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CNOOC UGANDA LIMITED

# KINGFISHER OIL PROJECT, HOIMA DISTRICT, UGANDA - ECOSYSTEM SERVICES REVIEW AND ASSESSMENT

**Submitted to:**

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### Executive Summary

This report consists of an Ecosystem Services Review and Impact Assessment for the proposed Kingfisher Development Area and Pipeline route to Kabaale, which CNOOC intends to develop (the Project). The objective of this study is to identify priority ecosystem services and goods currently supplied in the Project Area of Influence; qualify the relationship between ecosystem services, the ecosystems that provide them, and the condition of those systems and the current drivers of change of those systems; identify the beneficiaries who depend on priority ecosystem services; identify Project impacts on priority ecosystem services; and recommend appropriate mitigation measures.

The ecosystem services **Local Study Area** (LSA) for this assessment (Figure 4) generally aligns with the local study areas used for the socio-economic baseline assessment, which consisted of the Kingfisher Development Area study area (comprising 11 villages in the Buhuka Parish and villages on top of the escarpment), and the pipeline route study area (comprising 22 villages in the vicinity of the pipeline route).

Land cover mapping of the Local Study Area was carried out. A review of the biodiversity, socioeconomic and physical data and information gathered during the baseline phase of the ESIA was used to identify the specific ecosystem services associated with each of the mapped land cover types and determine the condition of the land cover types. This allowed a judgement on the condition of the land cover types to be made, and, therefore, their potential capacity to supply ecosystem services, based on the reported baseline condition of the habitat types supported therein. Ecosystem services provided by the various ecosystems within the Local Study Area were then listed and described. Priority ecosystem services upon which an impact assessment was conducted, were derived from this list of relevant ecosystem services. Priority ecosystem services are:

- Services for which Project impacts could affect beneficiaries' livelihoods, health, safety or culture (Type I); and
- Services that could prevent the Project from achieving operational performance (i.e., impact the Project) (Type II).

Beneficiaries for ecosystem services within the Local Study Area were defined as the Project, the inhabitants and herders of the Buhuka Flats, and subsistence farmers whose plots lie within the servitude of the proposed pipeline route. Priority ecosystem services supplied within the Local Study Area include:

- |   |  |
|---|--|
| • Grazing for livestock                                 | • Fresh Water (Type I)                   |
| • Capture fisheries                                     | • Fresh Water (Type II)                  |
| • Wild Foods  | • Regulating Air Quality (Type II)       |
| • Construction materials for traditionally-built houses | • Regulating Water Flows and Timing      |
| • Natural aggregates for Project facility construction  | • Water Purification and Waste Treatment |
| • Biomass Fuel  | • Ethical and spiritual values           |
|   | • Educational and inspirational values   |

The key direct, indirect and induced Project impacts that have the potential to affect beneficiaries will be:

- Changes in land cover and associated reductions in the supply or quality of ecosystem services due to the proposed construction of the Kingfisher Field facilities, the escarpment road, the oil export pipeline to Kabale, and all associated infrastructure.
- Population influx of people seeking jobs during construction and operation of the Kingfisher Development Area; people seeking to provide commercial services to the increasing population in the vicinity of the Project, and the concurrent increase in demand for ecosystem services. This is likely to impact the quantity and quality of ecosystem service supply to existing beneficiaries.



## ECOSYSTEM SERVICES ASSESSMENT

- Water abstraction from Lake Albert to provide make-up water for the oil extraction process is proposed as part of the Project; although this has the potential to affect water quantity and quality in Lake Albert and thus may affect the fisheries potential of those areas, and beneficiaries that rely on fishing in these areas for livelihoods; the proposed abstraction volumes are extremely low in the context of the available resource.
- As a result of these Project influences, moderate to major impacts are predicted on priority **provisioning ecosystem services**, moderate impacts are predicted on priority **regulating ecosystem services**, and major impacts are predicted on priority **cultural ecosystem services**, within the Project Area of Influence.

Application of recommended mitigation measures is expected to reduce the significance of predicted impacts. Mitigation measures include:

- Resettlement Action Plan
- Livelihood Restoration Plan
- Community Development Plan
- Influx Management Plan
- Corporate social responsibility initiatives
- Support of scientific studies and monitoring programs
- Worker and community education programmes
- Basin-wide water management initiatives
- Avoidance of sites of cultural heritage importance

Pre- and post-mitigation impacts on priority ecosystem services are summarised in the table below:

Priority Ecosystem Service	Significance Pre-mitigation	Significance Post-mitigation
Grazing for Livestock	Major – 16	Moderate – 6
Capture Fisheries	Major – 16	Moderate – 8
Wild Foods	Moderate – 9	Moderate – 6
Construction materials for traditionally-built houses	Major – 12	Moderate – 6
Natural aggregates for Project facility construction	Moderate – 9	Minor – 2
Biomass Fuel	Major – 16	Minor – 4
Fresh Water (Type I)	Major – 16	Moderate – 6
Fresh Water (Type II)	Minor – 4	Minor – 2
Regulating Air Quality (Type II)	Moderate – 8	Minor – 2
Regulating Water Flows and Timing	Moderate – 9	Moderate – 6
Water Purification and Waste Treatment	Major – 12	Moderate – 6
Ethical and spiritual values, and Inspirational values (Type I)	Major – 12	Moderate – 8
Ethical and spiritual values, and Inspirational values (Type II)	Major – 12	Moderate – 8

Potential impacts on the Project's social license to operate may occur due to negative public perception of the Project's *perceived* effect on air quality and fish stocks. Worker and community education programmes, as detailed in the mitigation measures, are deemed to be critical for the Project to maintain its social licence to operate over the lifetime of the Project.



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### APPENDIX A

Document Limitations

### APPENDIX B

Prioritisation of ES according to Project Impact

### APPENDIX C

Prioritisation of ES according to Project Demand

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### DEFINITIONS

Term	Definition
<b>Beach Management Units</b>	Legally empowered community organisations for planning and management of fisheries resources in partnership with national and local governments, established by the East Africa Community Partner States (Kenya, Tanzania and Uganda).
<b>Carrying capacity</b>	Carrying capacity is the largest population size that an ecosystem can sustainably support without degrading the ecosystem
<b>Critical Cultural Heritage</b>	Includes natural areas with cultural and/or spiritual value such as sacred groves, sacred bodies of water and waterways, sacred trees, and sacred rocks. Natural areas with cultural value are equivalent to priority ecosystem cultural services as defined in Performance Standard 6
<b>Cultural ecosystem service</b>	The nonmaterial contributions of ecosystems to human well-being, such as recreation, spiritual values, and aesthetic enjoyment.
<b>Customary land tenure</b>	Customary land tenure/holdings are plots which are held by individual households. Rights over a plot include the right to build a house, cultivate and to graze animals. These rights can only be abrogated if the occupier abandons the property or commits a taboo. This system has led to land fragmentation and associated economic consequences.
<b>Ecosystem Integrity</b>	The structure, composition, and function of an ecosystem operating within the bounds of natural or historic range of variation.
<b>Ecosystem Resilience</b>	The capacity of an ecosystem to respond to a disturbance by resisting damage and recovering quickly.
<b>Ecosystem Function</b>	Refers to all of the natural ecological processes that occur within an ecosystem, and is dependent on the composition and extent of a particular habitat or combination of habitats; their integrity or intactness, and their resilience.
<b>Irreplaceability</b>	Relates to rarity or uniqueness of an ecosystem in the landscape.
<b>Local Study Area</b>	The spatial context for the study
<b>Priority Ecosystem Services</b>	Those services on which project impacts affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries, and those services that could prevent the project from achieving planned operational performance.
<b>Project Area of Influence</b>	The area relevant to the assessment of project impacts and dependencies on priority ecosystem services; it includes the ecosystems that supply the priority ecosystem services, and the locations where the Project and affected stakeholders access priority ecosystem services.
<b>Provisioning Ecosystem Services</b>	The goods or products obtained from ecosystems, such as food, timber, fibre, and freshwater



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Term	Definition
<b>Regulating Ecosystem Services</b>	The contributions to human well-being arising from an ecosystem's control of natural processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards.
<b>Regulation of Air Quality</b>	The influence ecosystems have on air quality by emitting chemicals to the atmosphere (i.e., serving as a "source") or extracting chemicals from the atmosphere (i.e., serving as a "sink")
<b>Social Licence to Operate</b>	Social Licence to Operate (SLO) refers to the acceptance within local communities of both companies and their projects. In order to obtain an SLO it is necessary to develop good relationships with all stakeholders, especially with local communities
<b>Supporting Ecosystem Services</b>	The natural processes such as nutrient cycling and primary production, which maintain the other services.
<b>Spiritual ecosystem services</b>	Sacred, religious, or other forms of spiritual inspiration derived from ecosystems.
<b>Vulnerability</b>	Refers to degree of threat to an ecosystem or species.

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### 1.0 INTRODUCTION

This report consists of an Ecosystem Services Review and Impact Assessment for the proposed Kingfisher Development Area and Pipeline route to Kabale, which CNOOC intends to develop (the Project). The report describes the ecosystem services supplied by the various land cover types in the Project Area of Influence, and the benefits that the local community gains from them under existing conditions. The services that the Project itself will depend upon are identified, and existing drivers of ecosystem change discussed. The potential impacts of the Project on Priority<sup>1</sup> Ecosystem Services (Landsberg, et al., 2013) are assessed, and mitigation measures proposed for any adverse impacts on identified Priority Ecosystem Services.

#### 1.1 The Concept of Ecosystem Services

Ecosystem services consist of all the natural products and processes that contribute to human well-being, as well as the personal and social enjoyment derived from nature (Landsberg, et al., 2013). For example, wetlands provide grazing for livestock and act as nursery areas for juvenile fish at the edges of large open water systems. Wetlands often support populations of waterfowl, which can provide tourism and recreation opportunities for bird watchers; they may also help to mitigate climate change by sequestering carbon, and help reduce floods by storing rainwater (Macfarlane, et al., 2008).

Since different ecosystems provide different ecosystem services, there are trade-offs and synergies amongst ecosystem services - for example, conversion of forest to agriculture lowers the wood supply and potentially the water flow regulation, but it increases food production from crops. On the other hand, restoring a wetland may remove more pollutants from drinking water supplies and increase recreation benefits for bird watching (Landsberg, et al., 2013).

The benefits of ecosystems are passed on at many levels, and to many different beneficiaries. Examples of the benefits provided at different scales include:

- Local scale: ecosystem services may be the basis for rural livelihoods and subsistence; particularly for the poor; for example, artisanal fishing of inland lakes provides both cash income and food for low-income families.
- Regional scale: the provision of water to communities and businesses from a forested watershed.
- Global scale: ecosystems regulate climate and act as a reservoir of biodiversity that underpins biological production of all types, including agriculture.

#### 1.2 Ecosystem Services and the International Finance Corporation

The International Finance Corporation's (IFC) Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources (PS6) (IFC, 2012a), and its Guidance Notes (IFC, 2012b) - defines ecosystem services as **the benefits that people, including businesses, derive from ecosystems**. The IFC define two types of ecosystem services:

- Type I Ecosystem Services: Ecosystem Services on which the Project operations are most likely to have an impact and, therefore, which result in adverse impacts to affected communities (beneficiaries); and
- Type II Ecosystem Services: Ecosystem Services on which the Project is directly dependent for its operations, for example, water.

Although ecosystem services are largely addressed by IFC PS 6, the assessment of ecosystem services is spread throughout the environmental and social Performance Standards (PS) because the potential effects of a project on ecosystem services relates to all aspects of peoples' relationship with the environment, including health and safety risks, land ownership or usage, and cultural heritage. The specific PS that contain provisions for ecosystem services assessment are Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts; Performance Standard 3: Resource Efficiency and Pollution Prevention; Performance Standard 4: Community Health, Safety, and Security; Performance Standard 5: Land

<sup>1</sup> Priority ecosystem services are those where the significance of the project impact on the ecosystem services is considered likely to be high



Acquisition and Involuntary Resettlement; Performance Standard 7: Indigenous Peoples and Performance Standard 8: Cultural Heritage. These are described in Section 2.0.

### 1.3 Regional Ecosystem Services in the Context of the Project

The Albertine Graben is recognised as one of Africa's most important areas for biodiversity; it is an area of high endemism and threatened species, with over 50% of birds, 39% of mammals, 19% of amphibians and 14% of reptiles and plants of mainland Africa occurring in this region (Plumptre, 2002). The Graben is recognised as an area of global importance for conservation, which is reflected by the high density of areas protected or designated for biodiversity. As such, this biodiversity represents one of Uganda's most vital economic resources, with the services and products provided by biodiversity in the form of ecosystems, species and genetic resources contributing billions of shillings per year to Uganda's economy, and support some of the poorest and most vulnerable sectors of Uganda's population (NEMA, 2002). In particular, rural people, landless people, and women in certain areas are dependent on biological resource utilisation as a primary means of subsistence and livelihood, or as a supplementary resource during times of drought, or unemployment (NEMA, 2002).

The Kingfisher Development Area and pipeline route from there to Kabale is located in Hoima District, Kyangwali Sub-County, Western Uganda. Whilst subsistence farming and small-scale commercial farming are the main economic activities in the Hoima District, inhabitants of Buhuka Parish villages directly depend on subsistence fishing activities as a source of food, livelihoods and a cash income. The majority (approximately 98.9%) of the population in Hoima District use wood fuel and charcoal as the dominant source of energy, which is locally harvested; locally harvested natural resources are also used to provide building materials. Evidence suggests an increasing population in the Project area - the Hoima District Development Plan (Hoima District Local Government, 2011) indicated that the population of urban dwellers has increased from 31,671 in 2002, to 42,813 in 2009 and projected that the population would increase to 51,741 in 2013; in fact, by 2014, the district population had increased to 572,986 people, of whom just over 77% lived in rural areas (Uganda Bureau of Statistics, 2014). In addition, there is observational evidence of expansion and urban growth in Hoima town itself, attributed to the oil and gas exploration activities. This urbanisation rate is expected to increase as oil and gas exploration activities proceed, which is anticipated to increase demand for ecosystem services in the Project area.

It is worth noting at this point that, although oil is a natural resource, it is not considered to be an ecosystem service. Although fossil fuels and some minerals come from organic material that was alive millions of years ago, their quantity and quality do not depend on the living component of *existing* ecosystems, and so are not considered to be benefits derived from existing ecosystems (Hanson, et al., 2012).

### 1.4 Report Structure

The report is structured sequentially:

- The terms of reference are introduced in Section 2.0 which provide the context for the study.
- Relevant international and national legislation and policy in terms of the Project's obligations to take ecosystem services into account are summarised in Section 3.0.
- The methods used in the determination of the Local Study Area, identification of ecosystem services and beneficiaries within the Local Study Area, prioritisation of ecosystem services and impact assessment of those priority ecosystem services are detailed in Section 4.0.
- Sections 5.0 and 6.0 provide the results of the Land Cover Classification exercise and literature review in order to identify ecosystem services and beneficiaries within the study area.
- Section 7.0 provides the process and results of the ecosystem service review for the local study area, and the prioritisation of ecosystem services exercise.
- The Project Area of Influence for priority ecosystem services is defined in Section 8.0.



- Section 9.0 describes the assessment of Project impact on **Priority ecosystem services** within the Project Area of Influence.
- Recommended mitigation and monitoring measures are outlined in Section 10.0.
- Study conclusions are drawn in Section 11.0.
- References for the study are given in Section 12.0.

## 2.0 TERMS OF REFERENCE

In determining the requirements of the Ecosystem Service Review and Impact Assessment for the Project, reference was made to the international guidance document 'Weaving Ecosystem Services into Impact Assessment' (Landsberg et al., 2013), appropriate Ugandan legislation and guidance, as well as international standards and guidance. National policy and international standards pertaining to the Project are detailed in Section 4.0.

The ecosystem services impact assessment concentrates on assessing predicted changes in ecosystems and ecosystem function, physical and aesthetic changes in the Lake Albert landscape, and changes in human population dynamics within the Project Area of Influence; and the concomitant effects that these changes will have on ecosystem service supply and demand within the same area.

### 2.1 Objectives

The aim of this Ecosystem Services Review and Impact Assessment is to:

- Identify priority ecosystem services and goods currently supplied in the context of the area in which the Project will be located.
- Qualify the relationship between ecosystem services, the ecosystems that provide them, and the condition of those systems, and the current drivers of change of those systems.
- Identify beneficiaries of the services, that is, the Project and/or the people who benefit from the goods and services supplied, and their level of dependence on the ecosystem services.
- Identify potential impacts on priority ecosystem services arising from the Project and propose mitigation measures.
- Identify any necessary additional areas of investigation.

### 2.2 Scope

In order to address the above objectives, and in line with the Scoping Report (Golder Associates, 2014), a description and regional contextualisation of the baseline ecosystem services supplied and utilised within the Project Area of Influence was undertaken.

Using available regional data on ecosystem services in Western Uganda, and pertinent data gathered from the biodiversity, socioeconomic, surface water and cultural heritage baseline studies, an assessment of the predicted Project effects on the ecosystem services of the Project's area of influence was conducted to meet the requirements of IFC PS6.

### 2.3 Limitations

This assessment is a largely desk-based study, supplemented by the primary data gathered as part of the biodiversity, cultural heritage and socioeconomic baseline studies. Specific ecosystem service utilisation related questions were provided to the socioeconomic baseline team; and the data used to inform the prioritisation of the initial list of ecosystem services.

Study limitations include the following:

- No ecosystem service supply and demand modelling was done for this study, as the economic and numerical modelling approaches that would be required were beyond the scope of the current study.



- ❖ Limitations encountered by the specialist studies that pertain to the ecosystem service-related information that could be derived from the baseline data include:
  - § Access limitations due to health and safety considerations and site conditions.
  - § The information gathered in relation to traditional cultural places and intangible heritage is limited to that which the community was willing to share with the field team. Some of the recorded sites are considered 'secret', and there may be places known only to a small section of the community and/or some which are too sensitive to share. Consequently, there is a potential for unidentified features of cultural importance to exist within the **Local Study Area**.
  - § Transient populations and migratory population groups may not have been present during the period of socio-economic data collection. However, based on available research, the data collection period between November and December 2013 appears to be an optimal timeframe to encounter most of these transient population groups.

Despite these limitations to baseline data, the conclusions contained within this report are based upon a robust and transparent procedure, and represent an accurate evaluation and assessment of likely impacts.

### 3.0 LEGISLATIVE AND POLICY CONTEXT

#### 3.1 Ugandan Legislation and Policy relating to Ecosystem Services

Currently, there is no specific legislation directly pertaining to ecosystem service utilisation in Uganda; however, in the wake of increasing ecosystem degradation and biodiversity loss, Uganda has enacted several legislative and policy interventions to conserve natural resources and ensure that these resources provide sustainable benefit to the local community (CRA, 2006). Those considered most relevant to this ecosystem services assessment are described below.

##### 3.1.1 The Laws and Acts of Uganda

###### 3.1.1.1 *The Constitution of the Republic of Uganda (as at 15 February 2006)*

The over-arching government policy on natural resource conservation, cultural heritage preservation and social and economic wellbeing in Uganda is provided for in the Constitution of the Republic of Uganda. The relevant constitutional provisions in the National Objectives and Directive Principles of State Policy include the following:

- ❖ **Principles of State Policy XXVII (iv):** mandates the State (both central and local government) to create and develop parks, reserves and recreational areas, and to ensure conservation and promote the rational use of natural resources so as to safeguard and protect the biodiversity of Uganda.
- ❖ **Article 237 (2) (b):** the Government or local government, as determined by Parliament by law, shall hold in trust for the people and protect, natural lakes, rivers, wetlands, forest reserves, game reserves, national parks and any land, to be reserved for ecological and touristic purposes for the common good of all citizens.
- ❖ **Article 245:** the utilisation of natural resources of Uganda shall be undertaken in such a way as to meet the development and environmental needs of present and future generations of Ugandans and, in particular, the State shall take all possible measures to prevent or minimise damage and destruction to land, air and water resources resulting from pollution and other causes.
- ❖ **Social and Economic Objective (XIV):** Under the general social and economic objective, the State shall endeavour to fulfill the fundamental rights of all Ugandans to social justice and economic development and shall, in particular, ensure that all developmental efforts are directed at ensuring the maximum social and cultural well-being of the people.
- ❖ **Cultural Objective (XXIV):** Cultural and customary values, which are consistent with fundamental rights and freedoms, human dignity, democracy, and with the Constitution, may be developed and incorporated



in aspects of Ugandan life. The State shall promote and preserve those cultural values and practices which enhance the dignity and well-being of Ugandans.

- **Cultural Objective (XXV):** Preservation of Public Property and Heritage: The State and citizens shall endeavour to preserve and protect, and generally promote, the culture of preservation of public property and Uganda's heritage.

### Project Relevance

The constitution of the Republic of Uganda obliges the state, Government and local governments of Uganda to conserve and protect natural and cultural heritage resources for the social and economic wellbeing of the people of Uganda. This has significance for the Project in terms of gaining the appropriate authorisations/licences/permits from Government authorities for the Project to proceed – the Government authorities will need to be satisfied that the obligations of the Constitution of the Republic of Uganda are fulfilled.

#### 3.1.2 Uganda Wildlife Bill (2017)

The primary objectives of the Uganda Wildlife Bill are to provide for the conservation and sustainable management of wildlife, to strengthen wildlife conservation and management, to continue the Uganda Wildlife Authority; and to streamline roles and responsibilities for institutions involved in wildlife conservation and management.

The Bill re-aligns the Uganda Wildlife Act Cap. 200 with the 2014 Uganda Wildlife Policy, the Oil and Gas policy and laws, the Land use policy and law, the National Environment Act, the Uganda Wildlife Education Centre Act, the Uganda Wildlife Research and Training Institute Act and all other laws of Uganda and developments which came into force after the enactment of the Uganda Wildlife Act in 1996.

For the first time, nationally-protected species were declared in the 2017 Uganda Wildlife Bill. Wildlife species listed in the Third Schedule of Act V are protected species in Uganda, in addition Act V states that wildlife species protected under any international convention or treaty to which Uganda is a part (and to which the regulations set out in section 86 applies), are protected species.

### Project Relevance

Where the Project activities have the potential to affect wildlife reserves or community wildlife management areas, the appropriate permits must be sought. The Project will need to demonstrate that Project activities can be conducted in a sustainable manner that makes provisions to maintain the continued presence of wildlife within the area.

#### 3.1.2.1 Uganda Wildlife Act (1996)

The Uganda Wildlife Act defines two types of conservation areas: "wildlife protected" and "wildlife managed" areas. Although the Act made provision for the declaration of protected species, no protected species were declared in the Act.

#### Wildlife Protected Areas

- **National Park:** these are protected areas of international and national importance because of their biological diversity, landscape or national heritage, and in which biodiversity conservation, recreation, scenic viewing, scientific research and other economic activity may be permitted.
- **Wildlife Reserve:** these are protected areas of importance for wildlife conservation and management and in which conservation of biological diversity, scenic viewing, recreation, scientific research, and regulated extractive utilisation of natural resources are permitted.

#### Wildlife Management Areas

- **Community Wildlife Areas:** these are wildlife management areas where wildlife is protected, whilst taking into account the continued use of the land and the sustainable exploitation of wildlife in the area by people and communities ordinarily residing there. Sustainable exploitation of the natural resources of



the area, including by mining and other methods, is permitted - providing that it is in a manner compatible with the continued presence of wildlife in the area.

### 3.1.2.2 *Uganda Wildlife Act Cap 200 of 2000*

The Uganda Wildlife Act cap 200 of 2000 was enacted by an Act of Parliament to provide for sustainable management of wildlife (UWA 2014). The Act consolidated wildlife management law in Uganda and established the Uganda Wildlife Authority (UWA) as the responsible authority for wildlife management and conservation, and enforcement of wildlife laws and regulations. The Act covers all wildlife protected areas (PAs) and wildlife outside PAs, and specifically mandates UWA to control and monitor industrial and mining developments in wildlife protected areas.

### 3.1.2.3 *Uganda Wildlife Policy (1999, 2014)*

The Uganda Wildlife Policy generally promotes long-term conservation of wildlife and biodiversity in a cost-effective manner, which maximises the benefits to the people of Uganda in terms of ecology, economy, aesthetics, science and education. The policy aims at achieving this through promoting conservation and sustainable utilisation of wildlife throughout Uganda. The policy seeks to exclude industrial development, including mineral exploration and extraction, from wildlife protected areas (that is, national parks and wildlife reserves).

The Ugandan Government resolved to review Uganda's Wildlife Policy, to harmonise it with related instruments like the National Environment Policy, the Wetland Policy and the Constitution, in the form of the 2014 Uganda Wildlife Policy. New aspects incorporated in the policy included:

- To provide for incentives that supports the private sector to invest more in wildlife development in Uganda.
- To guarantee safety for tourists by enhancing security in in national parks and game reserves, under the expanded anti-terror surveillance in Uganda.
- To increase resource allocation to the tourism sector, specifically for extending and improving infrastructure to, within and around tourism sites.
- To reconcile the needs for wildlife conservation and human beings, particularly in areas that have been affected by insurgency and civil strife.
- To ensure that any infrastructural development within and around wildlife conservation areas does not compromise the support eco-systems for flora and fauna in the respective areas.
- Demands for land in national parks will not be entertained, except in very exceptional circumstances where survival of communities is involved.

### 3.1.3 *National Environment Act (1995)*

The National Environment Act provides for the sustainable management of the environment. It sets out principles of environmental management that assure all people living in the country the fundamental right to an environment adequate for their health and well-being. It addresses the sustainable use and conservation of the environment and natural resources of Uganda equitably, taking into account the rate of population growth and the productivity of the available resources; as well as the conservation of cultural heritage, for the benefit of both present and future generations. The NEA sets out to maintain stable functioning relations between the living and non-living parts of the environment through preserving biological diversity and respecting the principle of optimum sustainable yield in the use of natural resources.

### 3.1.4 *Uganda Water Act (1997)*

The Ugandan Water Act provides for the use, protection and management of water resources and supply, with the objectives of promoting the rational management and use of waters, provision of a clean, safe and sufficient supply of water for domestic purposes to all persons; allow for the orderly development and use of water resources for purposes other than domestic use; and control of pollution.



