

6 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

6.1 Introduction

This section describes the existing environmental and social baseline conditions of the valued environmental (and social) components (VEC) for the EACOP project.

Each of the VEC subsections includes:

- a description of the area of influence (AOI)
- the existing baseline condition of the VEC, including:
 - trends in condition
 - ecosystem services provided
 - sensitivity rankings
- key considerations.

The subsections summarise the information in the baseline reports for each VEC. For additional information, including methods, see Appendix A.

6.2 Valued Environmental Components

The VECs that have been selected are described below, along with the rationale for their selection. For the process of VEC selection, see Section 5.3.

VEC	Description
Biodiversity	
Habitats of conservation importance (terrestrial and aquatic)	Habitats of conservation importance include habitats within the project AOI that are not common or support species that are not common and include ecological assemblages that are unique, relict, remnant, have high bioquality or support International Union for Conservation of Nature (IUCN) critically endangered, endangered, vulnerable, migratory, congregatory, endemic or range-restricted species.
Flora and fauna species of conservation importance (terrestrial and aquatic)	Flora and fauna species of conservation importance within the project AOI include species that are IUCN (or national equivalent) critically endangered, endangered, vulnerable, protected, keystone migratory, congregatory, endemic or range restricted species.
Legally protected, internationally or nationally recognised onshore areas	Areas that are internationally or nationally recognised or legally protected within the project AOI such as: national parks; wildlife, forest and game reserves; Ramsar Sites, key biodiversity areas; important bird areas; endemic bird areas; wildlife management areas and alliance for zero extinction sites.

VEC	Description
Physical Environment	
Soil	The layers (soil horizons) above the bedrock are composed of weathered mineral materials, organic material, air and water. Soils support plant growth, agriculture and biodiversity by providing important ecosystem services, such as soil formation, nutrient cycling and primary production.
Surface water	Ephemeral and permanent surface watercourses and waterbodies can be used for domestic, agricultural and industrial supplies and for hydropower generation. The term 'ephemeral' covers those watercourses with seasonal flow and those with flow just following rainfall.
Groundwater	Aquifers and vulnerable groundwater used for abstraction or providing important ecosystem services, such as water purification. Groundwater is an important source of irrigation and potable water. Groundwater bodies can also have a connection with, and hence influence on, surface water.
Landscape	This VEC includes landscapes, valued as a resource in their own right, and the people who experience changes in views.
Air quality	The air quality, including dust within the airsheds of: <ul style="list-style-type: none"> the pumping stations (PS) construction facilities (main camp pipe yards (MCPY) and roads used during construction) construction work on the pipeline.
Acoustic	The health and wellbeing of humans and fauna is associated with the ambient sound level in the area of their inhabitancy.
Economy	Direct and indirect employment, contracting and procurement, workforce capability and skills, and taxes.
Local economy (non-land-based livelihoods)	Formal and informal (non-land based) economic activities and local economic conditions.
Land-based livelihoods	Land-based livelihood activities include crop farming, livestock rearing, mining and harvesting of natural resources (wild plants and game).
River-, lake- and marine-based livelihoods	Fishing and related economic activities including commercial and artisanal fishing, This VEC focuses on negative displacement impacts.
Land and property	Land and property or housing that may be affected by the project through permanent acquisition or change in value.
Workers' health, safety and welfare	Workforce health, safety, human rights and welfare.
Social infrastructure and services	Physical and social infrastructure such as access to utilities, waste services, roads.
Community health	Includes community health status and, access to health services, water and sanitation.
Community safety, security and welfare	Includes personal safety affected by the project from traffic and road use, and security affected by presence of workers, new populations, and security arrangements. Welfare includes social cohesion and community stability.

VEC	Description
Tangible and intangible cultural heritage	Tangible cultural heritage sites and intangible cultural heritage valued by local communities including cultures and traditions. This also includes any species of cultural or traditional importance not captured by the assessment of potential effects on ecosystem services, e.g., species valued for their part in oral history or traditions, rather than the physical (hunting or gathering) value to the community.
Climate	This VEC includes the global climate, including energy use, greenhouse gas emissions, carbon storage and sequestration, and local and global climate regulation.

6.3 Area of Influence

To identify, assess and manage potential environmental and social impacts, the potential AOI of the project has been defined.

International Finance Corporation (IFC) Performance Standard 1, paragraph 8 (IFC 2012), defines the AOI as encompassing the following components:

- “the area likely to be affected by:
 - (i) the project and the client’s activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project
 - (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location, or
 - (iii) indirect project impacts on biodiversity or on ecosystem services upon which affected communities’ livelihoods are dependent
- associated facilities, which are facilities that are not funded as part of the project, but which would not have been constructed or expanded if the project did not exist and without which the project would not be viable
- cumulative impacts that result from the incremental impact, on areas or resources used or directly affected by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.”

The whole project AOI is a combination of the AOIs for each VEC. The criteria for defining the AOI for each VEC takes account of the following, the:

- permanent footprint, associated with the operational right-of-way (RoW) for the pipeline and the other operational facilities such as the aboveground installations (AGI)
- temporary footprint associated with construction and other sites, such as borrow pits and waste management facilities, required to construct the project
- area outside the footprint potentially affected by direct impacts such as noise and dust
- area potentially affected by indirect impacts such as villages and towns affected by in-migration of contractor workers
- area potentially affected by unplanned events, such as oil spills during construction and operation
 - area used for assessing cumulative impacts, which is defined as the areas where AOIs for EACOP project and sources of cumulative impact VECs

experience overlapping impacts, spatially and temporally, from past, present and future activities, including from associated facilities and third-party projects.

The AOI for each VEC is defined in the following VEC subsections.

The AOI is different for the construction, operation and decommissioning phases of the projects and different for each VEC.

The study area for each VEC takes account of the AOI but may be larger than the AOI to understand the context in which the VECs exist, including trends and pressures on the condition of the VECs. A broader region is a study area larger than the AOI to provide regional context for biodiversity, geology and soils, economy and greenhouse gas emissions. The study areas are defined in the baseline reports (see Appendix A).

6.4 Environmental and Social Baseline

6.4.1 Biodiversity

6.4.1.1 Legally Protected, Internationally or Nationally Recognised Areas

Introduction

This section describes the following:

- the AOI for legally protected and internationally or nationally recognised areas
- baseline conditions in terms of:
 - international recognised areas
 - legally protected areas
 - trends in condition and sensitivity to change
 - ecosystem services provided
 - sensitivity rankings
- key considerations.

Legally Protected Areas

The following legislation is relevant to the governing of protected areas within the project AOI:

- Constitution of the Republic of Uganda, 1995. Article 237 (2b): the government holds in trust for the people, and is required to protect, natural lakes, rivers, wetlands, FRs, game reserves (GR), national parks and any land to be reserved for ecological or tourism purposes for the common good of all citizens
- National Forestry and Tree Planting Act, 2003: the Act provides for the conservation, sustainable management and development of trees and forests for the benefit of the people of Uganda
- National Environment Act, 1995. Ch. 153: the Act provides for sustainable management for the environment
- Wildlife Act, 1996, Ch. 200: the Act provides for the conservation of wildlife throughout Uganda so that the abundance and diversity of their species are maintained at optimum levels commensurate with other forms of land use to

allow for sustainable utilisation of wildlife for the benefit of the people of Uganda and the protection of rare, endangered and endemic species of wild plants and animals.

The following policies and plans are applicable to protected areas in Uganda:

- National Forest Plan 2011/12–2021/22, 2013. The plan acknowledges that oil exploitation can have negative effects on forest resources through deforestation and environmental degradation, including indirect effects resulting from induced development. However, it also recognises that revenue from the Albertine Graben developments provides an opportunity to invest in sustainable forest management. The National Forest Plan aims to:
 - enhance the capacity of forestry institutions to enable them to perform their mandates effectively
 - increase the forest resource base by increasing forest cover to 1990 levels
 - increase the economic productivity of forests and employment in the forestry sector
 - raise incomes for households through forest-based initiatives
 - restore and improve ecosystem services derived from sustainably managed forests.
- Uganda Forestry Policy, 2001. This policy outlines guiding principles for the management of forest resources, including conservation and sustainable management. It also outlines strategies for the management of forest resources that include social and environmental impact assessments for commercial forest plantations and forest-product-producing industries.
- Uganda Wildlife Authority Strategic Plan 2013–2018. The plan provides for sustainably managed wildlife areas that are providing enjoyment, supporting community livelihoods and contributing to national development.
- Uganda Wildlife Policy, 2014. This policy guides the conservation and development of wildlife resources in Uganda.
- The Ugandan National Policy for the Conservation and Management of Wetlands protects wetlands. This includes elements that protect rivers as a biodiversity area and as a resource for local communities. The policy, designated in 1995 (Ministry of Natural Resources, 1995), aims at protecting and curtailing the rampant loss of wetlands to sustain their ecological and socioeconomic functions (Glass, 2007).

Internationally and Nationally Recognised Areas

Key Biodiversity Areas

Key Biodiversity Areas (KBA) are sites that contribute to the global sustainability of biodiversity, including vital habitat for threatened plant and animal species in terrestrial, freshwater and marine ecosystems. In 2016, the International Union for the Conservation of Nature (IUCN) published a global standard for the identification of KBAs with the following aims:

- harmonise existing approaches to the identification of important sites for biodiversity
- support the identification of important sites for elements of biodiversity not considered in existing approaches

- provide a system that can be applied consistently and in a repeatable manner by different users and institutions in different places and over time
- ensure that KBA identification is objective, transparent and rigorous through application of quantitative thresholds
- provide decision-makers with an improved understanding of why particular sites are important for biodiversity.

Sites qualify as global KBAs if they meet one or more of 11 criteria, grouped into five categories:

- threatened biodiversity
- geographically restricted biodiversity
- ecological integrity
- biological processes
- irreplaceability.

Although anyone with appropriate scientific data may propose a site to qualify as a KBA, consultation with non-governmental and governmental stakeholders at the national level is required during the proposal process.

There are 48 KBAs in Uganda, none of which is crossed by the project AOI at the time of development of this baseline.

Important Bird Areas

Important Bird Areas (IBAs) form the largest subset of KBAs. These are sites of international importance for conservation, identified using birds as qualifying species. The global network of IBAs has been identified using a set of four internationally agreed criteria:

- A1, globally threatened species – the site is known or thought to hold ‘significant’ numbers of a globally threatened species
- A2, restricted-range species – the site is known or thought to hold a ‘significant’ component of a group of species whose breeding distributions define an Endemic Bird Area (EBA, see below)
- A3, biome-restricted species – the site is known or thought to hold a ‘significant’ component of the group of species whose distributions are largely or wholly confined to one biome
- A4, congregations – the site is known or thought to hold congregations of $\geq 1\%$ of the global population of one or more species on a regular or predictable basis.

Over 12,000 IBAs in over 200 countries have been identified globally. As bird populations have been shown to be effective indicators of wider biodiversity, many IBAs are likely to be KBAs for other animal and plant species, and ecosystems of concern (BirdLife International 2018).

Uganda has 34 IBAs covering about 1.9 million ha. The project AOI does not cross any IBAs.

Endemic Bird Areas

An EBA is defined as an area that encompasses the overlapping breeding ranges of restricted-range species, such that the complete ranges of two or more

restricted-range species are entirely included within the boundary of the EBA. This does not necessarily mean that the complete ranges of all an EBA's restricted-range species are entirely included within the boundary of that single EBA, as some species may be shared between EBAs.

Restricted-range species are defined as land-based birds that historically¹ have a total global breeding range estimated at below 50,000 km². Species with historical ranges estimated to be above this threshold, but which have been reduced to below 50,000 km² by habitat loss or other pressures, are not covered as EBAs should represent natural areas of endemism for birds.

There are six EBAs in Uganda, none of which is crossed by the project AOI.

Area of Influence

The AOI is the area of any legally protected, internationally or nationally recognised areas directly or indirectly affected by the project and its activities arising from, for example, facilitated access, edge effects, the spread of alien invasive species, and temporary and permanent habitat loss and fragmentation.

Most of the impacts to protected areas 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 re-established to preconstruction condition.

The following legally protected sites were identified within 1 km of the project AOI (including access roads and construction facilities); they are illustrated in Figure 6.4-1 and described herein:

- Wambabya FR
- Taala FR
- Kasana–Kasambya FR.

There are no adopted management plans for these reserves, so there are no formal management objectives other than those outlined in the National Forest Plan 2011/12–2021/22, 2013 (see section above).

¹ Considered since ornithological recording began after 1800

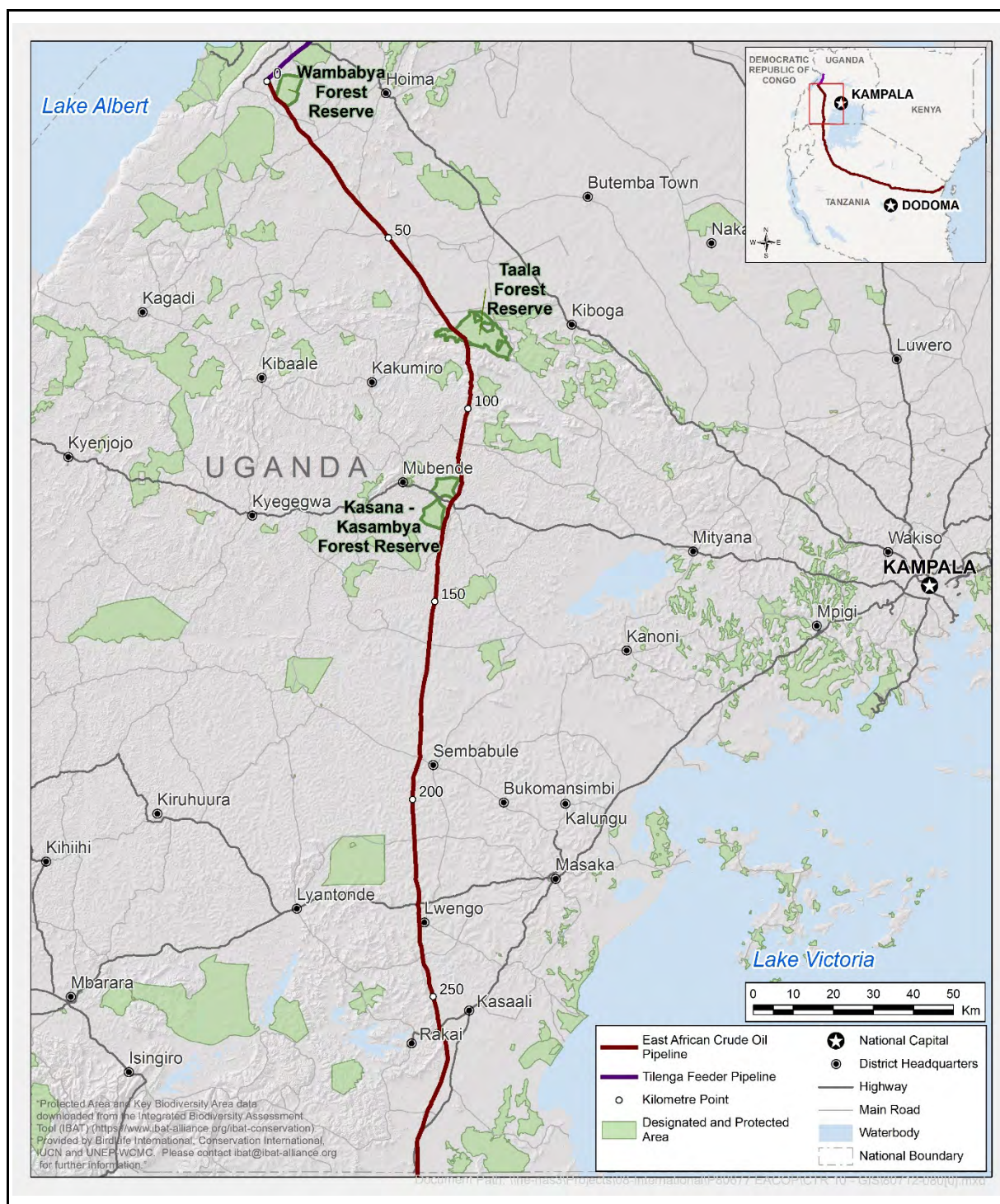


Figure 6.4-1 Protected Areas in the Area of Influence

Baseline Condition

Legally Protected Areas

Wambabya Forest Reserve

Between KP5 and KP9, the pipeline RoW is within 100 m of the Wambabya FR. The southern part of the reserve supports relatively intact forest. Although only 3420 ha in area, the Wambabya FR has the highest population density of chimpanzees in the Albertine Rift (Lamprey 2015) and is important for plant biodiversity. The Wambabya FR and the corridors of remnant riparian forest linking it to the Bugoma Central Forest Reserve (CFR) provides important habitat for the IUCN and Uganda endangered chimpanzee.

Designated in 1965 for environmental and ecological reasons (NEMA, 2010), the Wambabya FR is the largest remnant stand of semi-evergreen forest in the AOI and is of botanical importance because it represents one of a few remnant stands of Guineo–Congolian semi-evergreen forest in the region (Figure 6.4-2). This is likely to be attributable to the site's protected area status.

The Wambabya FR may become an important part of a proposal by non-governmental organisations to restore and enhance ecological corridors in the broader Albertine Rift landscape to enhance the conservation of chimpanzees within these forested areas and sustainable ecosystem services for local communities. These corridors are between the Wambabya FR and the following areas outside the project AOI:

- the Bugoma CFR, which is about 3.5 km southwest of the Wambabya FR in Hoima district
- the Budongo FR, which is about 29 km northeast of the Wambabya FR
- the Mukihani FR, which is about 20 km northeast of the Wambabya FR.

This corridor enhancement programme is being investigated jointly by Ecotrust, the Jane Goodall Institute and Fauna & Flora International (Lamprey 2015).

Additional information on fauna is provided in Section 6.4.1.5 and Appendix A4 Fauna Baseline Report, and 6.4.1.4 and Appendix A3, Avifauna Baseline Report.

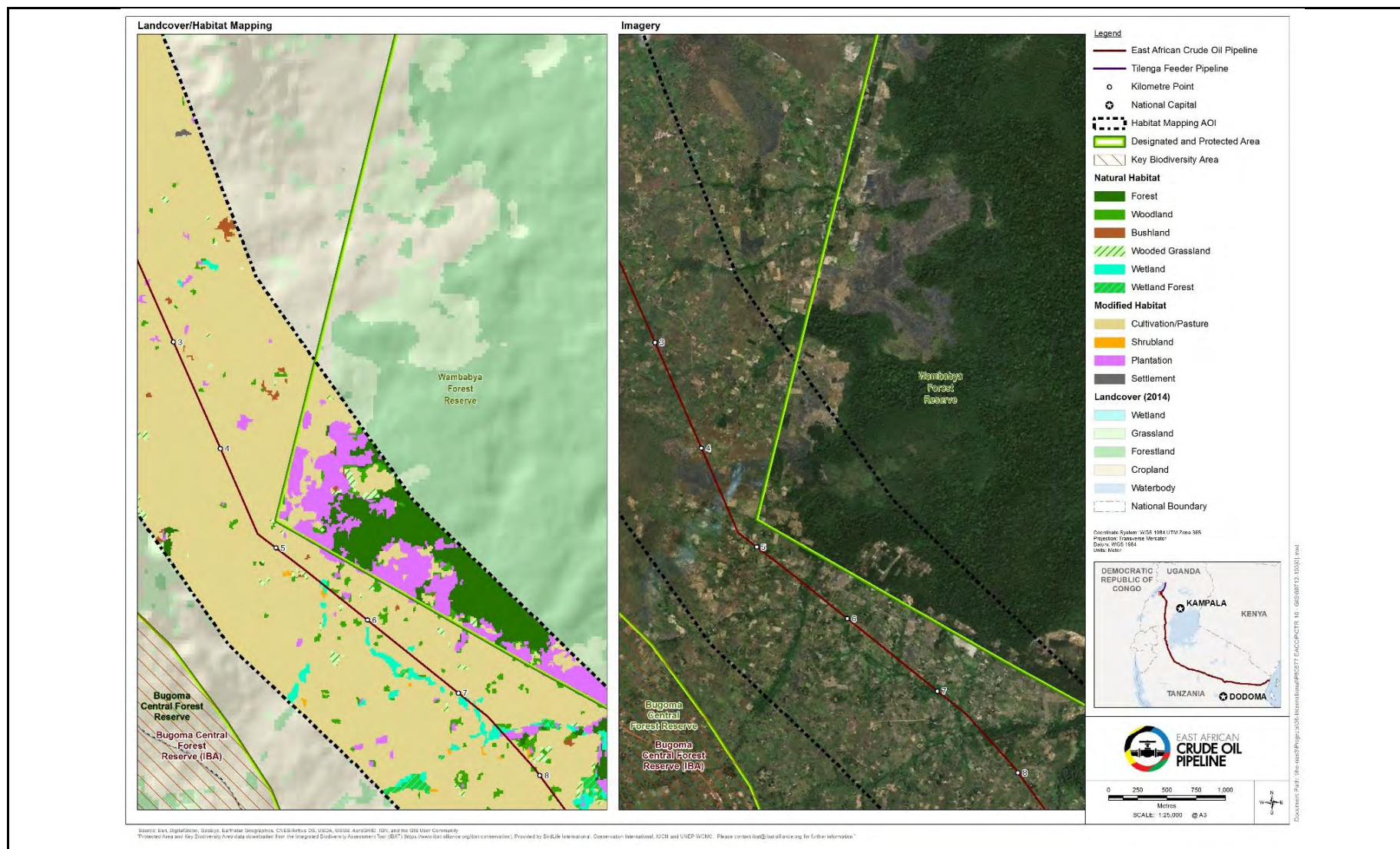


Figure 6.4-2 Wambabya Forest Reserve Land Cover, Habitat and Imagery

Taala Forest Reserve

The pipeline RoW traverses the western part of the Taala FR from KP78–82.5. The project is immediately adjacent to a village enclave and the existing land use is mostly agricultural. Field studies suggest that natural vegetation within the Taala FR only persists in the wet valleys, having been replaced elsewhere by plantations of eucalyptus and pine, and seasonal crops (Figure 6.4-3). The reserve was gazetted for environmental and ecology purposes, as it serves to protect the drainage system of the Kitumbi and Lugulima rivers that join and flow north into the Kafu River (NEMA, 2010). The NEMA Sensitivity Atlas² states that the Taala FR is good for biodiversity, particularly for unique butterflies, and has formerly supported hippopotamus and African buffalo (NEMA, 2010). The Sensitivity Atlas also states that 50% of the Taala FR is licensed for commercial tree planting in the private sector.

Additional information on these species is provided in the Fauna Biodiversity Baseline Report (Appendix A4).

² The overall aims of the Sensitivity Atlas are to “display, identify and provide the ability to analyse the relative environmental sensitivities (physical, biological and socio-economic) to oil spill and oil development within the exploration areas in the Albertine Graben region of western Uganda” (NEMA 2010)

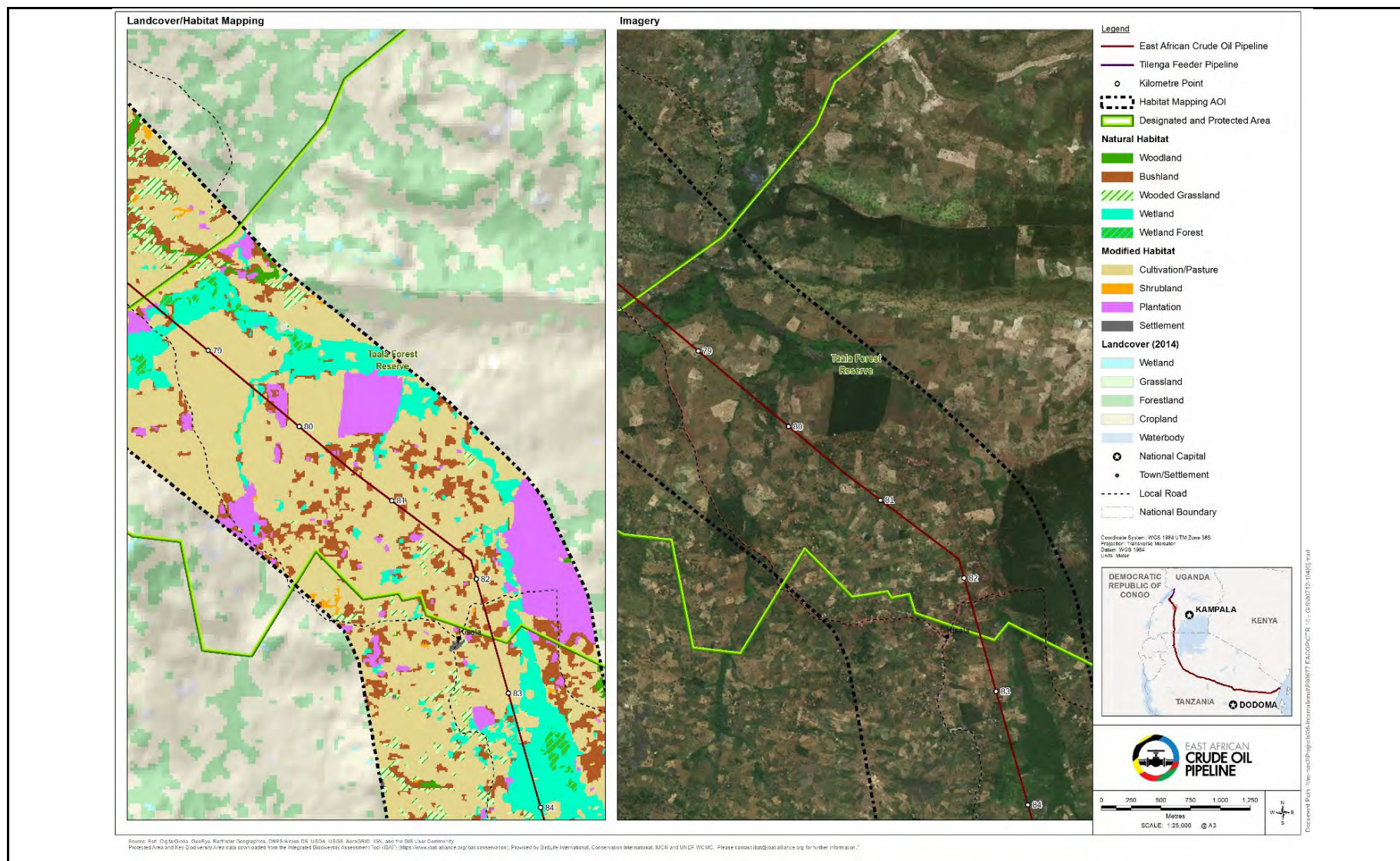


Figure 6.4-3 Taala Forest Reserve Land Cover, Habitat and Imagery

Kasana–Kasambya Forest Reserve

The pipeline RoW is within 100 m of a short section of the Kasana–Kasambya FR near KP123. This part of the reserve is exclusively commercially harvested pine tree plantations (Figure 6.4-4). Field studies suggest that eucalyptus plantations and maize fields are also widely present in the FR.

Additional information on the fauna species of conservation importance found within Kasana–Kasambya FR is provided in Section 6.4.1.5 and Appendix A4, Fauna Biodiversity Baseline.

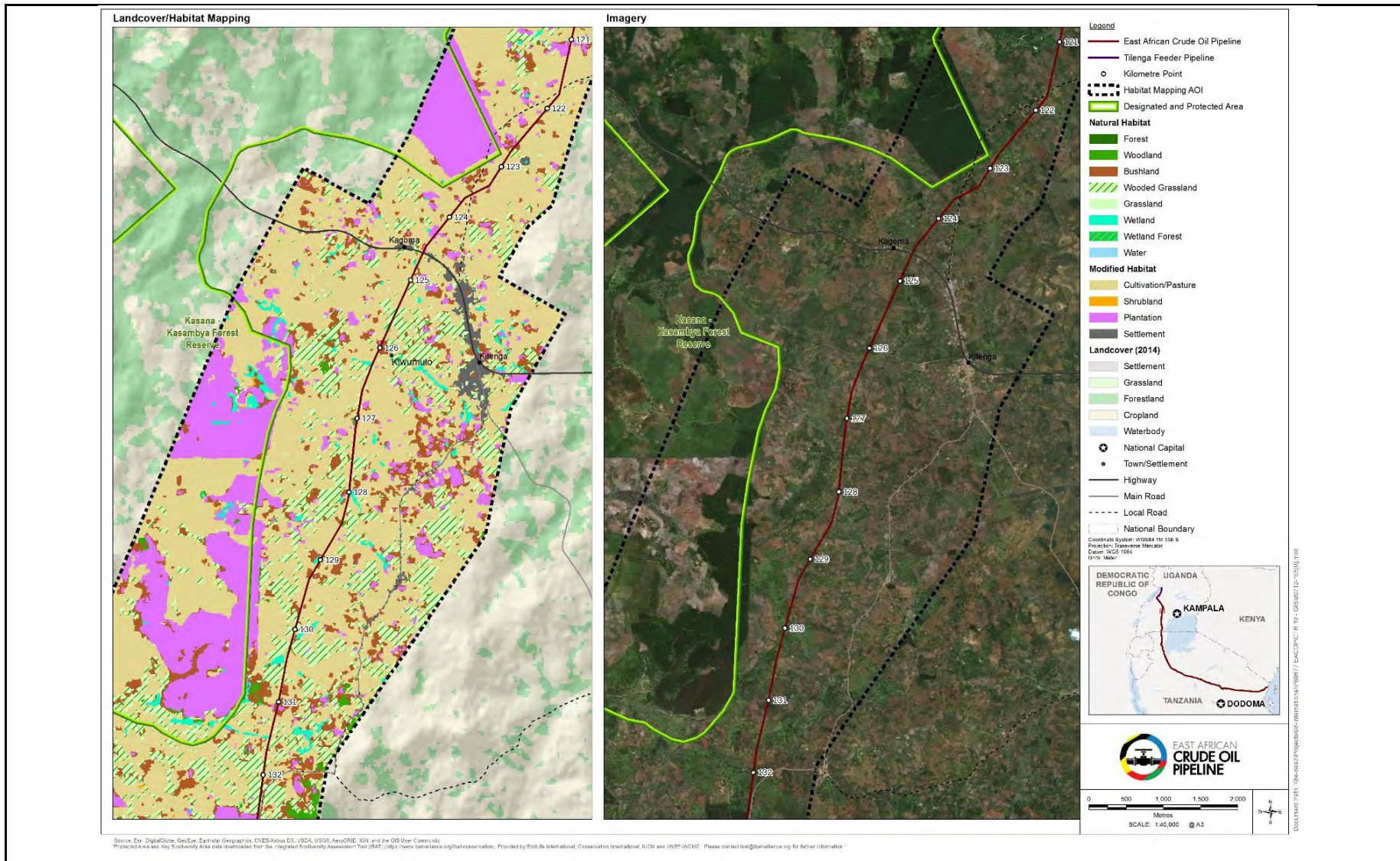


Figure 6.4-4 Kasana-Kasambya Forest Reserve Land Cover, Habitat and Imagery

Trend in Condition and Sensitivity to Change

Legally Protected Areas

Wambabya Forest Reserve

The Wambabya FR is predominantly surrounded by agro-pastoral land and settlements. The FR has an environment and ecological function (NEMA, 2010). Areas of forest habitat along the periphery of the reserve have been cleared for agro-pastoral activities. Selective logging also threatens the integrity of the reserve. However, illegal logging is notably less apparent compared with other FRs in the region, e.g., in the Bugoma CFR. These threats are likely to continue in the absence of intervention, as the local population increases and pressure on natural resources such as timber and land access rises (Hänni 2010).

Afforestation and restoration of the ecological connectivity between the Wambabya FR and Bugoma CFR would potentially reduce pressure on the reserve (FFI 2018). The Ugandan Wildlife Authority also intends to initiate a revegetation programme in degraded parts of Wambabya FR. Should these programmes proceed and be successful, it is anticipated that the condition of the Wambabya FR would improve.

The Wambabya FR is a nationally protected site with high biodiversity value, for example, it supports a population of IUCN endangered chimpanzee. Consequently, it has high sensitivity to change.

Taala Forest Reserve

The Taala FR is a nationally protected site that was originally designated for ecological purposes (NEMA 2010). Although it now comprises modified habitat, it has biodiversity value in some places (see Section 6.4.1.5 and the Fauna Biodiversity Baseline Report in Appendix A4), and so has high sensitivity to change.

Natural forests are coming under increasing pressure of encroachment for agriculture and timber plantations. The project AOI passes through a large village inside the Taala FR, which demonstrates this encroachment. In this location, the FR is already heavily degraded. The project is not aware of any proposals to try to remove the established village or to restore natural vegetation within the FR. There is no anticipated change in condition of this site.

Kasana–Kasambya Forest Reserve

The Kasana–Kasambya FR is a commercial plantation, so there is no anticipated change in condition.

The Kasana–Kasambya FR retains some biodiversity value, see Section 6.4.1.5 and the Fauna Biodiversity Baseline Report in Appendix A4. It is considered to have moderate sensitivity to change.

Ecosystem Services

The legally protected, internationally and nationally recognised areas described herein provide the following ecosystem services.

Provisioning services include:

- wood and wood fuel, including collection for charcoal manufacture. In some areas these activities are legal, in others they are not.
- food (hunting, gathering and foraging). In some areas these activities are legal, in others they are not.
- collection of medicinal products
- trapping of wildlife for the live trade market.

Regulating services include:

- climate change amelioration through carbon sequestration
- local climate regulation - in terms of providing a cooler micro-climate
- local water and air purification - through waste assimilation, and water and air filtration
- water regulation and erosion control (i.e., water catchment protection) in terms of maintaining greater river flows and for longer, reducing flood surges, and reducing erosion and sedimentation from vegetation of steep slopes and river banks.

Cultural services include:

- ethical and biodiversity 'non-use' values - particularly in terms of maintaining populations of endangered and endemic species
- sense of place and way of life - these locations are likely to provide value to local people living near and utilising them in terms of the way of life and special connection with such areas.
- 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 includes:

- providing refuge, feeding, watering, breeding and nursery areas for a host of animals that spend only part of their life in such areas.

Other supporting services include:

- provision of a range of supporting services such as photosynthesis and water, carbon and nutrient cycling whose values are typically accounted for in other ecosystem services.

Sensitivity Rankings

Based on the results of the studies undertaken, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown in Table 6.4-1.

Table 6.4-1 Protected Area Sensitivity Ranking

Wambabya FR		
Legally protected	High (4)	Nationally protected site with high biodiversity value (see Section 6.4.1.4 and the Avifauna Biodiversity Baseline Report in Appendix A3, and Section 6.4.1.5 and the Fauna Biodiversity Baseline Report in Appendix A4)
Taala FR		
Legally protected	High (4)	Nationally protected site originally designated for ecological purposes (despite now being highly degraded), which supports some fauna species of conservation importance (see Section 6.4.1.5 and the Fauna Biodiversity Baseline Report in Appendix A4)
Kasana–Kasambya FR		
Legally protected	Moderate (3)	Nationally protected site not specifically designated for biodiversity purposes but has biodiversity value in that it supports some fauna species of conservation importance (see Section 6.4.1.5 and the Fauna Biodiversity Baseline Report in Appendix A4)

Key Considerations

The following legally protected sites are key considerations:

- Wambabya FR
- Taala FR
- Kasana–Kasambya FR.

6.4.1.2 Botany Biodiversity

This section describes the:

- botanical biodiversity AOI
- biodiversity baseline condition in terms of:
 - habitats
 - protected areas
 - vascular plant species
 - trends affecting the condition of habitats, vascular plants and protected areas of conservation importance, and sensitivity to change
 - ecosystem services provided
 - botanical biodiversity sensitivity rankings
- key considerations.

For more information, the botanical biodiversity baseline report is included in Appendix A1.

Area of Influence

The spatial AOI encompasses the project footprint and areas within an ecologically relevant distance of the project to account for potential direct and indirect project-

related impacts (i.e., effects of habitat loss, facilitated access, habitat fragmentation, edge effects and spread of invasive species). The definition of an ecologically relevant distance relies on the mobility of a species, habitat connectivity between it and the project, and the potential impact pathways between it and the project.

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 RoW.

Most impacts to habitats and species of conservation importance will occur during the construction phase and early operation. Indirect impacts such as human influx and facilitated access into 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 re-established to preconstruction condition. For new access roads and parts of construction facilities that may be transferred with the land to the Government or a third party when no longer needed for project use, the impacts will be considered permanent.

Habitat Mapping

Habitats were identified and mapped using remote sensing, which is an effective approach for characterising the large area traversed by the project. It was then refined using data collected from the botanical field surveys. The advantage of using remote sensing to map vegetation classes is the ability to cover a large area using data from a representative sample of known sites.

Wet and dry season Sentinel-2 satellite imagery was used to map the habitat types along the extent of the project. The following data sets were also used:

- tree height data derived from LIDAR surveys undertaken in 2017
- slope data derived from the LIDAR Digital Elevation Model (DEM) (EACOP)
- very-high-resolution aerial imagery (EACOP)
- existing Africover land cover mapping (FAO).

Each of the satellite images was enhanced using ERDAS Image 2018 to reduce effects such as topographic shading, and light and shadows from solar illumination and forest fires. Each Sentinel-2 image was clipped to match the 2-km-wide LIDAR data corridor captured in 2017.

Physiognomic habitat classes were mapped based on the occurrence of habitats throughout the AOI and readily distinguishable differences in height and density. Data provided by the field surveys were used to inform this process. These habitat classes are primarily derived from the physiognomic types (Table 6.4-2) defined by White (1983).

Each Sentinel-2 tile was processed using the Random Forests algorithm in the ERDAS Imagine geospatial tool; this allocates a physiognomic habitat class, based on the statistical similarity, to each homogeneous area. Following the automated classification of habitat classes, the habitat map was refined based on the field data and observations.

Physiognomic habitat classes 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 and or animal species of largely native origin, and 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 or fauna species that are non-native in origin, and 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 of Appendix A1.

Table 6.4-2 Physiognomic Habitat Classes in the Area of Influence

Physiognomic Habitat Class	Summary of Description
Natural Habitats	
Forest	Semi-evergreen rainforest, with canopy >10 m high and emergent trees evident. Crowns generally interlocking.
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 dominate ground-level vegetation.
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
Bushland	Open stands of bushes (usually 3–7 m tall) with a canopy cover of 40% or more.
Thicket	Dense growth of bushes 3-7 m tall.
Wooded Grassland	Open woodland habitat dominated by <i>Combretum</i> 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. Also a modified grassland habitat with clear evidence of livestock grazing.
Plantation	Monoculture of woody species cultivated for timber production.

Most habitat types in the AOI are categorised as modified with only approximately 28% of the AOI classed as natural. Five main habitats are within the AOI that support different types of vegetation, namely:

- Guineo–Congolian semi-evergreen forest
- riverine and swamp forests
- swamp dominated by *Cyperus papyrus*
- secondary Acacia species woodland, bushland and wooded grassland
- cultivated land and plantations.

A description of each of the habitat types within the AOI and in the RoW and their alignment with the physiognomic habitat classes illustrated by the habitat map (Attachment A1.1 of Appendix A1) is presented in Attachment A1.3 of Appendix A1.

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 Rapid Botanical Survey (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 Appendix A1) 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 2,700 (Marshall and Hawthorn 2016). Botanical specialists from the University of Oxford 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 >250 are considered to be of global conservation importance.

Identification of Species of Conservation Importance

In the context of this baseline assessment, the vascular plants of conservation importance are defined as nationally rare species, globally rare species, and endemic and or restricted range species. The presence of these plants in the AOI 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 (see Table A1.2-4 of Appendix A1). In the context of this baseline assessment, only species in the AOI that are listed as IUCN vulnerable, endangered or critically endangered are of conservation importance. It is important to acknowledge that most vascular plant species in the AOI are categorised as IUCN not evaluated
- Species listed on the Uganda Red List prepared by Wildlife Conservation Society (WCS) in 2016 and which was upheld by the lead agencies of the Government of Uganda, conferring official recognition of the lists. Species are classified into Red List categories but based on information at the national level.
- The RBS star rating. The field data were screened against the RBS star rating criteria to determine the presence of endemic and or restricted-range species in

the AOI (see Table A1.2-5 of Appendix A1). 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 (1 degree square is approximately 100 × 100 km). All plant species in the study AOI were assigned a star rating (Hawthorne and Marshall 2016). The RBS star rating is described in more detail in the RBS manual (Hawthorne and Marshall 2016), which is presented in Attachment A1.2 of Appendix A1. 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 (i.e., herbarium records, monographs global and the Genebank Information System). However, in comparative terms, the RBS database is comprehensive with up to date information that accounts for historic and recent taxonomic changes.

