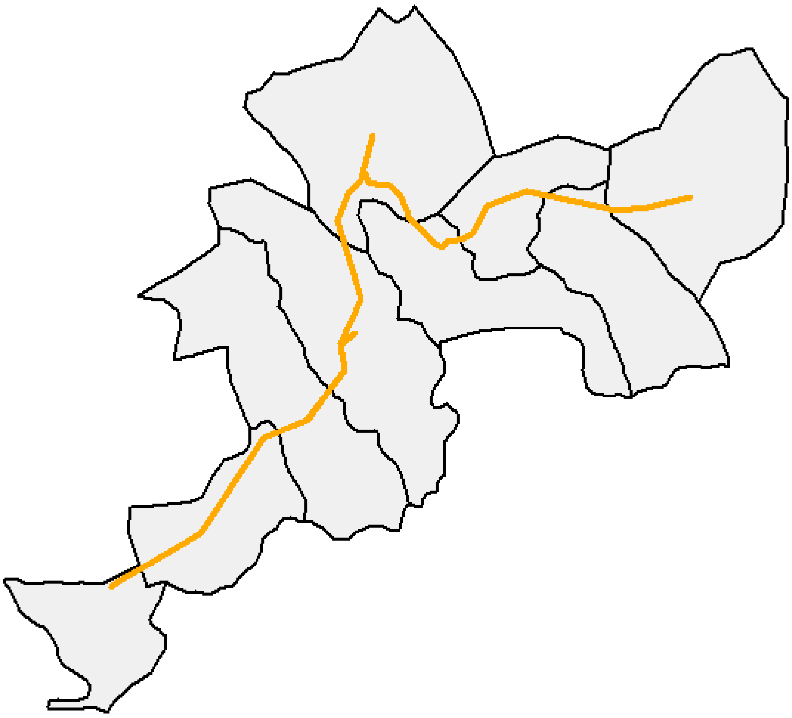

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE ELECTRIFICATION OF UIGE, ANGOLA – LOT 1, PHASE 1

Volume 1 – ESIA Report

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Volume 1 – Environmental and Social Impact Assessment Report

Volume 2 – Specialised Studies and Drawings

Volume 3 – Non-technical summary

Volume 4 – Meeting minutes and community surveys

Volume 5 – Environmental and Social Management Plans

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ACRONYMS AND ABBREVIATIONS

ADI - Area of Direct Influence, 2
AII - Area of Indirect Influence, 2
ALER - Associação Lusófona de Energias Renováveis, 16
CO - Carbon Monoxide, 74
DAA - Directly Affected Area, 2
dB - Decibel, 4
EHS - Environmental, Health and Safety, 39
ESIA - Environmental and Social Impact Assessment, 2
ENDE - Empresa Nacional de Distribuição de Electricidade (National Electricity Distribution Company), 18
ESMP - Environmental and Social Management Plan, 353
GHG - Greenhouse Gases, 6
HS - Hydroelectric Schemes, 134
IFC - International Finance Corporation, 3
ISCED - Instituto Superior de Ciências da Educação” (Higher Institute of Education Sciences), 148
ITCZ - Intertropical Convergence Zone, 80
LULUCF - Land Use, Land Use Change and Forestry, 94
LV - Low Voltage, 66
MDP - Municipal Director Plan, 55
NDP - National Development Plan, 56
NO - Nitrogen Monoxide, 153
NO_2 - Nitrogen Dioxide, 153
NO_X – Nitrogen Oxides, 153
NTG - Angola's National Transmission Grid, 17
NTN - National transport Network, 318
O_3 -Tropospheric Ozone, 148
OECD - Organisation for Economic Co-operation and Development, 3
PLANEAT - Plano Nacional Estratégico da Administração do Território (National Strategic Plan for Territorial Administration), 56
PM - Particullate Matter, 148
PM_{10} - Particulate matter with a diameter less than or equal to 10 µm, 148
$PM_{2.5}$ - Particulate matter with a diameter less than or equal to 2,5 µm, 148
PPE - Personal Protective Equipment, 335
SADC - Southern African Development Community, 56
SF6 - Sulphur hexafluoride, 255
SO_2 - Sulphur Dioxide, 74
SS - *Substations*, 51
SSC - Solar Home Systems, 19
VOCs - Volatile Organic Compounds, 74
WEI - Water Exploitation Index, 130
WHO - World Health Organisation, 148

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Executive summary

Project and ESIA framework

The current document corresponds to the Environmental and Social Impact Assessment (ESIA) of the Uíge Electrification Project - Lot 1, Phase 1, prepared by "Ambigest - Gestão Engenharia e Ambiente, S.A.", in collaboration with "NEMUS - Gestão e Requalificação Ambiental, Lda.", for Elecnor Servicios y Proyectos, S.A.U.

