based livelihood strategies:
Livestock keeping is undertaken in the village with some goats, sheep, pigs and chicken being reared. Crop farming is present with cassava, cotton, maize, bananas, beans, tobacco, sweet potatoes, sugarcane, groundnuts, simsims and tomatoes being just some of the produce grown. Fishing is also present though on a small scale and located outside of the village. There is also some small scale hunting for subsistence purposes including animals such as squirrels and wild rats. Plantations are located within the village with the plating of oranges, mangoes, jackfruits and avocados present. Beekeeping, grass cutting for thatching houses and firewood collection is also undertaken in the village.

Main aspirations for the future:
- Village health centre/hospital
- Clean water
- Good roads (tarmac)
- Public schools (not just private)
- A market place
- A clinic of their own

Timeline

Buseruka

PAC PROFILE BUSERUKA -MAP



PAC PROFILE BUSERUKA - COMMUNITY INFRASTRUCTURE

General

Administrative Offices:
- Buseruka Subcounty offices
- Uganda Prisons Buseruka Offices

Community gathering place:
- The subcounty main hall
- Buseruka Market area
- Buseruka boda boda stage

Churches/ Mosques:
- Buseruka Church of Uganda
- Buseruka Catholic Church
- Buseruka Church of God

Electric lighting:
- Several homesteads are connected to Hydro electricity power with other households using solar panels

Power cables:
- There are several power cables

Mobile phone antenna:
- 2 antennas

Communal roads:
- 1 tarmac road (Kaiso-Tonya Road)
- 2 trunk murram roads and several footpaths

General condition of roads within community:
- The tarmac road is very good.
- The trunk murram and earth roads are in poor state.

Level of traffic along main road:
- High rates of accidents especially along the Kaiso-Tonya Road, which is a highway with many motorists speeding

Recent history of accidents:
- There are several accidents including fatal ones this year especially along Kaiso-Tonya road, which passes through the middle of Buseruka Trading Centre

Education

Schools:
- Glorious Nursery school
- Devine Nursery and Primary school
- Buseruka Nursery and Primary school
- Lakeside Nursery and Primary school
- Buseruka Secondary school

Teachers' accommodation blocks:
- Some at Buseruka Primary and Buseruka Secondary schools

Cultural Heritage

Cemetery/ graveyard:
- There are no graveyards, burial is done at household level

Graves are marked by placing down concrete, planting flowers and heaping soil.

Health

Health centre:
- Buseruka Health Centre III

Clinic:
- 6 privately owned clinics

River:
- Wambabya River

Marshes:
- Papyrus on some sections of Wambabya River

Lake:
- None within the trading centre but the sub county borders Lake Albert

Piped water from storage tanks:
- Water harvest tanks at the Health Centre

Communal washing areas:
- Along the river banks of Wambabya River

Commerce

Market:
- Buseruka Market along Kaiso-Tonya Highway

Business:
- There are several shops especially along the roads dealing in retail and whole sale general merchandise
- There are 6 bars
- There are few road side food sellers
- 7 eating places
- 2 lodges
- 1 re-fuelling point (Kabagambe Station),
- Several tailors
- 5 saloons
- 2 stationary shops

PAC PROFILE BUSERUKA - DESCRIPTION

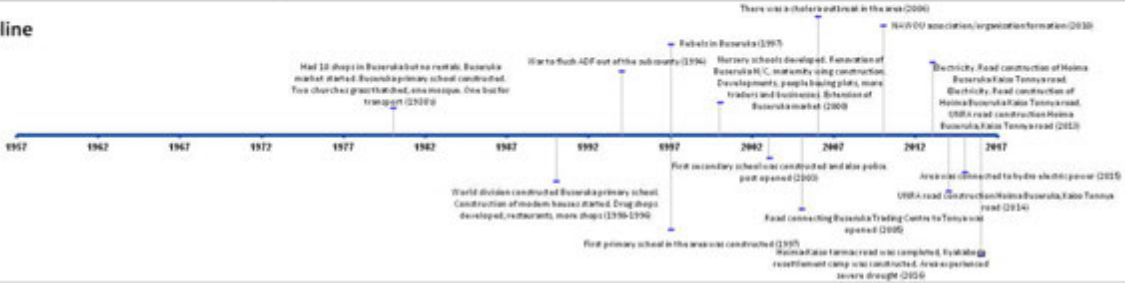
Principal land-based and water-based livelihood strategies

Buseruka Trading Centre is located in the subcounty of Buseruka within Hoima district. The trading centre is located along the busy Kaiso-Tonya road. It is characterised by many shops along the road and it is also the main hub within the subcounty due to its facilities; It has a health centre, a secondary school and the subcounty offices are located there.

Land-based and water-based livelihood strategies:
Subsistence and commercial farming are present within the trading area. The main crops grown include cassava, maize simsim, beans, bananas and sweet potatoes. Kept livestock include cattle, sheep and goats. Poultry is also kept for commercial purposes. Market gardening is also undertaken although on small scale. Fishing occurs on Lake Albert and hunting is also present but on a small scale. Several people engage in charcoal production especially in areas with shrubs. Firewood collection is common in the area.

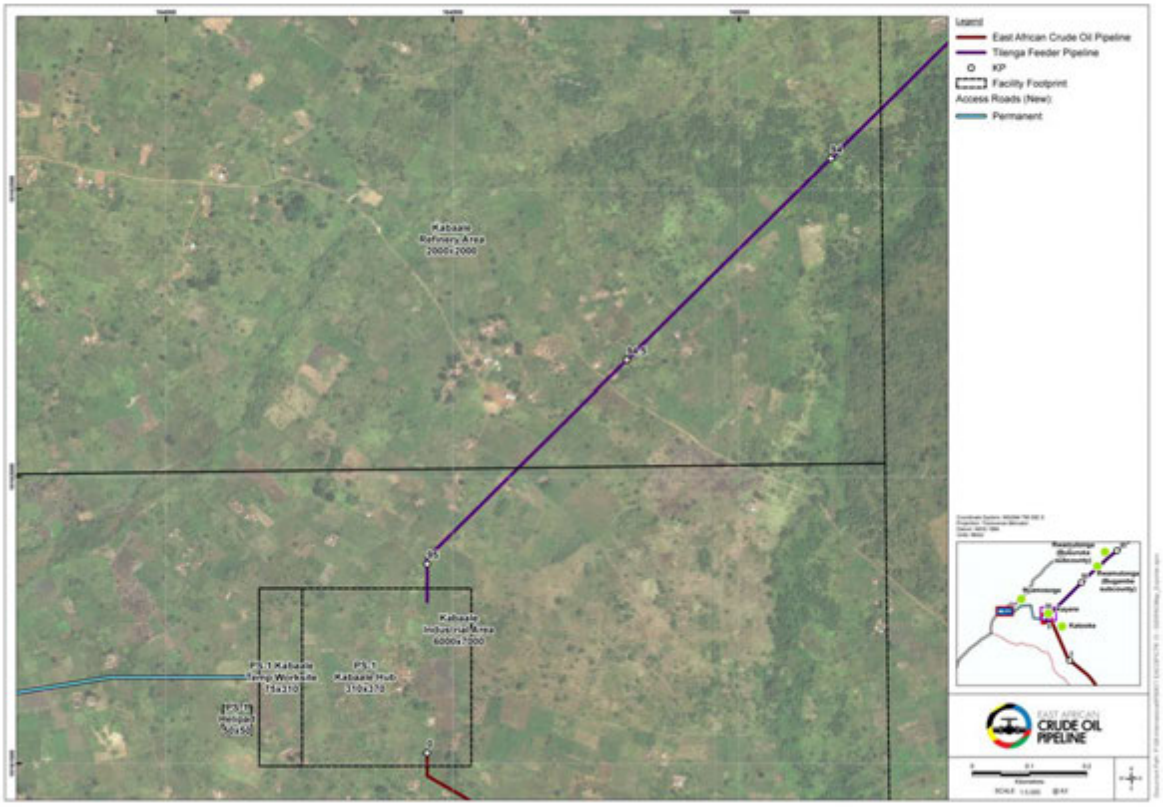
Main aspirations for the future:
- Better water facilities like tap water, boreholes
- Increase security
- Technical and vocational schools
- Support of women
- Sensitizations and trainings
- Employment for children
- Secondary school

Timeline



Kayere

PAC PROFILE KAYERE -MAP



PAC PROFILE KAYERE - COMMUNITY INFRASTRUCTURE

General

Administrative offices:
- At the chairman's house

Community gathering place:
- At Kayere Catholic Church

Churches/ Mosques:
- Kayere Catholic Church: a semi-permanent structure constructed with mud walls

Communal roads:
- Nyamasoga – Kayere road, a murram road

General condition of roads within community:
- Poor road condition

Level of traffic along main road:
- Average

Recent history of accidents:
- Yes, accidents involving motorcyclists claimed numerous lives shortly after road construction.

Education

Cultural Heritage

Graves are marked with heaped soil.

Health

River:
- Wambabya River located North East of the village

Community pumps:
- 2 in place, one located in the Naome Koojo's farm and but currently not functioning for a period of seven years. The other is located on the refinery land, but also not functioning.

Commerce

Business:
- Very few trading shops

PAC PROFILE KAYERE - DESCRIPTION

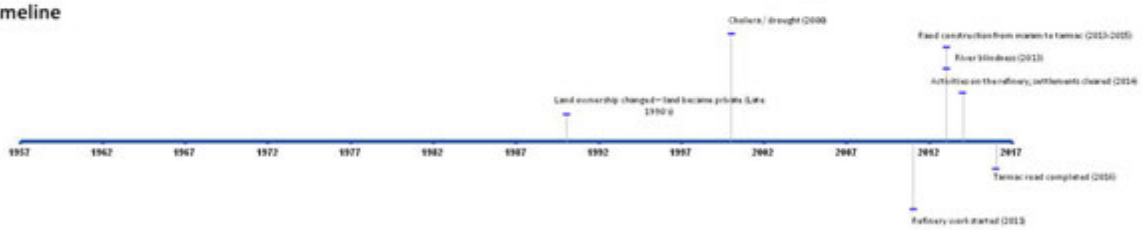
Principal land-based and water-based livelihood strategies

Kayere is located in the subcounty of Buseruka within Hoima district. The occupants of the village were resettled to other villages after the government acquired land for the establishment of the refinery. The area was observed to have scattered seasonal structures for shelters. The area is characterised with thickets and abandoned banana gardens.

Land-based and water-based livelihood strategies:
The majority of livestock reared within the community are goats, cattle, sheep, pigs and chickens. Crop farming is also present with a variety of different crops grown including cassava, cotton, maize, bananas, beans, tobacco, sweet potatoes, groundnuts and others. Hunting occurs on a small scale for subsistence purposes with animals such as squirrels and edible rats being the targets. Tree plantations are present in the area with the planting of oranges, pineapples, mangoes and avocados amongst others. A small proportion of the village depends on charcoal burning. The gathering of natural resources including beekeeping, grass cutting for thatched houses and firewood collection are all present within the community.

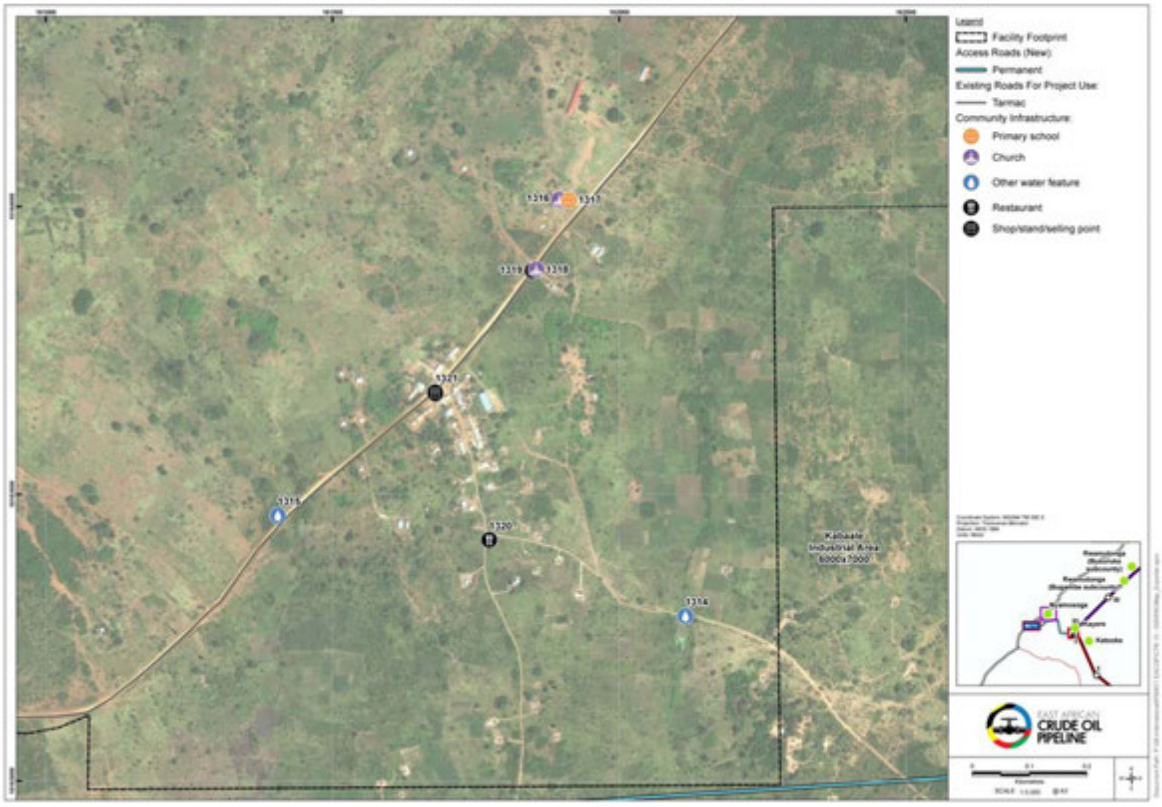
Main aspirations for the future:
- Clean water
- Good quality school so children are safe walking to school
- Health centre
- Better roads to community

Timeline



Nyamasoga

PAC PROFILE NYAMASOGA -MAP



PAC PROFILE NYAMASOGA - COMMUNITY INFRASTRUCTURE

General

Community gathering place:
- Under a mango tree

Churches/ Mosques:
- Catholic and protestant church

Electric lighting within community centre:
- Yes

Power cables:
- Yes

Communal roads:
- Refinery road (murram road). Good condition
- Buserukia road (tarmac).

General condition of roads within community:
- Good but dusty

Level of traffic along main road:
- Average

Recent history of accidents:
- Motorcycle accident, due to over speeding, over loading, poor mechanical conditions of motorcycle.

Education

Schools:
- 1 private nursery
- Nyamasoga Primary school

Cultural Heritage

Cemetery/ graveyard:
- Based at household level

Graves are marked by cement and heaped soil.

Health

Dispensary:
- 2 drug shops

Clinic:
- 1 clinic

Community well:
- Akkiidi

Community pumps:
- Yes but not working

Communal washing areas:
- Yes, Akkiidi

Commerce

Market:
- 1 market

Business:
- Shops
- Bars
- Street food seller
- Restaurants
- Barbers/ hair saloons
- Mechanic
- Tailors
- Pharmacy: 2
- Guesthouses
- Lodges

PAC PROFILE NYAMASOGA - DESCRIPTION

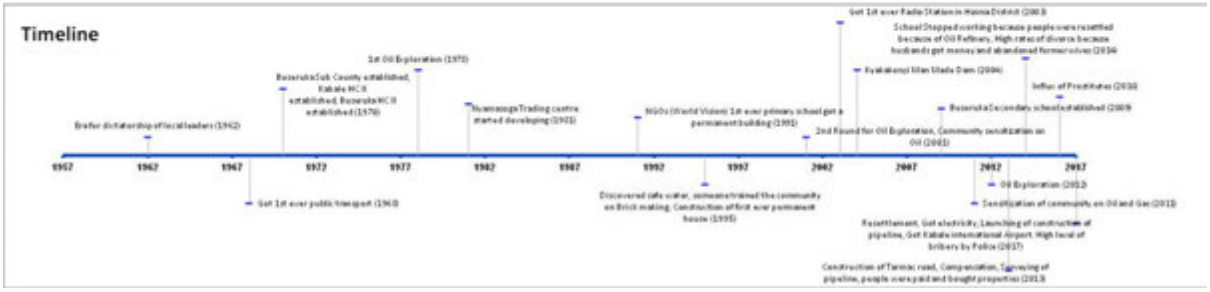
Principal land-based and water-based livelihood strategies

Nyamasoga is located in the subcounty of Buseruka within Hoima district.

Land-based and water-based livelihood strategies:
The main kept livestock in the village are goats, sheep, pigs, chickens and cows. Crop farming is present and the main crop types are cassava, cotton, maize, bananas, beans, tobacco, sweet potatoes, sugarcane, groundnuts, simsims, tomatoes and onions. Oranges, mangoes, jackfruits, avocados and eucalyptus are all grown in tree plantations. Charcoal burning and production is undertaken in the community, as is beekeeping.

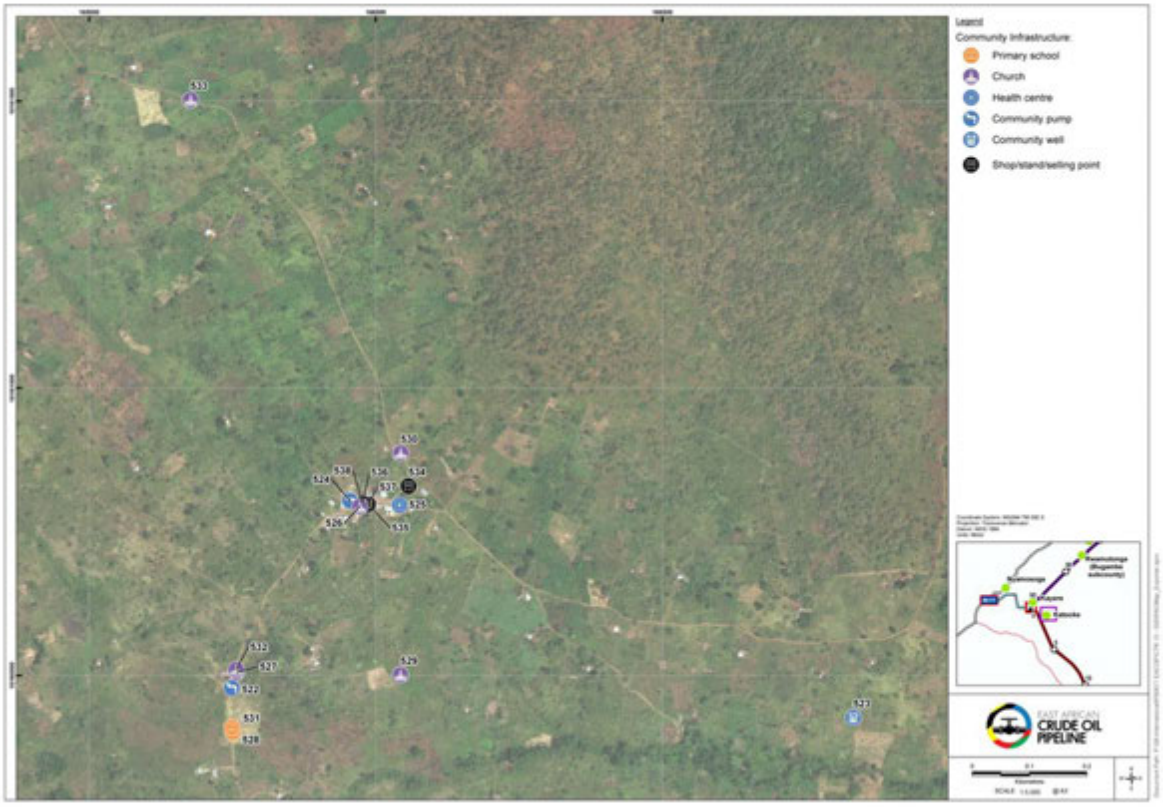
Main aspirations for the future:
- Economic development
- Improved access to education
- Access top good and clean water
- Organised community

Timeline



Katooke

PAC PROFILE KATOOKE -MAP



PAC PROFILE KATOOKE - COMMUNITY INFRASTRUCTURE

General

Community gathering place:
- Katooke Church of Uganda
- Katooke Trading Centre

Churches/ Mosques:
- Katooke Church of Uganda
- Katooke Catholic Church
- Christ the way Cchurch

Electric lighting within community centre :
- Use of solar panels

Communal road:
- Several trunk earth roads

General condition of roads within community:
- Poor condition

Level of traffic along main road:
- Medium, mainly comprising of boda boda cyclists

Recent history of accidents:
- Mainly involving boda boda cyclists

Education

Schools:
- Katooke parents Nursery school
- Katooke Primary school

Cultural Heritage

Place of worship:
- 2 shrines within the village on Katooke hill

Cemetery/graveyard:
- Burial is done at homesteads

Graves are marked by placing concrete, planting flowers and heaping soil.

Health

Clinic:
- 3 private clinics

River:
- Wambabya River

Marshes:
- Papyrus along sections of the river

Community well:
- 1 protected well
- 3 shallow wells

Community pumps:
- 1 borehole

Other:
- Odong stream

Commerce

Market :
- Katooke Market

Business:
- Hair saloons: 4
- Carpentry: 1
- Shops: 7
- Transport (Taxis/ motorcycles): 4
- Produce buying: 4
- Fresh food: 8
- Restaurants: 3
- Milk vending: 2
- Milling machine: 3
- Bars:10
- Butchers: 3
- Cinema: 2
- Clinics: 3
- Tailors: 4

PAC PROFILE KATOOKE - DESCRIPTION

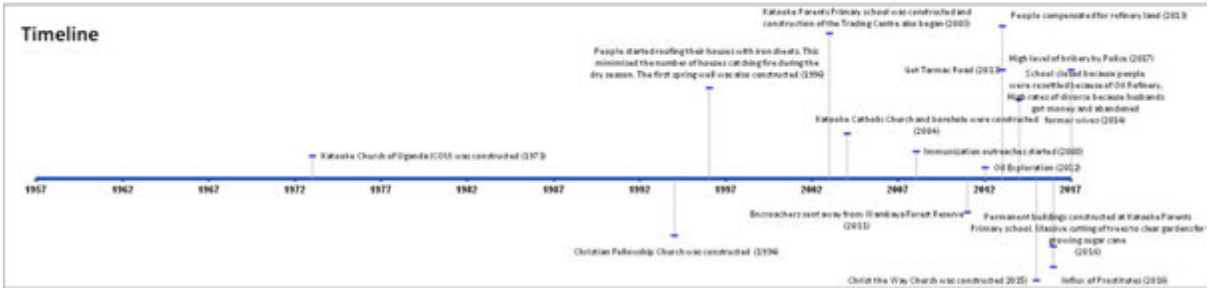
Principal land-based and water-based livelihood strategies

Katooke is located in the subcounty of Buseruka within Hoima district. The village is characterised with scattered settlements away from the trading centre and the population is sparse.

Land-based and water-based livelihood strategies:
The main economic activity within Katooke is agriculture. Crop farming is present for both subsistence and commercial purposes. Crops grown include cassava, maize, tobacco, beans, simsim, bananas, cotton and sweet potatoes. Sugarcane is grown for commercial purposes and is sold to Hoima Sugar Factory located in Kiziramfumbi subcounty. Fishing is present on a low scale in the community fish pond. Many people within the village are involved in hunting. Firewood collection is common, several people are engaged in charcoal production and lumbering is also practiced. Sand mining is also present, as is beekeeping although on a very small scale.

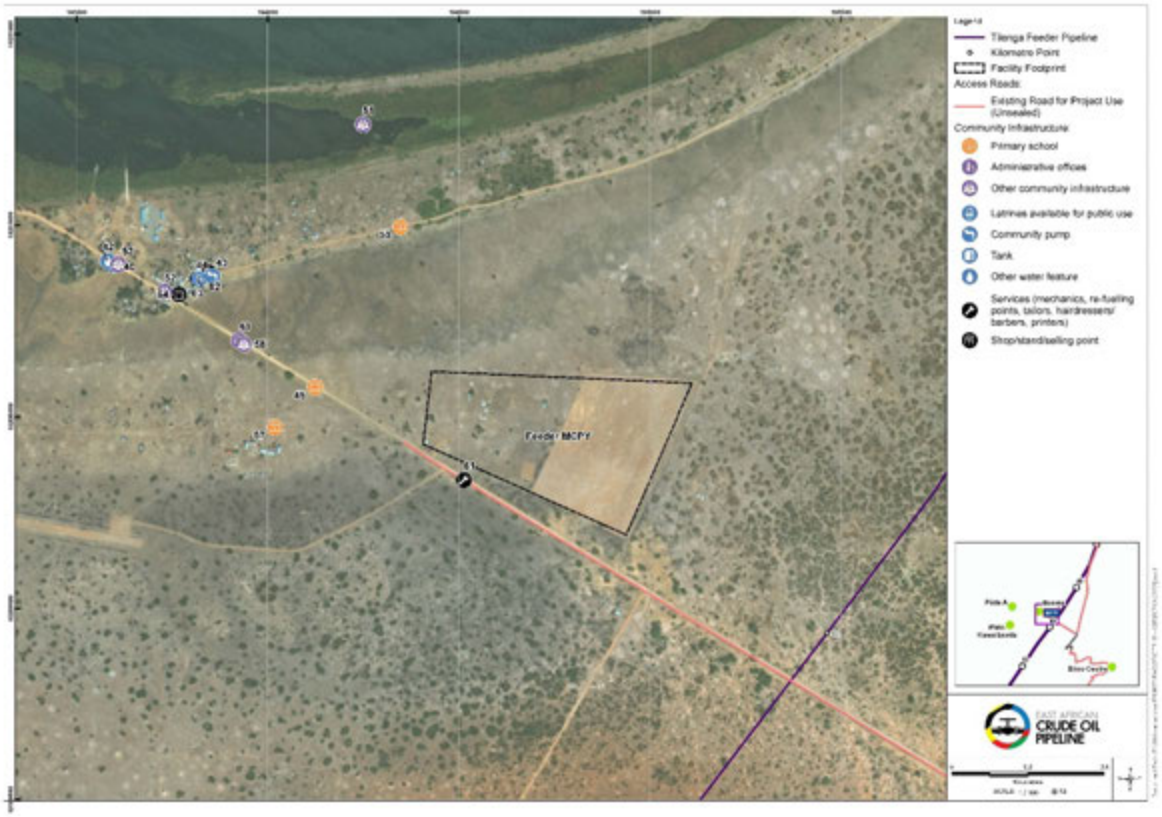
Main aspirations for the future:
- Turn Katooke into a city
- Build a hospital
- Construction of more primary schools, secondary schools, vocational schools
- Bring electricity
- Market construction
- Construction of industries
- Tap water
- Good, motor able roads
- Better security

Timeline



Site Profile

MCPY Feeder



ATTACHMENT A9.3 DATA COLLECTION TOOLS

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT COMMUNITY DEVELOPMENT OFFICER (DCDO)			
Name of district/sub county		**Date of the interview:**	
Name of interviewer		**Sample site/point:**	
Name(s) of the interviewee(s)			
SECTION 1 - INFORMATION ABOUT CDO TEAM/SUPPORT STAFF AND NETWORK			
Q1-1. How long have you, personally, been working in this area?			
Q1-2. Do you have a team that works under/with you? If so, how many people do you have working with you?			
Q1-3. What qualifications do you look for when employing team members?			
Q1-4. What resources do you have at your disposal (vehicles, meeting places)?			
Q1-5. How regularly do you hold meetings, both in-team meetings and meetings with the communities that you serve?			
Q1-6. Who do you report directly to, and how often?			
SECTION 2 – INFORMATION ABOUT AREA OF INFLUENCE/RESPONSIBILITY			
Q2-1. How many villages/towns do you cover? Which ones, specifically?			
SECTION 3 – INFORMATION ABOUT HUMAN RIGHTS ISSUES			
Q3-1. What have the human rights issues been over the past 10 years?			
Q3-2. Has there been an increase or a decrease in human rights issues more recently?			
Q3-3. What are the conflicts in this area (ethnic, farmers versus livestock keepers, land conflicts)?			
SECTION 4 - INFORMATION ABOUT NEEDS			
Q4-1. What are the most pressing needs of the areas in which you work?			
Q4-2. Are the needs led by any specific category of social deprivation/disadvantage (economics/poverty, education levels, cultural marginalization, geographic inaccessibility, mental health)?			
SECTION 5 – INFORMATION ABOUT COMMUNITY ASSETS			

Q5-1. What particular assets do you think the villages/towns in which you work have, or what particular assets do the communities/people have, that should be drawn upon in reaching development goals?	
Q5-2. Is there anything that distinguishes the identity of this community/area that we should know about?	
SECTION 6 – INFORMATION ABOUT DOMESTIC VIOLENCE (AND OTHER SOCIAL ISSUES)	
Q6-1. What is the incidence of domestic violence in this area?	
Q6-2. Is there any village/town that has a higher incidence than others?	
Q6-3. Do you have a door-to-door domestic violence education programme? If not, how else do you address the matter?	
Q6-4. Are there safe houses, or another support system for victims (women, children, men)?	
Q6-5. What other social-ills or inappropriate behaviours do you encounter?	
Q6-6. How are these factored into your work and programmes?	
SECTION 7 – INFORMATION ABOUT WOMEN AND CHILDREN	
Q7-1. Are there specific women-only interest groups/business organizations etc?	
Q7-2. What roles do women play in development projects?	
Q7-3. Could we discuss projects focused on early childhood development, and on other child and youth issues?	
Q7-4. Has gender-based violence been an area of focus for you?	
Q7-5. Has gender-based violence increased/decreased over the past few years? If so, please explain why.	
SECTION 8 – INFORMATION ABOUT NGOS	
Q8-1. Please could we discuss the most locally-active NGOs in the district/sub county?	
Q8-2. What do the NGOs focus on mainly (i.e. agriculture, women, children, HIV/AIDs, vulnerable groups, mental illness)?	
SECTION 9 – INFORMATION ABOUT ORGANISATIONS/GROUPS	

Q9-1. Please can you provide us with a list of the community organizations in this area that you're involved with managing/engaging with/building capacity with?	
Q9-2. What other organizations/groups do you work with (i.e. Ugandan ministries, police, social workers, teachers, small credit/finance institutions)?	
Q9-3. Do you have tight links to the Vision 2040 goals?	
SECTION 10 – INFORMATION ABOUT DEVELOPMENT ASPIRATIONS	
Q10-1. How do you plan and budget for future development aspirations?	
Q10-2. Where do the financial resources come from?	
Q10-3. Where do the human resources come from?	
Q10-4. What opportunities do you see for development in this area?	
Q10-5. What are your most critical projects at the moment?	
SECTION 11 – INFORMATION ABOUT PROJECT PERCEPTIONS	
Q11-1. What do you see as the potential positive impacts of this project?	
Q11-2. What do you see as the potential negative impacts of this project?	
Q11-3. Are you aware of people's perceptions in this area, of this project? Please elaborate.	

TILENGA FEEDER & EACOP PIPELINE
KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT ECONOMIST

Name of district/sub county		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s):			

SECTION 1 - INFORMATION ABOUT EMPLOYMENT AND ECONOMIC OPPORTUNITIES

Q1-1. What type of employment opportunities exist in the district/sub county/affected communities? Please indicate:
- **The number of people engaged in these economic activities**
- **The average wage for each activity**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Employment opportunity	Number of people engaged	Average wage
Teaching		
Nursing		
Law enforcement		
Administration		
Other *(please indicate)*		
Other *(please indicate)*		
Other *(please indicate)*		

Q1-2. In the past five years, has the number of employment opportunities increased, decreased or remained the same? Please elaborate on your answer.	☐ Increased ☐ Decreased ☐ No Change
Q1-3. What opportunities are there for existing and new businesses in the district/sub county?	
Q1-4. Are businesses in the district/sub county formally registered?	☐ Yes ☐ No
Q1-4-1. If so, through what entity/ organization or committee?	
Q1-5. Are disabled people considered for job opportunities? Please elaborate on your answer and indicate if there are any laws or regulations in place with regards to employment for disabled people.	☐ Yes ☐ No
Q1-6. In your view what role do women play in local business and industry? Please describe the areas in which they are represented and which not?	
Q1-7. What are the key challenges relating to employment in the district/sub county?	
Q1-8. What are the potential negative impacts on or challenges for businesses by the proposed project?	
Q1-9. What would be the best way to mitigate such negative impacts on businesses or enhance existing employment opportunities or positive impacts in the area?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT/SUB-COUNTY LAND EXPERT			
Name of district/sub county		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
SECTION 1 - INFORMATION ABOUT LAND			
Q1-1. Are there any cadastral maps available for the villages in the district/sub county?	☐ Yes ☐ No		
Q1-2. What are the land tenure categories (personal and communal) applicable to land in the district/sub county?			
Q1-3. If decisions need to be made relating to communal land (village land or land used by pastoralists), who makes those decisions?			
Q1-4. Are the boundaries between pastoralist and farming land well known to the local communities (farmers and pastoralists)?			
Q1-5. What kind of occupancy rights exist and are used in the district/sub county?			
Q1-6. What rights do women in the district/sub county have in terms of land ownership and inheritance?			
Q1-7. What is the range and average landholding of the subsistence farmers in the district/sub county?			
Q1-8. What type of land disputes have occurred in the district/sub county?			
Q1-9. Are there currently land disputes in the district/sub county?	☐ Yes ☐ No		
Q1-9-1. If so, what mechanism is being used to resolve them?			
Q1-10. Who is the regulatory/decision-making authority responsible for land use, planning and management?			

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT ENVIRONMENTAL OFFICER			
Name of district		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)		**Position of the interviewee(s)**	
SECTION 1 - INFORMATION ABOUT ENVIRONMENTAL MATTERS IN THE DISTRICT			
Q1-1. What are the key environmental concerns in the district?			
Q1-2. What interventions are being made to address these concerns?			
Q1-3. How much of an emphasis is placed on community consultation when developing environmental interventions and measures?			
Q1-4. There have been many discussions around water resources and climate change and one intervention seems to entail planting trees. Please explain this process.			
Q1-5. What are the notable achievements in addressing environmental issues in the district?			
Q1-6. Do environmental concerns tend to be overshadowed by livelihood and agricultural concerns? Please explain your answer.			
Q1-7. Do people recognise the importance of sustainable land use? Please explain your answer.			
Q1-8. Are environmental issues incorporated into the local school curriculum?	☐ Yes ☐ No		
Q1-9. Does the district work with agricultural extension officers to identify environmental issues?	☐ Yes ☐ No		

TILENGA FEEDER & EACOP PIPELINE
KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT NATURAL RESOURCE OFFICER

Name of district		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)		**Position of the interviewee(s)**	

SECTION 1 - INFORMATION ABOUT NATURAL RESOURCES IN THE DISTRICT

Q1-1. Do people consume bush meat in the district?	☐ Yes ☐ No	
Q1-1-1. If so, what type of bush meat and how much bush meat is consumed?	Bush meat consumed	Amount of bush meat consumed
Q1-2. How much, if any, bush meat is sold and for what price?		

Q1-3. What are the strategies for hunting/catching, storing/preserving, cooking and trading bush meat?	Hunting/catching	Storing/preservation	Cooking	Trading

Q1-4. What are people's legal rights with regards to hunting?	
Q1-5. What are the key constraints faced by hunters in the district?	
Q1-6. Are any of the animals hunted classed as endangered species?	☐ Yes ☐ No
Q1-7. Who is the regulatory/decision-making authority responsible for local fauna in the district?	

SECTION 2 – SPECIFIC INFORMATION ABOUT MINING

Q2-1. Are there artisanal mining activities in the district? If so, please indicate: • **The number of sites** • **Where these are located** (use map if possible) • **What is being mined (i.e. gold, salt, kaolin)** • **The approximate number of miners per site** • **Problems related to sites** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Site	Location	Minerals Mined	Number of Miners	Problems at Site

Q2-2. Please describe the mining practices in the district as far as possible (i.e. methods used, equipment used, seasonality and supply chain).	
Q2-3. What are the typical incomes of artisanal miners?	
Q2-4. What are the key challenges faced by artisanal miners?	
Q2-5. What are the key social challenges faced by communities living in close proximity to large scale mining operations?	
Q2-6. Has there been an influx of people searching for resources in the district?	
Q2-7. Who is the regulatory/decision-making authority responsible for artisanal mining?	

TILENGA FEEDER & EACOP PIPELINE
KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT/SUB-COUNTY AGRICULTURE EXPERT

Name of district/sub county		**Date of the interview:**	
Name of interviewer			
Name(s) of the interviewee(s):			

SECTION 1 - INFORMATION ABOUT AGRICULTURE

Q1-1. What are the main crops grown in the district/sub county/affected communities (including vegetables, fruit and trees)? For each crop, please indicate:
- **Average yield/ha**
- **Cost of production**
- **Sale price per kg or ton**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Crop	Average yield/ha	Cost of production	Sale price per kg/ton

Q1-2. Please describe the seasonal calendar for agricultural crops in the district/sub county (including planting, growing and harvesting).
(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Crop	Planting months	Growing months	Harvesting months

Q1-3. What is the proportion of subsistence farmers to commercial farmers in the district/sub county? Please elaborate on your answer and indicate if there are pockets of commercial farmers.