Baseline Condition of Botany

Habitats of Conservation Importance

Overview

A description of each of the habitat types within the AOI including their GHI scores and their alignment with the physiognomic habitat classes illustrated by the habitat map (Attachment A1.1 of Appendix A1) are presented in Attachment A1.3 of Appendix A1.

Anthropogenic activities have severely impacted natural habitats in Uganda. Habitats are highly fragmented with low land cover (National Environment Management Authority 2016; Winterbottom and Eilu 2016). Given the status of natural habitats in Uganda, the Guineo–Congolian semi-evergreen forest, and riverine and swamp forest are considered to be of conservation importance in the context of the AOI and broader region. Appendix A1 presents habitats of conservation importance with respect to the project AOI only; all other habitat types, including those not of conservation importance in the AOI are presented in Attachments A1.3 of Appendix A1.

Guineo–Congolian Semi-evergreen Forest

The estimated coverage of Guineo–Congolian semi-evergreen forest in the AOI based on remote sensing is illustrated in Figure A1.3-1 of Appendix A1 and the habitat map (Attachment A1.1 of Appendix A1). Within the broader region, approximately 68% of this habitat type is within the Wambabya FR. Only 34 ha of Guineo–Congolian semi-evergreen forest are outside this protected area, as illustrated by the habitat map. Guineo–Congolian semi-evergreen forest is a highly threatened and unique ecosystem (as defined in IFC 2012).

The RBS characterised the floristic composition of Guineo–Congolian semi-evergreen forest within the Wambabya FR at KP6.7 (approximately 667 m from the RoW centre line). This is the largest remnant stand of forest in the AOI and

represents one of a few forest stands in the region. Hence, Guineo–Congolian semi-evergreen forest is of conservation importance in the context of the AOI.

In Uganda, Guineo–Congolian semi-evergreen forest is restricted to the periphery of Lakes Victoria, Albert and Edward (Kindt et al. 2011; see Figure 6.4-5). This forest type is typically floristically diverse with an estimated 78 species. The understorey is characteristically evergreen and the forest canopy has a short patchy deciduous phase (White 1983).

The survey confirmed the presence of four species of vascular plants at KP6.7 that are listed as nationally rare on the Ugandan Red List (2016), namely:

- *Chrysophyllum perpulchrum* – vulnerable
- *Chrysophyllum albidum* – vulnerable
- *Citropsis articulata* – vulnerable
- *Leplaea cedrata* – endangered.

The evergreen tree *Leplaea cedrata* is also listed as vulnerable by the IUCN Red List (IUCN 2017).

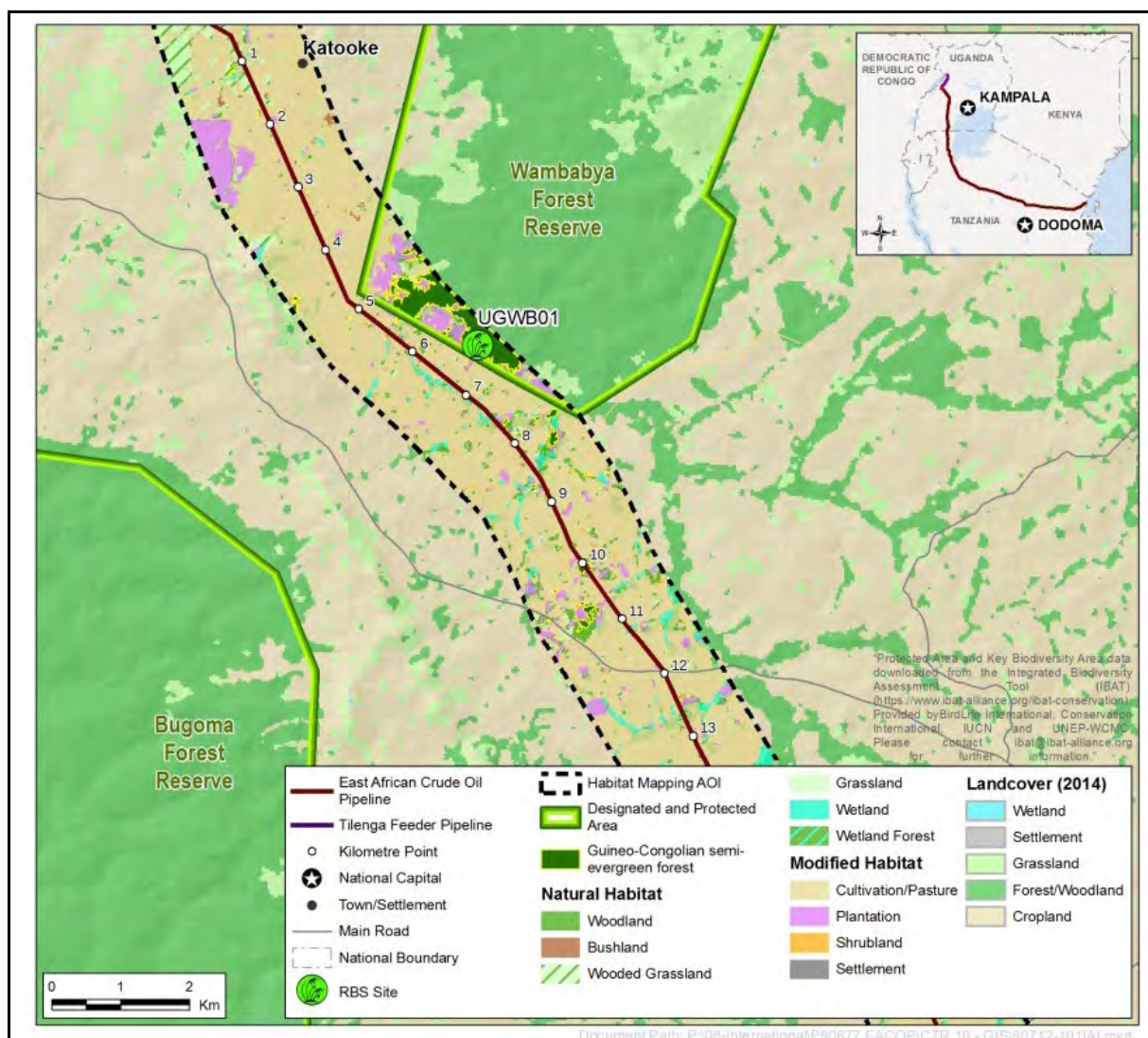


Figure 6.4-5 Estimated Extent of Guineo–Congolian Semi-Evergreen Forest in the Area of Influence and the Broader Region

Riverine and Swamp Forest

Small and highly fragmented stands of riverine and swamp forests (types of wetland forests) are scattered along the extent of the AOI. These forest stands are restricted to the margins of watercourses and springs and are predominantly surrounded by cultivated land and plantations, and collectively comprise 289 ha in the AOI and approximately 5 ha in the RoW. The extent of riverine and swamp forests within the AOI are illustrated in Figure A1.3-3 of Appendix A1 and by the habitat map (Appendix A1.1 of Appendix A1). Wetland forest (i.e., riverine and swamp forest) is a highly threatened and unique ecosystem (as defined in IFC 2012). While riparian and swamp forests are of low bioquality, they represent one of the few natural habitats (IFC 2012 criteria) found within the broader region (see Figure 6.4-6).

The endemic/restricted range (Black Star) species *Leptonychia mildbraedii*, was recorded in an area of riverine forest of low bioquality (GHI 71) at KP12.3, approximately 967 m from the pipe centre line. The perennial woody climber *Mondia whitei*, was recorded within a swamp forest of low bioquality (GHI 46) in the

RoW at KP106. This species is listed as vulnerable by the National Red List for Uganda (WCS 2016).

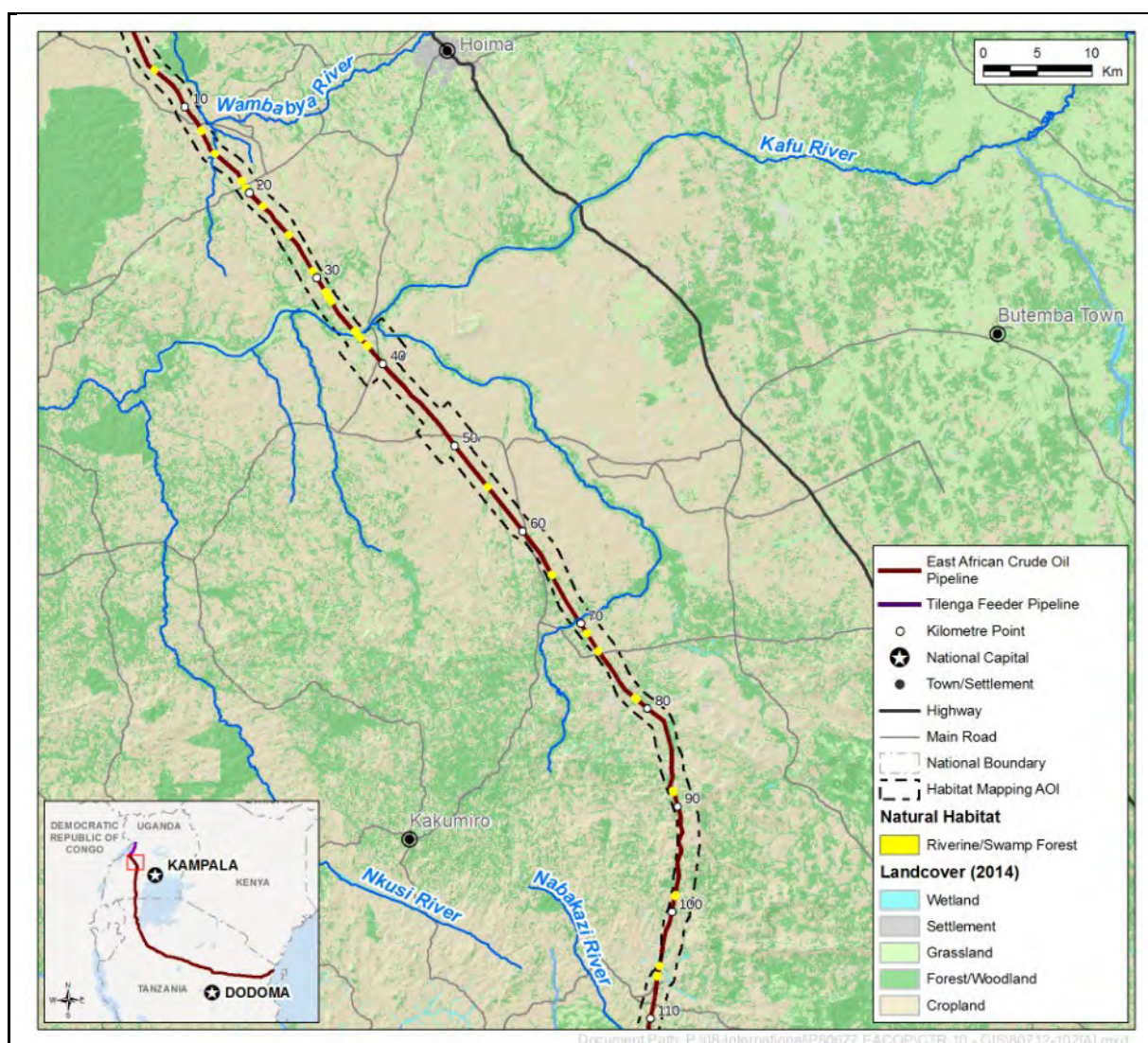


Figure 6.4-6 Estimated Extent of Riverine and Swamp Forest

Species of Conservation Importance

In total, 482 species of vascular plants were identified within the AOI during the field surveys. Of these, only 38 species have been assessed by the IUCN Red List of Threatened Species (IUCN 2017, Version 2017-3) and assigned a threat category. Within this survey sample, one tree, *Lepalea cedrata*, is listed as vulnerable. The remainder are categorised as IUCN least concern, and as such are not globally rare or of conservation importance.

The following six plant species recorded during the baseline surveys are listed on the National Red List for Uganda (WCS 2016):

- *Nymphaea nouchali* – critically endangered (further studies would be required to verify presence of this species in the RoW)
- *Lepalea cedrata* – endangered

- *Chrysophyllum perpulchrum* – vulnerable
- *Chrysophyllum albidum* – vulnerable
- *Citropsis articulata* – vulnerable
- *Mondia whitei* – vulnerable.

Leptonychia mildbraedii, a restricted-range or endemic (Black Star) species, was identified in a sample plot in the broader region at KP12.3 (outside of the AOI); further studies would be required to verify the presence of this species in the RoW. *Leptonychia mildbraedii* is of high conservation importance as it has a highly limited distribution.

Rytigynia beniensis, a restricted-range or endemic (Black Star) species, is thought to have been identified in a sample plot in the AOI at KP201.1. Because the identification of the genus *Rytigynia* is particularly complex, correct identification of these species is not guaranteed. Further surveys would be necessary to verify the presence of this species in the RoW.

The botanical survey also confirmed the presence of two Gold Star species of vascular plants, namely *Blepharispermum pubescens* (KP33, 43, 46, 50, 51, 53, 55, 57 and 110) and *Leucas calostachys* (KP39, 51 and KP57). These species are considered by national botanical specialists to be of conservation importance.

Protected Areas

The FRs traversed by, or immediately adjacent to the project AOI, and are described and mapped in Section 6.4.1.1. FRs addressed in this section are identified as protected areas supporting areas of high habitat quality in Uganda and / or vascular plants of conservation importance. Other protected areas that do not meet these criteria (i.e., the Taala FR) are described in Section 6.4.1.1.

The Kasana–Kasambya and Wambabya FRs are of botanical or floristic value. Note that the Bugoma CFR is outside of the AOI.

At KP123, the project AOI is approximately 100 m from the eastern border of Kasana–Kasambya FR. The project AOI is parallel to, and about 450 m from the FR near KP113. Both these sections of reserve closest to the project AOI are exclusively commercially managed pine tree plantations. Field studies indicated that eucalyptus plantations and maize fields are also widely present in the reserve further to the west. While this reserve does not support habitats of conservation importance, the Gold Star evergreen scrambling shrub *Blepharispermum pubescens* was identified on the boundary of the reserve during the botanical survey. This particular area had a low bioquality (GHI 57) and comprised swampy grassland with occasional woody species.

Between KP5 and KP9, the project is within 100 m of the Wambabya FR. This is the largest remnant stand of Guineo–Congolian semi-evergreen forest in the AOI and is of botanical importance as this reserve represents one of a few remnant stands of Guineo–Congolian semi-evergreen forest in the region. This is likely to be attributed to the site's protected area status.

The baseline survey also confirmed the presence of four species of vascular plants within the reserve that are listed on the Ugandan Red List, namely:

- *Chrysophyllum perpulchrum* – vulnerable
- *Chrysophyllum albidum* – vulnerable
- *Citropsis articulata* – vulnerable
- *Leplaea cedrata* – endangered.

The evergreen tree *Leplaea cedrata* is also listed as vulnerable by the IUCN Red List of Threatened Species (IUCN 2017).

Trend in Condition and Sensitivity to Change

Habitats of Conservation Importance

Guineo-Congolian Semi-evergreen Forest

Forest habitats, including Guineo-Congolian semi-evergreen forest, 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 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).

The primary causes of forest degradation and deforestation are land conversion for agro-pastoral activities and urbanisation; unsustainable exploitation of timber for fuel (firewood and charcoal); illegal and unregulated trade in forest products and unsecure forest tenure rights (Ministry of Water and Environment 2016).

In addition to the increased pressure on forest resources for natural resource collection, remnant forest fragments are vulnerable to edge effects that can have serious impacts on species diversity, composition, community dynamics and ecosystem functioning (Laurance et al. 2010). As such, Guineo–Congolian semi-evergreen forest is considered to have high sensitivity to change.

However, an estimated land area of 8,079,622 ha in Uganda has been identified as suitable forest restoration sites (Ministry of Water and Environment 2016). This indicates that Guineo-Congolian may be effectively restored and recover following clearance.

Riverine and Swamp Forest

The botanical survey indicates that riverine and swamp forests are degraded. Existing threats to the habitat quality and integrity of these forests include over-exploitation of timber resources and habitat clearance for the development of plantations and agro-pastoral activities. This trend is likely to continue in the absence of intervention.

Generally, wetland forests are unlikely to naturally regenerate if upstream seed stock is depleted and edaphic and hydrological dynamics are disrupted by extensive clearance. Consequently, wetland forest, such as riparian and swamp forests, are unlikely to be resilient to substantial disturbance over large areas and as such have a high sensitivity to change.

Species of Conservation Importance

The global population of *Leplaea cedrata* (IUCN vulnerable) is at risk of extinction. This species has undergone a substantial decline in distribution and abundance

from unsustainable harvesting for timber. As *Leplaea cedrata* is IUCN vulnerable and Ugandan Red Listed endangered, it has a high sensitivity to change.

As *Nymphaea nouchali* is listed as critically endangered on the Ugandan Red List (WCS 2016), it has a high sensitivity to change. Vascular plants listed on the Ugandan Red List as vulnerable, *Chrysophyllum perpulchrum*, *Chrysophyllum albidum*, *Mondia whitei* and *Citropsis articulate*, have a moderate sensitivity to change.

Restricted-range or endemic (Black Star) species (i.e., *Leptonychia mildbraedii* and *Rytigynia beniensis*) have a highly localised distribution, and niche physical or environmental requirements. These species are particularly vulnerable to the impacts of habitat loss, degradation and fragmentation. Restricted-range or endemic (Black Star) species have a high sensitivity to change.

The Gold Star species of vascular plants (i.e., *Blepharispermum pubescens* and *Leucas calostachys*) are relatively more common and widespread than Black Star species and as such have a low sensitivity to change.

Forest Reserves and Other Protected Areas

The Kasana–Kasambya FR is a commercial plantation and there is no anticipated change in condition.

The Wambabya FR is predominantly surrounded by agro-pastoral land and settlements and is threatened by selective logging. The Ugandan Wildlife Authority intends to initiate a revegetation programme in degraded parts of Wambabya FR. Should these programmes proceed and be successful, it is anticipated that the condition of the Wambabya FR would improve. See Section 6.4.1.1 for the trends and sensitivity of protected areas.

Ecosystem Services Provided

The habitats described in the preceding sections, with the species they comprise, generate the range of ecosystem services set out below. Further information on the general nature and extent of the provisioning ecosystem services listed can be found in the Land-based Livelihoods, Section 6.4.3.8 and in Appendix A11, 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, in others they are not.
- food (gathering and foraging). In some areas these activities are legal, in others they are not.
- collection of medicinal products.

Regulating services include:

- climate change amelioration through carbon sequestration
- local climate regulation - in terms of providing a cooler micro-climate local water and air pollution control – through waste assimilation, water and air filtration
- water regulation, erosion control and water catchment protection –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, emergent habitats

- erosion control of terrestrial habitats (i.e., wind erosion) – controlling ambient fugitive dust emissions through the stabilisation of soil by terrestrial habitats and maintaining edaphic conditions including soil moisture levels
- regulation of ambient noise levels – habitats and vegetation acting as a natural sound barrier buffering noise emissions including those arising from anthropogenic sources (i.e., vehicle movement, people and machinery).

Cultural services include:

- ethical and biodiversity ‘non-use’ values – in particular, maintaining populations of endangered and endemic species. These values are difficult to ascertain.
- sense of place or 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 include:

- providing refuge, feeding, watering, breeding and nursery areas for a host of animals that spend only part of their life in such areas.

Other supporting services include:

- provision of a range of supporting services such as photosynthesis and water, carbon and nutrient cycling, whose values are typically accounted for in other ecosystem services.

Sensitivity Rankings

From the survey results, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown in Table 6.4-3.

Table 6.4-3 Habitat and Flora Sensitivity Ranking

Ecology VEC	Sensitivity Ranking	Rationale for Ranking
Guineo-Congolian Semi-Evergreen Forest		
Habitat of conservation importance	Very High (5)	Guineo–Congolian semi-evergreen forest is a highly threatened and unique ecosystem and is natural habitat (as defined by IFC Performance Standard 6 and the accompanying Guidance Note).
Flora species of conservation importance	High (4)	Supports <i>Leplaea cedrata</i> , an IUCN vulnerable and Ugandan Red List (WCS 2016) endangered species Also supports Ugandan Red List (WCS 2016) vulnerable species: <ul style="list-style-type: none"> • <i>Chrysophyllum perpulchrum</i> • <i>Chrysophyllum albidum</i>

Table 6.4-3 Habitat and Flora Sensitivity Ranking

Ecology VEC	Sensitivity Ranking	Rationale for Ranking
		<ul style="list-style-type: none"> <i>Citropsis articulata</i>
Swamp and riparian forest		
Habitat of conservation importance	Very High (5)	Swamp and riparian forest is a highly threatened and unique ecosystem and is natural habitat (as defined by IFC Performance Standard 6 and the accompanying Guidance Note).
Flora species of conservation importance	High (4)	Supports <i>Leptonychia mildbraedii</i> , a range-restricted or endemic (Black Star) species Also supports <i>Mondia whitei</i> , a Ugandan Red List vulnerable species
Kasana–Kasambya FR		
Legally protected area	Moderate (3)	Designated as an FR and retains some biodiversity value
Flora species of conservation importance	Low (2)	Gold Star species recorded on reserve border: <i>Blepharispermum pubescens</i>
Wambabya FR		
Legally protected area	High (4)	Legally protected site designated as a nature forest reserve
Habitat of conservation importance	Very High (5)	Supports Guineo-Congolian semi-evergreen forest which is a highly threatened and unique ecosystem
Flora species of conservation importance	High (4)	Supports <i>Leplaea cedrata</i> , an IUCN vulnerable and Ugandan Red List (WCS 2016) endangered species Also supports Ugandan Red List (WCS 2016) vulnerable species: <ul style="list-style-type: none"> <i>Chrysophyllum perpulchrum</i> <i>Chrysophyllum albidum</i> <i>Citropsis articulata</i>

Key Considerations**Habitats**

Based on the outcomes of the botanical assessment, the following habitats with high bioquality are considered sensitive VECs:

- Guineo–Congolian semi-evergreen forest
- swamp and riparian forest.

Flora

The botanical survey confirmed the presence in the AOI of seven species of vascular plants of conservation importance. Of these, further studies would be

required to verify the presence or absence of *Rytigynia beniensis*, *Nymphaea nouchali* and *Leptonychia mildbraedii* in the RoW. Table 6.4-4 summarises species of conservation importance.

Protected Areas

Based on the baseline assessment, and particularly the known or likely presence of species and habitats of conservation importance, the following protected areas and corridors are identified as sensitive VECs:

- the Wambabya FR
- the Kasana–Kasambya FR.

Table 6.4-4 Key Flora Considerations

Species	Location(s)	Conservation Status	Considerations
<i>Nymphaea nouchali</i>	Secondary <i>Acacia</i> sp. woodland, bushland and wooded grassland Over 1 km from the RoW	Uganda Red Listed critically endangered	<p>The IUCN listed vulnerable vascular plant <i>Leplaea cedrata</i> is at risk of extinction. Generally, this species has undergone major declines in distribution and abundance from unsustainable harvesting.</p> <p>Restricted-range or endemic (Black Star) species have a highly localised distribution, and niche physical or environmental requirements. These species are particularly vulnerable to the impacts of habitat loss, degradation and fragmentation.</p> <p>Most globally rare and restricted-range or endemic species and Gold Star species in the AOI were recorded in Guineo–Congolian semi-evergreen forest, and swamp and riparian forest habitat types. While these habitats are of low bioquality, they are highly threatened and unique ecosystems. The impact assessment should consider conserving these key habitat types.</p>
<i>Leplaea cedrata</i>	Guineo–Congolian semi-evergreen forest	IUCN vulnerable, Uganda Red Listed endangered	
<i>Chrysophyllum perpulchrum</i>	Guineo–Congolian semi-evergreen forest	Uganda Red Listed vulnerable	
<i>Chrysophyllum albidum</i>	Guineo–Congolian semi-evergreen forest	Uganda Red Listed vulnerable	
<i>Citropsis articulata</i>	Guineo–Congolian semi-evergreen forest	Uganda Red Listed vulnerable	
<i>Mondia whitei</i>	Swamp forest Wetland	Uganda Red Listed vulnerable	
<i>Leptonychia mildbraedii</i>	Swamp and riparian forest Bugoma–Wambabya Corridor	Endemic or restricted range (Black Star)	
<i>Rytigynia beniensis</i>	Swamp and riparian forest	Endemic or restricted range (Black Star)	
<i>Blepharispermum pubescens</i>	Secondary <i>Acacia</i> sp. woodland, bushland and	RBS Gold Star	

Table 6.4-4 Key Flora Considerations

Species	Location(s)	Conservation Status	Considerations
	wooded grassland, swamp		
<i>Leucas calostachys</i>	Secondary <i>Acacia</i> sp. woodland, bushland and wooded grassland, swamp	RBS Gold Star	

6.4.1.3 Aquatic Biodiversity

This section describes the:

- aquatic biodiversity AOI
- baseline condition of aquatic biodiversity in terms of:
 - aquatic habitats
 - aquatic fauna species (fish and macroinvertebrates)
 - trends affecting the condition of aquatic habitats and fauna species of conservation importance and sensitivity to change
 - ecosystem services provided
 - aquatic biodiversity sensitivity rankings
- key considerations.

For more information, the aquatic biodiversity baseline report is included in Appendix A2.

Area of Influence

The spatial AOI for aquatic biodiversity encompasses 250 m upstream and 750 m downstream of the proposed pipeline crossings of the following rivers:

- Kafu River and tributaries
- Nabakazi River (two crossings)
- Katonga River
- Kibale River.

The 1 km length of AOI was chosen to encompass the immediate area surrounding the potential crossing location that could perceivably be impacted by construction activities. Sediments are unlikely to mobilise beyond these distances based on the rivers' typical flow conditions.

Impacts on these rivers occur only during the construction phase. The temporal AOI will be the duration of pipeline crossing construction plus the time required for the river to recover to pre-construction condition.

Baseline Condition of Aquatic Biodiversity

Aquatic Habitats of Conservation Importance

Kafu River

The Kafu River survey site is close to KP37 of the pipeline AOI. The habitat predominantly comprises a large wetland covered almost entirely by papyrus with no obvious main river channel. There were some small channels and areas of open water between papyrus stands, and local inhabitants advised that these had been created by local fishermen. Although there was no obvious main river channel, there was notable flow out of a perched culvert that was underneath the road. The road and associated culvert represent an obstacle to the movement of fish at this location.

There were also small areas of open water interspersed with wetland plants other than papyrus. These areas were predominantly found along the margins of the road. These areas may provide refuge and foraging areas for some species and life stages of fish as well as various macroinvertebrates. They may also provide hunting opportunities for fish-eating birds and other fauna.

Except for the road passing through the centre of the papyrus wetland and the small channels cut through the wetland by fishermen, the observed habitat appeared to be in an undisturbed state. Although there was clear flow through the wetland, the river channel was indistinct from the rest of the papyrus wetland.

Nabakazi River

The Nabakazi River is crossed by the AOI at two locations, KP114 and KP148.

Water depths at crossing 1 (KP114) within the accessible areas of the main channel at the survey site were in excess of 2 m. The channel substrate was comprised predominantly of clay overlain with sand in patches and some accumulations of organic debris towards the edges of the small area of open water. Ditches of approximately 1 m width and 1.5 m depth have been dug along the sides of the access road providing potential habitat for fish and access for local fishermen.

At crossing 2 (KP148) an old railway line splits a narrow strip of wetland from the main papyrus wetlands, which is well supplied with water through culverts to the south of the Nabakazi River. The strips of wetlands have a diverse flora dominated by sedges or *Typha* sp. Papyrus mats are by far the dominant vegetation cover comprising the bulk of the main wetland. Among the papyrus were several sedge dominated vegetation mats fringed by *Vossia* species. Anthropogenic impacts were also observed, mostly trampling and erosion of the banks at watering points for the large herds of cattle.

Katonga River

Water depths of up to 2.6 m were recorded in the Katonga River, but access was blocked to most of the channel by floating vegetation mats. The banks of the channel consist of *Vassia* sp, papyrus and dwarf sedges. Ditches have been dug either side of the road, approximately 2 m wide and 1.5 m deep. While offering potentially good habitat for fish, they were in places packed with thorny branches

and rocks from road construction making surveying difficult. Evidence of hippopotamus was recorded close to the survey site.

Kibale River

The land adjacent to the Kibale River channel on the left³ bank comprised steeply sloping farmland with banana and plantain plantations, with level ground by the river that appeared to have been cleared less than 6 months previously. Remnants of the cleared papyrus beds could still be found in a thin strip a few metres wide along much of the left bank. The land on the right bank appeared to be undisturbed.

The river channel mostly comprised glide-flow types and a silt substrate, with densely vegetated marginal and riparian zones. Several sections of the river had shallow, marginal slack water areas with aquatic vegetation. Such habitat provides important spawning and refuge areas for juvenile and small fish and macroinvertebrate species. Predatory fish species may also use the vegetation for camouflage to ambush prey.

Flow and substrate diversity throughout the channel was poor but the river channel showed no obvious signs of disturbance. Turbidity levels were high.

Overall, the river habitat at this location is considered to be in a near to natural state. A reasonably good range of different fish and macroinvertebrate species were caught here, indicating that the river and its associated fauna are in good condition.

Ephemeral Rivers

The AOI crosses 10 ephemeral watercourses in Uganda. Local experts advised that these would not be flowing at the time of the surveys in June 2017 and they were therefore not surveyed. It is possible that small isolated pools may have remained with aquatic life seeking refuge in such pools. However, locating these pools would have required a substantial survey effort. Furthermore, such pools are likely to be heavily impacted by people, wildlife and livestock.

Aquatic Fauna Species of Conservation Importance

Overview

The Fishbase (2018) and IUCN (2018) websites identified 72 fish species occurring in Ugandan freshwater habitats that were listed by the IUCN as vulnerable, endangered or critically endangered. Many of these species were also considered endemic or at least range-restricted (i.e., only found in the Lake Victoria or Victoria Nile basins). Many of these species could be present in the AOI but were not recorded during field surveys.

Freshwater macroinvertebrates have been poorly studied in the AOI. Notwithstanding this, 44 threatened dragonfly species are listed in the Uganda Red List (WCS 2016). Of these 44 species, only *Pseudagrion bicoerulans* is listed as vulnerable on the IUCN Red List and this species has only been recorded from montane streams greater than 2000 m above sea level and is therefore not

³ It is standard practice for aquatic surveys to describe the river banks as being either the left or right of the channel, as observed when facing downstream

expected in the AOI. All other species listed as threatened at a national level are listed globally as not evaluated, data deficient, least concern or near threatened.

Secondary literature indicates that the actual number of fish and macroinvertebrate species within the AOI for the aquatic habitats studied is likely to be larger than the sampling results of the surveys. Field survey data only provide a snapshot in time, so are unlikely to represent the full diversity of species at a site. Therefore, baseline assessments include secondary data as well as data gathered during field surveys.

Kafu River

Three species of fish were caught during the Kafu River fish surveys:

- *Barbus kerstenii* comprised most of the catch at this location. This species undertakes freshwater migrations to breed (IUCN 2018).
- *Astatotilapia* sp.
- *Clarias liocephalus*.

It is likely that other species occur at this site. Local inhabitants informed the survey team that the following species were also encountered regularly at this location:

- *Protopterus aethiopicus*
- *Schilbe intermedius*
- *Labeo* sp.
- small mormyrid spp.

Three types of macroinvertebrate were recorded for the Kafu River. Chironomids (midges or lake flies) dominated the samples with a relative abundance of 98%.

Secondary literature indicates that papyrus wetlands and swamps are known to act as nursery areas for several fish species (Mnaya and Wolanski 2002) and to have abundant macroinvertebrate communities. The actual number of fish and macroinvertebrate species can therefore be assumed to be much larger than the sampling results indicate.

Nabakazi River – Crossing 1

Six fish species were caught during the Nabakazi River crossing fish surveys. *Barbus neumayeri* comprised most of the catch with 11 individuals caught. *Clarius liocephalus*, *Clarius gariepinus*, *Protopterus aethiopicus* and unknown species of *Astatotilapia* and *Aplocheilichthys* were also caught. All species are classed by the IUCN as least concern.

It is likely that other species will occur at this site that were not caught during the surveys. The district state of environment report for Mubende (NEMA, 2004) suggest the following species also inhabit the river system:

- *Oreochromis niloticus* – IUCN not assessed
- *Oreochromis zilli* – IUCN not assessed
- *Oreochromis leucostictus* – IUCN least concern
- *Clarias* sp.

Eighteen species of macroinvertebrates were recorded during the June 2018 surveys. Of these, *Biomphalaria sudanica* was the most frequently recorded aside from a relative abundance of Oligochaetes.

The macro-invertebrate taxon recorded here was varied indicating a relatively undisturbed habitat that is free from serious degradation. The survey results show that overall the species diversity is relatively high with no significant dominance of any particular species or taxonomic group.

One species of conservation importance was recorded, *Gabiella humerosa* spp *alberti* – IUCN endangered. This species has a disjunct distribution in the Great Lakes of central Africa but is sub-divided into six subspecies according to which lake they are found (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).

Nabakazi River – Crossing 2

Five species of fish were recorded at this river crossing. *Ctenopoma muriei* (IUCN least concern) was the most common. The further four species caught at this survey site were as follows:

- *Clarias liocephalus*
- *Aplocheilichyts* sp. – unknown species
- *Clarias gariepinus*
- *Protopterus aethiopicus*.

It is likely that other species occur at this site that were not caught during surveys. The district state of environment report for Mubende (NEMA, 2004) suggest the following species also inhabit the river system:

- *Oreochromis niloticus*
- *Oreochromis zilli*
- *Oreochromis leucostictus*
- *Clarias* sp.

All species are classed as by the IUCN as least concern.

Fourteen species of macroinvertebrates were recorded during the June 2018 surveys. Of these, *Biomphalaria sudanica* was the most frequently recorded, with an unknown species of the genus *Derallus* the second most frequent.

Katonga River

Only four species of fish were recorded in the Katonga river during the field surveys. These were:

- *Clarias liocephalus*
- *Clarias gariepinus*
- *Protopterus aethiopicus*
- *Ctenopoma muriei*.

All species found during the surveys are listed by the IUCN as least concern.

However, the species *Haplochromis katonga* (IUCN data deficient) is only known from the type locality in the Katonga River (FishBase team RMCA & Geelhand 2016). While little is known about this species, it is assumed to not be very common.

Three species of macroinvertebrate were recorded during the surveys. These could not be identified at species level but were of the genera *Chironomidae*, *Naucoris* and *Appasus*. None of these species are of conservation importance.

Kibale River

Seven fish species were caught in the Kibale River:

- fish from the genus *Astatotilapia* comprised most of the fish catches
- fish from the genus *Barbus* were encountered most frequently after *Astatotilapia*
- *Clarias liocephalus*, *Aplocheilichthys* sp. and *Astatoreochromis* sp. were only recorded in small numbers or as single specimens.

Local inhabitants informed the surveyors that the following species were caught regularly from this section of the Kibale River:

- *Protopterus aethiopicus*
- *Schilbe intermedius*
- *Labeo* spp.
- small mormyrid species.

Nine types of macroinvertebrate were recorded for the Kibale River. Protoneuridae species (a type of damselfly) were the most abundant macroinvertebrates.

However, the survey results show that overall the species diversity was relatively high with no major dominance of any particular species or taxonomic group.

Trend in Condition and Sensitivity to Change

Papyrus wetlands are under increasing anthropogenic pressure with large areas cleared for agriculture or the harvesting of papyrus. Clearing of wetland vegetation and the creation of open water can increase evaporation rates leading to a shrinking of the wetland area. Papyrus will readily regenerate if left undisturbed after the initial encroachment. However, land use pressures in the region are likely to restrict opportunities for permanent regeneration. Increasing pressure on this system will affect the flora and fauna.

Rivers are also very sensitive to change, with their associated flora and fauna most sensitive to factors such as water quality, suspended sediment and changes in flow conditions. Changes to land adjacent to the river or the river channel are likely to result, as a minimum, in localised impacts on associated flora and fauna.

Table 6.4-5 provides site-specific trends in condition and sensitivity to change.

Table 6.4-5 Site-Specific Trends in Condition and Sensitivity to Change

Site	Trend in Condition	Sensitivity to Change
Kafu River	Comparatively undisturbed natural habitat, though there is evidence of some clearing of riparian habitats for agriculture and harvesting of papyrus. This trend is likely to continue owing to ongoing land use pressures.	High
Nabakazi River	Comparatively undisturbed natural habitat, though there is evidence of some clearing around the wetland edges for agriculture and harvesting of papyrus. This trend is likely to continue owing to ongoing land use pressures.	High
Katonga River	Comparatively undisturbed natural habitat with some evidence of clearing for agriculture. This trend is likely to continue owing to ongoing land use pressures.	High
Kibale River	In good condition, but there had been vegetation clearing for agriculture on one bank within the 6 months of the June 2017 survey. This trend is likely to continue due to ongoing land use pressures.	High

Ecosystem Services Provided

The Kafu, Nabakazi, Katonga and Kibale Rivers and associated papyrus wetlands provide the following ecosystem services:

Provisioning services include:

- fisheries and a source of other wild food. These provisioning ecosystem services are covered in freshwater livelihoods section of Appendix A11 Socio-economic and Health Baseline Report.

Regulating services include:

- water regulation, whereby the river helps to retain and control the flow of water in times of heavy rainfall and during the wet season. The vegetation and shape of the river are important factors in this role.

Habitat and species support services include:

- habitat and species support services, whereby the river supports various fauna that either use the water for drinking or cooling in the heat, or as a food source (e.g., birds eating the insects that frequent the river). It also provides important connectivity between habitats, particularly during the wet season.

Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown in Table 6.4-6.

Table 6.4-6 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Ecological VEC	Sensitivity Ranking	Rationale for Ranking
Kafu River		
Legally protected, internationally or nationally recognised areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protects the Kafu River wetlands as a biodiversity area and a resource for local communities.
Flora and fauna species of conservation importance	Very High (4)	Endemic, range-restricted and migratory (potamodromous) species are known, or considered likely, to be present.
Aquatic habitat of conservation importance (wetlands and watercourses)	High (4)	<p>The Kafu River and associated wetlands are considered to be a natural habitat¹. Apart from a road crossing, there were no obvious signs of anthropogenic habitat modifications.</p> <p>The Kafu River provides connectivity, including riparian corridors and wetlands, which creates ecological linkages between the Albertine Rift Lakes.</p>
Nabakazi River		
Legally protected, internationally or nationally recognised areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protects the Nabakazi River wetlands as a biodiversity area and a resource for local communities.
Flora and fauna species of conservation importance	High (4)	Endemic, range-restricted and migratory (potamodromous) species are known or considered likely to be present.
Aquatic habitat of conservation importance (wetlands and watercourses)	High (4)	<p>Secondary sources and information from in-country aquatic ecologists indicate that the river and associated wetlands can be classified as natural habitat¹.</p> <p>The river and associated wetlands are likely to be important breeding and feeding grounds for aquatic fauna.</p> <p>The Nabakazi River provides connectivity, including riparian corridors and wetlands, which creates ecological linkages between the Albertine Rift Lakes.</p>

Table 6.4-6 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Ecological VEC	Sensitivity Ranking	Rationale for Ranking
Katonga River		
Legally protected, internationally or nationally recognised areas	Very High (5)	The Katonga River and associated wetlands and tributaries are connected with or flow through numerous nationally protected sites. The river also connects with Lake George to the west, which is a Ramsar wetland and fKBA.
Flora and fauna species of conservation importance	High (4)	Endemic, range-restricted species and migratory (potamodromous) species are known to be present.
Aquatic habitat of conservation importance (wetlands and watercourses)	High (4)	<p>Although the river could not be accessed during surveys, reports from in-country surveyors suggest that the river and associated wetlands can be classed as natural habitat¹.</p> <p>The river and wetlands are also likely to be important breeding and feeding grounds for a range of fauna.</p> <p>The Katonga River provides connectivity, including riparian corridors and wetlands, which creates ecological linkages between the Albertine Rift Lakes.</p>
Kibale River		
Legally protected, internationally or nationally recognised areas	High (4)	The Kibale River and associated wetlands and watercourses are connected with, or flow through numerous nationally protected sites. The river also connects with the Nabajjuzi wetland to the east, which is a Ramsar site.
Flora and fauna species of conservation importance	High (4)	Endemic, range-restricted and migratory (potamodromous) species are known to be present.
Aquatic habitat of conservation importance (wetlands and watercourses)	High (4)	<p>There are no obvious signs of anthropogenic disturbance or modification apart from the road crossing, so the site can be classed as natural habitat¹.</p> <p>The Kibale River provides connectivity, including riparian corridors and wetlands, which creates ecological linkages between the Albertine Rift Lakes.</p>

NOTES: ¹ As defined by IFC Performance Standard 6 and the accompanying Guidance Note.