The Uíge Electrification Project - Lot 1, Phase 1, located in the Northern region of Angola, includes the extension of 2 substations (Uíge and Negage), the construction of 3 new substations (Aldeia Viçosa, Rio Dange, Puri), the execution of 230 km of transmission lines (110; 60 and 30 kV) and 5 000 home connections and public lighting. The operation of the line will be the responsibility of the Uíge Provincial Government.

Along its 230 km length, the project crosses several municipalities and communes of the Uíge Province, namely:

- Uíge Municipality, Uíge Commune;
- Negage Municipality, Kisseke, Negage and Dimuca Communes;
- Municipality of Puri, Puri Commune; and
- Quitexe Municipality, Quifuafua, Quitende and Quitexe Communes.

It also covers the Bengo Province partially, namely the Municipality of Dembos and the Kibaxe Commune.

The total estimated construction period of the project is 15 months, distributed as follows:

- Uíge- Aldeia Viçosa 110 kV transmission line - 452 days
- New substations (SS) of Puri, Dange River and Aldeia Viçosa, and expansion of the SS of Uíge and Negage - 452 days
- 60 kV Negage - Puri transmission line - 424 days
- 60 kV Aldeia Viçosa – Dange River transmission line - 250 days
- Aldeia Viçosa- Quitexe 30 kV transmission line - 221 days
- 30 kV transmission line to connect Negage to the villages of Cangundo, Piqui, Dambi and Calumbo to Quiongua - 265 days

It is planned to use an existing construction yard located on the main road of the Uíge airport, on the grounds of *Lar São José, Bairro Papelão Z-3*, in the city of Uíge.

The Environmental and Social Impact Assessment (ESIA) aims to analyse the project's potential interference in the biophysical and socio-economic environment and to propose measures to mitigate/potentiate impacts that will allow for a sustainable implementation. The ESIA also seeks to integrate the main concerns and issues raised in the public participation process regarding the effects of the project.

Prepared in accordance with Presidential Decree n. º 117/20 of 22nd of April, the ESIA comprises the:

- Characterisation of the current state of the environment;
- Identification and evaluation of the impacts and risks that may be generated directly and/or indirectly by the project;
- Indication of a set of measures to mitigate negative impacts and to enhance the positive impacts on the physical, ecological, cultural heritage and socio-economic environments.

In this context, a set of descriptors likely to be affected by the interventions of the project were analysed: climate and climate change; geology, geomorphology and topography (including natural disasters related to seismicity and slope instability); mineral resources; hydrogeology; surface water resources; soil and land use; environmental quality (including air quality and noise); ecology; socio-economics and human rights; and cultural heritage.

The ESIA focused on the areas potentially affected by the interventions and activities to be developed under the project, namely considering:

- Directly Affected Area (DAA) - corresponding to the project implementation area, including a marginal area where the effects of its presence and operation are directly felt;

- Area of Direct Influence (ADI) - corresponding to a 500 m buffer around the area directly affected by the project;

- Area of Indirect Influence (AII) - corresponding to a more extensive area defined to analyse the influence of the project, not directly, but through possible secondary effects that may result from it. The AII includes the area of all Communes crossed by the project.

Diversified approaches adapted to the scope of the analyses (including available bibliography and fieldwork) were adopted in the preparation of the ESIA, and the relevant Angolan legislation was considered. In a complementary manner, whenever justifiable, the Performance Standards of the International Finance Corporation (IFC) and the international guidelines of the World Bank, Organisation for Economic Co-operation and Development (OECD) and the Equator Principles were also considered.

Current environmental state

The project is located in a region classified as having a **tropical savannah climate**, characterized by average temperatures in the coldest month of more than 18 ºC. In Uíge, the average monthly air temperature varies between 20 ºC and 25 ºC. The summer months (from May to September) are particularly dry due to high temperatures and low precipitation values. The winter months (October to April) are characterised by high precipitation. The average annual precipitation between 2000 and 2021 was 1 443 mm.

In terms of **geology**, the project covers mainly Pre-Cambrian metasedimentary rocks (such as gneisses, schists, quartzites, migmatites and amphibolite), over which sedimentary rocks with ages ranging from the Mesozoic (Cretaceous) to the Tertiary are deposited, which outcrop in the extreme northeast.

Regarding **geomorphology**, the project covers 2 of the 11 geomorphological units in which Angola is subdivided: the Escarpment zone and the Congo Peneplain. The region presents a high **topography**, with approximately 84 % of the territory at more than 700 metres altitude. About 67 % of the study area has a gentle to undulating relief. Flat areas occupy approximately 24 % of the territory under study, while 10 % is moderately steep to steep (> 25 %).

In terms of natural disasters, Angola presents a moderate **seismic risk**. In the provinces covered by the project, the probability of potentially damaging earthquakes occurring in the next 50 years is low (only 2 %). In the provinces covered by the project, the predominance of gentle to undulating relief and flattened areas make the susceptibility to **slope instability** low to very low.