### 3.1.5 Uganda Forestry Policy (2001) and the National Forestry and Tree Planting Act (2003)

The Forestry Policy is implemented through the National Forestry and Tree Planting Act (2003). The Act provides for:

- The conservation, sustainable management and development of forests.
- The declaration of forest reserves for the purposes of protection and production of forests and forest produce.
- The sustainable use of forest resources and enhancement of productive capacity of the forests.
- The promotion of tree planting.
- Consolidation of the law relating to the forestry sector and trade in forest produce.

Parts of Uganda's permanent forest estate carry dual status as National Parks, Wildlife Reserves and Animal Sanctuaries; such areas are subject to additional regulations under the Uganda Wildlife Act (1996).

Declared forest reserve categories include Central Forest Reserves (CFRs), Local Forest Reserves, Community Forests, private forests, and forests forming part of a wildlife conservation area (declared under the Uganda Wildlife Act, Cap 200).

CFRs fall in two main categories, namely those designated for production and those for protection. Such forest reserves are subsequently managed in a manner consistent with the purpose for which they were declared:

- **Production forests:** includes savanna bushland and grassland areas - reserved for supply of forest products and future development of industrial plantations.
- **Protection forests:** includes all the tropical high forests, savanna woodlands and/or grasslands – reserved forests include those that protect watersheds and water catchments, biodiversity, ecosystems and landscapes that are prone to degradation under uncontrolled human use.

CFRs are held in trust for the people of Uganda and managed by the National Forestry Authority (NFA) and are classified according to the following categories:

- Site of special scientific interest;
- Strict nature reserve;
- Joint management forest reserve;
- Recreation forest for purposes of eco-tourism; and
- Any other area, for a purpose prescribed in the order.

In a forest reserve, it is prohibited to cut, disturb, damage, burn or destroy any forest produce, remove or receive any forest produce, or undertake activities not consistent with the specific management plan except under conditions set out in the Act or in accordance with a licence granted under the Act. The Act also makes provision for classification of trees as reserved/protected and therefore subject to specific controls. In addition, Section 38 of the Act requires that an environmental impact assessment be undertaken for any project or any activity which may, or is likely to have a significant impact on a forest.

### 3.1.6 The Land Act (1995)

Section 43 of the Land Act provides for management and utilisation of land in accordance with the Uganda Wildlife Act, and other laws. Section 44 (i) mandates the government or local governments to protect national parks, wetlands and forest reserves (amongst others) for ecological and tourism purposes, and hold these in trust for the people of Uganda.



### 3.1.7 Uganda National Land Policy (2013)

The Uganda National Land Policy makes provisions in relation to natural resource management and biodiversity. These include Government resolutions to ensure that land use practises conform to land use plans, and that the principles of sound environmental management including biodiversity preservation, soil and water protection, conservation and sustainable land management are applied. The policy commits the Government to take measures including to

- Provision of special protection for 'fragile' ecosystems (that is, unique and sensitive biodiversity features).
- Development of harmonised criteria for gazetting and de-gazetting conservation areas.
- Establishment and implementation of effective mechanisms for management of wildlife outside protected areas.
- Incentivise community participation in conservation on privately-owned land and co-management of conservation on public land.
- Regulate the use of hilltops and other sensitive ecosystems.
- Develop mechanisms to resolve human-wildlife conflict.

### 3.1.8 Uganda National Biodiversity Strategy and Action Plan (2015-2025)

Published by the Ugandan National Environmental Management Authority (NEMA) in October 2016, the National Biodiversity Strategy and Action Plan (NBSAP) provides a framework to guide the setting of conservation priorities, channelling of investments and building of the necessary capacity for the conservation and sustainable use of biodiversity in the country.

The overarching principles of the NBSAP are:

- a) Sustainable development and environmental sustainability
- b) Mainstreaming of biodiversity conservation, sustainable use of biological resources and equitable sharing of benefits from biological resources into existing policy, legislative, institutional and development frameworks as appropriate;
- c) Stakeholder participation in the development and implementation of biodiversity strategy and action plans;
- d) Awareness creation, education, training and capacity building at local, national and institutional levels to enhance effective participation and implementation of biodiversity measures;
- e) Recognition, promotion and upholding of traditional and indigenous knowledge of biological resources and sustainable resource management and where benefits arise from the use of this knowledge;
- f) Engagement and collaboration with international partners to enhance conservation and sustainable use of Uganda's biological diversity;
- g) Integrated implementation of Multi-Lateral Environmental Agreements;
- h) Equal consideration of the three objectives of the Convention on Biological Diversity – conservation; sustainable use; and benefit sharing arising from the use of biological resources

The Uganda NBSAP recognises that the services and products provided by biodiversity in form of ecosystems, species and genetic resources contribute billions of shillings per year to Uganda's economy, through economic output in the fisheries, forestry, tourism, agriculture and energy sectors; and support of the poorest and most vulnerable sectors of Uganda's population, who are highly dependent on biological resource utilisation. It emphasises the need to safeguard important ecosystem services, and the importance of social considerations in biodiversity conservation, and particularly in people's ownership of, or participation in, biodiversity management, and conservation and wise use of biological resources.



### **Project Relevance**

Uganda's NBSAP commits the Government to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity, which directly relates to the use of and impacts on ecosystem services. The Project will need to demonstrate alignment with these instruments in order to satisfy Government obligations as a signatory to the CBD.

#### **3.1.9 Uganda Oil Policy**

The Oil and Gas Policy (2008) recognises that many areas with potential for petroleum production coincide with areas of important biodiversity, including national parks, water bodies, and forest reserves. It also acknowledges the risk of the oil and gas industry leading to significant in-migration of people looking for work, and seeks to enforce regulations restricting population movements and settlements in wildlife protected areas, with only a minimum of required infrastructure being allowed in such areas.

### **Project Relevance**

The Project will need to demonstrate alignment with the objectives of the Uganda Oil Policy, through wise application of the mitigation hierarchy in areas of biodiversity importance, and development of appropriate population influx management planning for the lifetime of the Project.

#### **3.1.10 The Uganda National Culture Policy, 2006**

Cultural Heritage is defined in paragraph 2.2 of the Uganda National Culture Policy as:

*"The cultural heritage of Uganda includes artistic and cultural expressions. These are; language and literary arts, performing arts, visual arts and handicrafts, indigenous knowledge, cultural beliefs, traditions and values, cultural sites monuments and antiquities".*

The Uganda National Culture Policy provides the framework for the promotion of cultural heritage; it is all-inclusive and advocates the rights of indigenous groups in Uganda. The core principle underlying this policy is respect for all cultures. The Culture Policy promotes social change and encourages new ideas and approaches within the laws of Uganda.

### **Project Relevance**

The policy directly relates to the supply of cultural, spiritual and intangible services provided by the Lake Albert and escarpment landscape within the Project Area of Influence, and the associated traditions, folklore and ways of life of the people local to the area. The Project will need to demonstrate alignment with the policy to gain the necessary permits to proceed.

## **3.2 IFC Performance Standards 2012**

At the project financing level, the assessment and management of ecosystem services is largely dealt with in PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012a); however, elements of PS 1, 3, 4, 5, 7 and 8 are also relevant to ES assessment. Relevant parts of the PSs are briefly summarised as follows.

### **PS 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources**

PS 6 directly relates to the four types of ecosystem services, as one of the three major objectives of PS 6 is to maintain the benefits of ecosystem services. It establishes objectives and requirements to avoid, minimise and, where residual impacts remain, compensate/offset for risks and impacts to ecosystem services within a project's area of influence. It puts an onus on project developers (the 'client') to carry out a systematic review (including participation of beneficiaries) of all ecosystem services a project will impact, or is dependent upon, to identify priority ecosystem services, and avoid, minimise, and mitigate impacts on priority ecosystem services for which a client has direct management control or significant influence.



### **PS 1 – Assessment and Management of Environmental and Social Risks and Impacts**

This PS requires that all reasonably expected risks and impacts related to ecosystem services are identified, and broader definition of a project's area of influence be used. Indirect project impacts on ecosystem services upon which beneficiaries' livelihoods are dependent should be included in the assessment.

### **PS 4 – Community Health, Safety and Security**

This PS establishes the requirement for the assessment of impacts on priority ecosystem services that may result in adverse health and safety risks to beneficiaries.

### **PS 5 – Land Acquisition and Involuntary Resettlement**

PS5 relates to project situations where restrictions on land use, access to natural resources, and use of natural resources, such as aquatic resources, timber products and fresh water, impact affected beneficiaries of ecosystem services. The client must assess impacts on, and compensate for, loss of provisioning ecosystem services resulting from land acquisition and involuntary resettlement.

### **PS 7 – Indigenous Peoples**

PS7 addresses impacts on lands and natural resources that may be subject to traditional ownership, or under customary use. Such use may be seasonal/cyclical, and may be ceremonial, cultural, or economic in nature. PS7 requires that adverse impacts on affected Communities of Indigenous Peoples should be avoided where possible; or otherwise be subject to appropriate application of the mitigation hierarchy to minimise adverse impacts.

### **PS8 – Cultural Heritage**

PS8 deals with the protection of tangible and intangible Cultural Heritage, and sets out requirements for avoidance, or the application of an appropriate mitigation hierarchy to minimise adverse impacts. When replicable cultural heritage is removed and avoidance is not possible, restoration measures including the maintenance of ecosystem services required to support the cultural heritage must be taken, either in situ or in a different location. Non-replicable cultural heritage should not be removed unless several specific conditions are met. The Project should not remove or significantly alter or damage critical cultural heritage.

### **Project Relevance**

In the case of its direct investments (including project and corporate finance provided through financial intermediaries), the IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. Together, the Performance Standards establish standards that the Project is to meet throughout the life of an investment by IFC. As stated above, Performance Standards 1, 4, 5, 6, 7 and 8 have components that directly relate to ecosystem services and maintenance of their supply despite project impact. Therefore, in order to secure Project funding from IFC, the Project must demonstrate that it is in compliance with the requirements of each of the above-mentioned performance standards.

## **3.3 International Conventions**

### **3.3.1 The Convention on Biological Diversity (1992)**

Under the convention, each contracting party is expected to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity. Uganda is a signatory to the CBD, which aims for the conservation of biodiversity, its sustainable use, and sharing of the benefits of biodiversity. Uganda's commitments as a signatory to the CBD are provided for in the Uganda NBSAP (ref. Section 3.1.8).

### **Project Relevance**

As a signatory to the CBD, Uganda's Government is committed to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity, implemented through a National Biodiversity Action Plan (ref. Section 3.1.8). The Project will need to demonstrate alignment with the provisions of the NBSAP in order to satisfy Government obligations as a signatory to the CBD.



### 3.3.2 The Convention for the Protection of the World's Cultural and Natural Heritage (1972)

Uganda is a signatory to the Convention on the Protection of the World Cultural and Natural Heritage (1972). To date, Uganda has three sites on the list of the World heritage sites namely: Kasubi tombs, enlisted in 2001; Bwindi Impenetrable Forest National Park; and Ruwenzori Mountains National Park. In 2005, UNESCO proclaimed the art of barkcloth making in Uganda a masterpiece of the oral and intangible heritage of humanity. Currently, five sites are on the World Heritage nomination list, including the ancient salt making sites at Kibiro that lies within the Albertine Graben, approximately 45 km north east of the Kingfisher Field development area.

#### *Project Relevance*

The Project will need to demonstrate alignment with the provisions of the convention in order to satisfy Government obligations as a signatory to the convention, through identifying and protecting cultural heritage by ensuring that internationally recognised practices for the protection, field-based study, and documentation of cultural heritage are implemented.

### 3.3.3 The Convention for the Safeguarding of the Intangible Cultural Heritage (2003)

Uganda has been a signatory to the United Nations Educational, Scientific and Cultural Organisation's (UNESCO's) Convention for the Safeguarding of Intangible Cultural Heritage since 2009. The Convention seeks to raise awareness of threats to intangible heritage and encourages member states in the identification, protection and management of such assets, ensuring respect for those individuals and communities concerned.

#### *Project Relevance*

The Project will need to demonstrate alignment with the provisions of the convention in order to satisfy Government obligations as a signatory to the convention, through identifying and protecting intangible cultural heritage and cultural practices by ensuring that internationally recognised practices for the protection, field-based study, and documentation of cultural heritage are implemented.

FINAL PRINT READY VERSION



### 4.0 METHODOLOGY

Ecosystem services are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems. In the strictest sense, without those beneficiaries, there are no ecosystem services. The benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. For the purposes of this assessment, the definitions of ecosystem services were based on those developed by the Millennium Ecosystem Assessment (MA, 2005), (Table 1). These definitions were chosen to keep consistency with the IFC’s Performance Standards, and because they are widely recognised.

Ideally, the Project should maintain the value and functionality of priority ecosystem services to those beneficiaries directly dependent upon them, through direct management control. As such, ecosystem services whose beneficiaries are at the global scale, and to a lesser extent, the regional scale, are not covered by this assessment.

Table 1: Ecosystems services categories

Broad categories	Definition
Supporting services	Natural processes essential to resilience, and functioning of ecosystems. <i>e.g., primary production</i>
Regulating services	Control of the natural environment <i>e.g., maintenance of key ecological processes, protected areas, habitat of special value, groundwater recharge, catchments</i>
Provisioning services	Supporting human needs <i>e.g., traditional hunting grounds, medicinal plants and minerals, water sources, fishing grounds, fire wood</i>
Cultural services	Aesthetic, spiritual, recreational, and other cultural values. <i>e.g., sacred sites, recreation, sense of place</i>

As mentioned, without the beneficiaries (that is, the local community (Type I) and the Project (Type II)), there are no ecosystem services. In terms of a project’s setting, that is, its location, an understanding of the ecosystem processes occurring in the area is important, as it enables an understanding of how those processes affect the supply and demand of the ecosystem services arising from such processes, and the value the ecosystem services eventually offer to beneficiaries (that is, the supply side). A conceptual ecosystem services flow path illustrating these supply linkages, using photosynthesis and the functions, services and benefits that flow from it as an example, is shown in Figure 1.



Figure 1: The flow of ecosystem services to beneficiaries

Given the above, and given that the assessment of ecosystem services is also concerned with the social aspects of the benefits of services (that is, the demand side), the assessment of ecosystem services relied upon data gathered during the stakeholder engagement processes carried out as part of the socio-economic baseline study and the cultural heritage baseline study . Other information for the ecosystem services assessment was gathered from the various specialist inputs to the baseline for the ESIA, during the Desktop Review (Section 3.3).



### 4.1 Local Study Area

An over-arching ecosystem services assessment for the entire Albertine Graben region is currently being completed by independent consultants. Therefore, the focus of this assessment is only on ecosystem services at the local scale to the Project, specifically, the Kingfisher Development Area where the main project footprint will be located, the proposed escarpment road, and the proposed pipeline route (Figure 2, Figure 3). This ecosystem services Local Study Area for this assessment (Figure 4) generally aligns with the local study areas used for the socio-economic baseline assessment, which consisted of the Kingfisher Development Area study area (comprising 11 villages in the Buhuka Parish and villages on top of the escarpment), and the pipeline route study area (comprising 22 villages in the vicinity of the pipeline route). Throughout the report, the various areas of the Local Study Area are discussed in terms of its unit components, that is, the Buhuka Flats, the escarpment, and the pipeline route.

### 4.2 Approach Overview

The approach taken to conducting the ecosystem services review is based on Steps 1 to 3 of the method put forward by Landsberg et al. (2013). Given that the current assessment is a desk-based study, the method was adapted to preclude additional baseline data gathering for priority ecosystem services once the initial list of relevant ecosystem services list was refined to focus on priority ecosystem services only. Instead, baseline data on all ecosystem services (priority and non-priority) was gathered during stakeholder engagement (Step 2) in order to determine how all ecosystem services currently contribute to stakeholders' livelihoods, health, safety or culture.

The approach to impact assessment consisted of a combination of the Project impact assessment on priority ecosystem services method in Landsberg et al. (2013), and the prescribed impact assessment method being used for the ESIA (Section 4.7).

### 4.3 Identification of Ecosystem Services Relevant to the Project

The ecosystem services that that Project could impact were identified by first defining which ecosystems could be affected, determining the ecosystem services supplied by and demanded from those ecosystems, and identifying the beneficiaries who use those services supplied by the ecosystems that could be affected, as per Step 1 of the guidance provided in (Landsberg, et al., 2013).

This was done by means examination of the land cover mapping exercise done during the biodiversity baseline assessment to identify the land cover types and thereby ecosystems that could be affected by the Project, and a desk study to identify the ecosystem services supplied by those land cover types, and the beneficiaries that use them.

#### 4.3.1 Land Cover Mapping and Condition Assessment

A land-cover dataset was produced using existing multi-band, high-resolution satellite imagery (Figure 6). The locations of Project infrastructure and activities were mapped against the land cover types that potentially supply ecosystem services, to identify those land cover types may be impacted by the proposed construction, operation and decommissioning of the Project.

- The land-cover dataset provided the following information:
- Land-cover types that would be affected by loss in area to the Project footprint.
- The area/extent (hectares) of loss of each land cover type identified. The size of each land cover type was measured from aerial photography via GIS, as was the area of each land cover type being lost to the Project footprint – allowing the proportion of loss within the different Project Area of Influence to be calculated.
- Identification and location of communities dependent on services supplied within the Local Study Area.
- Together with information from the existing biodiversity/social/physical baseline data (Section 4.2.2), the land cover dataset was used to identify ecosystems that could be impacted by the Project, and



subsequently the ecosystem services supplied by the potentially impacted ecosystems could be identified.

**4.3.1.1 Land Cover Condition Assessment**

Condition assessments are widely adopted as regulatory indicators of ecosystem function, and for some services (e.g., habitat) links between condition and function are often direct (McLaughlin & Cohen, 2013)

Ecosystem integrity, or the condition of the land cover types (and therefore their capacity to supply ecosystem services – ref. Figure 5) was therefore assessed, primarily based on the ecosystem integrity assessment of the various habitat types identified in the biodiversity baseline report . The integrity of ecosystems was determined based on the criteria put forward Table 2 (after: (Kent & Coker, 1992), (Treweek (ed), 1999), (Tucker, 2005), and (Secretariat of the Convention on Biological Diversity, 2006)).

**Table 2: Criteria for assessing ecosystem integrity / land cover condition**

Criterion	Description
Composition	Diversity and complexity - what is there and how abundant (in a particular time frame) it is
Structure (or pattern)	How biological units are organised in time and space. Ecosystem 'scale' refers to the space it occupies and the way it changes over time. The structure and interactions that shape the flow of energy and the distribution of biomass.
Linkages and corridors	To habitat of the same or different ecosystems, which provide an important 'playing field' for ecological processes and enable persistence. These linkages are in contrast to a highly fragmented landscape where patches of natural habitat are effectively isolated.
Key processes (including ecosystem function)	Which natural (that is, physical and/or biological) and/or human-induced processes are of key importance for the creation and/or maintenance of ecosystems. These are termed drivers of change, and include direct and indirect drivers. Examples of direct drivers include: changes in land use and land cover; fragmentation and isolation; extraction, harvest, or removal of species; external inputs such as emissions, effluents, chemicals; disturbance; introduction of invasive, alien and/or genetically modified species; and restoration. Examples of indirect drivers of change include: demographic; economic; socio-political; cultural; and technological processes or interventions.
Representativeness in the landscape	The uniqueness of the ecosystems within the LSA and the wider landscape; this rarity factor is related to the concepts of irreplaceability and vulnerability.
Resilience and stability	The ability of the ecosystem to absorb change, persist, and maintain the same form.

Based on the assessment of these criteria, the condition of the ecosystems and habitats was estimated and assigned a subjective class, as defined in the biodiversity baseline assessment :

- Pristine
  Moderately-degraded
- Near-pristine
  Heavily-degraded
- Slightly-degraded

Note that not all ecosystem services supply dynamics are affected to the same degree by the condition of the land cover type; for example, harvest of wood for fuel takes place both in forest habitats in good condition, and in bushland that might be considered to be in a degraded condition due to overgrazing.



However, the bushland may be more important in terms of supply as a result of proximity to settlements and ease of access.

### 4.3.2 Desktop Review

A review of the biodiversity, socioeconomic and physical data and information gathered during the baseline phase of the ESIA was conducted, and a full literature review of available publications, reports and data relating to ecosystem services and biological resource use in the Albertine Graben and Western Uganda was done. Relevant information from the review was collated to identify the specific ecosystem services associated with each of the mapped land cover types and determine the condition of the land cover types, and thus their potential/capacity to supply the ecosystem services,

The socioeconomic baseline data enabled the identification of the people who depend on those potentially impacted ecosystem services for their livelihoods, health, safety, and culture, i.e. the beneficiaries. Beneficiaries are defined as those individuals, communities, institutions, and companies (including CNOOC) that could be positively or negatively affected as a result of Project impacts on ecosystem services (Landsberg, et al., 2013).

The baseline data for the Project footprint reviewed and presented in this report was sourced from the following specialist chapters of the baseline study for the Project ESIA:

- Cultural Heritage Baseline (Vol.2, Chapter 6.4);
- Socio-Economic Baseline (Vol.2, Chapter 6.3);
- Surface Water Baseline (Vol.2, Chapter 6.1.5);
- Soils and Land Capability Baseline (Vol.2, Chapter 6.1.7);
- Biodiversity baseline report .

Numerous reports relating to ecosystem service supply and natural resource utilisation in the Albertine Graben and Western Uganda were used to inform the study; these are referenced throughout the text.

### 4.3.3 Listing of relevant Ecosystem Services

- A comprehensive ecosystem services supply and demand list was then developed based on relevant information collated from the desktop review. This included: the land cover types and associated ecosystem services that could be directly impacted by the Project; the natural resources that the Project will require for its operation; information on water supply, energy use, economic activities and population movement and migration derived from the baseline socioeconomic study; and the cultural and spiritual traditions and beliefs of people in the Project area detailed in the baseline cultural heritage study.
- The ecosystem services used, and beneficiaries of those services, were described. No ranking of importance of the ecosystem services was done at this stage; instead, the list was carried through to the next step where ecosystem services were prioritised (Section 4.4).

## 4.4 Step 2: Prioritisation of Ecosystem Services

Priority ecosystem services, upon which the impact assessment was focused, were selected from the list of relevant ecosystem services generated in Step 1. Priority ecosystem services are:

- Services for which Project impacts could affect beneficiaries' livelihoods, health, safety or culture (Type I);
- Services that could prevent the Project from achieving operational performance (i.e. impact the Project) (Type II).

### 4.4.1 Stakeholder Engagement Approach

Collection of stakeholder input to the prioritisation of ecosystem services for which Project impacts could affect beneficiaries was undertaken via surveys of local residents within the area of influence, as part of the



socioeconomic and cultural heritage baseline data gathering fieldwork. The interviews gathered information on Type I priority ecosystem services as defined by the IFC (2012a).

The information gathered during the interviews was used to:

- i Identify what ecosystem services were being used by beneficiaries, and gain an understanding of how much of the particular services were used, how far people had to travel to obtain it, and the importance of that service to their livelihood, wellbeing, and culture.
- i Identify existing drivers of ecosystem change.
- i Assess current supply of priority ecosystem services, the degree of dependence that beneficiaries have on priority ecosystem services, and whether the services are readily substitutable, compensable, irreplaceable etc.
- i Estimate foreseeable supply of ecosystem services and their contribution to beneficiaries' well-being in the absence of the project.

The interviews were carried out by the social and cultural heritage specialists in December 2013 to April 2014, during the baseline data gathering phase of the ESIA. All conversations were facilitated by CNOOC's Community Liaison Officer (CLO).

### **Socio-economic baseline**

Primary data collection for the socio-economic baseline study was conducted in the Local Study Area during December 2013 for the Kingfisher local study area, and March 2014 for the pipeline study. Data collection included focus group discussions, key stakeholder interviews, a sample household socio-economic survey and a land-use constraint mapping ground-truthing exercise.

### **Cultural Heritage baseline**

A non-invasive field survey to record all cultural heritage sites within the Local Study Area was conducted between 20 January and 2 February 2014. During the field work, consultation with the affected communities (those villages within the respective discipline-specific LSAs) was undertaken. Consultation was done via transcribed interviews in order to capture places of local cultural and/or sacred importance (for example, ritual sites, burial grounds, churches and mosques) and any related intangible heritage practice (taboo, oral history, traditional plant and medicinal plant usage etc.).

#### **4.4.2 Ecosystem Service Prioritisation Exercise**

- i The ecosystem service prioritisation exercise was carried out systematically, using the WRI Impact and Dependence Scoping tools, and current guidance regarding conducting an Ecosystem Services Review (Landsberg, et al., 2013). In addition, ecosystem services guidance specifically pertaining to the oil and gas industry was applied for the assessment of potential dependencies and impacts of oil and gas projects and operations (IPIECA, 2011).
- i The list of priority ecosystem services supplied in the Project's area of influence was developed by identifying priority ecosystem services; that is, those where the significance of the Project's impact is considered high, specifically:
  - i Type I priority ecosystem services were identified and defined by:
    - § Identifying potential Project-caused drivers of ecosystem change.
    - § Identifying potentially impacted ecosystems and associated ecosystem services, and potentially affected beneficiaries.
    - § Assessment of Project's impact on the ecosystem services.
  - i Type II priority ecosystem services were identified and defined based on the Project's requirements as outlined in the Project Description.



- i The importance of each ES to communities, and their level of dependence upon the supply of the ecosystem services, was established via engagement with the socio-economic, cultural heritage, biodiversity and surface water specialists.
- i Identification of the availability of alternatives for the supply of identified ecosystem services, including the existence of, and access to, those alternatives, based on land cover mapping, stakeholder interviews and information derived from the baseline studies conducted for the ESIA.

### 4.5 Step 3: Delineation of the Project Area of Influence

The **Project area of influence** is the area relevant to the assessment of project impacts and dependencies on priority ecosystem services; it includes the ecosystems that supply the priority ecosystem services, and the locations where the Project and affected stakeholders access priority ecosystem services (Landsberg, et al., 2013).