Key Considerations

Based on the outcomes of the aquatic biodiversity study, and particularly the known or likely presence of fish species of conservation importance, the following rivers are identified as sensitive VECs:

- Kafu River
- Nabakazi River
- Katonga River
- Kibale River.

The presence of large intact mats of aquatic or wetland vegetation, in addition to several macroinvertebrate species from the order Ephemeroptera, indicates that these rivers are largely undisturbed.

None of the fish species sampled during the surveys is considered critically endangered, endangered or vulnerable (IUCN Red List), although secondary data indicate that fish, crustacean and macroinvertebrate species of conservation importance are likely to be present in the AOI.

Two of the fish species sampled (*Barbus kerstenii* and *Schilbe intermedius*) undertake in-river migrations. Secondary data also indicate the likely presence of endemic and range-restricted species in the AOI.

6.4.1.4 Avifauna Biodiversity

This section describes the:

- avifauna biodiversity AOI
- baseline condition of avifauna biodiversity in terms of:
 - habitats of importance for avifauna
 - avifauna species of conservation importance
 - trends affecting the condition of avifauna habitats and species of conservation importance and sensitivity to change
 - ecosystem services provided
 - avifauna biodiversity sensitivity rankings
- key considerations.

For more information, the avifauna biodiversity baseline report is included in Appendix A3.

Area of Influence

The AOI for the avifauna study is a 2-km corridor centred on the pipeline RoW as this encompasses the area that has the potential for 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 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

relevant habitat to recover to its pre-project potential (i.e., the habitat is able to support the species' diversity and abundance, and ecological processes of the habitat in its pre-project condition). The temporal AOI for avifauna species of conservation importance is the duration of operation of the AGIs where these have the potential to cause noise or visual disturbance.

Baseline Condition of Avifauna Biodiversity

Avifauna Habitats of Conservation Importance

Wambabya Forest Reserve

Within the Wambabya FR there are a few remaining old trees in the riverine forest alongside the Wambabya River, but generally the avifauna habitat within the reserve is degraded. The 76 species recorded during the field surveys included forest-specialist species such as:

- spotted greenbul, *Ixonotus guttatus* (IUCN least concern)
- toro olive greenbul, *Phyllastrephus hypochloris* (IUCN least concern, Uganda near threatened)
- grey parrot, *Psittacus erithacus* (IUCN endangered, Uganda vulnerable).

Papyrus Swamp

Extensive swamps, largely dominated by papyrus are found throughout the AOI. Surveys at these swamps recorded papyrus endemics, notably papyrus gonolek, *Laniarius mufumbiri* (IUCN near threatened, Uganda vulnerable). Another wetland site of note for avifauna are ponds at a disused airstrip at KP288. Although artificial, these ponds are now well vegetated with native plants and support an interesting variety of birds, including:

- white-backed duck, *Thalassornis leuconotus* (IUCN least concern, Uganda vulnerable, congregatory)
- rufous-bellied heron, *Ardeola rufiventris* (IUCN least concern, Uganda vulnerable, congregatory).

Southern Valleys

The southern valleys are typified by grassland and agricultural land, around KP232. The grey-crowned crane, *Balearica regulorum* (IUCN endangered and Uganda endangered) is the national bird of Uganda and is present in a variety of open habitats including grasslands and cultivated land. During both the wet and dry season surveys, pairs were recorded in about two-thirds of the valleys in the southern sites (sites 1, 5, 8, 9 10, 11, 13 and 24 as shown in Appendix A3). According to the bird atlas of Uganda, this once-widespread species is now confined largely to southwest Uganda and the distribution maps indicate that the species is present in the AOI. While only a sample of valleys were surveyed it is likely to be present in other areas of suitable habitat within the same area.

Avifauna Fauna Species of Conservation Importance

Uganda is a bird-rich country, with about 1040 species recorded, of which about 800 are resident species (Carswell et al. 2005). The AOI avoids protected areas,

but the Lake Albert flats, which are pastoral areas, are known to be species-rich. 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).

Bird species richness was high in 15 of the 30 sites surveyed, often with 40 or more species recorded. This indicates the importance of birds as contributors to ecosystem function, notably pollination, seed dispersal and pest control. Species were also identified as being of conservation importance, as detailed in Table 6.4-7.

Table 6.4-7 Avifauna of Conservation Importance

Common Name <i>Scientific Name</i> (Alternative Name)	Global					Uganda					
	CR	EN	VU	NT	DD	CR	EN	VU	NT	RR	DD
White-backed duck <i>Thalassornis leuconotus</i>								✓			
Grey-crowned crane <i>Balearica regulorum</i>		✓					✓				
African woollyneck <i>Ciconia microscelis</i>								✓			
Saddlebill <i>Ephippiorhynchus senegalensis</i>								✓			
Striated heron <i>Butorides striata</i> (green-backed heron)									✓		
Rufous-bellied heron <i>Ardeola rufiventris</i>								✓			
Hooded vulture <i>Necrosyrtes monachus</i>	✓						✓				
Ovambo sparrowhawk <i>Accipiter ovampensis</i>								✓			
Grey parrot <i>Psittacus erithacus</i>				✓				✓			
Papyrus gonolek <i>Laniarius mufumbiri</i>				✓				✓			

Table 6.4-7 Avifauna of Conservation Importance

Common Name Scientific Name (Alternative Name)	Global					Uganda					
	CR	EN	VU	NT	DD	CR	EN	VU	NT	RR	DD
Toro olive greenbul <i>Phyllastrephus hypochloris</i>									✓		
Number of species	1	1	-	2	-	-	2	8	2	-	-

NOTE: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, RR = Regionally Restricted, DD = Data Deficient.

The hooded vulture, *Necrosyrtes monachus* (IUCN critically endangered, Uganda endangered), African woollyneck, *Ciconia microscelis*, (ICUN least concern, Uganda vulnerable), saddlebill, *Ephippiorhynchus senegalensis* (ICUN least concern, Uganda vulnerable) and the Ovambo sparrowhawk, *Accipiter ovampensis*, (ICUN least concern, Uganda vulnerable) were also recorded during field surveys, but are not connected specifically with any of the habitats described here.

Trend in Condition and Sensitivity to Change

Wambabya Forest Reserve

The Wambabya FR could become an important part of an ecological corridor being investigated for restoration and enhancement by Ecotrust, Jane Goodall Institute and Fauna & Flora International within the broader Albertine Rift landscape (Lamprey 2017). Similarly, the Ugandan Wildlife Authority has advised the project of its intention to initiate a revegetation programme in degraded parts of the Wambabya FR. Should these programmes proceed, it is anticipated that the condition of the Wambabya FR would improve.

As the Wambabya FR provides nesting habitat for grey parrot (IUCN endangered) and other forest-specialist avifauna, it is considered to have very high sensitivity to change.

Papyrus Swamp

Papyrus wetlands are under increasing anthropogenic pressure with large areas cleared for agriculture or the harvesting of papyrus. Clearing of wetland vegetation and the creation of open water can increase evaporation rates leading to a shrinking of the wetland area. Papyrus will readily regenerate if left undisturbed after the initial encroachment. However, land use pressures in the region are likely to restrict opportunities for permanent regeneration. Increasing pressure on this system will affect the flora and fauna.

Wetlands and the specialist bird species that depend on them for nesting and foraging habitat have high sensitivity to change.

Southern Valleys

The grasslands are subject to pressures through over-grazing and conversion to agriculture; these pressures on land use are anticipated to continue.

As the southern valleys provide important habitat for grey-crowned crane (IUCN and Uganda endangered), they are considered to have high sensitivity to change.

Ecosystem Services Provided

The habitats described, together with the avifauna species they support, generate a range of ecosystem services as set out below.

Provisioning services include:

- food (bushmeat hunting and egg gathering).

Regulating services include:

- many of the bird species (raptors, vultures and owls) being keystone species that provide pest control and other regulating services.

Cultural services include:

- eco-tourism, particularly in protected areas
- use of feathers, bones and other body parts in ceremonial rituals.

Habitat and species support includes:

- refuge, feeding, watering, breeding and nursery areas for a range of bird species.

Supporting services include:

- pollination and seed dispersal.

Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown below in Table 6.4-8.

Table 6.4-8 Avifauna Valued Environmental Components and Sensitivity Ranking

Avifauna VEC	Sensitivity Ranking	Rationale for Ranking
Wambabya FR		
Legally Protected area	High (4)	Legally protected as a FR
Flora and fauna species of conservation importance	Very high (5)	Supports the IUCN endangered (Uganda vulnerable) grey parrot
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Habitats providing important breeding habitat for forest-specialist species, including the IUCN endangered (Uganda vulnerable) grey parrot

Table 6.4-8 Avifauna Valued Environmental Components and Sensitivity Ranking

Avifauna VEC	Sensitivity Ranking	Rationale for Ranking
Papyrus swamp and other wetlands		
Flora and fauna species of conservation importance	Moderate (3)	Supports Uganda vulnerable species: <ul style="list-style-type: none"> • papyrus gonolek • white-backed duck • rufous-bellied heron
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Natural habitat providing nesting and foraging habitat for wetland-specialist birds
Southern valleys		
Flora and fauna species of conservation importance	Very high (5)	Supports IUCN and Uganda endangered species: <ul style="list-style-type: none"> • grey-crowned crane
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Natural habitat supporting the national bird of Uganda, the grey-crowned crane
Avifauna species		
Flora and fauna species of conservation importance	Very high (5)	IUCN critically endangered and endangered species: <ul style="list-style-type: none"> • hooded vulture (critically endangered) • grey-crowned crane (endangered) • grey parrot (endangered) Uganda vulnerable species: <ul style="list-style-type: none"> • papyrus gonolek • white-backed duck • rufous-bellied heron

Key Considerations

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 VECs:

- Wambabya FR
- papyrus swamp and other wetlands
- southern valleys.

Avifauna species of conservation importance were recorded during the field surveys that are key considerations for the impact assessment. These species are important because they are listed as IUCN or Uganda critically endangered, endangered or

vulnerable; some are congregatory; and some are range-restricted or habitat specialists. Species of conservation importance are listed in Table 6.4-9.

Table 6.4-9 Avifauna Key Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
Hooded vulture	KP127 close to Kasana-Kasambaya FR	IUCN CR, Uganda EN	Main threats to this species include habitat loss, intentional or unintentional poisoning, bushmeat hunting and small clutch size meaning loss of one parent will lead to loss of offspring.
Grey-crowned crane	Kafu River swamps, KP37, 91, 210, 220, 226, 232, 259 and 289	IUCN EN, Uganda EN	The main threats to this species are loss and degradation of wetland breeding areas, illegal captive trade, hunting and egg capture and human disturbance.
White backed duck	MCPY4 at KP288.5	Uganda VU, congregatory and partially migrant	The species is threatened by the modification of wetlands, deterioration in water quality and pollution.
African woollyneck	Kafu River swamps – KP37 and 232	Uganda VU	Uganda vulnerable due to a declining population and subpopulations being less than 1000 mature individuals.
Saddlebill	Kafu River swamps, KP37	Uganda VU	The species is vulnerable to disturbance and wetland degradation (e.g., pesticide contamination) and conversion to agriculture (del Hoyo et al. 1992).
Rufous-bellied heron	MCPY4 at KP288.5	Uganda VU	Uganda vulnerable due to a declining population and subpopulations being less than 1000 mature individuals.
Ovambo sparrowhawk	KP274	Uganda VU	Loss of woodland habitat due to cutting is a threat (Kemp and Kirwan 2013).
Grey parrot	Wambabya FR	IUCN EN, Uganda VU	Trapping for the wild bird trade is the main threat to the species, with habitat loss also being a notable threat to the species in East Africa (BirdLife International 2017b).
Papyrus gonolek	Kafu River swamps, KP37	IUCN NT, Uganda VU	The highly specialised habitat required by this species makes it vulnerable to threats such as drainage, burning and the over-exploitation of wetlands (BirdLife International 2016f).

Key considerations for avifauna species are:

- loss of habitat
- disturbance to nesting and foraging, both of which occur throughout the year.

6.4.1.5 Fauna Biodiversity

This section describes the:

- fauna biodiversity AOI
- baseline condition of fauna biodiversity in terms of:
 - habitats
 - fauna species (large mammals, small mammals, reptiles, amphibians, and invertebrates)
 - trends affecting the condition of habitats and fauna species of conservation importance and sensitivity to change
 - ecosystem services provided
 - fauna biodiversity sensitivity rankings
- key considerations.

For more information, the fauna biodiversity baseline report is included in Appendix A4.

Area of Influence

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, the spread of invasive species and permanent habitat loss and fragmentation. The definition of an ecologically relevant distance relies on the mobility of a species, habitat connectivity between it and the project, and the potential impact pathways between it and the project. On a precautionary basis, the spatial AOI was generally defined by a 10-km-wide corridor centred on the pipeline route and AGIs to account for the mobility of some fauna species.

The temporal AOI is defined as the duration of the project construction phase extended by the time required for the relevant 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).

Baseline Condition of Fauna Biodiversity

Habitats of Conservation Importance

Wambabya Forest Reserve

The Wambabya FR is a closed, tropical high forest and is designated as an ecological and environmental FR (NEMA 2010). The southern part of the reserve is relatively intact forest. The FR supports the highest population density of chimpanzees, *Pan troglodytes schweinfurthii*, in the Albertine Rift. The chimpanzee is listed as endangered by the IUCN and critically endangered on the Ugandan Red List. Other species of conservation concern either recorded during field surveys or identified from literature review include the tree pangolin *Phataginus*

tricuspis, long-tailed pangolin *Phataginus tetradactyla* and the African golden cat *Caracal aurata*, all of which are listed as IUCN vulnerable. The African golden cat is listed as endangered on the Uganda Red List, while the two pangolin species are listed as vulnerable.

Remnant fragments of riparian forest link the Wambabya FR to the Bugoma CFR. This network provides important habitat for the IUCN and Uganda endangered chimpanzee.

Taala Forest Reserve

Taala FR was originally designated for ecological purposes and, although heavily degraded and converted to agriculture, it retains biodiversity value. The spot-necked otter *Hydricitis maculicolois* was recorded in a small watercourse at the northern end of the Taala FR, and is listed by the IUCN as near threatened, and as endangered on the Ugandan Red List. Several butterfly species of importance were also recorded here during the project baseline surveys.

Kasana–Kasambya Forest Reserve

The pipeline RoW is within 100 m of the Kasana–Kasambaya FR near KP123, which is exclusively pine tree plantations with field studies suggesting that eucalyptus plantations and maize fields are also widely present. The Sierra Leone mops bat *Mops brachypterus* (Uganda Red List vulnerable) was recorded in project surveys. Pousargue's mongoose *Dologale dybowskii* is listed as data deficient by IUCN. There is uncertainty about its abundance throughout its range and it could be more common than thought. This species was also recorded in baseline surveys. Interviews with local communities suggest that leopard *Panthera pardus* (IUCN and Uganda vulnerable) visit the reserve. Three butterfly species of conservation importance were recorded during the baseline surveys.

Disused Airstrip Borrow Pits

The AOI traverses a disused airstrip at KP288, where there are former borrow pits that have filled with water approximately 200 m to the west of the pipeline RoW. The ponds provide good quality habitat for amphibians, reptiles and invertebrates within an otherwise relatively dry, agricultural landscape. The Bohor reedbuck *Redunca redunca* (IUCN least concern and Uganda endangered) was recorded in baseline surveys. One butterfly species of conservation importance *Uranotaema heritsia* (IUCN not listed and Uganda endangered), one dragonfly species *Acisoma inflatum* (IUCN least concern and Uganda vulnerable) and one damselfly species *Azuragrion vansomerani* (IUCN least concern and Uganda data deficient) were recorded.

Wetland and Aquatic Habitats

Aquatic habitats throughout the AOI, including wetlands, ponds and riparian habitats, support species of interest, particularly amphibians. In addition, wetlands serve as watering holes for wildlife, with access to a reliable water source generally the main range-limiting factor for large carnivores (Abade et al. 2014).

Sitatunga *Tragelaphus spekii* (Uganda Red List vulnerable) was recorded in the baseline surveys in the papyrus swamps associated with the Nabakazi River

around KP106 and KP141, and around KP165 at the Katonga River papyrus swamp. The Bohor reedbuck (IUCN least concern and Uganda endangered) and Temminck's ground pangolin *Smutsia temminckii* (IUCN and Uganda vulnerable) were recorded at KP165 (Katonga River).

Evidence of spot-necked otter (IUCN near threatened and Uganda endangered) was found during surveys at the Nabakazi River crossing at KP147.5.

Interviews with local communities suggest that leopards are present around the Nabakazi swamp and Katonga River wetlands area although no evidence was noted during the field surveys.

Fauna Species of Conservation Importance

Bats

Uganda has 95 documented species of bats. Of these species, none were noted within the project AOI from literature or community consultations. However, three species were observed during the baseline surveys.

Only one species, Sierra Leone mops bat (Uganda vulnerable) is of conservation importance. This species was identified in the Kasana–Kasambaya FR.

Large Mammals

Of the 45 large mammal species reported during the surveys, most were recorded during the wet season in the Katonga River wetland system around KP165. Most species recorded or reported to be present are common and widespread except for the following, which are considered of conservation importance:

- sitatunga (*Tragelaphus spekii*), IUCN least concern, Uganda vulnerable
- Bohor reedbuck (*Redunca redunca*), IUCN least concern, Uganda endangered
- Temminck's ground pangolin (*Smutsia temminckii*), IUCN vulnerable and Uganda vulnerable
- tree pangolin (*Phataginus tricuspis*): IUCN vulnerable, Uganda vulnerable
- long-tailed pangolin (*Phataginus tetradactyla*), IUCN vulnerable, Uganda endangered
- African golden cat (*Caracal aurata*), IUCN vulnerable, Uganda endangered
- African clawless otter (*Aonyx capensis*), IUCN near threatened and Uganda vulnerable
- hippopotamus (*Hippopotamus amphibious*), IUCN vulnerable, Uganda vulnerable
- spotted-necked otter (*Hydrictis maculicollis*), IUCN near threatened and Uganda endangered
- leopard (*Panthera pardus*), IUCN vulnerable and Uganda vulnerable
- chimpanzee (*Pan troglodytes*), IUCN endangered and Uganda endangered.

Small Mammals

No small mammals of conservation importance were recorded during the baseline surveys.

Reptiles

No reptile species of conservation importance were recorded during the baseline surveys.

Amphibians

The baseline surveys in the AOI observed 26 species of amphibians. The borrow pits at the disused airstrip at KP288 had the most amphibians with 17 species.

One species of conservation importance was recorded during the field studies: golden-throated rocket frog (*Ptychadena chrysogaster*), IUCN least concern and Uganda vulnerable.

Invertebrates

A total of 314 lepidopterans (butterflies and moths) was recorded during the surveys. For butterflies, the highest number of species was recorded in the forests and woodland areas. In a woodland area near KP275, 58 species of butterfly were recorded. However, most species of conservation importance were recorded around the Wambabya FR and larger wetland areas such as the Kafu River wetlands.

Twenty-four butterfly species and nine dragonfly species of conservation importance were recorded during the field surveys. No species were listed by the IUCN, but all were listed on the Uganda Red List. No records were available for the AOI from literature or consultations.

The following butterfly species are of conservation importance:

- *Acada biseriatus*, data deficient – only second known record in Uganda
- *Actinote alciope*, critically endangered
- *Actinote pharsalus*, vulnerable
- *Actinote rahira*, vulnerable
- *Actinote pentapolis*, vulnerable
- *Actinote wigginsi*, data deficient – first known record in Uganda
- *Anthene indefinita*, vulnerable
- *Anthene liodes*, vulnerable
- *Bebearia laetitioides*, vulnerable
- *Bicyclus istaris*, vulnerable
- *Borbo holtzi*, vulnerable
- *Cymothoe egesta*, endangered
- *Euchrysops subpallida*, vulnerable
- *Hewitsonia ugandae*, data deficient
- *Lachnocnema divergens*, data deficient
- *Metisella willemi*, vulnerable
- *Monza alberti*, vulnerable
- *Mylothris rhodope*, data deficient – first known record in Uganda
- *Neptis nicomedes*, vulnerable
- *Pentila inconspicua*, vulnerable

- *Pentila tachyroides*, critically endangered
- *Prosopalpus styli*, vulnerable
- *Uranotaenia heritsia*, endangered
- *Zenonia zeno*, vulnerable.

The following dragonfly species are of conservation importance:

- *Acisoma inflatum*, vulnerable
- *Acisoma variegatum*, vulnerable
- *Agriocnemis palaeforma*, endangered
- *Azuragrion vansomereni*, data deficient – few known records in Uganda
- *Chlorocypha victoriae*, vulnerable
- *Neodythemis afra*, critically endangered
- *Pseudagrion* (B) *torridum*, vulnerable
- *Platycypha lacustris*, vulnerable
- *Pseudagrion* (B) *glaucoideum*, critically endangered.

Trend in Condition and Sensitivity to Change

Wambabya Forest Reserve

Trends in condition and sensitivity to change for the Wambabya FR are described in Section 6.4.1.1.

The Wambabya FR and the corridors of remnant riparian forest linking it to the Bugoma CFR provide important habitat for the IUCN and Uganda endangered chimpanzee. This area is therefore of very high sensitivity to change.

Taala Forest Reserve

The Taala FR was originally designated for ecological purposes and now comprises modified habitat that has biodiversity value in places. It is considered to have low sensitivity to change and there is no anticipated change in condition of this forest.

Kasana–Kasambya Forest Reserve

As this FR is a commercial plantation, there is no anticipated change in condition.

Kasana–Kasambya FR comprises modified habitat with some biodiversity value. It is considered to have low sensitivity to change.

Disused Airstrip Borrow Pits

The airstrip borrow pits have developed into important ecological features over the last 40 years. Unaltered, it is anticipated that their condition would continue to be important for the species that use the borrow pits and associated wetland habitat.

The airstrip borrow pits provide important breeding and feeding habitat for reptile, amphibian and invertebrate species, and are therefore considered to have high sensitivity to change with no anticipated change in condition.

Wetland and Aquatic Habitats

As noted in the Aquatic Biodiversity Baseline Report (Appendix A2), Uganda's wetlands are under increasing pressure from agricultural activities, extensive livestock husbandry, agro-chemical and other pollution, reservoir construction, deforestation and mining practices (Dugan 1990).

Papyrus wetlands are under increasing anthropogenic pressure with large areas cleared for agriculture or papyrus harvesting. Clearing of wetland vegetation and the creation of open water can increase evaporation rates leading to a shrinking of the wetland area. Papyrus will readily regenerate if left undisturbed after the initial encroachment. However, land use pressures in the region are likely to restrict opportunities for permanent regeneration. Increasing pressure on this system will affect the flora and fauna.

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.

Ecosystem Services Provided

The fauna generates the range of ecosystem services as set out below. Further information on the general nature and extent of the provisioning ecosystem services listed can be found in the land-based livelihoods Section 6.4.3.8 and in Appendix A11, Socio-economic and Health Baseline Report.

Provisioning services include:

- food (hunting, gathering and foraging). In some areas, these activities are legal whereas in others they are not.
- trapping of wildlife for the live trade market
- other products (e.g., skins)
- collection of medicinal products.

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.
- eco-tourism, particularly in protected areas
- aspects of these species may provide spiritual, sacred or religious values; inspiration for culture and design; and cognitive development.

Sensitivity Rankings

The sensitivity of the VECs has been ranked and is shown in Table 6.4-10.

Table 6.4-10 Fauna Sensitivity Ranking

Fauna VEC	Sensitivity Ranking	Rationale for Ranking
Wambabya FR		
Legally protected areas	High (4)	Designated as an FR, originally for ecological purposes.
Flora and fauna species of conservation importance	Very high (5)	The Wambabya FR and the corridors of remnant riparian forest linking it to the Bugoma CFR provide important habitat for the IUCN and Uganda endangered chimpanzee.
Fauna habitats of conservation importance	Very high (5)	Natural habitat (as defined by IFC Performance Standard 6) and habitat providing important feeding or breeding ground.
Taala FR		
Legally protected areas	High (4)	Designated as an FR, originally for ecological purposes
Flora and fauna species of conservation importance	High (4)	Supports spot-necked otter, a Uganda endangered species (IUCN near threatened).
Fauna habitats of conservation importance	Low (2)	Comprises modified habitat that has biodiversity value in places.
Kasana–Kasambya FR		
Legally protected areas	Moderate (3)	Designated as an FR and retains some biodiversity value.
Flora and fauna species of conservation importance	Low (2)	Supports several species ranked as IUCN least concern.
Fauna habitats of conservation importance	Low (2)	Comprises modified habitat with some biodiversity value.
Nabakazi River		
Legally protected areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protect the Nabakazi River wetlands as a biodiversity area and as a resource for local communities.
Flora and fauna species of conservation importance	High (4)	Supports spot-necked otter, a Uganda endangered species (IUCN near threatened).
Fauna habitats of conservation importance	High (4)	The river and associated wetlands can be classified as natural habitat ¹ . The Nabakazi River provides connectivity, including riparian corridors and wetlands, which creates ecological linkages between the Albertine Rift Lakes.

Table 6.4-10 Fauna Sensitivity Ranking

Fauna VEC	Sensitivity Ranking	Rationale for Ranking
Katonga River		
Legally protected areas	Very High (5)	The Katonga River and associated wetlands and tributaries are connected with or flow through numerous nationally protected sites. The river also connects with Lake George to the west, which is a Ramsar wetland and freshwater Key Biodiversity Area (fKBA).
Flora and fauna species of conservation importance	High (4)	Supports IUCN near threatened, Uganda endangered spot necked otter. Supports IUCN vulnerable and Uganda vulnerable species: <ul style="list-style-type: none"> • hippopotamus • sitatunga • Temminck's ground pangolin • tree pangolin.
Fauna habitats of conservation importance	High (4)	The Katonga River can be classed as natural habitat ¹ . It provides connectivity, including riparian corridors and wetlands, which creates ecological linkages between the Albertine Rift Lakes.
Disused airstrip borrow pits		
Flora and fauna species of conservation importance	High (4)	Supports Bohor reedbeek, a Uganda endangered species.
Fauna habitats of conservation importance	High (4)	Provides important breeding and feeding habitat for reptile, amphibian and invertebrate species.

Key Considerations

Based on the outcomes of the fauna biodiversity study, and particularly the known or likely presence of species of conservation importance, the following areas are identified as sensitive VECs:

- the Wambabya FR and riparian corridors linking the Wambabya FR with the Bugoma CFR to the south owing to the presence of chimpanzee, which is IUCN endangered and Uganda endangered
- the Taala FR owing to the recorded presence of the spot-necked otter, which is Uganda vulnerable
- the disused airstrip borrow pits at KP288 owing to the recorded presence of Bohor reedbeek, which is Uganda endangered

- papyrus wetlands associated with the Nabakazi and Katonga rivers, owing to the recorded presence of Bohor reed buck and Temminck's ground pangolin, which is IUCN vulnerable and Uganda vulnerable.

Some species identified during the survey (either recorded during field surveys or reported in secondary data) are of conservation importance. These species are important because:

- they are listed as IUCN endangered or vulnerable
- some are endemic to Uganda
- some are included in species action plans or the Uganda Red List, or are listed in the Convention on Migratory Species.

A summary of these species is provided in Table 6.4-11.

Table 6.4-11 Key Fauna Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
Sitatunga	KP165 (Katonga River), KP141 (Nabakazi swamp) and KP106 in the area of a papyrus swamp	IUCN vulnerable, Uganda vulnerable	The main threat to the species is habitat degradation and hunting (East 1999).
Bohor reed buck	KP6, KP165, KP187, KP218–231 and KP289	IUCN least concern, Uganda endangered	This species has been eliminated from large parts of its range due to hunting, and loss of habitat to the expansion of settlement and livestock.
Temminck's ground pangolin	KP165 (Katonga River)	IUCN vulnerable, Uganda vulnerable	The main threat to the species is exploitation for cultural uses, traditional medicine and bushmeat, and increased intercontinental trade to Asia (Pietersen et al. 2014).
Tree pangolin	KP165 (Katonga River)	IUCN vulnerable, Uganda vulnerable	The main threat to the species is exploitation for cultural uses, traditional medicine and bushmeat, and increased intercontinental trade to Asia (Pietersen et al. 2014).
Long-tailed pangolin	Wambabya FR	IUCN vulnerable, Uganda endangered	The main threat to the species is exploitation for cultural uses, traditional medicine and bushmeat, and increased intercontinental trade to Asia (Pietersen et al. 2014).

Table 6.4-11 Key Fauna Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
African golden cat	Wambabya FR	IUCN vulnerable, Uganda endangered	The species main threats are habitat loss and deforestation, informal bushmeat trade reducing its prey base and being a bycatch in informal hunting activities.
African clawless otter	Wambabya FR	IUCN near threatened, Uganda vulnerable	The species main threats are the declining state of freshwater ecosystems and informal hunting for skins and other body parts
Hippopotamus	KP165 (Katonga River)	IUCN vulnerable, Uganda vulnerable	The main threats are habitat loss and degradation, and illegal and unregulated hunting for meat and ivory (Lewison and Pluháček 2017).
Spot-necked otter	KP165 (Katonga River)	IUCN near threatened, Uganda endangered	Alteration and degradation of freshwater habitats and riparian vegetation are a major threat to this species. Other threats include anthropogenic activity leading to disruption of denning activity and alterations to the prey base, water pollution and otters being killed for food and skins.
Leopard	KP165 (Katonga River), KP205	IUCN vulnerable, Uganda vulnerable	Leopards have limited levels of ecological resilience to habitat fragmentation. Other threats include persecution from increasing human populations, illegal wildlife trade (such as the ceremonial use of skins), prey base decline and poorly managed trophy hunting (Stein et al. 2016).
Chimpanzee	Wambabya FR and connecting forests	IUCN endangered, Uganda endangered	Species main threats include poaching (infrequent and mostly opportunistic), conflict killings, habitat loss and degradation and disease.

Table 6.4-11 Key Fauna Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
Sierra Leone mops bat	Kasana–Kasambaya FR	IUCN least concern, Uganda vulnerable	Vulnerable within Uganda due to threat of habitat loss through deforestation and the conversion of land to agricultural use.
Golden-throated rocket frog	KP187	IUCN least concern, Uganda vulnerable	Vulnerable in Uganda owing to habitat loss and only known in 10 or fewer locations.

6.4.2 Physical Environment

6.4.2.1 Geology and Soil

This section describes the:

- soil AOI
- baseline condition of soil and geology along the route:
 - ecosystem services provided
 - soil sensitivity rankings
- key considerations.

For more information, see Appendix A5: Geology and Soil Baseline Report.

Area of Influence

The geology and soil AOI are based on the project footprint and construction and operation of:

- the 30-m pipeline RoW
- AGI locations
- construction camps and facilities
- access roads.

Aggregates are considered in the project description (see Section 2.4.2).

Baseline Condition of the Soil and Geology

Geology

In Uganda, precambrian crystalline rock, including gneiss and granite, underlies approximately 90% of Uganda's land area. The remaining area is mostly underlain by younger volcanic and sedimentary rocks. The regolith over 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).

Seismicity and Earthquakes

The occurrence of earthquakes in Uganda is associated with the East African Rift system but the proposed EACOP route does not traverse the system. However, the pipeline RoW crosses six major faults. Its tectonic setting makes Uganda prone to earthquakes. Since 1929, the country has had seven earthquakes measuring 5 or more on the Richter scale, some of which killed people, destroyed buildings and triggered landslides.

Landslides and Sinkholes

Review of secondary data did not identify any landslides or sinkholes across the AOI and broader region at the time of writing.

Mining and Quarrying

Review of secondary data indicates that there may be existing mining and quarrying operations inside the AOI and broader region, further information is not available at the time of writing.

Artisanal and small-scale mining is described in the Socio-economic and Health Baseline Report (see Section 6.4.3.7).

Soil

Soil types within the AOI and broader region are shown on the soil type map in Figure A5.4-2 of Appendix A5. Table A5.4-1 of Appendix A5 presents the EACOP baseline survey soil classifications. In addition to a field survey, data from Isabirye et al. (2004) and Kaizzi (2017) have also been used to map soil resources within the AOI. The soil type classifications resulting from the 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) provides consistent and comparable soil data and information in the AOI and broader region, whereas the field survey provides point data, relevant to the sampling location only. Soil profile data in Isabirye et al. (2004) and Kaizzi (2017) can sometimes be incomplete, which explains why there may be inconsistencies with the field survey classifications. Where inconsistencies exist at individual sample sites, the field survey data has been given preference.

Soil Structure

Soil texture varies along the length of the AOI (see Table A5.4 -1 in Appendix A5), although soil with a high sand content was found to be present along most of the route and identified at more than 60% of the sample locations. Soil containing high proportions of sands is less vulnerable to dust and silt generation. However, soil with a low sand content was also identified at several of the sample locations. Further, the potential for dust generation is also greatly influenced by the moisture content of the soil, and during the dry season it is likely that many sections of the route will be prone to dust generation.

Sandy soil also tends to have a relatively low bulk density, owing to the larger particle size, and will be less sensitive to compaction. Soil comprised primarily of silt and clay (e.g., at KP0, KP80 and KP260) has a higher bulk density and therefore

will be more sensitive to compaction. Silty clay soil also has poor trafficability when wet.

Top soil depth within the study area was found to range from 15–40 cm, although for most of the route the depth was 20–30 cm (see Table A5.4 -1 in Appendix A5). Thin top soils (<5 cm) were not encountered during the field survey, although it is likely that such soils may be present along the route, particularly in areas of steep slopes or where shallow soils are developed on exposed bedrock.

Soil Productivity and Nutrient Content

Most soil types within the AOI are characterised as low to medium in productivity and support grazing, commercial farms and plantations, and subsistence farming (Kaizzi 2017). Soil with higher productivity was found at KP5, KP45 and KP280.

Arenosols, rhodic ferralsols, skeletal leptosols, petroplinthic plinthosols, rhodic nitisols and gleysols were identified along the pipeline route. Most of the profiles were within the slightly acidic to moderately alkaline range and therefore indicate good agricultural production potential. Most topsoil was of low to medium organic matter content and high base status, indicating that soils could be productive if well managed. Most soil had low to very low extractable soil phosphorus, the one exception being the gleysol at SU013.

Phosphorus, potassium, and magnesium are macronutrients required by plants that are necessary for the basic biological functions such as growth, photosynthesis and respiration (Singh and Schulze 2015). Deficiencies can negatively affect vegetative growth and yield and can result in increased mortality rates. Soil erosion risk is categorised in the erosion risk assessment (Appendix G1) and soil sensitivity is categorised in the sensitivity tables. There are no Ugandan standards for soil quality, so no screening for exceedances was undertaken.

Potential Sodic B Horizons

Attachment A5.1 of Appendix A5 presents the results of the soil laboratory tests for parameters potentially indicative of possible 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 cation exchange capacity). Soils with a high exchangeable sodium content are associated with adverse physical conditions such as slumping or compaction and deflocculation of clay particles, making them more susceptible to erosion. Sodic B horizons were not observed during the field survey.

Soil Contamination

At the time of writing, potential sources of contamination such as industry, commerce or heavily populated areas do not occur within the AOI and there was with no evidence of existing sources of potentially substantial contamination.

Attachment A5.1 of Appendix A5 presents the results of the soil laboratory tests for parameters potentially indicative of contamination.

The results of the laboratory analysis undertaken on the 14 samples collected (SU006–SU019) during the field survey included :

- copper in six samples at a maximum of 0.195 mg/kg.
- manganese in 11 samples at a maximum of 3.082 mg/kg.
- zinc in 14 samples at a minimum of 0.139 mg/kg and a maximum of 1.353 mg/kg.

The results indicate that there is no soil contamination at the locations sampled and that the levels detected are typical of natural soil concentrations in Uganda. No arsenic, cadmium, hexavalent chromium, lead, mercury, molybdenum, nickel, selenium or total petroleum hydrocarbons were detected in the samples, which indicates no industrial related contamination at sampling locations.

Unexploded ordnance dating back to the five-month Liberation War (1978–1979) has been reported on both sides of the Uganda–Tanzania border. Unexploded ordnance risk is considered low because of the short duration of the conflict and high amounts of agricultural activity in the area. The latter activities include soil being dug over and therefore if unexploded ordnance were present, it is likely that they would already have been found.

Trends Affecting Condition and Sensitivity to Change

The soil types within the AOI are of reasonable agricultural quality but are vulnerable to differing pressures. External physical (e.g., vehicle movement) or chemical (e.g., fertiliser use) pressures may reduce soil quality because of nutrient loss, compaction, erosion and or contamination. Throughout the AOI, there has been long-term drought, as well as flooding and heavy rainfall at different times, with some areas experiencing both drought and flooding during the same year (see climate baseline report, Appendix A14). 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 AOI. Animals and machinery can diminish protective plant cover and cause structural damage and erosion of soil. Fertiliser is now required to improve soil fertility in many areas. If used incorrectly, fertiliser can cause diffuse and point-source agricultural pollution to surface and groundwater. In addition, there is increasing evidence of severe soil degradation caused by erosion (from mining and deforestation) in Uganda (Lufafa et al. 2003).

Stakeholders engaged as part of the baseline surveys have commented that much of their land is less fertile and productive than it has been in the past. Continued use of the land within the study area for agriculture and grazing is likely to result in continuing deterioration in soil quality.

Ecosystem Services Provided

The soil in the AOI, and their associated micro-organisms, provide a range of ecosystem services as set out below.

Provisioning services include:

- quarrying operations for rock and construction aggregate materials

Regulating services include:

- soil quality regulation, nutrient cycling, carbon storage, and water storage and flow control.

Sensitivity Rankings

Fertility

Table 6.4-12 summarises the sensitivity ranking for soil fertility which is 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). 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 6.4-12 Soil Fertility Sensitivity Ranking

Fertility	Sensitivity Ranking	Rationale for Ranking
13 locations	Very low (1)	No ecosystem or agricultural value
39 locations	Low (2)	Soil with low agricultural productivity
29 locations	Moderate (3)	Soil with moderate agricultural value. May take up to 3 years to fully recover
7 locations	High (4)	Soil with high agricultural productivity. May take 3-6 years to fully recover
None recorded but may occur locally	Very high (5)	Soil with very high agricultural productivity or ecosystem value

NOTE: KP ranges can be found in Appendix A5

Compaction

Table 6.4-13 summarises the sensitivity ranking for soil compaction which is 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 6.4-13 Soil Compaction Sensitivity Ranking

Compaction	Sensitivity Ranking	Rationale for Ranking
1 locations	Very low (1)	Not susceptible to erosion or compaction.
18 locations	Low (2)	Soil will respond well to restoration techniques to mitigate compaction.
19 locations	Moderate (3)	Soil will usually respond moderately well to restoration techniques to mitigate compaction. May take up to 3 years to fully recover.