Angola has significant potential for **mineral resources**, most of which are related to the Pre-Cambrian subsoil. Nevertheless, in the area of direct influence of the project, no mining operations or quarries for the exploitation of geological resources has been identified.

Surface water resources are the main source of water for the population, and **groundwater** is used occasionally, since the predominance of Pre-Cambrian crystalline rocks do not favour the development of regional aquifers.

The project's area of influence covers the Dande, Northwest and Lower Kwanza and Cuango hydrographic units. Water uses comprise human supply, irrigation and livestock, with urban supply predominating, with the exception of the Dande Hydrographic Unit, where the main use of water is for irrigation.

Floods and flooding are frequent along the Kwanza and Dande rivers in Bengo province, downstream of the project. Due to the urban occupation of the banks, local flooding is also reported in the rainy season along the water lines in the municipality of Uíge. Episodes of **drought** are not frequent in the region. However, in 2008, in the province of Uíge, drought was responsible for affecting agricultural crops.

Umbric ferralsols, xanthic ferralsols and ferralic arenosols predominate in the region. Tree cover and grassland areas are the main **land use** classes.

The results of particulate matter monitoring indicate worse **air quality** in the urban context than in the rural areas (mostly covered by the project), due to the higher frequency and intensity of air pollutant sources such as vehicle circulation, biomass burning and the use of generators.

The **noise** monitoring carried out under the project shows that the local noise environment is affected by road traffic and people's daytime activities, in a more intense way in urban and peri-urban areas than in rural areas, compromising the well-being of the populations concentrated there. With the exception of one monitoring point, all noise levels recorded exceed the limit for residential areas during the day (55 dB(A)).

In terms of **ecology**, it should be noted that the area of direct influence of the project is located in a transition zone between the humid tropical forest region and the arid Zambezian region. The landscape is largely anthropized and is currently dominated by savannah vegetation. It is, however, interspersed with formations of greater complexity and ecological value such as the Quitexe coffee forests, gallery forests and wetlands.

The following table presents a summary of the habitats mapped in the study area and their respective size.

Habitat	IFC-PS6 Classification	ADI	
		Area (ha)	**Proportion of total (%)**
Artificial areas	Modified	500.8	2.45
Cultivated areas	Modified	5 376.11	26.29
Forests	Natural	6 013.93	29.41
Mosaic of scrubland/ wooded savannah and cultivated areas	Modified	1 888.39	9.24
Scrubland / Wooded savannah	Natural	4 334.86	21.20
Grasslands and herbaceous savannahs	Natural	2 124.24	10.39
Wetlands	Natural	209.35	1.02
	Total	**20 447.68**	**100**

It is worth highlighting the potential affectation of the Braun's bush-shrike (*Laniarius brauni*), an endemic species, endangered globally, and with a very restricted known distribution, which is crossed by the project.

In terms of **socio-economics and human rights**, the rurality of the Uíge province should be mentioned, where various agriculture, animal production, hunting, forestry and fishing companies are concentrated.

An estimated 28,4 thousand people live in the project's direct area of influence. Approximately 80 % of the households in the settlements affected by the project are socially vulnerable, as most are heavily dependent on the land for subsistence and income generation, and have low monetary incomes.

In Uíge province, only 17 % of the population has access to the public power grid and uses energy as a source of lighting.

Living standards in Angola, in general, and in rural areas, in particular (as is the case of the project's area of influence), are unsatisfactory, so that the right to an adequate standard of living (including access to health care, food and adequate housing), the right to education, and workers' rights are compromised and limited.

At present, the knowledge and systematisation of **cultural heritage** is still at an embryonic stage, although there is a public cultural policy theorisation for its protection, especially in academic circles, and there is awareness of its importance in the social and economic sphere. However, the lack of systematisation of the heritage reality makes its defence difficult. Near the corridor of the project, along the EN120, between Aldeia Viçosa and Quitexe, Lagoa do Feitiço stands out as a place identified as *intangible heritage*.

Main project impacts

The implementation of the project is expected to result in negative impacts on **climate and climate change** in the construction phase, related to fuel use in construction equipment, vehicles and the construction yard, which cumulatively cause greenhouse gas (GHG) emissions of low significance with other activities in the project's area of influence. Deforestation along the route of the transmission lines contributes to the reduction of carbon sinks, which although constituting a negative impact of moderate significance is mitigable to low significance with the afforestation of other area(s) with similar characteristics to the area affected by the project.

In the operation phase the project is expected to cause a positive impact of high significance with the reduction of GHG emissions associated with the supply of hydropower electricity, aligning strongly with the national commitment under the Paris Agreement and the mitigation initiatives of the National Climate Change Strategy 2018-2030.