The Project area of influence was set by firstly mapping the locations of Project infrastructure and activities against the land cover types that supply priority ecosystem services to identify those land cover types that may be impacted by the proposed construction, operation and decommissioning of the Project. Secondly, the locations where the beneficiaries of the identified priority ecosystem services (Figure 2, Figure 3) access those services were then mapped and used to define the boundary of the Project Area of Influence for Impact Assessment.

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Figure 2: Locations of beneficiaries of ecosystem services that may be affected by the Kingfisher Development Area



# ECOSYSTEM SERVICES ASSESSMENT

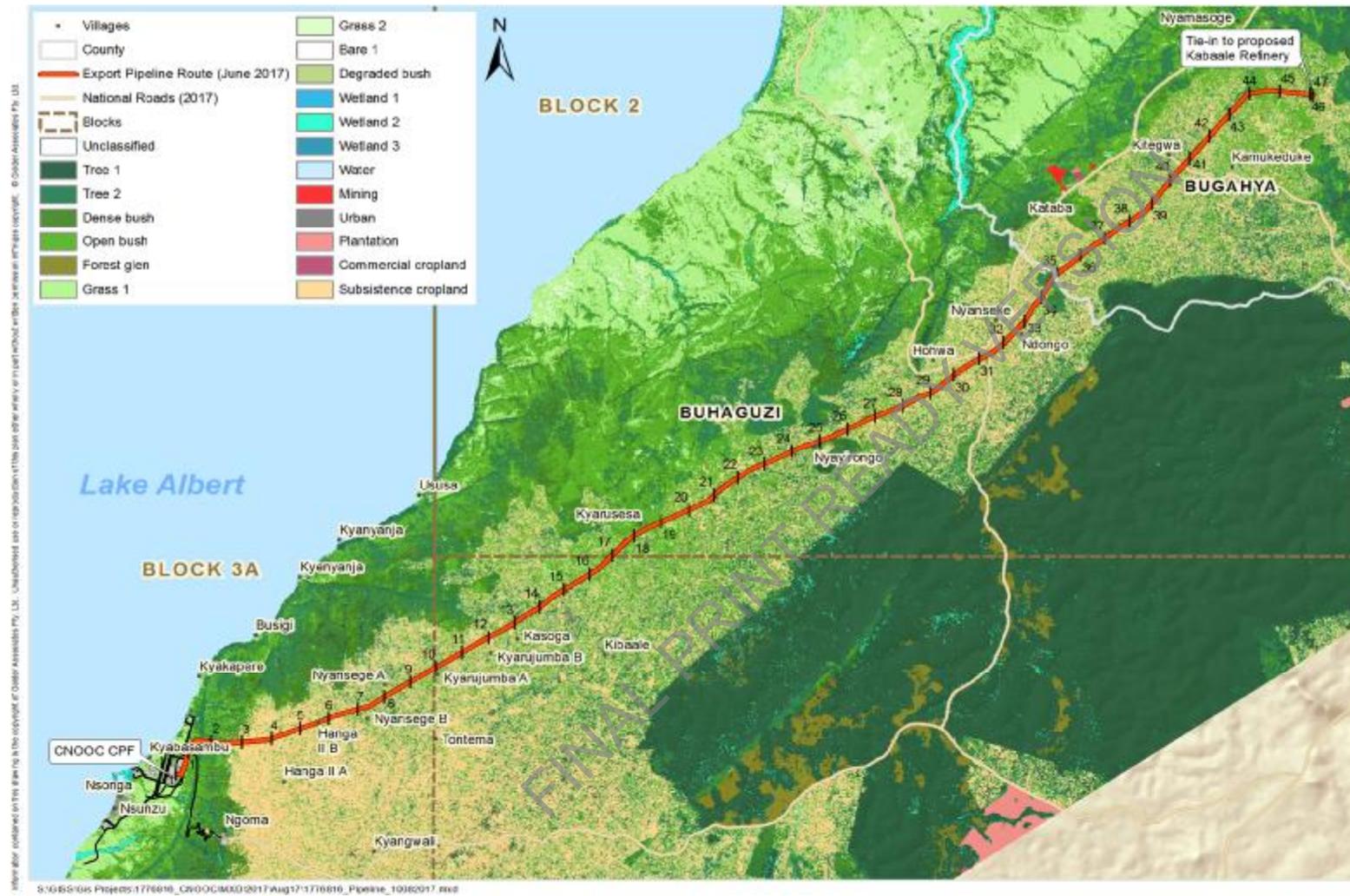


Figure 3: Locations of beneficiaries of ecosystem services that may be affected by the Pipeline route





### 4.6 Step 4: Establishment of the baseline for priority ecosystem services

As mentioned previously, Landsberg *et al.*'s (2013) ecosystem service review method was adapted to preclude additional baseline data gathering for priority ecosystem services once the initial ecosystem services list was refined (Step 4). Instead, baseline data on all ecosystem services (priority and non-priority) was gathered during stakeholder engagement (ref. Section 4.4.1) in order to determine how all ecosystem services currently contribute to stakeholders' livelihoods, health, safety or culture.

### 4.7 Step 5: Assessing Project Impacts on Priority Ecosystem Services within the Project Area of Influence

The impact assessment identifies the magnitude of a particular impact from the Project and then compares that magnitude with the sensitivity of the receiving environment to derive an overall significance for the impact. This method relies on a detailed description of both the impact and the ecosystem service valued component that is the receptor. The magnitude of an impact depends on its characteristics, which includes factors such as its magnitude, duration, reversibility, area of extent, and nature in terms of whether positive, negative, direct, indirect or cumulative.

One of the main purposes of the impact assessment is to provide answers to questions that people have about how a project could affect something that matters to them, such as a valued component. To focus this assessment, and ensure that the impact assessment clearly addressed the key issues raised by the stakeholders (see Section 4.4.1), and the objectives set for this impact assessment (see Section 2.1), questions were formulated that captured the concerns relative to a particular issue. In this report, those concerns are expressed as a 'key question', which forms the basis of the investigations of potential effects and impacts of the Project:

#### 1) What impact could the Project have on the supply of priority ecosystem services to beneficiaries?

In order to answer the key question in relation to ecosystem services, the impact assessment involved the following steps:

- 1) Review and identification of the trends and external, non-project-related threats to current ecosystem services supply - current pressures on ecosystems and the resilience inherent in those ecosystems were identified.
- 2) Assessment of the replaceability/substitutability of ecosystem services, and/or spatial alternatives for confirmed vulnerable beneficiaries.
- 3) An impact significance assessment (ref. Section 4.7.3.3) was conducted on Type I and II priority ecosystem services before and after mitigation.
- 4) Identification of social/operational/financial/regulatory/reputational risks associated with the residual impacts.
- 5) Identification of potential alternatives to supply of services.

#### 4.7.1 Impact Assessment Process

The impact assessment process compares the magnitude of the impact with the sensitivity of the receiving environment. This method relies on a detailed description of both the impact and the environmental or social component that is the receptor. The magnitude of an impact depends on its characteristics, which may include such factors as its duration, reversibility, area of extent, and nature in terms of whether positive, negative, direct, indirect or cumulative.

The impact assessment process was aligned with the World Resources Institute (WRI) approach (Landsberg, et al., 2013), consisting of a combination of those workers' approach to assessment of Project impact on priority ecosystem services and thereby assessment of impact on beneficiaries (Figure 5); and the prescribed impact assessment method being used for the ESIA (ref. Section 4.7.3).

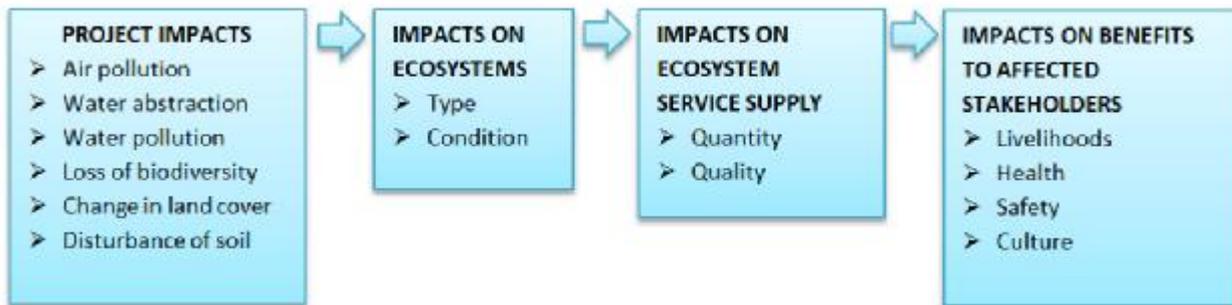


Figure 5: How assessment of Project impacts on ecosystems leads to assessing impacts on beneficiaries of ecosystem services (Landsberg et al., 2013)

### 4.7.2 Description of Potential Project Impacts

Interactions between the proposed Project activities and priority ecosystem services were identified through a review of the current Project Description in the context of the identified baseline environment in the Local Study Area (Section 6.0). In summary, Project activities will change the physical landscape and socio-economic context of the Project Area of Influence, which will result in direct and indirect impacts to priority ecosystem services. The key Project impacts affecting beneficiaries will be:

- ❖ Changes in land cover and associated reductions in the supply of ecosystem services due to the proposed construction of the Production Facility, the oil export pipeline to Kabaale, and all associated infrastructure:
  - § The physical presence of the Project in the landscape will directly change the land surface and will potentially interact with cultural heritage features - these are 'direct impacts', which are likely to affect both beneficiaries within or adjacent to the Project footprint, and beneficiaries from further afield who may travel to avail of cultural heritage ecosystem services intrinsically linked with the Lake Albert and Escarpment landscape.
  - § Activities that will not affect the land surface directly may indirectly alter the setting in which a site is experienced (for example, by related dust and noise disturbance) or limit the supply of provisioning ecosystem services (e.g., oil development areas may be fenced off which could restrict access to grazing lands for cattle) – these are 'indirect impacts'. These are likely to affect beneficiaries within close proximity to the development.
- ❖ Population influx of people seeking jobs during construction and operation of the Production Facility, and people seeking to provide commercial services to the increasing population in the vicinity of the Project, and the concurrent increase in demand for ecosystem services; this is likely to impact the quantity and quality of ecosystem service supply to existing beneficiaries.
- ❖ Water abstraction from Lake Albert to provide make-up water for the oil extraction process is proposed as part of the Project; this has the potential to affect water quantity and quality in areas of Lake Albert and thus may affect the fisheries potential of those areas, affecting beneficiaries that rely on fishing in these areas for livelihoods.



The types of potential Project impacts considered appropriate for the ecosystem services assessment are summarised in Table 3.

Table 3: Types of Ecosystem Service Impact

<b>Direct Impact</b>	Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptors (e.g., destruction of a sacred site as a result of construction of well pads, loss of an ecosystem's capacity to supply an ecosystem service due to degradation from over-grazing).
<b>Indirect impact</b>	Secondary impacts that result from project activity and affect the environment in which the receiving receptor is experienced (e.g., job-seeking population influx to the area and concurrent increase in demand for ecosystem services).
<b>Cumulative impact</b>	Impacts that act together with other impacts (including those from concurrent or planned activities from other projects) to affect the same resources and/or receptors as the Project.

4.7.3 Assessing significance of Project impacts on affected Stakeholders

4.7.3.1 Determination of Magnitude of Impact

Magnitude or magnitude describes the significance of the effect. To classify magnitude using an ordinal scale (that is, negligible, low, medium, or high) in a manner meaningful for ecosystem services, the effect size (loss of land cover class that supplies the ecosystem services to the Project footprint) must be placed in the context of the availability of the land cover class and thus available supply of the ecosystem services within the Project's Area of Influence. The magnitude of the potential impact was gauged by considering the following factors:

Direction

Direction describes the trend of the effect compared with baseline conditions. There are three options for direction:

- ❖ Adverse – effect is worsening or is undesirable.
- ❖ Neutral – effect is not changing compared with baseline conditions and trends.
- ❖ Positive – effect is improving or is desirable.

Geographic Extent

Geographic extent describes the quantitative measurement of area within which an effect occurs. Effects are described in terms of whether they are limited to the Project Footprint, Project Area of Influence, or extend farther:

- ❖ Site – effect is limited to the Project footprint.
- ❖ Local – effect extends beyond the Project footprint, but is limited to the Project Area of Influence Local Study Area.
- ❖ Regional – effect extends beyond the Project Area of Influence.

Duration

Duration refers to how long an effect lasts. Duration is described in relation to the phases of the development of the Project within the RSA, although effects may last longer than the phases of the Project for some valued components. The following framework was used:

- ❖ Short-term – effect is limited to the construction period (~2 years), or the period of decommissioning activities (~2 years).
- ❖ Medium-term – effect extends throughout the project operations, that is, 25 years.



- i Long-term – effect extends beyond the 25 years of operation.
- i Far future – effect extends more than 30 years after closure.

## Reversibility

This criterion describes whether the effect is reversible or not. This can be associated with duration, as many effects eventually could be considered to be reversible (that is, in geological time). However, the extinction of a species can be considered as irreversible.

**Table 4: Magnitude assessment rating scale**

Criterion	Rating scales
<b>Negligible</b>	Where the impact affects the environment in such a way that natural, and /or cultural and social functions and processes are negligibly affected and valued, important, sensitive or vulnerable systems or communities are negligibly affected.
<b>Low</b>	Where the impact affects the environment in such a way that natural, and/or cultural and social functions and processes are minimally affected and valued, important, sensitive or vulnerable systems or communities are minimally affected. No obvious changes prevail on the natural, and / or cultural/ social functions/ process as a result of project implementation
<b>Medium</b>	Where the affected environment is altered but natural, and/or cultural and social functions and processes continue albeit in a modified way, and valued, important, sensitive or vulnerable systems or communities are moderately affected.
<b>High</b>	Where natural and/or cultural or social functions and processes are altered to the extent that they will temporarily or permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. The changes to the natural and/or cultural / social- economic processes and functions are drastic and commonly irreversible.

### 4.7.3.2 Determination of Sensitivity of a Receptor

Sensitivity for each Ecosystem Service supplied and/or demanded ranged from very low to high according to increasing level of threat (Table 5).

**Table 5: Sensitivity assessment rating scale**

Criterion	Rating scales
<b>Negligible</b>	None of the below
<b>Low</b>	Ecosystem service is readily substitutable or replaceable
<b>Medium</b>	Ecosystem service is substitutable or replaceable
<b>High</b>	Ecosystem service is not substitutable and/or irreplaceable

### 4.7.3.3 Determination of Impact Significance

Once the magnitude of the impact and the sensitivity of the receiving environment were described, the significance of the potential impact was determined. The determination of significance of an impact is largely subjective and primarily based on professional judgment.

To provide a relative illustration of impact significance, it is useful to assign numerical descriptors to the impact magnitude and receptor sensitivity for each potential impact. Each is assigned a numerical descriptor of 1, 2, 3, or 4, equivalent to very low, low, medium or high. The significance of impact is then indicated by the product of the two numerical descriptors, with significance being described as negligible, minor, moderate or major, as in Table 6. This is a semi-quantitative method designed to provide a broad ranking of the different impacts of a project.



Table 6: Determination of impact significance

			Sensitivity of receptor			
			Negligible	Low	Medium	High
			1	2	3	4
Magnitude of Impact	Negligible	1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low	2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium	3	3 Minor	6 Moderate	9 Moderate	12 Major
	High	4	4 Minor	8 Moderate	12 Major	16 Major

### 5.0 LAND COVER MAPPING AND CONDITION ASSESSMENT

The land cover types within the Local Study Area are illustrated in Figure 6.

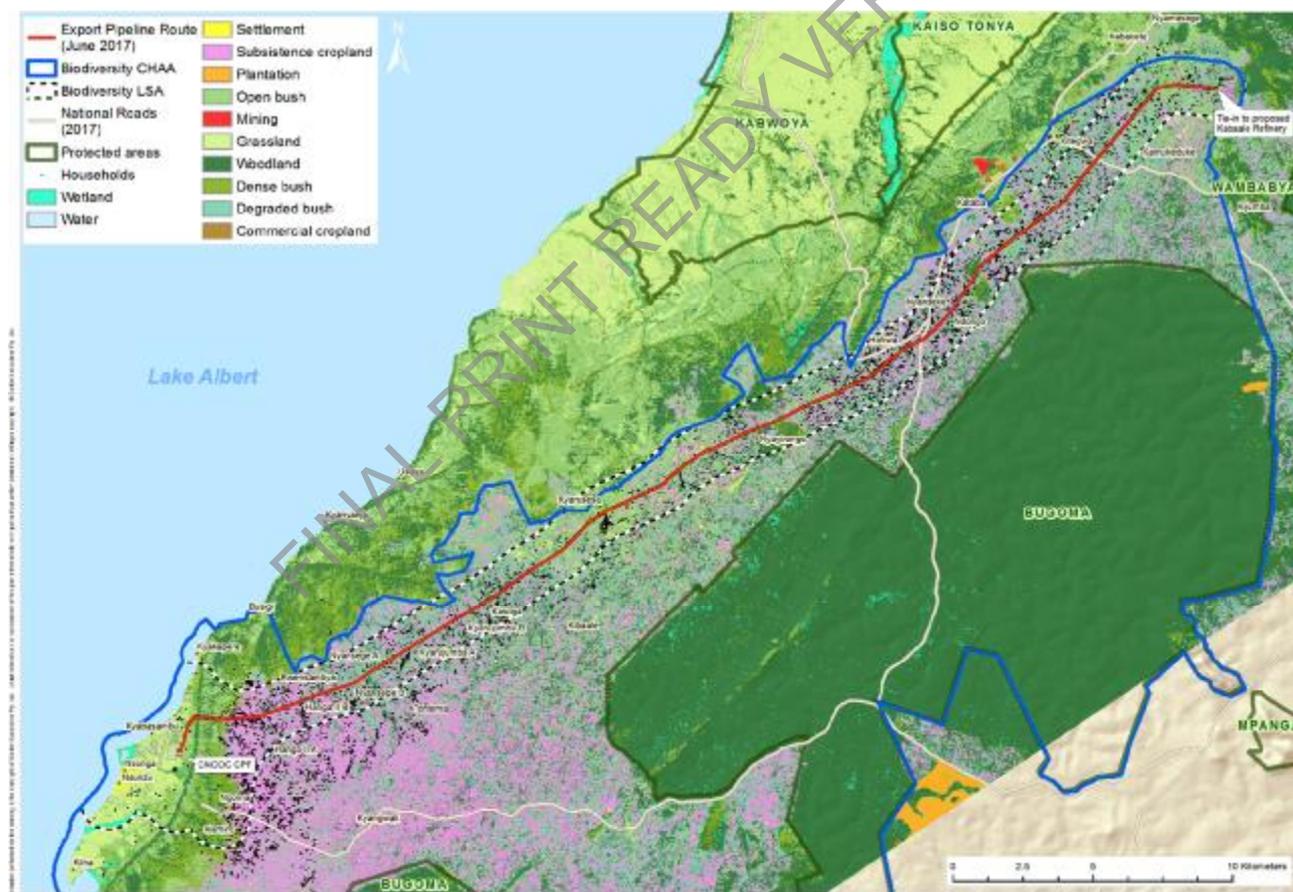


Figure 6: Land cover in the Project Area of Influence

The area of each land cover category within the Local Study Area in relation to estimated land take from Project components (that is, footprint, escarpment road and pipeline) are shown on Table 7 and Table 8.

Land cover is treated separately for the Kingfisher Development Area of the Local Study Area (the Project footprint the escarpment road, and the pipeline servitude from the Buhuka Flats to the top of the escarpment)



and the pipeline route above the escarpment, as the dominant land cover types in these two areas are quite different.

**Table 7: Land cover in the Buhuka Flats and proportion lost as a result of existing permitted, and proposed land take**

Kingfisher Development Area		Existing permitted land-take (Ha)	Proposed additional land-take (Ha)	% loss
Land cover Class	Total Area (Ha)			
Bare	5.0	1.9	0.3	44%
Dense Bush	53.3	0.0	0.6	1%
Grassland	773.8	34.5	57.5	12%
Open Bush	27.5	0.1	0.2	1%
Settlement	142.2	0.3	2.8	2%
Water	21.2	0.0	0.0	0%
Wetland	184.0	0.8	2.9	2%
Woodland	109.5	0.0	0.0	0%
<b>Total:</b>	<b>1316.5</b>	<b>37.6</b>	<b>64.3</b>	<b>8%</b>

Excluding bare ground, grassland on the Buhuka Flats and open bush of the escarpment will suffer proportionately the greatest loss to the Project (Table 7); while subsistence cropland will be the most affected land cover type by the pipeline route servitude, beyond the escarpment (Table 8).

**Table 8: Land cover in the Export Pipeline area of influence and proportion lost as a result of proposed land take**

Pipeline Route LSA (1km buffer)		Estimated land take by 30 m pipeline servitude	
Land cover Class	Area (Ha)	Area (Ha)	% of total
Bare	3.05	0.00	0%
Degraded Bush	2459.23	36.98	2%
Dense Bush	246.45	0.82	0%
Grassland	408.98	4.93	1%
Open Bush	2467.99	39.35	2%
Settlement	6.62	0.00	0%
Subsistence cropland	2562.94	39.93	2%
Water	44.55	0.00	0%
Wetland	12.29	0.36	3%
Woodland	1270.69	15.57	1%
<b>Total:</b>	<b>9482.78</b>	<b>137.94</b>	<b>1%</b>

**5.1.1 Land cover condition**

The ecosystem condition of the various land cover types within the Local Study Area was estimated. Table 9 shows each of the affected mapped land cover categories as they relate to habitat types recorded within the



Project Area of Influence, and their condition. This allowed a judgement on the condition of the land cover types to be made (and, therefore, their potential capacity to supply ecosystem services), based on the reported baseline condition of the habitat types supported therein.

**Table 9: Land cover classes, associated ecosystems, habitat types and condition**

Land cover class	Ecosystems	Dominant Habitat types	Estimated condition
Dense Bush Open Bush Grassland	Escarpment vegetation corridors	Open wooded grassland Dense wooded grassland Dense bushland Riverine bushland	Slightly degraded to moderately degraded
Degraded Bush Settlement Subsistence cropland	Settlement and cultivation areas	Open bushland and shrubland Grassland with thicket Open grassland	Heavily degraded
Wetlands	Wetlands	Permanent wetlands, seasonally flooded grassland	Slightly degraded to moderately degraded
Woodland	Bugoma Central Forest Reserve	Woodlands, Wooded bushlands	Slightly degraded to moderately degraded
Water	Near-shore habitats of Lake Albert	Shallow river-associated waters, open sandy shores, lagoons, large bays, rocky escarpments, open-water habitats	Near-Pristine

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## 6.0 REVIEW OF BASELINE BIODIVERSITY, SOCIOECONOMIC AND BIOPHYSICAL ENVIRONMENT OF THE LOCAL STUDY AREA

The Project will be located on the south-eastern flank of the Lake Albert Basin, which is part of the western arm of the East African Rift System. This area is commonly known as the Buhuka Flats, situated in the administrative boundary of Kyangwali Sub-County in Hoima District (Figure 2). The Project also includes the pipeline route to Kabaale (Figure 3).

This section presents a description of the existing environment within the Local Study Area, in relation to the supply of, and demand for, ecosystem services. In particular, it presents a summary of the relevant information distilled from the biodiversity and surface water baseline reports, in order to put the proposed Project area's provisioning, supporting and regulating ecosystem services supply capability in context. Terrestrial and aquatic biodiversity is discussed in terms of vegetation communities and habitats and their condition, which directly relates to the results of the land cover condition assessment discussed in Section 5.0 above. This section also addresses drivers of ecosystem change that already exist within the Study Area, in the absence of the Project.

### 6.1 Terrestrial and Aquatic Biodiversity

Surveys of flora and fauna were conducted in the Project footprint and along the pipeline route, for the baseline biodiversity assessment (Eco & Partners, 2014). The data gathered on vegetation communities and fauna is presented in the following sections in the context of ecosystem service provision within the Local Study Area.

#### 6.1.1 Vegetation Communities Providing Ecosystem Services

##### *Buhuka Flats*

The vegetation communities that dominate the Buhuka Flats include thicket-grassland mosaic, open grassland, wooded bushland and wetlands (Figure 7, Figure 9). These areas are a source of fodder for grazing cattle, and are over-exploited for grazing in many parts. The wetlands are a source of thatching material, wattle and mud 'daub' for traditionally built houses (Golder Associates, 2014) (Figure 8). Papyrus culms are also harvested from wetlands and used as a construction material for houses (NEMA, 2002).