Table 6.4-13 Soil Compaction Sensitivity Ranking

Compaction	Sensitivity Ranking	Rationale for Ranking
None recorded but may occur locally	High (4)	Soil that may need more intensive restoration techniques to mitigate compaction. May take 3–6 years to fully recover.
None recorded but may occur locally	Very high (5)	Soil that may be difficult to restore to its former condition

NOTE: KP ranges can be found in Appendix A5

Erosion

Table 6.4-14 summarises KP ranges for soils with sensitivity rankings of very high risk for erosion. The erosion risk assessment focuses on areas of very high sensitivity rankings only. The erosion sensitivity scores are in the erosion risk assessment (Appendix G1) where the list of KP locations are presented in full.

Table 6.4-14 Soil Erosion Sensitivity Ranking

KP Ranges ¹	Sensitivity Ranking	Rationale for Ranking
43 locations	Very high (5)	Soil at very high risk of erosion, according to soil type and slope.

NOTE: ¹KP ranges can be found in Appendix A5

Soil Contamination

Throughout the length of the AOI, the agricultural and ecosystem value of the soil varies. However, contamination was not identified at any of the locations in the AOI, and due to the predominantly rural nature of the AOI, contamination is unlikely to exist. Therefore, soil is considered to have a moderate sensitivity to contamination.

Unexploded ordnance may exist in certain areas near the Uganda–Tanzania border region, although the risk of unexploded ordnance being encountered is considered low.

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 (e.g., erosion and soil quality regulation) and provisioning ecosystems services (e.g., provision of aggregate).

6.4.2.2 Surface Water

This section describes the surface water:

- AOI and study area boundaries
- baseline conditions:
 - trend in condition and sensitivity to change
 - ecosystem services provided
 - sensitivity rankings
- key considerations.

Surface water may occur as permanent or ephemeral watercourses (channels and floodplains), wetlands and waterbodies. The term 'ephemeral' is used to include those watercourses with seasonal flow and those with flow just following rainfall.

For more information, see the surface water baseline report (Appendix A6).

Area of Influence

The AOI for the construction phase includes:

- the project footprint at the location where the pipeline or access road crosses a watercourse or waterbody
- surface waterbodies downstream of AGIs and construction facilities.

The spatial AOI for construction varies from 2–5 km downstream of the pipeline crossing point, access road crossing point, AGI or construction facility, 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 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.

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 water courses and waterbodies and the temporal AOI for operation is the life of the project, approximately 25 years.

The study area is larger than the AOI as it comprises the upstream catchment areas of the watercourses crossed by the pipeline, access roads or discharge points and downstream to key VECs. 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 pipeline route crosses many minor tributaries. These are characterised by indistinct channels when viewed on satellite imagery and small catchment areas. The route crosses 10 major watercourses, a tributary of the Wambabya River, the Kafu River, two tributaries of the Kafu River, two tributaries of the Nabakazi River, the Nabakazi River, the Katonga River, the Kibale River and the Jemakunya River. These major rivers are the focus of this report (Figure 6.4-7). The rivers ultimately drain into Lake Albert (via the Victoria

Nile in the case of the Kafu River) or Lake Victoria. However, these waterbodies are outside the AOI.

Water accessibility and scarcity for communities was assessed within a 2km corridor along the pipeline, along project roads and near construction facilities and AGIs.

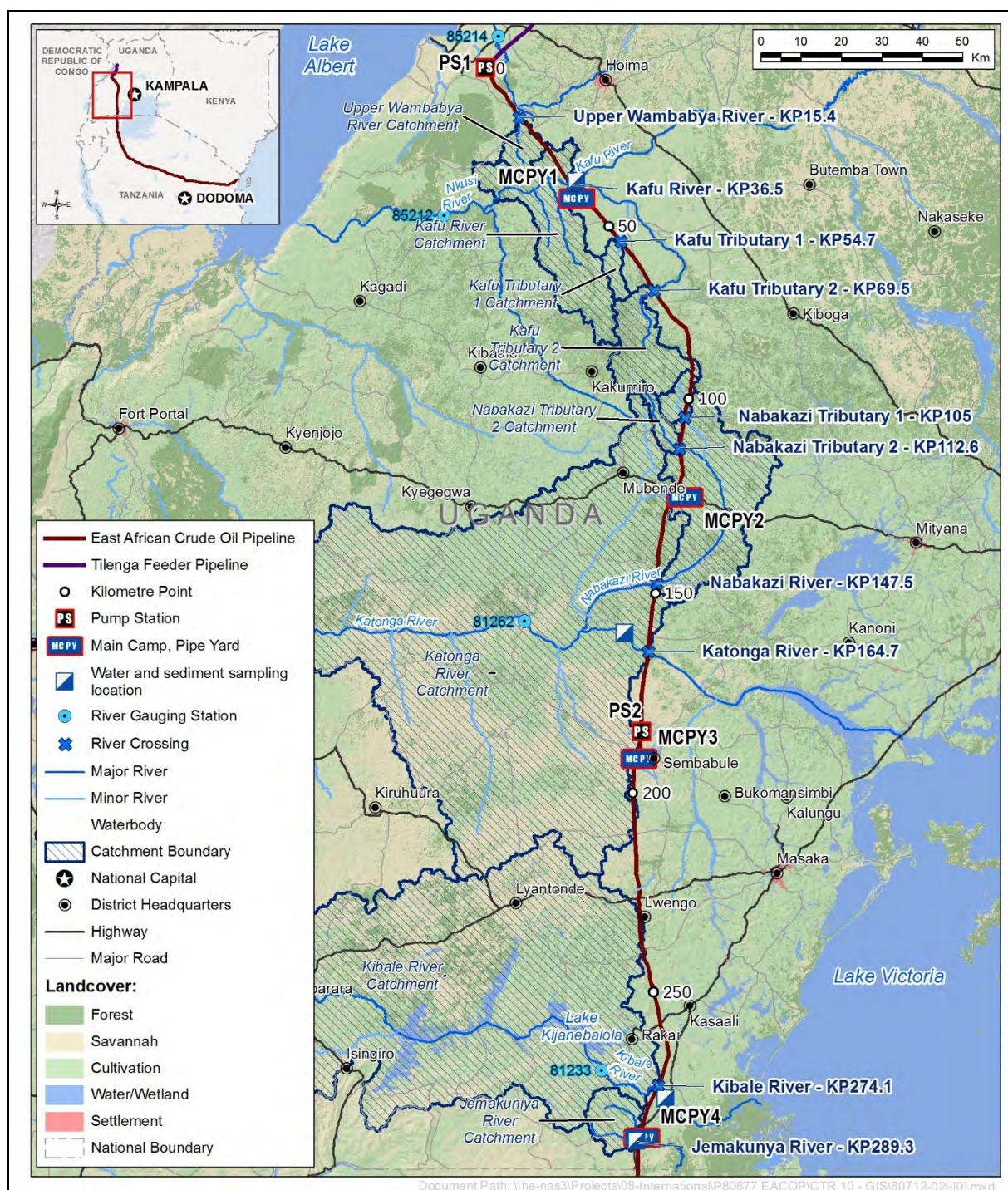


Figure 6.4-7 Main Watercourse Crossings and Catchments

Baseline Condition of Surface Water

Flow and Flood Regimes

Pipeline Crossings

There are ten pipeline crossings of major watercourses as listed in Table 6.4-17. There are no other surface waterbodies within the AOI other than those listed in this table.

A bimodal flow distribution is evident in most rivers, with higher flows in April–May and October–November reflecting rainfall maxima in these periods and dry seasons from December to March and from June to July (Table 6.4-17 and Figure 6.4-8). Flow from Lake Kijanebalola gives the Kibale River a different regime with a single peak flow in May.

The flood study (see Appendix A6) suggests that the bankfull capacity of the Kibale and Jemakunya Rivers is exceeded and these rivers flow across their floodplains during relatively minor but frequent flood events. The frequency of floodplain flow could not be determined for those watercourses dominated by swamp vegetation. Their channels may be silted up and floodplain flow may occur under non-flood conditions.

The Wambabya River is used for hydroelectricity generation at the Kabalega hydroelectric power station in Hoima district about 25 km downstream of the pipeline crossing.

Road Crossings, Construction Facilities and Aboveground Installations

Table 6.4-15 presents a list of road crossings and nearby watercourses. Table 6.4-16 presents a list of construction facilities and AGIs and nearby watercourses. Maps of project roads are presented in Appendix A6.

All the watercourses crossed by project roads and near project facilities are ephemeral and most lack defined channels. Flow and floods at the road crossings may be characterised as surface runoff occurring for short periods, perhaps only for minutes, during and after storm rainfall.

Table 6.4-15 Road Crossings - Stability of Road Drainage Valued Environmental Components

KP	Road ID	Location (Road KP) ¹	Channel Present?	Nature of Road Drainage VEC	Likely Nature of Soil	Evidence of Existing Erosion	Stable or Unstable VEC
0	PAR-PS-1	2.5	Yes	Minor stream channel; cultivated fields on floor of valley with ephemeral flow	Loam soil	None	Stable
		4.8	Yes	Minor stream channel; riparian vegetation on floor of valley with ephemeral flow	Silty-clay soil	None	Stable
125	TAR-MCPY-2	0.42	No	Dry valley with scrub and rainfed cultivation delivers runoff into existing road drain alongside Kampala–Kiwumulo tarmac road	Sandy soil	Sheet erosion of soil	Potentially unstable
		0	Yes	Existing road drain alongside Kampala–Kiwumulo tarmac road	Sandy soil	None	Stable
126	ERU-MCPY-2	1.0	No	Scrub	Sandy soil	Sheet erosion of soil	Potentially unstable
185	ERU-PS-2	0.5	No	Grassland	Silty-clay soil	Sheet erosion of soil	Stable

NOTES: ¹Distance from start of road. The start of road is assumed as the junction with a national or district road. ERU – existing road upgrade. PAR – permanent access road. TAR – temporary access road.

Table 6.4-16 Project Facilities – Stability of Watercourses Nearby Installations

KP	Project Facility	Watercourse type ¹	Distance to Watercourse / VEC from Facility (m)	Land Cover	Likely Nature of Soil	Evidence of Existing Erosion	Stable or Unstable VEC
0	PS1	Ephemeral watercourse	650 (east)	Cultivated land	Loam	None	Stable
		Ephemeral watercourse	200 (south)	Cultivated land	Loam	None	Stable
		Ephemeral watercourse	300 (north west)	Cultivated land	Loam	None	Stable
40	MCPY1	Floodplain, ephemeral flow	70 (east)	Wooded grassland	Silty-clay	Sheet erosion of soil	Stable
125	MCPY2	Ephemeral watercourse	Within site	Cultivated land & wooded scrub	Sandy	Sheet erosion of soil	Potentially unstable
185	PS2	Ephemeral watercourse	70 (south west)	Scrub	Sandy	Sheet erosion of soil	Potentially unstable
191	MPCY3	Ephemeral watercourse	300 (north east)	Scrub	Sandy, silty	Sheet erosion of soil	Potentially unstable
		Ephemeral watercourse	500 (south west)	Scrub	Sandy, silty	Sheet erosion of soil	Potentially unstable
283	MPCY4	Ephemeral floodplain	400 (south east)	Wooded grassland	Silty-clay	None	Stable

NOTES: ¹There are no defined watercourses near some facilities, in such cases the appropriate receptor has been stated

Table 6.4-17 Estimated Median Monthly Flows at Main Watercourse Crossings, m³/s

KP	River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
15.4	Wambabya tributary	0.23	0.15	0.19	0.42	0.6	0.31	0.35	0.46	0.59	0.78	0.85	0.4	0.41
36	Kafu	0.35	0.23	0.18	0.88	1.52	1.12	0.73	0.66	2.17	3.81	3.38	1.48	1.00
54	Kafu tributary 1	0.03	0.02	0.02	0.08	0.13	0.10	0.07	0.06	0.19	0.33	0.29	0.13	0.09
69	Kafu tributary 2	0.16	0.11	0.08	0.39	0.67	0.50	0.33	0.29	0.96	1.69	1.50	0.66	0.44
105	Nabakazi tributary 1	0.04	0.02	0.02	0.10	0.16	0.12	0.08	0.07	0.23	0.39	0.35	0.15	0.11
112	Nabakazi tributary 2	0.04	0.02	0.02	0.09	0.16	0.12	0.08	0.07	0.22	0.38	0.34	0.15	0.10
147	Nabakazi	0.50	0.33	0.26	1.27	2.18	1.61	1.05	0.94	3.13	5.49	4.88	2.14	1.44
164	Katonga	1.83	0.74	0.56	1.35	2.91	2.32	1.87	1.77	3.49	5.86	5.48	3.01	2.09
274	Kibale	1.4	1.81	1.735	2.02	2.64	2.24	1.58	1.275	1.225	0.895	0.98	1.27	1.49
289	Jemakunya	0.04	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.01

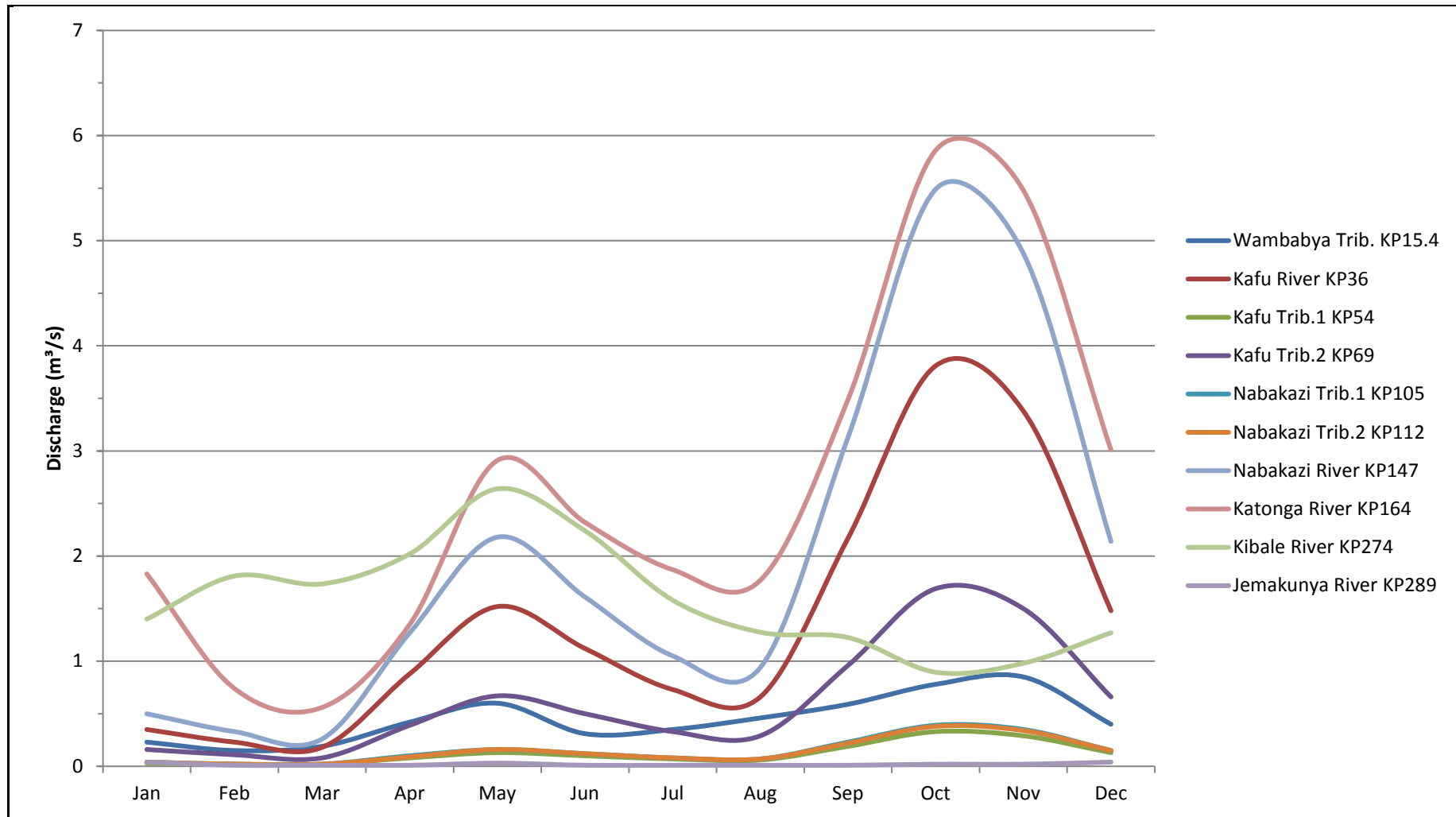


Figure 6.4-8 Streamflow Regime at Watercourse Crossings

River Channel Morphology and Stability***Pipeline Crossings***

Table 6.4-18 presents estimates of stream power (a measure of the energy available to cause erosion and sediment transport) and an assessment of stream channel stability based on stream power, channel planform, bed and bank materials and riparian vegetation.

With the exception of the Jemakunya River, most channels are assessed as being stable. The Jemakunya River channel is formed in alluvial and lacustrine sediments. Its meandering planform and limited riparian vegetation relative to the other floodplains, which are dominated by swamp vegetation, suggest that the Jemakunya River channel may be unstable.

Road Crossings, Construction Facilities and AGIs

Table 6.4-15 and Table 6.4-16 present estimates of watercourse stability at road crossings and project facilities respectively. Most VECs are valley floors with poorly defined channels and ephemeral flow. The VECs along the temporary access road at MCPY2 and the existing road to be upgraded from MCPY2 to the RoW are assessed as being potentially prone to erosion.

The potential waterbodies and or watercourses which will receive site drainage at MCPY2, PS2 and MCPY3 are assessed as being potentially prone to enhanced erosion because of the drainage (see Table 6.4-16).

Table 6.4-18 Main Pipeline Crossings - River Channel Morphology and Stability

Watercourse	KP	Stream Power (W/m) ¹	Estimated Floodplain Width (m)	Channel Bankfull Width (m)	Channel Planform ²	Channel Bed Materials	Channel Bank Materials	Riparian Vegetation	Stable or Unstable Channel
Upper Wambabya	15.4	521	180	ND	Sinuuous (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Kafu	36.5	85	500	ND	Sinuuous (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Kafu tributary 1	54.7	7	100	ND	Straight (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Kafu tributary tributary2	69.5	276	100	ND	Straight (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Nabakazi tributary tributary1	105	125	250	ND	Straight (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Nabakazi tributary tributary2	112.6	45	100	ND	Straight (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Nabakazi	147.5	32	300	ND	Sinuuous (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Katonga	164.7	56	200	ND	Straight (floodplain)	Sand, silt	Sand, silt	Swamp vegetation	Stable
Kibale	274.1	187	30	15	Sinuuous (floodplain)	Silt, clay	Silt, clay	Riparian vegetation	Stable
Jemakunya	289.3	64	400	4	Meandering	Silt, clay	Silt, clay	Riparian vegetation	Potentially unstable

NOTES: ¹Stream power is calculated at the mean annual flood (see Appendix A6, Attachment A6.4). ND – no data

Water Quality, Sediment Quality and Sensitivity to Contamination

Water Quality

Water quality was assessed in relation to the national potable water specification (UNBS 2014). The national potable water specification is incorporated into the EACOP project standards. Onsite and laboratory analytical results showed good water quality in the rivers at the times of sampling with low levels of anthropogenic contamination. Exceedances of national potable water quality standards were observed for:

- iron: one exceedance of the limit for natural and treated waters
- total coliforms and E. coli: exceedances in all samples.

For hydrocarbons, a single sample from the Katonga River downstream of a bridge where vehicles collect water showed the presence of polycyclic aromatic hydrocarbons (PAH). All other analyses of hydrocarbons in the Katonga and other rivers were below detection limits at the times of sampling.

Overall, the water quality results are consistent with rivers in catchments with dispersed rural settlement, frequent use by livestock and people and for domestic purposes, and in which there are high rates of biological activity.

Sediment Quality

The concentrations of hydrocarbons and PAHs were below the detection limit at all the sites sampled. However, some metals were above the detection limit in several samples taken downstream of road bridges, which suggests that road runoff affects sediment quality at these locations.

Sensitivity of Watercourses to Potential Contamination

The sensitivity to potential contamination depends on the degree of existing contamination and was ranked according to the table for water quality sensitivity in Appendix D. Attachment A6.17 of Appendix A6 presents the assessment of the sensitivity of watercourses to potential contamination at pipeline crossings.

Attachment A6.18 of Appendix A6 presents the assessment of the sensitivity of watercourses to potential contamination at road crossings. Attachment A6.19 of Appendix A6 presents the assessment of the sensitivity of watercourses near project construction facilities to potential contamination.

Pipeline Crossings

Attachment A6.17 of Appendix A6 presents the assessment of the sensitivity of watercourses to potential contamination at pipeline crossings. The sensitivity to potential contamination depends on the degree of existing contamination and was ranked according to Table D9 for water quality sensitivity in Appendix D of the ESIA.

Except for the Kibale and Katonga Rivers, all the watercourses are assessed as having a moderate sensitivity to contamination. Their catchment areas support relatively dense, dispersed rural populations engaged in rain-fed, mostly subsistence agriculture with some livestock rearing. The natural vegetation has

been removed and riparian vegetation remains along drainage lines. The main watercourses are wetlands and support swamp vegetation. These rivers are contaminated by livestock and people using them for domestic purposes.

The Katonga and Kibale Rivers are considered to have a high sensitivity to contamination because their catchments have lower rural population densities and the water quality has fewer anthropogenic influences.

Road Crossings, Construction Facilities and AGIs

Attachments A6.18 and A6.19 of Appendix A6 present the assessment of the sensitivity of watercourses to potential contamination at road crossings and project facilities respectively.

All the watercourses crossed by project roads and near project facilities are ephemeral and most lack defined stream channels. Most watercourses are assessed as having a high sensitivity to contamination because their catchment areas are rural and sparsely populated. Water quality at times of flow is likely to be very good.

Some VECs at project facilities are land rather than a watercourse. For land VECs, the assessment is of the sensitivity to potential contamination of ephemeral surface runoff rather than ephemeral flow in a watercourse. The majority of VECs are assessed as having a high sensitivity to contamination. This is because their catchments are rural and sparsely populated. Water quality at times of flow is likely to be very good.

Water Accessibility and Scarcity for Community Use

An assessment of relative water scarcity for communities along the pipeline route, along project roads and near the construction facilities and AGIs is included in the surface water baseline study (see Appendix A6). The assessment of relative water accessibility and scarcity includes groundwater as a source of water supply (please refer to the “Water Scarcity and Accessibility for Community Use” section in Appendix A6 which explains the methodology). A summary is shown in Table A7.4-3 of Appendix A7.

Project Districts

The percentage of the population in districts and subcounties without access to safe water supplies and the percentage of non-functioning water sources have been estimated from the Uganda Water Supply Atlas 2017 (UMWE 2017c). Official statistics on lack of access to safe water supplies and non-functioning sources (i.e., pumps not working) suggest lower non-access rates but higher non-functionality at the northern and southern ends of the pipeline and higher but variable nonaccess rates and lower non-functionality along the central portion of the pipeline, an area dominated by pastoralism which traverses an area known as the cattle corridor (Figure 6.4-9). In all districts and sub-counties, non-functionality of borehole pumps and or handpumps is predominately due to technical breakdown (i.e., non-functioning) (20–60%) and, to a lesser extent, low yield (15–20%). Water quality is a cause of non-functionality in the Hoima, Kyankwanzi and Lwengo Districts.

Some district towns also have access to piped water from surface sources like rivers and swamps. Some parts of Gomba, Lwengo and Sembabule districts in the cattle corridor have limited access to surface water sources with community water points located relatively far from community habitations. Ranches and farms in these districts depend on privately constructed rainwater harvesting dams for their cattle.

Entrepreneurs collect water from rivers using vehicles and pumps to sell to people in urban areas. The water is generally of reasonable quality apart from coliform counts, restricting its potential uses without some form of treatment.

The Wambabya River is used for hydroelectricity generation at the Kabalega hydroelectric power station in Hoima District about 25 km downstream of the pipeline crossing.

Pipeline

Attachment A6.20 of Appendix A6 presents the assessment of water scarcity for communities along the pipeline. Within the 2-km corridor water scarcity study area along the pipeline, water scarcity was assessed as moderate at the northern end of the pipeline, high through the cattle corridor and moderate towards the southern end of the pipeline, mainly owing to the types and numbers of water supply infrastructure and their functionality. However, there is substantial variation within each zone, depending on local circumstances. Through the cattle corridor, from approximately KP80–250, water scarcity was assessed as high. In this zone, there are fewer boreholes. Groundwater is available in shallow wells, which are often unprotected and, therefore, at risk from microbiological contamination. People obtain water from valley dams and floodplains that they share with livestock. These sources are often contaminated and ephemeral, drying up during the dry season and droughts. However, water scarcity can be low locally, depending on the number and nature of water sources.

Road Crossings, Construction Facilities and AGIs

Attachments A6.21 and A6.22 in Appendix A6 present the assessment of water accessibility and scarcity for communities along the pipeline at road crossings and project facilities respectively.

Water accessibility and scarcity along project roads is variable and dependent on water supply infrastructure in villages and in rural areas along the roads. Near the temporary access road at MCPY1, water scarcity is assessed to vary from high to low depending on the water sources available for the villages of Kisenyi (high), Kasambya (moderate) and the boreholes at Our Lady of Fatima and Nyamigamba (low). Water scarcity along roads at MCPY2 (KP125) is moderate to low. Water scarcity along roads at PS2 and MCPY3 is high. There are few boreholes at these locations and people share valley dams with cattle.

Water accessibility and scarcity at facilities is similarly variable to that along project roads, as the roads are associated with facilities. At PS1 (KP0) and at MCPY1 (KP40), water scarcity varies locally from high to low. At MCPY2 (KP125), PS2 (KP185) and MCPY3 (KP191), water accessibility and scarcity is moderate to high due to the absence of functioning boreholes. At the southern end of the pipeline, at

MCPY4 (KP283) water scarcity is moderate to low, mainly owing to the greater functionality of boreholes.

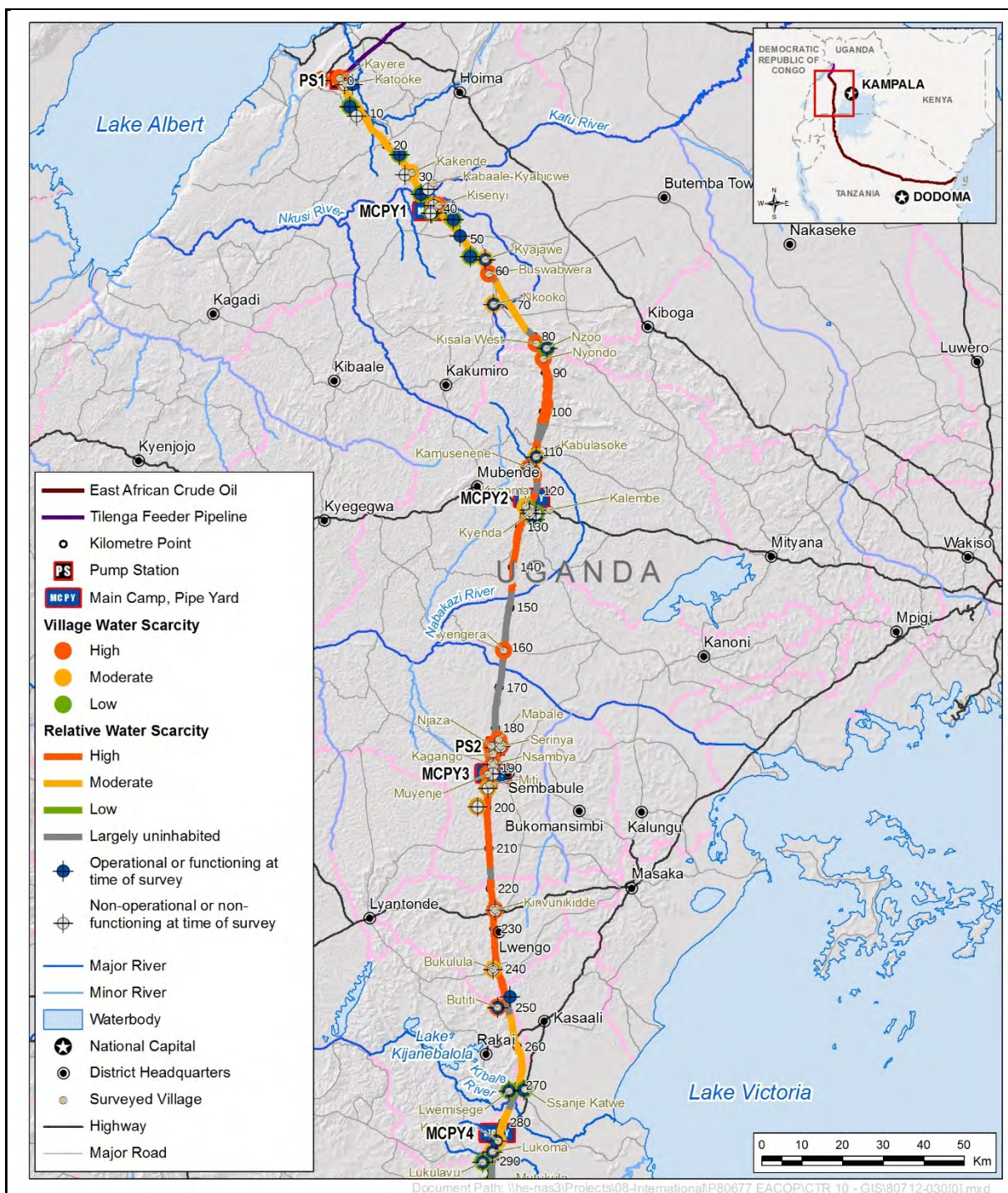


Figure 6.4-9 Water Accessibility and Scarcity Along the Pipeline

Trend in Condition and Sensitivity to Change

Flow and Flood Regimes

Several environmental changes have taken place in Uganda. Land cover has undergone rapid change because of increasing population pressures. Human

activities such as timber cutting, clearing of land for agriculture, settlement and overgrazing have affected the natural vegetation cover, which has resulted in deforestation, encroachment on wetlands (Government of Uganda 2016) and land degradation (MEMD 2013). Soil productivity has declined, and soil erosion is a major cause of river siltation (NEMA 2009). 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 and used mainly for livestock watering and domestic purposes. Water collection from the rivers is 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. This is likely to lead to reduced flows downstream. Sensitivity to change therefore depends on current levels of use and likely future development.

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. Where there is wetland encroachment and conversion to farmland, increased flooding and flood risk may be expected. At the time of writing, it is unclear whether this is occurring in the rivers traversed by the AOI.

River Channel Morphology and Stability

Floods deliver water and sediment from the land to river channels. The rate of wetland siltation and floodplain swamp formation is likely to increase as soil erosion intensifies. 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.

Water and Sediment Quality and Sensitivity to Contamination

Water and sediment quality are coming under increasing pressure from growing populations and human activities. Increased pesticide and fertiliser use, and urbanisation in the agricultural catchments traversed by the AOI threatens water supplies and ecosystems in the long term. As water quality deteriorates, sensitivity to potential contamination is likely to reduce.

Ecosystem Services Provided

The watercourses and water bodies in the AOI described herein provide the following ecosystem services.

Provisioning services include:

- 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.

- hydroelectricity generation at the Kabalega hydroelectric power station on the Wambabya River in Hoima District about 25 km downstream of the pipeline crossing.
- sources of water and food for visiting wild animals and birds.

Regulating services include:

- floodplains regulating floods by slowing water velocities; storing water on their surfaces, and transmitting water relatively slowly downstream and reducing peak flows
- wetlands along watercourses regulating 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 include:

- waterbodies providing habitat and support for aquatic and terrestrial species.

Sensitivity Rankings

Flow Regime

Pipeline Crossings

Based on the trend in condition and the sensitivity to change, the sensitivity ranking of the main watercourses (VECs) at pipeline crossings with respect to their flow regimes and uses is shown in Table 6.4-19. Sensitivity has been ranked according to the table for surface water sensitivity in Appendix D.

Table 6.4-19 Surface Water Flow Sensitivity Rankings – Pipeline Crossings

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking ¹
Upper Wambabya River	15.4	Moderate (3)	Provides water directly for rural communities and hydropower generation downstream. Water demand will rise.
Kafu River	36.5	Low (2)	Provides water directly for rural communities. Water demand will rise.
Kafu tributary 1	54.7		
Kafu tributary 2	69.5		
Nabakazi tributary 1	105		
Nabakazi tributary 2	112.6		
Nabakazi River	147.5		
Katonga River	164.7		
Kibale River	274.1		
Jemakunya River	289.3		

NOTE: ¹Rationale 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

Road Crossings

Table 6.4-20 shows the sensitivity ranking of the watercourses traversed by project roads with respect to their flow regimes.

Table 6.4-20 Surface Water Flow Sensitivity Rankings – Road Crossings

KP	Road ID	VEC Location (Road KP) ¹	Sensitivity Ranking	Rationale for Ranking
0	PAR-PS-1	2.5	Low (2)	Waterbody provides water for rural communities and livestock.
		4.8		
125	TAR-MCPY-2	0.42	Very low (1)	Waterbody does not provide a source of water supply for rural communities and livestock.
		0		
126	ERU-MCPY-2	1.0		
185	ERU-PS-2	0.5	Low (2)	Waterbody provides water for rural communities and livestock.

NOTES: ¹Distance from start of road. The start of road is assumed as the junction with a national or district road.
ERU – existing road upgrade. PAR – permanent access road. TAR – temporary access road.

Construction Facilities and Aboveground Installations

Table 6.4-21 presents the sensitivity ranking of the flow regime to changes in watercourses near project facilities.

Table 6.4-21 Surface Water Flow Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse or VEC	Sensitivity Ranking	Rationale for Ranking
0	PS1	Ephemeral watercourse (650 m east)	Low (2)	Watercourses provides water for rural communities and livestock.
		Ephemeral watercourse (200 m south)		
		Ephemeral watercourse (300 m north west)		
40	MCPY1	Ephemeral watercourse (70 m east)		
125	MCPY2	Ephemeral watercourse within site	Very low (1)	Watercourse does not provide water for rural communities and livestock.
185	PS2	Ephemeral watercourse (70 m south west)	Low (2)	Watercourse provides a source of water supply for rural communities and livestock at livestock watering points 70 m and 400 m from PS2.

Table 6.4-21 Surface Water Flow Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse or VEC	Sensitivity Ranking	Rationale for Ranking
191.5	MPCY3	Ephemeral watercourse (300 m north east)	Low (2)	Livestock watering point 800 m from MPCY3 provides water for rural communities and livestock.
		Ephemeral watercourse (500 m south west)	Very low (1)	Does not provide water for rural communities and livestock.
288	MPCY4	Ephemeral floodplain (400 m south east)	Low (2)	Floodplain provides seasonal source of water for rural communities and livestock.

River Channel Morphology and Stability

Pipeline Crossings

Based on the trend in condition and the sensitivity to change, the sensitivity ranking of the morphology and the stability of the main watercourses at pipeline crossings is shown in Table 6.4-22. Sensitivity has been ranked according to the table for surface water sensitivity in Appendix D.

Table 6.4-22 River Channel Morphology and Stability Sensitivity Rankings – Pipeline Crossings

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking
Upper Wambabya River	15.4	Low (2)	Channel formed in uncohesive materials (sand, silt) with thick continuous floodplain swamp vegetation.
Kafu River	36.5		
Kafu tributary1	54.7		
Kafu tributary 2	69.5		
Nabakazi tributary 1	105.0		
Nabakazi tributary 2	112.6		
Nabakazi River	147.5		
Katonga River	164.7		
Kibale River	274.1	Low (2)	Channel formed in cohesive materials (silt, clay) with thick continuous riparian vegetation.
Jemakunya River	289.3	Moderate (3)	Channel formed in cohesive materials (silt, clay) with a narrow zone of continuous riparian vegetation.

Road Crossings

Table 6.4-23 presents the sensitivity ranking of watercourses crossed by project roads for morphology and stability.

Table 6.4-23 River Channel Morphology and Stability Sensitivity Rankings – Road Crossings

KP	Road ID	VEC Location (Road KP) ¹	Sensitivity Ranking	Rationale for Ranking
0	PAR-PS-1	2.5	Low (2)	Minor channel formed in cohesive materials. Cultivated fields in a valley floor with ephemeral streamflow.
		4.8		
125	TAR-MCPY-2	0.42	Moderate (3)	Ephemeral valley floor with uncohesive soil materials but a cover of scrub vegetation and rainfed cultivation.
		0	Low (2)	Existing road drain alongside Kampala–Kiwumulo tarmac road.
126	ERU-MCPY-2	1.0	High (4)	Ephemeral valley floor with uncohesive soil materials with a cover of scrub vegetation.
185	ERU-PS-2	0.5	High (4)	Valley floor with uncohesive soil materials with a cover of scrub vegetation. Ephemeral flow.

NOTES: ¹ Distance from start of road. The start of road is assumed as the junction with a national or district road.
ERU – existing road upgrade. PAR – permanent access road. TAR – temporary access road.

Construction Facilities and Aboveground Installations

Table 6.4-24 presents the sensitivity ranking of watercourses (VECs) near project facilities for morphology and stability.

Table 6.4-24 River Channel Morphology and Stability Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse or VEC	Sensitivity Ranking	Rationale for Ranking
0	PS1	Ephemeral watercourse (650 m east)	Low (2)	Watercourse in loam soil, with scrub-vegetation cover and rain fed cultivation.
		Ephemeral watercourse (200 m south)		
		Ephemeral watercourse (300 m northwest)		
40	MCPY1	Ephemeral floodplain (70 m east)		Floodplain in cohesive materials with cover of wooded-grassland.
125	MCPY2	Ephemeral watercourse (within site)	Moderate (3)	Watercourse in uncohesive materials and wooded scrub-vegetation cover.

Table 6.4-24 River Channel Morphology and Stability Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse or VEC	Sensitivity Ranking	Rationale for Ranking
185	PS2	Ephemeral watercourse (70 m southwest)	High (4)	Watercourse in uncohesive materials with cover of scrub-vegetation.
191.5	MPCY3	Ephemeral watercourse (300 m northeast)		Watercourse in uncohesive materials with cover of scrub-vegetation.
		Ephemeral watercourse (500 m southwest)		
288	MPCY4	Ephemeral floodplain (400 m southeast)	Low (2)	Floodplain with cohesive materials, with cover of wooded grassland.

Water and Sediment Quality and Sensitivity to Contamination

Pipeline Crossings

Based on the trend in condition and the sensitivity to change, the sensitivity ranking of the 10 watercourses (VECs) at pipeline crossings with respect to potential contamination is shown in Table 6.4-25. Sensitivity has been ranked according to the table for surface water sensitivity in Appendix D.

Table 6.4-25 Water and Sediment Quality and Sensitivity to Contamination Sensitivity Rankings – Pipeline Crossings

KP	Watercourse/VEC	Sensitivity Ranking	Rationale for Ranking
15.4	Upper Wambabya River	Moderate (3)	Rural catchment, densely settled with rain-fed cultivation, some plantation agriculture with swamp vegetation along floodplain.
36.5	Kafu River	Moderate (3)	Rural catchment, densely settled with rain-fed cultivation with swamp vegetation along floodplain.
54.7	Kafu tributary 1		
69.5	Kafu tributary 2		
105	Nabakazi tributary 1		
112.6	Nabakazi tributary 2		
147.5	Nabakazi River		
164.7	Katonga River	High (4)	Rural catchment, sparsely settled with rain-fed cultivation with swamp vegetation along floodplains. Only minor contamination from vehicles collecting water.

Table 6.4-25 Water and Sediment Quality and Sensitivity to Contamination Sensitivity Rankings – Pipeline Crossings

KP	Watercourse/VEC	Sensitivity Ranking	Rationale for Ranking
274.1	Kibale River	High (4)	Rural catchment, sparsely settled with lakes and swamp vegetation along floodplains.
289.3	Jemakunya River	Moderate (3)	Rural catchment, densely settled river valleys.

Road Crossings

Table 6.4-26 summarises the results of the assessment of the sensitivity of watercourses (VECs) traversed by project roads to potential contamination.