The excavations and embankments required for the construction of the infrastructures are activities that interfere with **geology, geomorphology and topography**. The impacts resulting from local morphological changes and land balance are, in general, of low significance, being mitigable to negligible if leftover land is reused in the project area. No impacts are expected in the operation phase.

Impacts on **mineral resources** or **natural disasters** associated with seismicity and slope instability are not expected in any of the project implementation phases.

The project will have negative impacts of low significance on **hydrogeology**, particularly in the operation phase due to the reduction of the recharge area of small local aquifers due to local sealing of the land.

Negative impacts on **surface water resources** are expected to result with the implementation of the project, especially concentrated in the construction phase and related to deforestation activities, excavations and earth movement, operation of the construction yard and presence of workers and operation of construction vehicles and equipment. The main impacts refer to the increase in turbidity and total suspended solids in water lines, the potential contamination with faecal and organic matter and the risk of pollution of water lines with hydrocarbons and hazardous substances in accident situations, which may reach moderate significance, but can be minimised to low with the implementation of mitigating measures.

Excavations and the removal of vegetation along the lines during the construction phase leave **soils** exposed to erosion and possible quality problems following an accident with contaminating substance spills, giving rise to mitigable negative impacts of low significance.

The negative impacts on **land use** are mainly related to changes that will last throughout the life of the project, since new infrastructures will be built and, in the case of high-voltage transmission lines, crops will have to be removed and restrictions on land use will be permanent. These negative impacts are mitigable to low significance with appropriate compensation for loss of land and forest products and/or alternative access to land of equal productivity.

The expected impacts on **air quality** will result mostly from exhaust emissions from vehicles and equipment used in the construction works and from particulate and dust emissions from road traffic, especially on unpaved roads, earthworks and other construction activities. With the application of mitigation measures (including the Air Quality Monitoring Programme defined by Elecnor) the significance of negative impacts is reduced, particularly with regard to emissions of particulate matter and dust.

Also expected impacts on **noise** result from vehicles and equipment used in construction works, earthworks and other construction activities. Considering the application of mitigation measures (including the Noise Monitoring Programme defined by Elecnor), the significance of the impact of noise emissions is negligible to low. In the operation phase, the expected impacts of the project result from the noise generated by the operation of the substations and the electrical discharges from the transmission lines. The significance of these impacts varies with the current existence of infrastructure and proximity to inhabited areas.

It is in **ecology** that some of the main negative impacts are expected with the implementation of the project, namely regarding the disturbance of faunistic communities due to human presence and noise emissions and the elimination/loss of forest habitats during the construction phase, including forest vegetation of conservation relevance (where impacts are of moderate significance). In all other non-forest habitats, impacts are of low (savannahs and wetlands) to no significance (modified habitats).

It is important to note that in the transmission lines safeguard strips, not all vegetation will be removed, and that it will only be thinned or the largest tree cover removed. Overall, it is estimated that the loss resulting from the implementation of the project represents an increase of 0,03 % of the total area of deforestation to the annual average in Angola, a value that although low contributes to the intensification of fragmentation of vegetation of extreme relevance, in which any elimination effectively affects the processes and functions of the habitat.

Considering the type of lines, the negative impacts on forests may be more relevant in 110 kV lines, as wider corridors are required for the protection of structures and cables. In the remaining lines the impact will be smaller, which in the case of 30 kV lines may occur along corridors with widths that are estimated to be at most 10 m wide (5 m on each side of the line).

With the improvement of electricity distribution conditions, during the operation phase, there is likely to be an increase in human pressure on habitats (once again with particular emphasis on forests), with the intensification of their degradation/fragmentation/loss due to deforestation for cultivation and the exploitation of forest resources, but also the disturbance and deterioration of fauna populations (mammals and birds). In the case of fauna, it is also important to mention the potential affectation of mammals and birds in the forest south of Uíge due to increased risk of electrocution and collision, an impact that will be accompanied by a monitoring programme.

In terms of **socio-economics and human rights**, positive impacts are expected, albeit of limited significance, during the construction phase related to the creation of temporary job opportunities and the boosting of the regional economy. Negative impacts of moderate significance, which can be mitigated, are also expected during this phase, related to the safety and health of local communities and workers, increased transmission of diseases and temporary loss of livelihood due to occupation/impeded access to farmland.

During the operation phase positive impacts are expected to result mainly from local employment opportunities, improved living conditions due to the provision of electrical capacity and related benefits, increased community safety following mine clearance and street lighting, and benefits to local settlements from improved road infrastructure. The only negative impact in the operation phase will result from the permanent loss of livelihoods due to occupation/impeded access to farmland, with particular emphasis on seasonal crops, fruit trees and resources extracted from forest areas (firewood, charcoal and others) in the safeguard corridors of the 110 KV lines, with low significance expected with post-mitigation measures.