Subsistence farmers: % Commercial farmers: %

Q1-4. Please describe the agricultural practices used in the district/sub county (i.e. use of machinery, pesticides, division of labour, fertilizer).

Q1-4-1. Please describe any changes in these agricultural practices in the past 5 years, if any.

Q1-5. Please describe the agricultural supply chain. Where are the main crops sold? And to whom (individual costumers, main buyers etc)?

Crop	Sold where	Sold to whom

Q1-6. How important is farming for livelihoods in the district/sub county/ affected communities? Please elaborate on your answer.

Q1-7. What are the key challenges relating to farming (including natural calamities such as droughts and floods) in the district/sub county/affected communities?

Q1-8. Are agricultural services available to farmers? Please can you elaborate and discuss if the situation is the same for farmers with a permanent crop, farmers that use semi-permanent/rotational crop practices?

☐ Yes ☐ No

Q1-9. What would be the best way to enhance or support agricultural production in the area?	
Q1-10. Are there any programmes being developed by the district/sub county to encourage production? Please elaborate on your answer.	☐ Yes ☐ No
Q1-11. Who is the key regulatory/decision-making authority responsible for agriculture?	
Q1-12. Are any prices (for certain crops) regulated by the government? Please elaborate on your answer.	☐ Yes ☐ No
Q1-13. If land is bought and sold in the district/sub county, what determines the price of land?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR LIVESTOCK EXPERT			
Name of district/sub county		**Date of the interview:**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• Veterinary • District /sub county livestock officer		
SECTION 1 - INFORMATION ABOUT LIVESTOCK			
Q1-1. What are the main livestock species in the district/sub county? For each species, please indicate: • **The typical selling price of the specimen** • **The cost of production per specimen** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Livestock species	Selling price per specimen	Cost of production per specimen
Q1-2. What is the proportion of subsistence livestock rearing to commercial livestock rearing to nomadic livestock rearing in the district/sub county?	Subsistence rearing: % Commercial rearing: % Nomadic rearing: %		
Q1-3. What are the common diseases and parasites for different livestock species in the district/sub county and when was the last serious epidemic? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Livestock species	Common diseases/parasites	Last serious epidemic (year)
Q1-4. What was the incidence of livestock injuries in the district/sub county over the past year.			
Q1-5. Please describe the movement/migration of livestock within the district/sub county. Please provide any maps to illustrate this, if available.*(if not use own map or draw map)*			
Q1-6. Have migration routes changed over the past 5 years?	☐ Yes ☐ No		
Q1-6-1. If so, please explain the reasons behind these changes.			
Q1-7. What is the importance of livestock movement/migration for pastoralists in the district/sub county?			
Q1-8. What is the importance of livestock to local livelihoods in the district/sub county?			
Q1-9. What is the availability of veterinary services in the district/sub county? Please indicate where they are located *(show on map)*			
Q1-9-1. What is their level of utilisation? Are they used regularly or not? Please elaborate on your response.			
Q1-10. Is livestock theft a problem in the district/sub county? Please elaborate on your answer.	☐ Yes ☐ No		

Q1-10-1. If so, has the manner and incidence of livestock theft changed in the past 5 years?	
Q1-11. What would be the best way to enhance or support livestock production in the district/sub county?	
Q1-12. Who represents the interests of pastoralists?	
Q1-13. Has the prevalence of nomadic livestock rearing increased, decreased or remained the same in the past 5 years?	☐ Increased ☐ Decreased ☐ No Change
Q1-13-1. Please indicate the reasons behind this change, if any.	

TILENGA FEEDER & EACOP PIPELINE
KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT/SUB-COUNTY FISHERIES EXPERT

Name of district/sub county		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			

SECTION 1 – GENERAL INFORMATION ABOUT FISHING

Q1-1. Do people fish in the district/sub county?	☐ Yes ☐ No			
Q1-1-1. If so, what type of fishing takes place?	☐ Commercial ☐ Subsistence ☐ Both			
Q1-1-2. If so, please indicate: • **The fish species caught** • **Where fishing takes place (i.e. lakes, rivers, estuaries, coasts, ponds, mangroves)** • **The typical market prices per kg of each fish species** • **Any changes in fish stocks during the past 10 years (i.e. an increase, decrease or no change)**	Fish species	Where caught	Market price per kg	Change in stock in past 10 years
Q1-2. Do seasonal changes affect fishing activities in the district/sub county?				
Q1-3. How many households are involved in commercial fishing and in subsistence fishing in the district/sub county?				
Q1-4. Are the commercial fishermen worse or better off, in terms of socio-economic status, relative to households with other livelihoods such as farming and keeping livestock etc? Please discuss.	☐ Worse off ☐ Better off ☐ No difference			
Q1-5. Do fishermen migrate in search of fish or do they have permanent sites? Please elaborate on your answer and discuss for river, sea and lakes.	☐ Migrate ☐ Have permanent sites ☐ Both			
Q1-6. Is access to fishing landing sites (i.e. lakes, rivers) easy or difficult? Please elaborate.				
Q1-7. Are fishermen able to use these sites freely or are there certain rules to abide by?				

SECTION 2 - INFORMATION ABOUT FISHING VESSELS AND EQUIPMENT

Q2-1. What type of fishing vessels are used? Please list in priority order and for rivers, sea and lakes.	1. 2. 3. 4. 5.
Q2-2. For sea fishing, is there any dynamite fishing, beach seine or coral mining?	☐ Yes ☐ No
Q2-2-1. If so, please elaborate.	

Q2-3. Is there intertidal gleaning?	☐ Yes ☐ No
Q2-3-1. If so, who is involved (i.e. men, women, children)?	
Q2-3-2. If so, what is being caught?	
Q2-4. Which gear catches more than others?	
Q2-5. Do people tend to own fishing gear or do they borrow or rent it from somebody else?	☐ Own ☐ Borrow/rent ☐ Both
Q2-6. Is the fishing gear expensive to buy/borrow/rent?	☐ Yes ☐ No
Q2-7. Is some equipment more effective than other equipment in terms of fish catch?	
SECTION 3 - INFORMATION ABOUT COMMERCIAL FISHING	
Q3-1. Where are fish products sold?	
Q3-2. How are fish products transported to market?	
Q3-3. Does fishing generate a satisfactory income?	
Q3-4. How important is fishing in comparison to other livelihoods in the area (i.e. mining, pastoralism)?	☐ Very important ☐ Quite important ☐ Not very important ☐ Not important at all
Q3-5. Over the past 5 years, has the importance of fishing increased, decreased or remained the same relative to other livelihoods?	☐ Increased ☐ Decreased ☐ No change
SECTION 4 – INFORMATION ABOUT CHALLENGES FOR FISHERMEN	
Q4-1. Are there any legal requirements related to fishing? For example, is a permit needed in order to fish?	
Q4-2. Are there any illegal fishing activities in the district/sub county?	
Q4-2-1. If so, what is the scale of illegal fishing compared to legal fishing?	
Q4-3. What key challenges do fishermen face in relation to their work?	
Q4-4. Have there been many accidents involving fishermen in the area? If so, what caused them?	
Q4-5. What would be the best way to enhance or support fisheries in the area?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR BUNYORO-KITARA AND BUGANDA KINGDOM REPRESENTATIVES			
Name of district		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)		**Position of the interviewee(s)**	
SECTION 1 – GENERAL INFORMATION			
Q1-1. How do you feel your roles and responsibilities should be incorporated into the consultation process for this project?			
Q1-2. In the past five years, has your role changed in society?	☐ Yes ☐ No		
Q1-2-1. If so, how has it changed?			
Q1-3. What is the process of land allocation in the area?			
Q1-4. What is the current situation regarding land availability in the area?			
Q1-5. Are there any specific livelihoods attached to each cultural identity which need to be specifically acknowledged, itemised and protected during the EACOP project?			
Q1-6. What are the key cultural heritage sites in the area (i.e. churches, burial grounds, holy trees)?			
Q1-6-1. How often are these sites used? And by whom?			
Q1-7. Who is the regulatory/decision-making authority responsible for the management of cultural heritage and archaeology in the area?			

TILENGA FEEDER & EACOP PIPELINE
KEY INFORMANT INTERVIEW GUIDE FOR DISTRICT/SUBCOUNTY TOURISM AUTHORITY

Name of district/sub county		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			

SECTION 1 - INFORMATION ABOUT TOURISM

Q1-1. Please list the main tourist attractions in the district/sub county (both natural and man-made sites). For each attraction, please indicate:
- **What the attraction is**
- **Where it is located** *(show on map)*
- **Whether it depends on landscape views**
- **What type of tourists it attracts (i.e. national, international)**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Name of attraction	Location	Dependent on landscape views (y/n)	Type of tourists attracted (national/international)

Q1-2. In the past ten years has tourism increased, decreased or remained the same in the district/sub county?

☐ Tourism has increased ☐ Tourism has decreased ☐ No Change

Q1-2-1. Please explain the reasons behind this change, if any.

Q1-3. Please describe the main tourism facilities (i.e. hotels/lodges, restaurants/eating places, game reserves, museums) in the district/sub county. For each facility, please indicate:
- **Where it is located (** *please show on map*)
- **What services it provides**
- **What tourists it receives**
- **What condition it is in**
- **How many people it employs**
- **How well it is used**
- **What its revenue is**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)
Note we are not including local hotels

Name of facility	Location	Services provided	Tourists received (national/international)	Condition (excellent/good/poor)	Number of people employed	Usage (occupancy rate, visitor numbers)	Revenue generated

Q1-4. How do tourists move around the district/sub county? For example, what modes of transportation are used? *(Note: please tick all relevant boxes)*	☐ Car rental ☐ Tour bus ☐ Public taxi ☐ Private taxi ☐ Public bus ☐ Other *(please indicate)*
Q1-4-1. Are these transportation means considered safe to use? Please elaborate on your answer.	☐ Yes ☐ No
Q1-5. Is there any community involvement in tourism in the district/sub county (i.e. provision of services, cultural entertainment)? Please elaborate	
Q1-6. What key challenges are faced by tourism attractions and facilities in the district/sub county?	

Health Impact Assessment
East Africa Crude Oil Pipeline
Questionnaire for District Clinical Health/ Programme Managers

SHAPE has been appointed to undertake a health impact assessment for the East Africa Crude Oil Pipeline (EACOP) or 'project'. As part of this assessment it is important to understand the prevailing health conditions in communities that may potentially be affected by the project. Further to this, it is equally important to understand why these health conditions are important and what factors influence them. We would be most grateful if you could assist us in completing this questionnaire in as much detail as you can, as well as sharing data and other related information with us. This evidence will assist us to understand the specific context and develop management measures to avoid or reduce future negative impacts. As mentioned in other communications, SHAPE, nor the Project seeks to usurp the role of providing public health services, and has the objective of engaging with the District health departments in assessing risks and proposed management measures to avoid or minimise any negative impacts, and to enhance potential benefits, associated with the Project.

The questionnaire has different sections and as relevant, or if the person is available, it would be beneficial if each clinical or programme head can complete the section that is relevant to them.

We will either collect this questionnaire during our next visit, but you are welcome to complete it and email the copy to:

- Dr Milka Owuor: mowuor@shapeconsulting.org
- Dr Izak Olivier: iolivier@shapeconsulting.org

If you have any questions or comments please don't hesitate to contact us on the email addresses above.

Please can each person that completes a section of this questionnaire place their name, role/function and contact details in the table provided below.

Name of Respondent	Role/function of respondent	Contact details
		Tel: Email:
		Tel: Email:
		Tel: Email:
		Tel: Email:
		Tel: Email:
		Tel: Email:
		Tel: Email:
		Tel: Email:
		Tel:

		Email:

1. Health Profile of District/ Sub County or Potentially Affected Communities

Topic	Response
What are the main health challenges in the district, sub County that will be influenced by the proposed Project?	
Are these health challenges similar in our areas of the district (or other/similar geographical area), or are there unique patterns in other areas? *Please expand as relevant*	
What health challenges are the most urgent to address, and what plans or programmes are in place to consider these? *Note that questions relating to a number of topics are posed later, so you can refer to these sections as relevant.*	
Why are these the main health challenges and what influences them? *Please list for each health challenge or factors that cross cut into more than one area* *Note that questions relating to a number of topics are posed later, so you can refer to these sections as relevant.*	
Are there significant social challenges or factors that influence general well-being or health in the district (or other/similar geographical area)? *Items to consider:* • *Cultural factors or practices.* • *Health seeking behaviours.* • *Refugees or internally displaced people.* • *Focussed migration patterns*	

Topic	Response
to areas or emergence of make-shift settlement. • *Areas of severe poverty* • *Education* • *Employment* • *Substance abuse* • *Transactional sex* • *Suicide and mental health* • *Small scale mining* • *Behaviours/Lifestyle*	
Have other industrial development projects affected health and well-being in the district/sub County. If yes how?	*If any negative effects, in your opinion could anything have been done to anticipate these or manage them. If so, what?*
Has there been a change in burden of disease in the past 5 years?	*If so what new conditions are emerging and way and what conditions are improving and why?*
Who are vulnerable groups and why specifically are they specifically vulnerable?	
What the leading causes of morbidity and mortality in children under 5? *What factors influence these?*	
What the leading causes of morbidity and mortality in adults? *What factors influence these?*	

Topic	Response
As information is available please can you share reports, data and statistics with us? If there are any similar reports available that you think may be of use to us, we would be delighted to receive these. *These will not be published in any format in reports but used to consolidate other evidence on the baseline health conditions so we can anticipate how community health may be influenced by the project.*	• Annual reports from your district for the past three years. • Any disaggregated reports from the various County and Sub-County level for the past three years. • Annual reports for hospitals or health centres that are of relevance to the project area for the past three years. • Any district or County Integrated/strategic health development plans for next 3-5 years, as available. • Any district or County or health infrastructure development plans. • Health data from the district health information system for the past 5 years, including: ○ Mortality rates (infant, child and maternal) disaggregated to the district, County and Sub County levels. ○ Birth rates disaggregated to the district, County and Sub County levels. ○ Top 10 disease trends, disaggregated for: ▪ Children under 5 ▪ Children aged 5-15 ▪ Adults ○ TB indicators- case detection and treatment success rates and incidence ○ Acute respiratory infection/pneumonia (in under 5's, 5-15 and adults) ○ Measles- incidence/prevalence. ○ Malaria- incidence/prevalence. Coverage and utilisation of LLINs. Coverage of IRS. Coverage of IPTp. ○ Onchocerciasis- incidence/prevalence and coverage of CDTI. ○ Diarrhoeal disease separated by non-bloody, bloody (dysentery), typhoid and suspected cholera. ○ Prevalence or incidence of schistosoma and intestinal parasites. ○ HIV- incidence/prevalence. Antenatal care incidence rates. Any data from HCT and PMTCT. Number of care and treatment facilities, ART coverage, adherence to ART. ○ STIs- incidence/prevalence of genital discharge and genital ulcerative disease, age and gender splits as available. ○ Nutrition: incidence/prevalence of severe acute malnutrition. Any statistics on wasting, stunting and obesity as available ○ Rates of anaemia as available ○ Non-communicable diseases- incidence/prevalence of hypertension, diabetes, and cardiovascular diseases. ○ Accidents and injuries: incidence/prevalence of road traffic accidents, assault and other forms of non-accidental injury. ○ Cancers: incidence/prevalence separated by gender. ○ Trends on mental health conditions, separated by gender. ○ Epi coverage rates.

2. Health Infrastructure and Services

Please complete the table below on healthcare infrastructure/ resources in the District/ Sub County.
Please can you provide a map of the district that shows the location of health facilities?

Type of facility/Name	Location (Sub County and/or town)	Estimated population served	No. of beds	No. of doctors	No. clinic officers	No. of nurses
Hospitals						
Health centres (state level)						

Please complete the following section

Topic	Response
Is the health infrastructure and service adequate in the district or at the sub County level? *If not, what are the constraints and weaknesses?* *Are any plans in place to address the identified challenges?*	
Is there a specific health infrastructure development plan for the district or sub-County(s)? *If so, please expand?*	
Is access to healthcare facilities acceptable in the district and sub-County(s)? *If not, what are the constraints?*	
Is there any particular group or area that has a restricted access? *Why?*	
Are any public health services provided free of charge to the community? *Please expand and is utilisation of these services good?*	
Are health services affordable for the general population?	

Is accessibility and cost of transport a barrier to accessing health services?	
Are the community generally satisfied with the quality of health services provided? *Please expand as relevant?*	
What and where is the referral hospital for the district?	*What is the general travelling time to this facility from the main district health facility?*
Ambulance service	*Does the district have an adequate number of ambulances to support the referral process?* *Does the patient or the patient's family generally need to pay for the services of an ambulance, or buy fuel for the ambulance?* *Are there any dedicated ambulances used for obstetrical transfers?*
Is traditional medicine used commonly by the communities in the district?	
What do you think promotes the practice of accessing traditional medicine?	
Does health seeking behaviour towards traditional medicine impact on public healthcare service delivery or patient well-being?	

What collaboration is there between traditional medicine practitioners and health authorities?	
What outreach health activities performed in the district/ sub-County?	*Are there any constraints in providing these activities?*
Are village health teams active in the district and relevant sub-Counties?	*Are there any constraints in supporting these activities?*
Is there adequate health knowledge and health awareness in the community to support health prevention and health promotion activities in the community? *Please expand as required?*	
Does the district health department have adequate financial resources to support the provision of comprehensive health services in the district?	*Are there any constraints?*
Does the district health department have adequate human capital resources to support the provision of comprehensive health services in the district?	*Are there any constraints?*
Does the district have adequate financial and human resource capacity to manage a sudden increase in the demand for services that may be associated with rapid migration of people?	*Are there any constraints?*

Does the district have adequate financial and human resource capacity to manage a significant outbreak of communicable disease?	*Are there any constraints?*			
Where are medications and consumables for the district health facilities supplied from?	*Is the supply chain adequate and what are specific challenges?*			
Are the following services available in the district?	Blood transfusion	Yes ☐	No ☐	Where:_____
	General surgery	Yes ☐	No ☐	Where:_____
	Mortuary (freezer)	Yes ☐	No ☐	Where:_____
	Intensive care unit	Yes ☐	No ☐	Where:_____
Are basic services (water, power, accommodation) generally available in all public health facilities? *Expand as required?*				
Do all district health facilities have adequate medical waste management systems?	*Please expand as to how this functions at a district level?*			
Is a health service performance management programme in operation for the district in terms of health service provision and activity?	*If yes, please expand on this?*			

3. Health Strategy and Interventions

Is there a health strategy as part of the as part of the Districts Integrated Development Plan (or similar?)	

	If yes, does this strategy include consider the potential impact of private sector investment or industrial development projects?
What specific health programme interventions are taking place in the district or relevant sub-County's? *Please can you list them in the table below*	*Are there any weaknesses are areas for improvements in these programmes?*
Are there any public/private partnerships working on public health programmes in the district/sub- County? *Please can you describe as relevant as to what the programme is and who the private sector company is?*	**Project** / **Private Company** (5 empty rows)
Are there other health actors/partners from the NGO or bi-lateral donor agencies working on health programmes? *If so please complete the table below*	

Please complete the table below to describe on-going health programmes in the district/sub-County.

Type of Health Programme	Location	Date intervention started	Duration of intervention	Programme funder	Programme Partners	Key programme contact
						Name: Tel: Email:
						Name: Tel: Email:
						Name: Tel: Email:
						Name: Tel: Email:
						Name: Tel: Email:
						Name: Tel: Email:
						Name: Tel: Email:
						Name: Tel: Email:

4. Specific Health Topics

Where possible please can the clinical programme head complete the section relevant to their portfolio.

Maternal and child health		
What are the following district health indicators	Maternal mortality rate	_____ per 100,000 live births
	Infant mortality rate	_____ per 1000 live births
	Child mortality rate	_____ per 1000 live births
	HIV prevalence in antenatal care	_____%
	Syphilis prevalence in antenatal care	_____%
	Hepatitis B prevalence rate in blood donors	_____%
	HIV prevalence in blood donors	_____%
	Prevalence of children under 5 that are underweight	_____%
	Prevalence of children under 5 that are severely underweight	_____%
Do mothers generally deliver in healthcare facilities, or at home?	*If at home, what factors drive this behaviour?*	
Is the coverage of childhood vaccination programmes in line with established targets?	*If not, what are challenges to achieving targets?*	
Does the district keep statistics on the rate of still-births?	*If so, is there an increasing or decreasing trend?*	
Respiratory disease		
Are the rates of tuberculosis (TB) rising or falling in the district or sub County(s)?	*What is the reason for this?* *Is it worse in any particular areas within the County, and are there areas with higher incidence/prevalence?* *And in any particular population or demographic group?*	
What health programme		

<table>
<tr><td>interventions are in place to manage TB?</td><td colspan="3">Are there any constraints in detecting TB at an early stage?</td></tr>
<tr><td>Please complete the following TB indicators</td><td colspan="3"><table>
<tr><th>TB Indicators</th><th>Current Value (%)</th><th>Trend (increasing/ decreasing/ no change)</th></tr>
<tr><td>Prevalence of TB infection</td><td></td><td></td></tr>
<tr><td>Case detection rates</td><td></td><td></td></tr>
<tr><td>Treatment success rates</td><td></td><td></td></tr>
<tr><td>TB morbidity</td><td></td><td></td></tr>
<tr><td>TB mortality</td><td></td><td></td></tr>
<tr><td>MDR TB</td><td></td><td></td></tr>
<tr><td>TB/HIV co-infection</td><td></td><td></td></tr>
</table></td></tr>
<tr><td rowspan="3">MDR-TB</td><td>Are there facilities available to diagnose MDR-TB in the district? If so, where?</td><td colspan="2"></td></tr>
<tr><td>Are medications to treat MDR-TB readily available in the district?</td><td colspan="2"></td></tr>
<tr><td>Has the district seen an increase or decrease in MDR TB in recent times?</td><td colspan="2"></td></tr>
<tr><td>Are the rates of acute respiratory infection rising or falling in the district or sub County(s)?</td><td colspan="3">What is the reason for this?

Is it worse at a certain time of the year? Is it worse in any particular areas within the district?</td></tr>
<tr><td>What are housing conditions like in the community that live in the district or sub-County(s)?</td><td colspan="3">In indoor sleeping arrangements, is overcrowding a problem?

Is ventilation in sleeping or living rooms generally adequate?</td></tr>
<tr><td>Has there been a recent outbreak of measles in the district or sub-County(s)?</td><td colspan="3">If so, where and what was the likely contributing factor?

Are there any risk factors that may lead to the potential for a measles outbreak in the future?

Are there any particular areas of the district that are prone to measles outbreaks?</td></tr>
<tr><td>Is the Epi programme effective in the County?</td><td colspan="3">What are the vaccine coverage rates in the past three years for:<table>
<tr><th>Vaccine</th><th>District (%)</th><th>_____ Sub County (%)</th><th>_____ Sub County (%)</th></tr>
<tr><td>Measles 2013</td><td></td><td></td><td></td></tr>
<tr><td>Measles 2014</td><td></td><td></td><td></td></tr>
<tr><td>Measles 2015</td><td></td><td></td><td></td></tr>
</table></td></tr>
</table>

DPT 2013				
DPT 2014				
DPT 2015				

Vector related disease

Is malaria the number one public health challenge in the district? *Are disease trends increasing or decreasing in the past 3-5 years?* *Is the transmission of malaria seasonal and is it worse in certain areas?*	*If so, why is this and in what area has this been noticed?* *What season:* *Geographical locations:*
Has a malaria cluster indicator survey been completed in the district in the past 3-5 years? *If so, what were the results?*	*If so do you have the results that you can share. Please can you share data on the table below as well.*

Malaria indicators	2012	2013	2014	2015	2016
Prevalence of malaria infection- District					
Prevalence of malaria infection- sub-county					
Prevalence of malaria infection- sub-County					
Case numbers (children <5)					
Case numbers (children >5)					
Malaria mortality					
N/B: can report absolute case numbers if rate is not known.					

What programmes are offered to reduce malaria transmission in the district/sub-County(s)?

If so, are these interventions successful?

Please complete the relevant sections below.

Programmes	Yes	No
Health information and education		
Malaria case management with RDT and ACT at clinic level		
Malaria case management with RDT and ACT at clinic level		
Intermittent preventive therapy in children		
Insecticide treated bednet		
Indoor residual spray		
Active case detection		

If there is an indoor residual spray programme ongoing in the district please complete the following questions	Who is managing the programme?	
	What is the spray coverage area?	
	What insecticide is being used?	

	Have entomological studies been conducted and what mosquito species was dominant?	
If there is an insecticide treated bednet (ITN) programme ongoing in the district please complete the following questions	What ITNs are in use?	
	Is there a universal distribution campaign or only for vulnerable groups?	
	Is payment required?	
	Is utilization of ITNs good or poor? Why?	
If there is a diagnosis and treatment programme ongoing in the district please complete the following questions	Are rapid diagnostic test kits readily available in health centres? If so, are staff trained to use them? Do patients need to pay extra for them?	
	Is ACT readily available in health centres?	
	Do pregnant women receive intermittent prevention therapy in their pregnancy?	
Have any arbo-viral diseases been recorded in the district, or sub-County(s)?	*If yes, please expand on where?* *Are there adequate diagnostic services to detect arbo-viral disease outbreaks in the district?*	
Have any cases of Yellow fever been reported in the district?	*Does the district have the capacity to address a yellow fever outbreak or would it require external support? Please expand?*	
Does lymphatic filariasis or onchocerciasis occur in the district or sub County(s)?	*What controls are in place to combat these diseases?*	

Does leishmaniasis occur in the district or sub County(s)?	*If yes, where do most of the cases occur? Is there any particular part of the county where the risk is highest?* *What controls are in place to combat diseases?*
Water and sanitation related diseases	
Is housing and general environmental health conditions a challenge in the district or sub County(s)? *Why is this the case and are there any specific areas of concern?*	
Is access to safe water a problem for the community in the district or sub County(s)?	*Are there any specific areas that experience more challenges than others and why this is the case?* *Has access improved or worsened in the last 3 years:* *In urban areas:* *In rural areas:* *What is the coverage of improved water sources in the:* • *District:* • *Sub- County_____:* • *Sub- County_____:* • *Sub- County_____:*
Is access to sanitation services a problem for the community in the district or sub County?	*Are there any specific areas that experience more challenges than others and why this is the case?* *What is the coverage of improved latrine coverage in the:* • *District:* • *Sub- County_____:* • *Sub- County_____:* • *Sub- County_____:*
How do household dispose of domestic waste/garbage?	*Generally:* *Urban areas:*

<table>
<tr><td></td><td>Rural areas:</td></tr>
<tr><td>Are diarrhoeal diseases a challenge in the district/ sub-County(s)?

Please complete table on diarrheoal disease indicators</td><td>Are there any specific areas that experience more challenges than others and why this is the case?

Is it worse at any specific time of the year?

<table>
<tr><th>Diarrhoea indicators</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th></tr>
<tr><td>Prevalence of diarrhoea- district</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of bloody diarrhoea- district</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of diarrhoea- _____ sub-county</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of diarrhoea- _____ sub-county</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of bloody diarrhoea- _____ sub-county</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of bloody diarrhoea- _____ sub-county</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Case numbers (children <5)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Case numbers (children >5)</td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Have there been outbreaks of dysentery?</td><td>Are there any specific areas that experience more challenges than others?</td></tr>
<tr><td>Have there been any recent outbreaks of typhoid fever in the district/ sub-County(s)?</td><td>If so, please expand on when and where the outbreak occurred?

If yes, is it a major problem? Is it increasing?</td></tr>
<tr><td>Have there been any recent outbreaks of cholera in the district/ sub-County(s)?</td><td>If yes:
• When was the last outbreak (year):
• Where did it occur:
• What were the risk factors:
• Case load:
• Case fatality rate:

What is the likelihood of future outbreaks?

What capacity does the County have to respond to these outbreaks?</td></tr>
</table>

Does urogenital or intestinal schistosomiasis occur in the district/ sub-County(s)?	*If so, what particular areas/communities are more affected?* *Are there any public health (e.g school based) programmes to control the disease?*
Are intestinal parasites common in the district/ sub-County(s)?	*If so, what particular areas/communities are more affected?* *Are there any public health (e.g. school based) programmes to control the disease?*
Are skin diseases common in the district/ sub-County(s)?	*If so, where does this occur most commonly and what type of skin disease?* *Is:* • *Scabies is an issue and if so why?* • *Impetigo is an issue and if so why?* • *Other skin disease and if so why?*
Are infectious eye diseases common in the district/ sub-County(s)?	*If so, where does this occur most commonly and what type of disease?* *Is:* • *Trachoma is an issue and if so why?* • *Viral conjunctivitis is an issue and if so why?* *What controls are in place to reduce these risks?*
Sexually transmitted infections (STIs)	
Are STIs common in the district/ sub-County(s)?	*Is there trend increasing or decreasing? Why?* *Please complete the burden of disease table*

STI indicators	2012	2013	2014	2015	2016
Prevalence of syphilis (or ulcerative STI)- District					
Prevalence of syphilis (or ulcerative STI)- _____ sub-county					
Prevalence of syphilis (or ulcerative STI)- _____ sub-County					

	Prevalence of urethral discharge STI- District					
	Prevalence of urethral discharge STI- _____ sub-county					
	Prevalence of urethral discharge STI - _____ sub-County					
What factors influence the transmission of STIs in the district/ sub-County(s)? *Please expand as relevant?*	*Are truck stops or transport corridors a concern?*					
Are there any high risk areas or 'hot-spots' in the district/sub-County(s) where the transmission of STIs is particularly high? *Please expand as relevant?*						
Are there any groups that are regarded as high risk or vulnerable for the transmission of STIs in the district/ sub-County(s)? *Please expand as relevant?*						
Is commercial sex or forms of transactional sex a challenge in the district/ sub-County(s)? *Please expand as relevant?*	*Has the practice of commercial sex work changed in recent times?* *Who are generally the clients that seek paid sex?* *Is the practice generally tolerated in the community?*					
Are young girls the target for sexual advances for favours from older men ('sugar-daddy's) *Please expand as relevant?*						

Condoms, safe sex and family planning. *Please answer the questions and expand as relevant*	Are condoms widely used in the district/ sub-County(s) or are there cultural or other reasons that limit use?		
	Are condoms generally easily accessible to the community?	Urban areas	
		Rural areas	
	Are there active condom distribution points in communities?		
	Do young girls or women generally have the ability to negotiate safe sex practices?	Urban areas	
		Rural areas	
	Is there good uptake of family planning in the district/ sub-County(s)? *Are there any factors that limit the uptake of family planning?*		
Is the prevalence of HIV increasing or decreasing in the district/ sub-County(s)?	*If so, why do you think this is the case?*		
Does population movement influence the prevalence of HIV and other STIs? *If so, please expand*			
Is there any specific high risk groups in the district/ sub-County(s)? *Please complete section and expand as relevant?*	Fishermen	Yes☐ No☐	
	Farmers	Yes☐ No☐	
	Transport workers	Yes☐ No☐	
	Military/police	Yes☐ No☐	
	Business men	Yes☐ No☐	
	NGO workers	Yes☐ No☐	
	_____	Yes☐ No☐	
	_____	Yes☐ No☐	
HIV testing *Please complete section and expand as relevant?*	Are there facilities available to diagnose HIV in the district/sub-County(s)? If so, where?		
	Do people openly subject		

<table>
<tr><td></td><td>themselves to HIV tests or are these generally provider initiated?

Is there stigma associated with testing?</td><td></td></tr>
<tr><td></td><td>Is uptake of HIV testing high in antenatal care as part of PMTCT?</td><td></td></tr>
<tr><td></td><td>Are the rates of treatment initiation good in newly diagnosed cases?</td><td></td></tr>
<tr><td rowspan="4">HIV care and treatment</td><td>Are there facilities available to provide care and treatment (including ART) in the district/sub-County(s)? If so, where?</td><td></td></tr>
<tr><td>Which facilities can support CD4 counts and viral load determination?</td><td></td></tr>
<tr><td>Has there been an increase in the number of HIV positive people enrolling in ART programmes?</td><td></td></tr>
<tr><td>Is adherence to treatment good? Are there any barriers to adherence to ART?</td><td></td></tr>
<tr><td>Please complete the following information related to HIV/AIDS indicators</td><td colspan="2"><table>
<tr><th>HIV indicators</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th></tr>
<tr><td>Prevalence of HIV district</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of HIV-_____ sub-county</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of HIV-_____ sub-County</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of HIV-_____ sub-County</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prevalence of HIV – age 15-49 in district</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Percentage enrolment on ART</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Coverage of PMTCT and % of HIV+ babies from horizontal transmission.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Number of AIDS related deaths</td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Does the community have good and consistent knowledge related to HIV transmission and prevention?</td><td colspan="2">Does this level of knowledge affect high risk sexual behaviour?

Does the community have unique cultural practices that may predispose them to higher rates of STIs and HIV?</td></tr>
<tr><td>Are there high levels of stigma or discrimination in the communities?

Please expand as relevant</td><td colspan="2"></td></tr>
<tr><td colspan="3">Nutritional disorders</td></tr>
</table>

Is malnutrition a problem in the district/sub-County(s)? *If so, please complete the accompanying questions*	Is this an increasing trend?		
	Are there specific geographical areas of concern?		
	Is malnutrition associated with food shortages or poor feeding practices?		
	Are there any specific groups that may are more prone or vulnerable to malnutrition than others?		
Is nutritional surveillance performed in the district/sub-County(s)? *If so, please complete the accompanying questions*	Severe acute malnutrition rates	District	
		_____ Sub-County	
		_____ Sub-County	
		_____ Sub-County	
	Wasting rates	District	
		_____ Sub-County	
		_____ Sub-County	
		_____ Sub-County	
	Stunting rates	District	
		_____ Sub-County	
		_____ Sub-County	
		_____ Sub-County	
Is obesity a growing concern? *If so, please expand*			
Is there a specific time of the year when food insecurity is a challenge?			
Non-communicable disease			
Is there a district strategy to address the risks of non-communicable diseases?	*If so, please expand and outline if there are any challenges in dealing with these conditions?*		
Is hypertension a public health challenge in the district/sub-County(s)?	*If so why, and is this trend increasing?* *Is there an adequate range of medications and special investigations to manage hypertension?*		
Is diabetes a public health challenge in the district/sub-County(s)?	*If so why, and is this trend increasing?* *Is there an adequate range of medications and special investigations to manage diabetes?*		

Is asthma a public health challenge in the district/sub-County(s)?	*If so why, and is this trend increasing?*		
Is there good care and treatment support for people that are diagnosed with hypertension or diabetes?	*Please expand as relevant, and advise if there is good adherence to treatment for hypertension or diabetes?*		
Does the district keep statistics of cancer? *What is the most common cancers in men and women*	*If so, is the incidence increasing/ decreasing?* Men: Women:		
Accidents			
Does the district keep statistics of on the trends of trauma from accidents?	*If so, is the incidence increasing/ decreasing?*		
Are road traffic accidents or non-accidental injuries (assault) the most common form of accident?	*What are contributing factors to road traffic accidents?* *Are emergency services or medical facilities currently adequately staffed and equipped to deal with road traffic accidents and related trauma?*		
Are physical assaults common in the in the district/sub-County(s)?	*If so are these general assault, stab wounds or gunshot wounds?* *If so, what influences these (please complete questions below)?*		
	Domestic violence	Yes☐ No☐	
	Substance abuse	Yes☐ No☐	

	Other:	Yes☐ No☐	
Environmental health			
Does environmental health management fall under the DHMT or under the District Environmental Department (DED)?	*If the DED, what collaboration occurs with the DHMT?*		
Is food hygiene a concern at markets? *Please expand as relevant?*			
Are there any concerns in the district/sub-County(s) related to pollution or contaminated land? *Please expand as relevant?*			
Zoonotic diseases			
Is there a veterinary public health department in the district/sub-County(s)?	*If so, how does the DHMT interact with this department?*		
Is rabies a concern in the district/sub-County(s)? *Please expand as relevant?*	*Are there effective vaccination programmes in place for rabies?*		
Is brucellosis or leptospirosis a concern in the district/sub-County(s)? *Please expand as relevant?*			
Are viral haemorrhagic fevers a concern in the district/sub-County(s)? *Please expand as relevant?*			

Does the movement of people pose a risk to the introduction of zoonotic disease through the movement of cattle and domestic animals?	
Social Determinants of Health	
Is alcoholism a public health challenge in the district/ sub-County(s)?	***If so, where is this most common (urban or rural areas)*** ***Are there any specific areas of concern in the in the district/ sub-County?***
Is the trend of abuse increasing?	***If yes, please expand?***
Are traditional brews or commercial products mainly consumed?	***If so, how?***
Does alcoholism add significantly to the burden of disease in the district?	
Is drug abuse a public health challenge in the district/ sub-County?	***If so, where is this most common (urban or rural areas)*** ***Are there any specific areas of concern in the district?***
What are the most common drugs of abuse?	
Is the trend of abuse increasing?	***If yes, please expand?***
Is suicide an issue in the district?	***If so, please expand?***
Are women marginalised in society?	***If so how,*** ***Does this affect the health of the family unit?***
Is gender based domestic violence common or rare?	***Please expand?***
Are the trends of	

domestic violence increasing or decreasing? Is child abuse common or rare? Are the trends of child abuse increasing or decreasing?	***Please expand?***

-x-x-x-x-x-x-x-x-END-x-x-x-x-x-x-x-x-x-

Thank you for your efforts in completing this.