Table 6.4-26 Sensitivity to Contamination Sensitivity Rankings – Road Crossings

KP	Road ID	VEC Location (Road KP) ¹	Sensitivity Ranking	Rationale for Ranking
0	PAR-PS-1	2.5	High (4)	Rural catchment, sparsely settled with subsistence cultivation and livestock rearing. Water quality likely to be very good during periods of flow.
		4.8		
125	TAR-MCPY-2	0.42	Low (2)	Runoff with good quality from natural catchment will mix with road drainage water of poor quality.
		0	Very low (1)	Water quality in existing road drain may be poor.
126	ERU-MCPY-2	1.0	High (4)	Rural catchment, sparsely settled with subsistence cultivation and livestock rearing. Water quality likely to be very good during periods of flow.
185	ERU-PS-2	0.5	High (4)	Rural catchment, sparsely settled with livestock rearing. Water quality likely to be very good during periods of flow.

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. PAR – permanent access road. TAR – temporary access road. Project roads at MCPY3 and MCPY4 do not cross watercourses.

Construction Facilities and Aboveground Installations

Table 6.4-27 presents the sensitivity of watercourses (VECs) near project facilities to potential contamination.

Table 6.4-27 Sensitivity to Contamination Sensitivity Rankings – Project Facilities

KP	Project Facility	Watercourse/ VEC	Sensitivity Ranking	Rationale for Ranking
0	PS1	Ephemeral watercourse (650 m east)	Moderate (3)	Rural catchment, densely settled with subsistence cultivation and livestock rearing. Water quality likely to be reasonably good during periods of flow.
		Ephemeral watercourse (200 m south)		
		Ephemeral watercourse (300 m northwest)		
40	MCPY1	Ephemeral floodplain (70 m east)	High (4)	Rural catchment, sparsely settled with subsistence cultivation and livestock rearing. Water quality likely to be very good during periods of flow.
125	MCPY2	Ephemeral watercourse within site		
185	PS2	Ephemeral watercourse (70 m southwest)		
191	MPCY3	Ephemeral watercourse (300 m northeast)		
		Ephemeral watercourse (500 m southwest)		
283	MPCY4	Ephemeral floodplain (400 m southeast)		

Key Considerations

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.

Flow in Watercourses

Flow in watercourses traversed by the AOI is considered to have a low or very 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 demand, based on the available information, are relatively low. The exception is the Wambabya River, which is used for hydroelectricity generation at the Kabalega hydroelectric power station in Hoima district about 25 km downstream of the pipeline crossing. The Wambabya River is considered to have a moderate sensitivity to change in flow.

The sensitivity to change in flow is also low or very low at road crossings and near project facilities since the watercourses either provide water to a rural population and livestock by means of a livestock watering point or seasonal floodplain or are assessed as not providing water.

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 swamp vegetation that limits flow velocities, inhibits erosion and makes the watercourses very stable. The exception is the Jemakunya River, which is considered to have a moderate sensitivity to change. The Jemakunya River has a relatively narrow zone of riparian vegetation along its channel, which increases the risk of instability.

Of the watercourses traversed by project roads in the AOI, two are considered to have a high sensitivity to change:

- the watercourse at road KP1.0 on the existing road to be upgraded from MCPY2 (KP126) to the pipeline RoW
- the watercourse at road KP0.5 on the access road to PS2 (KP185).

These watercourses are valley floors with uncohesive materials and scrub vegetation; defined channels are absent.

Of the watercourses near project facilities, four are considered to have a high sensitivity to change:

- the watercourse southwest of PS2 (KP185)
- the watercourse to the north east of MCPY3 (KP191)
- the watercourse to the south west of MCPY3 (KP191)
- the ephemeral floodplain at MCPY4 (KP283).

The watercourses at PS2 and at MCPY3 are formed in uncohesive and easily erodible materials and have a cover of scrub vegetation.

Water and Sediment Quality and Sensitivity to Contamination

The following watercourses crossed by the pipeline were considered to have a high sensitivity to contamination:

- Katonga River
- Kibale River.

Their catchments are sparsely settled rural areas and predominantly rangeland. Pollution sources are limited to livestock and people using the rivers.

For the same reasons, the following watercourses traversed by project roads were considered to have a high sensitivity to contamination:

- the watercourse at road KP2.5 on the permanent access road at PS1 (KP0)
- the watercourse at road KP1.0 on the access road to the pipeline RoW from MCPY2 (KP126)
- the watercourse at road KP0.5 on the existing road to be upgraded to PS2 (KP185).

Similarly, the following watercourses adjacent to project facilities were considered to have a high sensitivity to contamination:

- the ephemeral floodplain east of MCPY1 (KP40)
- the ephemeral watercourse south west of PS2 (KP185)
- the ephemeral watercourse north east of MCPY3 (KP191)
- the ephemeral watercourse south west of MCPY3 (KP191)
- the ephemeral floodplain south east of MCPY4 (KP283).

6.4.2.3 Groundwater

This section describes:

- groundwater AOI and broader region
- the baseline condition of groundwater:
 - trends affecting groundwater
 - sensitivity of groundwater to change
 - ecosystem services provided
 - groundwater sensitivity rankings
- key considerations.

For more information, see Appendix A7: Groundwater Baseline Report.

Area of Influence

The groundwater AOI during the project construction and operational phase will encompass aquifers:

- affected by project groundwater abstraction
- that may be affected by planned discharges and spills, and leaks of fuels and chemicals by the project.

During construction, the AOI will include aquifers crossed by the RoW and aquifers from which groundwater will be abstracted for the MCPYs and other construction activities. During the approximate 25-year operational phase, the AOI will include aquifers crossed by the RoW.

Baseline Condition of Groundwater

Aquifer Characteristics

The AOI traverses areas that are characterised by unconsolidated fluvial, sedimentary and basement aquifers. In all the districts that are traversed, groundwater is an important source of public water supply. A review of Ministry of Water and Environment (MWE) published data (2008a, 2008b, 2012a, 2012b and 2012c) indicates that groundwater quality is generally good in all districts.

A summary of aquifer characteristics is presented in Table 6.4-28.

Sampling was undertaken at 11 locations during the field survey. No exceedances of the national water quality standards (The Uganda Standard, US EAS 12: 2014) or the project standards for the parameters tested in the laboratory were identified.

Table 6.4-28 Summary of Aquifer Geology and Characteristics

District, Approximate KP Range and Project Facilities or AGIs	Geological Formations and Aquifer Lithology	Soil Description ¹	Main Water Strike ² (mbgl) (Average)	Static Water Level (mbgl) (Mean Value) ³	Vulnerability ⁴	Yield (m ³ /h) and Recharge ⁵
Hoima KP0–40 PS1 near KP0 MCPY1 near KP40	Regolith and fluvial sediments (palaeochannels); Tertiary–Quaternary sediments within the Rift Valley system predominantly sandstones, siltstones, claystones and shales	Clay loams (petric plinthosols)	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
Kakumiro/ Kyankwanzi KP40–100	Precambrian basement (weathered and fractured crystalline bedrock): phyllites and schists with basal quartzites and amphibolites; undifferentiated gneisses and granulite facies rocks	Loamy sand; sandy/silty clay loam	38	27	High	Yield: 1.75 Recharged by rainfall

Table 6.4-28 Summary of Aquifer Geology and Characteristics

District, Approximate KP Range and Project Facilities or AGIs	Geological Formations and Aquifer Lithology	Soil Description ¹	Main Water Strike ² (mbgl) (Average)	Static Water Level (mbgl) (Mean Value) ³	Vulnerability ⁴	Yield (m ³ /h) and Recharge ⁵
Mubende KP100– 160 MCPY2 near KP126	Precambrian basement (weathered and fractured crystalline bedrock): undifferentiated gneisses and in the north granulite facies rocks; Buganda-Toro Series: argillites (phyllites and schists) with basal quartzites and amphibolites	Gravelly sandy loam	47	23	High	Yield: 2.38 Recharged by rainfall Poor yields owing to deep water table causing wells to often break down; DWO is considering installing piped groundwater systems to facilitate access for communities
Sembabule KP180– 220 PS2 near KP180 MCPY3 near KP191	Precambrian basement (weathered and fractured crystalline bedrock): undifferentiated acid and basic gneisses; Buganda- Toro system: mica schist, quartz mica schist and undifferentiated schist and acid gneisses	Sandy clay loam	64	36	Low	Yield: 1.78 Recharged by rainfall Poor yields owing to deep water table causing wells to often break down; DWO is considering installing piped groundwater systems to facilitate access for communities

Table 6.4-28 Summary of Aquifer Geology and Characteristics

District, Approximate KP Range and Project Facilities or AGIs	Geological Formations and Aquifer Lithology	Soil Description ¹	Main Water Strike ² (mbgl) (Average)	Static Water Level (mbgl) (Mean Value) ³	Vulnerability ⁴	Yield (m ³ /h) and Recharge ⁵
Rakai KP240–290 MCPY4 near KP283	Precambrian basement rocks (weathered and fractured crystalline bedrock): undifferentiated acid and basic gneisses	Sandy clay loam	45	34	Moderate	Yield: 2.1 Recharged by rainfall
	Precambrian Buganda-Toro system: mica schist, quartz mica schist and undifferentiated schist and acid gneisses			24	Moderate	
	Precambrian Karagwe-Ankolean system: quartzites, quartzose sandstones, conglomerates and some shales and phyllites			18	High	

SOURCE: From district groundwater reports provided by DWRM (2012a, 2012b).

NOTES: KP = kilometre point; AGI = aboveground installation; MCPY = main camp and pipe yard; PS = pumping station; DWO = district water officer

¹Based on field observations during the baseline survey in November 2017

²Main 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 Recharge data from BGS (2017); qualitative information on yield was obtained during the field survey; average airlift yields from district groundwater reports provided by DWRM (2008a, 2008b; 2012a, 2012b, 2012c)

⁵ 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.

Trend in Condition and Sensitivity to Change

Groundwater will continue to be a primary source of water for the population in all districts with shallow wells and boreholes providing water for over 60% of the population (MWE 2017).

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 of these aspects. However, the information available was considered sufficient to support this assessment. Groundwater in both the sedimentary and basement aquifers is considered highly sensitive to change.

Ecosystem Services Provided

The groundwater in the AOI provides the range of ecosystem services set out below.

Provisioning services include:

- groundwater supplying freshwater for community use.

Regulating services include:

- groundwater supporting aquatic and riparian habitats and wildlife, both directly (where groundwater feeds wetlands) and indirectly (where groundwater maintains surface water flows).

Sensitivity Rankings

Table 6.4-29 summarises the sensitivity ranking for groundwater.

Table 6.4-29 Groundwater VEC Sensitivity Ranking

District	Groundwater VEC	Sensitivity Ranking	Rationale for Ranking
Hoima	Sedimentary and basement aquifers	High (4)	Quality of the groundwater is good and is the primary source of water for 68% of the population. Boreholes and wells, at the time of writing, are between 500 m and 1 km from the RoW.
Kakumiro–Kyankwanzi	Basement aquifers	Medium (3)	Although quality of the groundwater is good, at the time of writing, the boreholes and wells are more than 1 km from the RoW.
Mubende	Basement aquifers	Medium (3)	Quality of the groundwater is good; boreholes and wells, at the time of writing, are between 500 m and 1 km from the RoW; however, yields are poor due to a deep-water table.
Gomba	Basement aquifers	High (4)	No data on quality is available from DWRM.

Table 6.4-29 Groundwater VEC Sensitivity Ranking

District	Groundwater VEC	Sensitivity Ranking	Rationale for Ranking
Sembabule	Basement aquifers	Very high (5)	Quality of the groundwater is good; boreholes and wells, at the time of writing, are between 500 m and 1 km from the RoW; however, yields are poor due to a deep-water table. Groundwater is the primary source of water for a very high percentage (96%) of the population.
Lwengo	Basement aquifers	High (4)	Quality of the groundwater is good; it is the primary source of water for a very high percentage (87%) of the population.
Rakai	Basement aquifers	High (4)	Quality of the groundwater is good; boreholes and wells, at the time of writing, are between 500 m and 1 km from the RoW.

Key Considerations

The key considerations are summarised below:

- the sensitivity rankings of groundwater VECs are medium to very high, depending on the district in question
- groundwater is an important ecosystem service.

6.4.2.4 Landscape

This landscape section describes the:

- landscape AOI
- baseline condition of the landscape:
 - the landscape character for the AOIs for PS1 and 2
 - trends affecting the condition of the landscape and views, and sensitivity to change
 - ecosystem services provided
 - landscape sensitivity rankings
- key considerations.

For more information, see Appendix A8: Landscape Baseline Report which includes information on views of the AGIs.

Area of Influence

The project components included in the AOI are PS1 and 2. Other project components, such as other AGIs, MCPYs and the RoW, were screened out during scoping, as they are considered unlikely to have major impact on visual receptors. This was confirmed during the landscape field survey.

The PS1 and 2 landscape AOI was set provisionally at a 5-km radius, see Figure 6.4-10 and Figure 6.4-11, based on an initial study using engineering information and satellite images to identify the location of potential receptors.

The field survey confirmed that most PS1 and 2 views will be restricted to within 1–3 km except for a few vantage points from higher hills that extend the AOI in some directions to the 5-km radius.

The PSs are permanent and will remain operational over the lifetime of the project, so the temporal AOI will be approximately 25 years.

Baseline Condition of Landscape

Introduction

The AOI traverses a mixed landscape of gently undulating grasslands and farmland, hills with open plateaus and bare rocky outcrops, forested areas, wetlands and, near the border with Tanzania, a drier, more sparsely vegetated landscape. Most of the AOI is in an area of modified habitat with the exception of a few sections that are within, or adjacent to, FRs that are less modified. Areas of high biodiversity value are often linked to sensitive landscapes, as they can possess valued or rare natural scenic features, such as forests. However, the areas affected by the AOI have been affected by human activity for farming and grazing and are of low landscape sensitivity.

Landscape Character

Pumping Station 1

The PS1 AOI consists of undulating to hilly terrain, which rises from approximately 650 m above sea level (masl) in the west to over 1300 masl in the southeast; see Figure 6.4-10. PS1 is on a slightly elevated area (1083 masl) of an escarpment that includes some pronounced hills.

The landscape is characterised by farmland, comprising grazing (grassland) and mixed cropland dominated by maize and sugar cane, interspersed with clusters of trees and scrubland. Field patterns are typically irregular with field boundaries usually defined by changes in crop type or land use, although simple fencing made of tree branches strung with wire or scrub hedges demarcate some of the plots.

A section of the Wambabya FR is within the AOI, 3 km to the east of PS1, and remains mostly intact, although field observations show some encroachment by farming and logging for charcoal (see Appendix A1 Botany Biodiversity Baseline Report). There is no marked change in landscape character between the wet and dry seasons, although groundcover (e.g., grasses) becomes dry and sparse during the dry season.

There are two quiet, small, mainly agricultural settlements along a sealed main road that traverses the AOI north to south, parallel to Lake Albert. There are small trading centres within the two settlements, where there is a slight increase in activity, although this is restricted to relatively small areas. Another quiet, small agricultural settlement is to the east of PS1. Other areas of habitation are limited to smaller agricultural settlements and isolated farms surrounded by cultivated land,

all accessed by local unsealed roads. Although a predominantly rural, agricultural landscape, the main road and a telecommunication mast are indicators of limited development within the AOI.

Most of the landscape within the AOI has been modified by human activity. Although rural in nature, the landscape has lost most of its natural vegetation, except for the forest remaining in the Wambabya FR. Stakeholders did not perceive the proposed project infrastructure as negative visual intrusions in the landscape and no tourist attractions were identified. The Wambabya FR was identified as having biodiversity value in the biodiversity baseline, Section 6.4.1.1 and Appendix A1 Botany Biodiversity Report. It contains intact forest that increases the landscape sensitivity due to its natural scenic value. However, there are no views of PS1 from the reserve and it is therefore not considered further within the landscape baseline.

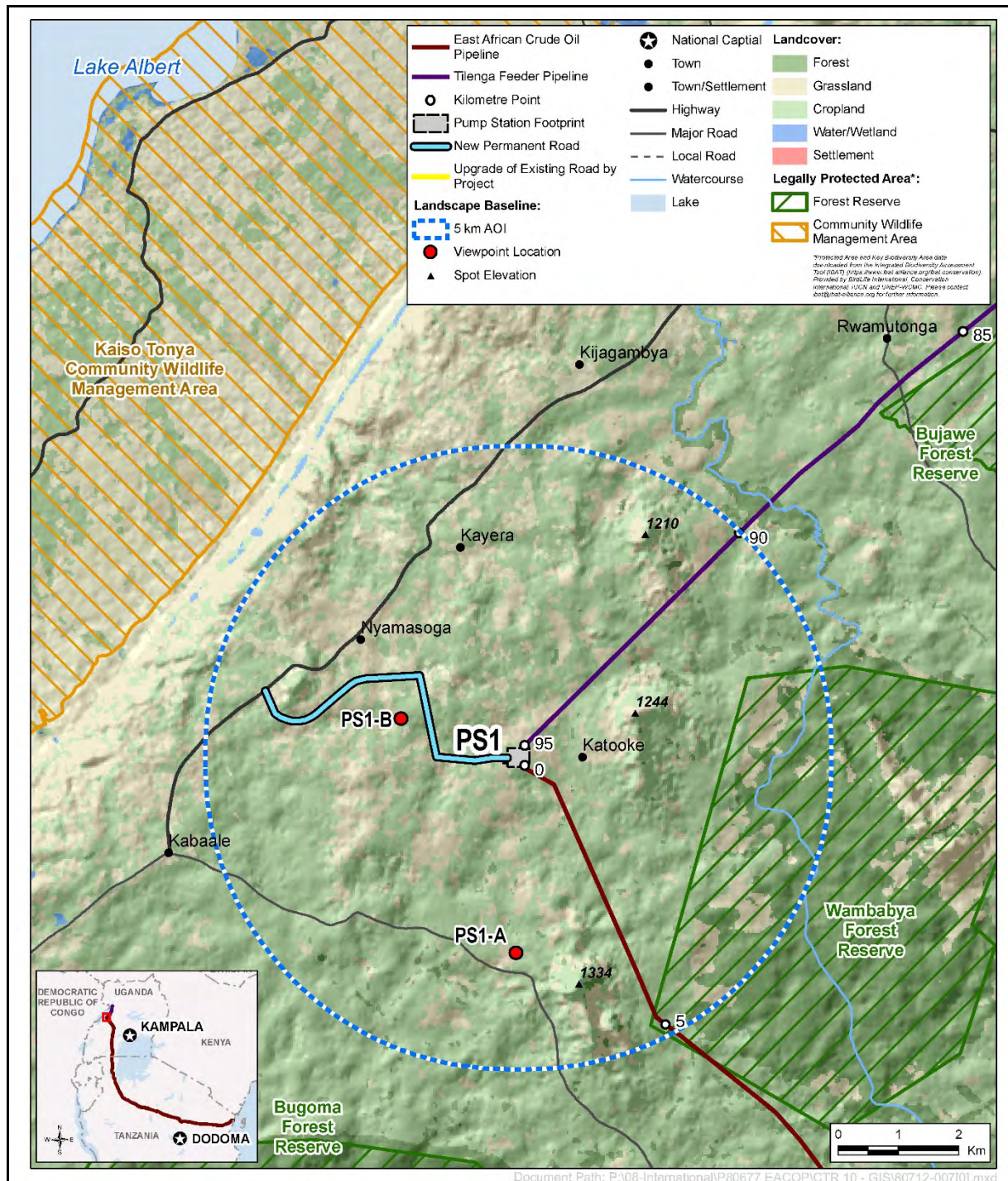


Figure 6.4-10 Area of Influence, and Pumping Station 1 Viewpoint Photograph Locations

Pumping Station 2

The PS2 AOI consists of undulating terrain, with several hills rising to more than 1300 masl, separated by seasonally inundated, low-lying areas; see Figure 6.4-11.

The landscape is characterised by grazing land interspersed by scrub and some trees. There is little evidence of farming, other than small gardens directly adjacent to dwellings. Simple fencing made of tree branches strung with wire or scrub

hedges demarcate grazing plots. Some tree plantations, predominantly pine and eucalyptus, are within the AOI. There is no marked change in landscape character between the wet and dry seasons because of the density of tree and scrub vegetation, although groundcover (e.g., grasses) becomes dry and sparse during the dry season.

The area is remote, with a widely dispersed population. There are four quiet, small agricultural settlements along the unsealed main road that traverses the AOI north–south and four similar settlements distributed along local unsealed roads. There is a small trading centre within one of the settlements, Selinya, where there is a slight increase in activity, although this is restricted to a relatively small area. Other than these settlements, occasional livestock farms with associated *kraal*⁴ dot the landscape.

Although remote, this is not a wild or particularly scenic landscape, as human activities have altered it over time. Stakeholders did not perceive the proposed project infrastructure as negative visual intrusions in the landscape and no tourist attractions were identified. There are no areas of biodiversity value within the AOI that would have natural scenic value.

⁴ Livestock enclosure

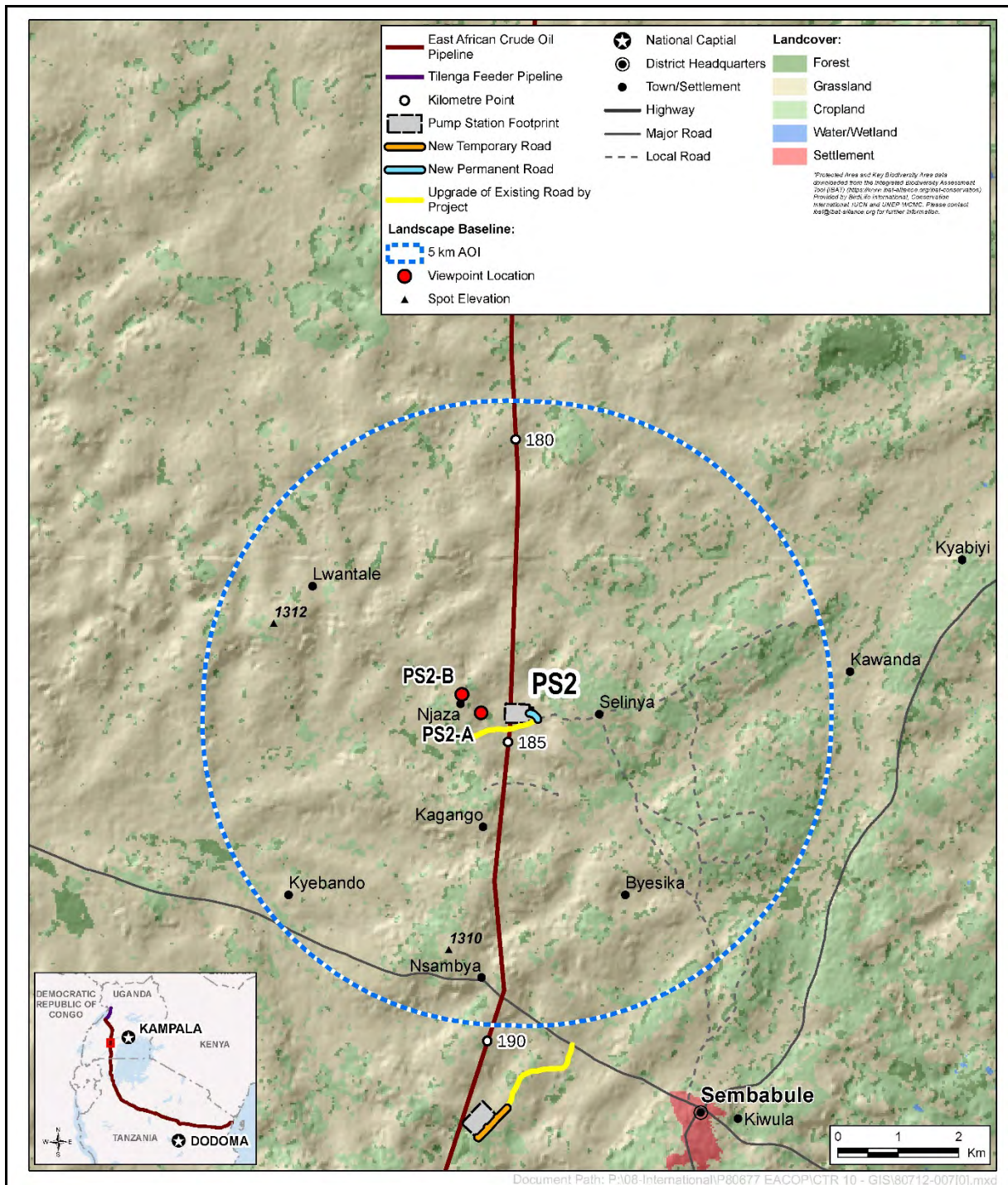


Figure 6.4-11 Area of Influence, and Pumping Station 2 Viewpoint Photograph Locations

Trend in Condition and Sensitivity to Change

Pumping Station 1

PS1 is in an area that, over time, has been converted from a mixture of grassland and scrub to farmland. This trend is predicted to continue, maintaining the rural landscape character of the AOI.

The sealed main road to the west of the AOI has not resulted in increased development, but this may change if oil industry related activities, such as a refinery, are developed. The landscape is expected to be able to tolerate further similar change or modification without change to its present character, so is not regarded as sensitive to change.

Pumping Station 2

PS2 is in an area that has seen gradual conversion from grassland and scrub to predominantly grazing land, which is sparsely settled. This trend appears to be continuing. The landscape is expected to be able to tolerate further similar change or modification without change to its present character, so is not regarded as sensitive to change.

Ecosystem Services Provided

Landscape provides the following ecosystem services:

Cultural services include:

- nonmaterial benefits from the sense of wellbeing and value provided to people by living in an attractive environment.

However, stakeholders did not perceive proposed project infrastructure as negative visual intrusions in the landscape and the two areas do not attract tourists (see Appendix C Stakeholder Engagement and Appendix A11 Socio-economic and Health Baseline Report). Consideration of the ecosystems and local context suggest that landscape values at these two locations are limited. The sites are remote, the local environments comprise highly modified habitat, and there is minimal current or potential tourism in the area.

Sensitivity Rankings

Based on the survey and engagement with stakeholders and trend in condition and sensitivity to change, the sensitivity of the landscape character and visual receptors within the PS1 AOI have been ranked and are shown below in Table 6.4-30.

Table 6.4-30 Pumping Station 1: Landscape Receptor Sensitivity Ranking

Landscape Receptor	Sensitivity Ranking	Rationale for Ranking
Farmland landscape	Low (2)	Agricultural landscape tolerant of further similar change.
Small settlements, farms and users of unsealed roads	Low (2)	Stakeholders did not perceive the proposed project infrastructure as negative visual intrusions in the landscape.

Based on the survey and engagement with stakeholders and the trend in condition and sensitivity to change, the sensitivity of the landscape character and visual receptors within the PS2 AOI have been ranked and are shown below in Table 6.4-31.

Table 6.4-31 Pumping Station 2: Landscape Receptor Sensitivity Ranking

Landscape Receptor	Sensitivity Ranking	Rationale for Ranking
Grazing land, grassland and scrub	Low (2)	Agricultural landscape tolerant of further similar change.
Small settlements, farms and users of unsealed roads	Low (2)	Stakeholders did not perceive proposed project infrastructure as negative visual intrusions in the landscape.

Key Considerations

For the PS1 AOI, most of the landscape has been modified by human activity. Although rural in nature, the landscape has lost most of its natural scenic value and it is of low landscape sensitivity.

Although remote, the landscape sensitivity of the AOI for PS2 is low: it is not a wild or particularly scenic landscape, as human activities have altered it.

Stakeholders did not perceive proposed project infrastructure as negative visual intrusions in the landscape and no tourist attractions were identified.

6.4.2.5 Air Quality

This section describes:

- air quality AOI
- baseline condition of air quality
 - baseline characteristics
 - trends in condition and sensitivity to change
 - ecosystem services
 - sensitivity rankings
- key considerations.

For more information, the air quality baseline report is included in Appendix A9.

Area of Influence

The AOI for air quality depends on the nature and scale of each source of project emissions. The AOI is established by modelling and is the distance to the furthest receptor where the air quality standards are met. Changes in substance concentrations are likely to be measurable within a few kilometres of these facilities. The AOI for emissions from construction activities and project vehicles will be no more than a few hundred metres from each source.

Baseline Condition of Ambient Air Quality

Nitrogen dioxide (NO₂), nitrogen oxides (NO_x), ozone (O₃), sulphur dioxide (SO₂) and volatile organic compound (VOC) concentrations were measured using continuous monitoring using diffusion tubes over three four-week periods between 31 October 2017 and 14 February 2018. Spot measurements of particulate matter

(PM) and carbon monoxide (CO) concentrations were made on five occasions at each location during this period using calibrated instruments.

Table 6.4-32 presents the average substance concentrations recorded at PS1 and PS2

Table 6.4-32 Summary of Average Measured Baseline Substance Concentrations

Substance	Average Concentration in Each Facility AOI ($\mu\text{g}/\text{m}^3$ Unless Otherwise Specified)		Project Environmental Standard (PES) ($\mu\text{g}/\text{m}^3$ unless otherwise specified)
	PS1	PS2	
NO ₂	5	4	40 (annual average) 150 (24-hour average) 120 (8-hour average) 200 (1-hour average)
NO _x	6	4	No PES
O ₃	81	77	100 (8-hour average, daily maximum)
SO ₂	<1	<1	50 (annual average) 20 (24-hour average) 500 (10-minute average)
Benzene	2.5	1.2	No PES
Total VOC	132	97	6,000 (24-hour average)
PM ₁₀ ¹	56	34	20 (annual average) 50 (24-hour average) 200 (1-hour average)
PM _{2.5}	52	29	10 (annual average) 25 (24-hour average)
CO (mg/m^3)	0	0	10 (8-hour average) 30 (1-hour average) 60 (30-minute average) 100 (15-minute average)

The following observations and conclusions can be made from the ambient air quality monitoring results presented in Appendix A9, noting that comparisons with the PES are indicative only as the sampling and PES averaging periods do not match:

- concentrations of NO₂, and NO_x are low at all locations and show a high degree of uniformity between the two PSs. No sample measured greater than 12 $\mu\text{g}/\text{m}^3$
- concentrations of VOC are low at all locations and show a high degree of uniformity between the two PSs. No sample measured greater than 398 $\mu\text{g}/\text{m}^3$
- at all locations and in all the surveys, CO measurements were below the limit of detection of the technique used

- of 23 SO₂ measurements, 20 recorded results below the limit of detection of the technique used
- ground-level O₃ concentrations are moderate and consistent across the locations. This uniformity is expected, as ozone is not a directly emitted substance, but is formed by reactions in the atmosphere and, therefore, changes are normally seen at a regional scale and are not sensitive to local emission sources.
- particulate concentrations are high and, in some cases, exceed the PES included in Appendix F. This is to be expected given the dusty nature of the environment.
- the surveys undertaken for this study focussed on the PSs. However, it is reasonable to assume that the levels of substances found in these areas will be representative of the air quality for most of the project's AOI throughout Uganda.
- a marked increase in the concentrations of NO₂, NO_x, O₃ and SO₂ in the third (final) sample round, relative to the first two rounds, was recorded at all sampling locations. For PM spot monitoring was undertaken on five occasions, and an increase in concentrations was observed in the final two measurements when compared to the earlier three measurements. There is no clear explanation for the increases observed.
- NO_x, VOC and PM concentrations at the measuring location PS1-1, in the small settlement of Kyabalendere, are higher than those measured at the more isolated stations around PS1. This is likely to be a result of the greater traffic and general activity close to the sampling location.
- around PS2, the roadside locations PS2-3 and PS2-4 (see Figure A9.2.2 in Appendix A9) show consistently higher PM concentrations than the non-roadside sites. PS2-3 shows a similarly higher NO_x level, but PS2-4 which lies further from the road does not.
- substance levels recorded within small settlements and at the side of roads were measured to be greater than at other locations.

Trend in Condition and Sensitivity to Change

Air quality is sensitive to change, reacting to emission sources which are almost always associated with human activity. These activities can include vehicles, nonroad machinery for construction, industry or agriculture; and burning for agriculture, waste disposal, cooking or heating.

The substances included in this baseline will be emitted during project activities, change the air quality within a limited distance of the source, and will return to background levels a short time after the activity has ceased.

Sensitivity to change is related to how close the baseline levels are to the standards. The baseline survey has shown the VEC to have a low level of sensitivity to NO_x, VOC, CO or SO₂ emissions, and that sensitivity to changes in PM is greater as the baseline levels are moderate to high. NO_x and VOC are the primary precursors of low-level O₃, which had moderate baseline levels. As such, emissions of NO_x and VOC are important in the control of O₃ formation on a regional scale.

No historical air quality data for identifying trends in development and activity in the AOI have been identified, so air quality trends were not established.

Based on the air quality surveys, engagement with stakeholders, trend in condition and sensitivity to change, the sensitivity of the air quality related receptors within the AOI has been ranked and is shown in Table 6.4-33. The sensitivity is determined by two primary factors:

- the quantity and nature (including likely exposure patterns) of VECs (predominantly people) that are sensitive to air quality
- the baseline levels of substances present, relative to project environmental standards, which determines the environment's capacity to accommodate new emission sources without substance levels becoming potentially harmful.

The sensitivity rankings are shown in Table 6.4-33.

Table 6.4-33 Air Quality VEC Sensitivity Ranking

VEC and Specific Sensitivity	Sensitivity Ranking ¹	Rationale
Sensitivity to dust	Very low (1) to moderate (3)	Dust sensitivities are highly transient and geographically variable, and therefore it is inappropriate to apply rankings at a large scale and impracticable to identify small-scale variations in advance. Most of the AOI for dust will be sparsely occupied by people. Where the AGIs will be constructed the areas are of low ecological value. The AOI will occasionally include buildings, crops and animals of moderate sensitivity.
Sensitivity to gaseous emissions	Moderate (3)	Long term exposure to O ₃ must be assumed as the AOI is regional.
Sensitivity to airborne fine PM	Low (2) to very high (5)	Baseline concentrations are moderate to high, with exceedances of standards. ² The range reflects the variability of public presence.
Sensitivity to hydrocarbon vapour – refuelling sites' AOIs	Very low (1)	Impacts of this activity will be highly localised and members of the public are highly unlikely to be present within the area of impact.

NOTES: ¹The definitions of sensitivity are described in the VEC sensitivity tables included in Appendix D.

²All comparisons of baseline concentrations are indicative owing to differences in sampling periods and averaging periods of standards.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Key Considerations

High levels of airborne fine PM, above standard levels, were consistently detected by the baseline survey.

Much of the project's AOI is sparsely populated.

There is capacity in the environment for gaseous emissions without harmful levels being reached. However, ground-level O₃ concentrations were found to be moderately high. As such, control of NO_x and VOC, the primary precursors of ground-level O₃, will be important in limiting regional-scale O₃ levels.

6.4.2.6 Acoustic Environment

This section describes the:

- acoustic AOI
- baseline conditions
 - acoustic character
 - trends in condition and sensitivity to change
 - ecosystem services
 - sensitivity rankings
- key considerations

Baseline acoustic conditions were measured in the AOI.

For more information, the acoustic baseline report is included in Appendix A10.

Area of Influence

AOIs apply to existing, planned new and upgraded construction access roads, PS1 and 2, MCPY1–5 and the RoW.

The AOI was set at a 500-m radius around the PSs, MCPYs, access road and RoW, based on a review of engineering information and satellite images taking into consideration likely noise emission levels and to identify the location of potential receptors.

The PSs are permanent and will remain operational over the lifetime of the project, so the temporal AOIs for PS1 and 2, and the access roads will be approximately 25 years. For the temporary construction access roads and MCPYs, the temporal AOI is the period of construction, approximately three years.

Baseline Condition of the Acoustic Environment**Acoustic Character***Pumping Station 1*

The noise environment in the PS1 AOI is consistent with a rural environment with interspersed farming, localised traffic on unsealed roads and small-scale human settlements. The noise environment was observed and considered to be made up of human interactions (traffic and pedestrian movement, domestic and commercial agriculture – crops and livestock) and some wildlife noise (birds and insects).

Quantified noise levels during the day around PS1 were measured at 32–55 dB(A) $L_{90,1hr}$ and 40–56 dB(A) $L_{eq,1hr}$. At night they were measured at 26–47 dB(A) $L_{90,1hr}$ and 36–53 dB(A) $L_{eq,1hr}$. The PES against which operational impacts are assessed is 35 dB(A) $L_{Aeq,T}$. For large periods of time, the current noise environment is already exceeding the PES.

Watercourse and existing industrial (plant) noise was not observed in the PS1 AOI.

These levels of noise are considered consistent to what would be expected in the given environment.

Pumping Station 2

The noise environment in the PS2 AOI is similar to PS1. The landscape is slightly different to the PS1 AOI with less large-scale farming, and more varied vegetation. However, the proximity to settlements and motorised traffic roads is similar to that of the PS1 AOI.

Quantified noise levels during the day around PS2 were measured at 29–45 dB(A) $L_{90,1hr}$ and 41–53 dB(A) $L_{eq,1hr}$, and 29–43 dB(A) $L_{90,1hr}$ and 35–52 dB(A) $L_{eq,1hr}$ at night. The PES against which operational impacts are assessed is 35 dB(A) $L_{Aeq,T}$. For large periods of time the current noise environment is already exceeding the PES.

Watercourse and existing industrial (plant) noise was not observed in the PS2 AOI.

These levels of noise are considered consistent to what would be expected in the given environment.

Main Camps and Pipe Yards 1–4

The noise environment in the AOI surrounding MCPY 1-4 is similar to those identified at the AOI for the PSs. Although the environment changes (some are more vegetated than others and some have more intensive farming), the noise environment was observed to consist of similar sources, including motor vehicles (particularly motorbikes), localised farming activities (predominantly restricted to hand tool use), bird song and wind through vegetation.

Watercourse and existing industrial (plant) noise was not observed in any of the MCPY AOIs.

As for the PSs, large-scale settlements are outside the acoustic AOI, but smaller groups of dwellings are within the AOI.

Quantified noise levels during the day around the MCPYs are in the range of 33–41 dB(A) $L_{90,1hr}$ and 45–55 dB(A) $L_{eq,1hr}$.

Although the ranges across each AOI for the MCPYs is relatively large (8–10 dB(A)), this is expected from short duration measurements, and varies with specific activities, such as vehicle movements, during each measurement. However, the magnitudes measured are in the order that would be expected in such an environment and is consistent throughout the RoW.

Right-of-Way

The landscape and environmental components of the RoW AOI vary dramatically. However, the noise character is very similar. This is due to the absence of large-scale road networks, industrial and commercial facilities, and other intense noise sources. The main noise sources contributing to baseline conditions throughout the RoW include wind through vegetation, localised and larger scale farming, people interactions (with land, livestock and each other), motorised vehicle movements (dominated by motorbikes) and occasional construction activities.

In the most remote areas of the RoW, there is an absence of human induced noise. However, there is also the absence of human receptors.

The noise associated with terrestrial fauna was not considered to be dominant through any of the monitoring surveys, although the noise environment across the RoW did include some bird, insect and occasional amphibian noise (frogs at night).

Given the similarity of noise sources along the RoW, and the varying contribution of such sources throughout a given time period, the levels measured across the RoW can be considered to be a good representation of the range of levels to which the baseline noise environment is exposed. This is particularly the case given the short-term nature of noise measurements (i.e., 1-hour measurements).

Quantified noise levels during the day through the RoW are in the range of 27–42 dB(A) $L_{90,1hr}$ and 41–59 dB(A) $L_{eq,1hr}$ and 26–47 dB(A) $L_{90,1hr}$ and 35–53 dB(A) $L_{eq,1hr}$ at night. The PES against which operational impacts are assessed is 35 dB(A) $L_{Aeq,T}$.

Construction Access Roads

As for the RoW, the noise environment surrounding proposed new and upgraded construction access roads varies according to time of day, fluctuation in traffic flow and proximity to existing roads. The noise environment around road upgrades is expected to be higher due to the proximity to existing traffic noise. Therefore, levels are more likely to be in the upper region of values experienced in the RoW. The noise environment around new construction access roads will experience lower levels due to the absence of existing road traffic noise.