In terms of **cultural heritage**, no negative impacts are expected in the construction phase, with the Lagoa do Feitiço, the Quibaxe tombs and the traditional cemetery not being affected. However, potential interference with cultural heritage that is not currently inventoried and which may be identified during construction (for example traditional cemeteries) is a potential impact.

Impact mitigation measures

For a good environmental performance of the project, it is essential that in all phases of the project where negative impacts were identified, general and specific mitigation measures are implemented, but also measures to enhance positive impacts.

The general mitigation measures proposed in the ESIA are mainly related to the construction activities of the project, namely with the management of the construction yard, machinery operation, transport and execution of the works. Most of these measures correspond to recommendations on good environmental practices and on the strategy thought to be the best to guarantee the sustainable implementation of the construction work.

It should be noted that the project already provides for a set of mitigation measures and monitoring programmes of significant relevance in mitigating impacts, namely a Waste

Management Plan, a Noise Monitoring Programme and an Air Quality Monitoring Programme.

Due to their importance in mitigating negative impacts and enhancing positive impacts, the following specific mitigation measures proposed in the ESIA should be highlighted:

- In the detailed design phase of the project, under the responsibility of the design team, the following measures are proposed:
    - Whenever possible, in forest areas (humid and gallery) and wetlands, the **line must be constructed at least 50 metres away from the nearest dwellings** to mitigate noise
    - The line should be **as short as possible** to minimise the probability of bird collision and at the same time guarantee the safety of human populations
    - **Installing bird flares** to reduce the risk of bird collision in the most sensitive areas for birds of the Guinea-Congolese biome, and for Braun's petrel, *Laniarius brauni*
    - Whenever alternative locations for transmission lines and access roads are considered, **preference should be given to those furthest from water lines**
    - Drawing up a **plan to minimise damage to transmission towers** from the impacts of **climate change, such as floods, droughts and soil erosion**
    - **Drawing up a Procedural Guide** to be applied whenever cultural heritage is identified, especially graves
- In the construction phase, under the responsibility of the contractor, the following measures should be highlighted:
    - If there is surplus soil that cannot be reused in the project area, it is recommended for the materials to be **deposited in deactivated quarries or used in the recovery of degraded areas** in the project's surroundings
    - **Minimise the removal of vegetation cover from construction areas**

- To **avoid, whenever possible, the felling or affecting of individuals** of the following **species considered to be a priority for the conservation of biodiversity**: *Adansonia digitata; Albizia glaberrima; Antiaris toxicaria subsp. welwitschii; Autranella congolensis; Brachystegia spiciformis; Ceiba pentandra; Celtis mildbraedii; Chlorophora excelsa; Dalbergia latifolia; Diospyros mespiliformis; Entandrophragma angolensis; Entandrophragma utile; Gambeya africana; Gnetum africanum; Khaya anthoteca; Libidibia ferrea var. leiostachya; Pterocarpus angolensis; Ricinodendron heudelotii; Santalum album;*
- In forest areas, **work should be preceded by driving off the animals - by a specialized technician (biologist)**;
- In forest areas, after the initial scaring, in order to avoid causing injury or death to fauna, an **active search of the treetops should be carried out to detect less mobile or vulnerable animals** (injured, injured or juvenile animals) for rescue;
- **Implementation of a fauna monitoring programme;**
- **Implementation of actions to raise workers' awareness** of environmental conditions, cultural heritage, soil protection and prevention of pollution of surface water resources;
- **Prevent local communities from potential disturbance** to air quality and noise by recording all complaints for investigation and resolution;
- **Ensure the employment of workers from rural communes and the procurement of products and services** (water supply, waste management, catering, cleaning services, among others) wherever possible in the project municipalities;
- **Seal off access to traditional burial grounds and sacred forests** that may be identified during the works.

- In <u>the operation phase</u>, under the responsibility of the Uíge Provincial Government, the following measures stand out:

    - **Avoid, whenever possible, the felling or affecting of individuals** of the following **species** considered a **priority for the conservation of biodiversity**: *Adansonia digitata; Albizia glaberrima; Antiaris toxicaria subsp. welwitschii; Autranella congolensis; Brachystegia spiciformis; Ceiba pentandra; Celtis mildbraedii; Chlorophora excelsa; Dalbergia latifolia; Diospyros mespiliformis; Entandrophragma angolensis;*

Entandrophragma utile; Gambeya africana; Gnetum africanum; Khaya anthoteca; Libidibia ferrea var. leiostachya; Pterocarpus angolensis; Ricinodendron heudelotii; Santalum album

- **Reinforce the monitoring and maintenance of the line in areas of potential occurrence of primates** with special interest for biodiversity conservation - Cercopithecus mitis, Colobus angolensis, and Miopithecus talapoin -, i.e., in the forest areas to the south of Uíge
- **Economic compensation for the loss of income opportunities** from seasonal and permanent crops, as well as the loss of community resources such as firewood and charcoal collection
- Implementation of a **fauna monitoring programme to monitor the number of bird fatalities resulting from collisions or electrocutions** caused by the presence of the power line, as well as detecting new impacts or direct interactions with the presence of the project
- **Support for the rehabilitation of the public water supply systems** in the communes of Quitexe, Negage, Aldeia Viçosa and Puri, to minimise water leaks

1. Introduction

1.1. Identification of the project and the legal frameworks of thew AIA

The project and its environmental and social impact assessment (ESIA) legal framework are identified in the Table 1.