Health Facility SARA Tool

Health Facility	Health Facility 1	Health Facility 2	Health Facility 3	Health Facility 4	Health Facility 5
Contact Person					
Function					
Contact Details					
Health care provider availability					
General doctor					
Medical specialist					
Community Health Assistant					
Community Health Officer					
Surgical Technologist					
Community Health Nurse					
Nurse Midwife					
Nurse Aide					
Nurse specialist/public health nurse					
Registered Nurse (RN) anaesthetist					
Pharmacist					
Laboratory technologist					
Laboratory assistant					
Data clerks					
Psychosocial specialist					
HIV Counsellor					
Public health officer					
Radiographer					
Dental technician/officer					
Physiotherapist					

Health Facility SARA Tool

Health Facility	Health Facility 1	Health Facility 2	Health Facility 3	Health Facility 4	Health Facility 5
General support staff					
Administrators (non-clinical)					
Total					
Service availability					
Out-patient services					
In-patient services					
24 hour emergency					
Emergency surgery					
Caesarean section					
Assisted vaginal delivery					
Blood transfusion					
Neonatal resuscitation with bag and mask					
Pharmacy					
Immunization					
Growth monitoring					
VCT for HIV/AIDS					
PMTCT of HIV/AIDS					
Primary health care					
Maternal health care					
Ambulance service (functioning)					
Intensive care					
Laboratory services					
General surgery					
Orthopaedic surgery					
Specialist services					
Radiology					
Isolation facility					
Number of in-patient beds					

Health Facility SARA Tool

Health Facility	Health Facility 1	Health Facility 2	Health Facility 3	Health Facility 4	Health Facility 5
Diagnostic ability					
Malaria RDT					
Malaria microscopy					
HIV RDT					
HIV ELISA					
HIV CD4 count					
TB diagnostic					
Haematology					
Biochemistry					
Parasitology					
Availability of drugs (always in stock)					
ACTs					
Parenteral quinine					
IPT_p (Fansidar/SP)					
ART (Zidovudine, Nevirapine, Efavirenz)					
TB drugs					
EPI vaccinations					
Antihelmintic drugs					
Oral rehydration solution					
Oxytocin/Misoprostol					
Penicillin/Ampicillin/Benzathine P					
Erythromycin					
Doxycycline					
Vitamin A					
Vitamin K					
Iron supplements					
Folic acid					
Insecticide treated bednets					

Health Facility SARA Tool

Health Facility	Health Facility 1		Health Facility 2		Health Facility 3		Health Facility 4		Health Facility 5	
Hypertension drugs										
Antipyretics										
Injectable diazepam / valium										
Injectable magnesium sulphate or other anticonvulsant										
Injectable ergometrine										
Tetanus anti-toxin injection										
Adrenaline injection										
Anti-protozoa drugs										
Anti-histamines										
Dermatological preparations										
Opioid analgesia										
Injectable anaesthesia (Ketamine)										
Availability and functionality of medical equipment										
A=Available; F=Functional	A	F	A	F	A	F	A	F	A	F
Table for gynaecological examination										
Fetoscope										
Autoclave										
Pressure cooker for sterilisation										
Speculum										
Blood giving set										
Delivery forceps										
IV sets										
Vacuum extractor										
Manual vacuum aspirator										
Dilatation and curettage kit										
Operating table										
Operating light										

Health Facility SARA Tool

Health Facility	Health Facility 1		Health Facility 2		Health Facility 3		Health Facility 4		Health Facility 5	
Anaesthesia equipment										
Oxygen equipment										
Bag valve mask and resuscitator										
Blood pressure apparatus										
Stethoscope										
Thermometer										
Weighing scale										
Glucometer										
Endo-tracheal tube/Larymgeal mask										
Intercostal drain										
Urinary catheter/Naso-gastric tube										
Central line or high gauge IV catheter (16G and below)										
Infrastructure										
Regular/reliable running water										
Regular/reliable electricity										
Solar power										
Generator										
Any type of electricity										
Functioning refrigerator										
Functioning landline										
Functioning mobile										
Functioning 2-way radio										
Continuity of services										
In-patient services 24/7										
Emergency services 24/7										
Official opening hours per day (in hours)										

Health Facility SARA Tool

Health Facility	Health Facility 1	Health Facility 2	Health Facility 3	Health Facility 4	Health Facility 5
Staff lives in proximity to HF					
Access to a referral hospital					
Proximity of referral hospital (in km and hours)					
Transportation possibility to referral hospital					
Cost of referral (both ways)					
Staff in-service training					
Staff trained in life saving skills					
Process of health care					
Use of disposable gloves					
Use of protective eye wear and aprons					
Evidence of use of cleaning disinfectant in wards and casualty					
Evidence of soap in wash basins, or hand sanitizer in wards					
Hand washing					
Use of autoclave					
General state of building and state of cleanliness					
Cost of health care					
How much does a basic outpatient consultation cost					
How much does diagnosis and treatment for malaria cost (with RDT use)					

Health Facility SARA Tool

Health Facility	Health Facility 1	Health Facility 2	Health Facility 3	Health Facility 4	Health Facility 5
How much does an admission for a child cost?					
General Questions					
How many people have access to this health care facility- the target population?					
On average how many out-patient consultations do you conduct on a monthly basis?					
What are the 3-5 main health challenges facing the community					
If you had 3-5 wishes to improve health care in the communities that you serve in, what would they be?					

Health Facility SARA Tool

Health Facility	Health Facility 1	Health Facility 2	Health Facility 3	Health Facility 4	Health Facility 5
What are the 5 most common diseases or causes of morbidity in children under 5 years?					
What are the 5 most common diseases or causes of morbidity in adults					
Are there measures in place to deal with disease outbreaks? How has this changed post-Ebola?					

TILENGA FEEDER & EACOP PIPELINE FOCUS GROUP DISCUSSION GUIDE FOR WOMEN			
Name of village		**Date of the interview**	
Name of interviewer:			
Name(s) of the interviewee(s):			
Criteria to be used to select participants:	• *Women's group representatives;* • *Female heads of households;* • *Housewives;* • *Widows;* • *Single mothers* • *Women engaged in business activities.*		
SECTION 1 - INFORMATION ABOUT HISTORICAL TIMELINE			
Q1-1. Thinking back as far as possible, please recall all important events in the life of the community from that moment onwards. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Date/period	Event	
SECTION 2 – INFORMATION ABOUT GENDER ROLES, TASKS AND RESPONSIBILTIES			
Q2-1. What are the roles, tasks and responsibilities of men and women in the community? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Task/role/responsibility	Task for women	Task for men
	Household budget		
	Buying goods for the household (i.e. food, clothing etc)		
	Sale of local produce/commerce		
	Education/upbringing of children		
	Water collection		
	Wood collection		
	House construction		
	Cultivating the land (crops cultivated)		
	Managing livestock		
	Hunting		
	Collecting wild plants		
	Fishing		
	Cooking and cleaning		
	Migrant work		
	Making household decisions		
	Protecting the family		
	Owning land		
	Inheriting (how is land divided)		
	Other *(please indicate)*		
	Other *(please indicate)*		
Q2-2. What skills (amongst women) exist in this village (i.e. sewing, weaving, soap making)? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Skill	Proportion women with skill (all, majority, less than half, few)	
Q2-3. Are employment opportunities available in the area equal and open to women and men? Please elaborate.	☐ Yes ☐ No		
Q2-4. Do women believe they will be considered for jobs on the project or do you feel mainly that men will benefit from it?			

Q2-5. Are there any women organisations in the village?	☐ Yes ☐ No			
Q2-5-1. If so, please indicate: • **The name of the organisation** • **The organisation's activities** • **The criteria for membership** • **The number of members** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Organisation name	Activities	Criteria for membership	Number of members
SECTION 3 – INFORMATION ABOUT LOCAL DIET AND DAILY NECESSITIES				
Q3-1. Do people in the village generally produce sufficient food as a family to feed the family throughout the year?	☐ Yes ☐ No			
Q3-1-1. If not, please indicate the hunger months and what measures are used to manage these.				
Q3-2. Which markets (if any) do people use to buy and sell goods? Please indicate: • **The name of the market**				
SECTION 4 – INFORMATION ABOUT ENERGY				
Q4-1. What do you use as energy source(s) for cooking? Please indicate: • **The source of energy** • **The proportion of the village (all, majority, less, few) reliant on this energy source for cooking** • **Where it is obtained** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Source of energy for cooking	Proportion of village reliant on energy source for cooking	Where it is obtained	
Q4-2. What do you use as energy source(s) for lighting? Please indicate: • **The source of energy** • **The proportion (All, majority, less, few) the village reliant on this energy source for lighting** *(Note: only ask these questions if the participatory map completed previously shows sacred places)*	Source of energy for lighting		% of village reliant on source for lighting	
SECTION 5 – INFORMATION ABOUT WATER				
Q5-1. Where does local drinking water supply come from (i.e. tap/river/borehole/well)?				
Q5-2. Is the water safe to consume (i.e. is it potable)?	☐ Yes ☐ No			
Q5-3. Is the supply reliable (i.e. does it provide water	☐ Yes ☐ No			

throughout the year)?	
Q5-4. Is local water supply sufficient to meet local demand throughout the year or are there any times when water availability becomes a problem? Please explain.	
SECTION 6 – GENERAL INFORMATION ABOUT HEALTH	
Q6-1. Where is the nearest health facility from the village?	
Q6-2. How would you rate the quality of the health facility (i.e. good, average or poor)?	☐ Good ☐ Average ☐ Poor
Q6-2-1. Please explain your answer.	
Q6-2-2. If poor, what could be done to improve the facility?	
Q6-3. Is traditional medicine a popular form of treatment in your village?	☐ Yes ☐ No
Q6-3-1. If so, for what type of diseases?	
Q6-4. What are the main health problems of women in the village?	
Q6-5. What are the main health problems of children in the village?	
Q6-6. Is diarrhea common in the community?	☐ Yes ☐ No
Q6-7. Where do women go to give birth?	☐ A clinic ☐ At home
Q6-7-1. Please explain the reason why you give birth at home or at the clinic.	
Q6-8. Are family planning services available in the community?	☐ Yes ☐ No
Q6-9. Are there outreach services in the community that offer services such as vaccinations and weight measurements for children?	☐ Yes ☐ No
SECTION 7 – INFORMATION ABOUT HIV/AIDS	
Q7-1. Do you know what HIV/Aids is and is it a problem in the community?	☐ Yes ☐ No
Q7-2. Is there a stigma associated with HIV/AIDS (for example, are people shunned if they are HIV+)?	☐ Yes ☐ No
Q7-3. Are people aware of how to prevent HIV? Please explain how you think we can prevent it.	☐ Yes ☐ No
Q7-3-1. If so, do people follow	

measures for preventing HIV?	
Q7-4. Are women in the village selling their bodies for money?	☐ Yes ☐ No
Q7-4-1. If so, are these women from the local area or from other places?	
Q7-4-2. If so, who are the target groups of these women (i.e. fishermen, businessmen)?	
SECTION 8 – INFORMATION ABOUT MALARIA	
Q8-1. Is malaria a problem in the community?	☐ Yes ☐ No
Q8-2. Are you aware of the causes of malaria?	
Q8-3. What are people doing to prevent malaria?	
Q8-4. Do people use mosquito nets?	☐ Yes ☐ No
Q8-5. How many people here (in the group) have slept under a mosquito net last night?	
SECTION 9 – INFORMATION ABOUT SANITATION	
Q9-1. What sanitation systems are used in the village? Please indicate: • **The percentage of households using this system in the village** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	System / % of households using this system in the village Bush Pit latrines Improved pit latrines Other *(please indicate)*
Q9-2. Would you consider the local environment to be clean?	
SECTION 10 - EDUCATION	
Q10-1. Do you consider attending school as important? Please explain your answer.	
Q10-2. What is the level of literacy amongst women in the community? Please indicate the percentage of literate to illiterate women.	Literate women: % Illiterate women: %
Q10-3. Is there a difference in the literacy rate of men and women? Please explain your answer.	
Q10-4. Is schooling more important for boys than for girls? Please explain your answer.	
Q10-5. Are there any particular problems girls may face at school?	
SECTION 11 – GENDER AND VULNERABILITY	
Q11-1. Is there violence against women in the village? Please elaborate	☐ Yes ☐ No
Q11-2. Are there support networks for women who have problems and require help?	

Q11-3. Please identify the vulnerable people in the village.		
Q11-3-1. Why do you believe that they are vulnerable?		
Q11-4. What types of networks are available for vulnerable groups in the village?		
Q11-5. What are the challenges for each type of vulnerable group? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Vulnerable group	Key issues
SECTION 12 – INFORMATION ABOUT PERCEPTIONS		
Q12-1. Have there been any changes between life in the community in the past and present?	☐ Yes ☐ No	
Q12-1-2. If so, please explain what these changes are and the possible reasons behind them.		
Q12-2. What are your main aspirations for the village in the future?		
Q12-3. What do you think will be the positive and negative impacts of the project on your lives? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Positive impacts	Negative impacts
Q12-4. What would be the best way to support or enhance the lives of women in the area?		

TILENGA FEEDER & EACOP PIPELINE FOCUS GROUP DISCUSSION GUIDE FOR COMMUNITY LEADERS			
Name of village		**Date of the interview:**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *Elders/opinion leaders;* • *Women's group representatives;* • *Religious leaders;* • *Traditional leaders;* • *Youth representatives and/or;* • *Administrative leaders.*		
SECTION 1 - INFORMATION ABOUT HISTORICAL TIMELINE			
Q1-1. Thinking back as far as possible, please recall all important events in the life of the community from that moment onwards. *(Note: for the purpose of collecting and recording data on the computer, please use the following table and take a picture of the completed historical timeline)*	Date/period	Event	
SECTION 2 – INFORMATION ABOUT VILLAGE LIVELIHOOD STRATEGIES			
Q2-1. Please indicate which livelihood strategies exist in the village and the approximate percentage of households involved in each strategy. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Livelihood strategy	Proportion of households involved(all, majority, less than half, few)	
	Subsistence agriculture		
	Commercial agriculture		
	Livestock rearing		
	Pastoralism		
	Fishing		
	Commercial mining		
	Subsistence mining		
	Hunting		
	Wild plant collecting		
	Beekeeping		
	Other *(please indicate)*		
	Other *(please indicate)*		
Q2-2. Please draw a participatory village map including the surrounding area. On this map, please indicate: • **Residential areas** • **Social infrastructure (i.e. schools, clinics)** • **Water points** • **Agricultural areas (for subsistence and commercial agriculture)** • **Grazing areas (for local and nomadic livestock)** • **Fishing areas** • **Hunting areas** *(note: this may be an arrow in a direction as it may be off the map)* • **Wild plant collection** *(note: this may differ from timber, medicinal plants, food plants, charcoal)* • **Sacred sites (i.e. burial grounds, worship of holy trees, sacred groves, rivers)** • **Resource towns for education, health facilities, marketing goods, administration** *(note: this*			

may be an arrow in a direction as it may be off the map and different for different resources) *(Note: if people wish to draw other features then encourage them)* *(Note: please record discussions that go on whilst the maps are being drawn and record in the box to the right)* *(Note: participatory mapping exercise to be completed using flip chart paper and felt tip pens)*		
Q2-3. What type of formal employment opportunities exist in the village? Please indicate: • **How many of each opportunity exist (i.e. nurse, teacher, shop)** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Type of employment	Number
Q2-4. What types of businesses (i.e. restaurants, shops, hairdressers, carpenters) exist in the village? Please indicate: • **How many of each exist** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Business	Number
Q2-5. Please list the different skills available in the village. *(Note: allow the participants to define the notion of skills)*		
SECTION 3 – INFORMATION ABOUT LAND USE IN THE VILLAGE		
Q3-1. What are the land tenure categories in and around the village? Please indicate the prevalence (% of each) of the different categories. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)* *(Note: indicate the prevalence of the different categories by ranking them 1 for most prevalent, 2 for second most prevalent etc)*	Land tenure category (public, private, communal)	Prevalence (very common, common, not common)
Q3-2. Has the prevalence of the different land tenure categories changed over the past 10 years?	☐ Yes ☐ No	
Q3-2-1. If so, how?		
Q3-3. How is land allocated to people?		
Q3-4. Are there currently any land disputes in the village (including between farmers and pastoralists?	☐ Yes ☐ No	
Q3-4-1. If so, please describe where they are and what they are about.		
Q3-5. Are there more or less disputes today compared with 10 years ago?	☐ Yes ☐ No	

Q3-5-1. Please explain why this might be.	
Q3-6. What measures are used to solve the disputes, if any?	
Q3-7. Are there more or less conflicts today compared with 10 years ago?	☐ Yes ☐ No
Q3-7-1. Please explain why this may be.	
Q3-8. What measures are used to solve the conflicts, if any?	

SECTION 4 – INFORMATION ABOUT VILLAGE CULTURE

Q4-1. What are the different ethnic groups in the village? Please indicate:
- **The name of the ethnic group**
- **Their area of origin**
- **Their main characteristics**
- **Their representation (All, majority, less than half, few) in the village)**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Tribal group	Area of origin	Main characteristics	Representation in village

Q4-2. If there are any sacred sites on your village land, please describe their characteristics. Please indicate:
- **Its significance**
- **Its frequency of use/visit**
- **Who uses it**
- **Whether it has moveable items**

(Note: only ask these questions if the participatory map completed previously shows sacred places)

Sacred place	Significance	Frequency of use	Used by	Movable? (y/n)

Q4-3. Are there any rituals or ceremonies at certain times of the year? Please indicate:
- **What the ritual/ceremony is about**
- **When it takes place (i.e. timing)**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Ritual/ceremony	Description	Timing

Q4-4. Are there any local customs and practices in the village regarding ancestors and spirits?	☐ Yes ☐ No
Q4-4-1. If so, please describe them.	

SECTION 5 – INFORMATION ABOUT TRAFFIC IN THE VILLAGE

Q5-1. In your view, who has the main responsibility for road safety? *(Note: please select just one option)*	☐ National/regional road authority ☐ Police ☐ Drivers ☐ Pedestrians

Q5-2. What are the main causes of road traffic incidents in the local area? *(Note: please select the two most important options)*	☐ Poor road conditions ☐ Poor weather conditions ☐ Speeding drivers ☐ Drink driving ☐ Poor condtiions of vehicles ☐ Drivers using mobile phones
Q5-3. Are there any advertisements about road safety?	☐ Yes ☐ No
Q5-3-1. If yes, please indicate what the focus of these advertisements was. *(Note: please tick all relevant boxes)*	☐ Alcohol consumption ☐ Speeding ☐ Use of seat belts ☐ Careful driving ☐ Other *(please indicate)*
Q5-4. In the local area, is the presence of main roads viewed as a risk to public safety? For example, is there a history of accidents on the local road network?	
Q5-5. If there was a significant increase in road traffic volumes along the local road network, would this have a significant impact on safety and quality of life within the community?	

SECTION 6 – INFORMATION ABOUT DECISION-MAKING IN THE VILLAGE

Q6-1. Who are the key people (including religious leaders) in terms of leadership and decision-making in the village? Please indicate their particular roles. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Stakeholder	Role
Q6-2. How are decisions made in the village? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)* *(Note: there may be different types of decisions and hence different processes)*	Type of decision	process
Q6-3. What types of conflict may arise in the village (i.e. ethnic, crime etc) and who is the regulatory/decision-making authority responsible for managing them? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Type of conflict	Responsible authority

SECTION 7 – INFORMATION ABOUT VILLAGE QUALITY OF LIFE

Q7-1. Have there been any changes between life in the community in the past and present?	☐ Yes ☐ No
Q7-1-2. If so, please explain what these changes are and the possible reasons behind them.	
Q7-2. What are your main aspirations for the village in the future?	
Q7-3. What are the main challenges for the village?	1.

	2. 3. 4. 5.
Q7-3-1. What are community members doing to address these challenges?	

Q7-4. What are the main social problems in the village? For each problem, please indicate: • **Its importance** • **Any changes in its frequency (i.e. increase, decrease) over the past 5 years** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)* *(Note: indicate the prevalence of the different problems by ranking them 1 for the biggest problem, 2 for second biggest etc)*	Social problem	Importance	Changes in frequency in past 5 years
	Alcoholism		
	Theft		
	Prostitution		
	Gambling		
	Other *(please indicate)*		

SECTION 8 – INFORMATION ABOUT PERCEPTIONS

Q 8-1. Have there been any changes between life in the community in the past and present?	☐ Yes ☐ No
Q8-1-2. If so, please explain what these changes are and the possible reasons behind them.	
Q 8-2. What are your main aspirations for the village in the future?	

Q 8-3. What do you think will be the positive and negative impacts of the project on your lives? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Positive impacts	Negative impacts
Q8-4. What would be the best way to support or enhance the lives of the community in the area?		

TILENGA FEEDER & EACOP PIPELINE
SMALL GROUP INTERVIEW GUIDE FOR CROP FARMERS

Name of village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *Individuals who are reliant on subsistence crop agriculture as their main source of food;* • *Individuals who are involved in subsistence/cash crop agricultural activities as a source of income;* • *Individuals who are involved in processing/transporting crop products to markets and/or;* • *Individuals who are representatives of an agricultural association.*		

SECTION 1 - INFORMATION ABOUT CROP AGRICULTURAL PRACTICES

	Crop type	Whether crop is eaten or sold	Who grows the crop (i.e. men, women, children)	Typical crop yield per household per year (kg)	Location where crop is grown (i.e. household land, communal area)
Q1-1. What are the main types of crops grown in the area? For each crop, please indicate: • **Whether the crop is eaten or sold** • **Who grows the crop (i.e. men, women, children)** • **Typical crop yield per household per year (kg)** • **Location where crop is grown (i.e. household land, communal area)** (refer to map if needed) *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*					

	Crop sold	Method used to transport crop to market	Role of middlemen/associations in sale of crop	Typical income generated from crop each year	Typical price obtained per crop/per unit
Q1-2. In relation to the sale of crops, please indicate: • **Method used to transport crop to market** • **Role of middlemen/associations in the sale of the crop** • **The typical price obtained per crop/per unit** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*					

	Challenge	Description	Changes in past 5 years
Q1-3. What are the key challenges / problems involved in growing crops? For each type of challenges/problem , please: • **Provide more details about the challenge/problem (i.e. causes, impact on crop farmers in the area)** • **Describe whether this has changed in the past 5 years (i.e. worsened, improved)** *(Note: challenges associated with water and irrigation are asked separately below)* *(Note: for the purpose of collecting and recording data on the computer, please use the following table. Also the challenges in the table are examples and may not be applicable)*	Changes in the market value of crops sold		
	Interference/conflicts between individual farmers		
	Availability of hand equipment/tools		
	Availability of mechanized equipment (i.e. tractors)		
	Transportation of produce to markets (i.e. how is this done?)		
	The application of fertiliser/pesticides		
	Drought causing crop failure		
	Flooding causing crop failure		
	Crop health and disease		
	Soil quality		
	Presence of invasive plant species overtaking crops		
	Poor extension service		
	Other *(please indicate)*		
	Other *(please indicate)*		

SECTION 2 – INFORMATION ABOUT WATER AND IRRIGATION IN CROP AGRICULTURE

Q2-1. What are the main sources of water used in agriculture (i.e. boreholes, wells, canals, river pumps)? *(show on the map where the source for irrigation is)*	
Q2-2. If irrigation is used for crops, how is water diverted to fields and plantations?	
Q2-3. When is irrigation used by farmers (i.e. throughout the year, during certain periods)?	
Q2-4. Are there any challenges associated with using irrigation in the area?	☐ Yes ☐ No
Q2-4-1. If so which?	
SECTION 3 – INFORMATION ABOUT SUPPORT FOR CROP FARMERS	
Q3-1. Is any support offered to farmers through organisations?	☐ Yes ☐ No
Q3-1-1. If so, please discuss.	
Q3-2. Is any support offered to farmers through government	☐ Yes ☐ No
Q3-2-1. If so, please discuss.	
Q3-3. Have farmers in the area ever received training in enhanced productivity techniques? *(Note: tick all boxes applicable)*	☐ Using high-yield crop species ☐ Enhanced irrigation techniques ☐ Increased use of fertilisers ☐ Ways to access higher value markets ☐ Using information technology (i.e. including phone applications and provision of credit) ☐ Increased efficiency of land use (defining property rights, securing land tenure, increased governance) ☐ Other *(please specify)* ☐ No training received
Q3-3-1. If training has been given to farmers, who was this provided by (i.e. NGO, regional community development officer)	

TILENGA FEEDER & EACOP PIPELINE
SMALL GROUP INTERVIEW GUIDE FOR FISHERMEN

Name of village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	Fishermen at sea, in rivers and lakes		

SECTION 1 - INFORMATION ABOUT FISHERMEN

Q1-1. What is the proportion of households in the village involved in fishing (all, the majority, less than half, only a few)?			
Q1-2. What is the percentage of households that live totally off fishing (all, the majority, less than half, only a few)?			
Q1-3. Has the importance of fishing versus other livelihoods increased/decreased in the last 5 years or stayed the same?	☐ Increased ☐ Decreased ☐ No Change		
Q1-3-1. If any change, please explain the reasons behind this change.			
Q1-4. Who are involved in fishing (i.e. young men, older men, women and children) and how are they involved (specific tasks)? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Household member	Involved (yes/no)	Tasks
	Young men		
	Older men		
	Women		
	Children		
Q1-5. Do people pay others to help them with fishing?	☐ Yes ☐ No		
Q1-6. Do people fish in groups or alone?	☐ Groups ☐ Alone ☐ Both		
Q1-6-1. How are tasks and profits divided amongst people who fish in groups?			
Q1-7. Do fishermen generally belong to specific ethnic groups? Please name them. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Ethnicity		

SECTION 2 - INFORMATION ABOUT THE TYPE OF FISH THAT ARE CAUGHT AND SUPPLY CHAIN

Q2-1. For each of the type of fish or other sea lake or river animal (i.e. crab, sea cucumber) caught, please provide the following information: • **Typical yields (kg per trip)** • **Change in fish stock abundance (increase/decrease)** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Fish/ sea-lake-river animal species	Typical yield	Change in fish stock (increase/decrease)
Q2-2. What proportion of the fish /animal caught is sold? Please indicate for each species. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Fish/ sea-lake-river animal species	% of fish/animal sold	
Q2-3. What factors influence decisions to sell versus use at home?			

Q2-4. Where are the fish/animals sold? Please indicate if there are differences for the different species.				
Q2-5. How are the fish/animals transported? Please indicate if there are differences for the different species.				
Q2-6. How are the fish/animals preserved during transport to markets? Please indicate if there are differences for the different species.				
SECTION 3 - INFORMATION ABOUT FISHING AREAS AND FISHING PERIODS				
Q3-1. Where does fishing/ catching animals take place (i.e. in lakes, rivers, estuaries, coasts, mangroves)? For each place, please indicate: • **The best periods for fishing, catching (i.e. all year around or specific months)** • **Periods when fishing/ catching is not allowed** • **The accessibility of the fishing/ catching location (easy, difficult)** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Type of fishing location (lakes, rivers etc)	Best periods for fishing	Periods when fishing is not allowed	Accessibility of location (easy, difficult)
Q3-2. Do fishermen use specific routes from the shoreline to access fishing grounds?	☐ Yes ☐ No			
Q3-2-1. If so, please describe them *(refer to map)*.				
Q3-2.2 How far from the shore do people go?				
SECTION 4 - INFORMATION ABOUT FISHING BOATS/VESSELS				
Q4-1. What types of fishing vessels are used? For each vessel, please indicate: • **The type of fishing vessel** • **How they are powered (motor, manpower)** • **Typical number of people per vessel** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Fishing vessel type	Powered by	Number of people per vessel	
Q4-2. Of the households involved in fishing, what is the proportion of households who own their own vessels/boats?	%			
Q4-3. Has the number boats/vessels increased or decreased over the last 5 years or stayed the same?	☐ Increased ☐ Decreased ☐ No change			
Q4-3. 1 Please explain the reasons behind this change, if any.				
SECTION 5 - INFORMATION ABOUT FISHING GEAR/TECHNIQUES				
Q5-1. How do people catch the fish/ other water animals? Please list the different types of techniques used and explain the main advantages (i.e. ease of use, large yield) and disadvantages (i.e. expensive, dangerous) of using each technique. *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Fishing technique	Advantages	Disadvantages	

Q5-2. Do people fish/catch during the day, night or at both times?	☐ Day ☐ Night ☐ Both		
Q5-3. Does seasonality affect the fishing techniques that are used? Please explain.	☐ Yes ☐ No		
Q5-3-1. If so, please explain why.			
Q5-4. Do people do intertidal gleaning?	☐ Yes ☐ No		
Q5- 4-1. If so, what percentages of households do gleaning?	%		
Q5-4-2. If so, what do they glean? Please list the targets.			
Q5-5. What types of fishing equipment are used? For each type of equipment, please indicate: • **Whether it is generally owned or rented** • **What costs are involved in purchasing or renting the equipment** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Fishing equipment	Status (owned /rented)	Cost involved
	Nets		
	Long lines		
	etc		
SECTION 6 - INFORMATION ABOUT REGULATION			
Q6-1. Are any regulatory bodies managing artisanal/subsistence fishing/catching?	☐ Yes ☐ No		
Q6-1-1. If so, please can you name them and say what their roles are? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Regulatory bodies	Roles	
Q6-2. Are any licenses required to fish/catch?	☐ Yes ☐ No		
Q6-2-1. If so, please can you describe them?			
Q6-3. Are there formal and informal rules to abide by when fishing?	☐ Yes ☐ No		
Q6-3- 1. If so, what are they?			
SECTION 7 - INFORMATION ABOUT KEY CHALLENGES			
Q7-1. What key challenges do fishermen face in relation to their work (i.e. conflicts with commercial fishing companies)?			
Q7-2. What are the dangers associated with fishing/catching?			
Q7-3. How many accidents involving fishermen in the area have there been in the last year?	☐ 0 ☐ Less than 5 ☐ More than 5		
Q7-3-1. If so, what caused them?			
Q7-4. Is there any illegal fishing taking place in the area? Please explain the type of illegal fishing activities that occur	☐ Yes ☐ No		

TILENGA FEEDER & EACOP PIPELINE SMALL GROUP INTERVIEW GUIDE FOR PASTORALISTS				
Name of community		**Date of the interview**		
Name of interviewer				
Name(s) of the interviewee(s) and contact details				
Criteria to be used to select participants:	Leaders or members of nomadic pastoralist communities or organisations			
SECTION 1 - INFORMATION ABOUT LIVESTOCK AND GRAZING LAND				
Q1-1. Please describe the livestock you keep using the table:	Type of livestock	Typical herd size of household / family	Typical value(selling price) per animal in herd	Typical annual income earned from herd (sale, products. etc)
Q1-2. Please describe the task of each household member with regards to the livestock.				
Q1-3. Do you or other members of your household cultivate crops?	☐ Yes ☐ No			
Q1-3-1. If so can you describe how you combine these two activities? Different members of the family, different times of the year etc.				
Q1-4. For the most important livestock species, please describe how the animals are bred and the main sources of food.				
Q1-5. Where are your main grazing lands located? *(refer to map)*				
Q1-6. Is the land you use for grazing communal or private land or both?	☐ Communal ☐ Private ☐ Both			
Q1-6-1. If private (and not yours) how do you obtain permission to use the land?				
Q1-7. Do you have to pay to use grazing land?				
Q1-8. Where does your livestock get water from (river, boreholes, trough /pond, village supply etc).				
Q1-9. Are there enough watering points where				

you graze your animals?	
Q1-10. Are these water points providing good quality water?	
Q1-11 Is obtaining water for your livestock ever difficult? If so, please explain why and show where (on the map).	
SECTION 2 - INFORMATION ABOUT NOMADIC PASTORALIST GROUPS AND MOVEMENTS	
Q2-1.Do you travel as a household or only few members of household or as a group of several households with your livestock?	☐ Household ☐ Few members of household ☐ Group of households
Q2-2. If you travel in group, what is the composition of the group (i.e. households, only men, only young men)?	
Q2-3. To which tribe do you belong?	
Q2-4. Do you have a village that you call home and return to annually for an extended period of time? Please explain.	☐ Yes ☐ No
Q2-5. Please explain your annual movements. If it changes every year then please describe your movements of last year. *(Note: Ask participants to draw their movements on a local or regional livestock migration map if available, if not use own)*	
Q2-6. Do you occasionally cross national borders with your herd?	
SECTION 3 – INFORMATION ABOUT THE SALE OF LIVESTOCK/LIVESTOCK PRODUCTS	

Q3-1. Please explain the general process for buying and selling livestock. **Q3-1-1 Are there markets?** **Q3-1-2 If so, what type of markets and where are they** (name the town or area and *if possible show on the map)* **Q3-1-3 What type of livestock is sold/bought there?** **Q3-1-4 Are the markets privately owned / managed or public?**					
Q3-2. Please indicate the following in the table:	Livestock products (meat, cheese, milk, hide, etc. indicate from which animal)	Methods of transportation of livestock product to the market	Role of middlemen/associations in the sale of livestock product	Average price per animal/unit of the product sold	Responsibility for the sale of livestock product (i.e. men, women)
SECTION 4 - INFORMATION ABOUT SUPPORT FOR AND CHALLENGES FACING PASTORALIST GROUPS					
Q4-1. What problems, if any, do you face as pastoralists?					
Q4-2. How are you trying to deal these problems?					
Q4-3. What have been the major changes to your way of life over the past 5 years?					
Q4-4. In your view do pastoralists have a higher, lower or similar income to farmers?	☐ Higher ☐ Lower ☐ Similar				
Q4-5. Are there services or infrastructure to support you (i.e dips for	☐ Yes ☐ No				

diseases prevention)? If so, please describe them.			
Q4-6. Are there any animal husbandry organisations in your area?	☐ Yes ☐ No		
Q4-6-1. What role do these organisations play? What support can they provide to you?			
Q4-7. Are there any animal veterinary services available in your area?	☐ Yes ☐ No		
Q4-7-1. Are these services affordable?			
Q4-7-2. How are these services delivered to you?			
Q4-8. What are the common diseases and parasites for different livestock species in the area and how has this changed over the past 5 years? *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Type of livestock	Common diseases and parasites	Changes noted in the past 5 years
Q4-9. How common are livestock injuries in the area?			
Q4-10. Is livestock theft a problem in this area?	☐ Yes ☐ No		
Q4-10-1. If yes, how has livestock theft changed in the past 5 years?			
Q4-11. Are threats from wild life (predators) a problem from this area?			
Q4-12. Is there any conflict between different nomadic pastoralist groups?			
Q4-13. Is there any conflict between farmers and nomadic pastoralists?			
Q4-14. What are the good and the bad sides of being a pastoralist and has this changed over the years?			

TILENGA FEEDER & EACOP PIPELINE
SMALL GROUP INTERVIEW GUIDE FOR NATURAL RESOURCE USERS

Name of village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *People who may rely on bush meat as a source of protein;* • *People who own traps/snares, or have knowledge of them, or sell bush meat products;* • *People who live close to designated conservation areas where bush species (and people hunting them) may be present;* • *People who are beekeepers;* • *People who are known to collect wild plants, fruits, nuts, mushrooms, honey etc for a source of nutrients, medicinal use, or for alcohol;* • *People who provide locally sought building materials in the form of sand, gravel, timber, poles, thatch, cordage, etc and/or;* • *People who produce charcoal for household consumption or cash sale.* • *People who collect intertidal marine resources (seaweed, coral for lime making, salt)* • *People who harvest mangroves (for household use or cash sale)* • *People who collect plant materials for firewood* • *People who collect craft materials (weaving, curving, pottery)* • *People who graze, collect animal fodder* • *People who use forested areas / trees /caves / open areas for rituals*		
SECTION 1 - INFORMATION ABOUT WILD/BUSH ANIMALS			
Q1-1. Do people in the village hunt wild animals?	☐ Yes ☐ No		

Q1-1-1 If yes, please complete the following table:

Animal	How they are hunted	Purpose	Season(s) hunted	% Sale/own use	Frequency of hunting (how often per month)	Income generated per month- during hunting season	Those involved in hunting (i.e. men, women, children)

Q1-2. Where are animals being hunted and caught?	
(refer to map)	
Q1-3. Have the numbers of animals increased or decreased in the past 5 years or remained the same? Please describe for the different animals that you hunt as indicated in the table above.	
Q1-3-1. Please explain the reasons behind this change, if any.	
Q1-4. What proportion of households in the village hunt animals (all the majority, less than half, a few)?	
Q1-5. Has the number of people hunting increased or decreased in the past 10 years or remained the same?	☐ Increased ☐ Decreased ☐ No change
Q1-5-1. If any change , please explain the reasons behind this change.	
Q1-6. Has the need for bush meat increased or decreased in the past 10 years or remained the same?	☐ Increased ☐ Decreased ☐ No change
Q1-6-1. If any change please explain the reasons behind this change.	
Q1-7. Is a hunting permit required?	☐ Yes ☐ No
Q1-7-1. If a permit is required who provides it?	