Trend in Condition and Sensitivity to Change

Pumping Station 1

Although classed as rural, the area has been developed over time and there are settlements and basic infrastructure, including murram roads, clay brick structures and power cables. However, there is no fixed industrial or mechanical plant noise nearby.

The introduction of a sealed main road to the west of the AOI has not increased development, but this may change if oil industry related activities, such as a refinery, are developed.

The noise environment around PS1 ranges from around a maximum of 55 dB(A) $L_{90,1hr}$ daytime to lowest 26 dB(A) $L_{90,T}$ night time and is characterised by natural noises (bird song, wind through trees and weather), manual human interactions and

vehicle noise. The area is exposed to intermittent but regular high noise events resulting from road traffic, and often these can be perceived as more intrusive than a steady noise source. Therefore, the introduction of a steady noise source (assuming the absence of disturbing characters such as impulsive or tonal features) into the area will not necessarily be highly sensitive. For large periods of time, the current noise environment is already above the PES. Therefore, the AOI has the potential to tolerate changes to the existing noise environment.

Pumping Station 2

Although classed as rural, within the eastern African context, the area has been developed over time and there are settlements and basic infrastructure, including murram roads, clay brick structures and some power cables. However, there is no fixed industrial or mechanical equipment noise nearby.

The noise environment around PS2 ranges from a maximum of 45 dB(A) $L_{90,1hr}$ daytime to lowest 29 dB(A) $L_{90,T}$ night time and is characterised by natural noises (bird song, wind through trees and weather), manual human interactions and vehicle noise. Daytime levels were measured to be lower than night levels, but it is expected that night noise levels will be as low as daytime levels, over a longer period of observation. The area is exposed to intermittent but regular high noise events resulting from road traffic, and often these can be perceived as more intrusive than a steady noise source. Therefore, the introduction of a steady noise source (assuming the absence of disturbing characters such as impulsive or tonal features) into the area will not necessarily be highly sensitive. The baseline noise levels are relatively low and therefore the magnitude of noise from the operation of PS2 will be critical to the tolerance the AOI has to change in the noise environment. However, for some periods of time the current noise environment is already above the PES.

Right of Way, Main Camp Pipe Yards and Access Roads

The impacts, and tolerance to change, across the AOI for the RoW, MCPYs and construction access roads will be from temporary activities such as construction and operation of camps.

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 access roads are created than where existing roads will be used to facilitate project access.

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.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Rankings

Based on the survey, engagement with stakeholders and trend in condition and sensitivity to change, the sensitivity of the acoustic environment for AGIs, construction facilities, RoW and access roads across the AOI has been ranked (Table 6.4-34). The sensitivity ranking is reasonably generic across the AOI.

Table 6.4-34 Acoustic Receptor Sensitivity Ranking – Presence in Area of Influence

Project Component	Receptor				
	Very Low	Low	Moderate	High	Very High
PS1	-	X	X	X	-
PS2	-	X	X	X	-
MCPY1	-	X	X	X	-
MCPY2	-	X	X	X	-
MCPY3	-	X	X	X	-
MCPY4	-	X	X	X	-
RoW	X	X	X	X	-
Construction access roads	X	X	X	X	-

NOTES: 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 this is 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 used to be known for fauna habitation or breeding.

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, MCPYs and PS AOIs.

The noise environment across most of the AOIs, particularly around AGIs, is dominated by human induced sources such as road traffic, farming and general human interactions. Therefore, the addition of temporary noise sources during construction and operation of MCPYs is unlikely to be of concern. As there is an absence of industrial and commercial noise throughout the RoW AOI, and due to the character of this noise not being heard at sensitive receptors in the AOI, there is a higher likelihood that the noise from PSs will be noticeable in the existing

environment. This does not necessarily mean it will dominate, as this will depend on the magnitude of emissions.

6.4.3 Socio-economic and Health Environment

This section describes the:

- socio-economic and health AOI
- baseline conditions of socio-economic and health along the route:
 - trend in condition and sensitivity to change
 - ecosystem services provided
 - sensitivity ranking
- key considerations.

Baseline conditions are described for the following 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 section also includes an overview of governance, demography and education.

For more information see Appendix A11, Socio-economic and Health Baseline Report.

6.4.3.1 Area of Influence

The spatial AOI for the construction, operation and decommissioning phases of the project is identified at three levels:

- national and regional
- 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 A11.3 and Section A11.3.2.2 in Appendix A11) the geographical boundary was determined as approximately 4 km either side of the pipeline and 4 km around construction facilities and AGIs where PACs were identified to potentially experience a range of direct and indirect impacts, such as air and noise pollution, land take and project induced in-migration (PIIM).

There are nine districts, 41 parishes, 22 subcounties, four town councils (TCs) and an estimated 172 villages and hamlets traversed and passed by the project.

6.4.3.2 Methods

Three teams performed the study: a social team, a health team and a human rights team, who collaborated to develop the socio-economic and health baseline.

The screening report and scoping stakeholder engagement was conducted by the social and health teams between 19 April and 1 June 2017 at national, district and PAC levels. It 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, 82 meetings were held, and 1,848 people were reached.

Subsequent secondary and primary data were collected at national and district levels through Small Groups Interviews (SGI) and Key Informant Interviews (KII) which enabled further descriptions of the VEC.

The health team conducted eight SGIs with health service providers (including the district health management teams) across the districts traversed by the AOI. The aim was to obtain 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, 13 district health services were assessed using the service availability and readiness assessment (SARA) tool.

Based on this data PACs were identified. To develop a sample of PACs for inclusion in the social study, the following process was undertaken.

Sites (areas) within a 4 km distance of construction facilities, the pipeline route, AGIs 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 EACOP facilities and activities were included
- sites representing all the characteristics listed below:
 - 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 and river)
 - natural habitats (protected and designated areas)
 - vicinity of access roads.

Thirteen sites were identified, which formed the sample sites for the data collection. In each of those sites, the PACs were identified. Figure 6.4-12 and Figure 6.4-13

show the sample sites and sample PACs for the social, health and human rights baseline studies.

The PAC data provided qualitative and quantitative elaborations on the district data. In-depth data collected at PAC level were embedded in the district and national context to ensure both depth and breadth.

This methodology was adopted because a statistical random sampling approach was not appropriate due to the initial lack of reliable data on the number and location of PACs in the AOI and the linear nature of the project (296 km). In addition, statistical sampling could have led to a sample of PACs that did not necessarily include all socio-economic characteristics.

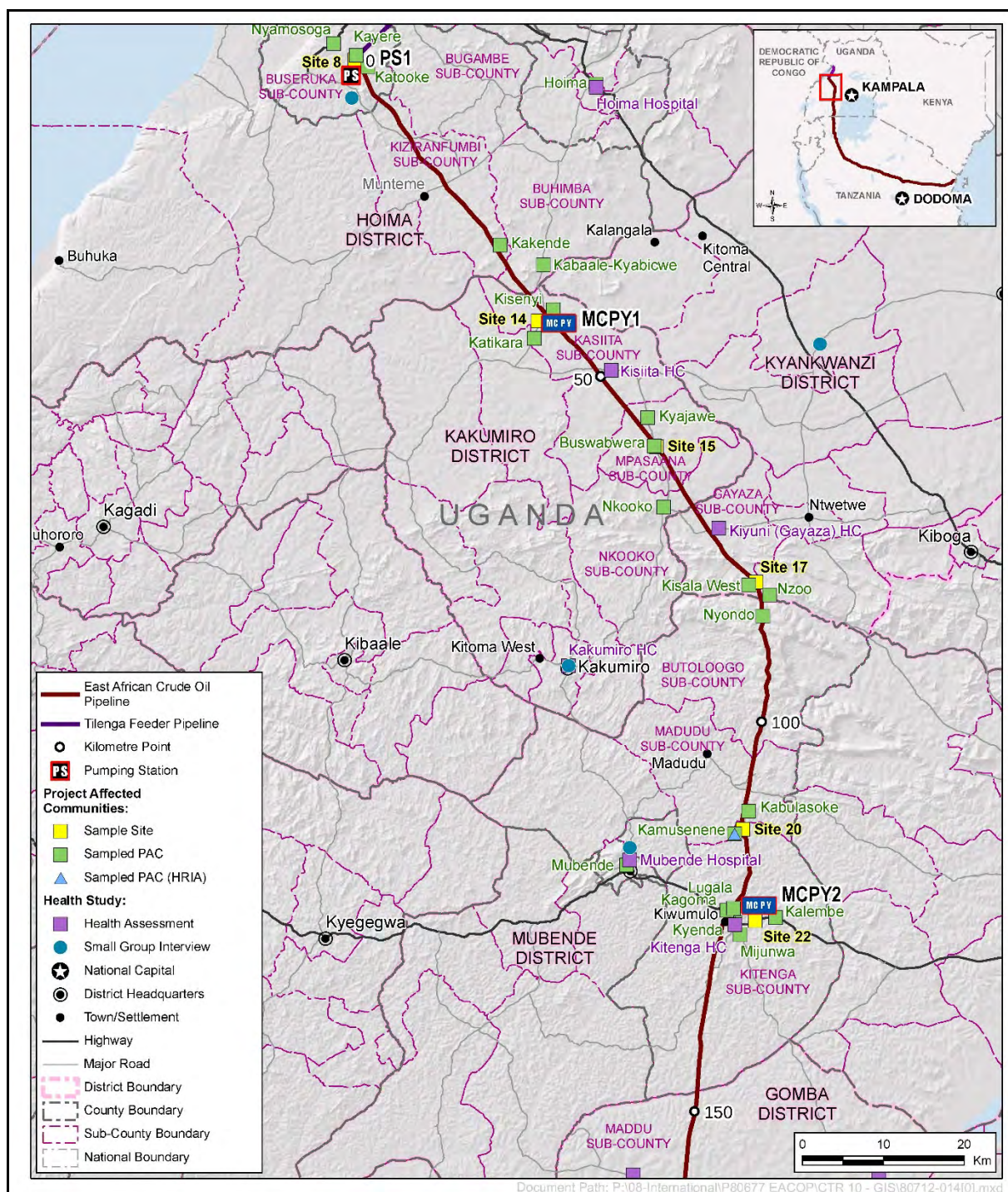


Figure 6.4-12 Sample Sites and Potentially Affected Communities – North



Step 1: Compilation of Factsheets

Based on satellite imagery, a ‘factsheet’ was created for each sample site, which provided initial information of 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 the period 26 October to 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 (BIDs) were used to explain the project and the ESIA study. Concerns and questions of stakeholders were recorded and, where possible, responses were 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 (AGI and construction facility) 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 (FGDs), SGIs, KIIs and household interviews (HHIs) 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 A11.2 in Appendix A11). 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 been brought about in the village over the years. The timelines are included in the PAC profiles
- KIIs, which included interviews with informants with an expertise or knowledge. These included: business people, traders, commerce, shopkeeper, commercial farmers, fishermen, health workers, local leaders, local women, natural resource users, religious leaders, subsistence farmers, teachers and traditional healers SGIs to understand different livelihood strategies with: crop farmers, fishermen, natural resource users, pastoralists

- 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 resource 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. A total of 176 HHIs were held across the different PACs. No statistical validity was attempted, as a full household survey will be conducted by the RAP team. The HHIs served to enhance understanding of particular concerns related to vulnerable households and particular livelihoods.



Figure 6.4-14 Focus Group Discussion and Participatory Mapping with Women in Miti, Sembabule District (KP194)

Figure 6.4-15 shows the number of different data collection tools used in the PACs and the districts by the three teams.

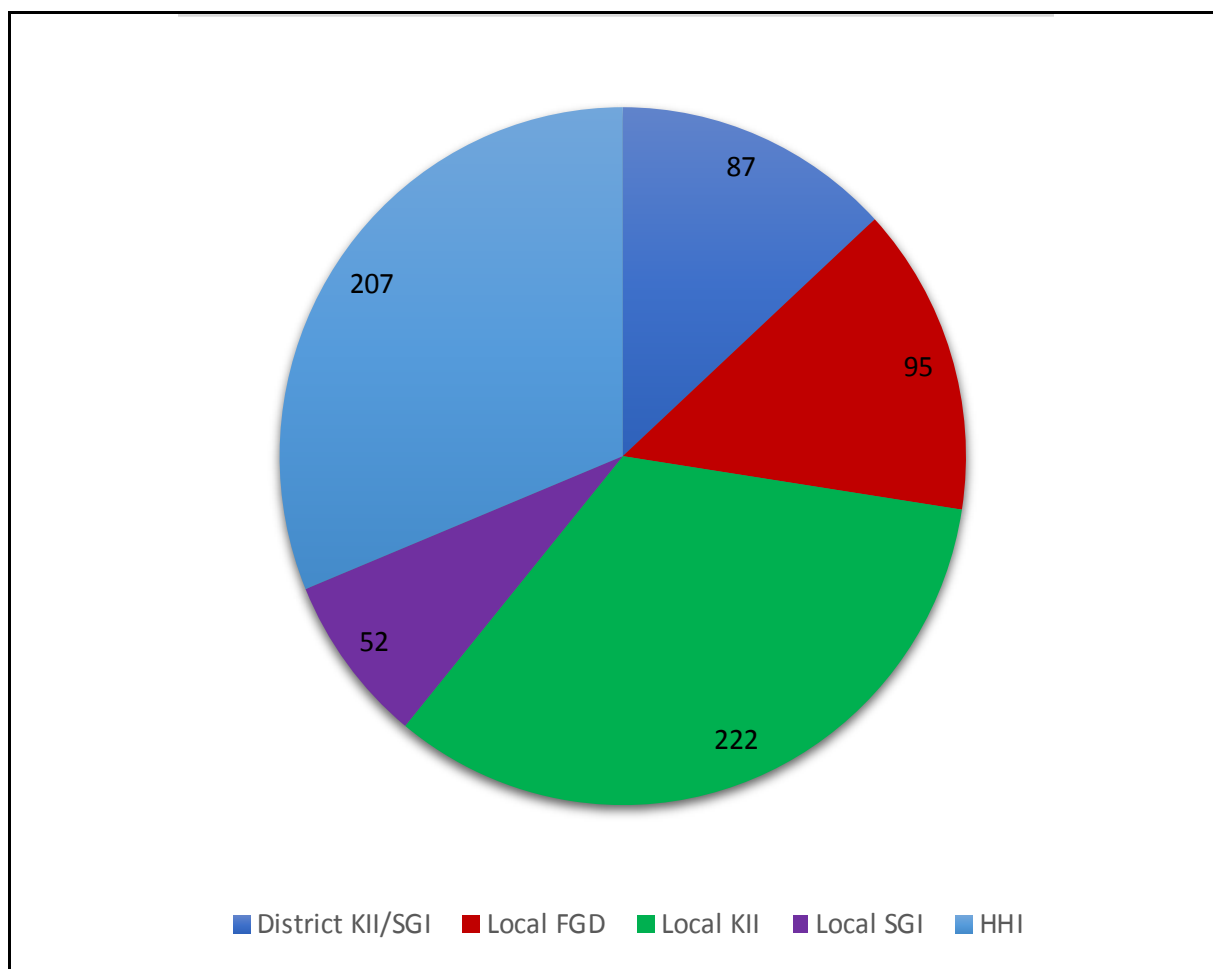


Figure 6.4-15 Data Collection at District and Potentially Affected Community Level

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 A11.2)
- maps showing locations of the VECs which are described in the text.

6.4.3.3 Governance and Administration

National Government

The President of the Republic of Uganda is both Head of State and Head of Government. The Government of Uganda 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 6.4-16). Through this structure, power and decision-making at the national level is decentralised.

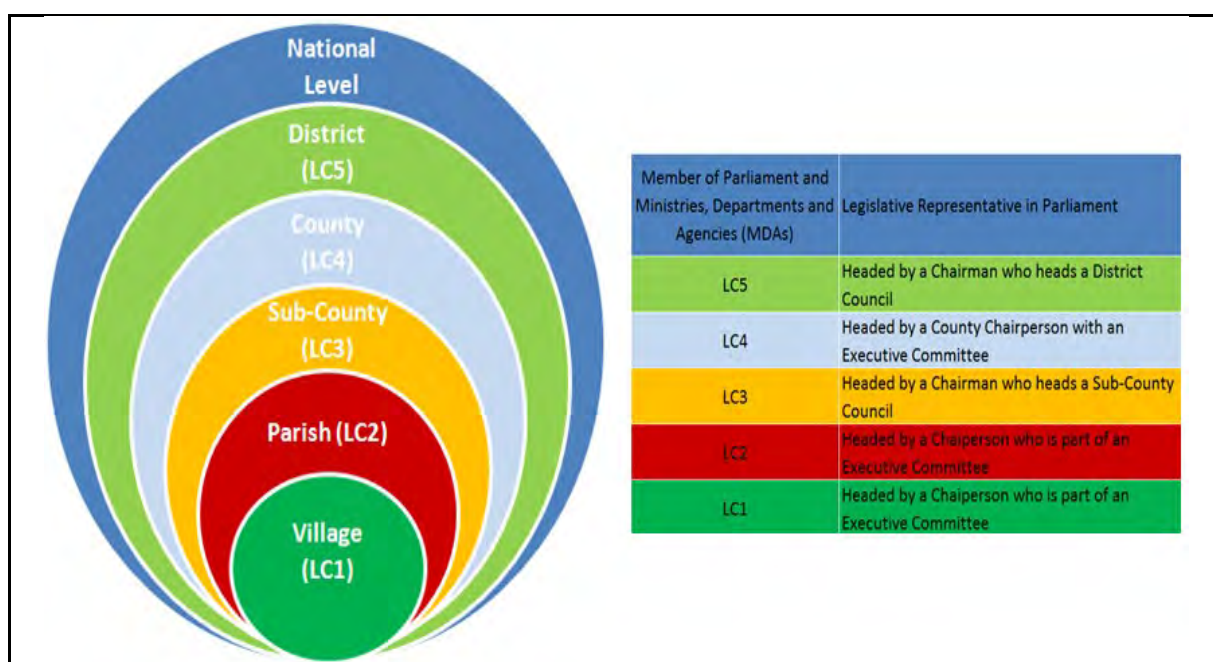


Figure 6.4-16 Government Structure of Uganda

SOURCE: Modified from the TEPU Stakeholder Strategy, June 2013-June 2014

Local 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 (LC5), 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).

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 Chief Administrative Officer includes heads of departments of that district.

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. Similar to the district administration, a team of technical personnel coordinates the activities and functions of the subcounty.

Each subcounty is comprised of parishes, which are further divided into villages. Parish councils have elected executive committees.

At the village level, all village citizens aged 18 years and above are members of the council.

Ancient traditional kingdoms, also known as cultural institutions, are a key feature of Ugandan society. Within the project area, there are three cultural institutions:

- the Buganda Kingdom
- the Bunyoro–Kitara Kingdom
- the Kooki Chieftdom.

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 (KIs with kingdom representatives)
- undertaking community sensitisation and awareness campaigns (KIs with kingdom representatives)
- preserving history (crafts, sites), cultural norms and identity.

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 decision-making at community level. Village councils are headed by an elected chairperson and vice-chairperson. 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).

6.4.3.4 Demographics

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.

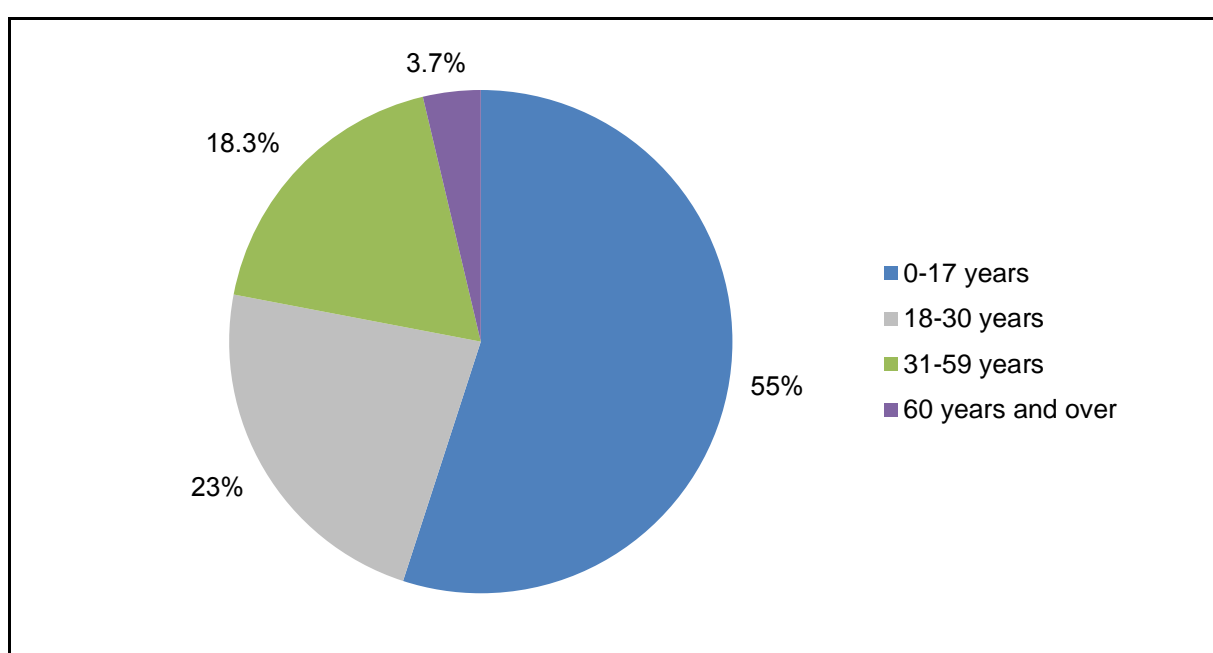


Figure 6.4-17 Age Profile

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).

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 Buganda, which consist 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).

There is great ethnic and linguistic diversity, intermarriage, rural-urban migration and other migratory movements, including trans-border migration, and this 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. In addition, 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.

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).

Internal Migration

Internal migration has occurred throughout Uganda's history and is driven mainly by employment. Internal movements are mostly towards 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).

District and PAC Level

Table 6.4-35 Demographic Data, 2014

District	Population Size			Population Density (/km ²)	Growth Rate Per Annum (2002-2014)	Average Household Size
	Total	Male (%)	Female (%)			
Hoima	573,903	49.9	50.1	158.9	4.3	4.5
Kakumiro	293,108	50.2	49.8	184	3	4.7
Kyankwanzi	213,267	51.7	48.3	91.6	4.7	4.4
Mubende	688,819	50.3	49.7	148	4.1	4.5
Gomba	160,075	50.9	49.1	180	2.9	4.5
Sembabule	252,994	49.6	50.4	79	2.8	4.5

Table 6.4-35 Demographic Data, 2014

District	Population Size			Population Density (/km ²)	Growth Rate Per Annum (2002-2014)	Average Household Size
	Total	Male (%)	Female (%)			
Lwengo	275,450	48	52	192	3.1	5
Rakai/Kyotera	518,002	48.9	51.1	159.4	2.1	4.4

The population in the districts traversed by the AOI is predominantly rural. Over 95% of people in Kakumiro, Kyankwanzi and Lwengo live in rural areas (DDPs 2015). However, consistent with national trends, the districts experience urbanisation.

Ethnicity and Religion

The main ethnic groups found in the districts in the southern part of the AOI are the Baganda and Banyankole. In the northern part of the AOI, the main ethnic group is the Banyoro.

The populations of the subcounties traversed by the AOI are diverse. The settlements near the start of the pipeline route at KP0 in Hoima district are sparsely populated and poorly connected. The population gradually increases as the AOI traverse's southwards through the districts of Kakumiro and Kyankwanzi.

Continuing southwards through the districts of Gomba and Sembabule, population levels are lower owing to the expansive rangeland of the cattle corridor except for urbanised settlements such as Kyotera town.

The main languages spoken amongst the PACs are:

- Alur
- Runyoro (Western districts)
- Luganda (Central districts)
- Runyankore-Rukiga (Central districts)
- Kinyarwanda (Central districts).

Religion is important in the sample PACs. HHIs and KIs 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.

Indigenous Peoples

According to IFC Performance Standard 7 (IFC 2012), the term 'indigenous peoples' 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.

In Uganda groups 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).

PAC Level

The ratio of males to females in the PACs is unequal. In some PACs, 40% of the population were reported to be male compared to 60% female. In other PACs, the proportion of males is said to be much greater.

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 between 2 and 5% per year, above the 1.2% world average (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.

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.

6.4.3.5 Education**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.

Figure 6.4-18 shows the national literacy rates.

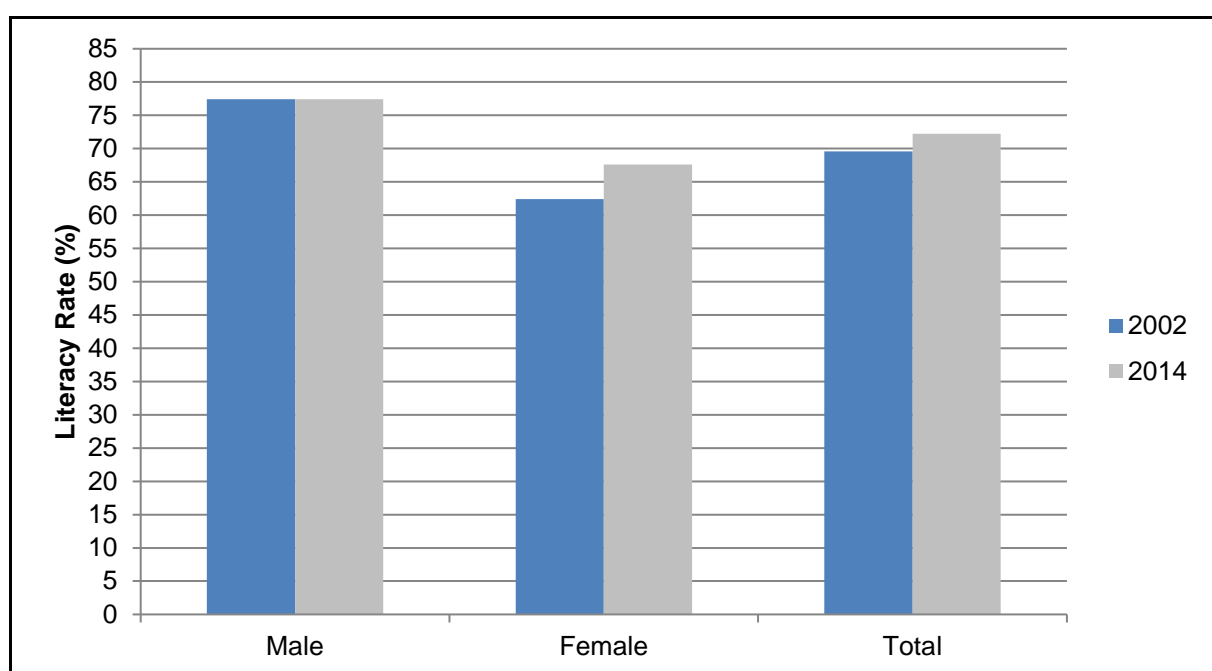


Figure 6.4-18 Literacy Rates for Persons Aged 10 Years and Above, 2002–2014

SOURCE: UBOS (2016a)

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 of the regions.

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 staff turnover and retraining costs for companies.

District and PAC Level

Key points with regards to school attendance rates in the districts traversed by the AOI are the following:

- primary school attendance ranges between 79.4% and 85.5%
- secondary school attendance rates range from 24.7% to 33.1%
- boys have slightly higher attendance rates compared to girls at primary school level
- girls have slightly higher attendance rates compared to boys at secondary school level in some districts.

Consistent with the national level, there are substantial skills gaps present in the districts traversed by the AOI. Recognising the importance of human capital development, the District Development Plans (DDPs) place emphasis on increasing the skill level and productivity of the workforce through vocational training programmes (DDPs 2015).

The DDPs highlight numerous challenges for district education departments including:

- personnel shortages
- inadequate infrastructure
- high drop-out rates amongst girls due to early marriages, teenage pregnancies and domestic chores (Kakumiro, Gomba and Lwengo DDPs 2015).

There are a small number of Technical Institutes (TIs) in the districts traversed by the AOI.

The literacy rate of the population in the PACs varies considerably. Interviews with PAC teachers reported literacy rate estimates ranging from 30-40% in sample PACs such as Kabulasoke village (KP111) to 70-80% in others (Muyenje village, KP192). Female literacy rates were mostly estimated to be below 40% (FGDs with women in all PACs).

The percentage of children estimated to be attending primary school ranges from 40 to 96%. These findings differ from national and district level secondary data, which reports average primary school attendance rates of 79% and 86%.

Teachers reported domestic chores, long travel distances from home to school and the low value attributed to education by children and parents as reasons for low attendance rates.

The majority of teachers in the PACs interviewed reported that their classrooms were not adequately equipped, lacking desks, science kits and textbooks. Other reported concerns include low wages for teachers relative to the cost of living, lack of accommodation for teachers and lack of food for teachers and students during the school day.

Trend in Condition and Sensitivity to Change

Future trends with regards to education in Uganda 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 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 aim to increase enrolment in TIs and offer vocational training programmes to citizens (Gomba and Hoima DDPs 2015).

Sensitivity Ranking

The social baseline study identified sensitive VECs for education, see Table 6.4-36.

Table 6.4-36 Education Valued Environmental Components 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

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.

6.4.3.6 Economy**Baseline Condition of the Economy**

East Africa is the fastest growing economic region in Africa with recorded regional growth estimated at 6–7% for 2016 and 2017.

As a member of the East African Community (EAC) since 2010, Uganda 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 extractive industries.

National Level

Gross Domestic Product (GDP)

Uganda's economy 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).

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 as a result of growth in other sectors such as manufacturing. Major crops include coffee, tea, 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.

Oil and Gas Sector

Uganda's first major oil discoveries were confirmed in 2006.

⁵ NOTE: Deloitte (2016) notes that the agricultural sector contributes 5.5% to the formal and 47% to the informal economy.

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).

In 2014, the Government of Uganda 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 60,000-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.

Inflation

Uganda 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). 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 inflation⁶ increased to 7.2%. However, food price inflation dropped to 11.8% by August 2017 (Bank of Uganda 2017).

Government Finances

Total government revenue in 2015–2016, including taxes and grants, was projected at USD 3.75 billion (UGX 14 trillion)⁷ (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).

Public and publicly guaranteed (PPG) debt in Uganda has 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).

Debt

Public debt is considered sustainable and the risk of debt distress is considered as low, provided planned investments in energy and transport infrastructure raise growth and revenue (UNDP 2016, Internet site, IMF 2017a, Internet site).

⁶ 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.

⁷ Conversions based on exchange rate on 24/08/2018. Source: <https://www.xe.com/currencyconverter/>.

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%).

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.

Uganda's top import partners in 2015 were Kenya (16% of import value), UAE (16%), India (13%) and China (13%) (CIA 2017, Internet site).

Employment

The following bullet points 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 is 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 (Spence et al. 2009: 26-27 cited in 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).

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 SSA, and met the Millennium Development Goals (MDGs) Target 1a of halving poverty by 2015. The proportion of people living below the international poverty line (USD 1.90 per day) (UGX 7200 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.

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 remain stable despite the view that global warming is likely to make seasons more unpredictable, foreign direct investment (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 impact 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.

Uganda is in the process of implementing the second National Development Plan (NDPII), the objective of which is to propel the country towards 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).

Ecosystem Services Provided

The Ugandan economy is heavily dependent upon agriculture, fishing, mining and tourism (all provisioning services). These ecosystem services are described in Section 6.4.3.8, Land-based Livelihoods and 6.4.3.9, River and Lake-based livelihoods.

Sensitivity Ranking

Sensitivity ranking is included in sections describing livelihood activities including crop farming, livestock rearing and mining (Section 6.4.3.7) and Local Economy (nonland-based livelihoods) (Section 6.4.3.6).

Key Considerations

Key considerations are:

- major projects create employment opportunities
- international projects may provide training and capacity building of the Ugandan workforce and local companies to satisfy Uganda's local content policy.

6.4.3.7 Local Economy (Nonland-Based Livelihoods)

Baseline Condition of Local Economy (Nonland-Based Livelihoods)

District Level

Although primary agriculture is the most important livelihood in the districts traversed by the AOI, the following economic activities are also important (DDPs 2015):

- small-scale processing of agricultural products
- small-scale trade in retail merchandise and agricultural produce
- provision of services including tourism and transport.

Local economic activities are predominantly small-scale and informal, they are neither taxed nor regulated by the state, and offer little security to workers (WIEGO 2018, Internet site).

Small-scale cottage industries, largely based on the processing of agricultural products, are based in urban areas. The development of cottage industries in rural areas is limited due to lack of rural electrification and lack of access to appropriate technology and markets (Mubende DDP 2015).

Small-scale trade occurs in all the districts traversed by the AOI. The sale of retail goods and agricultural produce by micro-enterprises predominantly occurs on roadsides in trading centres, towns and cities due to ease of access to customers and good transportation links.

The types of retail merchandise sold range from medicines and hygiene products to fuel wood, mobile airtime and agricultural produce. Women more often engage in small business enterprises than men.

Trade in retail merchandise and agricultural produce is important to the districts. Constraints to the growth of micro-enterprises are:

- lack of skills, which undermines the competitiveness and productivity of enterprises (Kakumiro DDP 2015)
- limited physical access to markets due to poor road conditions (Gomba DDP 2015)
- limited access to micro-credit and borrowing facilities.

Tourism-based livelihoods are important in Hoima district given the abundance of wildlife and geographical features.

Hoima district is a hub for tourists travelling from Murchison Falls to Queen Elizabeth National Park. Hoima has hotels and guesthouses which have invested in facility upgrades to meet increasing tourist and oil industry requirements.

Plans are underway for the construction of 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.

KIIs with kingdom representatives indicate that kingdoms promote tourism and tourism-based livelihoods in the districts traversed by the AOI.

Potentially Affected Communities Level

Trade in retail merchandise and agricultural products and the provision of services are livelihood strategies present in the sample PACs, particularly among women. Shops selling retail merchandise and agricultural products are present in virtually all the sample PACs (PAC profiles).

A variety of local services is available in the sample PACs:

- 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.

Mutukula Town (KP295.5,) a large and densely populated settlement within the AOI, serves as an economic hub for surrounding agricultural communities. Located at the international border between Uganda and Tanzania, the town is a prominent trading centre with a diverse provision of goods and services. Economic activity in Mutukula is reportedly increasing, driven predominantly by the in-migration of economic migrants. This has benefited local business owners and traders, but has exacerbated pressure on public services (especially health centres) and infrastructure (power, sanitation and roads).

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 (KII with community development officers (CDOs).

KIIs and focus group discussions (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 found that sex work takes place in several of the sample PACs.

Trend in Condition 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.
- infrastructure development is a priority at national and district levels (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 Hoima Municipality (KP22) and most especially Mutukula Town (KP295.5) in Kyotera at the Uganda-Tanzania border.

Sensitivity Ranking

the social baseline study identified several local economy (nonland-based livelihoods) sensitive VECs. These are presented in Table 6.4-37.

Table 6.4-37 Local Economy (Nonland-Based Livelihoods) Valued Environmental Components 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.

Ecosystem Services Provided

Local economy (nonland-based livelihoods) does not provide ecosystem services. It however relies on ecosystem services which are described in Section 6.4.3.8 (land-based livelihoods).

Key Considerations

Key considerations are as follows:

- 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 communities and urban centres are crucial for business owners to source supplies and market their goods.

6.4.3.8 Land-Based Livelihoods

Land-based livelihoods include:

- crop farming
- livestock rearing
- mining
- natural resources use.

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).

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 main cash crops grown are coffee, cotton, tea, tobacco and sugar cane. Crops are mainly rain fed. 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).

Agricultural production is predominantly at household level with household members, including children, assisting after school and during weekends. 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.

Commercial tree planting is increasingly important partially due to increasing construction industry, charcoal and firewood demand.

Commercialisation of agricultural produce is limited primarily due to remote farms lacking access to local and regional markets (UBOS 2011b).



Figure 6.4-19 Local Market in Katikara Trading Centre, Kakumiro District (KP41)

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).

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 a farmers group.

District and PAC Level

Crop farming is the primary and most important livelihood strategy adopted by nearly all households in the sample PACs, with the exception of some households in trading centres or towns.

Both commercial and subsistence farming takes place. Only Kakumiro district has an equal number of commercial and subsistence farmers, which is possibly due to extensive maize production as a cash crop, which is marketed in Kampala. Most agricultural activities are classified as subsistence or small-scale farming. Interviews with district agricultural experts revealed the following reasons for the large number of subsistence farmers:

- small land holdings due to division of inherited farmland into smaller parcels
- lack of access to the capital required to develop commercial farming
- costs associated with agricultural inputs (seeds and fertilisers), machinery and storage
- lack of knowledge to transform from small- to commercial-scale farming.

The main cash crops in the districts traversed by the AOI include coffee, cocoa, sugar cane, tea, soya beans, sorghum and tobacco, and on a smaller scale cotton and upland rice. Sugar and tea tend to be grown in the less arid areas of Hoima and Kakumiro districts. Coffee is traditionally grown towards the south of the AOI in the districts of Rakai, Kyotera and Mubende, and to a lesser extent in Kyankwanzi, Kakumiro and Hoima.

Subsistence crops in the districts traversed by the AOI are beans, maize, bananas (matoke), groundnut, sweet potato, potato, cow peas, sesame, passion fruit, cassava, rice, cabbage and pumpkin. Beans are the most commonly grown crop, followed by maize. In all districts, trees such as mango, oranges, pawpaw, pine and eucalyptus are interspersed with arable crops. Crops grown to a lesser extent are ground nut, potatoes, sweet potatoes, millet, sesame, tomatoes, yam and vanilla.

Commercial forestry exists in the area crossed by the AOI, but to a lesser degree than crop farming or livestock rearing.

Farming Inputs

District agricultural officers have disclosed that agricultural activities remain dependent on rudimentary hand tools. With increasing numbers of pests, pesticides have reportedly become a necessity. Yet costs associated with pesticides prevent the majority of farmers in the PACs from using them. Soil fertility of agricultural plots was reported to be declining. However, application of chemical fertilisers is not common among PACs due to their cost.

Storage of agricultural goods is critical for sample PACs, and it was reported that produce often spoils or has to be sold in a hurry at reduced prices because of lack of storage facilities within the household.

Labour

Farming in PACs is predominantly household-based, with household members, including children, executing the agricultural tasks such as tilling, planting, weeding and harvesting. Women and men are involved in all aspects of agricultural activities, such as tilling, sowing 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, whereby households work on each other's plots on a rotational basis, or community members, are hired as labourers and are served a meal as payment.

Role of Women in Crop Farming

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.

Marketing

Across the districts, value chain linkages between production, processing and marketing are weak, which results in the majority of agricultural produce being sold unprocessed at the farm gate. Nevertheless, maize milling, coffee processing and fruit processing facilities were found in the larger towns such as Hoima Municipality.

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 price
- lack of market price information from surrounding districts, preventing farmers from negotiating prices
- market gluts.

Many sample PAC farmers are supported by either the NAADS, a registered farmers' group or an informal farmers' group.

Trend in Condition and Sensitivity to Change

Crop farming trends are as follows:

- the Government of Uganda 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, in particular 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 include:

- 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, the majority of the 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 6.4-38 presents the sensitive VECs with regards to crop farming identified during the social baseline study.

Table 6.4-38 Crop Farming VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Agro pastoralists	Moderate (3)	Agro pastoralists have diversified income streams across crop farming and livestock rearing, therefore are more resilient to external shocks such as pest infestations, animal diseases and climate change.
Commercial farmers (large scale, coffee and tea)	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 as a result 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 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, 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 their rural location and lack of education, skills and experience. There is low resilience to external shocks such as crop failure. This can impact on food and nutritional status, as well as cash for cost of education and health care.

Table 6.4-38 Crop Farming VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
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.

Key Considerations

Key considerations are:

- crop farming in the sample PACs is mostly undertaken on household 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, and therefore harvests are vulnerable to pests, diseases and climate 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.

Baseline Condition of Livestock Rearing

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 litres of milk per capita per year for all Ugandans, compared to 41 kg meat and 26 litres of milk in Sudan and 15 kg of meat and 198 litres of milk per person in Kenya (ICPALD 2013). Figure A11.4-30 in Appendix A11 presents a national livestock inventory for 2009.