*Thicket-grassland*



*Open grassland*



Woodland (riparian areas)



Seasonally-flooded wetlands on shore of Lake Albert

Figure 7: Vegetation communities of the Buhuka Flats



Figure 8: Traditionally built house in process of being thatched



# ECOSYSTEM SERVICES ASSESSMENT



Figure 9: Focus on vegetation communities and aquatic habitats of the Buhuka Flats

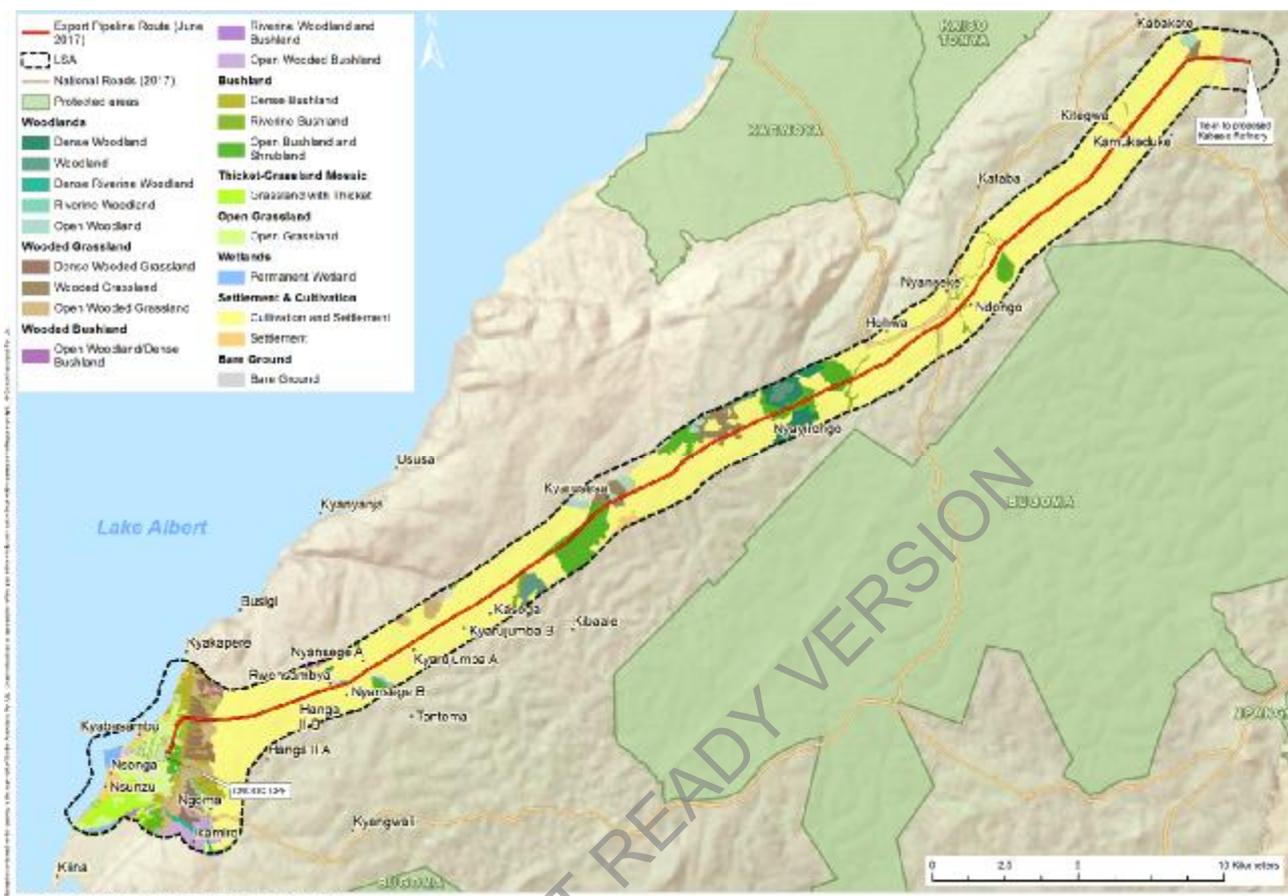


Figure 10: Vegetation communities of the Local Study Area

## Escarpment

The slopes of the Escarpment are characterised by wooded grassland, bushed grassland and bush-land and shrub-land (Figure 11). These vegetation types lend themselves to ecosystem services provision including wood for charcoal production, and subsistence hunting (Golder Associates, 2014).

Tamarind (*Tamarindus indica*) is fairly common on the escarpment in woodland and wooded grassland; this species is commercially used for food in parts of northern Uganda (Katende, et al., 1995) though it is unclear whether it is used for this purpose in the Local Study Area. Due to its heavy exploitation, it is of conservation concern in Uganda and is on the Uganda Reserved Tree Species List of the National Forest Authority (Eco & Partners, 2014).

The total length of the escarpment road is approximately 7 km and 9 metres wide, including shoulders. The construction of the road is likely to influence the supply and demand of ecosystem services. The loss of the wooded grassland and woodland will reduce the supply of ES such as availability of wood for charcoal production; the presence of the road will enhance access to wooded areas and this may increase demand for ES supplied by woodlands in these areas.

## Pipeline route

The pipeline route to the refinery area and Kabale is approximately 46 km in length. The majority of this part of the Local Study Area has been subjected to high intensity, subsistence agriculture, which has altered much of the original natural landscape (Forest Department, 2002); the dominant vegetation type along the pipeline route is cultivated land associated with settlement.



Widespread cattle grazing and charcoal manufacture have put significant pressure on the few natural vegetation communities in the vicinity of the pipeline route, which consist of fairly degraded seasonal wetlands, riverine bushland along Hohwa River and pockets of natural woodlands. The effects of large-scale conversion of natural habitats to subsistence agricultural fields are particularly noticeable between the escarpment proper and Bugoma Central Forest Reserve.

### 6.1.1.1 Invasive plant species

A number of invasive plant species are present throughout the Local Study Area. *Mimosa pigra* (Giant Sensitive Tree), *Lantana camara* (Lantana), and *Eichhornia crassipes* (Water Hyacinth) were the commonest species recorded, predominantly on the Buhuka Flats and the shore of Lake Albert, which are recognised as some of the most noxious weeds in the world (Lowe, et al., 2000).

Several of the invasive species recorded in the Local Study Area provide ecosystem services to local communities and are planted specifically for this purpose, including Castor oil (*Ricinus communis*), Neem (*Azadirachta indica*), Jatropha (*Jatropha curcas*), and Parkinsonia (*Parkinsonia* sp.):

- ❖ **Castor oil:** planted and used for medicinal purposes in the LSA (Golder Associates, 2014).
- ❖ **Jatropha:** its non-edible seeds are harvested for biodiesel production, it is also planted on graves in the LSA (Golder Associates, 2014).
- ❖ **Neem:** used in East Africa for various medicinal purposes including the treatment of scabies and head lice, and its hard wood is harvested for use in construction (BioNET-EAFRINET, 2011).
- ❖ **Parkinsonia:** may be used for firewood, charcoal production, medicine, fodder, shade, mulch, as a 'live' fence, and as a windbreak for soil stabilisation (BioNET-EAFRINET, 2011).



Wooded Grassland



Bushland and shrubland



Bushed grassland



Wetlands associated with Escarpment ravines

Figure 11: Vegetation communities of the Escarpment

### 6.1.2 Faunal Communities Providing Ecosystem Services

#### 6.1.2.1 Freshwater Fish Communities of Lake Albert

Nile Perch (*Lates niloticus*), Ragoge (*Brycinus nurse*), Ngassa (*Hydrocynus forskahlii*), Shield-head Catfish (*Synodontis schall*), Black Nile Catfish (*Bagrus bajad*), Muziri (*Neobola bredoi*) and Angara (*A. baremoze*) made up the majority of the wet and dry season baseline fish survey catch, and are some of the most commercially important species in Lake Albert (Taabu-Munyaho, et al., 2012).

In 2014, the fish community in the near-shore zone of the LSA was composed of a fairly uniform, multispecies mix of various ages in good condition. The diversity, age classes and condition of the species assessed was a reflection of adequate food and a healthy environment.

The near-shore artisanal fishery is dominated by gillnets, and is mostly focused on Nile Perch, Ragoge, Ngassa, and Angara; whilst Muziri features strongly in the seine net fishery. The condition of the near-shore aquatic habitats that support the fishery was considered Near-Pristine (ref. Section 5.1.1); therefore, the capacity of this ecosystem to continue to supply this ecosystem service is high. Further information on the fisheries value of the Lake Albert fish community to beneficiaries is provided in Section 6.4.1.

#### 6.1.2.2 Terrestrial Fauna Hunted for Bush Meat

A study of bush meat consumption in Uganda found that bush pig (*Potamochoerus larvatus*), cane rat (*Thryonomys* sp.), guinea fowl (*Numida meleagris*) and kob (*Kobus kob*) were the main sources of bush meat in the Murchison Falls area (Olupot, et al., 2009), which is the nearest (approx. 150 km northeast) studied area to the ecosystem services Local Study Area. Other species taken for bushmeat in Uganda include bushbuck (*Tragelaphus scriptus*), duikers (*Cephalophinae*), oribi (*Ourebia ourebi*), buffalo (*Syncerus caffer*), hippopotamus (*Hippopotamus amphibius*), redtail monkey (*Cercopithecus ascanius*) and black-and-white colobus monkey (*Colobus* sp.). However, Olupot et al. (2009) reported that bush meat was eaten by a comparatively low number of respondents (5-32%) when compared to the (reported) consumption of livestock meat and fish (94-100%).

Due to the heavily human-impacted nature of the Local Study Area, vegetation cover is compromised and the potential of the area to support terrestrial mammal species is considered limited (Eco & Partners, 2014); however, a few medium sized mammals were recorded during the biodiversity baseline studies. These tended to be thicket and dense bushland specialists, such as bushbuck and duiker. The low populations and diversity of these species could also be a reflection of increased pressure for bush meat from the local human population, which has increased markedly over the last ten years (AECOM, 2012).

The socio-economic baseline report makes reference to hunting occurring in several villages, and hunting of 'rats' as an alternative livelihood in the village of Kamukeduke; these, together with mammal species that were



reported (during interviews with locals, and trapping and observation of track/sign during field work) in the biodiversity baseline study of the LSA, that are known bush meat sources in the area, are outlined in Table 10.

**Table 10: Mammals recorded in the Kingfisher LSA that are bush meat sources<sup>2</sup>**

Common name	Species
Hippopotamus	<i>Hippopotamus amphibius</i>
Bush Duiker	<i>Sylvicapra grimmia</i>
Lesser Cane-rat	<i>Thryonomys gregorianus</i>
Northern savanna multimammate rat	<i>Mastomys hildebrandti</i>
Black rat	<i>Rattus rattus</i>

The biodiversity baseline report identifies bush meat hunting as a driver of change in the Local Study Area, particularly in Bugoma Central Forest Reserve (NEMA 2010, Plumtre et al. 2010). Between 2011 and 2012, increased immigration into the areas surrounding the forest resulted in increased deforestation, with an estimated 5,000 ha of the forest subject to encroachment by about 1,000 families and pit-sawyers (AECOM, 2013). In Bugoma CFR, trapping of large mammals now appears to have declined, which is attributed in part to the decline in large mammals to such an extent that hunting is not very productive any more (Plumtre et al., 2010).

A study of nearby Budongo Central Forest Reserve (Zommers & MacDonald, 2012), identified that of the local communities that hunted bush meat in the forest, nearly 73% were immigrants to the area; and furthermore, that the households of immigrants were also more likely to be involved with deforestation.

Overall, the indication is that bush meat is a resource utilised by beneficiaries within the Local Study Area, and may be of greater importance to immigrant populations than residents who have established subsistence crops or livestock grazing areas. Pressure on faunal species that are hunted for bush meat is thus expected to increase as a result of population influx associated with development of the Project.

## 6.2 Surface Water Systems

Lakes and rivers provide provisioning services in the form of water supply, food (fish), and vital regulating services such as groundwater recharge, water storage, flood control and water purification/waste assimilation (IPIECA, 2011).

The information presented in the following sections contextualises the baseline information presented in the Surface Water baseline report in terms of supply of fresh water to the Project and to beneficiaries, and regulating ecosystem service provision within the Local Study Area.

### 6.2.1 Surface Water Resources in Local Study Area

The location of the proposed Project in relation to regional surface water features and topography is shown in Figure 12 and Figure 13 respectively. The local surface water features in relation to the Project are illustrated in Figure 14.

Hydrologically, the Project is located within the Lake Albert catchment, which drains westwards from the escarpment into the south-eastern shores of Lake Albert. Lake Albert's catchment is strongly associated with the adjacent escarpment, draining into the lake via several streams flowing westwards. Surface water bodies within the Project's Area of Influence include the Kamansing and Masika Rivers. Various other streams also flow off the escarpment and either join the main rivers mentioned above (such as Masika) or gradually and independently feed Lake Albert. The area below the escarpment is approximately 13 km<sup>2</sup> and, besides the rivers mentioned, is characterised by relatively scattered wetlands at an elevation level associated with most Project infrastructure (Figure 13).

<sup>2</sup> Based on WCS study (Olupot, et al., 2009) and (Golder Associates Africa, 2014 (a))



The escarpment catchment generates runoff during the rainy season that discharges onto the Buhuka flats via ravines. High energy ravine flows are quickly dissipated as the slope meets the flats and the bushy vegetation at the bottom of the escarpment further slows the flow of water. Streams that are large enough slowly make their way through densely vegetated wetlands to Lake Albert. Some of the smaller streams disappear from the surface a few hundred metres away from the bottom of the escarpment; this shows that the zone at the bottom of the escarpment is an important zone of recharge of water into the soil.

Water quality results for the baseline assessment were compared with the local Ugandan Acceptable Standards for drinking standards (NEMA, 1996), and the World Health Organisation (WHO) for Drinking Water (WHO, 2011). Overall, the water quality in the Buhuka Flats area during the dry season is generally good; during the wet season there is potential for humic acids (from surrounding land areas such as wetland systems) to increase pH levels and introduce metals into Lake Albert.

### 6.2.2 Ecosystem Services Provided by Surface Water Systems in Local Study Area

The zone at the bottom of the escarpment is an important zone of recharge of water into the soil; therefore, this area has a role in provision of regulating services in the Buhuka Flats area, including groundwater recharge, water storage and flood control. Scattered wetland areas in the Buhuka Flats consist of riparian floodplains, and permanent wetlands at the Lake's edge. These wetland areas also provide regulating ecosystem services including flood attenuation and sediment retention.

Main water sources within the villages along the pipeline route include springs, streams and boreholes, which are used for drinking and domestic purposes as well as animal watering. These water sources provide typically poor-quality drinking water, which commonly causes various illnesses in the local communities .

The communities of the Buhuka Flats region source drinking and bathing water from either Lake Albert or from the gravity flow scheme (which is contaminated with human waste). These households also dispose of solid waste and waste water into the Lake ; therefore, the lake has importance both as a source of drinking water, and for provision of some waste assimilation services.

The construction and operation of the Project has potential to influence or change the processes that drive these systems and thus their capacity to supply ecosystem services. For example, the road leading from the foot of the escarpment and the borrow pit has noticeably influenced the flow regimes and drainage patterns of the seasonally flooded grasslands associated with the Kamansing River, resulting in the alteration of the wetland on the western side of the road and associated loss of function. Construction of the pipeline route is expected to intercept several permanent wetland systems which may alter flow regimes and ultimately affect the capability of the wetlands to provide services such as flood attenuation or nutrient (waste) assimilation.

### 6.2.3 Project Water Demand

During the operational phase, the Project will require a maximum of 9360 m<sup>3</sup>/day, which equates to a maximum of 3.416 Ml/year. This equates to between 0.00000857% of the average inflow into Lake Albert (39750 Million Ml/a). This is much less than the monthly variations observed naturally at Lake Albert. Therefore, the supply of fresh water provided by the Lake is not expected to be significantly affected by the water required for Project operation.



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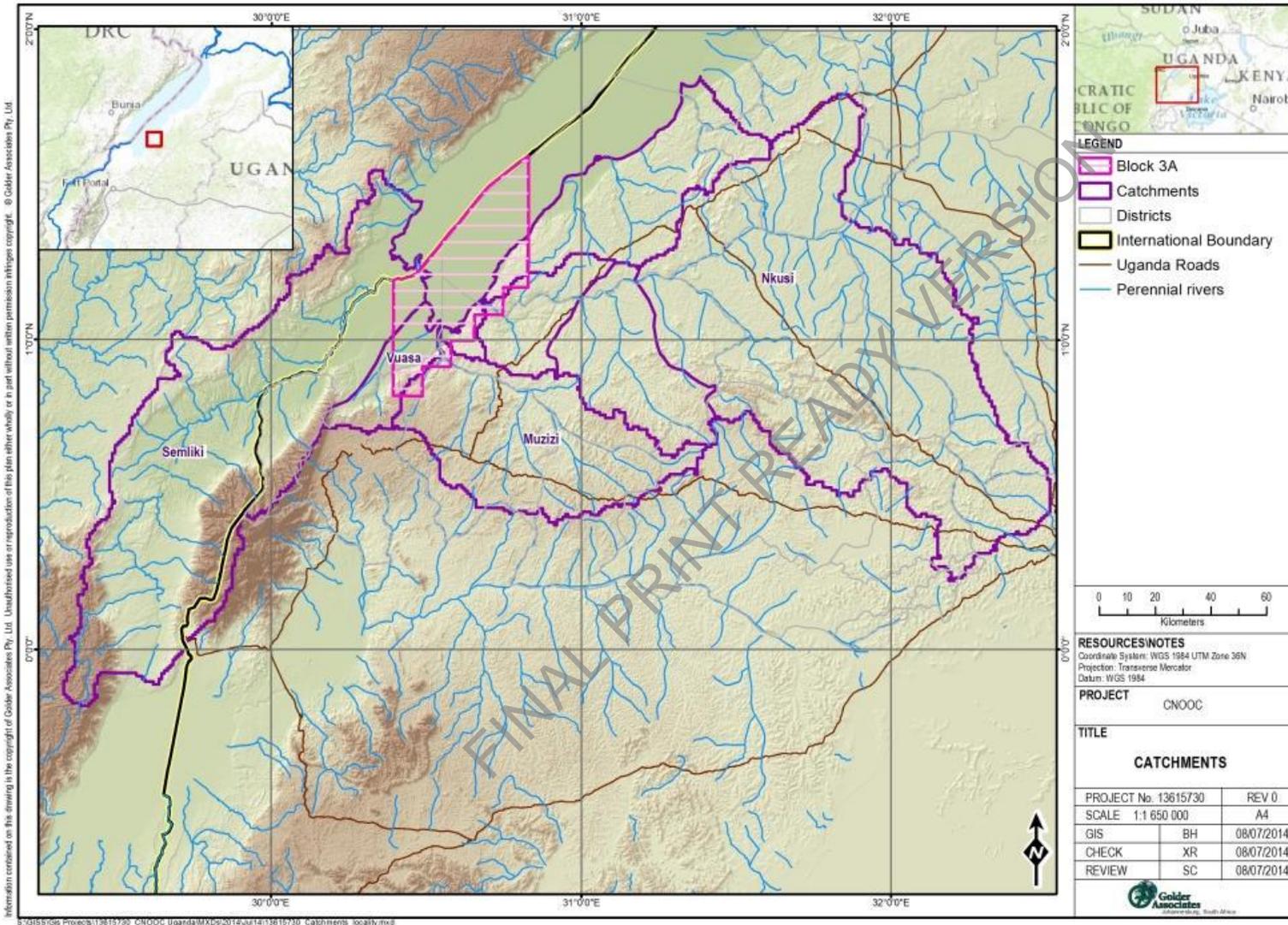


Figure 12: Regional location of the Project in relation to surface water features



# ECOSYSTEM SERVICES ASSESSMENT

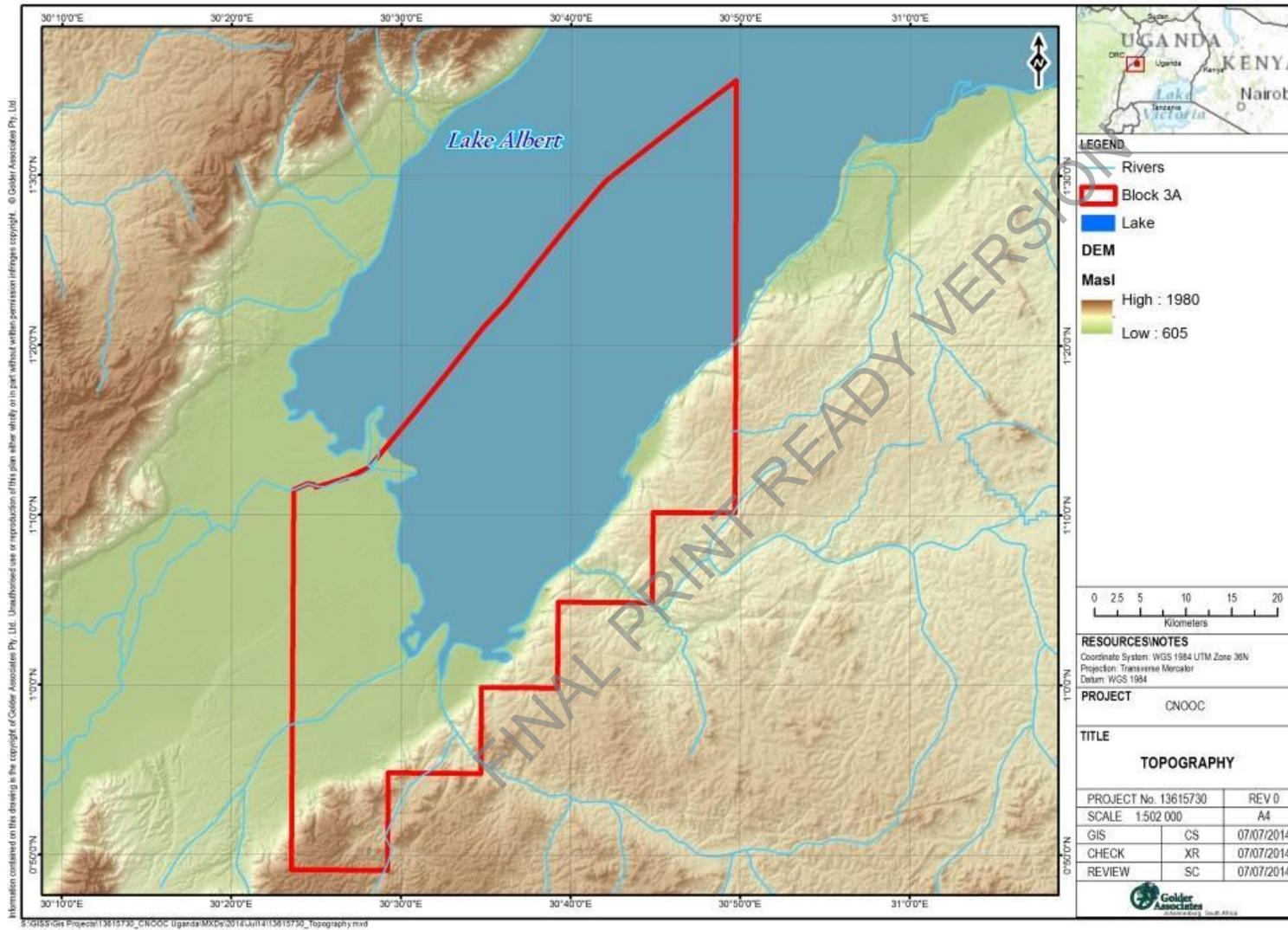


Figure 13: Regional Topography



Figure 14: Local context of the Project in relation to surface water features and floodlines



### 6.3 Land Use, Land Capability and Soils

Land uses in the Local Study Area were assessed as part of the baseline study for the ESIA. Land capability was determined based on the types of soil present in the areas investigated.

In the Buhuka Flats, 'natural grassland' consisting of thicket-grassland mosaic, open grassland, and seasonally flooded grassland vegetation categories, is the dominant existing land use (Table 11). This area is currently used for grazing cattle. The land potential of this area is appropriate for arable crop production. Wetlands (approx. 19%) and settlements (approx. 16%) account for the majority of the remainder of land use in the Buhuka Flats area.

Land use along the pipeline route is dominated by 'cultivated land' (Table 11). Patches of permanent wetland, seasonally flooded grassland, and open bushland and shrubland occur along the pipeline route, these are classified as 'natural grassland' in terms of land use category. The land potential of the areas classified as 'natural grassland' is also considered suitable for arable crop production.

Table 11: Land use within the Local Study Area

Area	Land Use	Surface Area (ha)	% of Total
Buhuka Flats	Existing CNOOC Base & Airstrip	24	3.16
	Natural Grassland	468	61.57
	Cultivated Land	5	0.66
	Villages and immediate surrounds	120	15.79
	Wetlands	143	18.82
Pipeline Route	Natural Grassland	396	17
	Cultivated Land	1,923	83

Examination of the land use categories in the Local Study Area, shows that livestock grazing opportunities provided by natural grassland and wetland categories accounts for approx. 80% of the land use of the Buhuka Flats area. This highlights the importance of this area for provision of grazing ecosystem services. Almost no crop cultivation occurs in this area.

Land use along the pipeline route is dominated by cultivated lands (83%). These areas are used for subsistence farming and small-scale commercial farming, which are the main economic activities along the pipeline route. Production is carried out on small farm holdings less than 1 acre in size (Figure 15), and crops are mostly used for household consumption or sale in community markets.



Figure 15: Backyard farming in Nsonga, Buhuka Flats



### 6.4 Baseline Socio-economic Setting

The information in the following sections is largely derived from the interviews done as part of the socio-economic baseline study. Other relevant information sources are referenced as appropriate throughout the text.

The Local Study Area is starkly different from the general district and national trends in terms of primary economic activity. While agriculture is a major economic activity in the district, the Local Study Area is mostly characterised by fishing and livestock (mainly cattle) keeping as economic activities. The villages in the Buhuka Flats have traditionally predominantly engaged in fishing and cattle farming as a livelihood, whilst villages on top of the escarpment engage in agricultural crop farming activities as a main livelihood activity. A substantial amount of processing and trade across Lake Albert occurs with the fish produce. The Buhuka area in general is experiencing rapid economic development since the opening of the escarpment road into the Flats, where two large markets have developed, selling various goods and services which attract an extensive daily clientele. This has resulted in induced and indirect employment opportunities being created. More details regarding economic activities are provided in the following sections.

Household size on the Buhuka Flats ranged between 1 and 11 persons, with an average of 8 members per household. This figure is substantially higher than the average district household size of 4.9 persons and the national average of 4.7 persons.. There has been a substantial increase in the growth of villages on the Flats over the past 10 years, with figures for the period 2003-2013 indicating that the rate of growth in the number of structures in villages ranged between 96%-175%, with the exception of Kacunde village which experienced a 439% increase in the number of structures in the village over the same period (59 to 256) (see Vol 8, Specialist Study 9 SIA). This increase is thought to be driven by a multitude of factors including regional instability, attractive livelihood opportunities to engage in fishing on Lake Albert interest in capitalising from opportunities related to oil and gas developments, and more recently, the opening of the escarpment road.