Q1-8. Are there any restricted areas where hunting is not permitted?	☐ Yes ☐ No
Q1-8-1. If so where are these? (*show on the map*)	
Q1-9. Are there any taboos related to hunting, to particular wild animal species?	☐ Yes ☐ No
Q1-9-1 If there are taboos, please describe these.	
Q1-10 Are there any animals that cannot be hunted? Please name them.	☐ Yes ☐ No
Q1-11. What do you understand by illegal hunting?	
Q1-11-1. Are people ever caught for illegal hunting by the authorities?	☐ Yes ☐ No
Q1-12. How is bush meat sold (i.e. locally, in other villages, privately, in an open market)?	
Q1-13. If alternatives were available (i.e. chicken for meat), would they be used?	

SECTION 2 - INFORMATION ABOUT WILD PLANTS (INCLUDING LEAVES, NUTS, FRUITS AND BERRIES)

Q2-1. Please complete the following table:	Wild plant	Purpose (i.e. medicine, food)	Who collects (i.e. men, women)	Where collected *(refer to map)*	Seasonal variations in availability	Frequency of collection (how often per month)	Own use/sale or both	Income generated per month	Importance of wild plant	Where plant is sold (if relevant)

Q2-2. What percentages of households in the village collect wild plants?	
Q2-3. Has the number of people collecting wild plants increased or decreased over the past 10 years or remained the same?	☐ Increased ☐ Decreased ☐ No change
Q2-3-1. Please explain the reasons behind this change, if any.	
Q2-4. Has the need for wild plants increased or decreased over the past 10 years or remained the same?	☐ Increased ☐ Decreased ☐ No change
Q2-4-1. If there is a change, please explain the reasons behind this change.	
Q2-5. Is a permit to collect wild plants required?	☐ Yes ☐ No
Q2-5-1 If a permit is	

required, who provides it?	
Q2-6. Are there any areas where collecting plants is not permitted? *(please show on the map)*	☐ Yes ☐ No
Q2-7. Are there any plants that are protected and cannot be gathered?	☐ Yes ☐ No
Q2-7-1. If yes, please name them	
Q2-8. Are there any taboos related to particular wild plant species?	☐ Yes ☐ No
Q2-8-1. If there are taboos, can you please describe them?	
Q2-9. Please explain how and where wild plants are sold (i.e. locally, in other villages, privately, in an open market).	

SECTION 3 - INFORMATION ABOUT OTHER NATURAL RESOURCES (FUELWOOD, TIMBER, SAND, GRAVEL, HONEY, MUSHROOMS)

Q3-1. Q2-1. Please complete the following table. Add details of other types of products if collected, such as freshwater sea products (fish, seaweed, etc.)	Type of product	How collected	Roles of men and women	Seasonal variation in product availability	Where collected *(refer to map)*	Permission required to collect? (Y/N)	Frequency of collection (how often per month)	Whether product is sold or for own use	Where product sold (if relevant)	Proportion of households involved (a few, less than half, majority, all)	Increase/decrease in availability
	Honey										
	Mushrooms										
	Fuelwood										
	Timber										
	Sand										
	Gravel										
	Other *(please indicate)*										
	Other *(please indicate)*										
	Other *(please indicate)*										

Q3-2. Please describe how the products are sold (i.e. locally, in other villages, privately, in an open market).	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR BUSINESS OWNERS			
Name of district/sub county/village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *A business owner (i.e. shop, artisan, bicycle mechanic etc) in the village*		
SECTION 1 - INFORMATION ABOUT BUSINESSES IN THE VILLAGE			
Q1-1. What type of business do you operate?			
Q1-2. What are the main products/services you trade in?			
Q1-3. When did you start your business?			
Q1-4. Do you purchase materials/goods for your business?	☐ Yes ☐ No		
Q1-4-1. If so, where do you purchase them from?			
Q1-5. Is your premise owned or rented?	☐ Owned ☐ Rented		
Q1-6. How many people does your business employ?			
Q1-7. Do you have competition?	☐ Yes ☐ No		
Q1-7-1. If so, please elaborate.			
Q1-8. What is the average income and profit of your business in a good and bad month?	Good month: Bad month:		
Q1-9. Please describe your typical customers (i.e. whether men or women, whether from inside or outside the village, etc)			
Q1-10. What are the main challenges you face in running the business?			
Q1-11. What changes have you observed since y started your business in terms of customers, profits etc and please explain possible reasons why.			

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR COMMUNITY HEALTH FACILITY			
Name of village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)		**Position of the interviewee(s)**	
Name of facility			
Type of facility			
Walk through done	☐ Yes ☐ No		
Photos taken	☐ Yes ☐ No		
GPS reference taken	☐ Yes ☐ No	**GPS reference**	
Criteria to be used to select participants:	• *Senior representative of the community health facility*		

SECTION 1 - INFORMATION ABOUT MEDICAL STAFF AVAILABILITY			
Q1-1. Please indicate: • **Which staff are available at the community health facility** • **How many of these staff are available** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Staff	Currently have/how many	Do not have
	General doctor		
	Specialist doctor		
	Clinical technicians		
	Registered nurses		
	Enrolled nurses		
	Midwives		
	Laboratory technologist		
	Laboratory assistant		
	Pharmacist		
	Community health worker		
	Cleaning staff		
	Security personnel		
	Other *(please indicate)*		

SECTION 2 - INFORMATION ABOUT FACILITY INFRASTRUCTURE	
Q2-1. Does the facility have regular/reliable running water?	☐ Yes ☐ No
Q2-2. Does the facility have regular/reliable electricity?	☐ Yes ☐ No
Q2-2-1. What type of electricity does the facility rely on?	☐ Generator ☐ Solar power ☐ Other *(please indicate)*
Q2-3. Does the facility have a functioning refrigerator?	☐ Yes ☐ No
Q2-4. Does the facility have a functioning landline?	☐ Yes ☐ No
Q2-5. Does the facility have a functioning mobile phone (not personal)?	☐ Yes ☐ No
Q2-6. Does the facility have functioning two-way radio communication?	☐ Yes ☐ No
Q2-7. What is the condition of the equipment and infrastructure of the facility?	
Q2-8. Any other comments?	

SECTION 3 – INFORMATION ABOUT SERVICE AVAILABILITY	
Q3-1. Does the facility provide out-patient services?	☐ Yes ☐ No
Q3-2. Does the facility provide in-patient services?	☐ Yes ☐ No
Q3-2-1. How many in-patient beds are available (if any)?	
Q3-3. Does the facility provide 24-hour emergency services?	☐ Yes ☐ No
Q3-4. Does the facility provide delivery services (births)?	☐ Yes ☐ No
Q3-5. Does the facility provide blood transfusions?	☐ Yes ☐ No
Q3-6. Is there a pharmacy at the facility?	☐ Yes ☐ No
Q3-7. Does the facility provide immunisations?	☐ Yes ☐ No
Q3-8. Does the facility provide growth monitoring services?	☐ Yes ☐ No
Q3-9. Does the facility provide HIV services (any)?	☐ Yes ☐ No
Q3-10. Does the facility have a functioning ambulance service?	☐ Yes ☐ No
Q3-11. Does the facility offer rapid diagnostic tests for malaria?	☐ Yes ☐ No
Q3-12. Does the facility offer rapid diagnostic tests for HIV?	☐ Yes ☐ No
Q3-13. Does the facility offer HIV CD4 counts?	☐ Yes ☐ No
Q3-14. Does the facility offer TB diagnosis (any kind)?	☐ Yes ☐ No
Q3-15. Do medical staff live in close proximity to the facility?	☐ Yes ☐ No
Q3-16. What are the official daily opening hours of the facility?	
Q3-17. Any other comments?	

SECTION 4 - INFORMATION ABOUT ACCESS TO A REFERRAL HOSPITAL	
Q4-1. How far away is the referral hospital from the community health facility (in hours)?	
Q4-2. Is transportation from the community health facility to the hospital available?	☐ Yes ☐ No
Q4-2-1. What is the cost of this transportation (both ways)?	
Q4-3. Any other comments?	
SECTION 5 – INFORMATION ABOUT THE COST OF HEALTHCARE	
Q5-1. How much does a basic outpatient consultation cost?	
Q5-2. How much does diagnosis and treatment for malaria cost (with RDT use)?	
Q5-3. How much does admission for a child cost?	
Q5-4. Any other comments?	
SECTION 6 – GENERAL INFORMATION ABOUT COMMUNITY HEALTH AND THE FACILITY	
Q6-1. How many people have access to this health care facility?	
Q6-2. What are the 3-5 main health challenges facing the community?	1. 2. 3. 4. 5.
Q6-3. What are the 5 most common diseases in children under 5 years?	1. 2. 3. 4. 5.
Q6-4. What are the 5 most common diseases for all age groups?	1. 2. 3. 4. 5.

Q6-5. What treatment/management plans are in place for addressing such diseases?	
Q6-6. Are there measures in place at the facility to deal with disease outbreaks?	☐ Yes ☐ No
Q6-6-1. If so, what are they?	
Q6-7. What is the status of violence against women in your area?	
Q6-7-1. Has violence against women increased, decreased or remained the same in the past 5 years?	☐ Increased ☐ Decreased ☐ No Change
Q6-8. Is there good community support for local health initiatives?	☐ Yes ☐ No
Q6-9. If you had 3-5 wishes to improve health care in the communities that you serve, what would they be?	1. 2. 3. 4. 5.

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR COMMUNITY HEALTH STAFF			
Name of village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *Staff based in local health facilities (i.e. dispensaries)* • *Community health workers* • *Midwives (trained)* • *Traditional Birth Attendants (TBAs)* • *Local community development officers*		
SECTION 1 - INFORMATION ABOUT COMMUNITY HEALTH FACILITIES			
Q1-1. Please describe the health facilities and health services (i.e. outreach programmes) available in the area.			
Q1-2. Please describe how accessible (good, medium, poor) these facilities are to local people in terms of: • **Physical distance between facilities and homes** • **The cost of transportation** • **The cost of a consultation** • **The cost of a treatment/medicine**		**Good/medium/ poor**	
	Physical distance between facilities and homes		
	Cost of transportation		
	The cost of a consultation		
	The cost of a treatment/medicine		
Q1-3. Do people trust the local health facility to correctly diagnose and treat illnesses?	☐ Yes ☐ No		
Q1-4. What proportion of women in the village give birth at a health facility (all, majority, less than half, very few)?	Health facility :		
Q1-5. Do women typically receive advice from a trained community health worker before giving birth?	☐ Yes ☐ No		
Q1-6. Do women typically receive advice from a trained community health worker after giving birth?	☐ Yes ☐ No		
SECTION 2 - INFORMATION ABOUT COMMUNITY HEALTH PROFILE AND CHALLENGES			
Q2-1. What are the main sources of protein consumed by the local population?			
Q2-2. What are the five most common illnesses in the local community?	6. 7. 8. 9. 10.		

Q2-3. How many people (babies, children, adults) are affected by malnutrition in the village and in what manner?		
Q2-3-1. If people are malnourished, what are the main reasons behind people not having enough food?		
Q2-3-2. What are the key challenges/problems relating to food production in the area?		
Q2-3-3. Who is the regulatory/decision-making authority responsible for food and nutrition?		
Q2-4. What role do sexual norms and behaviours play in the existence of diseases such as HIV/AIDS?		
Q2-5. What is the local attitude towards the use of contraception?		
Q2-6. Are any groups in society particularly vulnerable to certain diseases?		
Q2-7. Is food hygiene a problem or has it been a problem in the past?		
SECTION 3 – INFORMATION ABOUT THE ROLE OF TRADITIONAL HEALERS		
Q3-1. Are there any traditional healers practicing in the area?		
Q3-2. Where do they come from (i.e. inside or outside the area)?		
Q3-3. What kind of training have they received?		
Q3-4. Do they need to be registered with the local health authority in order to practice?		
Q3-5. What methods do traditional healers typically use?		
Q3-6. Is there any collaboration between traditional healers and modern medicine?		
Q3-7. Why might somebody favour a traditional healer over a regular doctor at a health facility?		
Q3-8. Are there any problems associated with people choosing traditional medicine over modern medicine?		
SECTION 4 - INFORMATION ABOUT SOLID WASTE MANAGEMENT		
Q4-1. What types of waste	**Type**	**Yes or No**

management services are available in the community?	private waste pit near homestead	
	landfill	
	compost waste	
	waste ever burnt in the open air near to houses	
	Other	

SECTION 5 – INFORMATION ABOUT WATER, SANITATION AND HYGIENE

Q5-1. Please provide a summary of local drinking water sources. Please indicate:

- **Sources of water**
- **Purpose of water sources**
- **Average distance travelled to reach water sources**
- **The reliability of water sources (always available or not)**
- **The perceived quality of water sources**
- **The monthly cost associated with water (if it is paid for)**
- **Who collects water from the source (i.e. men, women, children)**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

Source of water	Purpose of water	Distance travelled to source	Reliability of water source	Perceived quality of water source	Monthly cost of water (if paid for)	Who collects water from source
Village well						
Village hand pump						
Public borehole						
Private borehole						
Surface water (lake, river etc)						
Bottled water						
Other *(please indicate)*						

TILENGA FEEDER & EACOP PIPELINE
KEY INFORMANT INTERVIEW GUIDE FOR COMMERCIAL AND SUBSISTENCE FARMERS

Name of district/sub county/village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *Farmers engaged primarily in commercial agriculture (attempt to get a variety of crops)*		

SECTION 1 - INFORMATION ABOUT CASH CROPS GROWN

Q1-1. What types of cash crops do you grow (including vegetables, fruit and trees)? Please indicate: • **Acreage under cultivation per crop** • **Typical income earned per acre** • **Value or sale price per unit of crop** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Name of crop	Acreage under cultivation	Typical income per acre	Value/sale price per unit

SECTION 2 – INFORMATION ABOUT FARMING PRACTICES, WORKFORCE AND OPERATIONS

Q2-1. Please describe the type of machinery you use, if any.			
Q2-2. Do you use pesticides?	☐ Yes ☐ No		
Q2-3-1. If so, please indicate: • **What pesticides you use** • **Where you purchase them** • **How much they cost** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Pesticide	Purchased from	Cost
Q2-4. Do you use fertilisers?	☐ Yes ☐ No		
Q2-4-1. If so, please indicate: • **What fertilisers you use** • **Where you purchase them** • **How much they cost**	Fertiliser	Purchased from	Cost

(Note: for the purpose of collecting and recording data on the computer, please use the following table)			
Q2-5. Which members of your family are involved in your farming operations?			
Q2-6. Do you employ anybody to help with your farming operations?	☐ Yes ☐ No		
Q2-6-1. If so, are these men, women or both?	☐ Men ☐ Women ☐ Mixture		
Q2-7. Do you use irrigation?	☐ Yes ☐ No		

Q2-7-1. If so, please indicate: • **The source of irrigation** • **When you irrigate** • **The cost of irrigation** • **The reliability of irrigation** • **Whether the irrigation infrastructure you use is communal or private** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Source of irrigation	Timing of irrigation	Cost of irrigation	Reliability of irrigation	Communal versus private irrigation infrastructure

Q2-8. Please describe any changes in commercial agricultural practices over the past 10 years.	
Q2-9. How much land do you farm?	
Q2-10. Please describe the seasonal calendar for agriculture (i.e. planting, growing, harvesting).	
Q2-11. Where are your crops sold? Does this vary according to the crop being sold?	
Q2-12. Who are your main customers? Does this vary according to the crop being sold?	
Q2-13. How do you transport your crops to	

the market place? Does this vary according to the crop being sold?				
SECTION 3 – INFORMATION ABOUT COMMERCIAL FARMING CHALLENGES AND OPPORTUNITIES				
Q3-1. What challenges do you face in marketing?				
Q3-2. What are the key challenges relating to farming (i.e. water, pests, theft, soil quality, natural calamities such as flooding or drought)? Please indicate: • **The frequency of these challenges** • **The severity of these challenges** • **The consequences of these challenges** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Challenge	Frequency	Severity	Consequences
	Water shortages			
	Pests and diseases			
	Crop theft			
	Poor soil quality			
	Natural calamities			
	Other *(please indicate)*			
	Other *(please indicate)*			
Q3-3. What are the opportunities associated with commercial farming?				
Q3-4. Are there any farmer organisations that you are a member of?	☐ Yes ☐ No			
Q3-4-1. If so, please provide details of the organisation. Please indicate: • **The name of the organisation** • **The number of members** • **Its role/function** • **The support provided** *(Note: for the purpose of collecting and recording data on the computer, please use the following table)*	Organisation name	Number of members	Role/function	Support provided
Q3-5. What kind of support does the government provide to farmers?				
Q3-6. Are there ever conflicts between farmers or between farmers and pastoralists?	☐ Yes ☐ No			
Q3-6-1. If so, please elaborate.				

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR TRADITIONAL HEALERS			
Name of district/sub county/village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants:	• *One or a small group of traditional healers in the village*		
SECTION 1 - INFORMATION ABOUT TRADITIONAL HEALING IN THE VILLAGE			
Q1-1. How important is traditional medicine as a form of treatment in the local area? For example, is it more popular than orthodox medicine?			
Q1-2. Are your patients mainly men, women or children?	☐ Men ☐ Women ☐ Children ☐ Mixture		
Q1-3. What typical health complaints do people have who come to see you?			
Q1-4. What is the average cost of a treatment?			
Q1-5. What methods do you use (i.e. herbs, rituals)?			
Q1-6. Please describe the relationship you have with the modern medicine (health clinics etc)?			
Q1-7. Why might somebody choose a traditional healer over a regular doctor at a health facility?			
Q1-8. Are you from this village?	☐ Yes ☐ No		
Q1-8-1. If not, where do you come from, how long have you lived here and what brought you here?			
Q1-9. What ethnic group are you from?			
Q1-10. Do people from outside the village seek treatment from you?	☐ Yes ☐ No		
Q1-11. Do you collect any specific wild plants or animals to use in your treatments?	☐ Yes ☐ No		
Q1-11-1. If so, please state the 5 most used plants and how much is required of each plant per year.	**Plant**	**How much needed**	
Q1-12. Do you know of any travelling traditional healers that pass through this area?			

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR TEACHERS			
Name of district/sub county/village		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
Criteria to be used to select participants	• *One or a small group of teachers in the village*		
SECTION 1 - INFORMATION ABOUT EDUCATION IN THE VILLAGE			
Q1-1. What is the literacy rate in the village?			
Q1-2. How does this compare to neighbouring villages?			
Q1-3. What is the proportion of children in the village that attend school on a regular basis?	Attend school: % Do not attend school: %		
Q1-3-1. If relevant, what are the reasons for children not attending school?			
Q1-3-2. Does school attendance vary by gender?	☐ Yes ☐ No		
Q1-3-2-1. If so, please explain the reasons behind this variation.			
Q1-4. How much importance do parents place on education?			

Q1-5. Please describe the local school(s). Please indicate:
- **The level of education taught (i.e. primary, secondary)**
- **The number of students (male/female) per class**
- **The ratio of students to staff**
- **The ratio of students to classrooms**
- **Whether classrooms are adequately equipped with materials and facilities**

(Note: for the purpose of collecting and recording data on the computer, please use the following table)

School name	Level of education	Number of students per class	Ratio of students : staff	Ratio of students : classrooms	Are classrooms adequately equipped?

Q1-6. What is the pass rate at the level of primary education?	%
Q1-7. What percentage of children go onto secondary school?	%
Q1-8. Do children have to pay to attend primary school?	☐ Yes ☐ No
Q1-8-1. If so, what do they pay for and how much do they pay?	
Q1-9. Do children have to pay to attend secondary school?	☐ Yes ☐ No
Q1-9-1. If so, what do they pay for and how much do they pay?	

Q1-10. What typical challenges are faced by teachers in the school and village?	
Q1-11. How have these challenges changed in the past 10 years, if at all?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR CREDIT ACCESS			
Location of the interview		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
SECTION 1 – INFORMATION ABOUT MICRO-FINANCE SOCIETY/COOPERATIVE			
Q1-1. What collateral do people need in order to become a member of the group/society?			
Q1-2. What is the membership criteria for joining the group/society?			
Q1-3. What is the typical amount of money borrowed by the members?			
Q1-4. What are loans typically used for?			
Q1-5. What interest rate is attached to the loans? What are the repayment terms?			
Q1-6. What area(s) does the society cover?			
Q1-7. What is the level of financial literacy in the communities that you cover?			
Q1-8. Do you offer any training or awareness campaigns to build capacity? If so, please elaborate.			
Q1-9. What are the main challenges you face as a micro-finance society?			
Q1-10. What might the impacts of the society be (positives and negatives)?			
SECTION 2 – INFORMATION ABOUT COMMUNITY-BASED SAVINGS GROUP			
Q2-1. When was the group founded?			
Q2-2. How many members do you have?			
Q2-2-1. What expansion/growth have you had since the group started?			
Q2-2-2. What would be the ideal membership size of the group?			

Q2-3. What is the composition of the group (i.e. men, women or both, young or old, from within or outside the village)?	
Q2-4. How often do you meet?	
Q2-5. Do you have specific focuses that you decide upon as a group?	
Q2-6. What is the criteria for joining the group?	
Q2-7. How did you obtain the money to invest in the first place?	
Q2-8. How much money is typically borrowed?	
Q2-9. What is the money typically used for?	
Q2-10. How does the allocation of payments work? How much interest is attached to loans and what are the repayment intervals?	
Q2-11. What other support do you feel the group provides to members?	
Q2-12. What are your thoughts about the EACOP project?	
Q2-13. What impacts do you feel the project could have on your livelihoods and the investment/growth plans of the group?	
Q2-14. What mitigation measures do you suggest for any possible negative impacts?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR MILITARY BARRACKS			
Location of the interview		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
SECTION 1 – BACKGROUND INFORMATION			
Q1-1. When were the military barracks established?			
Q1-2. How many military personnel are based here?			
Q1-3. How many units of accommodation are provided?			
Q1-4. Do families of the military personnel also live in the accommodation, or are they living in nearby communities?			
SECTION 2 - INFORMATION ABOUT COMMUNITY INTERACTIONS			
Q2-1. What interactions do military personnel have with local communities?			
Q2-2. Do military personnel travel into the communities, or do people from the communities approach the barracks?			
Q2-3. Has there been or are there any tension/disputes between the local communities and the military personnel based in the barracks?			
Q2-4. Are any goods/services sourced from the communities, such as:	☐ Food ☐ Water (from boreholes or shallow wells) ☐ Health facilities ☐ Educational establishments (such as schools, colleges etc) ☐ Water disposal sites ☐ Sanitary waste/water disposal sites ☐ Other (please specify)		
Q2-5. Are any non-military personnel from the local community working in the barracks? If so, how many are working and what type of roles do they have?			
SECTION 3 – INFORMATION ABOUT LAND AND PROPERTY			
Q3-1. Are there any nearby land conflicts that military personnel get involved in? If so, please provide details of the different groups involved, and the reason for the conflict.			
Q3-2. Is neighboring land beyond the fence used for military activities, such as training exercises or the storage of materials?			

Q3-3. Have you experienced people starting to live close to the barracks to try and set up housing areas and small-scale vending activities, such as bars, shops, food outlets etc?	
Q3-4. Do they need to be registered with the local health authority in order to practice?	
SECTION 4 - INFORMATION ABOUT HEALTH AND SAFETY	
Q4-1. Are there any other local health and safety issues that the development may need to take into consideration?	
Q4-2. Are there any emergency response vehicles and resources based at the barracks such as a fire truck or ambulance?	
Q4-3. Are there any emergency response vehicles and resources based at the local community such as a fire truck or ambulance?	
Q4-4. Have there been any crime incidents between the communities/pastoralists/in-migrants and barracks?	
Q4-5. One concern is a potential increase in congestion on the road as a result of construction traffic. The barracks is one of the main road users. Are there any particular times of the day/year when it is used more for military movements?	
Q4-6. What is the condition of the local road network?	
Q4-7. Have there been any types of traffic accidents on the road? If yes, what was the main cause of these accidents in your view?	
SECTION 5 – INFORMATION ABOUT THIRD PARTY DEVELOPMENTS	
Q5-1. Do you know of any other major infrastructure developments that are going to take place in the area? These may include the development of new schools, health facilities, establishment of industrial activities, new cattle markets, road improvements etc.	
Q5-2. Are there any plans to expand the barracks in the near future?	

SECTION 6 – INFORMATION ABOUT PROJECT IMPACTS	
Q6-1. How do you think the pipeline may impact the community?	
Q6-2. Are there any stakeholders locally whom you feel would be important for the team to talk with?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR BODA BODAS/TAXIS			
Location of the interview		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
SECTION 1 – GENERAL INFORMATION			
Q1-1. How many vehicles do you own or operate?			
Q1-2. In terms of ownership status, do you:	☐ Own the vehicle outright ☐ Continue to pay the vehicle off ☐ Drive for the owner		
Q1-3. What price do you charge and for what distance?			
Q1-4. What area do you cover/service?			
Q1-5. Do you belong to an association? If so, please name the association you belong to.			
Q1-6. Have you observed any changes in your customer base in the past year? If so, please elaborate.			
Q1-7. What times of the day are you most and least busy?			
Q1-8. Are there any hazards on any particular roads?			
Q1-9. Do you encounter many road accidents during your work? Please elaborate.			
Q1-10. What do you think about the project development coming to your area? How do you think it will impact you and the community?			
Q1-11. Can you recommend any other stakeholders for us to speak to?			

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR RELIGIOUS LEADERS			
Name of district/sub county/village		**Date of the interview:**	
Name of interviewer:			
Name(s) of the interviewee(s):			
Criteria to be used to select participants:	• *Religious leaders of the different denominations in the village*		
SECTION 1 - INFORMATION ABOUT RELIGIOUS LIFE IN THE VILLAGE			
Q1-1. What are the main religious groups in your village?			
Q1-2. How important is religion for members of the community?	☐ Very important ☐ Quite important ☐ Not very important ☐ Not important at all		
Q1-3. Do people follow traditional belief systems in parallel with religious belief systems? Please elaborate on your answer.	☐ Yes ☐ No		
Q1-4. What are the key spiritual beliefs of the villagers?			
Q1-5. Are there any religious sites in the area (whether man-made or natural)? If so, please indicate where.	☐ Yes ☐ No		
Q1-6. Where are religious ceremonies held within the village?			
Q1-7. Are there any tensions between different religious groups?	☐ Yes ☐ No		
Q1-8. What is the role of religious leaders in village decision-making (including conflict resolution)?			
Q1-9. Has this changed in the past 10 years?			
Q1-10. Are there any local prophets that people follow?			

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR SEX WORKERS			
Location of the interview		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
SECTION 1 – GENERAL INFORMATION			
Q1-1. What is your familial/marital status?			
Q1-2. Do you operate on your own or as a more formal group?			
Q1-3. Do you pay for security protection?			
Q1-4. Who are your main customers?			
Q1-5. Are there any types of people that you will not see?			
Q1-6. Where do you do your work?			
Q1-7. How much do you earn a day?			
SECTION 2 – INFORMATION ABOUT HEALTH			
Q2-1. Do you have any health issues? If so, please specify.			
Q2-2. Do you encounter gender-based violence?			
SECTION 3 – INFORMATION ABOUT LAND AND PROPERTY			
Q3-1. Are there any nearby land conflicts that military personnel get involved in? If so, please provide details of the different groups involved, and the reason for the conflict.			
Q3-2. Is neighboring land beyond the fence used for military activities, such as training exercises or the storage of materials?			
Q3-3. Have you experienced people starting to live close to the barracks to try and set up housing areas and small-scale vending activities, such as bars, shops, food outlets etc?			
Q3-4. Do they need to be registered with the local health authority in order to practice?			

SECTION 4 - INFORMATION ABOUT ALTERNATIVE LIVELIHOODS	
Q4-1. Do you have any alternative means of generating an income?	
Q4-2. What do you think about the project development coming to your area? How do you think it will impact you and the community?	

TILENGA FEEDER & EACOP PIPELINE KEY INFORMANT INTERVIEW GUIDE FOR GUESTHOUSES/HOTELS			
Location of the interview		**Date of the interview**	
Name of interviewer			
Name(s) of the interviewee(s)			
SECTION 1 – BACKGROUND INFORMATION			
Q1-1. Is this hotel managed by the owner or a specific hotel manager?			
Q1-2. Is this person a man or a woman?			
Q1-3. How many rooms does the hotel have?			
Q1-4. What conference facilities are available?			
Q1-5. How many staff do you employ (and are they local people or from further afield)?			
Q1-6. Where do you source your fresh produce from for your kitchen?			
Q1-7. Where do you source your other supplies from?			
Q1-8. How do you market yourself?			
Q1-9. Do you have any other hotels in this same chain elsewhere in Uganda?			
SECTION 2 - INFORMATION ABOUT GUESTS			
Q2-1. What is the annual guest figure for this hotel/guesthouse?			
Q2-2. Are there certain times/periods of the year that are more popular/busy than others? Please elaborate.			
Q2-3. Are your clients mostly business travelers/in transit, or are they mostly travelling for leisure/tourism?			
Q2-4. What percentage (just an indication) of your clients are:	Ugandans from this District : % Ugandans from other parts of Uganda : % Nationals from other parts of East Africa : % Nationals from other parts of Africa : % Nationals from other parts of the world : %		
SECTION 3 – INFORMATION ABOUT ATTRACTIONS			
Q3-1. Do you feel that this hotel is strategically placed for business because of tourists or people in transit?			

Q3-2. What tourist attractions are local to this area?	
Q3-3. Do you accommodate people for any cultural events?	
Q3-4. What are the main business activities that attract guests?	
SECTION 4 - INFORMATION ABOUT PROJECT IMPACTS AND BENEFITS	
Q4-1. Have you identified any benefits that you anticipate the project bringing to you?	
Q4-2. Have you identified any negative project impacts that you are concerned may affect you?	
Q4-3. Are you making any changes to how you run your business in the lead up to this project?	
SECTION 5 – INFORMATION ABOUT TOURISM STAKEHOLDERS	
Q5-1. Who do you feel the local tourism stakeholders are in this area?	
Q5-2. What do you feel tourism contributes to socio-economic development?	
Q5-3. How is your relationship, as a hotel, with the rest of the community?	

TILENGA FEEDER & EACOP PIPELINE SOCIAL AND HEALTH BASELINE STUDY – HOUSEHOLD QUESTIONNAIRE

This household questionnaire is being administered as part of social baseline data collection for the EACOP project. The questionnaire contains a series of questions designed to gather information about households in terms of their composition, homestead structure, economic activities, health, use of natural resources and so forth.

Questionnaire ID			
Name of village		**Name of parish/ward**	
Name of sub-county		**Name of district**	
Name of interviewer			
Date of the interview			

INFORMATION ABOUT THE PERSON BEING INTERVIEWED

First name	
Last name	
Gender	☐ Male ☐ Female
Age	☐ 15-20 years old ☐ 20-30 years old ☐ 30-40 years old ☐ 40-50 years old ☐ 50-60 years old ☐ over 60 years old
Marital status	☐ Single ☐ Married ☐ Divorced ☐ Separated ☐ Cohabitant ☐ Widowed
Education level	☐ none ☐ Primary school (not completed) ☐ Primary school (completed) ☐ Secondary school (not completed) ☐ Secondary school (completed) ☐ University
Mobile phone number	
Is the interviewee the household head?	☐ Yes ☐ No
If not, please name the household head	
If not, relationship to the household head (HH)	☐ Spouse of the HH ☐ Son/daughter of the HH ☐ Son-in-law/daughter-in-law of the HH ☐ Parent of the HH ☐ Parent in law of the HH ☐ Grandchild of the HH ☐ Brother/sister of the HH ☐ Other (specify)

SECTION 1: GENERAL INFORMATION ABOUT THE HOUSEHOLD/HOUSEHOLD HEAD

Q1-1. Household size	Adults		Children (0-5)		Children (6-10)		Children (10-16)	
	Men	Women	Boy	Girl	Boy	Girl	Boy	Girl

Q1-2. Household structure	☐ Nuclear ☐ Extended
Q1-3. Home language	☐ Luganda ☐ Ruyakitara ☐ Lunyora ☐ Other (specify)
Q1-4. Nationality of the household head	☐ Ugandan ☐ Other (specify)
Q1-5. Religion of the household head	☐ Islam ☐ Christian ☐ Animism ☐ Other (specify)
Q1-6. Tribe of the household head	☐ Muganda ☐ Musoga ☐ Munyankole ☐ Mutoro ☐ Munyoro ☐ Mukiiga ☐ Mufumbira ☐ Alur/Luo ☐ Bahaya ☐ Bakonjo/Bamba ☐ Non-Ugandan ☐ Other (specify)
Q1-7. Persons with disability and/or other vulnerabilities in your household	☐ Disability ☐ Other vulnerabilities in household

→ **If so, provide number and type of disability and/or other vulnerabilities in household**	Number	Disability
	Number	Other vulnerabilities

SECTION 2: RESIDENCY

Q2-1. How many years has the household been living here for?	years

Q2-2. Has the household always resided in this village?	☐ Yes ☐ No		
→ If No, from where did the household move from?	Option	Tick if yes	Specify
	Other village in this sub-county		
	Other sub-county in this district		
	Other district		
	Other country		
Q2-3. Who gave the household permission to live on this land?	☐ District Land Board ☐ Chief/headman ☐ Employer ☐ Government ☐ Family inheritance ☐ Cannot recall ☐ Other (specify)		
Q2-4. Does the household pay to stay on this land?	☐ Yes ☐ No		
→ If so, who does the household pay to stay on this land?	☐ District Land Board ☐ Chief/headman ☐ Employer ☐ Government ☐ Landlord ☐ Kingdom agents/chiefs ☐ Clan-head ☐ Other (specify)		

SECTION 3: HOMESTEAD STRUCTURE

Q3-1. How old is your house structure?	years
NO NEED TO ASK - OBSERVATIONS ONLY	
Q3-2. Material used for walls	☐ Sawn planks ☐ Wooden planks/poles ☐ Mud/Stick ☐ Sun dried bricks ☐ Burnt bricks ☐ Cement blocks ☐ Mud plastered with cement ☐ Corrugated iron ☐ Stone/aggregates ☐ Other (specify) (more than one option can be selected)
Q3-3. Material used for roof	☐ Corrugated sheet ☐ Leaves ☐ Thatch grass ☐ Plastic sheet with planks ☐ Clay roof tiles ☐ Mud/Stick ☐ Other (specify)
Q3-4. Material used for floor	☐ Sawn planks ☐ Wooden planks/poles ☐ Paving Bricks ☐ Mud ☐ Mud plastered with cement ☐ Cement ☐ Clay floor tiles ☐ Stone/aggregates ☐ Other (specify) (more than one option can be selected)

SECTION 4: ACCESS TO LAND AND AGRICULTURAL ACTIVITIES

Q4-1. Does your homestead currently have access to arable land?	☐ Yes ☐ No	
→ If no, please provide reasons	☐ Not enough money to rent land ☐ Not enough land available ☐ No need for land ☐ Other (specify)	

→ If yes, for each plot, could you please provide us with the following information?	Plot No.	Plot size (Acres)	Plot ownership	Is the plot within 100m of the homestead? 1 = yes 2 = no	If not within 100m, travel time by foot from homestead plot (minutes)	Current use of the land	If cultivated, primary crop/vegetable grown (see Q6-2 for list)
OPTIONS FOR ANSWERING: For plot ownership: 1 = Plot with Title Deed/ Letter of Allotment 2 = Plot with Signed Lease 3 = Traditional land rights For travel time: 1 = 1-15 min 2 = 16-30 min 3 = 31-45 min 4 = 46-60 min 5 = over 1 hour For current use of the land: 1 = Cultivation of crops 2 = rented or lent to someone else 3 = fallow/resting 4 = not ever use 5 = other (specify)	1						
	2						
	3						
	4						
	5						
	6						
	7						