Livestock are reared 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). Breeds of livestock remain principally indigenous.

Agro-pastoralists undertake livestock rearing alongside crop farming. A small number of animals are kept. Pasture lands, either in 'paddocked' areas with informal hedging or fencing on privately owned land or on communal village land are used to graze livestock.

Semi-intensive production systems, whereby livestock including fowl are kept in confined spaces, are 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 areas of fenced private lands and are 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 the northeast of Uganda or the Banyarwanda from the Southwest of Uganda or Rwanda.

The fourth system, nomadic pastoral production, which is less common and remains mainly in the North East of 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 due to factors including:

- government policies which prioritise modern livestock development
- climate change resulting in prolonged droughts
- land tenure matters.

‘Localised nomadism’ is still practiced (Rakai DDP 2015). 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 carried out 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 are however prohibited during disease quarantines.

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 types in the districts traversed by the AOI are cattle, goats, pigs, donkeys, poultry and sheep. The most common livestock production system is agro-pastoralism performed on a subsistence basis. To a lesser extent, but growing in popularity, is the semi intensive production system of chicken and pigs.

Cattle rearing, as a commercial system, is most common in Hoima, Gomba, Sembabule, Lwengo, Kyotera and Rakai districts, with large cattle ranches concentrated in Gomba, Sembabule and Lwengo. Cattle ranches commonly cover tens of square kilometres of paddocked private land with herd sizes of reportedly up to 10,000 heads of cattle.

The PAC household survey showed that the majority of households keep livestock for both subsistence and sale (54%). Cattle, goats, pigs, sheep and poultry (chicken, duck and turkey) are kept.

Labour

Within the agro pastoralist system at the PAC level, all household members share the task of caring for livestock, although females are more likely to care for smaller livestock such as chickens and goats. In the case of large herds of cattle, men dominate. The care, slaughter and sale of livestock are locally perceived as the primary activity of men, but in practice it is shared between sexes.

Localised nomadism of cattle is common in the sample PACs and essential for the larger herds of cattle. Figure 6.4-20 shows the localised nomadic movements.



Marketing of livestock takes place at mixed markets. Agro pastoralists commonly walk livestock to markets, however the commercial ranches use trucks.

Livestock products are sold at the farm gate, in markets and to local milk collectors. Milk coolers were reported in Hoima, Sembabule, Gomba, Kyotera and Mudende districts, in addition commercial cattle ranches invest in coolers due to scale of operations.

Products are transported to markets primarily on foot or, less commonly, by motorcycle (Figure 6.4-21) and vehicle. Women sell dairy products such as ghee, cheese, and yoghurt and men market meat and hides. No intermediaries are engaged in the selling of livestock products.



Figure 6.4-21 Milk being Transported to the Dairy by Motorcycle in Hoima, Hoima District (KP74.5)

Key Challenges

The following key 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 have resulted in the closure of livestock markets which has left livestock owners unable to market their animals, leaving them without access to cash
- climate variability has resulted in sustained lengthening of the dry seasons, making access to water sources and pastures difficult
- livestock theft, especially cattle. This is cited as a major challenge and on the increase. Cattle breeders reported theft to be particularly high in the border areas with Tanzania (KP296). Cattle are branded to identify livestock, but this does not act as a deterrent with many thefts never being reported or recovered
- 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, were cited by 28% of livestock owners interviewed. Baboons were said to be a problem in Buseruka, Lugusulu, Madudu and Butoloogo subcounties
- increasing livestock injuries, including falling into excavations related to informal ASM, when moving animals to pastures and water sources

- prices of livestock and their products fluctuate as a result of the sellers' need for cash and condition of the animals
- conflict because of damage to crops when herds stray into farmland
- competition for resources such as water and land between pastoralists and host communities.

Trend in Condition and Sensitivity to Change

Several trends were reported by livestock keepers, pastoralists and village leaders. These are outlined below:

- long distance movements 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, there are scarce water sources
- government initiatives promote the introduction of exotic livestock breeds. However, livestock owners are slow to engage, and the new breeds are less disease resistant
- despite an increased prevalence of livestock diseases, livestock owners lack access to veterinary services. At the time of the survey, 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 as a result 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 access to land is likely to worsen due to the growing population and changing weather patterns
- settlements that are better connected to markets have seen an increase in income from sale of milk and animals.

Ecosystem Services Provided

The land-based livelihoods (livestock rearing) described herein provide the following ecosystem services:

Provisioning services include:

- 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 and livestock products are used both for subsistence and for sale. Livestock rearing in the sample PACs is predominantly sedentary with grazing on owned or rented land,

while a form of localised nomadism takes place due to increasingly unpredictable rains, particularly in the Kyankwanzi, Buseruka and the Sango Bay areas.

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 Ranking

Table 6.4-39 presents the sensitive VECs in relation to livestock rearing identified during the social baseline study.

Table 6.4-39 Livestock Rearing Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Commercial ranch owners	Moderate (3)	Commercial ranch owners own large tracts of land and rear livestock commercially with assistance of production inputs. As operations are large-scale, they are more resilient to external shocks with the exception of disease, climatic change and a shortage of labour (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 are 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 rearing	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-Uganda 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:

- owners of large herds do not have diversified income streams
- livestock rearing activities are under pressure due to shortage of land and water resources

- localised nomadic pastoralism within and between villages is undertaken in the sample PACs during the dry seasons
- livestock diseases are common and increased movements of vehicles and people could increase the spread of diseases
- human rights of access to food and a decent standard of living are maintained.

Baseline Condition of Artisanal and Small-Scale Mining

National Level

Deposits of gold, tin, tungsten, niobium, coloured gemstones, limestone, marble, kaolin, clay and granites are present in Uganda. In addition, construction materials such as sand, clay, murram, limestone, marble, kaolin and stone aggregates are quarried.

To date, Uganda's mining sector is characterised by a combination of officially registered local and international mining companies.

The Mining Act (2003) provides legislation for prospecting, exploration and mining (Alchetron 2017, Internet site). Two aspects of the Act applicable to ASM are listed below:

- Prospecting Licence: a one-year, non-exclusive licence is granted to the holder to prospect for minerals around the country
- Exclusive Prospecting Licence: the licence is mineral specific and is limited to an area of 20.48 km² (7.91 square miles).

ASM provides livelihoods for almost 200,000 women and men, and over a million Ugandans indirectly benefit (EARF 2018). It is estimated that ASM has grown by 40% since 2008 (Spiegel 2012).

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. 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.

District and PAC Level

Full-scale geological studies have not been carried out 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.

Construction materials such as sand, stone for aggregates, laterite soils for brick making and gold are the main targets for mining and quarrying in the districts.

Sand mining occurs in all the districts traversed by the AOI, in particular in wetlands. For the majority of existing sand pits, permission is sought from land owners and a fee paid. Sand sources were said to be decreasing due to an increasing number of people seeking to make a living from this resource.

ASM of gold takes place in Kakumiro, Kyankwanzi and Mubende districts. ASM involves the collaboration of various teams: land owners who own the pits, miners

or 'diggers' extract the ore, 'grinders' pulverise the ore and washers or 'panners' clean the ore.

Gold buyers from Kampala buy from miners, the pit owners or local dealers. The buyers then sell the gold to brokers, generally Indian traders, in Kampala. The gold is reportedly exported to China and Dubai.

Mubende district has become a hub for gold mining with finds in 2016, which caused an in-migration of thousands of miners, including experienced miners from the DRC, Rwanda and Tanzania.

Extraction of clay (lateritic soils) from wetlands for brick making is undertaken in all districts traversed by the AOI (DDPs and KIs with natural resource officers). It is undertaken for household use and sale.

Crushing stone for aggregate was undertaken to a lesser extent.

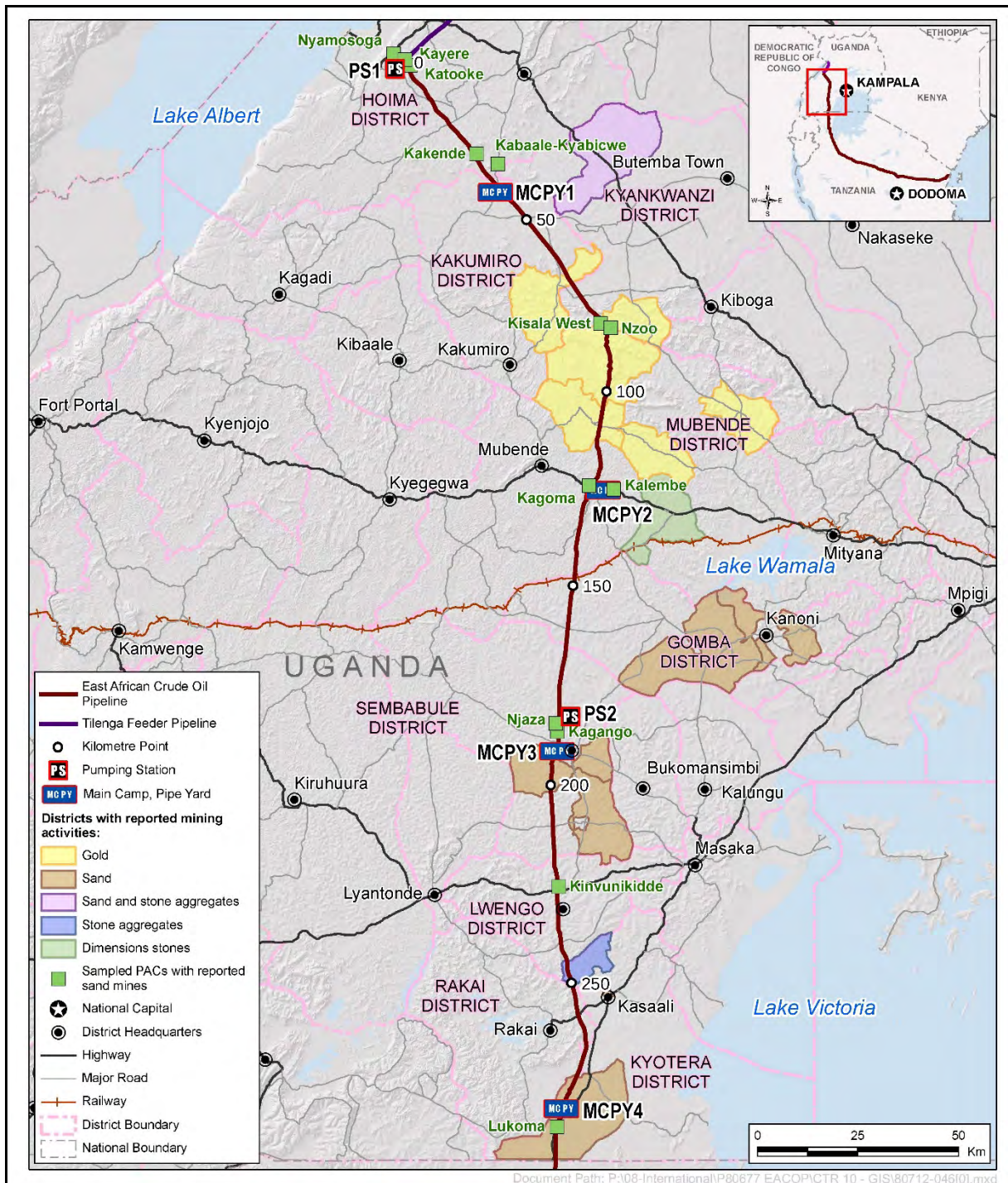


Figure 6.4-22 Artisanal Mining in the Sample Potentially Affected Communities

Problems associated with ASM, as reported by district natural resource officers, were as follows:

- ASM is undertaken in an uncontrolled manner, without a licence, and often without the knowledge of the authorities.

- environmental degradation can occur. 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 aesthetic value of abandoned and active mine sites is low
- mining is undertaken without protective equipment, exposing miners to health and safety matters. Unsupported tunnels in hard rock associated with gold mining were reported in Kyankwanzi district
- women working in ASM obtain fewer benefits than men
- child labour is prominent, especially in extremely poor households in rural communities
- gaining access to the deposits can create conflicts and boundary disputes
- in-migration of people, including experienced ASM miners from Tanzania, Rwanda and the DRC, is common (reported in Kakumiro, Gomba, Kyankwanzi and Mubende districts)
- demand for sand, clay and aggregate fluctuates
- customers do not always pay miners
- miners in Mubende district are using mercury and cyanide to process gold. These chemicals drain into waterbodies (Akumu and Kelly 2016).

Trend in Condition and Sensitivity to Change

ASM trends include:

- the government is increasingly acknowledging the importance of ASM and moving towards formalisation of the sector
- extraction of construction materials, such as sand, clay for bricks and stone for aggregate, is on the increase due to an expanding construction industry in Uganda
- ASM activities provide increasingly major benefits to households and create multiplier effects in local communities
- ASM activities slow down urbanisation and create downstream employment
- rush scenarios (large and sudden in-migration of people) for gold ASM have been encountered in subcounties neighbouring those traversed by the AOI, in Mubende district.

Ecosystem Services Provided

The land-based livelihood (ASM) described herein provide the following ecosystem services:

Provisioning services include:

- income from sale of minerals and construction materials (e.g., sand, clay and gravel)
- materials for dwellings and shelter
- salt for livestock and domestic consumption.

ASM is an abiotic provisioning ecosystem service carried out throughout the AOI by sample PACs, primarily in the dry season. Information about the nature and extent of this ecosystem service is included in the text above.

Sensitivity Ranking

Table 6.4-40 presents the sensitive VECs with regards to ASM identified during the social baseline study.

Table 6.4-40 Mining Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Pit owners on ASM sites dependent on mining for their income	Moderate (3)	These VECs are moderately vulnerable to loss of income but are likely to be more resilient if relocated owing to the relatively cash rich nature of pit ownership.
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 have therefore 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.
Women in ASM	Very high (5)	These VECs are highly vulnerable as they have less access to productive capital than men and may be relying on ASM activities as a sole livelihood.

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
- due to the informal and hence often covert nature of ASM activities, it is difficult to assess the precise location of ASM sites at any particular time
- PACs' human rights to a decent livelihood, safety and security.

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, 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.

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.

District and PAC Level

Forest, rangeland and wetland habitats characterise the districts traversed by the AOI. Local communities harvest natural resources in these habitats for subsistence or for cash income.

Figure 6.4-23 presents the natural resources use in the sample PACs.



Trees, mainly eucalyptus and pine, are used for construction (poles for scaffolding or joists and uprights in houses and planks for walls; Figure 6.4-24), household furniture, kitchen utensils, poultry cages and shelters. Wood is sourced from private land in areas adjacent to communities with permission sought from the landowner.



Figure 6.4-24 Wood Cut for Firing a Brick Kiln in Katikara Trading Centre, Kakumiro District (KP41)

Fibre from the inner bark of the Mutuba tree *Ficus natalensis* is used to make the traditional bark cloth (olubuggo), which is used as mats and decorations.

Firewood, an important source of cooking fuel, is collected in communal land by communities in all districts traversed by the AOI. Responsibility for collecting firewood falls largely on women and children. Distances travelled to find firewood have reportedly increased due to diminishing sources. In some instances, permission from private land is sought to access firewood and an annual fee is paid.

Charcoal use is popular in all districts traversed by the AOI. Charcoal processing, predominantly for sale, with small amounts used for the household, is found in a small number of sample PACs.

Papyrus *Cyperus papyrus* grows in abundance in wetland areas of the districts traversed by the AOI and the shore of Lake Albert to the west of the pipeline route. The papyrus is cut, dried and used to make sleeping mats, flooring and screens, baskets and fish traps.

Grasses, which are harvested by both women and men predominantly on village land have several uses. These include:

- thatching of 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 due to ongoing depletion of communal grazing areas and the shortage of pasture land during the dry season. Grass for animal fodder is mainly collected in the central and southern sample PACs within the traditional cattle corridor.
- making brooms is a seasonal activity and are generally sold at local markets.

There is 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 the remote rural areas.

Wild fruit and vegetables are harvested by all sample PACs throughout the year, and serve to supplement the diet. Surplus is 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. Wild foods are mainly collected by women and children. Mushrooms are harvested between March and May and August and October from scrubland, forest and groves near communities.

Grasshoppers are harvested, mainly in open areas, by men, women and children to supplement the diet. Ants are collected between February and April and between March and June.

Hunting of wild animals was reported to occur in all sample PACs on an infrequent basis. Animals hunted include duiker, impala, bush buck; baboons, bush pig, rabbits; squirrels, hippopotamus, Ugandan cob, rats and warthog. Hunting is undertaken by men in crop growing areas and in uncultivated communal lands.

Apiculture is a livelihood activity practiced in all districts traversed by the AOI. Gomba, Mubende, Sembabule, Lwengo and Kyotera have high densities of beekeepers. Most sample PACs typically have one or two beekeepers.

Challenges for Natural Resources Use Across the Districts

Challenges facing natural resources include:

- a growing population has put pressure on the natural resources due 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
- the honey production is inefficient. Traditional beehives and rudimentary equipment can lead to contamination of the processed honey. Fermentation of honey is common due to lack of appropriate equipment and storage facilities. Potentially valuable by-products such as wax and propolis are discarded. To increase production, beekeepers need more support in terms of equipment and on-going practical training
- there is a loss of bee habitat due to clearing of vegetation and climate change.

Trend in Condition and Sensitivity to Change

Key trends affecting natural resources use include:

- natural forest and scrubland is diminishing so women have to travel increasing distances to collect wood. With few affordable alternatives to firewood and charcoal, long-term sustainability of existing sources of biomass fuel is uncertain
- medicinal plants are widely used for human and animal illnesses, especially in remote rural areas due 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 diminished because there is a decrease in game populations due to overhunting, clearing of forest 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 service include:

- 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 Ranking

Table 6.4-41 presents the sensitive natural resources use VECs identified during the social baseline study.

Table 6.4-41 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.
Fibres and grass collectors	Low (1)	Fibres and grass are widespread, and their availability will not be substantially impacted.
Hunters	Low (1)	Hunters are generally not reliant on the bush animals they catch for food or as a main income.

Table 6.4-41 Natural Resources Use and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
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 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.

Key Considerations

Key considerations are:

- communities, especially poorer households, are dependent on natural resources for the provision of 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
- there is a decline in bee populations 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.

6.4.3.9 River- and Lake-Based Livelihoods**Baseline Condition of River and Lake-Livelihoods*****National Level***

The fisheries sector provides a livelihood to fishermen 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 carried out in major and minor lakes, rivers and wetlands. 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.

The Government is supporting the emergence of pond- and dam-based aquaculture.

District and PAC Level

River, Stream, and Wetland Fishing

The AOI crosses the Kafu River (KP39 MCPY1), Nabikazi River (crossing at KP114 and KP148-149), Katonga River (KP165) and Kibale River.

FGDs found that freshwater fishing was undertaken in all sample PACs. Fishing is likely to be encountered at all river, stream and wetland crossings and in particular the major rivers (see Figure 6.4-25). The rivers contain *Protopterus aethiopicus*, *Schilbe intermedius*, *Labeo* species, small Mormyrids and macroinvertebrates such as Chironomids (see Appendix A2, Aquatic Biodiversity Baseline Report). Fish caught in rivers and wetlands are mainly consumed by the household.



Figure 6.4-25 Fishermen Using Nets to Catch Fish in Bethlehem, Kyotera District (KP247.5)

Lake Fishing

Fishing is practiced on Lake Albert (Buseruka subcounty, Hoima district), Lake Wamala (Gomba district) and Lake Victoria, and minor lakes such as Kijjanebarola (Rakai district) and Kacheera (Kyotera district).

Fishing communities are centred on landing sites, where boats and nets are shored, fish processing is undertaken, food stalls and traders operate and Beach Management Units are active. These sites also serve as gathering points for

recreation and have been linked with social ills and elevated HIV rates (see Section 6.4.3.12 on community health).

Fishing communities have expanded substantially in recent years and attracted unemployed youth and, in the case of Hoima district, youth from the DRC (Artelia 2015b). Males dominate the fishing activity (Hoima DDP 2015). However, women are involved in the processing and marketing fish part of the supply chain. Fishermen are of diverse ethnic backgrounds. In Hoima, fishing is undertaken by the Baganda, Bakobya, Bagungus and Banyoro. The Alur make up a large proportion of the fishermen on the shores of Lake Albert in Hoima district.

Lake fishing is predominantly a full-time occupation and fishing households are therefore solely dependent on this source of income. A small percentage of fishermen also engage in crop farming, livestock rearing or trading.

Lake fishing is undertaken from the shore or from vessels. Boats are usually paddled, with only a minority having outboard engines.

The main fish caught in lakes in the districts traversed by the AOI are Nile Perch, Tilapia, Mudfish and Clarias species.

Marketing and Processing of Lake Fish

Average fish prices are high due to the high demand and short supply. High market prices encourage fishermen to sell rather than consume or share their catches in the local fishing community. FGDs found that fish is sold:

- fresh or processed in local markets such as Hoima Municipality, Masindi Town and Kyotera Town
- fresh or processed at regional markets or in the DRC in the case of fish caught in Hoima district.

Where physical access is possible, refrigerator lorries collect the fresh fish from the landing sites for transport to the factories. Where such access is not possible, fishermen transport their catch by motorbike (Rakai DDP 2015).

Fish is also processed locally before being marketed. Processing is undertaken mainly by women by sundrying fish on makeshift papyrus racks or smoking the fish in firewood-fuelled mud ovens. Salting, which is a male activity, is also undertaken to preserve and sell the fish (Artelia 2015b).

Aquaculture

Aquaculture is a growing economic sector in the districts traversed by the AOI, and all districts are investing in aquaculture initiatives as evidenced in DDPs. However, it is still predominantly a subsistence activity, undertaken in manufactured or dammed ponds up to approximately 500 m² in size.

FGDs and KIs with district production officers and fishermen identified the following challenges associated with aquaculture:

- aquaculture is constrained by low inputs and the low quality of fish fry and feeds, resulting in poor productivity
- major diseases including fungal infection and stunted growth are experienced as a result of poor feeds

- predators such as monitor lizards, snakes and herons further reduce yields (UBOS 2009b).

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 and decreasing fish stocks encourage 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, and therefore further constraining fish availability.

Ecosystem Services Provided

The river and lake-based livelihoods described herein provide the following ecosystem services:

Provisioning services include:

- income from selling catch and fishing equipment
- food to supplement diets
- products for fish processing activities.

Cultural services include:

- Fishing has been an important activity for generations and is a major part of the PACs' way of life, in particular for the lake fisherfolk.

Sensitivity Ranking

The social baseline identified sensitive VECs for river and lake-based livelihoods. These are presented in Table 6.4-42.

Table 6.4-42 River- and Lake-Based Livelihoods Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
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.
Women who process and market fish (river) as part of a multiple livelihood strategy	Moderate (3)	Women have limited income-earning opportunities. Fish processing and marketing is undertaken alongside crop farming. Women have generally more than one income stream and will therefore not be dependent on fish processing and marketing as the sole means of making a livelihood for the household.
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.

Table 6.4-42 River- and Lake-Based Livelihoods Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
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
Landless who fish on rivers	Very high (5)	The landless are more reliant on deriving an income from natural resources. With no or limited alternative income generating opportunities other than fresh water fishing, this category is considered highly vulnerable.
Employed workers of aquaculture enterprises	Very high (5)	Often landless and exclusively dependent on their job.

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
- the human right to access to food and an adequate standard of living for communities.

6.4.3.10 Land and Property**Baseline Condition of Land and Property*****National Level***

The Land Act (1998; 2010) identifies four forms of land tenure: customary, leasehold, freehold and mailo (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 Hoima, Kakumiro

and Kyankwanzi. 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 certificate of customary ownership. A CCO can be acquired through a tiered application process. Applications are reviewed by the Area Land Committee and certificates are eventually issued by the district land board.
- 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 km²) is confined to Buganda (central Uganda) and Bunyoro (western Uganda). At present there are over 250,000 mailo land title holders in Uganda (MLHUD 2013).

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.

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).

Foreigners cannot own freehold land. However, 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 have to protect interests of women, children and disabled persons
- women have to be represented in land committees, CLAs and tribunals.

District and PAC Level

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).

At the subcounty level, land is administrated by an area land committee and a recorder. In 2016, an online cadastre (register of land ownership) was launched for the mining sector, which aims to reduce conflicts between different land owners who are involved in mining activities.

Large tracts of land are also owned by institutions like the Church and the Kingdoms who lease out to individuals on a lease-hold basis.

Land management challenges are shown in Table 6.4-43.

Table 6.4-43 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 otherwise is 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 as a result 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 evidence of a move towards individual ownership. CCO linked to membership of a given clan may not be relied on as stable instruments since social migration and community dynamics change family and community composition.

SOURCE: Adapted from CNOOC et al. (2016)

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 between 16–26% of the land, and informal (customary) ownership is reported to be approximately 15% and conjugal ownership is reported to be 3% (LANDac 2016). As the value of land is increasing, the 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.

Land Holdings

National data relating to average land holding size is scarce. However, UCA states that the national holding size is 1.1 ha (UBOS 2011b). According to the DDPs (2015), agricultural landholdings are fragmented and small.

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
- non-consented 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.

Settlements

In rural areas, most of the dwellings concentrate along national and secondary roads. Hamlets and villages often have a central trading place in which the main business and social activities take place.

Traditional house structures common throughout the PACs are constructed using wood joists and uprights, with thatched roofing and adobe walls. Other structures are improved houses with brick walls, and zinc or fired clay tiled roofs.

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 causing an increasing scarcity of land. The overall number of disputes involving land-related cases is increasing.
- 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. As a consequence, 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 is 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.

Ecosystem Services Provided

The ecosystem services provided by land have been considered in Section 6.4.3.8, Land-Based Livelihoods.

Sensitivity Ranking

Table 6.4-44 lists the sensitive VECs for land and property.

Table 6.4-44 Land and Property Valued Environmental Components 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 as a consequence of recent droughts and climate variability.
Landholders without title deeds	High (4)	Without title deeds land holders will be more vulnerable in terms of rights to compensation for loss of land.
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.
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.

Table 6.4-44 Land and Property Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
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 will have low resilience to additional shocks.

Key Considerations

Key considerations are:

- the increasing scarcity of land which may impact on the ability to provide alternative land to PAPs requiring resettlement
 - the vulnerability of most landowners due to lack of formal title deeds, potentially making them vulnerable in terms of rights to compensation for loss of land
- 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 shortage of land
- 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 6.4.3.8)
- 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.

6.4.3.11 Workers' Health, Safety and Welfare

Baseline Condition of Workers' Health, Safety and Welfare

The majority of the International Labour Organisation (ILO) conventions have been incorporated into national legislation.

Ministry of Gender, Labour and Social Development (MGLSD) through the district administration provide oversight to workplace conditions and worker employer relations. 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 their labour rights (DTCIDC 2016).

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 frequently violated (ISER 2017).

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. Workers have limited power to negotiate with their employers. This is exacerbated by poor awareness of labour rights amongst workers. High levels of illiteracy and the complexity of laws governing labour in Uganda make it difficult for people to understand their rights, rendering them vulnerable (ISER 2017).

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). 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 addition to women, other groups, including those living with HIV and or AIDS, casual or temporary workers and child-headed households, also experience workplace discrimination.

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 (PSPS) 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 (SHI), which would also cover workers from the informal economy. 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 MGLSD, through the Department of Occupational Safety and Health (DOSH), is responsible for administration and enforcement of 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 due to lack of regulators enforcing the Act. The management of OSH risks within the workplace is not recognised as a priority by business owners and staff supervisors, and Uganda's labour productivity is the lowest in East Africa due to poor working conditions. The Danish Institute for Human Rights reports that in 2011, Uganda had the highest rate of construction incidents in the world, with 4,200 major injuries taking place each year purportedly as a consequence of inadequate poor construction materials and high numbers of workers on sites (2016). The reality being, employers or employees do not consistently report workplace incidents, and workers do not commonly use legal processes to claim their entitlement for injury.

While there is no detailed 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 OHS controls to the workforce in the sample PACs.

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), and 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.

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 OHS controls to the workforce in the sample PACs.

Trend in Condition and Sensitivity to Change

The following trends could be identified:

- the recent, and ongoing, expansion of the informal mining sector across the country is resulting in greater OHS risks, as this sector is largely unregulated and the awareness of OHS amongst 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 6.4-45 provides the sensitivity ranking for the local workforce.

Table 6.4-45 Workers' Health, Safety and Welfare Valued Environmental Components 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.

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 existing PACs
- low levels of understanding of a non-discriminatory work culture such as with a mixed gender workforce in the PACs
- the human rights of workers with regards to health and safety.

6.4.3.12 Social Infrastructure and Services

Baseline Condition of Social Infrastructure and Services

National Level

Electricity

The liberalisation of Uganda's power sector in the late 1990s resulted in the unbundling of 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).

A large proportion of Uganda's rural population remains without access to electricity. To address the lack of electrical power provided to rural areas, a 10-year Rural Electrification Strategy and Plan (RESP-2) was approved by the Government of Uganda in 2013.

The Rural Electrification Agency (REA) was 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).

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).

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.

The number of people with mobile internet subscriptions is far greater than fixed internet subscriptions.

Mobile money services were first introduced in Uganda in March 2009 and have grown substantially since then (Bank of Uganda 2016). A survey conducted in 2015 found that 43% of Ugandan adults have access to, and 26% actively use, mobile money accounts (CGAP 2015, Internet site).

The benefits of mobile money include:

- increased accessibility to financial services
- agricultural commercialisation, rural development and poverty reduction (Baganzi and Lau 2017).

Media

There are 24 daily and weekly newspapers in Uganda (Freedom House 2015, Internet site). 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 broadcasting, which began in 1952, is the most widely accessed news medium in Uganda (Freedom House 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). 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).

There has been substantial growth in Uganda's television industry since the 1990s. In urban areas, roughly 80% of the participants reported watching television at home.

Waste Management

The provision of waste management services under the Local Government Act 1997 is the responsibility of local government authorities (Komakech 2014). Rapid population growth and higher levels of economic activity in urban areas has led to a substantial increase in waste generated.

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. Field observations found considerable amounts of waste dumped in open areas, streams and drainage canals, burnt near to homesteads or buried. Domestic liquid waste in Uganda is mainly disposed of via pit latrines.

District and PAC Level

Electricity

Less than 20% of households have access to electricity in the districts traversed by the AOI. However, access to electricity may improve following the completion of energy generation projects in the districts.

In the absence of electricity, people rely on alternative energy sources for lighting, principally fuel lamps and solar powered torches, and candles to a lesser degree.

Telecommunications

Up to 100% of households in the PACs own mobile phones which 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, which tend to have electricity and serve as mobile phones charging points.

Internet penetration in the districts remains low; on average, 4.4% of persons aged 10 years and above use the internet, despite reported growth in internet subscriptions at the national level. 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 the districts traversed by the AOI.

The popularity of radios in the districts may be a reflection of low literacy levels and limited disposable incomes, and these factors may limit access to newspaper and television.

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 is widely reported, particularly in town councils and trading centres.

During KIIs, it was found that the main waste management strategies undertaken in the sample PACs is the burning of waste in open air or burial of waste in private pits. These activities are undertaken near homesteads.

Trends in Condition and Sensitivity to Change

Trends for social infrastructure and services include:

- 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. 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 include:

- electricity from hydro, fossil fuels and solar energy
- cooking fuel from biomass and firewood (see Section 6.4.3.8, land-based livelihoods – natural resources use).

Sensitivity Ranking

Table 6.4-46 provides the sensitivity ranking for infrastructure and social services.

Table 6.4-46 Social Infrastructure and Social Services Valued Environmental Components and Sensitivity Ranking

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 sources.
PACs – electricity	Moderate (3)	Most PACs do not have access to grid electricity and rely on other means for cooking and lighting. Lack of grid electricity limits the economic development of PACs. 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 those media.

Key Considerations

Key considerations are:

- PACs rely on radio as a main means of receiving information
- mobile phone and internet is becoming increasingly important for exchanging information
- rural electrification is low, limiting general development.

6.4.3.13 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 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 HIV and AIDS
- food and nutrition related concerns
- noncommunicable diseases
- accidents and injuries

- veterinary medicine and zoonotic diseases
- social determinants of health
- social cultural health practices.

Exposure to potentially hazardous materials, noise and offensive odours has not been considered in the baseline but are considered in the impact assessment.

Baseline Condition of Health System

National Level

Health care in Uganda is delivered by both public sector (government) and private entities, which 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 6.4-47) 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 6.4-47.

Table 6.4-47 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 1000 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 5000 people	This is the second level of service delivery and includes: 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.

Table 6.4-47 Health System Delivery Structure

Structure	Level	Description of Role Function in Structure
	Health subcounty	HC IVs provide the same broad level of care as HC III, with the addition of more advanced inpatient care, 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.
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 occur at this level. They are generally managed by the district government.
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 subcounty 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 the delivery of 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 provide supervision and monitoring of 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 health officer, mandated to implement programmes and policy.

Table 6.4-47 Health System Delivery Structure

Structure	Level	Description of Role Function in Structure
Ministry of Health	National	<p>The MOH is responsible for:</p> <ul style="list-style-type: none"> • 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, technical support and supervision • provision of nationally coordinated services and coordination of research • monitoring and evaluation of the overall health sector performance.

The country has an estimated 1.55 health workers per 1,000 persons, which is below the WHO ratio of 2.28 per 1,000 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 suboptimal, notably pharmacists (8%), anaesthetic staff (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).

District and PAC Level

The distribution and types of health facilities available in the project districts are included in Figure 6.4-26.

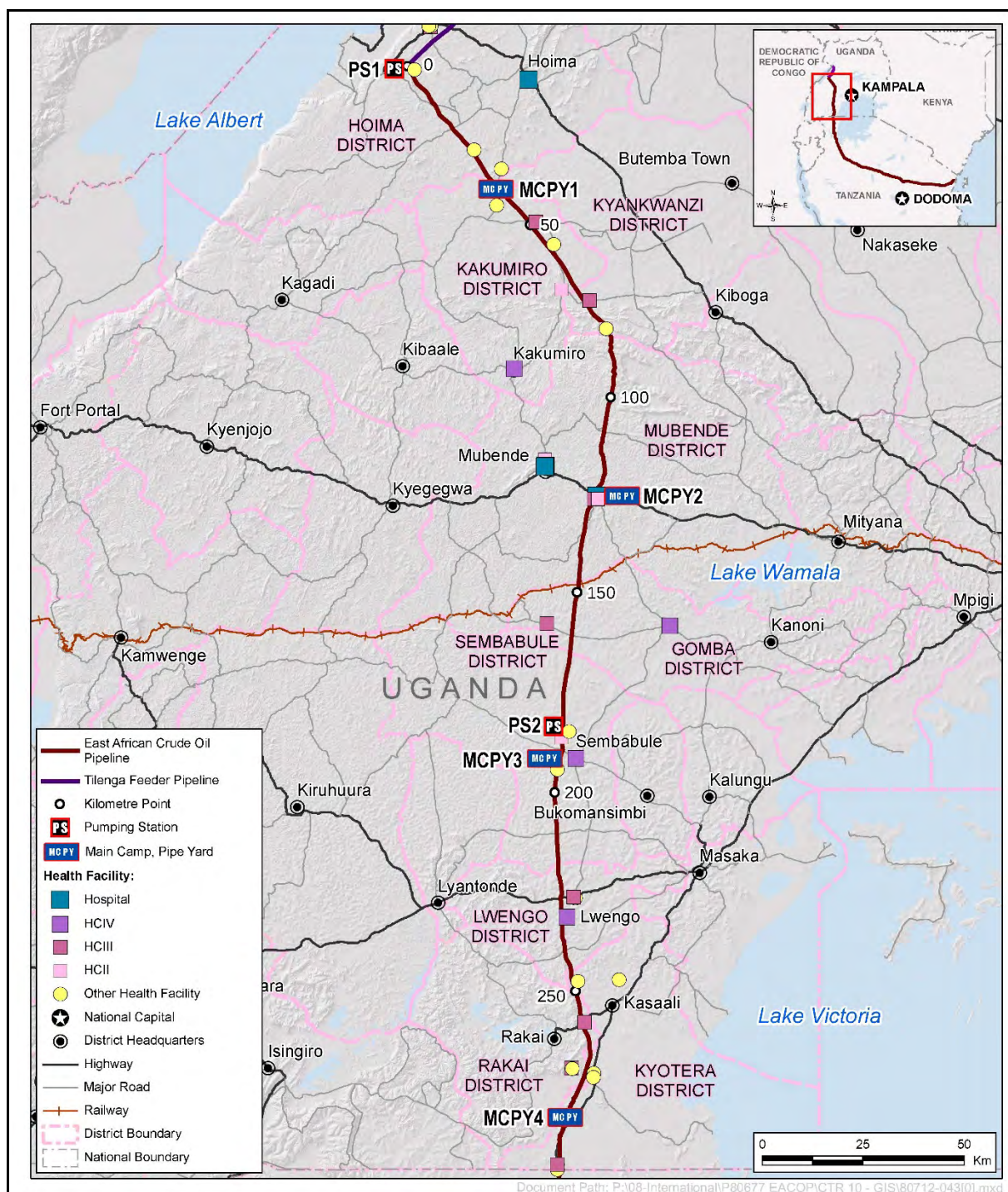


Figure 6.4-26 Health Facilities by District

Health System Challenges

The 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.

Trend in Condition and Sensitivity to Change

Despite the improvement in some parameters, the sensitivity to change of the health systems in the project districts is considered to be 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 (e.g., infective outbreaks), as well as longer-term impacts associated with chronic conditions.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table 6.4-48 presents the sensitive health systems VECs.

Table 6.4-48 Community Health Valued Environmental Component and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PACs in the districts of Kakumiro, Kyankwanzi, Lwengo, Gomba and Sembabule	High (4)	Difficult access to appropriate health care and services

Key Considerations

A key consideration is:

- population growth (natural and because of in-migration) may lead to local health care facilities being over-stretched.

Baseline Condition of Communicable Diseases Linked to the Living Environment

Acute Respiratory Infections

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).

Data obtained from the district level HMIS show that ARI contributed to at least 20% of the outpatient load in the project districts, with the highest burden recorded in the districts of Kyankwanzi (37%) and Gomba (35%).

Tuberculosis

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, WHO 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).

Baseline findings show that TB is endemic in all the districts traversed by the AOI. District level HMIS data from 2016 shows that Hoima district recorded the highest number of TB cases. The number of TB cases reported at PAC level were low with only a small concentration of reports in Kagango (KP186.5).

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 burden of disease (BOD) in the districts, the available health services, trends in disease, stakeholder concerns and in-migration into high burden areas.

The district of Rakai is considered to have a moderate sensitivity based on the available data, which illustrated no concerns regarding housing and overcrowding, and the lowest prevalence of diseases associated with living conditions. However, the data indicates that the other districts traversed by the AOI were deemed to have either a high or very high sensitivity to change.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table 6.4-49 presents the sensitive VECs identified for communicable diseases due to living conditions.

Table 6.4-49 Communicable Disease Valued Environmental Components 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.
Elderly	High (4)	Lower immune response and greater risk for contracting communicable diseases.
Children (especially under five years old)	High (4)	Immature immune systems and low herd immunity.
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.

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, potential in-migration into the PACs will likely increase the prevalence of communicable diseases.

Baseline Condition of Vector-Related Diseases***Malaria***

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 accounts for between 20–50% of outpatient cases in the districts traversed by the AOI. HMIS data from 2017 indicate that the malaria case load (confirmed by rapid diagnostic test) was highest in Hoima, Mubende and Kyotera, and lowest in Gomba.

Findings from FGDs and household surveys show that malaria is among the most common ailments experienced by sample PACs.

All the districts traversed by the AOI received periodic mass distribution of insect treated nets (ITNs). They also received targeted distribution of ITNs to pregnant mothers and children under-five years and malaria prophylaxis in pregnancy.

Malaria case management with rapid diagnostic test and artemisinin in combined therapy is routinely available in all health facilities.

Dengue

Dengue is endemic in Uganda.

Yellow Fever

Most recently in March to April of 2016, an outbreak of yellow fever was confirmed in Masaka district and spread to seven other districts including Rakai (WHO 2018, Internet site).