#### 6.4.1 Fisheries

At least 75% of the households in Buhuka Parish villages directly depend on subsistence fishing activities as a source of food, livelihoods and a cash income. The fish caught in the district is spread over 68 landing sites in the district which are distributed quite evenly along the shoreline. Drying and salting of fish along the lake shore (Figure 16) is undertaken before selling the fish at markets in Hoima. According to focus group discussions held in 2014, relatively little of the fish catch went up the escarpment for trade (about 25%), with village residents from the top of the escarpment being more likely to travel to the lake to catch their own fish for household consumption and transport it back to their houses than to purchase fish from the markets. Since then, the opening of the escarpment road has spurred significant change in the way that the traditional Buhuka Flats fisheries trade was conducted. Migration onto the Buhuka Flats has already been significant as a result of the access created by the escarpment road. The continued influx of migrants as well as opportunistic and uncontrolled fishing practiced by local villagers and people from outside of the Buhuka Parish, including commercial fisherman from Hoima and even Kampala, has resulted in overfishing, negatively affecting the livelihoods of local households. Fish trade appears to be conducted across the lake into the Democratic Republic of Congo (DRC) (e.g. at Panyimur, Bwera and Ntoroko), while vast quantities of silver fish of fingerling size are harvested and sold (primarily as poultry feed) within Uganda as well as in Kenya. The fishing trade (including both fishermen and traders) forms part of the informal economic sector, and therefore earnings are largely undocumented. What is clear, is that earnings are unpredictable in size and occurrence. Fishing has greatly influenced social and economic development in the sub-county of Kyangwali where the Project will be located.

There are numerous reports of declining fish numbers, driven by unsustainable fishing practises and an increasing population engaging in fishing activities. The fishing sector is also being threatened by declining catches, mainly due to the use of destructive and illegal fishing methods, fishing in breeding areas, non-compliance with regulations and inadequate control of catches. Poor fishing gear and techniques result in taking of immature fish before they have the chance to reproduce and maintain the fish population. Other factors that affect fishing activity on the lake shore include restrictions on illegal fishing methods and poaching put in place by **Beach Management Units (BMUs)**; however, limited funds and inadequate coordination between BMUs and fisheries authorities limits the conservation capacity of these organisations (Uganda Nile



Discourse Forum, 2013), and the BMUs are currently (2018) largely defunct. Most fisheries are formally open-access with no legal controls in place to prevent entry to fisheries (Scullion, 2007). The direct impact of oil exploration activities on fishing is thought to be the least detrimental impact on current amounts of fish caught. Indirect effects of oil exploration activity, such as population influx, is likely to increase in the number of people involved in fishing, putting fish stocks under increasing pressure which is expected to result in swifter fish stock decline. These indirect effects have been underlined since the opening of the escarpment road, which has facilitated easy vehicular access to the lake shore. The results of fieldwork conducted during November 2017 to update the social baseline suggest that fishing pressure on the Buhuka Flats has increased significantly to fuel the demand that has been generated by the new access to the shore, with trucks arriving daily from as far as Kampala to buy the catch.



Figure 16: Drying Nile perch at the shore of Lake Albert (2014)

### 6.4.2 Agriculture

Subsistence farming and small-scale commercial farming are the main economic activities in the Hoima District. The majority of people along the pipeline route are dependent on agriculture, with crop production as a major economic activity, followed by poultry and livestock. However, the Buhuka Flats is notably different, with households being heavily dependent on fisheries rather than agriculture. Where subsistence farming is engaged in, the dominant activity in this area is livestock keeping, rather than the growing of crops.

#### 6.4.2.1 Buhuka Flats

Very few households grow agricultural produce in the Buhuka Flats, and instead purchase this from sources on top of the escarpment, and at the daily markets that have become established on the Flats since the opening of the escarpment road.

Households in the Buhuka Flats that do grow crops, do so on small backyard plots. Crops typically consist of cassava, maize, beans, sweet potatoes, tomatoes and *matooke* (bananas). Some of the food crops are



sometimes sold in order to raise money needed for other household needs. Besides cultivating on open spaces in the backyard of their homesteads, approx. 33% of Buhuka Flats respondents reported that they also had access to arable land away from their homesteads, the majority of which (approx. 70%) is located on top of the escarpment and the rest comprising plots of land in the Buhuka Flats. The average size of land currently being cultivated according to the respondents is 3 acres and the most common size is 1 acre.

On the Buhuka Flats, livestock keeping is undertaken by a large percentage of households (approx. 80%). Livestock numbers are large. Carrying capacity calculations suggest that there is a high degree of overgrazing (approx. double the carrying capacity) already in both the Buhuka Flats and neighbouring areas into which cattle herders range to find alternative grassland sources .

In 2014, an influx of cattle keepers from as far as Tanzania and Kasese areas lead to a tremendous increase of cattle in the Kyangwali sub-county, including the Buhuka Flats. In Buhuka, the cattle keepers were attracted mainly by the abundance of water from the lake and the open grasslands that are conducive for grazing animals . Since the opening of the escarpment road, cattle grazing in the Buhuka Flats appears to have further intensified, with erosion and degradation of riparian habitats due to excessive cattle trampling being observed during the fieldwork conducted as part of the social baseline update in November 2017.



Figure 17: Cattle trampling around water source on Buhuka Flats, Nov 2017. Escarpment road in background.

### 6.4.2.2 Pipeline Route

Most of the pipeline route is covered by cultivated areas (Figure 6). The most common subsistence crops include bananas (for food), bananas (for beer), cassava, sweet potatoes, Irish potatoes, cotton, soybeans, groundnuts, pigeon peas, beans, sorghum and maize, whilst perennial crops including coffee, banana and



sugar cane plantations and tree plantations (pine wood, eucalyptus), which are typically commercial crops. Beekeeping for honey production is practised in a number of villages along the pipeline route (.

Both the crop farming and livestock sectors in the Kyangwali sub-county are faced with a number of challenges and these include: unpredictable weather changes, vermin attacks, crop diseases, poor farming practices which is leading to shortages of land for cultivation, and environmental degradation/deforestation because of the increase in clearing of land for farming practices.

### 6.4.3 Freshwater

On the Buhuka Flats, the main source of water for household consumption is piped water from the gravity flow scheme. The water is sourced from open water sources at the top of the escarpment and is then piped down to the Buhuka Flats area. Approx. 79% of the Buhuka population buy their water from taps and 15% draw their water from the lake (Environmental Assessment Consult (U) Ltd., 2013). Poor quality drinking water is a challenge for most villages in the Local Study Area, (for example, in Kyakapere village, tap water is reportedly polluted so water is drawn from the lake and boiled) and water-borne diseases are prevalent.

In the vicinity of the pipeline route, villages obtain water from sources including boreholes, wells, water holes, streams/rivers and swamps. In many cases, animals/livestock use the same sources for drinking water, and the bad quality of drinking water contributes to the spread of various illnesses. These water sources are considered sensitive where construction of the pipeline will take place.

### 6.4.4 Land tenure and use

The Hoima district covers a total land area of 3,612.17 km<sup>2</sup>. Out of this, 2,853.48 km<sup>2</sup> (79.1%) is under agriculture, settlement and other miscellaneous land uses. The remaining 758 km<sup>2</sup> (20.9%) is under protected areas, including forest reserves and wildlife conservation areas. Protected areas are classified as Public Land and include forest reserves, wetlands and any other land outside customary, free-hold or lease-held land.

On private land, customary land tenure (both individual and communal) is the most widely practiced system. The lack of a uniform land tenure system, presents management challenges particularly with regard to land speculation that has been exacerbated by the discovery of oil in the district. This could cause land use conflicts and result in landless households and communities in the district, as land purchases and delineation of previously communally owned land continue to take place. Such conflicts have the potential to affect the Project's social license to operate.

### 6.4.5 Human health risk

Most urban populations in Uganda lack water-borne sewage systems, and domestic wastes often flow directly into swamps and wetlands, which provide important water purification services (NEMA, 2002).

No formal waste disposal services or facilities exist in the Hoima District, and, therefore, by implication, the Local Study Area. This lack of sanitation and refuse disposal systems has implications for health conditions of communities. It also increases the importance of the role played by swamps and wetland in absorption of nutrients and waste assimilation, in the absence of formal municipal treatment schemes.

### 6.4.6 Recreation and Tourism

Ecosystems and biodiversity play an important role for many kinds of tourism, which in turn provides considerable economic benefits and can be a vital source of income for many countries (TEEB, 2010). Tourism is typically based on the use of both natural and cultural ecosystem services (PANParks, unknown). In addition, people derive recreational pleasure from natural or cultivated ecosystems (Landsberg, et al., 2013)). In Uganda, tourism is focused in the approximately 21,000 km<sup>2</sup> of gazetted wildlife protected areas (NEMA, 2002), where tourists pay to view wildlife in remote and pristine natural settings. The aesthetic value of the Lake Albert landscape offers cultural ecosystem services to tourists, in the form of inspirational experiences.

The development of accommodation establishments around Lake Albert (for example, Lake Albert Safari Lodge and Lake Albert Guest House) has been attributed to the developing oil industry, the employees of which are thought to be boosting tourism in the area (Solomon & George, 2012). Although Lake Albert has potential for community tourism, with activities such as sport fishing and canoeing/kayaking considered



feasible; most landing sites on the lake shore have not been developed for tourism and lack the necessary facilities and amenities (Solomon & George, 2012). However, oil industry-related activities may negatively impact tourism potential through land take and associated impacts on flora and fauna, potential pollution and primarily, visual intrusion. In order to assess the impacts of oil activities on tourism; number of species, number of tourists, tourism revenue, visual impact and habitat quality would need to be monitored .

### 6.5 Cultural Heritage Context

Due to the confidential nature of some of the cultural sites (for example, secret sites) their exact locations were not given in the baseline report. An overview of cultural sites present within the Project Area of Influence is provided in Figure 18. Further detail is provided in .

#### 6.5.1 Spiritual Values

People attach spiritual, religious, aesthetic values to ecosystems, landscapes and species (Landsberg, et al., 2013), which are non-material contributions of ecosystems to human well-being. The ecosystems, sites and landscapes that contribute to this ecosystem service in the Local Study Area are discussed in the following sections.

##### 6.5.1.1 Sacred Sites

Sacred sites within the Project Area of Influence fell into four broad categories:

- Ritual Sites
- Sacred Rivers
- Sacred Trees and/or Cultural Trees
- Ritual Objects.

##### Ritual Sites

- 'Luzira' is a lagoon close to the Project footprint. It is an active place of worship and the historic centre of cultural activity, where, traditionally, pilgrims would travel some distances to stay within the swamp for nine consecutive days, to make offerings and conduct ritual activities.
- Kasonga beach, near the village of Nsonga, is used for ritual ceremonies specifically related to fish catches – when lake stocks appear low or when fishermen have troubles.
- A secret sacred pool is located on the River Masika. It is well known by elders and taboo for younger members of the community. The site is utilised for rituals during cholera outbreaks in particular, and a specific ceremony for sick babies is also conducted there.

##### Sacred River

- The River Masika in itself is considered sacred. Areas on the river bank are used for ceremonies to improve fish catches and occasionally to cure sick children.

##### Sacred, Cultural and Barkcloth Tree

- A secret tree (species unidentified) at one of the lakeshore villages has a number of taboos associated with it. Another such tree is present near the escarpment road.
- A Barkcloth Tree (*Ficus natalensis*) near the pipeline route at Kaseeta – barkcloth making is an ancient craft listed on UNESCO's intangible world heritage list.
- A tree in Nsonga village is the village assembly tree.

##### Ritual Objects

- These were recorded at three locations - a village in Buhuka Flats, escarpment road and along the pipeline route. They consisted of stones used for feet washing, rituals and worship.



6.5.1.2 Cultural landscapes

Both Lake Albert and the escarpment are iconic features of the natural landscape, defining the local (communal) sense of place and apparent (traditional) cultural associations of the natural features (rivers, lakes, trees). Both sites provide a strong historic and religious focus for the lakeside communities in particular, evident within the oral traditions and the sacred places associated with both locations (Box 1).

“There is a tradition that (as a sign of respecting the fish and ensuring their continued supply from the lake) if a woman comes from the escarpment top with cassava flour, it’s up to her husband to prepare it to accompany a fish. When the woman leaves the lake shore to return she is then given a fish to take back up the escarpment top” (Golder Associates, 2014(e))

Box 1: Example of Oral Tradition associated with Escarpment

6.5.2 Inspirational Values associated with Lake Albert

People in the Local Study Area have derived various elements of information from the ecosystems surrounding them in Lake Albert, and used this information for aspects of culture, traditions, art and story-telling. These practices that are intrinsic to Lake Albert contribute to the local people’s sense of place.

Local legends and revered animals

Throughout the lakeside villages consulted during the community survey, some common beliefs and practices were identified. Some traditional practices call on a giant snake (seen to bring good fortune) or a giant crocodile (can bring or take away fish shoals).

Beliefs associated with Lake Albert

A number of taboos and beliefs are specifically associated with Lake Albert, such as ceremonies to cure sick children and bless new boats and nets, beliefs that evil spirits roam the area at night time, and conducting of certain activities during the night is a sign of disrespect to the ancestors, and taboos relating to women bathing in the Lake, amongst others.

Oral history and village naming

The names of many of the lakeshore villages are directly derived from natural features (e.g. Nsunzu is the name of the type of grass that is good for feeding cattle).

Medicinal plants

About 80% of the population in Uganda depend on traditional plant medicines derived from >300 plant species (CRA, 2006). Medicinal/traditionally used plant species observed by the cultural heritage field team are summarised in Table 12; specific knowledge on the exact identification (taxonomy) of these plants was not gathered. ‘Secret plants’ were also mentioned to be used by women in labour, specifically to address complications with the afterbirth.

Table 12: Traditional Plant names and uses

Table with 2 columns: Local Plant name, Medicinal Use. Rows include Omwoyante (Malaria), Kyangwe (sponges/ringworm), Tengo (Backache, bilharzia, etc.), and Omulisana (Ringworms).



Local Plant name	Medicinal Use
Omukoma	Constipation; allergy: the stem
Ekiryabiruku	Cough
Kibeere	Cough, making the placenta stable
Omususa	Allergy, syphilis
Omupeera (guava)	Cough (leaves), asthma (roots)
Omusheshe	Allergy (leaves and roots), syphilis (stem),
Omukwatange	Fibroids (stems and roots)
Akagando	Wounds locally called ebironda (leaves), asthma (roots), Allergies, Teeth
Omululuza	Worms, malaria, wounds, and burns. Note: it has to be picked early in the morning when the chlorophyll is in the leaves but if the roots are to be used it is advisable to pick them in the evening.
Omushebashebe	Pancreas (stem to be drunk).

### 6.5.3 Intangible cultural heritage

A number of intangible heritage practices were identified during interviews with the local community within the Local Study Area that can be associated with certain ecosystem services.

#### *Hand-crafted ghee storage gourds*

Ghee-making is traditionally practised by the Balalo pastoralist community ('cattle keepers') who were interviewed near the Project during the cultural heritage field work. The hand-crafted ghee storage gourds also traditionally made by this group were displayed by the community members to the cultural heritage field team. The use of biological raw materials for fashioning ornamental/functional items, such as a ghee storage gourd, is a recognised ecosystem service (Landsberg, et al., 2013)

#### *Making bark-cloth*

Bark-cloth making is an ancient craft performed by the Baganda people from the Buganda kingdom in south Uganda (UNESCO, 2005). Although no direct evidence of bark-cloth making within the Local Study Area was gathered, a tree that can be used for bark-cloth making (*Ficus natalensis*) was identified in proximity to the pipeline route; however, there was no evidence of use for this purpose on that individual.

#### *Traditionally built houses*

Hand built shelters for ducks and chickens were observed within the villages surveyed by the field team . Traditionally built houses, without any manmade materials, were also prevalent amongst the isolated communities on the Buhuka Flats. The practice of constructing a house is done by men only, with women only allowed to smear the house to finish off the building. Materials used in construction of these shelters and houses are mud (daub) and 'wattle', which is wood harvested from trees. It is unclear exactly which tree species are harvested to provide the timber for the wattle. One estimate for Uganda suggests that if the stock of wattle and daub housing in Uganda was to be maintained, 136,000 trees per year would be needed to supply enough wood (European Commission, 2001). Grasses and reeds are used to thatch the roof (Figure 8).

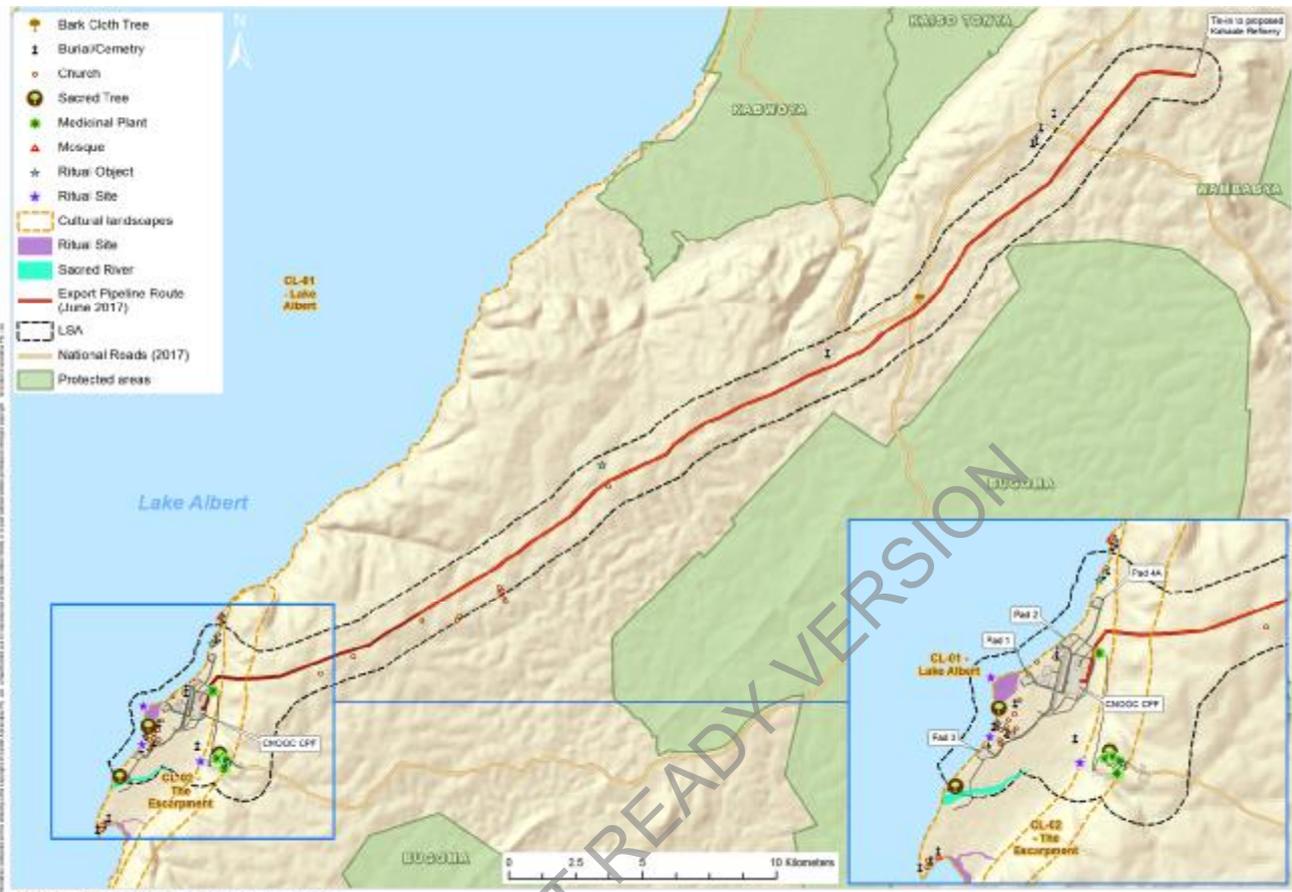


Figure 18: Overview of cultural sites and objects identified in the wider Local Study Area



# ECOSYSTEM SERVICES ASSESSMENT



Figure 19: Cultural sites and objects identified on the Buhuka Flats



### 6.6 Existing Drivers of Ecosystem Change

Ecosystems are directly affected in two ways; by natural processes (for example, desertification) that cause continual change in species composition and habitat structure across regions; and by human activities and increased human population pressure. Five direct drivers of ecosystem change directly attributable to human activity have been identified (Landsberg, et al., 2013); changes in local land use and land cover, harvest and resource consumption, pollution, introduction of invasive species, and climate change. These are considered to have the greatest effects on ecosystem health and condition, and therefore the supply of ecosystem services. In summary, the existing land cover within the Local Study Area is already modified by the five main drivers of ecosystem change, which are directly attributable to human activity and behaviour.

#### 6.6.1 Changes in local land use and land cover

The natural vegetation of the Buhuka Flats region has been substantially modified, largely due to over-grazing and uncontrolled harvesting of trees for wood and charcoal production, and house construction (Golder Associates, 2014).

Along the pipeline route, the natural vegetation has been replaced by a mosaic of commercial crop production, subsistence farming, with remaining non-cultivated areas consisting of heavily-modified grassland, wetland and woodland habitats. The occurrence of frequent fires was also evident on the escarpment. Over-frequent fire is known to detrimentally affect the functioning and processes of savanna ecosystems (Smith, et al., 2013), thus may be a driver of change in land cover condition, and, therefore, ecosystem condition and ecosystem service delivery in this part of the Local Study Area.

As mentioned in the next section, population influx has increased demand for ecosystem services such as grazing for cattle; livestock grazing has now been extended into areas that might not previously have been typically grazed, such as dense reed stands in wetlands and difficult-to-access open bushland areas of the escarpment. Such changes in land use and land cover are likely to affect spiritual sites, as these sites have typically been selected due to their remoteness, natural setting, and difficulty to access. Further changes in land use and land cover in the LSA as a result of the Project are anticipated.

#### 6.6.2 Harvest and resource consumption

Fishing activities based out of both the fishing villages in the Buhuka Flats and villages further up the escarpment, puts pressure on the local fish populations. Apart from the published accounts of the decrease in commercial fish stocks (Wandera, 2000), (Wandera & Balirwa, 2010); Taabu-Munyahu et al. 2012), anecdotal accounts from the local fishermen also identify noticeable decreases in catches of fish per unit effort over the years. The main drivers of change influencing the vegetation communities along the escarpment are from livestock grazing, fuel wood harvesting, charcoal manufacture and the conversion of natural vegetation for subsistence agriculture. This is particularly noticeable along the pipeline route.

The keeping of livestock forms a substantial component of the local socio-economic structures in the Local Study Area, and particularly on the Buhuka Flats. Livestock numbers are large and there is strong evidence for overgrazing on the Buhuka Flats extending up onto the escarpment.

Large trees on the escarpment are becoming rarer as these individuals are selectively harvested for the manufacture of charcoal, which is typically then sold. Smaller woody species are regularly harvested for fuel wood used directly in the fishing villages. The harvest of fibre and other house construction materials is common on the escarpment. For example, thatching grass is regularly harvested on the escarpment and transported to the local fishing villages of the Buhuka Flats (Figure 20).

There has been a substantial increase in the local population over the past 10 years, driven by factors such as regional instability, livestock grazing opportunities, attractive livelihood opportunities to engage in fishing on Lake Albert, and more recently, the opening of the escarpment road, as well as interest in capitalising from opportunities related to oil and gas developments. This population influx is expected to exacerbate demand for numerous ecosystem services already used by the local population, including fisheries, fuel and construction wood, and bush meat, which will have knock-on effects on the extent and condition of the ecosystems that supply them.



Figure 20: "Chutes" used for the transport of thatching grass harvested from the escarpment, 2014

### 6.6.3 Pollution

Despite the human impacts evident throughout the Project Area of Influence, industrial/commercial facilities and/or concrete hard-standing typically associated with pollution potential are generally absent. Pollution of surface water and groundwater resources and air pollution has not been highlighted as a major issue in the baseline biophysical reports; however, Wandera (2000) and Wandera and Balirwa (2010) have identified that agricultural run-off is having real effects on increasing the nutrient levels of Lake Albert, contributing to eutrophication of the lake's waters. In addition, the presence of approximately 22,000 people on the Buhuka Flats and other nearby villages who do not have access to running water and sanitation, will put large pressures on the nutrient loading of the inflowing waters of Lake Albert.

Many ecosystem services are reduced when inland waters become eutrophic; water from lakes that experience algal blooms is more expensive to purify for drinking or industrial uses, fish populations can be reduced or eliminated, and many of the cultural services provided by lakes can be lost, for example, odours of rotting algae, slimes, and toxic chemicals produced by some blue-green algae during blooms keep people from swimming, boating, and otherwise enjoying the aesthetic value of lakes (Nelson, 2005).

### 6.6.4 Introduction of invasive species

A number of invasive plant species have been observed throughout the Local Study Area, including lantana, castor oil, neem, jatropha and Parkinsonia (Golder Associates, 2014). Some species, e.g., castor oil, are proliferating in uncultivated areas of the escarpment. Invasive aquatic plants including water lettuce (*Pistia stratiotes*) and water hyacinth (*Eichhornia crassipes*) have been recorded on the shores of Lake Albert itself (Figure 21).

Many invasive plant species do have the capacity to change vegetation community composition and the ecosystem services provided by those vegetation communities. This is particularly the case for water hyacinth, which can reduce biological diversity through reduction of water oxygen levels (e.g., oxygen-sensitive fish species may be affected), blocking sunlight to native plants, and blocking access to water to some animal communities (Center for Aquatic and Invasive Plants, University of Florida, 2014). Water hyacinth has already become dominant of the marginal ecotones of Lakes Kyoga and Victoria, which has resulted in negative



impacts on aquatic biodiversity and fishing activity in marginal habitats (Twongo, 1996). Spread of water hyacinth in Lake Albert could therefore become a major driver of change in the near-shore aquatic habitats of the Lake in the future.



*Invasive castor oil plant on escarpment*



*Invasive Pistia stratiotes on shore of Lake Albert*

Figure 21: Examples of invasive species in the Project Area of Influence

### 6.6.5 Climate change

Observed changes in climate, especially warmer regional temperatures, has already effected changes in species distributions, population sizes, and the timing of reproduction or migration events, as well as an increase in the frequency of pest and disease outbreaks, especially in forested systems (Nelson, 2005).

Uganda is expected to experience more extreme periods of intense rainfall, and erratic onset and cessation of the rainy seasons and more frequent episodes of drought due to future climate change (Global Climate Change Alliance, 2012). Recent increases in the range of water level fluctuations in Lake Albert have been attributed to climate change (International Lake Environment Committee Foundation, 1999). For example, flooding on the Buhuka Flats in 2012 - which could be attributable to climate change - caused the death of 10 people, the loss of 70 homes and other household losses (Golder Associates, 2014).