Q4-2. Who do you mostly use as labour for cultivating your plots of land?	☐ Family only ☐ Neighbours (non paid) ☐ Hired labour (paid) ☐ Family and non paid labour ☐ Family and paid labour ☐ Other (specify)				
Q4-3. What method of tillage do you use?	☐ Manual labour ☐ Cows ☐ Tractor ☐ Other (specify)				
Q4-4. For each crop/vegetable, could you please provide us with the following information?	Type	March/April-July/August (production in local units or kg) 2016-2017	September-November (production in local units or kg) 2016-2017	Are they used at home or for sale? 1 = Used at home only, 2 = for sale only, 3 = used at home and for sale	If part is sold, what proportion is sold for cash? 1 = most, 2 = some
	Maize				
	Sorghum				
	Millet				
	Rice				
	Cassava				
	Potato				
	Plantain				
	Yams				
	Beans				
	Peas				
	Cabbage				
	Onion				
	Tomato				
	Coffee				
	Tea				
	Cotton				
	Sunflower				
	Sesame				
	Tobacco				
	Oil Palm				
	Coconut				
	Other (specify)				
Q4-5. What challenges are associated with cropping and how do you overcome them?	Challenge		Methods to overcome		
SECTION 5: TREES					
Q5-1. Does your household grow trees?	☐ Yes ☐ No				
→ If so, for each tree, could you please provide us with the following information?	Tree	Number	Are they used at home or for sale? 1 = Used at home only, 2 = for sale only, 3 = used at home and for sale	If some is sold, what proportion is sold for cash? 1 = most, 2 = some	
	Banana				
	Pawpaw				
	Plantain				
	Mango				

	Citrus			
	Avocado			
	Oil palm			
	Coconut			
	Eucalyptus			
	Fir tree			
	Other (specify)			
	Other (specify)			

Q5-2. What challenges are associated with plantations and how do you overcome them?	Challenge	Methods to overcome

SECTION 6: LIVESTOCK

Q6-1. Does your household have livestock? ☐ Yes ☐ No

→ If so, for each animal, could you please provide us with the following information?	Animal	Number	Rearing method? 1 = no grazing 2 = grazing 3 = pastoralism	Are they used at home or for sale? 1 = Used at home only, 2 = for sale only, 3 = used at home and for sale	If some is sold, what proportion is sold for cash? 1 = most, 2 = some
	Cattle / cow				
	Goats				
	Ducks				
	Sheep				
	Pigs				
	Chickens				
	Pigeons				
	Donkey				
	Rabbits				
	Other Poultry				
	Other (specify)				

Q6-2. What challenges are associated with domestic livestock and how do you overcome them?	Challenge	Methods to overcome

SECTION 7: HUNTING AND FISHING

Q7-1.Does anyone in your household hunt? ☐ Yes ☐ No

→ If so, <u>for the 5 most important animals</u> that you hunt, please provide us the following information <u>OPTIONS FOR ANSWERING:</u> <u>For frequency of hunting:</u> 1 = once a week 2 = once a month 3 = less than once a month <u>For travel distance:</u>	Species	Frequency of hunting	Travel distance from homestead plot	Means of hunting 1 = guns 2 = traps 3 = other	Use? 1= skins, 2 = rituals, 3 = food, 4 = other	What proportion is sold for cash? 1 = all, 2 = most, 3 = some, 4 = none
	Impala/antelopes					
	Hare					
	Rabbit					
	Partridge/quail					
	Wild pigs/Warthogs					
	Other please specify					

1 = 500m 2 = 500m – 2km 3 = 2km – 5km 4 = above 5km						

Q7-2. Do you fish?	☐ Yes ☐ No

→ If so, <u>for the 5 most important fish species</u> that you fish, please provide the following information (5) <u>OPTIONS FOR ANSWERING:</u> <u>For frequency of fishing:</u> 1 = every day 2 = once a week 3 = once a month 4 = less than once a month <u>For Fishing gear:</u> 1 = Gillnets 2 = Seine nets 3 = Drag nets 4 = Cast nets 5 = Scoop nets 6 = Basket traps (large basket, small basket) 7 = Fixed traps 8 = Handline 9 = Longlines 10 = Troll lines 11 = Spear, stick 12 =Poison fishing 13 = Dynamite fishing 14 = Harpoons	Species	Frequency of fishing	Location: 1 = River/stream, 2 = Lake, 3 = Sea	Fishing gear	1 = On the shore 2 = on boat	What proportion is sold for cash? 1 = all, 2 = most, 3 = some, 4 = none
	Tilapia					
	Catfish					
	Other (specify)					

SECTION 8: USE OF NATURAL RESOURCES

	Type	How often this is collected? 1 = every day 2 = once a week 3= once a month 4 = less than once a month	Is this sometimes bought? 1 = yes, 2 = no	What proportion is sold for cash? 1 = all, 2 = most, 3 = some, 4 = none
Q8-1. Does anyone in your household collect, buy, use or sell the following natural resources?	Wood for making charcoal			
	Wood for construction (timber)			
	Trees for rituals			
	Grass/vegetation for grazing animals			
	Grass or reeds for thatching			
	Wild fruits, berries, roots and vegetables for food			
	Mushrooms for food			
	Honey for food			
	Plants for traditional alcohol			
	Plants for weaving			
	Plants or animals for use as medicine			
	Insects for food			
	Artisanal mining for gold or other resources			
	River sand /clay for construction/pottery			
	Stones, aggregates for construction			
	Others (specify)			

SECTION 9: HEALTH

	Disease/illness	Number of household members affected in last six months	Did you seek treatment? 1-=Yes 2 =No	Type of treatment: 1 =Self-medicated 2 = Traditional healer 3 =Medical health facility
Q9-1. Did any members of your household suffer from the following diseases or illnesses in the past six months? If yes, please tell us how many of the household members were affected by each and the type of treatment they used	TB			
	Respiratory infection			
	Malaria			
	HIV/AIDS			
	Other STDs			
	Skin rash			
	Diarrhea			
	Diabetes			
	High blood pressure			
	Cardiovascular disease			
	Cancer			
	Typhoid			
	Meningitis			
	Sleeping sickness			
	Bilharzia			
	Measles			
	Mental disorder			
	Cholera			
	Worms			
	Paralysis			
	Other (specify)			

Q9-2. Please provide the following information about the main water source your household uses in the dry/wet season?

	Dry season (tick correct answer)	Wet season (tick correct answer)
Type of water source	☐ Piped from mains system ☐ Village well/borehole – protected springs ☐ Village well/borehole – unprotected springs ☐ Private well/borehole ☐ Rain harvesting ☐ Piped from river ☐ Collect from river ☐ Pond ☐ Water through "Marambo" ☐ Other (specify)	☐ Piped from mains system ☐ Village well/borehole – protected springs ☐ Village well/borehole – unprotected springs ☐ Private well/borehole ☐ Rain harvesting ☐ Piped from river ☐ Collect from river ☐ Pond ☐ Water through "Marambo" ☐ Other (specify)
Distance travelled to water source	☐ 500m ☐ 500m-2km ☐ 2km-5km ☐ Over 5km	☐ 500m ☐ 500m-2km ☐ 2km-5km ☐ Over 5km
Use	☐ Drinking ☐ Domestic uses ☐ Irrigation/crops ☐ Livestock ☐ Other (specify)	☐ Drinking ☐ Domestic uses ☐ Irrigation/crops ☐ Livestock ☐ Other (specify)
Frequency of collection	☐ Once a week ☐ Twice a week ☐ every second day ☐ once a day ☐ twice a day ☐ three times a day ☐ more than 3 times per day	☐ Once a week ☐ Twice a week ☐ every second day ☐ once a day ☐ twice a day ☐ three times a day ☐ more than 3 times per day
Collection by	☐ Male household heads ☐ Women ☐ Children (more than one option can be selected)	☐ Male household heads ☐ Women ☐ Children (more than one option can be selected)
Reliability	☐ Low ☐ Good ☐ High	☐ Low ☐ Good ☐ High
Quantity	☐ Sufficient ☐ Insufficient	☐ Sufficient ☐ Insufficient
Quality	☐ Good ☐ Not good	☐ Good ☐ Not good
Cost	☐ Affordable ☐ Not affordable	☐ Affordable ☐ Not affordable

	Type of toilet	**Tick correct answer(s)**
Q9-3. What type of toilet facility does your household use?	Bush (open defecation)	
	Private latrine	
	Public pit latrine	
	Ventilated pit latrine	
	Interior toilet flush tank	
	Exterior flush tank	
	Other (please specify)	

	Option	Tick correct answer(s) if this option is used for solid waste	Tick correct answer(s) if this option is used for food waste
Q9-4.How does your household dispose of solid and food waste	Disposed on a public rubbish dump		
	Disposed in waste collection point		

	Burnt in private waste pit		
	Buried in private waste pit		
	Disposed in compost waste		
	Given to chicken/pigs		
	Other (please specify)		
	I do not know		

Q9-5. How far must you travel to access your nearest public and private health service?	Health service type	Distance travelled (1 = 500m, 2 = 500m-2km, 3 = 2-5km, 4 = Above 5km)
	Public	
	Private	

SECTION 10: FOOD SECURITY/NUTRITION

Q10-1. Do you experience hunger months? ☐ Yes ☐ No

→ **If so, could you tell us which of the following months were periods in which the household went hungry last year? For those months where the household was hungry, please give a reason why there was not enough food or why the household had to beg to get what it needed to eat.**

Reasons for hunger:
1. Could not produce/grow enough food
2. No money to buy food
3. Not enough land
4. Not enough labour
5. Natural Calamities (bushfire, drought, disease, pests)
6. Not enough agro-inputs (fertilizer, pesticide, implements)
7. Other (specify)

Month	Tick if yes	Reason for hunger
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

SECTION 11: ENERGY

Q11-1. What do you use for lighting? (tick more than once)	☐ Oil/kerosene ☐ Gas ☐ Candle ☐ Battery/torch ☐ Solar ☐ Electricity ☐ Paraffin ☐ Firewood ☐ Grass ☐ Other (specify)
Q11-2. What do you use for cooking?	☐ Firewood ☐ Charcoal ☐ Coal ☐ Electricity ☐ Generator/private sources ☐ Gas ☐ kerosene ☐ Animal residual (dried cattle dung) ☐ Crop husks/remains ☐ Paraffin ☐ Solar ☐ Saw dusts ☐ Other (specify)

SECTION 12: INCOME, EXPENDITURES, ASSETS AND CREDIT

Q12-1. What is the approximate annual income (i.e. amount of cash) for your household?	UGX

Q12-2. For each source of household income, could you provide us with the following information?	Income source		Regular (R)/ Occasional (O)/Never (N)	Rank the 3 most important sources of income (1 most important and 3 least important)
	Employment/self-employment	Gross profits from self-employment (artisans: carpenter/builder/ shopkeeper, restaurant)		
		Salaries		
		Migrant remittances		
	Agriculture	Livestock		
		Crops		
	Fishing	Fishing		
		Intertidal collection/gleaning		
		Diving		
		Processing		

		Trading		
		Aquaculture		
	Natural/wild resources	Wild Plants (wild yam/ mushroom)		
		Bush Meat		
		Timber		
		Charcoal/ firewood		
		Artisanal mining (gold, salt, kaolin, sand, other)		
	Other (specify)			

	Item	Rank the 5 most important items (1 most important and 5 least important)
Q12-3. Please indicate your 5 largest household's expenditure items in the last 12 months in the following table.	Food (inc baby food)	
	Personal Items (toiletries, washing powder, diapers etc.)	
	Transport (bus fares, taxis fees)	
	School fees, uniforms, books/equipment	
	Clothes	
	Savings society (micro credit group)	
	Taxes	
	Lighting (paraffin, gas, candles etc.)	
	Charcoal	
	Wood	
	Telephone (cellular)	
	Cost of charging mobile phones	
	Water (transport or pumping costs)	
	Medical expenses	
	Furniture/household equipment	
	Rental (housing/accommodation)	
	Agricultural expenses - crops	
	Agricultural expenses - livestock	
	New buildings or building improvements	
	Debt repayment	
	Other (specify)	

	Item	Number
Q12-4. How many of the items listed in the table below are available in your household and are in working condition?	Bicycle	
	Private motor bike	
	Private car	
	Tractor	
	Wheelbarrow	
	Plough	
	Maize/cassava/rice mill	
	Spade / tools	
	Sewing machine	
	Weaving loom	
	Generator	
	Radio	
	Hi-fi set/ music system	
	Cell phone	
	Television	
	Fridge	
	Table	
	Chair/stool/sofa	

	Bed	
	Cupboard	
	Fishing net	
	Canoe /boat	
	Shot gun (hunting)	
	Other (specify)	
Q12-5. How much did you as a household borrow, if any, from different credit facilities during the last 12 months?	Facility	Amount borrowed in UGX
	Micro credit project/group	
	Friends	
	Family	
	Other (specify)	
Q12-6. What was the main reason for the loan?	Reason	Tick only 1 option
	To cover health costs	
	To repay loan	
	To pay fine or tax	
	To cover education related costs	
	To buy food	
	To construct or repair house	
	To purchase clothing	
	No loan taken	
SECTION 13: TRAFFIC		
Q13-1. What is the main type of transport used by the household?	☐ Private car ☐ Public bus ☐ Taxi/boda boda ☐ Bicycles ☐ Motorbikes ☐ Other (specify)	
Q13-2. In your view, what are the main causes of road traffic incidents in the local area (select the most important two)?	☐ Poor road conditions ☐ Weather conditions ☐ speeding drivers ☐ Drivers under the influence of alcohol ☐ Poor condition of vehicles ☐ Drivers using mobile phones ☐ Other (specify)	
Q13-3. Have you or members of your household seen/heard any advertisements on road safety?	☐ Yes ☐ No	
→ **If yes, then please provide details – what was this focused on?**	☐ Consumption of alcohol ☐ Speeding ☐ Use of seat belts ☐ Careful driving ☐ Other (specify)	
Q13-4. If there were a significant increase in road traffic volumes along the local road network, would you expect this to have a significant impact on your safety and quality of life?	☐ Not at all ☐ A little ☐ Some ☐ A lot	
SECTION 14: PERCEPTIONS AND COMMENTS		
Q14-1. Are there any other comments that you would like to make about the proposed Tilenga Feeder / EACOP project?		
Q14-2.What are your 3 main wishes in life?		
Q14-3. What would you say is good or bad in your life?	Good	Bad

End of interview – please complete the text below

SECTION 15: TO BE FILLED BY THE INTERVIEWER						
Was the interviewee alone?	☐ Yes ☐ No					
If "No" specify who was present (name of the persons)						
Did you find anything remarkable about the interview? Please fill in the table	Criteria	Very satisfactory	Satisfactory	Neutral	Unsatisfactory	Highly unsatisfactory
	The trustfulness of the interviewee					
	The questions that were answered					
	The interview environment					

ATTACHMENT A9.4 SERVICE AVAILABILITY AND READINESS HEALTH FACILITY ASSESSMENT

Health Facility	**Hoima Referral Hospital**	**Buliisa District Hospital**	**Kigorobya HCIV**
District	Hoima	Buliisa	Hoima
Ownership	Government	Government	Government
Date of Interview	21/11/2017	20/11/2017	21/11/2017
Full Name of Informant (s)	Winifred Mbalazi	Silvia Kamanyire	David Andia
Position/Function	Principal Nurse	Clinical Officer	Senior Clinical Officer
Health Care Provider Availability			
Specialists (medical/surgical)	4	0	0
Medical officer	13	2	2
Clinical officer	13	5	4
Nursing officer	47	5	2
Nurse midwife	43	2	2
Enrolled nurses	52	13	4
Nursing assistant	16	3	0
Psychiatric nurse	4	0	0
Anaesthetist officer/assistant	6	1	0
Public health nurse	1	0	0
Physiotherapist	2	1	0
Laboratory technologist	9	2	0

Health Facility	Hoima Referral Hospital	Buliisa District Hospital	Kigorobya HCIV
Laboratory technician/assistant	7	1	4
Radiographer	4	2	0
Dentist/dental surgeon	2	0	0
Dental officer/technician	6	0	1
Pharmacist	1	0	0
Pharmacy technician	4	0	0
Allied health professional	15	5	2
Allied non-health professional (other)	13	6	1
Support personnel	Outsourced	28	4
Total	**261**	**76**	**26**
Service Availability			
Out-patient services	√	√	√
In-patient services	√	√	√
24-hour emergency	√	√	√
Emergency surgery	√	√	Limited to basic emergencies
Caesarean section	√	√	Nil, theatre not operational
Assisted vaginal delivery	√	√	√
Blood transfusion	√	Nil, no blood bank	Nil, no blood bank
Neonatal resuscitation with bag and mask	√	√	√
Pharmacy	√	√	√
Immunisation	√	√	√

Health Facility	Hoima Referral Hospital	Buliisa District Hospital	Kigorobya HCIV
Growth monitoring	√	√	√
IMCI (Integrated Management of Childhood Illnesses)	√	√	√
VCT for HIV and AIDS	√	√	√
PMTCT of HIV and AIDS	√	√	√
Primary health care	√	√	√
Maternal health care	√	√	√
Ambulance service (functioning)	Not functional	Yes, district ambulance, not on site	Yes, stationed at facility
Intensive care	√ (4 bed capacity)	Nil	Nil
Laboratory services	√	√	√
General Surgery	√	√ (basic)	Nil
Orthopaedic surgery	√	Nil	Nil
Specialist services	√	Nil	Nil
Radiology	√ (X-ray & Ultrasound)	Ultrasound only (but not functional)	Nil
Bed Occupancy	70%-80%	40%-70%	50%-70%
Total beds	400	30	20
Diagnostic Ability			
Malaria RDT	√	√	√
Malaria microscopy	√	√	√
HIV RDT	√	√	√
HIV ELISA	√	Nil	Nil
HIV CD4 count	√	√ (challenges of reagents)	√
TB diagnostic	√	√	√

Health Facility	Hoima Referral Hospital	Buliisa District Hospital	Kigorobya HCIV
Haematology	√	√	√
Biochemistry	√	√	Nil
Parasitology	√	√	√
Availability of Drugs (always in stock)			
ACTs	√	√	√
Parenteral Quinine/Artesunate	√	√	√
IPT_p (Fansidar/SP)	√	√	√
ART (Zidovudine, Nevirapine, Efavirenz)	√	√	√
TB drugs	√	√ (stock-outs of second line drugs)	√
EPI vaccinations	√	√	√
Antihelminthic drugs	√	√	√
Oral rehydration solution	√	√	√
Oxytocin/Misoprostol	√	√	√
Penicillin (Any)	√	√	√
Erythromycin	√	Out of stock	√
Doxycycline	√	√	√
Vitamin A	√	√	√
Vitamin K	√	√	√
Iron supplements	√	√	√
Folic acid	√	√	√
Insecticide-treated bednets	√ (Not adequate)	√ (but not all beds)	√
Hypertension drugs	√	√	√

Health Facility	Hoima Referral Hospital		Buliisa District Hospital		Kigorobya HCIV	
Antipyretics	√		√		√	
Injectable diazepam/Valium	√		√		√	
Injectable magnesium sulphate or other anticonvulsants	Out of stock		√		√	
Injectable ergometrine	√		Nil (oxytocin preferred)		√	
Tetanus anti-toxin injection	√		√		√	
Adrenaline injection	√		√		√	
Anti-protozoa drugs	√		√		√	
Anti-histamines	√		√		√	
Dermatological preparations (anti-fungal, anti-allergic or anti-inflammatory)	√		√		√	
Availability and Functionality of Medical Equipment						
A=Available; F=Functional	A	F	A	F	A	F
Table for gynaecological examination	√	√	√	√	√	√
Fetoscope	√	√	√	√	√	√
Autoclave	√	√	√	√	√	√
Pressure cooker for sterilisation	Nil	Uses autoclave	Nil		Nil	
Speculum	√	√	√	√	√	√
Blood giving set	√	√	Nil	Does not transfuse	Nil	Does not transfuse
Delivery forceps	√	√	√	√	Nil	
IV sets	√	√	√	√	√	
Vacuum extractor	√	Not functional	√	√	√	

Health Facility	**Hoima Referral Hospital**		**Buliisa District Hospital**		**Kigorobya HCIV**	
Manual vacuum aspirator	√	√	√	√	√	
Dilatation and curettage kit	√	√	√	√	Nil	
Operating table	√	√	√	√	Nil	
Operating light	√	√	√	√	Nil	
Anaesthesia equipment	√	√	√	√	√	New, but not in use
Oxygen equipment	√	√	√	√	√	√
Bag valve mask and resuscitator	√	√	√	√	√	√
Blood pressure apparatus	√	√	√	√	√	√
Stethoscope	√	√	√	√	√	√
Thermometer	√	√	√	√	√	√
Weighing scale	√	√	√	√	√	√
Glucometer	√	√	√	Not functional, lacks strips	√	√
Infrastructure						
Regular/reliable running water	√		Yes, reliable		Not reliable	
Regular/reliable electricity	Yes, reliable		Yes, reliable		√	
Solar power	√		√		√, only few areas	
Generator	√		√		Nil	
Any type of electricity	√		√		√	
Functioning refrigerator	√		√		√ (vaccine fridge)	
Functioning landline	√		Nil		√ (only HIV clinic)	
Functioning mobile	√		√		Nil, uses personal mobile	

Health Facility	Hoima Referral Hospital	Buliisa District Hospital	Kigorobya HCIV
Functioning two-way radio communication	Nil, relies on telephone	Nil	Nil
Continuity of Services			
In-patient services 24/7	√	√	√
Emergency services 24/7	√	√	√ (limited to basics)
Official opening hours per day (in hours)	24 hours	24 hours	24 hours
Personnel lives near health facility	√	√	√
Access to a Referral Hospital			
Proximity of referral hospital (in hours)	Mulago (3–4 hours)	Hoima (2 hours)	Hoima (45 minutes)
Transportation possibility to referral hospital	No ambulance. Rely on private means	District ambulance for emergencies	Ambulance (donated by area politician)
Cost of referral (both ways)	UGX 30,000 (USD 8.02)	Contributes fuel up to 20 L	Free for emergencies
Personnel In-Service Training			
Personnel trained in life saving skills (number)	√ (several)	√ (few)	√ (few)
Personnel trained in IMCI (number)	√	√	√
Process of Health Care			
Use of disposable gloves	√	√	√
Use of protective eye wear	√	√	Not commonly used
Evidence of use of cleaning disinfectant in wards and casualty	√	√	√
Evidence of soap in wash basins, or hand sanitiser in wards	√	√	√

Health Facility	**Hoima Referral Hospital**	**Buliisa District Hospital**	**Kigorobya HCIV**
Hand washing	√	√	√
Use of autoclave	√	√	√
General state of building and state of cleanliness	Generally good. Has new blocks	Very good. Built by Tullow, commissioned in 2015	Old infrastructure, built in1960s
Cost of Health Care			
How much does a basic outpatient consultation cost?	Free	Free	Free
How much does diagnosis and treatment for malaria cost (with RDT use)?	Free	Free	Free
How much does an admission for a child cost?	Free	Free	Free
General Questions			
How many people have access to this health care facility- the target population?	Entire western region	129,000	70,000
What are the 3–5 main health challenges facing the community?	1. Poor health seeking behaviour 2. Challenges with emergency care 3. High burden of communicable diseases 4. Shortage of medical supplies and drugs 5. Self-medication from private pharmacies	1. Poor health seeking behaviour 2. Use of traditional medicine 3. High burden of communicable diseases 4. High fertility rates couple with high rates of home deliveries 5. Unsafe drinking water 6. Lifestyle of fishing communities	1. Poor health seeking behaviour 2. High burden of malaria and other communicable diseases 3. Increasing of accidents especially by motorcycles 4. Unsafe drinking water and sanitation challenges 5. Inadequate health infrastructure

Health Facility	Hoima Referral Hospital	Buliisa District Hospital	Kigorobya HCIV
If you had 3–5 wishes to improve health care in the communities that you serve in, what would they be?	1. Health education 2. Address staffing challenges 3. Need at ambulance for emergency care 4. Needs a blood bank	1. Health education and promotion 2. Control of communicable diseases 3. Safe drinking water	1. Health education 2. Improve access to safe drinking water and sanitation 3. HIV interventions 4. Improve health infrastructure and staffing at facilities
What are the five most common diseases in children under five years?	1. Anaemia 2. Malaria 3. Acute respiratory infection 4. Malnutrition 5. Diarrhoeal diseases	1. Acute respiratory infections 2. Malaria 3. Septicaemia 4. Diarrhoeal diseases 5. Skin diseases	1. Malaria 2. Upper respiratory tract infection 3. Pneumonia 4. Diarrhoeal diseases 5. Malnutrition (from poor feeding habits)
What are the five most common diseases for all age groups?	1. HIV-related illness 2. Malaria 3. Hypertension 4. Acute respiratory infections 5. Diabetes 6. Accidents/injuries	1. Acute respiratory infections 2. Malaria 3. HIV/AIDS 4. Sexually transmitted infections 5. Diarrhoeal diseases Also TB, hypertension and diabetes	1. Malaria 2. Respiratory infections 3. HIV/AIDS 4. Diarrhoeal diseases 5. Trauma and injuries
Is there good community cohesion to supporting health initiatives?	Generally good	Generally good	Generally good. Outreach services supported by village health teams
Are there measures in place at facility level to address disease outbreaks? If yes, specify	Yes, has emergency response team. Has an isolation unit at the hospital	Yes, has emergency response procedures coordinated at district level	Has emergency response procedures coordinated at district level
Observation/notes	Well-equipped ICU. Lacks a refrigerated mortuary. Newly built theatre and emergency department	Good infrastructure. Quite withdrawn from major settlements. Has challenges of inadequate personnel and utilisation	Busy and overloaded facility with small old infrastructure. No waiting area, patients sit under a tree. Running water available only in the lab

ATTACHMENT A9.5 SUMMARY OF IMPORTANT HISTORICAL EVENTS

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
1958	Wayoyo	75	Path road upgraded to graded road increasing access to other communities
1960	Piida A	45.5	Flooding
1961	Kibambura	5	In migration of Alur from the DRC due to Katanga war until 1964
1962	Piida A	45.5	In migration of Congolese from the DRC
	Nyamasoga	95	Era of local leader dictatorship
1964	Katanga Serule B	4 30.5	In migration of refugees from the DRC due to war
	Kisansya West	6	Heavy rain caused area to flood and many people died
	Rwamutonga (Bugambe)	87.5	Bugambe Tea Estate started
1965	Kisomere	0	First occupant came from Nebbi district
	Kigwera	4	Construction of roads
	Katanga	4	West Nile virus epidemic Properties confiscated to house refugees
1967	Kisomere	0	Construction of roads
1968	Katanga	4	Village community split due to a year of low fishing (communities moved to West Nile or shores of Victoria Nile)
	Nyamasoga	95	Introduction of first public transportation system
1969	Katanga	4	Some Kikuyu moved to Katanga from Kenya for fishing

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
1970	Waki-Kawaibanda	47	Congolese started to arrive in large numbers (until 1975)
	Rwamutonga (Bugambe)	87.5	Cotton growing
	Nyamasoga	95	Establishment of Buseruka subcounty Establishment of Kabale HCII and Buseruka HCII
1972	Kigwera	4	Drought led to famine
	Katanga	4	Major rains and flooding
	Kibambura	5	Exodus of people from area due to famine (many did not return)
	Piida A	45.5	Vigorous training of soldiers
1973	Katooke	95	Katooke Church of Uganda (COU) constructed
1974	Kisansya West	6	Famine in the area Measles outbreak
	Rwamutonga (Buseruka)	86	Many wild animals in village Roads very bad and narrow
1978	Biiso	44.5	First cholera outbreak
	Rwamutonga (Buseruka)	86	Road connecting to Bugambe subcounty opened People had grass thatched houses only
	Nyamasoga	95	First oil exploration activities
1979	Kisomere	0	Cholera outbreak War that ousted Amin forced people to return to Nebbi district
	Piida A	45.5	Establishment of military barracks
	Rwamutonga (Bugambe)	87.5	War between Amin and Obote High poverty levels

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
1980	Kisansya West	6	Last meeting of clans in the village
	Rwamutonga (Buseruka)	86	Lack of roads and health facilities and market of agricultural products, wild animals, no modern houses, drinking water not boiled, shared water sources, no churches until 1990s
	Buseruka	84.5	10 shops in Buseruka Beginning of Buseruka market Buseruka Primary School constructed Two churches (grass-thatched), one mosque present One bus available for public transport
1981	Nyamasoga	95	Development of trading centre in Nyamasoga
1982	Kisomere	0	Famine lasting two years
1984	Avogera	0	Famine caused by cassava mosaic virus
	Rwamutonga (Bugambe)	87.5	War between National Resistance Movement (NRM) and Uganda's People Congress, Democratic Party Bugambe Tea Estate abandoned and became a forest
1985	Kisansya East	6	Upheavals prompted people to leave village
	Kibambura Biiso Kigorobya	5 44.5 64.5	National Resistance Movement (NRM) liberation war displaced many people
	Kigorobya	64.5	High yield of peas and sweet potatoes

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
1986	Avogera	0	Trading centre established in the village
	Kisansya West	6	Fishing regulations introduced
	Serule B	30.5	Cholera on shores of Lake Albert
	Biiso	44.5	Private land ownership started First AIDS victim in the village
	Booma	44.5	Overfishing due to many DRC refugees coming into area
	Piida A Rwamutonga (Bugambe)	45.5 87.5	National Resistance Movement (NRM) came into power
	Rwamutonga (Bugambe)	87.5	Restoration of Bugambe Tea Estate
1987	Kisansya West	6	Kisansya divided into two villages
1988	Katanga	4	Fighting between Alur and Bagungu clans
1989	Kigorobya	64.5	Foot-and-mouth disease outbreak killed many cattle
1990	Kigwera	4	Invasion of locusts for one month
	Biiso	44.5	Construction of health centre
	Booma	44.5	Banyankore pastoralists came into area with big herds of cattle
	Rwamutonga (Bugambe)	87.5	Bugambe Tea Estate Primary School established
	Buseruka	84.5	Construction of primary school by World Vision Beginning of construction of modern houses Development of drug shops, restaurants and general merchandise shops from this time onwards
	Kayere	94.5	Privatisation of land during this decade
1991	Avogera	0	Famine caused by cassava mosaic virus
	Wayoyo	75	Wayoyo Trading Centre established within Buhigiri community
	Nyamasoga	95	NGOs (World Vision) established permanent building at primary school

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
1992	Avogera	0	Tribal conflict between Alur and Bagungu Attempt to evict Alur from area
1993	Avogera	0	Construction of boreholes
	Biiso	44.5	Dispensary upgraded to a Grade 3 health centre
	Wayoyo	75	Cholera outbreak
1994	Katanga	4	Major rains and flooding
	Kigorobya	64.5	Government distributed food planting materials to farmers
	Wayoyo	75	Last time chimpanzees seen in Bujjawe Forest Reserve Road constructed for motor vehicles
	Buseruka	84.5	War against Allied Democratic Forces (ADF)
	Katooke	95	Christian Fellowship Church constructed
1995	Rwamutonga (Buseruka)	86	Allied Democratic Forces (ADF) rebels invaded the area
	Nyamasoga	95	Discovery of safe water Training of person in community in brick-making leading to construction of first ever permanent house
1996	Kisansya East	6	Famine caused by cassava mosaic virus
	Kibambura	5	New in migration of Alur into area until 1997
	Rwamutonga (Bugambe)	87.5	Establishment of Katonga Primary School Tobacco growing started to increase Number of churches also started increasing
	Katooke	95	People started roofing houses with iron sheets, minimising the number of houses catching fire during dry season First spring well constructed

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
1997	Rwamutonga (Bugambe)	87.5	Construction of feeder roads Introduction of Universal Primary Education (UPE)
	Wayoyo	75	Outbreak of river blindness
	Buseruka	84.5	Rebels in area
1998	Piida A	45.5	Fish preservation (icing) method introduced Establishment of marine police post
	Rwamutonga (Buseruka)	86	First church constructed in village
1999	Kigwera	4	Famine caused by cassava mosaic virus
	Booma	44.5	Start of animal thefts due to large number of Banyankore pastoralists who were constantly on the move
2000	Avogera	0	Oil exploration activities
	Serule B	30.5	Cultural practices stopped in area due to religion
	Rwamutonga (Bugambe)	87.5	Introduction of private schools Increase in maize growing Strong businesses started to emerge
	Rwamutonga (Buseruka)	86	Improved infrastructure and livestock and crop farming, increased market, better standards of living and transport methods and education, female empowerment form this time Government distributed drugs for river blindness Bugambe–Buseruka bridge constructed Road connected Buseruka to Lake Albert via escarpment constructed
	Buseruka	84.5	Development of nursery schools Renovation of Buseruka HC and construction of maternity wing Increase in traders and businesses and extension of Buseruka market
	Kayere	94.5	Cholera outbreak Drought

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
2001	Serule B	30.5	Serule B established as a settlement
	Nyamasoga	95	Second round of oil exploration activities with community sensitisation
2002	Serule B	30.5	Harassment of fishermen by government officials and police
	Piida A	45.5	High catch of Nile Perch In migration of people from various places People severely punished for illegal fishing practices
2003	Piida A	45.5	Inauguration of Luna Pub Business boom in Butiaba
	Buseruka	84.5	First secondary school constructed Opening of police post
	Nyamasoga	95	First ever radio station established in Hoima district
	Katooke	95	Katooke Parents Primary School constructed Construction of trading centre
2004	Kisomere	0	Construction of roads by government (made mobility easier)
	Piida A	45.5	Tullow Oil in the area Expulsion of Congolese Communication masts constructed by Airtel and MTN
	Rwamutonga (Bugambe)	87.5	Land conflicts Tribal conflicts leading to evacuation of none-Banyoro Poverty due to burning of tobacco (was major source of livelihoods)
	Wayoyo	75	Cholera outbreak
	Nyamasoga	95	Construction of Kyakakonzi Dam
	Katooke	95	Katooke Catholic Church constructed Borehole constructed

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
2005	Biiso	44.5	Great Biiso subcounty subdivided into three subcounties
	Piida A	45.5	Establishment of fish factory
	Waki-Kawaibanda	47	Cholera outbreak
	Buseruka	84.5	Road connecting Buseruka Trading Centre to Tonya opened
2006	Booma	44.5	Scramble for land and land conflicts following discovery of commercial oil
	Piida A	45.5	Construction of permanent houses Light fishing started
	Waki-Kawaibanda	47	Fish processing factory constructed (Indian owner, very large warehouse, generated employment for locals)
	Piida A Buseruka	45.5 84.5	Cholera outbreak
2007	Kibambura	5	Balaalo/Banyankole herdsmen drove cattle into area and created tensions
	Serule B Piida A	30.5 45.5	Butiaba Secondary School constructed (difficult for girls to attend due to long distance and safety concerns)
	Booma	44.5	Prolonged drought started to become an annual occasion Damage of roads due to increased road traffic
	Rwamutonga (Buseruka)	86	Youth mobilised to form groups so that they can assist with fighting poverty
2008	Katooke	95	Beginning of immunisation outreach programme
2009	Serule B	30.5	Surveys on Lake Albert for oil Dramatic drop in fish stocks Airtel mast constructed
	Waki-Kawaibanda	47	Health facility built nearby serving three communities on lakeshore. Fish stocks fell in lake causing fish factory to close
	Nyamasoga	95	Establishment of Buseruka secondary school

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
2010	Avogera	0	Construction of roads
	Biiso	44.5	Gravity water scheme established
	Piida A	45.5	Butiaba HCIII established Fish scarcity (lasting until 2011)
	Waki-Kawaibanda	47	Construction of hospital
	Rwamutonga (Bugambe)	87.5	Increased access to banks, savings and credit groups Introduction of NAADS Women's groups started emerging
	Buseruka	84.5	NAWOU association/organisation formed
2011	Kisomere	0	Person attacked and killed by crocodile
	Kayere	94.5	Beginning of refinery work
	Nyamasoga	95	Community sensitisation about oil and gas
	Katooke	95	Encroachers sent away from Wambabya Forest Reserve
2012	Waki-Kawaibanda	47	Arrival of Rwandese on lakeshore (between 2012 and 2013)
	Nyamasoga Katooke	95 95	Oil exploration activities
2013	Serule B	30.5	Health centre collapsed Cholera outbreak
	Rwamutonga (Bugambe)	87.5	NGO support groups (UWESO) Forced evacuation of people from land
	Rwamutonga (Buseruka)	86	Government distributed mosquito nets
	Buseruka	84.5	Electricity reached Buseruka Construction of Buseruka-Kaiso Tonya-Hoima road by UNRA started

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
	Kayere	94.5	Beginning of road upgrade from murrum to tarmac Outbreak of river blindness
	Katooke	95	Compensation for refinery land Construction of tarmac road
2014	Serule B	30.5	Two women killed and school fence destroyed by buffalo Bilharzia detected in the lake (ongoing) Drought
	Biiso	44.5	Road works in Butiaba caused a decline in trading activities in Biiso
	Booma	44.5	Government constructed military barracks, blocking access to areas of firewood and thatched grass collection
	Waki-Kawaibanda	47	Village granted autonomy from Piida A Construction of school
	Kigorobya	64.5	Mass free children immunisation programme launched Cholera outbreak in neighbouring subcounties (occurs every rainy season now)
	Rwamutonga (Bugambe)	87.5	Private school established Families displaced Land conflict
	Rwamutonga (Buseruka)	86	Hoima-Kaiso tarmac road constructed
	Kayere	94.5	Refinery activities; clearing of settlements
	Nyamasoga Katooke	95 95	School stopped working due to resettlement for oil refinery High divorce rates because husbands earned money and abandoned former wives
2015	Serule B	30.5	Storm caused health centre to collapse
	Biiso Waki-Kawaibanda	44.5 47	Cholera outbreak
	Piida A	45.5	Rural electrification reached Butiaba

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
	Kigorobya	64.5	Cough and measles outbreak among children
	Buseruka	84.5	Area connected to hydroelectric power
	Katooke	95	Construction of Christ the Way church
2016	Serule B Piida A Waki-Kawaibanda	30.5 44.5 47	Heavy storm came and caused a lot of destruction
	Biiso	44.5	Drought hit area in December until following May (2017) Trucks carrying hazardous waste from Buliisa passed through Biiso
	Booma	44.5	Killing of people by wild animals (especially crocodiles) intensified
	Kigorobya	64.5	Free circus entertainment brought to trading centre and peoples' money stolen during entertainment Kigorobya became a constituency and elected leader bought a community ambulance Prolonged drought leading to food scarcity (following destruction of crops by fall armyworm)
	Rwamutonga (Bugambe)	87.5	Rwamutonga market established
	Wayoyo	75	Private school constructed in village Drug shop established in trading centre
	Buseruka	84.5	Completion of construction of Buseruka-Kaiso Tonya-Hoima road by UNRA Kyakaboga resettlement camp constructed Severe drought in area
	Kayere	94.5	Tarmac road completed
	Nyamasoga Katooke	95 95	In migration of prostitutes
	Katooke	95	Permanent buildings constructed at Katooke Parents Primary School Massive tree cutting to clear gardens for sugar cane

Date	Sample PAC	KP	Event as Recorded in the FGD Historical Timelines with Community Leaders and Separately with Women
2017	Kisansya East	6	Changes in fishing regulations Violent conflicts with Congolese migrants
	Serule B	30.5	Famine
	Piida A	45.5	Water decrease in lake Long drought and famine
	Kigorobya	64.5	Outbreak of painless wounds among children
	Rwamutonga (Bugambe)	87.5	People forcefully evacuated were returned to their land Farming of maize, cassava, beans, coffee and sugar cane
	Rwamutonga (Buseruka)	86	Crop failure due to drought and outbreak of disease among cattle
	Wayoyo	75	Construction of church
	Nyamasoga	95	Resettlement activities Electrification Launch of pipeline construction Kabale International Airport
	Nyamasoga Katooke	95 95	High level of bribery by police

Appendix A10: Traffic Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

Symbols	
km	kilometre
m	metre
A	
AGI	aboveground installation
AOI	area of influence
B	
bajaj	three-wheeler motorcycle taxis
boda boda	motorcycle taxis
H	
HGV	heavy goods vehicle
R	
rural roads	roads that traverse rural areas, generally unsealed and often single tracks
S	
sealed road	road in Uganda that may be constructed of tarmac, bitumen or concrete
T	
trunk roads	national or international route linking two or more regional headquarters
U	
unsealed road	road in Uganda constructed from earth or gravel
URC	Uganda Railways Corporation
UNRA	Uganda National Roads Authority
urban roads	roads that pass through cities, small towns and built up areas
V	
VEC	valued environmental or social component

A10 TRAFFIC BASELINE REPORT

A10.1 Introduction

This baseline report describes the traffic:

- area of influence (AOI) and study area boundaries
- methods
- baseline condition:
  - traffic baseline conditions
  - trend in condition and sensitivity to change
  - sensitivity rankings
- key considerations.