Table 1 – Project, proposer and address

Project	*"Electrificação de Uíge, Angola - Fase 1";* *"Uíge Electrification, Angola – Phase 1"*
Framework of Presidential Decree 117/20 of 22 April	Category B activity - Anex II: • 35. Energy: Transmission line and energy distribution above 66 kV
	Category C activity - Anex III: • 8. Energy: Transmission line and energy distribution below 66 kV

1.2. Identification of the proponent

The proponent and its address are identified in the following table.

Table 2 – Project, proponent and address

Project	Uíge Electrification, Angola – Lot 1, Phase 1
Proponent	Provincial Government of Uíge
Address	Largo do Governo Provincial, in Avenida Dr. António Agostinho Neto

1.3. Project Justification of the need and interest of the Project

The global objectives of the long-term strategy “Angola 2025” to promote human development and the well-being of Angolans, to promote equitable and sustainable development, to ensure a high rate of economic development and to develop the national territory harmoniously, are only possible through an **adequate response from the electricity sector** (Ministério da Energia e Águas, 2016).

The Angola Energy 2025 strategy. Long-Term Vision for the Electricity Sector (Ministério da Energia e Águas, 2016) assesses the main long-term options and establishes the atlas and vision of the Government of Angola for the development of the electricity sector in the 2018-2025 horizon identifying the priority investments in generation, transmission and interconnection, as well as the distribution and network expansion model until 2025 (Ministério da Energia e Águas, 2016).

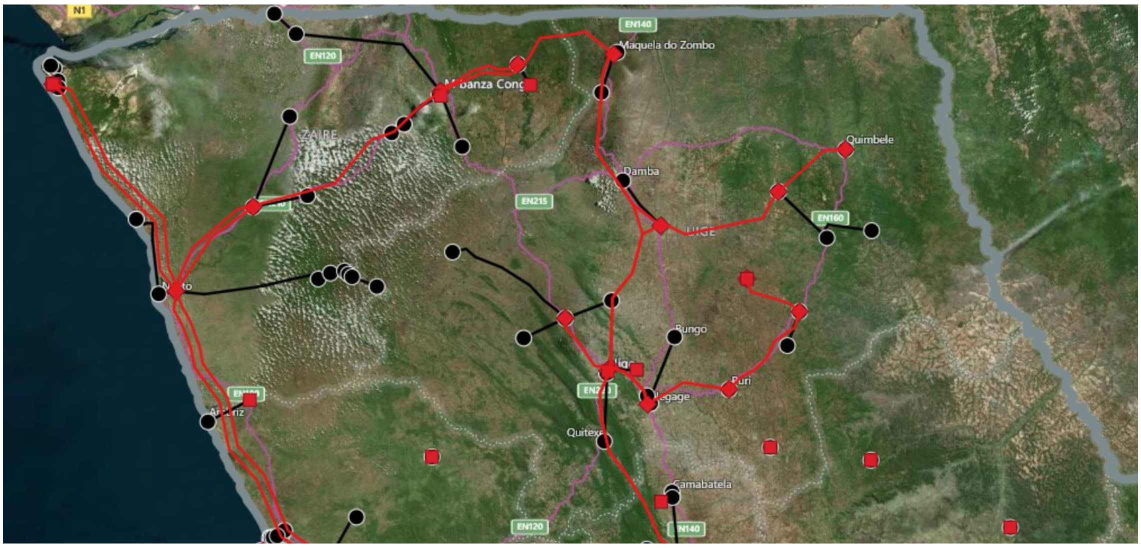
The **vision for the electricity system** in the 2025 horizon has as its starting point the satisfaction of the country's needs, and in view of the high needs and the time period available, the maximisation of well-being through ambitious targets and an efficient allocation of resources (Ministério da Energia e Águas, 2016), including, among others:

- A **strong growth in demand** which should reach 7,2 GW of load, increasing more than four times. This growth results from **providing electricity to 60 % of the population**, the **increase in residential consumption**, the **growth in national wealth** through services and the industrialisation of the country.
- **Electrification outside large urban areas** - the area of operation of the future Rural Electrification Agency - will focus on the goal of providing electricity to all the seats of municipalities and communes in the country. The network extension will be a priority and will allow reaching 5 % of the population and 173 locations.
- Demand will grow significantly through an **electrification process concentrated on provincial capitals, municipal headquarters** (where 97 % of the 3,7 million domestic customers will be in 2025) and on **communes’ headquarters** whenever economic and technical rationality allows. Priority will be given to extending the network to maximise the number of municipal and commune headquarters and to continue investing in structural projects in the interconnected network.