## 7.0 ECOSYSTEM SERVICE REVIEW FOR IMPACT ASSESSMENT

### 7.1 Step 1: Identification of Relevant Ecosystem Services

The Project's area of influence hosts numerous ecosystem services. The following sections characterise the supply of ecosystem services within the Project's area of influence, their quality, and their level of use or value to beneficiaries.

Beneficiaries considered most likely to be affected by the Project are the inhabitants and herders of the Buhuka Flats, and subsistence farmers whose plots lie within the servitude of the proposed pipeline route.

#### 7.1.1 Land Cover Types / Ecosystems which could be impacted by the Project

Given the limited amount of non-degraded natural habitat types within the Project footprint, the extent (Table 7, Table 8) and ecosystem condition (Table 9) of the various land cover types within the Project footprint was estimated. The ecosystems that could be impacted by the Project are discussed according to the relevant area of the Local Study Area.

##### *Buhuka Flats and Escarpment*

- The dominant land cover classes in the Buhuka Flats (grassland) and the Escarpment (open bush and dense bush) will have the greatest proportionate loss to the Project footprint.
- The condition of the escarpment vegetation corridors is slightly to moderately degraded, therefore, its capacity to supply provisioning ecosystem services such as fuel wood, construction wood and inspirational services such as spiritual sites is considered to be moderate to high.



- The Buhuka Flats have extensive settlement areas, which have resulted in over-exploitation of livestock grazing resources available in the open grasslands, grasslands with thickets and open bushland and shrublands that dominate the land cover of the Buhuka Flats. As a result, the condition of these ecosystems is considered heavily degraded, largely due to overgrazing. In addition, carrying capacity calculations indicated that these areas were being grazed by more than twice the amount of cattle than they were capable of.
- However, as stated previously (Section 4.3.1.1 ), not all ecosystem services supply dynamics are affected to the same degree by the condition of the land cover type. In this case, the capacity of degraded grasslands to supply livestock grazing ecosystem services is still considered high; however, ongoing poor grazing management practises are likely to result in ploughing of the ground by cattle’s hooves in wet conditions, and overgrazing in dry conditions, ultimately leading to soil erosion, bush encroachment and exotic species invasion. The Project and associated population influx will likely create additional pressure on these grazing resources. These expected changes in land cover will reduce the capacity of these ecosystems in the Buhuka Flats to supply ecosystem services (including grazing for livestock) in the future.

### Pipeline

- The dominant land cover classes are subsistence farmland and degraded bush; accordingly, these will have the greatest proportionate loss to the pipeline servitude footprint.
- Although the ‘ecological’ condition of subsistence cropland land cover class is considered poor due to the negative ecological impacts of cultivation, its functionality/ability to supply ES is an effect of its cultivation; therefore, its capacity to supply ecosystem services is considered high as it supports crop production.
- The condition of degraded bushland is heavily-degraded, largely as an effect of clearance of bush for cultivation, and probably over-grazing by browsing livestock. Its ability to supply its associated ecosystem services (Table 13) is thus considered Low.

### 7.1.2 Which Ecosystem Services could the Project impact?

The ecosystem services supplied within the Local Study Area are listed according to land cover type in Table 13. These ecosystem services are supplied by ecosystems that will have a loss in extent, condition or ease of access as a result of the Project, and thus could potentially be impacted by the Project.

**Table 13: ES supplied within the Project Area of Influence**

Ecosystem Service	Land Cover Type	Definition of Service
<b>Provisioning</b>		
Food	Subsistence cropland	<b>Crops:</b> Subsistence crops associated with individual households Small-scale commercial plantation crops along pipeline route
	Grassland Open bush	Grazing for livestock Cattle and goat herders in the Buhuka Flats are reliant on the availability of grazing resources
	Water (Lake Albert)	<b>Capture Fisheries:</b> Fish is the main source of nutrition for the people in Buhuka Parish



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Ecosystem Service	Land Cover Type	Definition of Service
	Degraded bush Open bush Dense bush	<b>Wild foods:</b> Subsistence hunting for bush meat was reported for several villages, mostly along the pipeline route. No reports of wild food (fruits, roots) use were recorded during baseline. One study of wild food use in Uganda reported stigma attached to use of wild foods (indicative of poverty and laziness) (Agea, et al., 2011); therefore, actual levels of use of wild foods may have been under-reported.
Biological raw materials	Wetland Woodland Grassland	Reeds and grasses are harvested from wetlands and escarpment grasslands for use as thatching material. Papyrus culms may be harvested from wetlands for construction of traditionally-built houses. Timber is harvested from trees for use as 'wattle' in construction of mud and wattle houses.
	All categories	Extraction of local natural materials (e.g. aggregates) for Project road and camp construction etc.
Biomass Fuel	Degraded bush Open bush Dense bush Woodland	Wood is harvested for firewood and charcoal production.
Freshwater	Water Wetland	Freshwater for consumption and irrigation is taken from Lake Albert, boreholes, wells, rivers, streams and swamps throughout the area.
Medicinal plants	Degraded bush Open bush Dense bush Woodland Grassland	Numerous medicinal plants are harvested for various purposes within the local study area.
<b>Regulating</b>		
Regulating air quality	Water Wetland	Baseline air quality is generally considered good but may deteriorate periodically as a result of biomass burning – Lake Albert and its associated sedimentary flats and wetlands would have a role as a 'sink' for any atmospheric pollutants.
Regulating climate	Woodland	The topography of the escarpment plays a role in the local climate, particularly in rainfall patterns in the Buhuka Flats, which are lower than those on the top of the escarpment.
Regulating water flows and timing	Grassland Open bush Wetland	Approximately half (56%) of the soils within the Kingfisher Development Area footprint are readily permeable, facilitating aquifer recharge. Wetlands in the Buhuka flats retain water and contribute to reduced flooding frequency.
Control of erosion	Grassland Open bush Wetland	Vegetation cover within the footprint reduces soil loss and prevents erosion. In areas where storm water infrastructure has been improperly installed, severe erosion was observed.
Water purification and waste treatment	Wetland	In the absence of municipal water treatment schemes, wetlands within the Project Area of Influence likely have an important role in partial water purification.



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Ecosystem Service	Land Cover Type	Definition of Service
Pollination	Subsistence cropland Degraded bush	Beekeeping is practised in several villages along the pipeline route. Subsistence agriculture reliant on pollination by bees for fruit and vegetable growth.
<b>Cultural</b>		
Recreation and ecotourism	Water (Lake Albert)	Some holiday lodge facilities have been constructed in the vicinity of Lake Albert to cater for tourism thought to be largely driven by staff of the local oil industry.
Ethical and spiritual values	Water (Lake Albert, rivers) Wetland Woodland (escarpment)	Local communities of the Buhuka Flats have strong spiritual ties with the lands. The Buhuka Flats area has numerous sacred sites, and has a rich, intangible cultural heritage that includes folklore and taboos related to the Lake, traditional crafts (e.g. making ghee, making bark-cloth), and oral histories.
Educational and inspirational	Water Wetland Grassland Open bush Dense bush Woodland	The communities of the Buhuka Flats area have stories and taboos relating to, and inspired by, the landscapes of the Lake and the escarpment.
<b>Supporting</b>		
Habitat	Wetland Water Woodland	Wetland areas are nurseries for juvenile fish. Lake Albert provides habitat for fish and waterfowl. Wooded areas on the escarpment support terrestrial fauna Forested areas contribute to landscape connectivity for terrestrial fauna through their role as wildlife corridors (Akwetaireho, et al., 2011).
Nutrient cycling	Subsistence cropland	The majority of the pipeline route is considered to have agricultural potential as arable land, due to the productive nature of the soils.
Primary production	Grassland Wetland	The Buhuka Flats is an important grazing area as a result of the combination of water availability and productive soils which promote the development of grasslands and wetland vegetation.
Water cycling	Grassland Wetland	The Buhuka Flats' hydrological system is different to that beyond the escarpment and plays a role in aquifer recharge. Wetland systems in the Buhuka Flats and on top of the escarpment have importance for water storage and flood attenuation.

### 7.1.3 Which Beneficiaries are potentially affected?

The beneficiaries who use those services supplied by the ecosystems that could be affected by the Project (Section 7.1.2) were identified, and fall into two categories:

- i The local community – the people that benefit from ecosystem services (Type I) supplied by the land cover types of the area that will be affected by the Project. This consists largely of the rural subsistence population, including subsistence farmers, pastoralists, fishermen, and the unemployed.
- i The Project (Type II):



- § the Project is dependent on the abstraction of appropriate quantities of fresh water from Lake Albert for make-up water as part of its operation;
- § the Project is dependent on the regulation of water quality of Lake Albert; if water quality decreases then treatment costs may be prohibitive;
- § the Project is dependent on flood attenuation in the Buhuka Flats due to aquifer recharge and wetland water storage;
- § the Project is dependent on a **social licence to operate**.

The demand for services by beneficiaries varies between the different Project-affected areas, largely depending on the dominant land cover type in that area.

### **Buhuka Flats**

In the Buhuka Flats, demand for services (Type I) arises principally from the following beneficiaries:

- The communities of the lakeshore villages that depend on the Lake Albert fisheries as a primary source of livelihood, income and nutrition.
- The communities of the lakeshore villages that depend on obtaining thatching material from wetland areas on the Buhuka Flats and grassland areas on the escarpment; and construction material for building mud and wattle houses from trees in woodland and bushland both on the escarpment and above it.
- Subsistence farmers resident in the lakeshore villages that use the Buhuka Flats for grazing livestock.
- Migratory herders that bring their cattle to the Buhuka Flats to avail of grazing opportunities there.
- The communities of the lakeshore villages that have strong spiritual attachment to the Lake, the river Malika and the Escarpment.

In addition, ecosystem services are demanded by the Project itself (Type II) - clean fresh water in the necessary quantities and of appropriate quality, which will be abstracted from Lake Albert and used in the oil extraction process during Project operations; as well as the social licence to operate from local communities, who may see their sense of place change as a result of the Project.

### **Pipeline Route**

Beyond the escarpment, demand for services arises principally from the communities of the villages along the pipeline route who depend on:

- Cultivation of subsistence and small-scale commercial crops as a primary source of livelihood, income and nutrition.
- Raising livestock as a primary source of meat and dairy products.
- Obtaining freshwater from rivers, streams, swamps, wells and boreholes.
- Harvest of timber for wood fuel for cooking, charcoal production and use in home construction.
- Harvest of grass for use in thatching traditionally built homes.
- Hunting of bush meat as a dietary supplement in times of hardship.

## **7.2 Step 2: Ecosystem Service Prioritisation**

Priority ecosystem services related to the Project were identified following an ecosystem service review (Landsberg, et al., 2013). The services were prioritised in two phases, and were aligned with the two types of Priority ecosystem services defined by IFC PS 6.



As *Supporting* ecosystem services have no specific/direct beneficiaries, and impacts to these are captured within the *Provisioning*, *Regulating* and *Cultural* categories for this project, they are not included in the prioritisation exercise.

### 7.2.1 Type I Ecosystem Services: Priority Ecosystem Services according to Project Impact

Ecosystem services were prioritised according to project impact, by answering three key questions (Landsberg, et al., 2013):

- 1) Could the Project affect the ability of others to benefit from this ecosystem service?
- 2) Is the ecosystem service important to beneficiaries' livelihoods, health, safety or culture?
- 3) Do beneficiaries have viable alternatives to this ecosystem service?

The results of the prioritisation exercise for Type I ecosystem services are detailed in Appendix B. All Type I ecosystem services and the reasoning behind their determination as Priority ecosystem services (or not) are discussed in the following sections.

#### 7.2.1.1 Provisioning

##### Food – Subsistence Crops

The majority of land cover along the pipeline route consists of subsistence cropland, which is a primary source of livelihood, income and nutrition for the beneficiaries in this part of the Local Study Area. Approximately 1.3% of this land cover will be temporarily lost to the footprint of the pipeline and its 30 m servitude during construction (Table 8), with cultivation of maize and other grain crops expected to resume once the pipeline has been buried and the soils reinstated. The average size of farm currently being cultivated according to the respondents is 3 acres (1.2 ha) and the most common size is 1 acre (0.4 ha). Therefore, average maximum land loss to the pipeline servitude is expected to range from 0.18 ha or 46% of the most common sized farms, to 0.33 ha or 27% of average farms.

Although this may temporarily impact the ability of farmers whose land is intercepted by the pipeline and servitude to benefit from this ecosystem service, alternatives may be provided to affected beneficiaries; if this is not possible, then fair and adequate compensation should be offered. The compensation should be in line with IFC Performance Standard 5 and will be addressed in an appropriate Resettlement Action Plan (RAP).

Food from subsistence crops is therefore classed as a non-priority ecosystem service for the purposes of this assessment.

##### Food – Grazing for livestock

Some residents of the Buhuka Flats raise cattle for subsistence purposes, so access to **grazing** areas is considered a priority ecosystem service. The availability of alternative locations to those that may be lost to the Project footprint is uncertain, as at baseline, the carrying capacity for grazing animals in the Buhuka Flats area was already being exceeded by approximately double the amount of livestock present. In addition, land tenure in the area is uncertain.

Both residents of the Buhuka Flats and the villages near the pipeline route, and migratory pastoralists, raise **livestock** for subsistence purposes. The extent to which these beneficiaries rely on the grazing opportunities provided by the grasslands in the Project Area of Influence is likely of high importance to their livelihoods and wellbeing. As the availability of alternative sources of grazing is likely to be limited, given the current rates of overstocking, this is considered a **Priority ES**.

##### Food – Capture fisheries

Although **capture fisheries** are not anticipated to be directly negatively affected by the Project, there is a perception amongst residents of the Buhuka Flats that the Project will affect fish stocks and catch success. Additionally, the development of the escarpment road for vehicular access to the Production Facility on the Buhuka Flats has driven increased demand for fish from areas above the escarpment and beyond, which is



now having repercussions on the supply of fish (both quantity and quality) from the lake shore fisheries for local beneficiaries. Capture fisheries are therefore included as a **Priority ES** for which potential impacts must be assessed.

### **Food – Wild foods**

Bush meat hunting and beekeeping were recorded in communities along the pipeline route. The importance of these ES for beneficiaries is uncertain, and the availability of viable alternatives to these ES is unclear, so **wild foods** are included as **Priority ES** based on the precautionary principle.

### **Biological Raw Materials – Construction Products**

The majority of houses in the communities of both the Buhuka Flats and the pipeline route are traditionally built, using grasses from on top of the escarpment as thatching material, mud daub on walls and wood or papyrus culms as construction material for walls. Grasslands, wetlands, woodlands are the primary source of these materials, small areas of which will be lost to the Project footprint in the context of the LSA.

Given the proportionately small amount of expected loss of this land cover type in the context of the Project Area of Influence, there should be viable alternative sources of these raw materials in other unaffected locations. However, the level of increased demand for these materials as a consequence of population influx is unknown. In addition, Project-associated population influx effects on wetland functioning beyond the footprint are uncertain. Supply of biological raw materials is therefore considered a **Priority ecosystem service**.

### **Biomass Fuel**

The majority (approximately 98.9%) of the population in Hoima District use **wood fuel** as the dominant source of energy. In some villages along the pipeline route, a mixture of firewood, banana leaves and grass are used as a source of fuel for cooking. However, firewood has become scarce and many people have resorted to using charcoal which is expensive, and therefore is not considered a viable (affordable) alternative for beneficiaries. Biomass fuel is therefore considered a **Priority ecosystem service**.

### **Freshwater**

The provision of **freshwater** is considered to be a **Priority ES**, due to its importance for beneficiaries throughout the Project Area of Influence, stakeholder perception that the Project may impact the availability and/or quality of freshwater supply, and the lack of viable alternatives to this ES.

### **Medicinal Plants**

Given the proportionately small areas of land take by the Project relative to the available areas within the Local Study Area, it is expected that alternative areas that support medicinal plant species are readily available to beneficiaries. This ES is therefore not considered as priority.

## **7.2.1.2 Regulating**

### **Regulating Air Quality**

Woodland and bushland vegetation of the escarpment may contribute to extraction of atmospheric chemicals (e.g., near roadways), and Lake Albert plays a role as a sink for air emissions of compounds from the burning of fires.

The Project is unlikely to push the regulation of air quality across a sustainability or regulatory threshold, and emissions are expected to be within the standards required by the IFC. This ecosystem service is not considered to be in short supply relative to demand in the Local Study Area, given the baseline of very little industrial or commercial enterprises in the area. Regulation of air quality is therefore not considered to be a priority ecosystem service in terms of Project impact for this assessment.

### **Regulating Climate**

Escarpment vegetation, wetlands of the Buhuka Flats and sediments of Lake Albert within the Local Study Area may contribute to climate regulation through their role as a carbon sink. The loss of the relatively small



areas of escarpment vegetation and wetlands to the project footprint, in the context of total available alternative areas in the Project Area of Influence is minimal. However, the effect of increased pressure on these systems, due to greater demand for services by the increased population, is uncertain. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future in terms of climate regulation is uncertain. Indications are that they will increase in importance (Ayebare, et al., 2013), provided human pressures do not overwhelm them. Overall predictions of Project impacts on the ecosystems involved in regulation of climate range from moderate on escarpment vegetation and wetlands ; to no impacts on Lake Albert deep water areas.

The Project is unlikely, however, to push the regulation of climate across a sustainability or regulatory threshold; neither is this service in short supply relative to demand in the LSA, given the minor loss of the ecosystems that supply this ES to the expected Project impacts. Regulation of climate is therefore not considered to be a priority ecosystem service for this assessment.

### **Regulating Water flows and timing**

The Buhuka Flats has a unique hydrological system which is not fully understood (for example, water supply to 'Luzira' lagoon, aquifer recharge in the Flats from escarpment streams, and wetland water storage capacity). The potential Project impacts on the hydrological system (crossing of drainage lines) are considered to still have a moderately severe impact post-mitigation. Therefore, the Project could affect the ability of others to benefit from this important ecosystem service in the Buhuka Flats area. Viable alternatives to this hydrological system are not evident; therefore, regulating water flows and timing is a **Priority ecosystem service**.

### **Regulating Soil Stability and Erosion Control**

Potential Project impacts on the regulation of soil stability and associated erosion control are considered likely, because clearance of vegetation for construction works in the Buhuka Flats, the escarpment road, and along the pipeline route will increase the vulnerability of soils in these areas to erosion by wind and water. The greatest impacts to soils typically occur during the construction phase. However, erosion-related mitigation measures and construction management controls are expected to be adhered to during construction of the Project infrastructure, therefore the Project is not expected to impact on this ecosystem service in such a way that the ability of others to benefit from this service would be affected. Therefore, this ecosystem service is not considered a priority for this assessment.

### **Water Purification and Waste Treatment**

Kyangwali sub-county, within which the Project Area of Influence is located, has low safe water coverage (approx. 47%); and many beneficiaries obtain their water supply directly from rivers, streams and swamps. This heightens the importance of the role that wetlands play in the removal of harmful pollutants such as metals and organic materials from surface water systems; this is thus considered a **Priority ecosystem service**.

#### **7.2.1.3 Cultural**

##### **Recreation and ecotourism**

This ES is not of importance to local beneficiaries, as tourism facilities are non-existent at Lake Albert within the Local Study Area. Although some tourism accommodation facilities (safari lodges) have been developed in the Hoima District to accommodate low-level tourism by oil workers, there is no evidence that the local communities of the Buhuka Flats or the pipeline route benefit in terms of livelihoods. This ES is thus not considered a priority ES.

##### **Ethical and spiritual values**

Sacred sites and intangible cultural heritage, evident throughout the Project Area of Influence, are intrinsically linked with natural ecosystems such as wetlands, rivers, lakes and forests. Changes in natural ecosystems arising from Project land take, and changes in the appearance of the landscape due to the visual presence of the Project are likely to affect the ability of local communities to benefit from this ES. This ES is important to beneficiaries as it substantially contributes to their sense of identity. It has thus been identified as a **Priority ecosystem service**.



### *Educational and inspirational values*

The Lake Albert and Escarpment landscapes inspire folklore, myths and taboos, thereby contributing to beneficiaries' sense of heritage and identity. Changes in appearance of the landscape are likely to affect the ability of beneficiaries to retain the benefit of this service that is considered important in terms of cultural heritage and identity; in addition, access to these areas may be increased (thus impacting the remote quality of the landscape) or restricted as a result of the Project (e.g., the lagoon near the Kingfisher Development Area) therefore this ecosystem service is considered a **Priority ecosystem service** for this assessment.

### **7.2.2 Type II Ecosystem Services – Priority Ecosystem Services according to the Extent of Project Dependence**

The outcomes of the prioritisation exercise for Type II ES are detailed in Appendix C. The Type II ecosystems and reasoning behind classification as priority/non-priority ecosystem services are discussed in the following sections.

#### **7.2.2.1 Provisioning Services**

##### **Freshwater**

The Project will depend on the abstraction of fresh water from Lake Albert for successful performance (oil extraction), and there are no viable alternatives to water abstraction. There is concern amongst beneficiaries that the Project may impact the quality of water; in addition, the quality of water in Lake Albert is already being pressured by elevated nutrient inputs and associated eutrophication. The Project is reliant on the quality of freshwater resources remaining constant throughout its lifetime, both in order to maintain its social license to operate and in order for operation to remain cost-effective - treatment of eutrophic waters to an acceptable standard for processing use may be cost-prohibitive for the Project.

Although the amount of water required by the Project is considered minimal in the context of the currently available resource (see Section 6.2.3), the ecosystem service could potentially change in ways that affect operational performance (e.g. water quality deterioration from eutrophication throughout the lifetime of the Project may affect water intake infrastructure, or require additional treatment). The Project has no viable alternative water source other than abstraction from Lake Albert. Therefore, freshwater provision is considered a Type II **Priority ecosystem service**.

##### **Aggregates for construction**

The Project depends on the extraction of locally-sourced aggregates for construction of facilities, such as camps and access roads, in order to reduce resource costs by using locally available materials, and reduce carbon emissions.

Existing demand for locally-extracted aggregate by other beneficiaries is unclear. Local beneficiaries in the Local Study Area currently mostly live in wattle and mud houses but it is unknown how construction practises may change in the future, if economic standards were to improve. The Project has no viable alternative to this ecosystem service; therefore, it is considered a **Priority ecosystem service** in terms of Project dependence.

#### **7.2.2.2 Regulating Services**

##### **Regulating air quality**

Air emissions from oil and gas development activities include combustion sources from power and heat generation and use of engines, emissions resulting from flaring and venting of hydrocarbons and fugitive emissions. Stakeholders in the Project Area of Influence perceive that the Project may impact the air quality; therefore, the Project is reliant on the quality of air remaining constant throughout its lifetime in order to maintain the social license to operate.

Although emissions from the Project are expected to be in compliance with the specified standards, and the service is not considered to be in short supply relative to demand in the Local Study Area, given the baseline of very little industrial or commercial enterprises in the area, public perception is that the Project will impact air quality within the Local Study Area. Therefore, this is a **Priority ecosystem service** in terms of Project dependence on maintenance of a social license to operate.



### ***Regulating climate***

Flooding of the shores of Lake Albert in 2012 resulted in damage and destruction of homes, and some loss of life. The predicted changes in climatic conditions over the lifetime of the Project could lead to a rise in Lake Albert's water level, which would result in flooding of the flats, which could affect operational performance.

To counter this risk, the Project infrastructure will be designed to stand at a raised elevation from the actual ground level to avoid potential impacts of flooding over the Buhuka Flats, and will also include additional designed and engineered controls.

These engineering design measures can be considered to be viable alternatives to the climate regulation service provided by ecosystems within the local study area, therefore regulating climate is a non-priority ecosystem service in terms of Project dependence.

### ***Regulation of water timing and flows***

The Buhuka Flats is a zone of aquifer recharge from escarpment streams, and the wetlands in the Buhuka Flats area play a role in water storage. The potential Project impacts on the hydrological system (crossing of drainage lines) are considered to have a moderately severe impact post-mitigation for the construction and operation phases, and this together with ecosystem changes external to the Project (such as increased flooding due to climate change) could potentially change this ecosystem service in a way that would prevent the Project from achieving operational performance.

However, the Project design takes into account such potential impacts, and will put in place appropriate stormwater and flood management engineered measures to prevent the predicted potential impacts taking place. These engineering design measures are viable alternatives to the ecosystem service.

Therefore, regulating water flows and timing is a non-priority ecosystem service in terms of Project dependence.

### ***Regulating soil stability and erosion control***

The predicted rise in the level of Lake Albert over the Project lifetime could lead to an increase in erosion of the shoreline, thereby reducing the width of the Flats and increasing flood likelihood; therefore, the Project depends upon continued supply of this ES for its operational performance.

Engineered measures for the control of erosion arising from vegetation removal are considered sufficient to minimise the impacts of vegetation clearance. The Project, in compliance with the requirements of IFC Performance Standards 1 and 3, has undertaken predictive modelling to ensure that the Project's operational performance will not be put at risk by rises in Lake Albert's level. Therefore, regulating soil stability and erosion control is not considered to be a Priority ecosystem service according to operational risk to Project Performance.

### ***Water Purification and Waste Treatment***

The Project is reliant on the availability of fresh water of a certain quality standard from Lake Albert, both for use as drinking water for Project staff, and for Project oil and gas activities and processes. The role that wetland systems and the lake itself play in water purification through nutrient assimilation may change over the lifetime of the Project, both in terms of wetland and lake ecosystem extent and condition which could potentially decrease in this time, due to existing drivers of change.

However, the Project incorporates a waste water treatment facility, which could be a viable alternative for this ecosystem service, should abstracted fresh water need to be treated to achieve appropriate standards prior to use. In addition, the Project's water management specification commits the Project to discharge waters that are treated to acceptable environmental standards. Water purification and waste treatment is thus not considered a priority ecosystem service in terms of Project dependence.