A10.2 Area of Influence and Study Area Boundaries

A10.2.1 Area of Influence Boundary

The AOI encompasses the transport network that connects key population centres, ports and airports to the aboveground installations (AGIs), construction facilities and pipeline right-of-way (RoW).

The traffic AOI will be the roads that will be used by the project.

AGIs will remain operational over the project lifetime, so the temporal AOI will be approximately 25 years. At other locations, the temporal AOI is the construction period.

A10.2.2 Study Area Boundary

The study area boundary for the Tilenga feeder pipeline is the same as the AOI boundary.

A10.3 Methods

A10.3.1 Secondary Data

A desktop review of the transport network using maps, satellite images, input from the project engineers, and prior consultation activities with relevant authorities was used to identify the road network likely to be used for the project, the main settlements on the road network and the location of field surveys to collect traffic data.

A review of types of road user was undertaken using information from the Uganda National Roads Authority (UNRA) and the World Health Organization, and data was gathered through social field surveys to identify the conditions experienced by users. Walking, cycling, public transport and typical forms of private transport were considered.

A10.3.2 Field Surveys

The traffic field survey was conducted between 21 and 23 January 2018 using the Uganda Ministry of Works and Transport and UNRA standard form for manual classified counts.

The survey objectives were to determine baseline traffic volumes and flow characteristics at two locations within the Tilenga feeder pipeline AOI identified by the desktop review. These locations (Table A10.3-1 and Figure A10.3-1) were identified as being on routes that would be used to transport equipment and materials toward project locations.

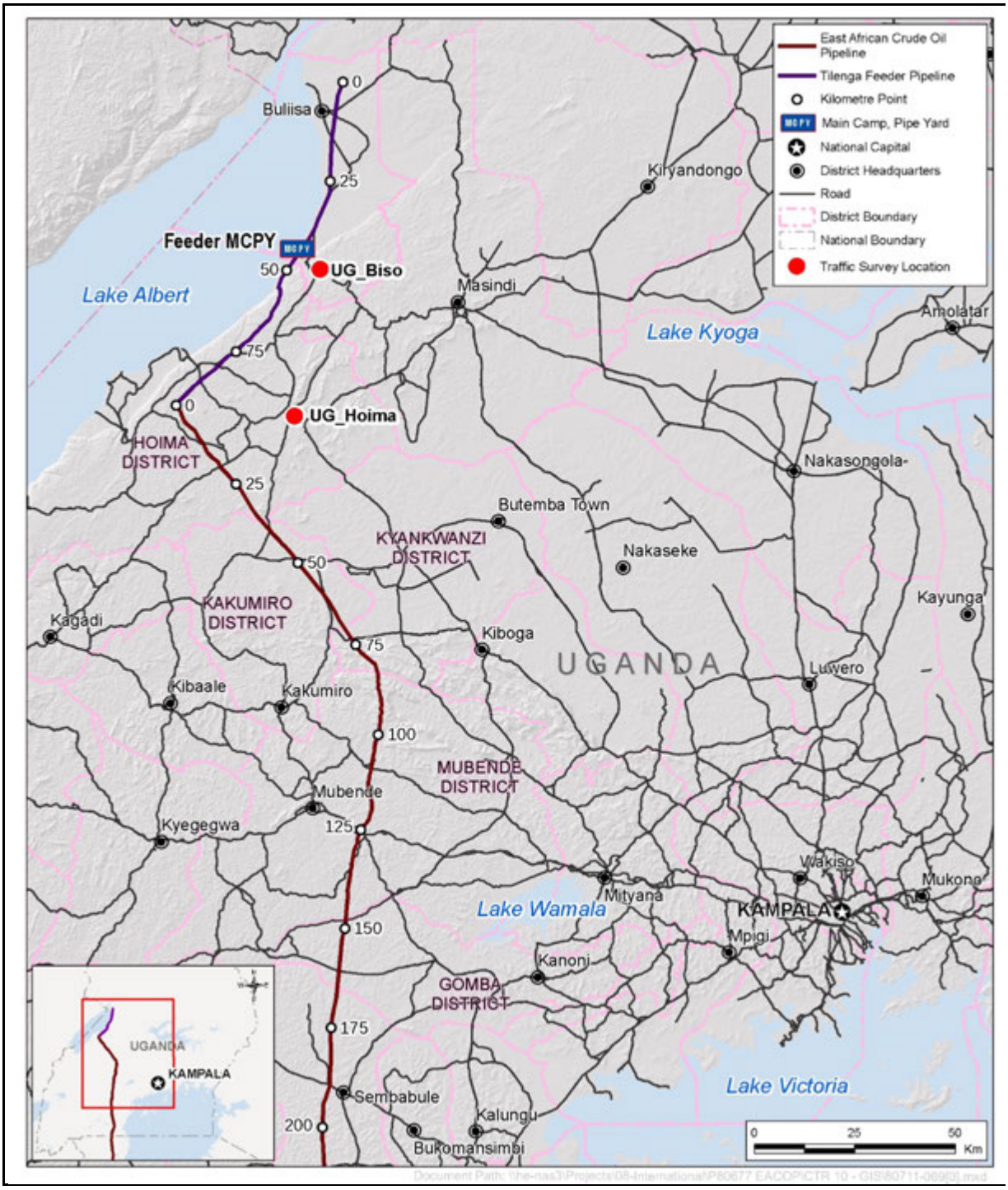

Figure A10.3-1 Location of Field Surveys

Table A10.3-1 Traffic Field Surveys

Survey Location (Towns)	Easting	Northing	Survey Period	Survey Method
Biiso	200306.5	10195362	One weekend count and one weekday count	10-hour manual classified count
Hoima	193980.9	10158875	One weekday count	10-hour manual classified count

NOTES: Coordinates based on Transverse Mercator 35°E S, International Terrestrial Reference Frame (2005)

At each survey location, field survey forms were used (one for each hour) to record the following information:

- the road link name and the traffic count station
- a brief description of the surroundings at the traffic count station
- the survey date and time period
- the weather conditions, which affect driver behaviour and traffic patterns
- the number of vehicles using the road, including bicycles and motorcycles, recorded by direction and vehicle type.

Information was also gathered during the social baseline surveys (including household surveys) and used to gain informal information on:

- perceptions of road safety and the causes of road accidents
- modes of travel.

For more information on the social surveys, see Appendix A9 Socio-economic and Health Baseline Report.

A10.3.3 Data Analysis

At the end of the survey, the total number of vehicle movements for each time period for each vehicle category was determined. The data was analysed for traffic flow characteristics.

The sensitivity of the receptors has been ranked according to the tables for the community safety, security and welfare, and social infrastructure and services valued environmental or social components VECs. The tables are presented in Appendix D.

A10.3.4 Data Considerations

The desk-based assessment, traffic field survey and social surveys provided sufficient information to accurately describe the traffic and road conditions, including all users of the road network.

A10.4 Baseline Conditions

The baseline conditions of traffic inform four VECs:

- social infrastructure and services
- community safety, security and welfare
- workers' health, safety and welfare
- community health.

Each of these is described below in terms of:

- ports and airports
- road network
- public transport
- walking and cycling
- road safety
- traffic flows.

A10.4.1 Baseline Condition of Traffic

A10.4.1.1 Ports and Airports

Ports

Uganda is a land-locked country and relies on goods being transported through neighbouring countries. Ugandan ports handle a negligible amount of cargo, with 95% of total cargo being transported by road. However, the following shipping routes offer the potential for cargo arriving by road to travel across Lake Victoria or Lake Albert with onward travel via road and rail:

- Lake Victoria offers shipping cargo routes to Kenya and Tanzania, including a ferry that transports train wagons from Kampala to each of these countries.
- Nonrailhead ferries operate across Lake Victoria for standard cargo.
- Commercial boats are used to transport goods on Lake Albert between Uganda and Congo.
- An UNRA ferry operates from Wanseko in Buliisa district to Panyimur in Nebbi district.

Airports

Airports are an entry point into land-locked Uganda for people and nonbulk goods, including specialist components.

Uganda's capital, Kampala, is served by Entebbe International Airport, 40 km southwest of the city. At the time of writing, the airport was being upgraded and expanded to modernise and improve its passenger and cargo facilities. The airport provides connections to countries across Africa, the Middle East and Europe, and offers opportunities for freight and specialist workers to be transported to Uganda with onward transport by road.

Kabaale International Airport in the Hoima district of Uganda is being developed to serve the region's oil industry, including the planned oil refinery in Kabaale. The

airport will handle large passenger and cargo aircraft for the transport of equipment and workers to the construction site and nearby oilfields.

There are also airstrips across the country that can accommodate smaller passenger and cargo aircraft. These can be used to reach more remote parts of Uganda, including the Tilenga Project development area which is served by existing airstrips at Bugungu and Pakuba in Murchison Falls National Park.

A10.4.1.2 Road Network

The project will use a variety of road types across Uganda. In Uganda, the road classification system has five levels, A–E, with A representing international trunk roads and E representing minor roads. In this baseline report, roads have been described in relation to the function they perform and the environment through which they pass as being:

- trunk roads
- urban roads
- rural roads.

At the time of writing, many of Uganda's unsealed trunk roads are being upgraded to become roads with sealed surfaces. In addition, enabling road networks are being put in place by UNRA to support oil and gas infrastructure development. This will include an upgrade to 11 roads and several bridges to become sealed roads (Figure A10.4-1). One of these roads (the Parra-Buliisa road) will be intersected by the Tilenga feeder pipeline.

In addition, the Hoima–Butiaba–Wanseko road is being upgraded at the time of writing. This road is intersected by the Tilenga feeder pipeline at KP15 and is close to the pipeline route between KP8–18 and KP28–40.

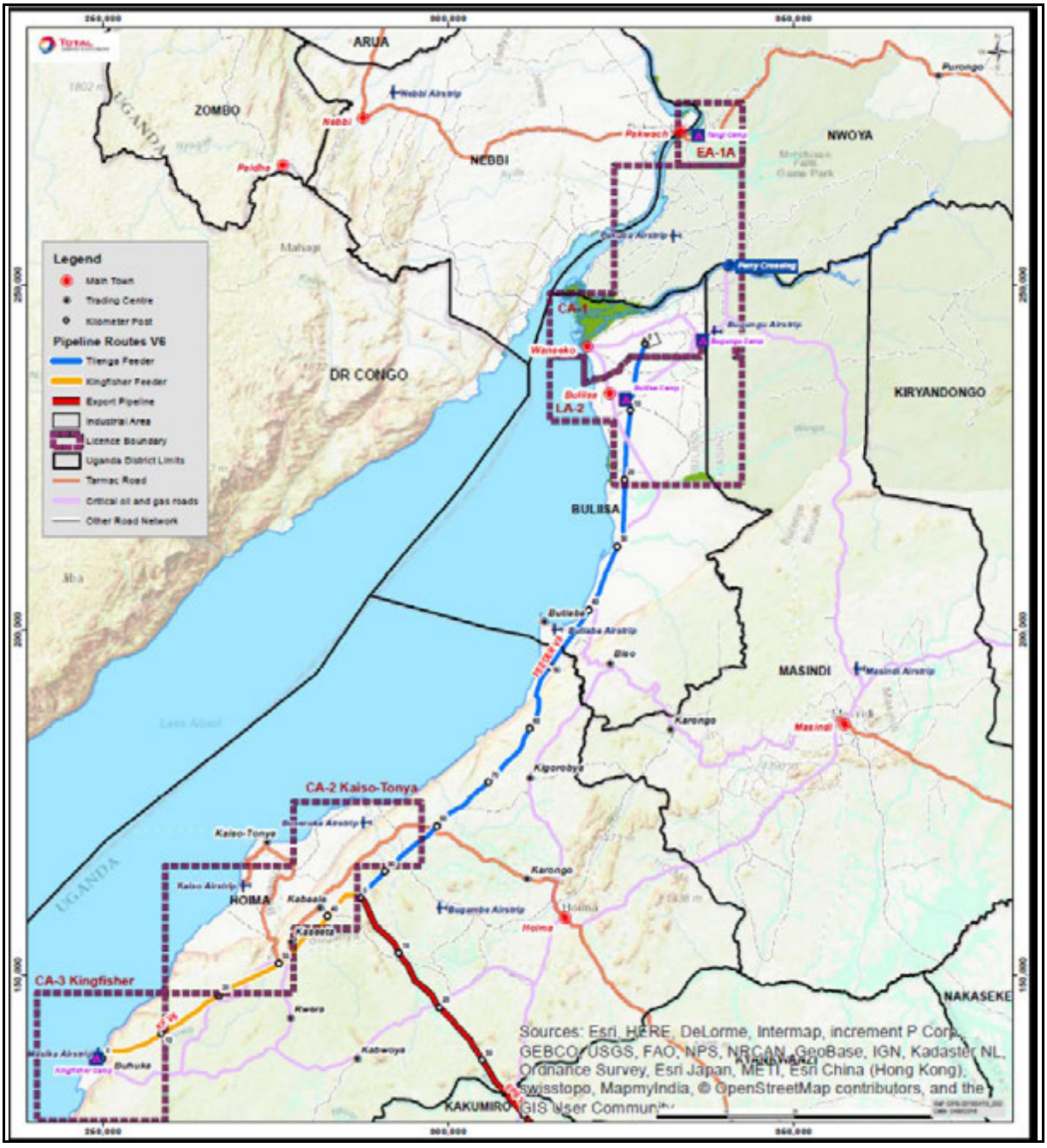

Figure A10.4-1 Road Upgrades

Trunk Roads

Many trunk roads in Uganda are unsealed. At the time of writing, some of these roads in the AOI, including those shown on Figure A10.4-1, are being upgraded to sealed surfaces.

The Hoima–Buseruka–Ngogole road connects Hoima with Kyabalendere and is likely to be used by the project. It is a sealed road with spare capacity except within Hoima town where congestion may occur (Figure A10.4-2).

Figure A10.4-2 The Hoima-Buseruka–Ngogole Road at Hoima with Typical Land Use Alongside

Urban Roads

In cities, urban roads are often sealed and provide segregated pedestrian facilities.

Outside cities, urban roads are generally unsealed. Often the same road varies in width owing to local constraints such as watercourses and buildings, although they are usually wide enough for two vehicles abreast. These roads pass through small towns and built-up areas with busy zones where people move on foot or motorcycle past numerous trading stalls on both sides of the road, and schools and other facilities.

Figure A10.4-3 illustrates a typical urban road through a village showing width, road condition and adjoining land uses.

Figure A10.4-3 Typical Urban Road through a Village

Rural Roads

Rural nontrunk roads are predominantly unsealed and often single track, requiring vehicles to move off the road to pass, unless passing places are provided. The road condition varies depending on the season, and frequency of maintenance. Adjacent land use varies between agriculture, forest and sparsely vegetated areas.

Watercourse crossings are usually over corrugated metal pipe or concrete culverts. Roads that are not elevated above ephemeral watercourses can become flooded during the rainy season, restricting movement to small towns and remote villages. Bridges in remote areas are not always well maintained and the approaches can be in poor condition because of flooding.

Roads on steep terrain can be in poor condition depending on the drainage on surrounding slopes with water damage causing rutting.

The Hoima–Buliisa road includes a section of road that runs along the eastern shore of Lake Albert and will be used for the project. This section of road traverses an escarpment, includes several pinch points, provides limited opportunities for passing and presents a hazard to heavy and loaded vehicles using the road. At the time of writing, this road is being widened to a 6-m-wide two-lane carriageway with 1–2 m shoulders, as part of the Hoima–Butiaba–Wanseko UNRA road upgrade project.

The Masindi–Bulyango–Nyantonzi road is a regional unsealed road that connects Kinyara to Biiso then continues northwards as the Biiso to Bukumi road. There is capacity to accommodate increased traffic volumes on this road (Figure A10.4-4). UNRA also plans to upgrade this road.

Figure A10.4-4 The Masindi–Bulyango–Nyantonzi Road through Biiso

A10.4.1.3 Public Transport

There is little public transport. As a result, many people walk long distances to use public transport.

Boda Boda and Bajaj

The social baseline survey showed that motorcycle taxis, boda boda, and three-wheeled motorcycle taxis, bajaj, are the most common form of transport, being used by the average Ugandan household for 75% of all journeys within urban areas. The survey also showed that a further 11% of household transport was by private motorcycle.

Buses

Kampala is preparing to introduce the first formal bus rapid transit system (National Transport Master Plan 2008–2023). This should improve travel times in Kampala and reduce health risks and pollution levels. Emphasis will be placed on high-capacity buses running on a small number of key routes that link with appropriate nonmotorised transport infrastructure and facilities. Minibuses also connect different suburbs of Kampala.

For intercity journeys, most towns have a form of taxi-park, with longer-haul minibuses departing to various destinations. These minibuses leave whenever they are full rather than following a timetable, and often make unscheduled stops to pick up passengers. Larger buses also make intercity journeys.

Rail

There are no railways close to the Tilenga feeder pipeline that are available for freight or passenger use. Rift Valley Railways, Uganda Railways Corporation (URC) and Kampala City Council Authority run the Kampala passenger train service. This passenger rail system is limited to the Kampala urban area.

A10.4.1.4 Walking and Cycling

Urban Areas

Many urban roads in Uganda have little or no infrastructure for pedestrians and cyclists. Often pedestrian access along designated footways is obstructed by traders, loading or parked vehicles, boda bodas and bajaj plying for trade, informal establishments, and pedestrians waiting to cross roads. In addition, open roadside drains create a safety hazard for pedestrians and cyclists, particularly in crowded urban streets and on unlit roads after dark.

The busy nature of the road infrastructure in urban areas and the lack of, or poor, maintenance of pedestrian crossings in Uganda discourage pedestrians from using designated crossing points. Some towns or areas of higher population density have pedestrian islands on the roads, allowing pedestrians to cross one lane of traffic at a time. In Kampala and other urban areas, there are few roads with formal traffic-light-controlled crossings.

Many market traders and customers rely on walking or cycling to access local markets in villages or urban areas

Rural Areas

Walking and cycling are extremely important for rural livelihoods. Often, people travel along rural footpaths before they can access roads; these paths range in use

and significance but can often link whole communities with the road network. For individuals living in rural areas, travelling by foot or bicycle is important for gaining access to water, fuel, wood, fields and livestock, education, healthcare and work. The conditions of footpaths and roads, and the traffic density, can therefore have an important effect on rural livelihoods.

The condition of Uganda's rural footpaths is highly variable and may change depending on the season.

District and community roads in rural areas have no provision for pedestrians and cyclists. There is the potential for pedestrian/cyclist–vehicle accidents, which are exacerbated by excessive speeds of vehicles, and at times of higher traffic. Where roads are poor and badly maintained, the shoulders of the roads can be rough and eroded. These conditions make it difficult to walk or cycle on the road shoulder, so pedestrians and cyclists use the road thus increasing the likelihood of accidents.

A10.4.1.5 Road Safety

Increasing levels of motorisation, combined with poorly maintained infrastructure, has made nonmotorised transport increasingly unsafe in both urban and rural areas. In many cases, road designs do not accommodate pedestrians and nonmotorised vehicles, although road humps are often installed to reduce the speed of traffic. In rural areas, the nature of the roads is such that overtaking requires the vehicle, motorcycle or cyclists to move to the side of the road in the area where pedestrians are travelling. Vehicles and motorcyclists also move onto the sides of roads to avoid hazards such as potholes, gullies and runoff deposits.

Uganda has experienced considerable growth in recorded road crash fatalities over the last decade with 24 people killed per 100 road crashes. On average, Uganda loses 10 people per day in road traffic crashes, which is the highest level in East Africa (United Nations Economic Commission for Africa).

Figure A10.4-5 shows the national statistics trend between 2011 and 2015 for the cause of road traffic accidents in Uganda, highlighting that previous growth in accidents has stabilised in the most recent five-year period.

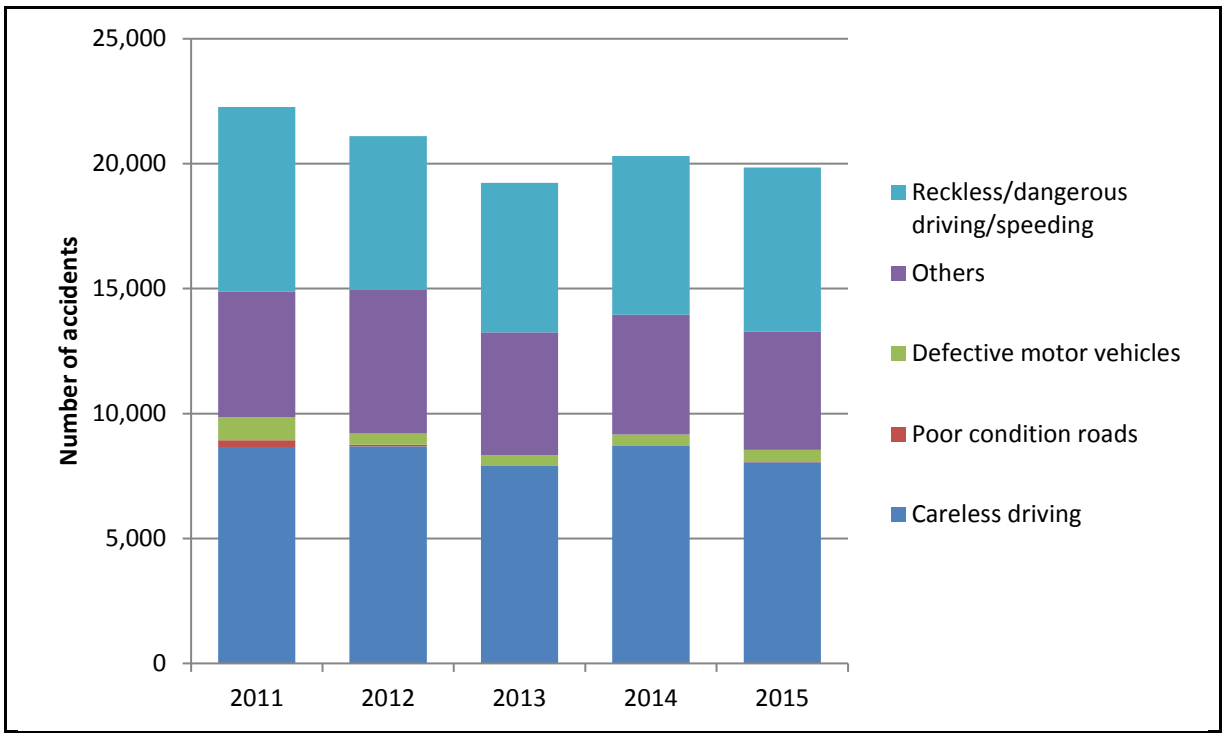

Figure A10.4-5 Causes of Traffic Accidents in Uganda

SOURCE: Uganda Police Force (Annual Traffic and Road Safety Report 2016)

Figure A10.4-5 shows that careless driving and reckless and dangerous driving are the principal causes for road accidents in Uganda. Outside the cities, drivers tend to drive at unsafe speeds because of the lack of traffic-calming measures and low level of speed limit enforcement.

A10.4.1.6 Traffic Flows

Field Survey in Biiso

The traffic count in Biiso was undertaken approximately 2.45 km from the main trading centre along the unsealed road connecting Biiso to Buliisa district headquarters. The road is used for transporting goods and accessing services such as schools, places of worship and health centres.

Table A10.4-1 shows the composition of the different types of vehicles for the weekday and weekend traffic counts.

Table A10.4-1 Weekday and Weekend Traffic Composition in Biiso

Vehicle Type	Weekday		Weekend	
	Traffic Volume (Two Way) 08:00–18:00	Percentage of Vehicle Type	Traffic Volume (Two Way) 08:00–18:00	Percentage of Vehicle Type
Cars and taxis	27	6.3	24	6.1
Light goods vehicles	34	7.9	29	7.3

Table A10.4-1 Weekday and Weekend Traffic Composition in Biiso

Vehicle Type	Weekday		Weekend	
	Traffic Volume (Two Way) 08:00–18:00	Percentage of Vehicle Type	Traffic Volume (Two Way) 08:00–18:00	Percentage of Vehicle Type
Buses and minibuses*	72	16.8	52	13.2
Heavy goods vehicles	26	6.1	36	9.1
Motorcycles	231	53.8	204	51.6
Bicycles	39	9.1	50	12.7
Daily traffic volumes	429	100.0	395	100.0

NOTES: *Commonly referred to as commuter taxis

The most common vehicle type used on the road link was the motorcycle, accounting for over 50% of total traffic.

The data collected were used to determine the hourly variation of traffic flow characteristics throughout the day. The total traffic volume was 429 vehicles during a 10-hour period on a weekday and 395 vehicles during a weekend. Given the low traffic volumes, there was general consistency throughout the day on a weekday and weekend. On a weekday, heavy goods vehicle (HGV) traffic was around 6% of the total volume and 10.7% during the 10:00–11:00 peak. At the weekend, truck traffic was 9% of the total and 14.5% during the 11:00–12:00 peak. Figure A10.4-6 illustrates the hourly variations throughout the survey period for both a weekday and weekend.

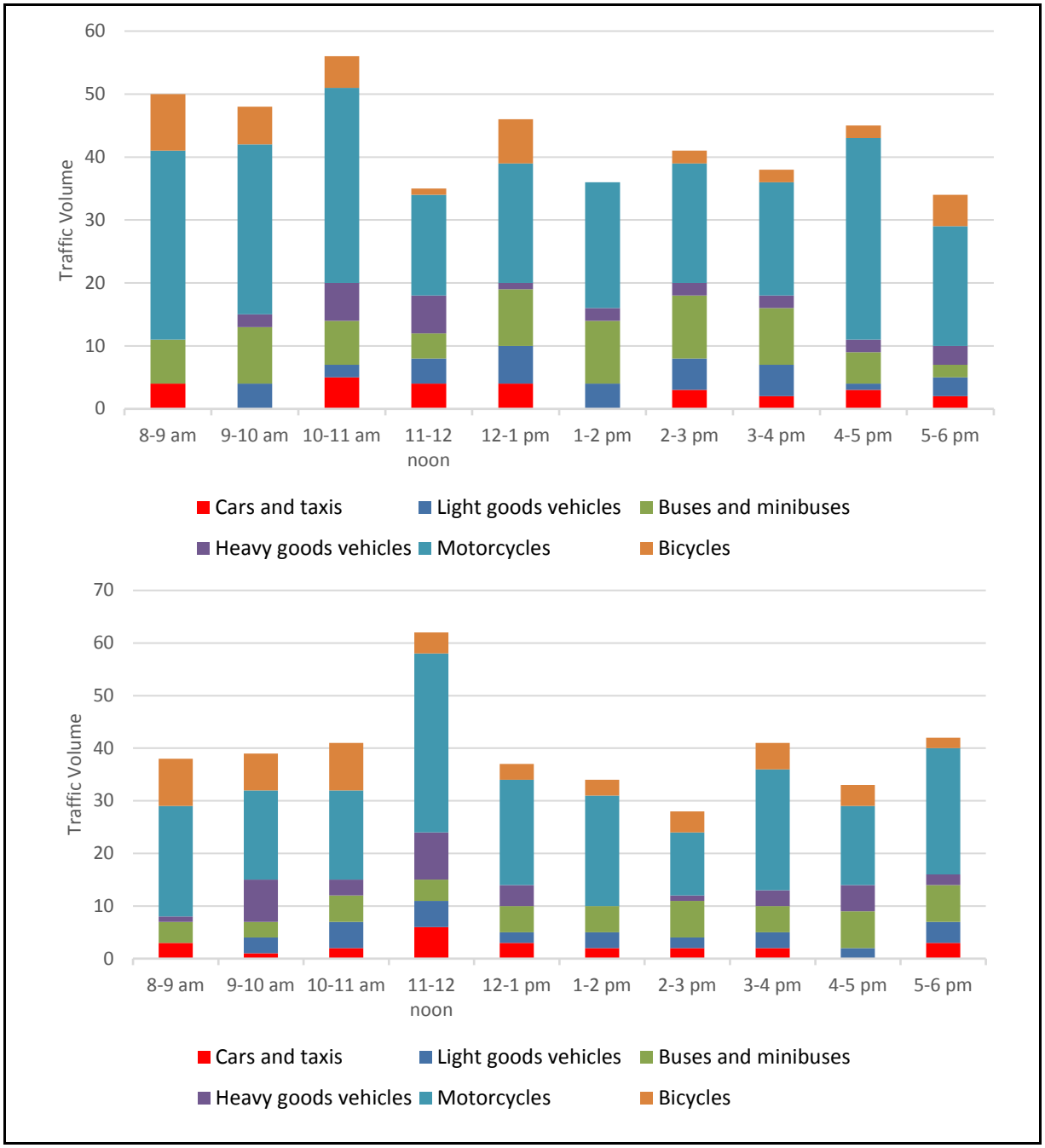

Figure A10.4-6 Weekday (Top) and Weekend (Bottom) Traffic Peak Flow Variation in Biiso

The survey showed there was little variation in vehicle numbers or types between weekdays and weekends.

Field Survey in Hoima

The traffic count in Hoima was taken along Butiaba road, which connects the towns to the northwest of Hoima and is used for transporting goods and accessing services such as schools and health centres.

The area is built up, with trading centres, markets, hotels, schools, health centres and other businesses. The areas beside the road are densely populated with both nuclear and linear settlements. The road is a single carriageway with one lane for each direction and a pedestrian pavement on one side. Traffic moves northbound toward Butiaba and southbound toward the centre of Hoima.

Table A10.4-2 shows the composition of the different types of vehicles for the weekday traffic counts.

Table A10.4-2 Weekday Traffic Composition in Hoima

Vehicle Type	Traffic Volume (Two Way) 08:00–18:00	Percentage of Vehicle Type
Cars and taxis	473	6.9
Light goods vehicles	505	7.3
Buses and minibuses*	50	0.7
Heavy goods vehicles	180	2.6
Motorcycles	5141	74.7
Bicycles	537	7.8
Daily traffic volumes	6886	100.0

NOTES: *Commonly referred to as commuter taxis

The most common vehicle type used on the road was the motorcycle, accounting for nearly 75% of traffic.

The traffic data were used to determine the hourly variation of traffic flow throughout the day (Figure A10.4-7). The total volume of traffic in the 10-hour survey period was 6887 vehicles. Peak flow was 10:00–11:00 with a similar peak around 17:00–18:00. The total traffic flows were broadly consistent throughout the day with similar proportions of vehicle types in any given hour. HGV traffic was around 2.6% of the total volume, reducing to 2.2% during the peak hour.

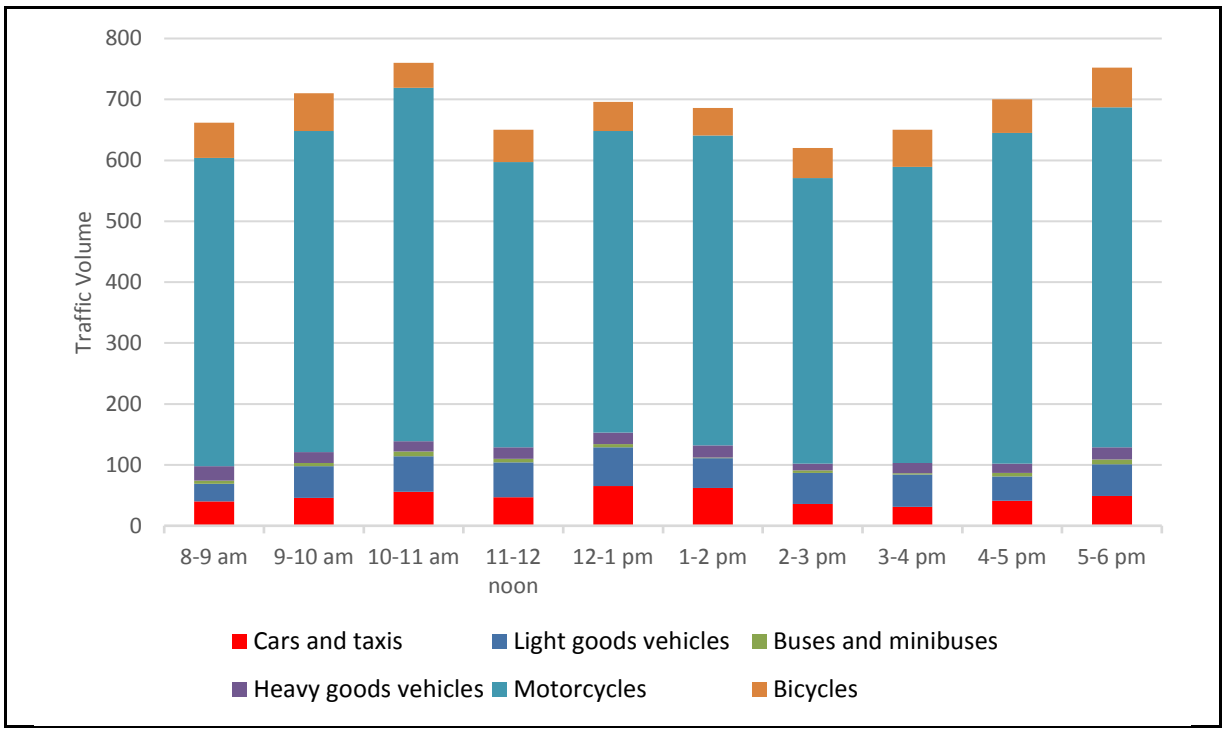

Figure A10.4-7 Traffic Peak Flow Variation in Hoima

A10.4.2 Trend in Condition and Sensitivity to Change

A10.4.2.1 Road Condition

The National Transport Master Plan 2008–2023 is a programme aimed at improving the condition of Uganda's road network. The Ugandan government is upgrading unsealed trunk roads sections. These upgrades will focus on the trunk road network and roads to be used for oil industry activities.