- The National Transportation Network will continue to grow after 2017 with the objective of **interconnecting all the provincial capitals**, taking the **electricity grid to more and more municipal and commune headquarters, maximising efficiency in generation** and **promoting the interconnection of Angola with the SADC Regional System**.

All investments foreseen in the vision are reflected in the territory, presenting the detailed Atlas of the sector in 2025 that allows the understanding of the territorial dimension of the vision and the possible impact in each Province, Municipality or Commune (Figure 1 and Figure 2).

The investments with the greatest impact on the country will be the hydroelectric plants, particularly with regularisation and the possibility of multiple purposes, biomass plants and electricity distribution (Ministério da Energia e Águas, 2016).

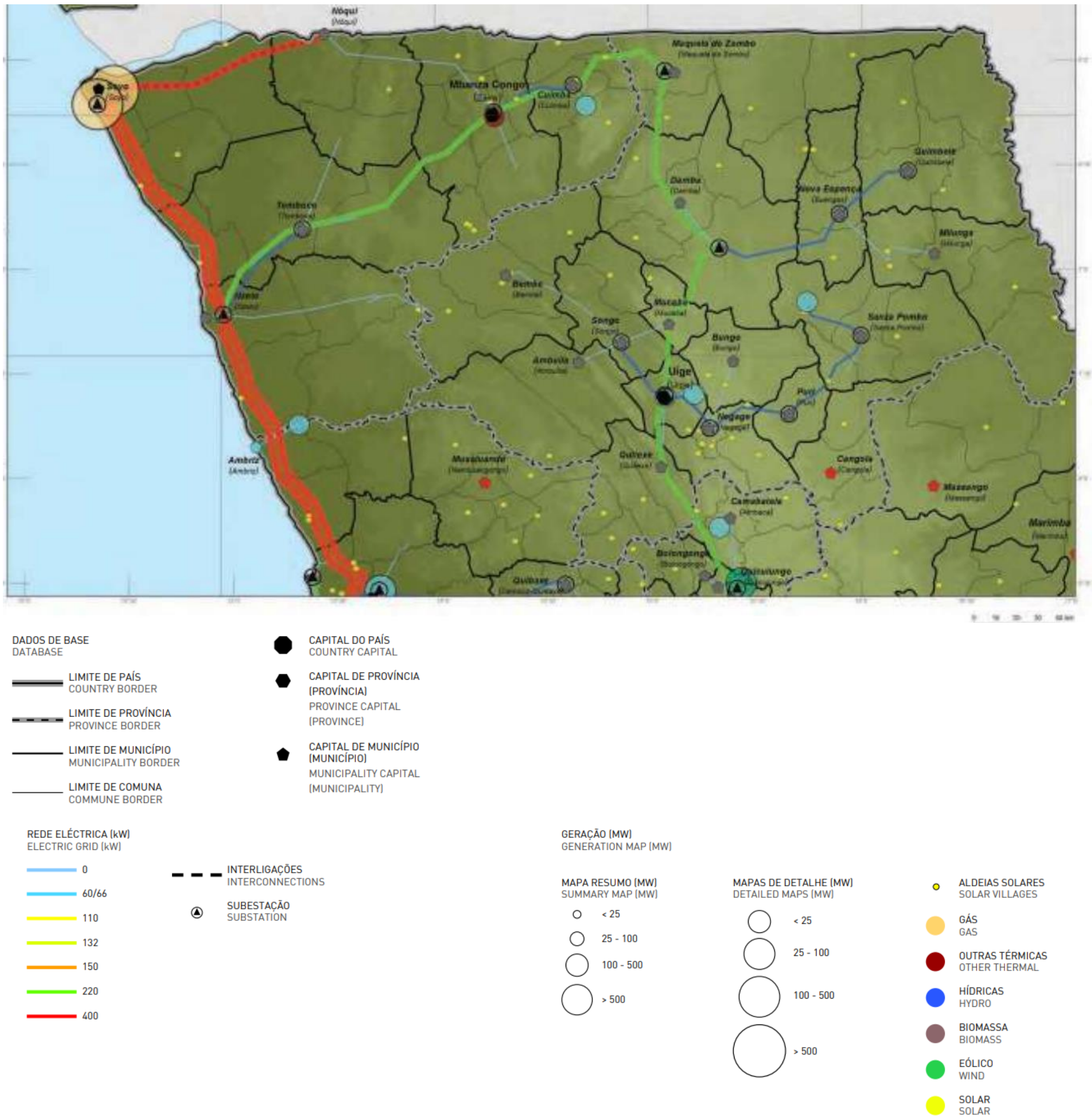


2025 Vision– Transmission lines
2025 Vision– Generation
2025 Vision– Substations

Electrified sites
Medium tension network

Source: adapted from https://angolaenergia2025.gestoenergy.com/mapviewer/#

Figure 1 – Vision 2025 Atlas, electrified sites and medium voltage network, for Uíge province