### 7.2.2.3 Cultural

#### *Ethical and spiritual values*

The Project may depend on the availability of this ES remaining constant throughout its lifetime, in order to maintain its social license to operate. However, the presence of the Project in the landscape may affect beneficiaries' affinity to sacred sites for example, which are most frequently associated with areas of natural beauty, and that also have less obvious qualities, such as being remote or isolated or quiet. Maintenance of such features and their associated ecosystem services is considered significant in order to maintain the Project's social license to operate, so these are classified as Type II **Priority ecosystem service**.

#### *Educational and inspirational*

As with the provision of ethical and spiritual values, the Project may depend on the availability of this ecosystem service remaining constant throughout its lifetime, in order to maintain its social license to operate. Similarly, the actual physical presence of the Project may reduce the inspirational value of the Lake Albert and Escarpment landscapes; and Project provision of an alternative inspirational resource would likely prove impossible. This is therefore considered a **Priority ecosystem service**.

## 8.0 PROJECT AREA OF INFLUENCE FOR PRIORITY ECOSYSTEM SERVICES

The Project Area of Influence for Priority Ecosystem Services was set by mapping the land cover types that supply Priority Ecosystem Services against the Local Study Area, within which the beneficiaries of those ecosystem services are encompassed. The Project Area of Influence for Priority Ecosystem Services is illustrated in Figure 22. It is in this context that impacts on priority ecosystem services are assessed.

FINAL PRINT READY VERSION



# ECOSYSTEM SERVICES ASSESSMENT

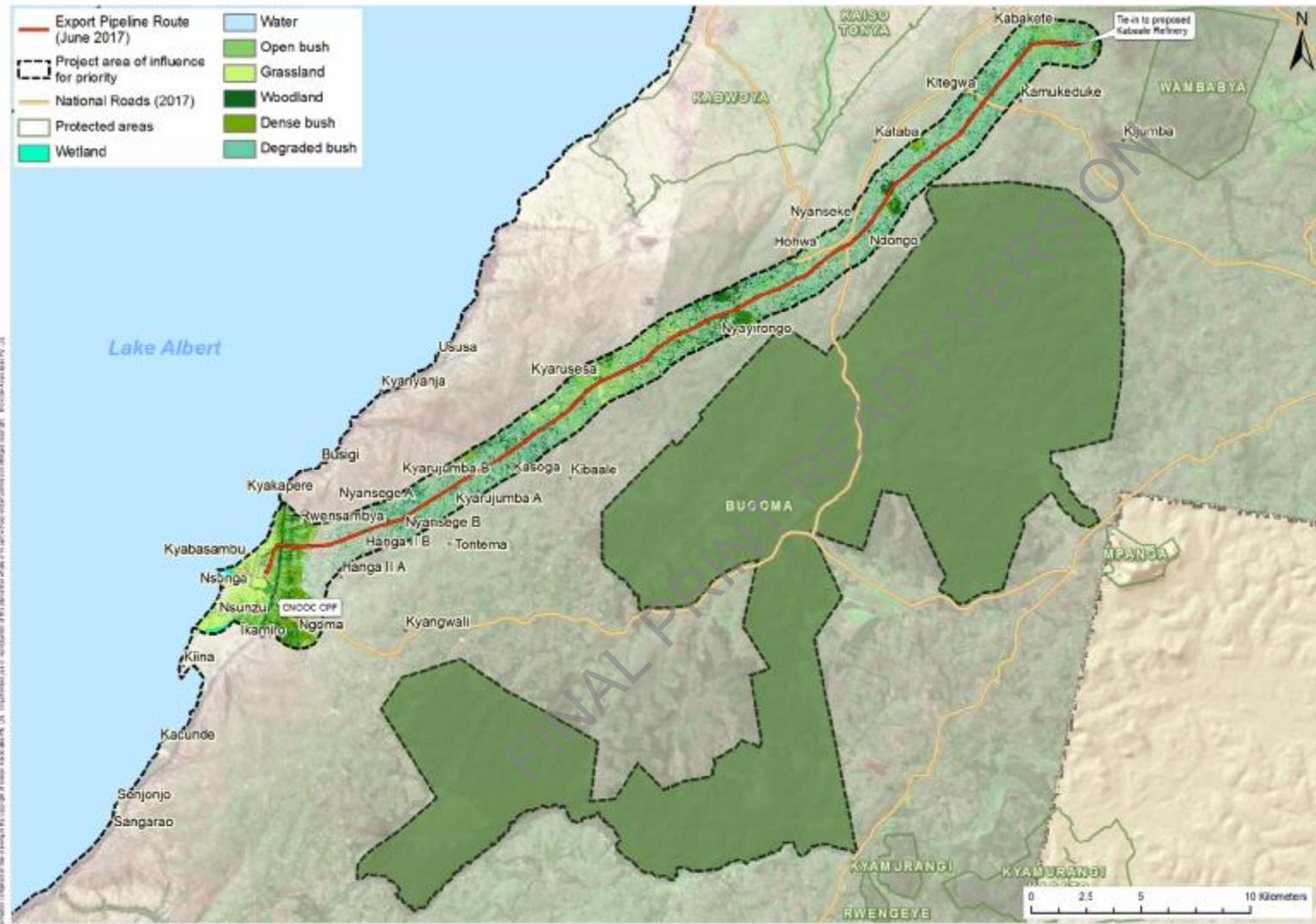


Figure 22: Project Area of Influence for Priority Ecosystem Services (includes Lake Albert)



### 9.0 ASSESSMENT OF PROJECT IMPACT ON PRIORITY ECOSYSTEM SERVICES

The following sections summarise expected impacts on Priority ecosystem services. Three of the four identified Type II ecosystem services overlap with Type I ecosystem services; in these cases, they are discussed under the same heading.

The impact assessment is not separated into construction/operation/decommissioning phases, as the ecosystem services are generally tied to land cover types and associated loss to the Project footprint (especially provisioning and regulating ecosystem services), or the presence of the Project in the landscape (cultural ecosystem services), which will be in effect for the lifetime of the Project. However, where potential impacts on ecosystem services are considered specific to a particular Project phase (for example, regulation of air quality is more likely to be affected during the operational phase of the Project), this is stated at the outset.

The impact significance ratings presented in Table 14, Table 15 and Table 16 are based on the anticipated impacts on ecosystem services, before and after specific mitigation measures have been applied. Specific mitigation measures relating to ecosystem services set out by relevant specialist studies are discussed in Section 10.0. In cases where the specialist studies do not address mitigation of impacts on ecosystem services (that is, food and biofuel provisioning ecosystem services), or where residual impacts on ecosystem services remain following application of specialist recommendations, additional mitigation measures to address such impacts are also provided in Section 10.0 Mitigation Measures.

#### 9.1 Food Provisioning

The potential impacts on food provisioning within the Project Area of Influence will extend throughout the construction, operation and decommissioning phases in the Project, due to the presence of the Project and associated loss of land cover to its footprint, and the increased demand on food supply that is expected to occur in tandem with population influx, once the Project commences construction and operation. The potential impacts will be limited to the construction phase for the Pipeline route, because the Pipeline will be buried and the servitude will be rehabilitated to its former land use following completion of the construction phase.

The impacts on all Provisioning ecosystem services are discussed in the following Sections and summarised in Table 14.

##### 9.1.1 Grazing for livestock

Potential Project impacts on this ecosystem service are related to the loss of available area for subsistence farming, and increased loss of cropland associated with increased risk of soil erosion in areas cleared (particularly along the pipeline servitude) grazing livestock. Grassland areas that are currently used for grazing livestock will be reduced in extent as a result of land-take for the Project footprint in the Buhuka Flats, and will be further pressured by population influx to the Buhuka Flats and concomitant increased demand for livestock grazing resources.

The loss and reduction in quality of this land constitutes a more significant impact in comparison to the loss of cropped land, because grazing pressure in the Buhuka Flats is severe and the loss of areas of grassland will place more pressure on the remaining grazing lands. Pastoralists travel to the Buhuka Flats specifically to graze their livestock, indicating a paucity of alternative grazing lands in the region. Population influx once the Project commences construction, and during operation may further contribute to increased grazing pressure in the Buhuka Flats. In addition, land tenure in the Project Area of Influence is not always well defined, which may affect the success of compensation schemes for beneficiaries.

The magnitude of potential Project impacts on supply of grazing for livestock was considered to be **high**, due to the current level of overgrazing in the Buhuka Flats, and its potential compoundment by loss of grazing lands to the Project footprint, and the Project population influx, which is expected to increase pressure on the availability of grazing for livestock. The geographic extent of the impact may reach to beneficiaries beyond the footprint, such as pastoralist herders who travel to the Flats specifically to access grazing lands.



The sensitivity of this ecosystem service is considered **high**, due to the apparent lack of alternative grazing resources elsewhere in the region. As with subsistence cropping, land tenure in the area is not always clear, and there are beneficiaries (for example, the Balalo pastoralist communities) grazing livestock in the Buhuka Flats that do not have the right land tenure, and therefore may be difficult to compensate for their loss.

The potential impact significance on this ecosystem service is thus considered **high**. With the application of the recommended mitigation measures, the magnitude of impact on this ecosystem service will be reduced; with appropriate resettlement, compensation and community development planning the sensitivity of the ecosystem service to impact can also be reduced, resulting in an impact of **moderate** significance, post-mitigation.

### 9.1.2 Capture Fisheries

The majority of beneficiaries in the Buhuka Flats rely on Lake Albert fishery as a sole source of livelihood, income and food, and there is concern amongst beneficiaries that the Project may impact fish stocks or the size of the fish catch. However, the Project itself, in terms of its footprint and operations, is expected to have minor impacts on the near-shore habitats of Lake Albert post-mitigation. The near-shore aquatic habitat is an important fish breeding area. Although it can be projected that construction of the Project and its operation will have minor impacts on the Lake Albert fishery, the predicted population influx associated with the Project and increased easy access to the lakeshore via the proposed escarpment road will place additional strain on the supply of natural resources and may contribute to over-fishing in the locality, as well as degradation of the near-shore habitats supporting important fish breeding zones.

Taking into account the construction impacts and the more intense potential effects of population influx, the magnitude of potential Project impacts on this ecosystem service is considered **high**, largely due to population influx. Population influx is expected to contribute to a negative feedback loop that will contribute to overfishing - as the villages on top of the escarpment become more accessible to fish sellers as a result of improved access via the escarpment road, more favourable conditions for trading fish on the escarpment (instead of at boat-accessible locations) are expected to develop, resulting in stimulation of economic growth in the Project Area of Influence – which in turn is expected to attract more people to the Project Area of influence – which may ultimately have dire consequences on the long-term viability of the Lake Albert fishery. These positive and negative socio-economic impacts will be addressed by the livelihood management plan. The effect of population influx would likely occur from construction through to the medium-term, that is, the lifetime of the project operations (25 years).

The sensitivity of the ES is **high**, as it is not substitutable or replaceable – beneficiaries are heavily dependent on this ES, and have no obvious alternate livelihoods, incomes or even food sources. The significance of the potential Project impact on the supply of this ES is thus considered **Major**. Following the application of the recommended mitigation measures, including influx management planning and provision of mess facilities, the magnitude of impacts is reduced to Low, leaving an impact of **moderate** significance, post-mitigation.

### 9.1.3 Wild foods

Bush meat hunting (specifically hunting for rats) was recorded in several villages near the pipeline routes. Bush meat hunting is a known pressure in Bugoma Central Forest Reserve in the Project Area of influence. The value of this ecosystem service to beneficiaries within the Project Area of Influence is unclear from the baseline data, however, the literature suggests that bush meat hunting may form an important 'bridge' or 'safety-net' resource for beneficiaries, particularly during times when food is scarce e.g. during times of unemployment, crop failure or drought (Akwetaireho, et al., 2011), (CRA, 2006).

Reductions in land cover types (woodland, dense and open bush) that support the supply of this ecosystem service due to Project impact will negatively affect the supply. In addition, the construction of the escarpment road and upgrade of the Hoima-to-Ikamiro Road will increase and enhance ease of access to the escarpment vegetation and Bugoma Central Forest Reserve, which, together with the expected population influx to the area, is expected to significantly increase demand for these ecosystem services. This could therefore likely affect the condition of the ecosystems and their capacity to supply ecosystem services. However, the demand for bush meat within the Project Area of Influence is uncertain. Bush meat is not thought to be a major source



of food within the Project Area of Influence. A **medium**-magnitude Project impact on this ecosystem service is expected for beneficiaries of this ES within the Project Area of Influence.

The sensitivity of this ES is ranked as medium – the supply of bush meat that would be affected by Project land take and population influx may not be easily substitutable. As mentioned earlier declines in poaching in Bugoma Forest Reserve were attributed to the lack of animals left to hunt, rather than changes in hunters' attitudes.

The significance of potential Project impacts on the supply of this ES is thus considered **moderate**. These impacts will still be of moderate significance following mitigation measures, but are predicted to occur at a lower magnitude as a result of promotion of sustainable farming and other activities that provide alternative food sources, and community education programmes.

## 9.2 Biological Raw Materials

### *Construction materials for traditionally built houses*

Almost all beneficiaries in the Local Study Area (approx. 98%) live in houses constructed with mud-and-wattle walls with earth floors; a very small percentage live in houses built with fired bricks. The majority have thatched roofs (approx. 76%), with the remainder having iron sheet roofs. As a sub-set of the Local Study Area, this pattern is also expected in the Project Area of Influence.

Thatching materials are sourced from grasslands on the escarpment (being traditionally transported to the flats via chutes Figure 20), and wattle is timber harvested from trees in woodland and bushland areas. Increases in the population in the Project Area of Influence is expected to increase demand for these raw construction materials, which could affect their supply; both in terms of immediate availability, and in the long-term, degradation of the ecosystems that supply these ecosystem services may also contribute to reduced supply capacity. At present however, there is no baseline evidence that suggests that availability of these resources is under pressure. The magnitude of potential Project effects on the supply of raw materials for traditional house construction is thus considered **medium**.

Alternative housing materials (fired bricks and iron roof sheeting) are available for purchase in the Project Area of Influence; however, purchase of these materials is probably not a viable alternative to harvesting grass and wattle timber, which is free. Therefore, the sensitivity of the ecosystem service is **high**.

The significance of potential Project impacts on the supply of this ecosystem service is considered **major**. Provision of housing for workers employed by the Project during construction and operation may alleviate the demand for these materials in the Project Area of Influence, which would reduce the magnitude of the impact, however the sensitivity of the ecosystem service remains unchanged as population influx will also include people who do not work at the Project, for whom the ecosystem service will not be substitutable. Post-mitigation impacts are thus expected to be of **moderate** significance.

### *Natural aggregates for Project facility construction*

The scale of extraction of aggregates for Project facility construction is unclear. It is not expected that the Project will affect the ability of other beneficiaries to benefit from this ecosystem service, as other beneficiaries within the Project Area of Influence do not typically rely on aggregate extraction as a priority/non-priority ecosystem service; however, construction practises may change over the lifetime of the Project, and local beneficiaries may come to depend on this ecosystem service. Based on current evidence, the magnitude of potential Project effects on the availability of natural aggregates is considered **medium**.

The Project is reliant on the availability of locally-sourced aggregates to maximise cost efficiency and carbon footprint reduction; however, alternatives in the form of imported resources are expected to be available to the Project. The sensitivity of the ecosystem service is thus considered **medium**.

The significance of potential Project impacts on the supply of this ecosystem service is considered **moderate**. Avoiding extraction of aggregate in areas important for ecosystem service supply, especially sites of cultural heritage importance, and Project development of a procurement strategy for using locally-sourced aggregates,



reduces the magnitude of impact and sensitivity of receptors, reducing the significance of potential impacts on this ecosystem service to **minor**.

### 9.3 Biomass Fuel

The majority of the population in the Hoima district and thus the Project Area of Influence use wood fuel as their main source of energy. However, firewood has become scarce and many beneficiaries have resorted to using charcoal, which is expensive. In addition, charcoal is derived from timber that is also harvested from woodland and bush areas.

Reductions in land cover types (woodland, degraded bush, open bush, dense bush) that supply this ecosystem services due to Project impact may negatively affect the supply of this ecosystem services. In addition, population influx to the area associated with the Project is expected to significantly increase demand for firewood and charcoal, which will have a direct impact on the condition of the woodlands and bush, and thus their capacity to continue to supply timber for use as fuel. The magnitude of potential Project effects on the supply of biomass fuel is thus considered **high**, as the ecosystems and their capacity to supply firewood may be altered to the extent that supply will temporarily or permanently cease.

The sensitivity of the ecosystem service is **high**, because there are almost no viable alternatives to the use of firewood and charcoal by beneficiaries, it is not easily replaceable – although non-wood products, such as banana leaves and grass, are used in some parts as a source of fuel for cooking to supplement firewood, such fuels could not replace firewood in terms of burning time and heat generation.

The significance of potential Project impacts on the supply of this ecosystem service is considered **major**. If the recommended mitigation measure of CNOOC, that is, investigating the feasibility of provision of cheap gas to local communities is enacted, the impact would be reduced in magnitude and the ecosystem service sensitivity would be lowered due to the availability of an affordable substitute to charcoal, resulting in **minor** impacts, post-mitigation.

### 9.4 Freshwater

Freshwater falls under both Type I and Type II priority ES – the Project may impact the supply of this ES and the Project is also dependent on both the quantity and the quality of supply of this ES.

#### 9.4.1 Freshwater as a Type I Priority ES

The Project footprint may impact the supply of Freshwater for beneficiaries, particularly in the vicinity of areas where the infrastructure will intercept drainage lines, streams, rivers and/or swamps. Pressure from increased populations in the Project Area of Influence may contribute to increased nutrient load and eutrophication of the lake, with concomitant effects on water quality. Although unlikely, an accidental spill of oil or process water in Lake Albert cannot be discounted as a potential impact on the quality of the freshwater supply. Impacts on the quality and quantity of water supply may ensue.

The magnitude or magnitude of potential effects could extend throughout the Project Area of Influence and beyond, but would most likely be short-term in duration. Potential impacts on water quality would most likely occur during the construction phase due to potential sediment release during earthworks activities, and may also occur during the medium-term operational life of the Project, in the event that inflow of untreated human waste and agricultural runoff continues and will increase due to population influx. Impacts on quantity of freshwater supply are considered unlikely, given the amount of water being abstracted from Lake Albert for the Project operations in the context of the available surface water resource. Nonetheless, should water quality be impacted negatively, for example, by eutrophication or an industrial accidental leakage, the magnitude of impacts could be **high**.

The sensitivity of the ecosystem service is **high**, as freshwater supply in the necessary quantities and to the required quality standards is not easily substitutable. In addition, impacts on Lake Albert water quality from potential eutrophication would also directly affect the fish population and thus the capacity to support capture fisheries, which is also a highly sensitive ecosystem service. The significance of potential Project Impacts on the supply of this ecosystem service is thus considered **major**. The magnitude of impacts can be reduced by



appropriate water management and monitoring mechanisms and influx management planning, reducing the predicted impacts post-mitigation to **moderate** significance.

### 9.4.2 Freshwater as a Type II Priority ES

The Project is dependent on the supply of Freshwater from Lake Albert for operational performance, as water use is a necessary part of the oil extraction process; however, the Project requirement is miniscule in the context of the available resource. No significant impacts on the quantity of this ES over the lifetime of the Project are envisaged, either as a result of changing water levels in Lake Albert or the cumulative effects of other oil development areas also abstracting (similarly negligible amounts) water from Lake Albert for the same purpose. Water quality deterioration may occur in Lake Albert as a result of eutrophication from nutrient loading of streams and rivers flowing into the lake. The Project is dependent on the lake's capacity to assimilate this waste loading, to avoid the financial implications of having to provide additional treatment to bring intake water to an appropriate standard for use in operations, other than that already planned<sup>3</sup>.

The magnitude of potential Project effects on this ecosystem service is considered **negligible**. The amount of water demanded by the Project in terms of the available water resource is negligible, and will be even more so if as predicted the water level in Lake Albert rises due to predicted effects of climate change. Although ongoing nutrient-loading to the lake is likely to result in water quality deterioration, treatment of the abstracted water prior to use is already planned as part of the Project.

The sensitivity of the ES is **low**, as during operation the majority of Project water requirements will be achieved through re-use of produced water, rather than abstraction of make-up water from the Lake, and thus is considered largely substitutable. The significance of potential impacts on this ES in terms of Project demand is thus considered **minor**. Participation in water catchment management activities in the Lake Albert basin can further reduce the Project impact magnitude to negligible, with overall impacts on this ecosystem service post-mitigation remaining **minor**.

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<sup>3</sup> Hypochlorite (NAOCl), together with a flocculent, will be injected close to the intake water pump station in order to minimise the risk of build-up of Sulphate Reducing Bacteria (SRB) in the pipeline to the CPF



**Table 14: Impacts on Provisioning ecosystem services within the Project Area of Influence**

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Ecosystem Service	Potential Impacts	Pre-mitigation			Post-mitigation		
		Magnitude	Sensitivity	Significan.	Magnitude	Sensitivity	Significan.
Grazing for Livestock	<ul style="list-style-type: none"> <li>Loss of grassland to Kingfisher Development area</li> <li>Increased erosion potential of grassland adjacent to cleared areas</li> <li>Population influx-associated pressures on already over-utilised resource</li> <li>Land tenure not clearly defined – there are pastoralist herders present on the Buhuka Flats who do not have land tenure and thus would not be compensated for loss</li> </ul>	High - 4	High - 4	Major - 16	Medium – 3	Medium – 3	Moderate – 9
Capture Fisheries	<ul style="list-style-type: none"> <li>Perception amongst beneficiaries that Project may impact fish stocks/fish catch</li> <li>Minor impacts on near-shore aquatic environment expected, which may affect fish breeding</li> <li>Population influx will increase demand on Lake Albert fisheries</li> </ul>	High - 4	High - 4	Major - 16	Low – 2	High – 4	Moderate – 8
Wild Foods	<ul style="list-style-type: none"> <li>Bush meat hunting takes place in some villages along the pipeline route and in Bugoma Central Forest Reserve;</li> <li>Woodland and bush that supports hunted species will be reduced in area by pipeline servitude land-take, and will be made more accessible to hunters by upgrade of road and clearance of pipeline servitude</li> <li>Population influx will increase demand for bush meat</li> </ul>	Medium - 3	Medium - 3	Moderate - 9	Low – 2	Medium - 3	Moderate – 6
Construction materials for traditionally-built houses	<ul style="list-style-type: none"> <li>Reductions in land cover types (grassland, wetland, woodland and bushland) that supply this ES due to Project land-take</li> <li>Population influx may increase demand for housing construction materials</li> </ul>	Medium – 3	High – 4	Major - 12	Low – 2	Medium – 3	Moderate – 6
Natural aggregates for Project facility construction	<ul style="list-style-type: none"> <li>Reductions in land cover types that supply this and other ES due to extraction of aggregates</li> <li>Local shortages in aggregates could lead to higher costs for other beneficiaries if importation becomes necessary</li> </ul>	Medium – 3	Medium – 3	Moderate - 9	Negligible – 1	Low – 2	Minor – 2
Biomass Fuel	<ul style="list-style-type: none"> <li>Reductions in land cover types that supply this ES due to Project land-take, particularly along pipeline route and escarpment road</li> <li>Population influx expected to increase demand for firewood and charcoal</li> </ul>	High - 4	High - 4	Major - 16	Low – 2	Low – 2	Minor – 4



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Fresh Water (Type I)	<ul style="list-style-type: none"> <li>• Impacts on quantity and quality of water supply where Project infrastructure intercepts drainage lines, streams, rivers and/or swamps</li> <li>• Impacts on water quality of Lake Albert should an accidental spill occur</li> <li>• Impact on water quality due to increased nutrient loading from population influx</li> </ul>	High - 4	High - 4	Major - 16	Low - 2	High - 4	Moderate - 6
Fresh Water (Type II)	<ul style="list-style-type: none"> <li>• Quantity of fresh water supply to the Project may be affected by climate change and change in Lake Albert levels</li> <li>• Cumulative effect of other oil development areas also abstracting water from Lake Albert</li> <li>• Water quality deterioration may necessitate treatment of water being used in Project activities, increasing Project operation costs and affecting operational performance</li> </ul>	Low - 2	Low - 2	Minor - 4	Negligible - 1	Low - 2	Minor - 2

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### 9.5 Regulating Air Quality

This is a Type II priority ecosystem service – the Project is also dependent on the supply of this ES in order to maintain its social licence to operate, and maintain operational performance by not triggering regulatory responses, for example, by exceeding emission guidelines.

#### *Regulation of Air quality as a Type II Priority Ecosystem Service*

The Project depends on the ongoing provision of this ecosystem service, as although Project emissions will be within the recommended limits set out in the relevant guidelines, there will still be some level of emissions by the Project to the air. Stakeholders perceive that the Project may affect air quality, so any changes in air quality (though not necessarily caused by the Project itself) might be attributed by beneficiaries to the Project, thereby affecting its social license to operate.

The principle ecosystem delivering air quality regulation services within the Project Area of Influence is Lake Albert's sediments and its associated flats and wetlands, which would have a role as a 'sink' for any atmospheric pollutants, as well as carbon sequestration. The escarpment vegetation and forest areas, particularly Bugoma CFR, grasslands and bushlands are also expected contribute to air quality regulation.

The significance of Project impacts to the Lake Albert and wetland ecosystems providing this service is expected to be minor following mitigation; however moderate-major effects remain on the escarpment vegetation and Bugoma CFR respectively, after mitigation. The magnitude of potential Project impact on the provision of this ecosystem service is considered to be **low**, given the limited amount of loss of escarpment vegetation and woodland area, and the minor effects anticipated on Lake Albert and wetlands post-mitigation.

The sensitivity of the ecosystem service is **high**, as although measures can be enacted to mitigate direct Project impact on this ecosystem service, the perceptions of local stakeholders may be difficult to change. The significance of potential future impacts on the Project is **moderate**, as a result of its dependence on this ES for operational performance and maintenance of its social license to operate.

Following the application of recommended mitigation measures, particularly community education programmes and corporate social responsibility initiatives, the negative public perception of potential Project impacts on air quality and thus the sensitivity rating for this ecosystem service can be reduced to low; and magnitude to negligible, resulting in a residual impact of minor significance.