Sealed roads are less likely than unsealed roads to degrade as traffic levels increase. Those parts of the network not being upgraded have the potential for higher rates of deterioration and are considered most sensitive to a change in traffic flows.

A10.4.2.2 Road Safety

Various initiatives have been implemented over recent years to promote road safety in Uganda. These have included advertising campaigns on radio and television, and road safety literature. The number of recorded minor injuries has reduced each year between 2011 and 2015. Conversely, the number of people killed or seriously injured fell between 2011 and 2013, but has, at the time of writing, risen to levels similar to 2011 (Figure A10.4-8). This is likely to reflect the increase in the number of motorcycles for private or boda boda use (UNRA vehicle registrations). These vehicles have a poor safety record.

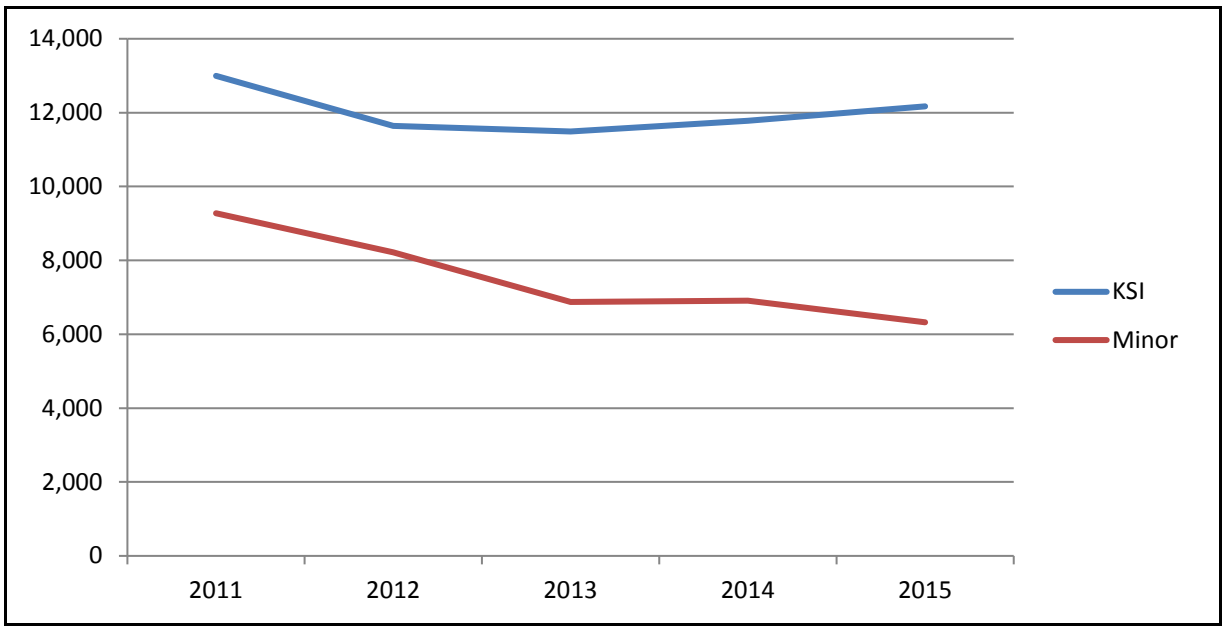

Figure A10.4-8 Severity of Traffic Accidents in Uganda
SOURCE: Uganda Police (2016)

Accident rates on roads that are upgraded should fall, although increased speeds can affect the severity of accidents. Accident rates on roads that are not upgraded are likely to be most sensitive to increased traffic flows, with a likely detrimental impact on road safety.

A10.4.2.3 Traffic Congestion

The key areas for congestion in Uganda are in Kampala, Hoima, other major towns and on the approach to border crossings.

Congestion has increased over recent years owing to an increasing number of people working in the centre of Kampala and all major towns.

The roads most sensitive to change are considered:

- those already congested, as a small increase in traffic can be detrimental to journey times. The road through Hoima is therefore sensitive to change.
- the Hoima–Buliisa road through Biiso where it runs along the eastern shore of Lake Albert and traverses an escarpment. At this location, the road is sensitive to an increased traffic volume if existing pinch points have not been removed by planned UNRA upgrades.

Other roads across the Tilenga feeder pipeline AOI are less sensitive to change, as they have spare capacity or are being upgraded by UNRA to support oil and gas infrastructure developments.

A10.4.3 Sensitivity Rankings

Based on the traffic surveys, engagement with stakeholders, trends in condition and sensitivity to change, the sensitivity of the traffic-related receptors within the AOI have been ranked (Table A10.4-3).

Table A10.4-3 Traffic-Related Receptor Sensitivity Ranking

Traffic-related Receptor	Sensitivity Ranking	Rationale for Ranking
Road condition: National roads (upgraded or planned upgrade)	Medium (3)	The national road network is generally in moderate condition with some sealed roads experiencing deteriorating conditions.
Road condition: Access roads	Very high (5)	The road network is generally in poor condition with the majority of nontrunk roads being unsealed.
Road safety: National roads (upgraded or planned upgrade)	High (4)	Sealed roads have a lower risk of accidents because of the sealed surface. Poor road conditions are a major cause of accidents in Uganda. However, settlements are usually alongside the road, with vulnerable road users (pedestrians and cyclists) being particularly sensitive to increases in the number of heavy goods vehicles.
Road safety: Access roads	Medium (3)	Accident rates are very high in Uganda. Vulnerable road users (pedestrians and cyclists) are particularly sensitive to increases in the number of heavy goods vehicles; however, access roads within the Tilenga feeder pipeline AOI are lightly trafficked.
Traffic congestion: Kampala, Hoima and major towns, Uganda–Tanzania border, Hoima–Buliisa road through Biiso where it runs along the eastern shore of Lake Albert and traverses an escarpment	Very high (5)	Where congestion is already experienced, a small change can be detrimental to journey times, compared to roads that have spare capacity. The Hoima–Buliisa road is being upgraded at the time of writing as part of the Hoima–Butiaba–Wanseko road upgrade which should reduce congestion.
Traffic congestion: Other roads	Medium (3)	Localised congestion can occur through areas of settlement where stalls, dwellings and pedestrians can cause narrowing of the road. Moderate increased traffic volumes could be detrimental to journey times in these areas.

A10.5 Key Considerations

Within the AOI, the condition of many sections of the road network will be upgraded by the government as part of its ongoing improvements or by the project for construction purposes.

Accident rates in Uganda are high, with pedestrians, children and cyclists considered particularly vulnerable.

Traffic levels are low, so congestion is rare except at the border with Tanzania and in Kampala and Hoima, and in other large towns.

The traffic baseline study identified the road at Biiso to be sensitive to changes in volumes of heavy goods vehicles owing to the low existing levels of traffic.

A10.6 References

National Transport Master Plan 2008–2023. August 2009.

Total East Africa Midstream BV. 2017. EACOP Environmental and Social Impact Assessment Scoping Report for Approval. Submitted to National Environment Management Authority, July.

Uganda Police. 2016. Annual Traffic and Road Safety Report 2016.

Appendix A11: Tangible and Intangible Cultural Heritage Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

A	
AGI	aboveground installation
AOI	area of influence
C	
CHU	cultural heritage Uganda
E	
ESIA	environmental and social impact assessment
F	
FGD	focus group discussion
I	
ICH	intangible cultural heritage
K	
KII	key informant interviews
KP	kilometre point
kraal	an enclosure for cattle or sheep
L	
LIDAR	light detection and ranging
M	
MCPY	main camp and pipe yard
monolith	small shaped flint, typically part of a composite tool such as a spear
P	
PAC	project-affected community
polity	a form or process of civil government or constitution
R	
RoW	right-of-way
T	
TCH	tangible cultural heritage
V	
VEC	valued environmental and social component

A11 TANGIBLE AND INTANGIBLE CULTURAL HERITAGE BASELINE REPORT

A11.1 Introduction

This baseline report describes the tangible and intangible cultural heritage:

- area of influence (AOI) and study boundaries
- methods
- baseline condition:
  - trends in condition and sensitivity to change
  - ecosystem services
  - sensitivity rankings
- key considerations.

Tangible cultural heritage (TCH) is defined as moveable or immovable objects, sites, structures, or groups of structures having archaeological, palaeontological, historical, cultural, artistic, and religious values (IFC 2012a).

Intangible cultural heritage (ICH) is defined as cultural resources, knowledge, innovations and practices of local communities embodying traditional lifestyles (IFC 2012b).

Cultural heritage provides continuity between tangible and intangible forms and between the past, present and future. People identify with cultural heritage as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. Cultural heritage, in its many manifestations, is important as a source of valuable scientific and historical information, as an economic and social asset for development, and as an integral part of people's cultural identity and practice (World Bank 2017).

A11.2 Area of Influence and Study Boundaries

A11.2.1 Area of Influence

The TCH AOI for the construction phase includes all construction areas:

- the right-of-way (RoW)
- aboveground installations (AGIs)
- main camp and pipe yard (MCPY)
- access roads
- temporary work spaces (at crossings).

The area affected visually or by noise, dust and vibration or restriction of access beyond the physical footprint is also included in the AOI, which extends to 100 m around the project footprint. It is unlikely that there will be discernible effects from noise, vibration, dust or restriction of access beyond this distance. This will be checked as part of the proposed programme of cultural heritage construction

planning survey and assessment, based on the findings of the impact assessment for noise and air emissions.

During the operational phase, the TCH AOI includes:

- the RoW
- AGIs.

Visual and noise impact on TCH valued environmental and social components (VECs) beyond the physical footprint is also included in the operational phase AOI, which extends to 100 m beyond the pipeline and AGIs. It is unlikely that there will be discernible effects from noise beyond this distance. This will be checked as part of the proposed programme of cultural heritage construction planning survey and assessment, based on the findings of the impact assessment for noise emissions.

The AOI for ICH is more difficult to define. For example, a sacred site may have no clear boundaries, worshippers may come from various areas and it may not be clear whether the RoW or other project components will affect access. The construction and operation AOI for TCH has been used as a basis but has been extended in cases where, based on professional judgement, sites may be affected.

A11.2.2 Study Boundaries

For TCH, the study area is larger than the AOI and is a 2-km-wide corridor centred on the RoW, construction areas (including the MCPY and AGIs) and access roads outside the corridor. A larger area was selected to assist with defining the types of TCH that may be encountered during construction and to enhance knowledge of the broader context, to assist with describing and assessing sites within the AOI.

Data for ICH were collected during social baseline data collection, using the same study boundaries as the socio-economic and health baseline study (see Appendix A9), at two levels:

- district-level, comprising all the districts and wards traversed by the Tilenga feeder pipeline
- project-affected community (PAC) level, comprising the sample PACs included in the social field survey.

A11.3 Methods

A11.3.1 Secondary Data

The baseline study utilised secondary data collected for the scoping phase, which included consultation of the following data sources:

- information from publications and previous surveys
- information on known sites provided by the Department of Museums and Monuments of Ugandan Ministry of Tourism, Wildlife and Antiquities
- satellite and internet-based information on the location of churches and mosques based on Google Earth and Google Maps, which in turn use a published list of sites such as https://maps.me/catalog/attractions/amenity-place_of_worship-christian/country-uganda/
- information held in Uganda's national archives and museums

- aerial photography and light detection and ranging (LIDAR) data.

An initial list of potential TCH sites was developed from the above sources.

Many of the documentary data sources do not include accurate location data and, in some cases, there are contradictions between sources. Data accuracy for all TCH was verified or improved by triangulating data sources, while sites that proved to be outside the study area were removed from the initial list of sites.

Nine potential sites were identified by an examination of LIDAR. The field survey described in Section A11.3.2.2 found that three of these had natural or agricultural origins while the remaining six showed no additional information as to their origin. Having gained an understanding of the features on the ground, the LIDAR data was re-examined and it was concluded that a large proportion of the features identified as potential TCH sites were likely to be the result of natural processes or agricultural activity. All the LIDAR sites have been removed from the list of sites but the six that yielded no further information during the field survey will be included in cultural heritage construction planning survey and assessment.

The refined list of sites is presented in Attachment A11.2, along with sites identified from the field surveys described in Section A11.3.2.

The location of each site in the study area was categorised:

- **inside** the project footprint (within the pipeline RoW and within project components; AGIs, MCPYs, access roads and temporary work spaces)
- **close**, within the AOI (i.e. within 100 m of the 30 m RoW and project components)
- **outside**, over 100 m from the 30 m RoW and project components and not expected to be affected.

A11.3.2 Field Survey

Cultural heritage data were collected during three field surveys, described below.

A11.3.2.1 Social Baseline Field Survey

Between 2 November and 7 December 2017, the social team undertook consultations with a sample of PACs as part of the socio-economic and health baseline survey of the social study area, see Section A11.2.2 and Appendix A9. This included:

- interviews with key stakeholders including community and religious leaders and traditional healers by means of key informant interviews (KIIs) and focus group discussions (FGDs)
- the cultural heritage component of the social survey, which asked PACs for information on intangible and tangible cultural heritage sites, including:
  - graveyards, churches and mosques
  - places such as sacred trees, groves and rocks
  - meeting sites
  - rivers and important ceremonial routes that are linked to local belief systems or associated with community histories
  - rituals, ceremonies, traditional healing and religious beliefs.

A11.3.2.2 Tangible and Intangible Cultural Heritage Field Survey

The cultural heritage team of local experts conducted a tangible and intangible cultural heritage field survey in January 2018. The objectives were to examine locations considered to have a high potential for cultural heritage assets based on the desktop study, including:

- ground truthing of potential TCH sites identified from secondary data in seven sample areas along the pipeline route totalling 50 km (approximately 50% of the pipeline length)
- sample areas were selected on the basis of previously identified sites from previous surveys, findings and studies; the LIDAR data and areas identified as having a high archaeological potential
- locations with evidence of abandoned settlements identified from satellite images and LIDAR data
- sites that the local community considered of ICH value based on the social field survey and the geophysical and geological surveys.

The field survey was mostly confined to the AOI but included locations in the study area, where needed, to assess their size or provide broader contextual information.

The ground truthing survey was undertaken by a walkover of locations to identify spreads of artefacts or other features on the ground surface. Multiple visits were made to locations where the evidence appeared to be particularly important or complex. Each site with confirmed TCH was recorded using a pro forma recording sheet, photographs and noting global positioning system coordinates. Any material observed on the ground was photographed and left in situ.

Informal meetings prior to undertaking the walkover were held with community leaders. These were valuable in establishing local knowledge of heritage features, both tangible and intangible.

A11.3.2.3 Geophysical and Geological Cultural Heritage Survey Monitoring

In March and April 2018, geophysical and geological surveys were undertaken for the project. This consisted of 25 trial pits dug by machine. The work was monitored by an archaeological team who observed the excavations and undertook a walkover survey near the trial pits, looking for evidence of surface spreads of pottery and other artefacts.

Archaeological features were found in 17 of the 25 trial pit locations. The material discovered included stone tools from early prehistoric periods. The most common discovery was pottery from the Early and Late Iron Age periods. Material recovered has been retained and will be passed to the Department of Museums and Monuments.

A11.3.3 Data Analysis

All sites identified during the field surveys were recorded in a geographic information system to identify their positions relative to the tangible and intangible cultural heritage AOI. Three categories of cultural heritage were defined based on the features identified by the studies:

- Category 1 – TCH:
  - archaeological sites
  - areas of high archaeological potential
- Category 2 – TCH with strong intangible elements:
  - cemeteries and graves, including kingdom burial sites and regalia
  - religious places where worship associated with the main established religions is practised (such as churches or mosques)
- Category 3 – ICH with a less-well-defined tangible component:
  - sites with an intangible component or traditional value, the importance of which is not always a factor of geography but of belief and ritual. Such sites may be used for music making, dance, storytelling and other rituals. This category may also include rituals that are not linked to any particular site but to a particular group of people.

Religious and other ICH valued environmental components VECs are more difficult to define, as these may have no fixed or easily mapped location, boundary or physical entity, and when they do (e.g., a sacred tree), the importance may be shared by people over a wider area. All the Category 3 features were identified during the social baseline field survey.

The sensitivity of Category 1 and 2 VECs has been ranked according to the table for cultural heritage sensitivity in Appendix D. The significance of a Category 3 VEC is defined by the local community who visit, use or engage in an intangible practice that is not objectively measurable. It takes a greater amount of time and the development of relationships of confidence and trust to enable a valuation of the sensitivity associated with ICH, making it difficult to get a real sense of importance to the communities during the baseline work, see Section A11.3.4. Therefore, a numerical ranking of Category 3 VEC sensitivity is not provided. In general, owing to their community value, these intangible features are considered to have high sensitivities.

A11.3.4 Data Considerations

The desk-based assessment, tangible and intangible cultural heritage field survey, social baseline field survey and cultural heritage monitoring of the geophysical and geological survey provided information to identify and describe the Category 1, 2 and 3 features in the study area. There is confidence that the full range of types of cultural heritage features have been identified for Category 1 and 2. However, potentially not all the sites within each type were identified.

The identification of all types of Category 3 is influenced by:

- ICH features that may have no visible or physical presence
- elements of belief in this context are often extraordinarily private and not easily shared.

Concerns surrounding ethnicity or tribal affiliation are often unmentioned or ignored in KIIs or FGDs undertaken as part of the social baseline survey (see Section A11.3.2.1 above). The exception to this general statement is at Mugasa, a sacred site identified as being specific to the Bunyoro.

This observation also applies to vulnerable minority groups such as pastoralists or hunter-gatherers who may occur in the AOI (see Appendix A9). The unwillingness of communities to speak about sensitive cultural heritage applies even more strongly to such minority groups who are very reluctant to speak in front of members of a majority group. FGDs were held with vulnerable groups and data was collected but eliciting such groups' ICH data was difficult because this requires trust, which is difficult to develop in the context of an environmental and social impact assessment (ESIA) FGD. The result of this is that the ICH of any such minority groups may be even less well-represented in the results of FGDs and KIIs, and thus less visible to this study. Despite these inherent limitations, a considerable amount of data was recorded during the surveys.

The social baseline field surveys generated good supporting information for the identification of ICH sites. However, every ICH site that could be affected will not have been identified as the social surveys were conducted on a sample of PACs, not every PAC within the AOI. Conversely, many of the ICH sites identified may not be affected as precise location information was not provided during the KIIs or FGDs.

The collected baseline data is sufficient to:

- define the types of sites in each of the three categories that may be found along the pipeline route
- guide the preconstruction programme of further survey and assessment required to help identify areas with a high potential for additional sites, both tangible and intangible, in sections of the RoW not covered during the surveys
- identify the mitigation measures for cultural heritage sites that are encountered during construction.

A11.4 Cultural Heritage Baseline Conditions

A11.4.1 Baseline Condition of Tangible and Intangible Cultural Heritage

A11.4.1.1 Historical Background

Lake Albert is formed within the western arm of the East African Rift Valley. The lake has a complicated tectonic history that includes drainage into the lake from the higher-level Lake Victoria (Logan et al, 2009). This drainage resulted in different sedimentary deposits that may contain fossil deposits. The northeast shoreline of the lake now drains via the Murchison Falls towards Lake Victoria and the Nile. There are two sedimentary formations: the Paraa Beds comprising sands and gravels of mid- to later-Pleistocene age and the Namiksika Beds comprising coarse grits of possibly Mio-Pliocene age.

Hominid fossils have not been found in the area, but Paraa Lodge provided a large assemblage of hand axes and smaller stone tools. This established an upper age limit of late Pleistocene deposits of the Paraa Beds (Bishop 1967).

The Great Lakes area was wetter 10,000 to 5000 years ago than it is today but it became drier throughout the second and first millennia BC. This change was accompanied by receding forests and wetlands and increasing land clearance that

continued until about 1000 AD, when the landscape became similar to how it is today.

Limited archaeological data are available for western Uganda before the second millennium AD. There are occasional sites containing microliths, but Neolithic material is apparently absent, although sites of this type are found in adjacent regions. Up to 2000 years ago, the main part of the Lake Albert area was occupied by hunter-gatherers who used stone tools. There is some evidence that pottery makers moved into the area beside the lake during the first millennium AD (Connah 1997).

The Early Iron Age began around 500 BC. Linguistic history suggests that Sudanic-speaking societies moved into the area between Lake Victoria and the Great Lakes before 500 BC. This was possibly the result of a population increase due to economic changes. Ironworking was introduced into an economy based on pastoralism and raising crops (Connah 1991). This is part of the background to the growth of the state of Bunyoro as shown by the sites of Ntusi, Mubende and Munsa.

Ntusi is the earliest complex site examined in western Uganda. This is a Late Iron Age site formed of large earthworks and mounds that date back to the 10th and 11th centuries (Reid and Meredith 1993). It contains house foundations, post-holes and indications of ironworking. The site appears to have functioned as a feasting and trading centre receiving goods brought in from the coast. The site expanded in size so that by the 13th and 14th centuries it covered more than 100 ha and had several smaller satellite sites.

The 12th century saw increasing aridity. Other large earthwork sites such as Bigo and the smaller Bwera present an economy dependent on cultivation and cattle breeding. Increasingly humid conditions in the 15th century led to population increases and consequent settlements and earthworks at Munsa, Kidengo, Kaswye and Nyiginya. The return of arid conditions in the 16th century led to a decline in settlement centres and a reduction in large sedentary populations in the late 17th and early 18th centuries.

Drought and migration are the two key repeating themes in the history of western Uganda. This is seen in the environmental, archaeological, linguistic and oral history datasets. The Great Lakes were subject to periodic droughts during the second millennium AD that resulted in a prominence of pastoralism and population movement. The return to normal conditions and the movement of the population back to the affected areas resulted in new ethnic mixes and leadership providing opportunities for innovation and social change.

The area was a sparsely populated frontier region before the second millennium AD. Diverse mixed-farming communities gradually settled into the lush mountains north of the Katonga River between the 11th century and the end of the 15th century. This culminated in the growth of several small competing polities and the construction of earthwork sites. At the beginning of the 16th century, the shift to a drier climate coincided with the appearance of more dispersed settlement patterns with greater emphasis on pastoralism. This territory, now eastern Uganda, was split into the two kingdoms of Kitara and Buganda.

The Bunyoro kingdom emerged in the west of the area of the Kitara nation. Bunyoro court histories identify three consecutive dynasties. The earliest dynasty was the Batembuzi, who imposed monarchical rule over the original Kitara society. The short-lived Bachwezi dynasty was said to have been ended by a “great drought”. The Babiito dynasty, which began in the late 16th and early 17th centuries, ruled at the time of European contact.

There are linguistic histories that show the movement of different groups into the area. Ethnic and social studies show the structure of the main kingdoms and the clan groups within them. The Buganda kingdom was established along the shores of Lake Victoria and into eastern Uganda. The Bunyoro kingdom was centred on the Great Lakes. It lost territory and power to Buganda and other kingdoms towards the end of the 19th century. At the time of European contact, Buganda was at the height of its power.

The project route traverses most of Bunyoro. This is also part of the focus of the ironworking industry within the context of the wider territory of Kitara. There are important salt production sites at Kibiro, approximately 4 km from the pipeline route and other places on Lake Albert. Kibiro was placed on Uganda’s Tentative List of World Heritage Sites in 1997. The Tentative List is an inventory of those properties that a country intends to consider for nomination to the World Heritage List. It played a significant part in the economy of the area along with iron smelting (Connah 1991).

Bantu speakers probably entered southern Uganda by the end of the first millennium. They had developed centralised kingdoms by the 15th or 16th century, and after independence from British rule in 1962, Bantu speakers constituted roughly two-thirds of the population in Uganda. Their languages, which may also have direct socio-ethnic relevance, are classified as either Eastern Lacustrine or Western Lacustrine Bantu. The Eastern Lacustrine Bantu speakers include the Buganda, the Basoga, and many smaller societies in Uganda. The Western Lacustrine Bantu speakers include the Banyoro, the Bastoro, the Banyankole, and several smaller populations.

Nilotic language speakers probably entered the area from the north beginning about 1000 AD. Considered the first cattle-herding people in the area, they also practised crop cultivation. The largest Nilotic populations in Uganda are the Iteso and Karamojong ethnic groups, who speak Eastern Nilotic languages, and the Acholi, Langi, and Alur, who speak Western Nilotic languages.

After independence in 1962, there were conflicting local nationalisms and allegiances. Buganda's large population, extensive territory in the environmentally favoured south, and what was often perceived as a self-proclaimed superiority created a resistance among other Ugandan peoples. Nubians shared little sense of identification with other groups.

The 1960s and 1970s were a period of social and cultural changes driven by national and regional politics. Milton Obote from northern Uganda forged an alliance of non-Bugandan politicians to form the Uganda People’s Congress. The Uganda People’s Congress was dominated by politicians who wished to rectify a perceived regional inequality in favour of Buganda. This had substantial support from outside

Buganda. Even at independence, the Buganda question remained unresolved. Prior to colonial rule, Buganda had been rivalled by the neighbouring Bunyoro kingdom. Buganda had conquered parts of Bunyoro and the British colonialists had formalised this in the Buganda Agreements. Known as the "lost counties", the people in these areas wished to revert to being part of Bunyoro.

These divisions brought some powerful influences into focus. For example, the army and police, which the British mandate had recruited almost exclusively from northern Uganda owing to their perceived suitability for these roles, alienated other ethnicities. In 1966, following a power struggle between the Obote-led government and King Muteesa, Obote suspended the constitution and removed the ceremonial president and vice-president. In 1967, a new constitution proclaimed Uganda a republic and abolished the traditional kingdoms. Obote was declared the president.

After a military coup in early 1971, Obote was deposed and General Idi Amin seized control of the country. Amin ruled Uganda for the next eight years. Amin's reign was ended after the Uganda–Tanzania War in 1979, in which Tanzanian forces, aided by Ugandan exiles, invaded Uganda. Museveni has been president since his forces toppled the previous regime in January 1986.

The social and ethnic repercussions of the political and military movements of more than a generation ago may still be perceived, sometimes in weakened forms, in cross-cutting social relationships in the present.

A11.4.1.2 Sites Identified Within the Study Area

Within the 2-km-wide study area, 49 features were located through secondary data reviews and by the field surveys:

- 17 within the project footprint (inside)
- three within the AOI (i.e. within 100 m of the 30-m RoW and project components and may be susceptible to some form of impact [close])
- 29 within the 2 km study area but beyond 100 m of the RoW and project components (i.e., beyond the area expected to be affected [outside]).

See Attachment A11.1 (map) and the table in Attachment A11.2.

A11.4.1.3 Cultural Heritage Features

The Category 1, 2 and 3 cultural heritage features are described below and shown on maps in Attachment 11.1 and in tables in Attachments 11.2 to 11.4. Site importance as identified by the project is identified in Attachment 11.2.

Category 1

Palaeo Fossil Sites

Lake Albert is known for deposits of paleo fossils. Many of these are closely correlated to the changing levels of water in the lake and are therefore near the lake shoreline. As the study area for most of the project does not include the edge of the lake shoreline, no fossil deposits have been identified in the study area. It is possible that deposits containing fossils, that could include early hominids, may be

encountered within the project footprint along the first 55 km of the pipeline route, which is closer to the water level of Lake Albert.

Sites with Pottery Remnants and Ironworking Sites

The geophysical and geological survey monitoring identified 17 locations with pottery, all directly on the RoW. Most of the pottery dates from the Early and Late Iron Age. One of the potsherds appears to be of Kansyore type, which is earlier than the Early Iron Age material and is of a type that appears to have been used by hunter-gatherers from 8,000 to 2,000 years ago (CHU428, KP68.9).

Only one archaeology site has been identified close to the project footprint (within 100 m, see Attachment A11.1). This is a pottery spread found in 1994 at Nyamukuta Bridge (CHU260; KP36) (Connah 1997). Other archaeological features consisting of pottery spreads and burial cairns are known in the study area and further away. It is expected that more features will be encountered during cultural heritage construction planning survey and assessment, including evidence of ironworking. The material recorded from earlier surveys indicates that a range of associated settlement sites may be present dating from the Stone Age through the Early Iron Age up to recent times.

Rock Art Sites

No rock art has been found in the study area. Rock art is thought to be common in the region, so it is possible that examples may be found during cultural heritage construction planning surveys and assessment especially in the escarpment area.

Category 2

Churches and Mosques

Twenty-four churches and mosques have been identified within the study area. Two churches are close to the project footprint. The church of the Liberty Spiritual Well of God is approximately 35 m from the RoW at KP82 (CHU136) and a Roman Catholic Church is located approximately the same distance from the RoW at KP84 (CHU131).

Figure A11.4-1 KP7, Kijanji Church (Site CHU314)

Figure A11.4-2 KP31, Waisoke Church (Site CHU280)

Graves and Cemeteries

Only one grave site has been identified within the study area. This is in contrast with surrounding areas where many are known. Further examples may be found during cultural heritage construction planning surveys and assessment.

Category 3

Sacred Natural Sites and Trees

Sacred trees were identified in the communities of Booma (the Mulolo tree at Booma-Kakere) and the Bujawe forest at Wayoyo as the focus of ceremonies. Sacred places, not specifically mentioning trees, were mentioned at Serule B (Wambiringitya, and at Kamawamboki) and at Katooke (place not named) and at Kigorobya where special trees and herbs linked to pastoralism were described.

Traditional Dance

Traditional dances were recorded in Serule B and implied by descriptions of rituals at Waki-Kawaibanda and Katooke.

Rituals to Interact with Ancestors for Good Health and Prosperity

Rituals to ensure good health and prosperity were identified in Piida A and at Busingiro Hill in Kihunghya. Rituals were identified for fertility and community property.

Traditional Healing

Traditional healing is widely practised. The practitioner may operate from a village house but will visit specific areas to gather herbs and leaves that are essential ingredients for the healer's processes. Trees are also a source of medicinal materials, which may link trees to as a locus for ancestral spirits. Specific mention was made in Katooke, Hoima and Kigorobya. Traditional healing is also covered in the socio-economic and health baseline (see Appendix A9) but mentioned here because the use of herbs is usually combined with rituals based on traditional African belief systems.

Syncretism

The amalgamation of established religions (Islam and Christianity) and traditional African belief systems was mentioned explicitly in many PACs including Katooke, Kigorobya, and Kihunghya

In some examples, syncretism is at first denied but subsequent KIIs or FGDs revealed places and trees where prayers or rituals are offered for many purposes ranging from bringing rain, healing the sick or cleansing troubled spirits, initiation to adulthood, and calming the spirits or ghosts of the ancestors in PACs, for example, at Katooke.

Meeting Places

Sacred places still used for important meetings were mentioned at Mugasa (in Katooke) for Bunyoro kingdom officials and at Katooke and Buseruka for negotiating marriages and dowries.

Twins

The birth of twins is commonly surrounded by a degree of spiritual ambivalence in traditional African belief systems; this was mentioned at Rwamutonga (Hoima) and

is likely to be observed in other PACs but was not mentioned in consultation meetings or interviews.

A11.4.2 Trend in Condition and Sensitivity to Change

Limited information exists on trends in condition of cultural heritage sites in the regions traversed by the project. Agriculture, expanding and new settlements, infrastructure, mining and other developments affect the cultural heritage baseline. Based on professional experience and opinion, and a precautionary principle that acknowledges that archaeological sites may be unique even if superficially similar to others, the definition adopted is that TCH is a finite resource and loss is considered nonreplicable by the project, but not under International Finance Corporation (IFC) definitions. IFC Performance Standard 8 (2012) defines replicable heritage as “tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites or structures.”

Nonreplicable cultural heritage is defined by IFC such that it “may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site.” Based on professional experience no sites within the AOI meet IFC criteria as nonreplicable. However, this does not diminish the potential archaeological interest of sites. Using a precautionary principle that acknowledges that archaeological sites may be unique, the approach adopted recognises that tangible archaeological heritage is a finite resource.

ICH is closely linked to individual and group identity and to all parts of a culture. ICH practices are not static; change is ongoing and further change is inevitable. ICH assets of value to the PACs are sensitive to change. This may be due to the movement of people in or out of the area, so that the resource loses value as the belief systems that gave the asset value are replaced. ICH assets may have little resilience and can be lost entirely to a new generation but more commonly, change at a rate and in a direction that at a point in time is considered undesirable by members of a community who commonly assume that the situation regarding beliefs that they know in the present pertained in the past.

The older established religions like Islam and Christianity presently have an ambivalent relationship with traditional African beliefs in ancestral spirits, which may be further eroded.

A11.4.3 Ecosystem Services Provided

Cultural heritage generates a range of ecosystem services as set out below.

Cultural services:

- provide a sense of self and the role of communities and individuals in the world. A sense of place and way of life is central to the effective functioning of many social systems in terms of agricultural production, craft production and trade, land ownership and inheritance and are based upon and maintained by intangible heritage practices.
- provide spiritual, sacred or religious values, inspiration for culture and design, and cognitive development
- support the effective functioning of other social activities in terms of agricultural production, craft production and trade, land ownership and inheritance.
- build resilience in terms of ability to adapt to continuous social changes without loss of basic social functions.

A11.4.4 Sensitivity Rankings

Sensitivity rankings for Category 1 and 2 sites are provided in Attachments A11.2–A11.4.

A11.5 Key Considerations

The key considerations are as follows:

- The tangible and intangible cultural heritage identified is considered a representative sample. The sample represents the full range of features for categories 1, 2 and 3 likely to be encountered, but there is less certainty for Category 3.
- Religious structures are the most common Category 2 sites.
- No known nationally or internationally designated sites or critical cultural heritage have been identified within the study area.
- Three high sensitivity Category 1 sites have been identified within the RoW. These are potential sites of Early to Late Iron Age settlement.
- The remaining Category 1 and 2 sites affected by the RoW are considered low to moderate sensitivity.
- Deposits containing paleo fossils that could include early hominids may be encountered within the RoW, on the first 55 km of the pipeline route, which is close to the water level of Lake Albert
- Category 3 is closely linked to individual and group identity and therefore sensitive to cultural change.
- Many more features for each category are likely to be identified in the AOI.
- Identification of further Category 3 features requires active participation of local key informants based on establishing a sufficient degree of trust.

The Convention for the Protection of the World Cultural and Natural Heritage, 1972 and the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage refer to international human rights in respect of tangible and intangible cultural heritage and the importance of:

- the tangible and intangible cultural heritage as mainsprings of cultural identity and diversity
- maintaining access to and the right to practice traditional cultural heritage and beliefs.