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 northwest and *T. b. rhodesiense* in the southeastern region (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 within a low risk area for sleeping sickness transmission.

HAT was reported in PACs near protected areas in Hoima, in the communities of Kayere (KP0), Katooke (KP1.5) and Nyamasoga (KP0), and in Lukoma (KP287.5) near the Tanzanian border.

Onchocerciasis

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*. It is most common in Hoima where 398 cases were recorded in 2016 and 245 cases in 2017. The district implements an onchocerciasis elimination strategy, which includes biannual mass treatment with ivermectin and vector elimination measures, and results indicate that transmission of the disease has been interrupted.

Trend in Condition and Sensitivity to Change

Confirmed malaria cases increased in all project districts from 2015 to 2016. The number of cases remained high in 2017, with minimal changes across all project districts. Other vector-related diseases generally show a decreasing trend.

The sensitivity of the districts traversed by the AOI with regards to vector-related diseases varies from moderate to high. Due to a high BOD, in conjunction with an increase in disease trends, the districts of Hoima, Mubende, Rakai and Kyotera are all considered highly sensitive to change with a lower resilience than the other project districts.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The sensitive VECs for vector-related diseases are presented in Table 6.4-50.

Table 6.4-50 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 can lead to changes such as an increase in bodies of standing water that provide breeding habitat for mosquitoes, and therefore an increase in malaria
- vector management treatments, if not performed in alignment with national strategies, result in an increase in vector resistance and negatively affect local preventative interventions that are implemented by local authorities
- PIIM may cause changes that promote vector breeding, disease transmission, changes in the distribution of vector-borne diseases and an increased burden on health systems
- environmental sanitation, health care services and prophylaxis, vector control programmes and PIIM management are key for controlling malaria.

Baseline Condition of Soil-, Water- and Waste-Related Diseases**Access to Drinking Water and Sanitation**

The prevalence of soil-, water- and waste-related diseases is highly dependent on sanitation facilities and access to safe drinking water.

The districts of Gomba, Lwengo and Kyotera recorded the best access to safe drinking water at 87%, 72% and 63%, respectively, while Mubende, Kakumiro, Sembabule and Rakai ranked in the bottom five with coverage below 50% (MWE 2017).

Information from 39 PAC profiles indicate that 51% of communities have access to boreholes, however many of these are noted as being non-functional. Moreover, 36% of the PACs state that they have access to unprotected community wells, suggesting that access to safe drinking water is limited. Others rely on surface water from lakes, rivers and reservoirs for their domestic needs, often sharing these water sources with livestock.

The majority of the population in the districts traversed by the AOI have access to some form of sanitation facility, with the highest coverage recorded in Hoima (91%), followed by Mubende (84%) and Rakai (84%) (MWE 2017).

Pit latrines are the commonest type of sanitation facility. Access to hand-washing facilities is still a challenge with coverage noted to be between 17% and 65% (MWE 2017).

Diarrhoeal Disease

Baseline findings show that diarrhoea is a common cause of morbidity in the districts traversed by the AOI. According to HMIS data, approximately 3% of all outpatient cases are present with diarrhoea. Cases were reported in the majority of PACs traversed by the AOI, ranging from Katooke (KP1.5) and Nzoo (KP84) in the north to Kabonera (KP284.5), and Mutukula Town (KP295.5) towards the south.

Cholera

Cholera remains a major risk in all of the districts traversed by the AOI with a variable level of vulnerability identified across districts.

The key underlying factors leading to higher vulnerability are:

- limited access to safe drinking water
- inadequate sanitation
- poor hygienic practices.

Typhoid Fever

Typhoid fever continues to be a public health concern in many developing countries, including Uganda. Typhoid is commonly over-reported due to the lack of required diagnostic facilities. HMIS data show that the districts traversed by the AOI record several cases annually. FGD participants in PACs consistently listed typhoid among common ailments in their community.

Intestinal Worms and Schistosomiasis

Intestinal worms were reported throughout the districts traversed by the AOI, with more cases noted towards the south in Miti (KP194), Muyenje (KP192) and Kinvunikidde (KP225). Mass de-worming of young children is implemented across the county to control the infection.

Schistosomiasis, also known as bilharzia, is prevalent in tropical and sub-tropical 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.

The Lake Albert area shows a community prevalence of up to 80% (Tukahebwa et al. 2013). Schistosomiasis is a high risk in Hoima district and generally low risk in the rest of the project districts.

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

- most 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 are focused on behaviour change communication (BCC) programmes that target open defecation. Programmes target approximately 5.6 million people in over 9,000 villages, to live in open defecation free (ODF) environments, and to adopt good hygienic practices. A particularly effective initiative is Community Led Total Sanitation (CLTS).
- potential for cholera and typhoid outbreaks remain high in all the project districts as a result of underlying challenges in environmental health conditions.

Ecosystem Services Provided

Soil-, water- and waste-related diseases are linked to safe water, which provides the following ecosystem services:

Provisioning services include:

- general health
- form of livelihood (see Section 6.4.3.9 on river- and lake-based livelihoods).

Sensitivity Ranking

Several sensitive VECs were identified in relation to soil, water and waste-related diseases (see Table 6.4-51).

Table 6.4-51 Soil-, Water- and Waste-Related Disease Valued Environmental Components 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.

Key Considerations

A key consideration is:

- in-migration to PACs may reduce the availability of water, exacerbate unsanitary conditions and increase disease spread and BOD.

Baseline Condition for Sexually Transmitted Infections

HIV and AIDS

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 the control of 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 (possibly high-risk groups such as commercial sex workers). Punitive laws and stigmatising attitudes towards 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). HMIS data show that the HIV positivity rate was highest in Rakai (12%) and Sembabule (8.5%), and lowest in Kakumiro (4.4%) and Kyotera (5.6%). These rates are derived from programme data and weighted HIV prevalence among pregnant women who attend antenatal clinics, and therefore do not necessarily reflect the true prevalence in the general population.

Hotspots for HIV infection were identified along major transport corridors, and in trading centres and fishing communities, the common underlying factor being availability of disposable income that drives commercial sex activity. 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.

Women FGDs revealed that most women had acquired their knowledge about HIV-AIDS via various public health messages broadcast on the radio or at health clinics. They understood preventative measures to include using condoms, abstinence, being faithful and male circumcision. When asked if people followed measures for preventing HIV, 84% of the women replied no. The FGDs revealed that those living with HIV and or AIDS were not stigmatised in communities, with only seven PACs (16% of the sample) stating there was stigmatisation.

Sexually Transmitted Infections

Sexually transmitted infections (STIs) such as gonorrhoea, syphilis and chlamydia are prevalent in Uganda.

Baseline findings shows that sexually transmitted infections (STIs) are common in the districts traversed by the AOI. The districts of Mubende, Hoima and Rakai recorded the highest number of cases in 2017. The incidence of STIs is prevalent in

the districts traversed by the AOI, with cases of syphilis recorded in 14 PACs, including Katooke (KP1.5) and Buswabwera (KP61) in the north and Butiti (KP249.5) and Kyakudusi (KP251) towards the south. STIs were also reported in Kyenda (KP125.5) and Mbirizi (KP225).

Unsafe sexual practices, especially among the youth, were seen as the key underlying factor despite widespread availability of condoms. STI services were generally available in most public health facilities.

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.
- more than half of the districts traversed by the AOI reported a decrease in HIV prevalence (based on data captured at antenatal clinics) over the past three years. This was attributed to an upscale of interventions, including health education, free condom distribution, increased availability and use of HIV care and treatment, and reduction of HIV-related stigma. The AIDS epidemic in Uganda in the 1990s, more than any other place, substantially impacted the districts of Kyotera and Rakai. Many young men and women died from AIDS related infections, leaving many households headed by the elderly. Recent government and international interventions have substantially reversed this trend.
- HMIS data shows that Kyankwanzi, Kyotera and Sembabule reported an increase in new HIV infections. The increase in Sembabule was attributed to ongoing major road construction that has caused a sudden in-migration of job seekers and traders. The increase in Kyankwanzi was linked to the in-migration of workers displaced from closed gold mines in Mubende. The location of Kyotera at the Tanzanian border, with high population mobility, was seen as the key determinant for increasing HIV infections in that district.
- all the districts are considered highly sensitive to change with regards to HIV and AIDS, and other STIs, with the district of Sembabule rated as highly sensitive based on a high BOD and an increase in disease trend
- none of the VECs is considered resilient to change as increases in disease prevalence related to construction projects and other extractive operations have been noted by stakeholders in some of the districts
- 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 to be longer term. As with other EHA's, 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 sensitive VECs for sexually transmitted diseases are presented in Table 6.4-52.

Table 6.4-52 Sexually Transmitted Disease Valued Environmental Components 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	High (5)	High risk group for disease spread due to unsafe sex.

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.

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 most of the districts reporting sufficient food availability throughout the year.

Malnutrition and Anaemia

Acute malnutrition is generally not regarded as a major public health concern in the districts traversed by the AOI, with hospital data showing that 0.2–1.2% of children less than five years of age are affected.

More than half of project district households (at 58%) reported that they experience periods of hunger, but these are generally short-lived. FGDs reported that malnutrition commonly occurs within PACs in Hoima, Kakumiro and Kyotera districts.

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 included in land and river and lake-based livelihoods, Sections 6.4.3.8 and 6.4.3.9.

Sensitivity Ranking

The sensitive VECs for food and nutrition are presented in Table 6.4-53.

Table 6.4-53 Food and Nutrition Related Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PAC households	Moderate (3)	Vulnerable to price inflation.
Landless households	Moderate (3)	May have less access to subsistence crops and wild foods.
Elderly	High (4)	Elevated level of vulnerability to food price inflation.
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:

- most farmers in the AOI are subsistence farmers and an increase in external demand will need to be managed
- in-migration into the AOI may increase food prices and, as a result, affect food security of vulnerable groups.

Baseline Condition of Non-Communicable Diseases

The BOD attributable to non-communicable 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). It is estimated that NCDs account for 27% of all deaths in the country, of which CVD contributes 9%.

Hypertension and Diabetes

Baseline findings show that heart disease and hypertension are common in the districts traversed by the AOI. HMIS data show that Hoima, Lwengo and Kyotera recorded the highest number of hypertension cases in 2017.

All districts traversing the AOI have recorded an increase in diabetes cases. HMIS data (2017) show high numbers of diabetes cases in the districts of Hoima, Mubende, Kyotera and Lwengo. Diabetes care and treatment services were generally available at hospitals, but very limited at lower level facilities.

Cancer

The burden of cancers in the districts traversed by the AOI is not well understood. HMIS data show that several cases of cancers are recorded in the districts every year, especially cervical cancer in women and prostate cancer in men, with most suspected cancer cases referred to higher level facilities.

Asthma

HMIS data show that asthma is common in the districts traversed by the AOI, while very few cases of chronic obstructive pulmonary disease (COPD) are recorded.

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 to be an important risk factor with regards to community health in general, 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.

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. The incidence of domestic violence and GBV was reported in 38 PACs traversed by the AOI. FGDs indicate that women generally do not have support networks for victims of domestic violence.

Trend in Condition and Sensitivity to Change

Trends in traffic accidents are described in the traffic baseline report (see Appendix A12). Trends in workers' health are described in Section 6.4.3.10 (workers' health, safety and welfare) and in the socioeconomic and health baseline report (Appendix A11).

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 A12). Women, particularly sex workers, are considered highly vulnerable (4) in terms of GBV.

Baseline Condition of Veterinary Medicine and Zoonotic Diseases

The most common zoonotic diseases in the AOI are viral haemorrhagic fever and rabies.

Viral Haemorrhagic Fever

Viral haemorrhagic fevers (VHFs), particularly Ebola and Marburg, pose a substantial risk in all the districts traversed by the AOI. In 2017, four project districts recorded suspected cases of VHFs as follows:

- Hoima (13 cases)
- Sembabule (11 cases)
- Mubende (1 case)
- Kakumiro (1 case).

Rabies

Rabies is a public health problem in many developing countries, although it is often under-reported due to limited awareness, public veterinary health services and diagnostic ability. Many cases of dog bites are recorded in the local health facilities and these are often promptly managed with post-exposure prophylaxis to prevent progression to full-blown rabies.

Brucellosis is common among pastoral communities in Uganda. Each of the districts traversed by the AOI recorded at least 100 cases of brucellosis in 2017.

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 burden of disease (BOD) is low.

However, potential for outbreaks is a substantial challenge that imparts a measure of risk in the AOI. Due to the low-grade reoccurrence of potential VHF cases in

Hoima, Kakumiro, Mubende and Sembabule, these 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:

- VHF and the associated outbreak potential remains a risk to PACs, in particular those that are impacted by in-migration.

Baseline Condition of Social Determinants to Health

Uganda has recognised mental health as a serious public health concern and has recently implemented reforms aimed at strengthening the country's mental health system.

Mental Illness

Although mental illness is recognised as a public health burden in all of 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 the AOI.

Only one PAC, Mbrizi (KP225), reported that a member of the community had a mental illness.

Substance Abuse and Social Ills

FGDs in PACs show that alcoholism, 'smoking drugs', prostitution, and theft and gambling are among the social challenges in the project districts. Commercial sex work (CSW) was particularly reported in the towns of Hoima, Kyotera, Mubende, Lwengo and Mutukula.

Gender-Based Violence

Baseline findings show that GBV is common in the study area. The highest number of cases was recorded in the districts of Mubende, Hoima and Kyotera. In addition, all sex workers interviewed reported that they had been subjected to GBV at some point. FGDs indicate that women in this setting are also marginalised in education, employment opportunities, decision-making and many other aspects.

Teenage Pregnancy and Early Marriages

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 the 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. This has been identified by the government as a key challenge to Uganda's development. Several campaigns by government and other donor agencies towards prevention of teenage pregnancy, abuse and education of the girl child are ongoing in 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 (economic strife, poverty and other social challenges), and alcohol and drug abuse were identified as contributing factors. In FGDs with health staff, 74% felt that social problems have increased, in particularly alcoholism and prostitution.

Based on the available data, the VECs' sensitivity to change as it relates to social ills, is considered moderate across all districts traversed by the AOI. However, four districts with a higher burden of GBV and CSW - Hoima, Mubende, Lwengo and Kyotera - have been identified as highly sensitive.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The sensitive VECs for the social determinants to health are presented in Table 6.4-54.

Table 6.4-54 Socially Determined Diseases Related Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PACs whose members are 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.

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.

Baseline Condition of Social Cultural Health Practices

Culture and spirituality may influence health-seeking behaviour, as well as the type and perceived severity of an illness.

Baseline findings show that the majority of the population in the districts traversed by the AOI make use of formal health care services. However, self-medication and

the use of traditional medicine is also used and can negatively affect treatment outcomes by delaying treatment.

FGDs show that traditional medicine is most often used in the treatment of pregnancy complications, infertility, epilepsy, ulcers, fever, skin diseases, cough, diarrhoea, stomach ache, malaria and head ache, and those who have been 'bewitched'. Traditional beliefs and practices, poor awareness of health concerns and 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:

- health-seeking behaviour has improved and the majority of the population in the districts traversed by the AOI now use the formal health care system, as well as traditional medicine. 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 traditional medicine 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 include:

- ingredients for treatment of common illnesses (traditional medicine).

Sensitivity Rankings

The sensitive VECs for social cultural health practices are presented in Table 6.4-55.

Table 6.4-55 Social Cultural Health Practice Related Valued Environmental Components 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 health-seeking behaviour.

Key Considerations

A key consideration is:

- in-migration may lead to inadequate health care services.

6.4.3.14 Community Safety, Security and Welfare

Baseline Condition of Community Safety, Security and Welfare

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 is a major police station at Hoima Municipality (KP22).

In addition, the national approach to community policing includes the establishment of community 'crime preventers', whom are individuals proposed by local communities and their leaders, to be trained in policing and to assist the police force in maintaining law and order in the community.

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 to bolster security (UPF 2017, Internet site; Oil in Uganda 2013, Internet Site).

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:

- 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.
- 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.

Community Aspirations

FGDs with PAC leaders and women's groups shared that most aspirations were related to infrastructure and service improvement (e.g., schools, health facilities, roads and electricity). This is in line with the data obtained for the historical events.

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 to 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 as a result of migrations, emerging use of technology and intermarriage.

Familial ties with ancestral lands are particularly deemed important in terms of burial ceremonies and rituals, which are deeply rooted in a diversity of numerous cultural beliefs, traditions and religions. 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 land holdings. Deemed sacred, graves are often marked with rocks or simply go unmarked. Often generations are buried at grave sites.

Little outside assistance from Government initiatives or NGOs was observed in the sample PACs. However, NGOs such as World Vision, the Rakai Health Sciences Programme, Hoima Catholic Development Organisation, Action AID and the World Bank were mentioned during KIIs with CDOs and FGDs in PACs. The Rakai DDP (2015) acknowledges that NGOs are working within the district on natural resource management projects.

Community based organisations (CBOs) were prominent in all PACs. Savings and credit cooperative organisations, commonly referred to as 'savings circles', are the most prevalent CBOs. The existence and functioning of the savings and credit cooperative organisations in PACs demonstrates the social capital of communities, trust and mutual reciprocity.

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 amongst disengaged youth, and the number of the members is increasing, despite Government arrests and crack downs on leaders and members.

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).

Conflict

Over the past 30 years, the Government of Uganda has introduced 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).

Even though 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)
- rumour mongering
- access to water resources
- unsettled debts.

The most often mentioned disputes related to theft and land. The latter is described in Section 6.4.3.10. Land conflicts are generally resolved with the assistance of the community leaders (see Section 6.4.3.3 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.

Gender

FGDs with women and village leaders 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. All other tasks are shared by women and men. Women have the largest responsibility for child upbringing, collecting water, wood, wild plants and fruit, cultivating land, household budgeting, buying goods and sale of 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 demonstrates 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. Substance abuse, especially alcohol, was seen as a major contributing factor.
- women are also vulnerable in marriage. This vulnerability relates to the non-contractual nature of some types of marriage and the resulting inability to claim spousal rights in the event of mistreatment, divorce or abandonment.

- the low quality and accessibility of policing, health and education facilities in very poor areas exacerbate women's situation. The lack of resources of the police service acts as a constraint on women trying to extricate themselves from abusive situations.

Other Vulnerable Groups

PAC members identified the following potential vulnerable groups.

Widow-Headed Households

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, in particular 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, in particular in livestock rearing households, where they were it was traditionally seen as a child's role to tend to livestock.

Elderly

The elderly were deemed vulnerable as they are unable to work the land and are depended on remittances sent by family members.

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.

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 the 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.

Ethnicities

The main ethnic groups in the AOI are discussed in Section 6.4.3.3. During baseline data collection it was found that, whilst some villages featured predominantly one ethnic group, many were composed of a diverse mix of ethnicities. This was reported to be as a result of mixed marriages across different ethnicities, and a relatively mobile population. It was repeatedly stressed during FGDs and KIs that ethnicity is not a defining feature of vulnerability, but that other factors, such as being landless (see Section 6.4.3.9), are more likely to make a household more vulnerable.

Trend in Condition and Sensitivity to Change

- 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 decreasing in prevalence. The Government is promoting traditions through the reestablishment 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 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 affect the females in society.
- Despite government efforts to combat women's discrimination, 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 sensitive VECs for community safety, security and welfare are listed in Table 6.4-56.

Table 6.4-56 Community Safety, Security and Welfare Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Widow headed households	Very high (5)	Widows are challenged to meet basic needs of the household in terms of food security, shelter, welfare and the ability to pay for schooling and health care. Their situation is compounded by the gender aspect. Elderly widows reported as being subject to theft of property and land.

Table 6.4-56 Community Safety, Security and Welfare Valued Environmental Components and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
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. Those 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.
Women	Very high (5)	Cultural attitudes towards 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.
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.
People living with illnesses	Very high (5)	People with illnesses (e.g., 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 as, without formal acknowledgement of land ownership, they will not be eligible for compensation, only for crops grown.

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 as a result of changing demographics and decentralisation, underlining the requirement for effective stakeholder engagement
- there are vulnerable groups which will need special considerations.

6.4.3.15 Traffic

This section describes the:

- traffic AOI
- methods
- baseline condition of the transport network, including
 - ports, airports, the road network, public transport, walking and cycling
 - trends affecting traffic conditions and sensitivity to change
 - traffic sensitivity rankings
- key considerations.

For more information, the traffic baseline report is included in Appendix A12.

Area of Influence

The potential traffic impacts in an AOI are those that connect to key population centres, ports and airports to the AGIs, construction facilities and pipeline RoW.

The traffic AOI includes the trunk road network across Uganda and Tanzania closest to the pipeline, other roads that connect to the construction facilities and AGIs, and roads that connect to major centres and ports, such as Kampala and Dar es Salaam.

AGIs will remain operational over the project lifetime, so the AOI at these locations is considered over approximately 25-years. At other locations, the AOI extends is the construction period.

Methods

A desktop review of the transport network using maps, satellite images, input from the project engineers 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 use was undertaken using information from UNRA, the World Health Organisation and data gathered through the social field surveys to identify the conditions experienced by users. Walking, cycling, public transport and the typical forms of private transport used were considered.

A field survey collected data on traffic volumes and flow characteristics at 16 selected locations within the project area, five in the Uganda EACOP AOI.

Baseline Condition of Traffic

The baseline traffic conditions relate to four VECs; social infrastructure and services, community safety, security and welfare, workers' health, safety and welfare, and community health. These VECs are associated with the transport network, including ports, airports, road network, public transport, walking and cycling, road safety and traffic flows.

Ports

Uganda is a land-locked country and therefore 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
- 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, approximately 40 km southwest of the city. At the time of writing, the airport is being upgraded and expanded to modernise and improve the passenger and cargo facilities. It 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 development area, which is served by existing airstrips at Bugungu and Pakuba in Murchison Falls National Park.

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, road networks are being upgraded by UNRA to support oil and gas infrastructure development. This will include an upgrade to 11 roads and several bridges to become sealed roads.

Uganda has a wide range of urban roads, some sealed and some unsealed. They vary in condition and are often poorly maintained.

Nontrunk rural roads are typically unsealed and can often be a single lane track or footpath of varying condition. Off-road vehicles or motorcycles are usually the only vehicles that can use these roads, particularly in the wet season, when they can become partially flooded.

Public Transport

Due to the low population density, and therefore in lower demand, the road condition is poor and there is very little public transport in Uganda outside of major urban areas. Therefore, many people in rural areas walk long distances to use public transport.

The social baseline survey showed that boda boda (motorcycle taxis) and bajaj (three-wheeled motorcycle taxis) are the most common form of transport, being used by the average Ugandan household for 75% of all journeys. The survey also showed that a further 11% of household transport was by private motorcycle.

There is no formal bus rapid transit (BRT) system in place in Uganda. However, Kampala is preparing to introduce a BRT service which should improve travel times within the city (*National Transport Master Plan 2008-2023*). For inter-city journeys, most towns have a form of taxi-park, with longer-haul minibuses departing to various destinations. Larger buses also make inter-city journeys.

There are no railways close to EACOP that are available for freight or passenger use. The Kampala service is a passenger network covering the Kampala urban area.

Walking and Cycling

Cyclists and pedestrians are the most vulnerable road users, having no physical protection against motor vehicles. Many urban roads in Uganda have little or no infrastructure for pedestrians and cyclists, creating safety risks for these road users.

In rural areas, walking and cycling are extremely important for people's livelihoods. Often, rural people travel along footpaths before they can access roads. These paths range in use and significance but can link whole communities with the road network. The condition of footpaths and roads, as well as 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.

Road Safety

Uganda has experienced significant growth in recorded road crash fatalities over the last decade with 24 people killed per 100 road crashes, although recent trends appear to show stabilisation in the most recent five-year period. On average, Uganda loses 10 people per day in road traffic crashes, which is the highest level in East Africa.

Careless and dangerous driving are the principal causes of road accidents in Uganda.

Traffic Flows

The data collected by the traffic surveys was analysed to determine:

- existing traffic with peak hour and directional distribution
- traffic composition
- percentage of truck traffic at peak hours and its proportion of the total traffic volume.

Daily two-way traffic flows ranged between 2,000 and almost 11,000 vehicles during the 10-hour survey period. On average, the proportion of trucks was around 5%. Motorcycles represented a significant proportion of traffic, usually approximately 50% and at some locations in excess of 75% of all traffic.

Trend in Condition and Sensitivity to Change

Road Condition

The Ugandan government is currently upgrading trunk road sections that are currently unsealed. The upgrades are focused on the trunk road network and those roads that will 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.

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 people killed or seriously injured fell between 2011 and 2013 but has, at the time of writing, risen to levels similar to 2011. This is likely to reflect the increase in motorcycles for private or boda boda use, which have a poor safety record.

Accident rates on upgraded roads have the potential to fall due to improved road surfaces, although it is acknowledged that this can introduce other factors which affect accident risk, such as increased speed. 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.

Traffic Congestion

The key areas for congestion in Uganda are in Kampala and on the approach to border crossings. Severe congestion can be experienced on a daily basis within Kampala due to the:

- volume of private traffic
- lack of public transport
- volume of boda boda and bajaj, which has increased as they offer a low-cost and effective means of travel.

Congestion has increased over recent years owing to an increasing number of people working in the centre of Kampala.

In other areas of the country, congestion only occurs when vehicles are travelling along routes with high volumes of pedestrians walking in the road as the volume of vehicles is relatively low.

The roads most sensitive to change will be those already congested as small increases in traffic may increase journey times. Other roads across Uganda are less sensitive to change as they have spare capacity.

Sensitivity Rankings

Based on the traffic surveys, engagement with stakeholders, trend in condition and sensitivity to change, the sensitivity of the traffic-related receptors within the AOI has been ranked and is shown in Table 6.4-57.

Table 6.4-57 Traffic-Related Valued Environmental Components Sensitivity Ranking

Traffic-Related VEC	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 access 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 accident risk. Poor road conditions are a major cause of accidents in Uganda. However, settlements are 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	Very high (5)	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.

Table 6.4-57 Traffic-Related Valued Environmental Components Sensitivity Ranking

Traffic-Related VEC	Sensitivity Ranking	Rationale for Ranking
Traffic congestion: Kampala, Hoima and other large towns, and Uganda–Tanzania border	Very high (5)	Where congestion is already experienced, a small increase can extend journey times, compared to roads with spare capacity.
Traffic congestion: Other roads	Medium (3)	Localised congestion can occur through areas of settlement where stalls, dwellings and pedestrians can reduce the road width. Moderate increases in traffic volumes could extend journey times in these areas.

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 and cyclists considered particularly vulnerable. Traffic levels are low, so congestion is rare, except at the border with Uganda and in Kampala, Hoima and other large towns.

6.4.3.16 Tangible and Intangible Cultural Heritage

This section describes the intangible and tangible cultural heritage:

- AOI and study area
- baseline condition
 - trends in condition and sensitivity to change
 - ecosystem services
 - sensitivity rankings
- key considerations.

For more information the baseline report is included in Appendix A13.

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).

Area of Influence

The TCH AOI for the construction phase includes all construction areas:

- the RoW
- AGIs
- MCPYs
- access roads
- temporary work spaces (at crossings).

The area affected visually or by noise, dust, vibration or restriction of access beyond the physical footprint is also included in the AOI. This distance extends to 100 m from 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 and additional engineering studies for noise and air emissions.

During the operational phase, the TCH AOI includes:

- the RoW
- AGIs.

Visual and noise impact on TCH 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 and additional engineering studies 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.

The study area is 2 km wide, 1 km either side of the pipeline.

Baseline Condition of Tangible and Intangible Cultural Heritage

Three categories of cultural heritage were defined based on the features identified by the studies:

- Category 1 – tangible cultural heritage:
 - archaeological sites
 - areas of high archaeological potential
- Category 2 – tangible cultural heritage 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 – intangible cultural heritage with a less well defined tangible component:
 - sites with an intangible component and 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 intangible cultural heritage 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.

Within the 2-km-wide study boundary (see Appendix A13), 66 features were located through secondary data reviews and by the field surveys:

- three within the project footprint (inside)
- five within 100 m of the 30 m RoW and project components and may be susceptible to some form of impact (close)
- 58 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 (outside⁸).

Potential sites identified from an examination of light detection and ranging (LIDAR) are excluded from the totals above, as the surveys showed a large proportion of the identified features were likely to be the result of natural processes or recent agricultural activity. However, the LIDAR sites not visited during the field survey will be included in cultural heritage construction planning survey and assessment.

Based on the baseline data collected, the following examples of cultural heritage features were identified for Categories 1, 2 and 3, see summary below, the figures in Attachment 13.1 and tables in Attachments 13.2 to 13.4 of Appendix A13.

Category 1:

- sites with pottery remnants: no known sites are in the study area, although there are many known sites outside the study area. The pottery recorded 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.
- ironworking sites: eleven ironworking sites are known within the study area from KP251 to KP261. They comprise signs of slag, associated with furnaces, and potential ore mining sites. This ironworking material could date from the early Iron Age up to the relatively recent past.

⁸ 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 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.

- rock art sites: one site with rock art has been identified within the study area (Kalyango cultural rock, near KP86) and there are other known sites outside the study area.

Category 2:

- churches and mosques: 47 churches and mosques have been identified within the study area
- graves and cemeteries: five cemeteries have been recorded within the study area. Two cemeteries have been identified within the project footprint (inside), with a third within 100 m (close).

Category 3:

- sacred natural sites and trees: identified in the communities of Nkooko at Nkooko Hill, Nyondo, Kakuuto and Bigada. In some communities, specific places were mentioned but the character of the place was not explained, such as Nyondo, and Kamusenene (both Mubende district) and at Buseruka (Hoima).
- traditional dances: implied by the description of rituals in Kakende (Hoima district) for exorcising evil spirits. At Katikara traditional dances also involve wearing specific clothing of white cloth.
- rituals to interact with ancestors to ensure good health and prosperity: Mentioned in the PACs of Nyondo, Miti, Bulakati, Buswabera and Nkooko
- traditional healing: widely practised, for example, at Bulakati (Sembabule), Kakende (Hoima), Nzoo (Kyankwazi), Mutukula (Kyotera) and Nyondo (Mubende). Traditional healing is also covered in the socio-economic and health baseline report (see Appendix A11).
- syncretism: the amalgamation of established religions (Islam and Christianity) and traditional African belief systems was mentioned explicitly in many PACs, including, for example, the village of Katooke in Hoima District and at Nzoo
- sacred meeting places still used for important meetings were mentioned at Katooke
- rivers and ceremonial ways: mentioned in Kayere, in association with sacred trees, but not elsewhere
- twins: the birth of twins is commonly surrounded by a degree of spiritual ambivalence and this was mentioned at Rwamutonga and Nyondo.

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 tangible cultural heritage is a finite resource and loss is considered non-replicable by the project, but not under 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 and 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 and, using a precautionary principle that acknowledges that archaeological sites may be unique, the approach adopted is that tangible archaeological heritage is a finite resource.

Intangible cultural heritage is closely linked to individual and group identity and to all parts of a culture. ICH practices are not static, as 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. Intangible cultural heritage assets may have little resilience and can be lost entirely to a new generation.

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.

Ecosystem Services Provided

Cultural heritage generates a range of ecosystem services as set out below.

Cultural services include:

- providing a sense of self and the role of communities and individuals in the world. A sense of place or 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 on and maintained by intangible heritage practices.
- providing spiritual, sacred or religious values, inspiration for culture and design, and cognitive development
- supporting the effective functioning of other social activities in terms of agricultural production, craft production and trade, land ownership and inheritance
- building resilience in terms of the ability to adapt to continuous social changes without the loss of basic social functions.

Sensitivity Rankings

Sensitivity rankings for Category 1 and 2 sites are provided in Attachment 13.2 of Appendix A13.

Key Considerations

Key considerations are:

- 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 that are likely to be encountered, but there is less certainty for Category 3.
- religious structures are the most common in 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 2 features (cemeteries) are within the AOI of which two are within the RoW
- the remaining Category 1 and 2 features within the RoW or the AOI are moderate sensitivity
- Category 3 is closely linked to individual and group identity, and is 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 right to practice traditional cultural heritage and beliefs.

6.4.4 Climate

This section describes the climate:

- AOI
- baseline conditions:
 - air temperature, precipitation, air humidity, solar radiation, wind and greenhouse gas (GHG) emissions
 - trends in the climate and GHG emissions
 - ecosystem services provided
- key considerations.

For more information, the climate baseline report is included in Appendix A14.

Area of Influence

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.

Baseline Condition of Climate

The tropical climate in Uganda is determined by large-scale monsoons 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 has an important role in the temporal and spatial distribution and the intensity of the weather systems in Uganda.

Air Temperature

Air temperature in Uganda is moderate throughout the year, with a mean daily temperature of 28°C (MWE 2014).

Between 1951–1980 and 1981–2010, there has been an increase in average annual minimum temperature of 0.5–1.2°C and 0.6–0.9°C for average maximum temperature (USAID 2013).

Average maximum air temperature within the pipeline route peaks at approximately 35°C in February–March and September–October. The average minimum temperature varies little throughout the year, ranging between approximately 9°C (June–July) and 11°C (March) (Actimar 2016a).

Precipitation

Rainfall in Uganda ranges from 400–2200 mm/a (MWE 2014). The southern regions of the country receive 600–2200 mm/a, while the north receives 400–1600 mm/a. Nationwide, Uganda receives an average of 1180 mm/a of rainfall.

Precipitation in Uganda is seasonal and its timing, intensity and duration vary considerably across the country. In general, Uganda experiences two modes of rain seasons. This includes 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)⁹, which is the principal driving force of annual to interannual rainfall variability in the tropics. The effects of ENSO are most pronounced in Uganda between September and December. El Niño is often associated with floods, whereas La Niña is associated with droughts (MWE 2014).

The timing of rainfall can vary considerably from year to year. The onset of rainy seasons can be 15 to 30 days earlier or later, while the duration of the rainy season can change by 20 to 40 days (USAID 2013).

The area that the pipeline route traverses experiences two rainy seasons per year from March to May and from August to November. During these two seasons, the

⁹ 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)

monthly mean precipitation exceeds 100 mm/month and the maximum can exceed 250 mm/month. Rainfall occurs on 17 days/month on average (Actimar 2016a).

Humidity

Uganda's climate is equatorial, with moderate humid and hot climatic conditions throughout the year. Maximum relative humidity reaches 100% almost everywhere throughout the year except between July and October in the south-west of Lake Victoria, where it remains above 85%.

Solar Radiation

Local conditions play an important role in the variability of daily solar radiation. The maximum daily peak of solar radiation occurs during the equinox periods from September to October and from March to April (the latter period has a slightly lower maximum daily peak due to a rainy season). The maximum daily peak of solar radiation along the pipeline route ranges between 800 W/m² in June to 950 W/m² in October.

Wind

Wind speeds in the region of the pipeline are low, with maximum 1-hour mean wind speeds along the pipeline route being 3–8 m/s, and not varying considerably throughout the year (Actimar 2016a).

Greenhouse Gas Emissions

Uganda has one of the lowest levels GHG emissions per capita in the world, estimated at 1.6 tCO₂e per capita for 2014, totalling absolute emissions of 59.9 MtCO₂e 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%.

Approximately 93% of Uganda's energy needs are met by biomass, with 6% met 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 expanded (MWE 2015).

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 unevenly distributed over the year. Extreme events such as droughts, floods and landslides are increasing in frequency and intensity (MWE 2015).

From 1970 to 2000, minimum and maximum temperatures have increased, with minimum temperature having risen faster than the maximum temperatures.

Climate change is affecting a wide variety of sectors, particularly agriculture, water, health and human settlements. 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 interannual rainfall. This is reflected in variations or shifts in the timing and duration of seasonal rainfall and intraseasonal 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 IPCC Fifth Assessment Report indicate an increase in near-surface temperature for the country. These predict increases 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), it is predicted to increase by +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. Rainfall totals might drop considerably (–20% from present levels) over Lake Victoria (MWE 2015).

Floods can lead to secondary impacts, including landslides, soil erosion, silting of dams and drainage channels, bursting of dams and river banks, 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, which can lead to desertification.

Anthropogenic GHG emissions, together 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, changes in climate 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% (Climate Watch 2014, internet site).

Uganda's Intended Nationally Determined Contribution (INDC) report (MWE 2015), sets out long-term goals and adaptation strategies in relation 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 emission 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 MtCO₂e per year in 2030, and a 22% reduction would result in emissions of approximately 60.3 MtCO₂e – close to the 2014 level.

Continued GHG emissions 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).

Ecosystem Services Provided

Although this VEC does not provide ecosystem services directly, climate influences VECs that do provide services.

Key Considerations

The key considerations related to the climate baseline are:

- the global climate has undergone unprecedented change¹⁰ 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, together 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).

6.5 Ecosystem Services**6.5.1 Ecosystem Service Coverage**

The above descriptions of VEC baselines have included ecosystem services with each reference summarised in Table 6.5-1.

Table 6.5-1 Ecosystem Service References

Ecosystem Service*	Reference
Provisioning services	
Crops	6.4.3.8 Land-Based Livelihoods
Livestock	6.4.3.8 Land-Based Livelihoods
Capture fisheries	6.4.1.3 Aquatic Biodiversity, 6.4.3.9 River- and Lake-Based Livelihoods
Aquaculture	6.4.3.9 River- and Lake-Based Livelihoods
Wild foods	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.3 Aquatic Biodiversity, 6.4.1.4 Avifauna Biodiversity, 6.4.1.5 Fauna Biodiversity, 6.4.3.8 Land-Based Livelihoods
Live trade in wildlife	6.4.1.1 Protected Areas, 6.4.1.5 Fauna Biodiversity
Timber and wood products	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.3.8 Land-Based Livelihoods
Fibres and non-wood products	6.4.1.2 Botany Biodiversity, 6.4.1.4 Avifauna Biodiversity, 6.4.1.5 Fauna Biodiversity, 6.4.3.8 Land-Based Livelihoods

¹⁰ "Since the 1950s, many of the observed changes are unprecedented over decades to millennia" (IPCC 2014).

Ecosystem Service*	Reference
Aggregates and minerals	6.4.3.8 Land-Based Livelihoods
Biomass fuel	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.3.8 Land-Based Livelihoods, 6.4.3.12 Social Infrastructure and Services
Ornaments and other products	6.4.1.4 Avifauna Biodiversity, 6.4.1.5 Fauna Biodiversity
Freshwater	6.4.2.2 Surface Water, 6.4.2.3 Groundwater
Medicinal plants	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.5 Fauna Biodiversity, 6.4.3.8 Land-Based Livelihoods
Regulating services	
Local air quality regulation	6.4.1.2 Botany Biodiversity
Global climate regulation	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.4 Avifauna Biodiversity, 6.4.1.5 Fauna Biodiversity, 6.4.2.1 Geology and Soil
Local climate regulation	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.5 Fauna Biodiversity
Water regulation	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.3 Aquatic Biodiversity, 6.4.2.1 Geology and Soil, 6.4.2.2 Surface Water
Erosion regulation	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity
Waste assimilation	6.4.1.2 Botany Biodiversity, 6.4.1.5 Fauna Biodiversity, 6.4.2.2 Surface Water
Pest control	6.4.1.4 Avifauna Biodiversity
Soil quality regulation	6.4.1.2 Botany Biodiversity, 6.4.2.1 Geology and Soil
Cultural services	
Recreation and ecotourism	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.4 Avifauna Biodiversity, 6.4.1.5 Fauna Biodiversity
Aesthetics, landscapes	6.4.2.4 Landscape
Sense of place / self	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.3.8 Land-Based Livelihoods, 6.4.3.9 River- and Lake-Based Livelihoods, 6.4.3.16 Tangible and Intangible Culture
Spiritual, sacred and religious values	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.5 Fauna Biodiversity, 6.4.3.16 Tangible and Intangible Culture
Ethical and biodiversity non-use values	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.5 Fauna Biodiversity
Supporting services	
Habitats and species support	6.4.1.1 Protected Areas, 6.4.1.2 Botany Biodiversity, 6.4.1.3 Aquatic Biodiversity, 6.4.1.4 Avifauna Biodiversity, 6.4.2.2 Surface Water, 6.4.2.3 Groundwater

NOTE: *The order of ecosystem services is based on a standard list of ecosystem services in WRI (2012) Corporate Ecosystem Services Review Version 2.0.