### 9.6 Regulating Water Flows and Timing

The effects of placing Project infrastructure within and intercepting wetlands, rivers, streams and drainage lines will both reduce the surface area of these land cover types, reducing their ability to regulate water flows, and alter their hydrological properties (e.g., subsurface flow through soils) and ecological integrity, which may affect their capacity to regulate water flows.

The magnitude of potential Project construction impacts on wetlands and drainage lines that supply this ecosystem service in the Project Area of Influence is expected to be **medium**, as although the wetlands will be altered, natural processes are expected to continue in impacted wetlands, albeit in a modified way.

The sensitivity of the ecosystem service is considered **medium**, as the proposed mitigation measures for wetlands that are directly affected by the Project should ensure that the provision of the ecosystem service will be maintained over the lifetime of the Project. A potential Project impact of **moderate** significance on the supply of this ecosystem service is predicted.

The application of the recommended mitigation measures, particularly the incorporation of engineered design features to ensure that water flows in impacted wetland systems and sub-surface flows are maintained, will reduce the extent of any potential impacts and limit their duration, however the sensitivity of the ecosystem service will remain medium; a potential Project impact of **moderate** significance is predicted for this ecosystem service, post-mitigation.



### 9.7 Water Purification and Waste Treatment

Many beneficiaries within the Project Area of Influence obtain their drinking water directly from sources including Lake Albert, rivers, streams, wetlands and swamps. The role that ecosystems such as wetlands play in the removal of harmful pollutants such as metals and organic materials from surface water systems is important in the context of the lack of formal water treatment systems. Lake Albert also plays a role in the assimilation of nutrients in surface water systems associated with the lack of human sanitation facilities in the region.

The amount of wetland cover being directly lost to the footprint is minimal in the context of the available resource in the Project Area of Influence. However, where wetlands are being intersected by linear infrastructure such as roads and the pipeline route, there is a potential for the downstream wetland habitat to be affected if proper management controls are not implemented, particularly during construction. Even with appropriate measures in place, erosion of wetlands is expected to take place downstream of pipeline and road crossings, and flooding upstream of crossings. Indirect Project impacts may put pressure on Lake Albert's capacity to deliver this ecosystem service, namely the presence of approximately 22,000 people on the Buhuka Flats and other nearby villages who do not currently have access to running water and sanitation. The effect of which is currently unknown but may extend regionally, should the water quality of Lake Albert and its capacity to supply water purification services be impacted. The overall potential Project impact magnitude on this ecosystem service is thus expected to be **high**.

The sensitivity of the ecosystem service to Project impact is **medium**, as although additional pressures on the nutrient loading of Lake Albert from the expected population influx cannot be readily predicted; the ecosystem service is substitutable with the development of appropriate water treatment and sanitation facilities, which will be addressed by the Influx Management Plan for the Project. The overall significance of potential Project impacts on this ecosystem service is thus considered **high**.

The incorporation of appropriate wastewater treatment and suitable sanitation facilities at the Project, as well as the Influx management plan will reduce the magnitude of Project impact on this ecosystem service where it is provided by Lake Albert. Appropriate mitigation to maintain wetland functioning in areas that will be intersected by the pipeline will also contribute to reduced impact magnitude. However, the sensitivity of the ecosystem service remains the same, therefore a post-mitigation impact of **moderate** significance is predicted.



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**Table 15: Impacts on Regulating ecosystem services**

Ecosystem Service	Potential Project Impacts	Pre-mitigation			Post-mitigation		
		Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance
Regulating Air Quality (Type II)	Loss and degradation impacts on wetlands and vegetation of escarpment and Bugoma Central Forest reserve may reduce the capacity of these ecosystems to supply this ES Reduction in supply of this ES may reduce social license to operate due to beneficiary perception that the Project is the cause, despite application of mitigation measures	Low - 2	High - 4	Moderate - 8	Negligible - 1	Low - 2	Minor - 2
Regulating Water Flows and Timing	Placing Project infrastructure within and intercepting wetlands, rivers, streams and drainage lines will both reduce the surface area of these land cover types, reducing their ability to regulate water flows	Medium - 3	Medium - 3	Moderate - 9	Low - 2	Medium - 3	Moderate - 6
Water Purification and Waste Treatment	The role that wetlands play in water purification and waste treatment, in the context of limited formal water treatment systems is likely significant Amount of wetland land cover being directly lost to the footprint is minimal in the context of the available resource in the Project Area of Influence, however indirect impacts on wetland functioning that may occur Indirect Project impacts on Lake Albert nutrient assimilation capacity due to population influx and lack of sanitation facilities	High - 4	Medium - 3	Major - 12	Moderate - 2	Medium - 3	Moderate - 6



### 9.8 Ethical and Spiritual Values; Educational and Inspirational Values

These ES are considered together given that they are rooted in the same cultural landscapes and are potentially affected and demanded by the Project in the same ways. These ecosystem services may be impacted by the Project, and the Project also relies on the maintenance of the supply of these ecosystem services in order to prevent potential impacts on its social licence to operate.

#### *Ethical and Spiritual Values, and Inspirational Values as a Type I Priority ES*

Sacred sites and intangible cultural heritage are inextricably linked with the landscapes and natural ecosystems of Lake Albert and the escarpment, and are important in terms of beneficiaries' sense of identity and heritage. The Project will impact these ecosystem services due to changes as a result of loss of areas of natural ecosystems, and the visual presence of the Project itself in these landscapes; both of which are expected to limit the beneficiaries' capability to benefit from this ecosystem services.

The potential Project impact on the supply of these ecosystem services will have a **medium** magnitude, as the effect will likely extend to beneficiaries in the Project Area of Influence, and will last for at least the duration of the Project and probably longer than that – it is probable that even if the Project footprint is rehabilitated post-decommissioning, the escarpment road will remain, and the landscape of Lake Albert and the escarpment will have changed irreversibly, and associated intangible cultural heritage such as oral histories of places though expected to continue, will become modified in future generations.

The sensitivity of these ecosystem services is **high** as they are irreplaceable, based as they are on the Lake Albert and escarpment landscapes as they stand and have stood for generations. The overall significance of the potential Project impact on these ecosystem services is thus considered **major**.

The application of mitigation measures can reduce the magnitude of Project impacts. However, the sensitivity of the ecosystem service remains high as it is essentially irreplaceable. A post-mitigation impact of **moderate** significance is predicted.

#### *Ethical and Spiritual Values, and Inspirational Values as a Type II Priority ES*

The Project relies on the continued supply of these ecosystem services to maintain its social licence to operate, granted by the local community who gains most from these ecosystem services.

The magnitude of potential effects on the Project due to its reliance on the continued supply of this ES to maintain its social license to operate are **medium** – the Project's operational performance could be moderately affected if beneficiary disaffection and social unrest due to loss of integrity of sacred sites begins to impact the Project's social licence to operate.

The sensitivity of the Project to changes in this ES is **high**, as the supply of this ES by the culturally significant landscapes of Lake Albert and the escarpment are not substitutable. The overall significance of potential impacts on the Project due to its dependence on this ES is therefore **major**.

The application of mitigation measures can reduce the magnitude of Project impacts. However, the sensitivity of the ecosystem service remains high as it is essentially irreplaceable. A post-mitigation impact of **moderate** significance is predicted.



**Table 16: Impacts on Cultural ecosystem services**

Ethical and spiritual values, and Inspirational values	Potential Impacts	Pre-mitigation			Post-mitigation		
		Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance
Type I	The Project will impact these ES due to changes as a result of loss of areas of natural ecosystems, and the visual presence of the Project itself in these landscapes	Medium - 3	High - 4	Major - 12	Low -2	High - 4	Moderate - 8
Type II	Potential reduction in the value of this ES for beneficiaries may adversely affect the Project's social license to operate	Medium - 3	High - 4	Major - 12	Low -2	High - 4	Moderate - 8

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### 10.0 RECOMMENDED MITIGATION AND MONITORING MEASURES

Mitigation measures provided in the following sections include those from specialist studies that are specific to potential impacts on the supply of ecosystem services, and suggested additional mitigation measures based on the guidance provided by IPIECA/OGP for oil and gas project impacts and dependencies on ES (IPIECA, 2011). The recommended mitigation measures are presented in Table 17.

**Table 17: Mitigation measures for impacts on Priority Ecosystem Services**

Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
<p><b>Food Provision – Grazing for Livestock</b></p>				
<p>Economic displacement experienced by impacted herding communities has been addressed in terms of the IFC Performance Standard 5 through development of an appropriate Resettlement Action Plan (RAP). The RAP includes provision in the entitlement matrix to compensate people with customary rights for loss of grazing</p> <p>The RAP may require a specialist livestock assessment and management component to address impacts to livestock.</p>	<p>As stipulated in RAP</p>	-	CNOOC	-
<p>A livelihood restoration plan or similar should be developed to specifically formulate mitigation strategies for the loss of grazing land</p>	<p>Livelihood Restoration Plan to be commissioned</p>		CNOOC	-
<p>Support of sub-county administration strategies to solve regional farming difficulties such as crop failure due to disease and drought (e.g. introduction of modern farming methods, training farmers in post-harvest techniques, and sensitising farmers about land degradation) as part of the Community Development Plan/Corporate Social Responsibility initiatives</p>	<p>Community development plan to be commissioned.</p>	-	CNOOC	-



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Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
The Project could support the local economy by sourcing food locally, where feasible	i Community development plan to be commissioned.	-	CNOOC	-
<b>i Food Provision – Capture Fisheries</b>				
An influx management plan will be developed to address appropriate measures to mitigate the expected Project-associated in-migration effects on capture fisheries	i Monitoring measures described in the plan	As required	CNOOC	-
Enforcement of a complete ban on wildlife harvesting (hunting/ trapping/ fishing) for all Project personnel	i No personnel and/or contractors allowed beyond footprint of Project	As required	CNOOC and Contractors	Inductions for all staff
Inclusion of a construction camp with mess facilities for locally-hired staff	i -	-	CNOOC	-
<b>i Food Provision – Wild Foods</b>				
Supporting local communities in developing sustainable farming, ecotourism or other activities that provide alternative food sources and income	i Livelihood Restoration Plan to be commissioned	-	CNOOC	-
Support scientific studies and monitoring programs aimed at assessing the sustainability of using local resources, as part of Corporate Social Responsibility initiatives	i -	-	CNOOC	-
Enforcement of a complete ban on wildlife harvesting (hunting/ trapping/ fishing) for all project personnel	i No personnel and/or contractors allowed beyond footprint of Project	-	CNOOC and Contractors	i Inductions for all staff



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Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
Worker and community education programme focussing on the impacts and risks of bush meat hunting (e.g. disease) to be incorporated into the Community Development Plan	i Community development plan to be commissioned	-	CNOOC	-
Inclusion of a construction camp with mess facilities for workers	i -	-	CNOOC	-
<b>i Biological Raw Materials – construction material for traditional houses</b>				
Inclusion of a construction camp with accommodation facilities for workers in Project plan	■ -	-	CNOOC	-
Support scientific studies and monitoring programs aimed at assessing the sustainability of using local resources for home construction	■ -	-	CNOOC	-
<b>i Biological Raw Materials – aggregates for construction of Project facilities</b>				
Avoid aggregate extraction in areas of natural habitat or in the vicinity of sites of cultural heritage importance; target aggregate extraction for areas already in degraded state such as subsistence cropland within the Project footprint	■ -	-	CNOOC	-
Develop a procurement strategy that encourages use of locally-sourced aggregates, but that involves mechanisms for assessing or maintaining the sustainability of the supply.	■ -	-	CNOOC and Contractors	-
<b>i Biomass Fuel – fire wood and charcoal</b>				
Supply of cheap alternatives (e.g. gas) to local markets by CNOOC to be investigated	■ -	-	CNOOC	-



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Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
Support scientific studies and monitoring programs aimed at assessing the sustainability of using commercially-planted forms of biomass fuel, such as Jatropha	i Livelihood Restoration Plan to be commissioned	-	CNOOC	-
Enforcement of a complete ban on harvesting of fire wood at for all project personnel	i No personnel and/or contractors allowed beyond footprint of Project	-	CNOOC and Contractors	Inductions for all staff
<b>i Fresh Water (Type I)</b>				
Implement appropriate water pollution control measures such as oil interceptors, treatment of sewerage and hydrotest discharge	■ As per Surface Water report	-		-
Assessment of the natural capacity of Lake Albert to provide waste assimilation services, and insurance through monitoring and analysis that these are not exceeded	■ Monitoring of lake water quality once assimilation capacity has been calculated	■ As required	CNOOC	-
The development of an Influx Management Plan will identify appropriate measures to mitigate the expected increased waste-loading to surface water systems as a result of in-migration due to the presence of the project.	■ Monitoring measures described in the plan	■ Monitoring frequency described in the plan	CNOOC	-
<b>i Fresh Water (Type II)</b>				
Contribute to water catchment management in association with other Projects in neighbouring exploration blocks to promote equitable sharing of fresh water resources of Lake Albert	-	-	CNOOC	-



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Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
<b>i Regulating Air Quality</b>				
Loss of vegetation and wetland ecosystems to the Project footprint and associated indirect effects to be addressed by the mitigation measures recommended in the Biodiversity Impact Assessment and the Surface Water Impact Assessment	<b>i</b> As per Surface Water and Biodiversity Impact Assessments	As required	CNOOC	-
Dedicate a portion of the land used for the project for native forest, and/ or invest in replacing or protecting CO2 sequestration/storage services in the immediate area, as part of Corporate Social Responsibility initiatives	-	-	CNOOC	-
Assess the relative importance of natural air quality regulatory services within the Project Area of Influence, and design infrastructure to accommodate and enhance such services where feasible.	-	-	CNOOC	-
Community education programmes on pollution prevention and monitoring schemes. Promotion of CNOOC corporate social responsibility initiatives	-	-	CNOOC	-
<b>i Regulating Water Flows and Timing</b>				
Where possible, avoid or enhance natural barriers such as wetlands before investing in man-made replacements.	<b>i</b> As per Surface Water and Biodiversity Impact Assessments	As required	CNOOC	-



## ECOSYSTEM SERVICES ASSESSMENT

Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
Mitigation measures outlined in the Surface Water Impact Assessment and Biodiversity Impact Assessment report include the incorporation of engineered design features to ensure that water flows in impacted wetland systems are maintained. Mitigation measures should be applied as recommended.	i As per Surface Water and Biodiversity Impact Assessments	As required	CNOOC	-
<b>i Water Purification and Waste Treatment</b>				
Minimising the amount of wetland being directly lost to the Project footprint will contribute to reduction of potential impacts on the supply of this ES. Appropriate engineered mitigation measures at wetland and riparian crossings along the pipeline route, which maintain surface and subsurface flows and subsequently the integrity of these systems will also contribute to minimisation of potential impacts	i As per Biodiversity Impact Assessment	i As required	CNOOC	-
Assessment of the natural capacity of Lake Albert and Project-affected wetlands to provide water filtration and waste assimilation services, and insurance through monitoring and analysis that these are not exceeded	i Monitoring of lake water quality once assimilation capacity has been calculated	i As required	CNOOC	-
Appropriate sewerage facilities and wastewater treatment systems to be put in place at construction camp and at long-term operational Project facilities	i Monitoring of quality of wastewater discharge	i As required	CNOOC	-
The development of an Influx Management Plan will identify appropriate measures to mitigate the expected increased waste-loading to surface water systems as a result of in-migration due to the presence of the project.	i Monitoring measures described in the plan	i Monitoring frequency described in the plan	CNOOC	-

### **i Cultural Heritage Ecosystem Services**



## ECOSYSTEM SERVICES ASSESSMENT

Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
In accordance with IFC PS8 (Cultural Heritage), where the Project may significantly impact on <b>critical cultural heritage</b> that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of beneficiaries' lives, priority will be given to the avoidance of such impacts.	<ul style="list-style-type: none"> <li>Avoid development in areas identified as spiritual or sacred sites</li> </ul>	-	CNOOC	-
Where significant project impacts on <b>critical cultural heritage</b> are unavoidable, the client will obtain the free, prior and informed consent (FPIC) of the Affected Communities, as per IFC PS8 and PS1 requirements	<ul style="list-style-type: none"> <li>Undertake a process of Informed Consultation and Participation of the affected communities</li> </ul>	-	CNOOC	-
Protection of the environmental setting for sacred sites close to construction / operation areas	<ul style="list-style-type: none"> <li>No personnel and/or contractors allowed beyond footprint of Project</li> <li>Designated no-go areas, e.g., sacred sites, ritual sites</li> <li>Screening planting around Project facilities to protect views</li> </ul>	<ul style="list-style-type: none"> <li>As required</li> </ul>	CNOOC and Contractors	<ul style="list-style-type: none"> <li>Inductions for all staff</li> </ul>
Maintaining community access to sacred sites and facilitating respect for local intangible cultural heritage, tradition and taboo will ensure that the negative socio-cultural effects are effectively managed – regular platforms for community liaison are recommended and provisions for such should be made in the Cultural Heritage Management Plan (CHMP)	<ul style="list-style-type: none"> <li>As per CHMP</li> </ul>	<ul style="list-style-type: none"> <li>As required</li> </ul>	CNOOC	<ul style="list-style-type: none"> <li>Inductions for all staff</li> </ul>



## ECOSYSTEM SERVICES ASSESSMENT

Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsible Entity	Training Necessary
Cultural sensitivity training to be provided to Project staff and incorporated into the site induction process	i As per CHMP	i As required	CNOOC and Contractors	i Inductions for all staff

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### 11.0 CONCLUSION

The Project will affect beneficiaries of priority ecosystem services in two main ways; the physical presence of the Project infrastructure, and population influx associated with the construction and operation of the Project.

The presence of the Project infrastructure will cause land cover changes and associated loss of supply of ecosystem services; it will also change the physical landscape of the area which lends itself to the cultural heritage value of Lake Albert and the escarpment to local communities. Population influx of job-seekers, and people seeking to provide commercial services to the increasing population, will increase demand for ecosystem services, and therefore increase pressure on the ecosystems that supply these services.

Other than the actual direct and indirect effects of Project activities, maintenance of the Project's social licence to operate from affected beneficiaries is critical. Local people perceive that oil exploration projects have affected fish stocks in Lake Albert and that air quality has deteriorated as a result of oil-related commercial activity in the area. It is therefore crucial that the mitigation hierarchy is followed and all efforts to avoid impacts on Lake Albert water quality, air quality and sites of cultural heritage value are made.

Where avoidance of impacts is impossible, application of the recommended mitigation measures is crucial. In particular, worker and community education programmes are key in both maintaining CNOOC's social licence to operate in the area, and educating beneficiaries to promote sustainable use of the ecosystem services that they rely on. Appropriate resettlement action plans, livelihood restoration plans and influx management plans are key mitigation measures to ensure that the beneficiaries that are most reliant on priority ecosystem services within the Project Area of Influence are suitably accommodated.

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# APPENDIX A

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# APPENDIX B

## Prioritisation of ES according to Project Impact

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## ECOSYSTEM SERVICES ASSESSMENT

### PRIORITISATION OF ES ACCORDING TO PROJECT IMPACT

Priority ecosystem services are those services for which the answers to questions 1 and 2 are “Yes” or “Unknown”, and “No” or “Unknown” to question 3.

#### Impact prioritisation spreadsheet

Ecosystem Service	Potentially affected beneficiaries	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
<b>Provisioning</b>						
Food – Subsistence crops	Pipeline route community	Income, livelihoods, food intake	Y	Y	?	1
Food - Grazing for Livestock	Buhuka Flats community	Reduced grazing area due to Project land-take and increased pressure from population influx will reduce grazing availability, which may limit the ability of people to raise livestock for subsistence and livelihood purposes	?	Y	N	1
	Migratory herders	As above	?	Y	N	1
Food – Capture fisheries	Buhuka Flats community	Income, livelihoods, food intake	Y – stakeholder perception that the Project will affect fish stocks, increased demand from population influx	Y	N	1
Food – wild foods	Pipeline route community	Reduced bush meat availability due to reductions in woodland/bush land cover that supports hunted species Reduced vegetation cover may limit bee's ability to produce honey and honey production	?	Y	?	1
Biological raw materials – construction of traditional houses	Buhuka Flats and Pipeline route communities	Ability to construct homes and animal shelters	?	Y	Y	0



## ECOSYSTEM SERVICES ASSESSMENT

Ecosystem Service	Potentially affected beneficiaries	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Biological raw materials – extraction of aggregates for Project Construction	The Project Buhuka Flats and Pipeline route communities	Landscape value and spiritual and inspirational values Impacts via land take of ecosystems that may provide priority ecosystem services	?	Y	N	1
Biomass fuel – wood and charcoal	Buhuka Flats and Pipeline route communities	Energy sources for cooking, fish processing, brick making	Y	Y	Y – most fuel sources in Project area of influence have been exhausted and charcoal and fire wood are purchased	1
Fresh water	Buhuka Flats and Pipeline route communities	Availability and quality of fresh water for drinking may be compromised by abstraction from Lake Albert and interception of sources by the pipeline	Y – stakeholder perception that the Project will affect water quality	Y	N	1
Medicinal plants	Buhuka Flats and Pipeline route communities	Availability of traditional medicines	N – areas of forest and grassland loss to footprint in context are minimal	n/a	n/a	0
<b>Regulating</b>						
Air quality	Buhuka Flats and Pipeline route communities	Project effects on ecosystems that provide this ecosystem service are negligible in the context of available unaffected areas in LSA	N	n/a	n/a	0
Water flows and timing	Buhuka Flats community	Wetlands and the unique hydrological system of the Buhuka Flats may be disturbed/interrupted	Y	Y	N	1
Soil stability & erosion control	Buhuka Flats community	Vegetation clearance for construction may reduce the ability of the surrounding soils to withstand erosive forces of wind and floods	N	n/a	n/a	0



## ECOSYSTEM SERVICES ASSESSMENT

Ecosystem Service	Potentially affected beneficiaries	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Water purification and waste treatment	Buhuka Flats and Pipeline route communities	Disturbance of wetlands by proposed infrastructure may impact the integrity of wetlands and their ability to provide ES Population influx may increase nutrient loading and pressurise assimilative capacity of Lake Albert	Y	Y	N	1
<b>Cultural</b>						
Recreation and ecotourism	Buhuka Flats community	Tourism associated with oil company staff is currently developing – development may ultimately be restricted by Project presence and visual impact effects	Y	N	n/a	0
Ethical and spiritual values	Buhuka Flats community	Sacred sites and intangible cultural heritage are intrinsically linked with natural ecosystems such as wetlands, rivers, lake and forests and substantially contribute to beneficiaries' sense of identity	Y	Y	N	1
Educational and inspirational	Buhuka Flats community	the Lake Albert and Escarpment landscapes inspire folklore and contribute to beneficiaries' sense of heritage and identity	Y	Y	N	1

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# APPENDIX C

## Prioritisation of ES according to Project Demand

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## ECOSYSTEM SERVICES ASSESSMENT

### PRIORITISATION OF ES ACCORDING TO PROJECT DEPENDENCE

Priority ES are those services for which the answers to question 1 is “Yes” or “Unknown”, **and** “No” or “Unknown” to question 2. If the answer to question 1 is no, it is automatically a non-priority ecosystem services. Changes in an ecosystem services can be driven both by causes of ecosystem change external to the Project and by the Project’s own impacts.

#### Priority ecosystem services according to the extent of Project Demand

Ecosystem Service	1. Could this ES change in ways that will affect operational performance (Y/N/?)	2. Does the Project have viable alternatives to this ES (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
<b>Provisioning</b>			
Food – Subsistence crops	N	n/a	0
Food - Grazing for Livestock	N	n/a	0
Food – Capture fisheries	N	N	0
Food – wild foods	N	n/a	0
Biological raw materials – aggregate extraction for Project facility construction	?	N	1
Biomass fuel – wood and charcoal	N	n/a	0
Fresh water	Y – stakeholders perceive that the Project may impact the quality of water, therefore the Project is reliant on the quality and quantity of freshwater remaining constant throughout its lifetime in order to maintain its social license to operate  Cumulative impact of abstraction by other projects unknown	N	1
Medicinal plants	N	n/a	0
<b>Regulating</b>			
Air quality	? – stakeholders perceive that the Project may impact the air quality, therefore the Project is reliant on the quality of air remaining constant throughout its lifetime in order to maintain the social license to operate	N	1



## ECOSYSTEM SERVICES ASSESSMENT

Ecosystem Service	1. Could this ES change in ways that will affect operational performance (Y/N/?)	2. Does the Project have viable alternatives to this ES (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Climate regulation	Y – the expected changes in climatic conditions over the lifetime of the Project could lead to a rise in Lake Albert’s water level, which would result in flooding of the flats, which could affect operational performance	Y – design and engineering mitigation measures take into account flood and climate modelling predictions	0
Water flows and timing	Y – Soils, wetlands and drainage lines influence the timing and magnitude of water runoff, flooding and aquifer recharge. The Project will affect wetlands and drainage lines which may cause flooding on the Buhuka Flats, which could affect operational performance	Y – engineering mitigation measures to manage surface and sub-surface flows in the construction and operation phases of the Project are considered sufficient to reduce potential impacts to negligible significance	0
Soil stability & erosion control	Y – predicted rise in the level of Lake Albert over the Project lifetime could lead to an increase in erosion of the shoreline, thereby reducing the width of the Flats and increasing flood likelihood. Vegetation removal for site clearance could also contribute	N – Engineered measures for the control of erosion arising from vegetation removal are considered sufficient to minimise the impacts of vegetation clearance. The Project, in compliance with the requirements of IFC Performance Standards 1 and 3, has undertaken predictive modelling to ensure that the Project’s operational performance will not be put at risk by rises in Lake Albert’s level	0
Water purification and waste treatment	Y - Nutrient assimilative capacity of the lake may reach thresholds, resulting in eutrophication	Y – Project incorporates a water treatment system which can be used as necessary	0
<b>Cultural</b>			
Recreation and ecotourism	N	n/a	0
Ethical and spiritual values	Y – the Project is reliant on the availability of this ES remaining constant throughout its lifetime in order to maintain its social license to operate	N – there are no alternatives to the presence of the Project in the landscape	1
Educational and inspirational	? – the Project could be reliant on the availability of this ES remaining constant throughout its lifetime in order to maintain its social license to operate	N – there are no alternatives to the presence of the Project in the landscape	1

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