A11.6 References

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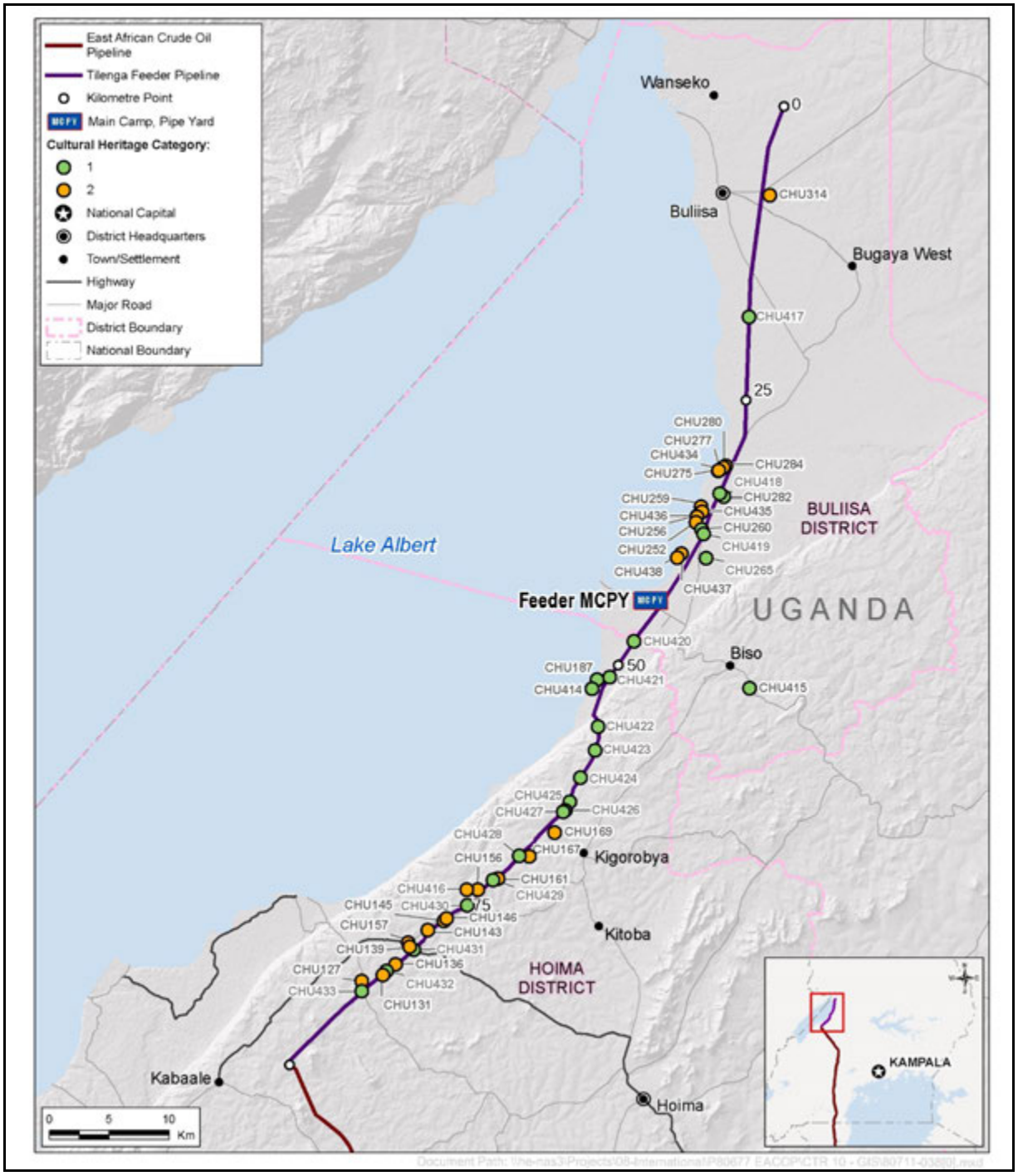
ATTACHMENT A11.1 MAP



ATTACHMENT A11.2 CATEGORY 1 AND 2 CULTURAL HERITAGE ASSETS RECORDED WITHIN THE STUDY AREA

Label	KP	Heritage Name	Category	Source	Tangible	Intangible Value	Sensitivity	Location
CHU314	7	Kijangi Church of Uganda	2	Satellite imagery	Yes	Yes	6	Outside
CHU417	18.1	Lithic core, Kabolwa	1	Kyazike (2018)	Yes	No	6	Inside
CHU284	30	Serure Church of Uganda	2	Satellite imagery	Yes	Yes	6	Outside
CHU275	31	Kigungu Mosque	2	Satellite imagery	Yes	Yes	6	Outside
CHU277	31	Bugiogo Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU280	31	Waisoke Pentecostal Assemblies of God Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU282	33	Pottery scatter	1	Connah (1997)	Yes	No	4	Outside
CHU418	33.3	Discoid and Levallois flakes; Early Iron Age pottery, Bugoigo	1	Kyazike (2018)	Yes	No	6	Inside
CHU259	34	Kyamukuta Church of Uganda	2	Satellite imagery	Yes	Yes	6	Outside
CHU434	34.6	Serue, Church of God	2	Satellite imagery	Yes	Yes	6	Outside
CHU256	35	Pottery scatter, Nyamukuta	1	Connah (1997)	Yes	No	4	Outside
CHU435	35.2	Nyamukuta Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU436	35.8	Nyamukuta Catholic of God	2	Satellite imagery	Yes	Yes	6	Outside
CHU260	36	Pottery scatter, Nyamukuta Bridge	1	Connah (1997)	Yes	No	4	Close
CHU252	36	Nyamukuta Pentecostal Assemblies of God Church	2	Satellite imagery	Yes	Yes	6	Outside

Label	KP	Heritage Name	Category	Source	Tangible	Intangible Value	Sensitivity	Location
CHU419	36.9	Lithic scraper, Late Iron Age pottery, Nyamukuta	1	Kyazike (2018)	Yes	No	6	Inside
CHU265	38	Pottery scatter	1	Connah (1997)	Yes	No	4	Outside
CHU437	39.2	Walukula Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU438	39.8	Walukula Church of Uganda	2	Satellite imagery	Yes	Yes	6	Outside
CHU420	47.6	Late Iron Age potsherds, Katonge	1	Kyazike (2018)	Yes	No	6	Inside
CHU187	51	Pottery scatter, Katonge	1	Connah (1997)	Yes	No	4	Outside
CHU421	51.2	Three lithic scrapers, potsherds, Katonge	1	Kyazike (2018)	Yes	No	6	Inside
CHU414	52.6	Pottery scatter, Katonge	1	Musalizi 2018	Yes	No	4	Outside
CHU415	52.7	Cairn burials	1	Musalizi (2018)	Yes	Yes	8	Outside
CHU422	55.8	Lithic axe, Late Iron Age pottery, Lunga	1	Kyazike (2018)	Yes	No	6	Inside
CHU423	57.8	Two potsherds, lithic axe, Kirwawanga	1	Kyazike (2018)	Yes	No	6	Inside
CHU424	60.5	Five potsherds, tuyere, Middle Stone Age lithic axe, Kirwawanga	1	Kyazike (2018)	Yes	No	8	Inside
CHU425	62.7	One potsherd, Kiganja	1	Kyazike (2018)	Yes	No	4	Inside
CHU426	63.5	Five Late Iron Age potsherds, Kiganja	1	Kyazike (2018)	Yes	No	4	Inside
CHU427	63.8	Two potsherds, Kiganja	1	Kyazike (2018)	Yes	No	4	Inside
CHU169	65	Ndaragi Church of Uganda	2	Satellite imagery	Yes	Yes	6	Outside
CHU167	68	Bisaka's Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU428	68.9	Early Iron Age and Late Iron Age potsherds and possibly Kansyore type pottery, Kabatindure	1	Kyazike (2018)	Yes	No	8	Inside
CHU161	71	Roman Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside

Label	KP	Heritage Name	Category	Source	Tangible	Intangible Value	Sensitivity	Location
CHU429	72	Many Early Iron Age and Late Iron Age potsherds, Hanga	1	Kyazike (2018)	Yes	No	8	Inside
CHU156	73	Roman Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU416	74	Hanga graves, Bushruka	2	Musalizi (2018)	Yes	Yes	8	Outside
CHU430	75.1	Two potsherds, Buhiriki	1	Kyazike (2018)	Yes	No	4	Inside
CHU145	77	Roman Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU146	77	Pentecostal Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU143	78	Roman Catholic Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU157	80	Church of Uganda	2	Satellite imagery	Yes	Yes	6	Outside
CHU431	80.9	Two potsherds, Nakabingo	1	Kyazike (2018)	Yes	No	4	Inside
CHU139	81	Mosque	2	Satellite imagery	Yes	Yes	6	Outside
CHU136	82	Liberty Spiritual Well of God Church. Approximately 35m from RoW	2	Satellite imagery	Yes	Yes	6	Close
CHU432	83.9	One potsherd, shell, Kyakabogga	1	Kyazike (2018)	Yes	No	4	Inside
CHU131	84	Roman Catholic Church. 36 m from RoW	2	Satellite imagery	Yes	Yes	6	Close
CHU127	86	Church	2	Satellite imagery	Yes	Yes	6	Outside
CHU433	86.5	One potsherd, Lwamutanga	1	Kyazike (2018)	Yes	No	4	Inside

ATTACHMENT A11.3 INTANGIBLE CULTURAL HERITAGE COMMUNITY LEADERS RESPONSES ON SACRED SITES

Nearest KP	District	Settlement Name	Sacred Place	Use	Frequency of Use	Comments on Importance[1]
30.5	Buliisa	Serule B	Wambiringitya	Elders	Not in use (preserved)	Sacred place
30.5	Buliisa	Serule B	Kamawamboki	Elders	Not in use (preserved)	Sacred place
30.5	Buliisa	Serule B	Kamakolomi	Elders	Not in use (preserved)	Sacred place
44.5	Buliisa	Biiso	War memorial of the great war in town	Not specified	Not in use (preserved)	Important
44.5	Buliisa	Biiso	Busingiro	Not specified	Not in use (preserved)	Important
44.5	Buliisa	Booma	Mulolo tree at Booma-Kakere	Pagans	Frequently	Sacred place
44.5	Buliisa	Booma	Mulolo tree at Booma-Kakere	All people	Occasionally	Medical significance
45.5	Buliisa	Piida A	Palm trees	All people	Not specified	Shelters, eating the fruit
45.5	Buliisa	Piida A	Island (Hansonga)	All people	Frequently	Traditional worshipping
45.5	Buliisa	Piida A	Escapment (Kikonko)	All people	Occasionally	Rituals
47	Buliisa	Waki-Kawaibanda	Kawabanda burial sites	All people	Occasionally	Of high value for Kawabanda villagers
49.5	Buliisa	Kihunghya	Busingiro Hill	All people	Frequently	Blessings and wealth

[1] These comments were made by respondents during KII and FGDs

Nearest KP	District	Settlement Name	Sacred Place	Use	Frequency of Use	Comments on Importance[1]
75	Hoima	Wayoyo	Bujawe Forest Reserve	Not specified	Not in use (preserved)	Important for ICH
84.5	Hoima	Buseruka	Yaramanga	Local council	Frequently	Burial ground
95	Hoima	Katooke	Mugasa	Bunyoro Kingdom officials	Occasionally	Cultural site for Bunyoro Kingdom

ATTACHMENT A11.4 INTANGIBLE CULTURAL HERITAGE RITUAL LEADERS – RESPONSES REGARDING CEREMONIES

Nearest KP	District	Settlement Name	Ritual Ceremony	Description[2]	Timing
1.5	Hoima	Katooke	Worship spirits	Families gather in one place where there is a shrine to slaughter animals, sing while moving in circles and play local instruments	Whenever community members suspect a disease outbreak within or outside the village
30.5	Buliisa	Serule B	Traditional dancing ceremonies	Not specified	Not specified
30.5	Buliisa	Serule B	Lam te kwar church / Lamtekwaru Chanting	A place where people only worship their dead ancestors, believing that Jesus is their dead ancestors and relatives who have died They pray to their dead ones for blessing and fulfilment of all their needs They believe that you have to die in order to bless others The church has got its origin from Panyimur in West Nile	Not specified
44.5	Buliisa	Biiso	None here – they said modernisation has killed ritual culture	Not specified	Not specified
44.5	Buliisa	Booma	Rituals are no longer practised owing to increased civilisation and they are there, they are done secretly	Not specified	Not specified

[2] These comments were made by respondents during KII and FGDs; N/A = not available

Nearest KP	District	Settlement Name	Ritual Ceremony	Description[2]	Timing
45.5	Buliisa	Piida A	Sacrifice to gods to give people blessings as the year ends and as the begins	Every end of year and every beginning of the year	December to early February
47	Buliisa	Waki-Kawaibanda	Drama story telling	Stories told to villagers by elders and those with a story to tell. An old tradition continued. All welcome called 'Ndongo'	Every Sunday
47	Buliisa	Waki-Kawaibanda	Weddings	During dry season	Not specified
49.5	Buliisa	Kihunghya	Empango	Every year the Banyoro gather at the palace to celebrate the memorial coronation of the King	June
64.5	Hoima	Kigorobya	Giving names to newly born children	Animals are slaughtered while mentioning words wishing better future. A tree can also be planted in memory	Any time
64.5	Hoima	Kigorobya	Providing security to the kraals	Special trees and herbs are put into the kraal or tied onto the animals' neck	Kraal establishment
64.5	Hoima	Kigorobya	Providing blessings and protection to newly constructed houses	Special trees are used to make a roof, herbs are buried in the foundation	Construction of the foundation and roofing
64.5	Hoima	Kigorobya	Birth of twins	They are given special names similar dress codes and families of the twin parents exchange or swap food which has to be similar.	During initiation of the twins into the family
64.5	Hoima	Kigorobya	Marriage	Girls sit on the laps of their parents and are counselled. While boys sit on the laps of their fathers	Before the couple unites officially
64.5	Hoima	Kigorobya	Last funeral rights	The heir is given a spear and stick	After burial

Nearest KP	District	Settlement Name	Ritual Ceremony	Description[2]	Timing
64.5	Hoima	Kigorobya	Burial	If the deceased was a nuisance to the community the body is caned. Some people put herbs into the coffin to suppress the ghost	Before burial
75	Hoima	Wayoyo	Drumming	Community drumming	Before burial
75	Hoima	Wayoyo	Xylophone dancing	They have a xylophone in the community	Perform during dry season when they have more time
84.5	Hoima	Buseruka	Marriage	Boys parents visit girl's parents and negotiate on the dowry	Whenever money is available and both (boy and girl) are ready for marriage
86	Hoima	Rwamutonga (Busuruka subcounty)	Last funeral rights	The heir is given a spear and stick	After burial
86	Hoima	Rwamutonga (Busuruka subcounty)	Birth of twins	Families of the twin parents exchange or swap food which has to be similar.	N/A
87.5	Hoima	Rwamutonga (Bugambe subcounty)	Twin Ritual	Welcoming the twins in the family People kill animals and eat and drink together Naming the child	November-January during harvesting time
95	Hoima	Katooke	Marriage	Boys parents visit girl's parents and negotiate on the dowry	Whenever money is available, and both are ready for marriage

Appendix A12: Climate Baseline Report

February 2020

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GLOSSARY AND ACRONYMS

Symbols	
°C	degrees Celsius
%	percent
A	
AOI	area of influence
B	
BAU	business as usual
C	
CO_2e	carbon dioxide equivalent, a standard unit for measuring GHG emissions (carbon footprints). The impact of each different greenhouse gas is expressed in terms of the amount of carbon dioxide that would create the same amount of warming. A GHG emission consisting of different greenhouse gases can be expressed as a single number.
E	
ENSO	El Niño–Southern Oscillation
ESIA	environmental and social impact assessment
G	
GHG	greenhouse gases
K	
KP	kilometre point
M	
m	metre
m/s	metres per second
mm/a	millimetres per annum
$MtCO_2e$	million metric tonnes of carbon dioxide equivalent
R	
RCP	representative concentration pathway
T	
tCO_2e	tonnes of carbon dioxide equivalent

A12 CLIMATE BASELINE REPORT

A12.1 Purpose and Scope of Report

This baseline report describes the climate:

- area of interest (AOI) and study area of boundaries
- methods
- baseline conditions:
  - baseline condition
  - trends in condition and sensitivity to change
  - ecosystem services provided
- key considerations.

A12.2 Area of Influence and Study Area Boundaries

A12.2.1 Area of Influence Boundary

The spatial AOI climate change boundary is global. However, for the purposes of assessing the project contributions to national emissions, Uganda's borders are considered the spatial AOI.

The temporal AOI will extend throughout the life of the project, from construction to decommissioning, as all these phases will generate GHG emissions.

A12.2.2 Study Area Boundary

The study boundaries are the same as the AOI boundary, Uganda's territorial borders. Where available, climatic conditions local to the project area have been reviewed.

A12.3 Methods

A12.3.1 Secondary Data

Secondary data was sourced from published literature, unpublished technical reports commissioned for the project and websites.

Abundant literature is available on the state of the global climate, GHG emissions and related trends, most notably the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2014).

A12.3.2 Field Surveys

Social baseline surveys conducted during this ESIA captured anecdotal evidence of climate change trends observed by the local population which were used in this baseline report to supplement other secondary data, see Appendix A9 Socio-economic and Health Baseline Report.

A12.3.3 Data Analysis

No data analysis was implemented for climate parameters. All data were obtained from secondary sources.

A12.3.4 Data Considerations

The following data considerations apply:

- Limited climate observation data are available at meteorological stations close to the proposed pipeline right-of-way. However, available data are likely to be representative of the local climatic conditions and sufficient to provide an understanding of the baseline condition and trends.
- All climate projections are uncertain, as they are based on modelling and emissions scenarios.

A12.4 Climate Baseline Conditions

A12.4.1 Baseline Condition of Climate

The tropical climate in Uganda is determined by the large-scale monsoon and the Intertropical Convergence Zone systems as they move north and south following the sun. In addition, the medium-scale systems influenced by the extensive physical features in the East African region like the Lake Victoria Basin, mountain ranges and the associated rift valleys, and the Congo Basin forest to the west play an important role in the temporal and spatial distribution and intensity of the weather systems in Uganda (MWE 2014).

A12.4.1.1 Air Temperature

Air temperature in Uganda is moderate throughout the year, with a mean daily temperature of 28°C. However, the mean daily temperature across the country ranges between 4°C in the southwestern area of Kabale and 30°C in northern and northeastern areas of Gulu, Kitgum and Moroto (MWE 2014).

Average annual minimum and maximum temperature vary little between years. However, the comparisons of long-term averages between 1951–1980 and 1981–2010 show increases in average annual minimum temperatures of 0.5–1.2°C and 0.6–0.9°C for average maximum temperature (USAID 2013).

A12.4.1.2 Precipitation

Rainfall in Uganda ranges from 400 to 2200 mm/a. The southern regions of the country receive between 600 and 2200 mm/a, while the north receives between 400 and 1600 mm/a. Nationwide, Uganda receives an average of 1180 mm/a of rainfall. Figure A12.4-1 shows the mean annual rainfall across the country (MWE 2014).

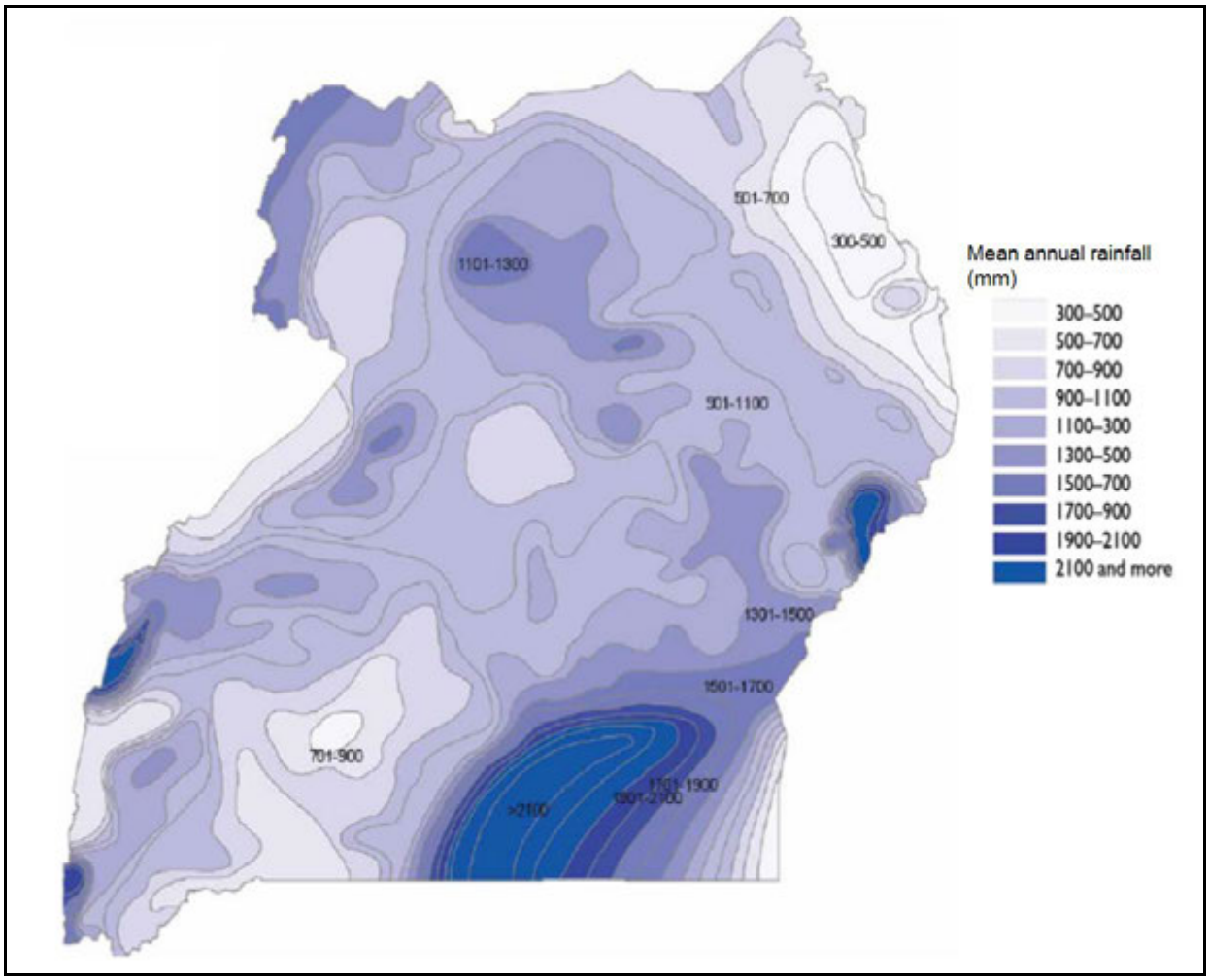

Figure A12.4-1 Mean Annual Rainfall

SOURCE: Modified from USAID (2013).

Precipitation in Uganda is seasonal. Its timing, intensity and duration vary considerably across the country. In general, Uganda experiences two modes of rainfall seasons: one long rainy season from late March to mid-October in the north; and a bimodal season from March to May and then from September to November in the western, central and eastern regions. Droughts sometimes occur in the dry season, affecting water availability for agriculture and the population.

Uganda also experiences the El Niño–Southern Oscillation (ENSO)[1] teleconnection pattern, which is the principal driving force of annual to inter-annual rainfall variability in the tropics. The effects of ENSO are most pronounced in Uganda during the period between September and December, when El Niño is often associated with floods, whereas La Niña is associated with droughts (MWE 2014). An example of the effects of El Niño and La Niña phenomena on precipitation in

[1] El Niño and La Niña are terms for climatic events originating in the tropical Pacific that recur every few years as part of a naturally occurring cycle. The name 'El Niño' is used specifically for the anomalous sustained warming of sea surface temperature that occurs every few years, typically concentrated in the central-east equatorial Pacific. 'La Niña' is the term adopted for episodes of cooler-than-normal sea surface temperature in the equatorial Pacific (Met Office 2017, Internet site).

Uganda, from the 1997–1998 event, one of the strongest in recorded history (Wikipedia 2018, Internet site) is illustrated in Figure A12.4-2.

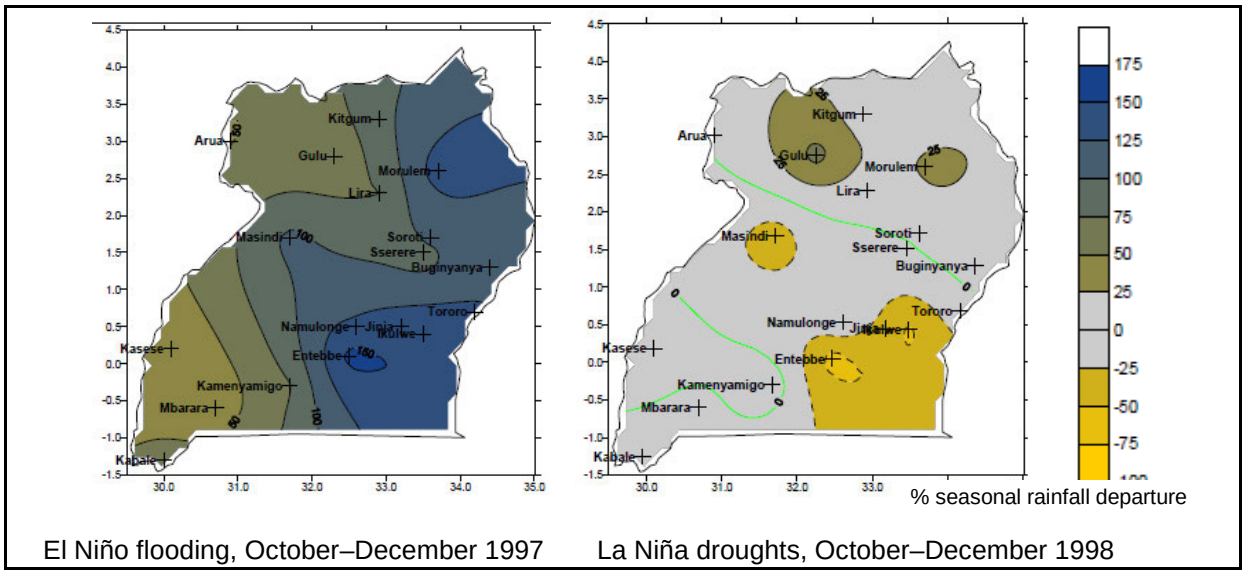

Figure A12.4-2 Effects of El Niño–Southern Oscillation on Precipitation in Uganda

SOURCE: Modified from MWE (2014)

The timing of rainfall can vary considerably from year to year. The onset of the rainy seasons can be 15–30 days earlier or later, while the duration of the rainy season can change by 20–40 days from year to year (USAID 2013).

Actimar (2016a) assessed precipitation conditions along the pipeline route. Rainfall occurs on 17 days/month on average (see Figure A12.4-3). Based on precipitation statistics and flooding analysis, Actimar (2016b) reports two rainy seasons near Lake Albert. However, the dry season in June, July and August is marked by flooding from water from northern regions of Uganda and the preceding wet season.

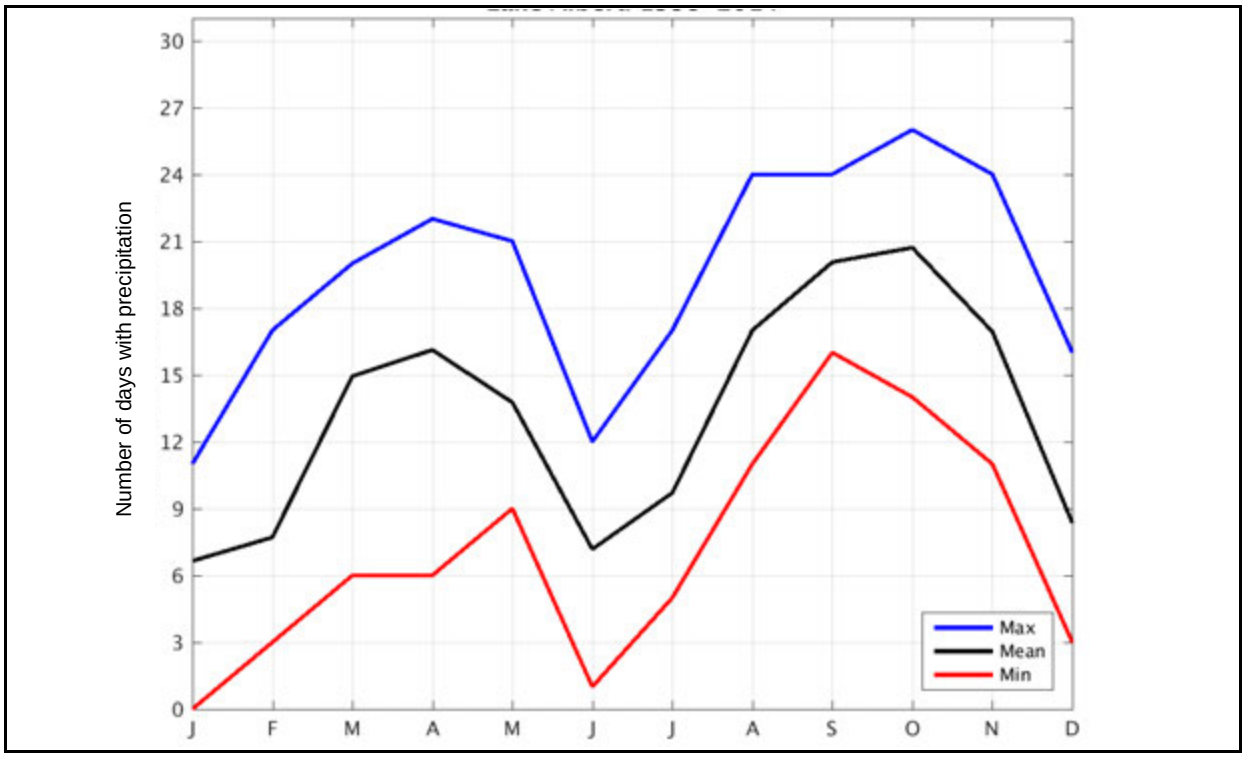

Figure A12.4-3 Minimum, Mean and Maximum Days with Precipitation at Lake Albert, 1998–2014

SOURCE: Actimar (2016a)

A12.4.1.3 Humidity

Uganda's climate is equatorial, with moderate humid and hot climatic conditions throughout the year. Relative humidity reaches 100% almost everywhere throughout the year.

A12.4.1.4 Solar Radiation

Local conditions play an important role in variability of daily solar radiation. The maximum daily peak of solar radiation occurs during the equinox periods in September–October and March–April (the latter period is characterised by slightly lower maximum daily peak observations due to a rainy season). The maximum daily peak of solar radiation along the pipeline route ranges from 800 W/m² in June to 950 W/m² in October.

A12.4.1.5 Wind

According to Actimar (2016a), maximum 1-hour mean wind speeds along the pipeline route in Uganda are 3–8 m/s, and do not vary considerably throughout the year. Actimar describes the wind speeds in the region as "especially low".

A12.4.1.6 Greenhouse Gas Emissions

Uganda has one of the lowest levels of GHG emissions in the world, estimated at 1.6 tCO_2e per capita for 2014, totalling absolute emissions of 59.9 $MtCO_2e$ which is approximately 0.12% of the world total (Climate Watch 2018, Internet site).

The same data show that land use change and forestry (LUCF) was the leading source of GHG emissions, accounting for 43%, with agriculture close behind at 40%. The energy sector contributed 14% and the remainder of the emissions are from the industrial and waste sectors.

Approximately 93% of Uganda's energy needs are met by biomass, with 6% supplied by oil and 1% by electricity. Agriculture sector emissions are primarily driven by livestock production, inefficient animal waste management systems and the cultivation of organic soils (MWE 2014). Forested land has been shown to be decreasing, with forest degradation highest outside protected areas and in areas where agriculture has expanded (MWE 2015).

A12.4.2 Trend in Condition and Sensitivity to Change

Since 1960, mean annual temperatures have risen by 1.3°C, and annual and seasonal rainfall has decreased considerably across Uganda. Rainfall has also become more unpredictable and evenly distributed over the year. Extreme events such as droughts, floods and landslides are increasing in frequency and intensity (MWE 2015).

Observations from 1970–2000 record an increase of the minimum and maximum temperature, with minimum temperature rising faster than the maximum. The minimum temperature increases are most pronounced in October–April of the El Niño phase of the ENSO cycle. During this phase, positive temperature anomalies of over 1°C can occur while during La Niña negative anomalies of up to –0.4°C can occur.

Climate change is particularly affecting agriculture, water, health and human settlement. In the 2007–2008 fiscal year, climate change damages were equivalent to 4.4% of the national budget, exceeding the budget allocation for the Environment and Natural Resource Sector (MWE 2015).

Climate variability and change in Uganda affect seasonal to inter-annual rainfall. This is reflected in shifts in the timing and duration of seasonal rainfall and intra-seasonal dry spells, and the intensity of rainfall, thunderstorms, lightning and hailstones. This can lead to floods, droughts and famine.

Climate projections developed for the country using the models used in the Inter-governmental Panel on Climate Change (IPCC) Fifth Assessment Report indicate an increase in near-surface temperature for the country. These are in the order of +2°C in the next 50 years, and +2.5°C in the next 80 years under representative concentration pathway (RCP) 4.5 (intermediate level of GHG emissions). Under RCP 8.5 (very high GHG emissions) the increases are in the order of +2.5°C in the next 50 years and +4.5°C in the next 80 years. The models also predict a slight decrease in total annual rainfall in most of the country, with slightly wetter conditions over the west and northwest under both RCP 4.5 and RCP 8.5 (MWE 2015).

Floods lead to secondary impacts of landslides, soil erosion, silting of dams and drainage channels, bursting of dams and riverbanks, water logging in low-lying valleys and wetlands, outbreaks of epidemics in animals, crop diseases and pests. Droughts lead to secondary impacts including degraded grazing and agricultural

lands leading to desertification. There can be drying of ponds, and reduced surface water, river flows and underground water levels, and increased wild fire outbreaks and dust storms.

According to a survey undertaken by Oxfam Uganda in 2012, climate change will have an impact on arabica coffee growing areas in Uganda, including the Rwenzori Mountains. Most areas will become less suitable, and those at altitudes less than 1500 m will be severely affected.

Anthropogenic GHG emissions, with other anthropogenic drivers, are extremely likely to have been the dominant cause of the observed warming since the mid-20th century. In recent decades, climate changes have affected natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to a changing climate (IPCC 2014). Between 1990 and 2014, Uganda's GHG emissions increased by 71%, as shown in Figure A12.4-4.

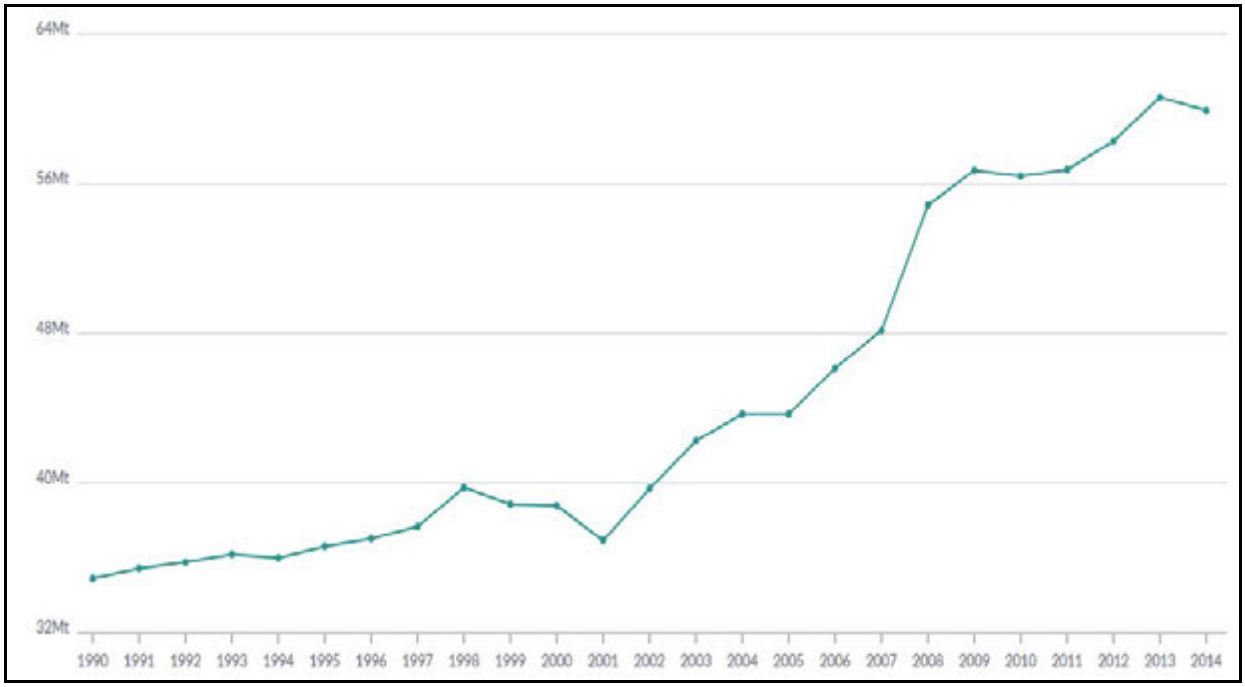

Figure A12.4-4 Trend in Uganda's Greenhouse Gas Emissions 1990–2014

SOURCE: Climate Watch (2018, Internet site)

Uganda's Intended Nationally Determined Contribution (INDC) report (MWE 2015), sets out long-term goals and adaptation strategies relating to climate change mitigation. It prioritises specific measures in energy supply, forestry and wetlands to provide GHG emission reductions and adaptation measures. The cumulative impact of the emissions reduction measures is predicted to be a 22% reduction of overall national emissions in 2030, when compared to the business-as-usual (BAU) projection. The BAU emissions baseline for Uganda is 77.3 $MtCO_2e$ per year in 2030. A 22% reduction would reduce emissions to 60.3 $MtCO_2e$.

Continued GHG emission will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe and

irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in GHG emissions which, with adaptation, can limit climate change risks (IPCC 2014).

A12.4.3 Ecosystem Services Provided

Although this VEC does not provide ecosystem services directly, climate influences VECs that do provide services.

A12.5 Key Considerations

The key considerations related to the climate baseline are:

- the global climate has undergone unprecedented change[2] and continuing change is predicted by climate scientists. Uganda's climate has changed and further change is predicted.
- Uganda is vulnerable to increased climate variability and climate change. For example, the severity and frequency of extreme events such as droughts and floods are projected to increase.
- global anthropogenic GHG emissions, with other anthropogenic drivers, are extremely likely to have been the dominant cause of the observed warming of the global climate since the mid-20th century
- the Ugandan government has put in place measures to reduce the risks of the changing climate. These include mitigation measures (reductions in GHG emissions relative to a BAU scenario) and adaptation measures (reduction of the vulnerability of social and biological systems).

A12.6 References

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[2] "Since the 1950s, many of the observed changes are unprecedented over decades to millennia" (IPCC 2014).

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