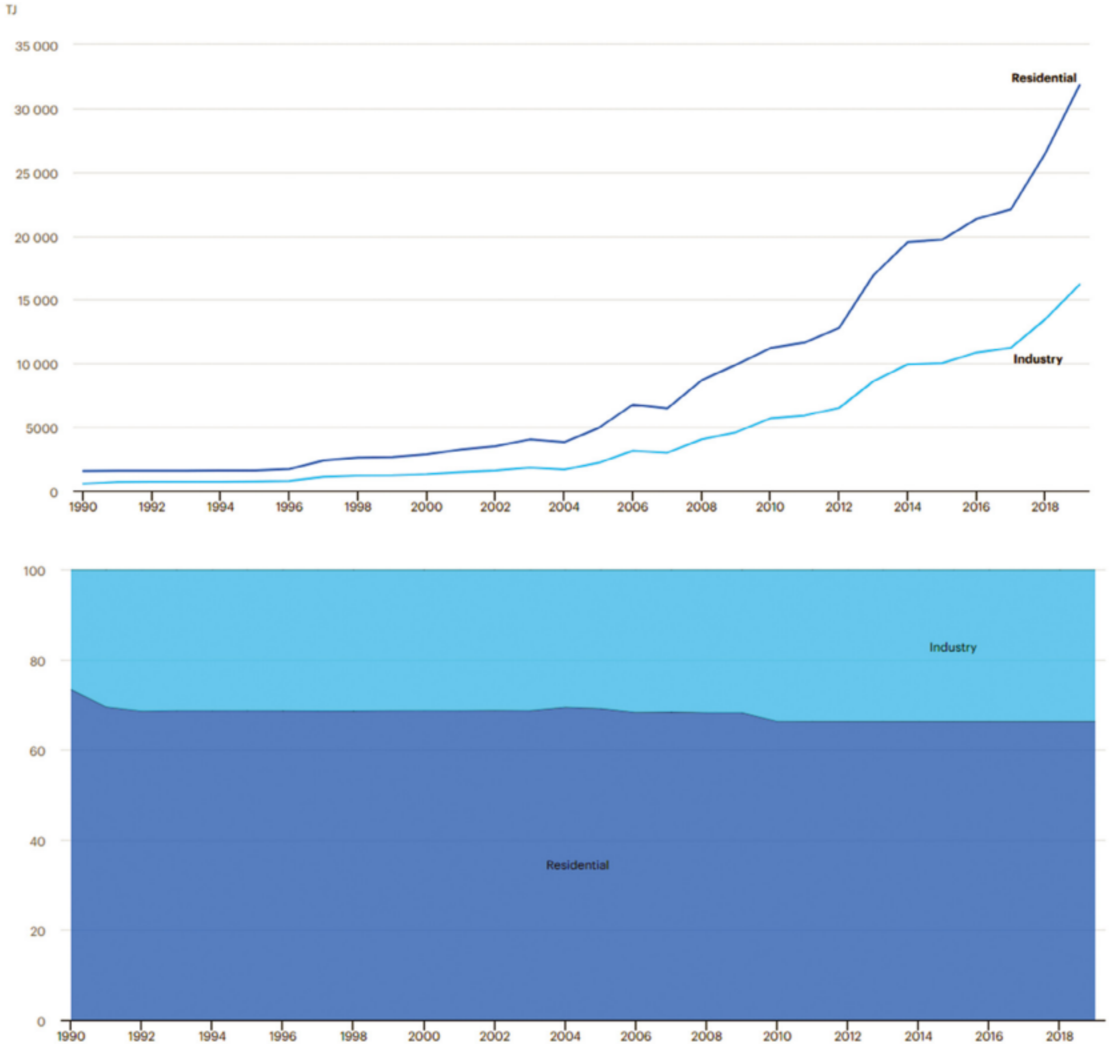
Source: adapted from (Ministério da Energia e Águas, 2016)

Figure 2 – Vision Energy Angola 20225

The study on renewable energies recently developed by the "Associação Lusófona de Energias Renováveis" - ALER (ALER, 2022) indicates a current electrification rate of 42%, so to achieve the goal of 60 % by 2025, strong investment will be needed in transmission networks, with interconnection between systems and extension of the distribution network being essential, along with the development of off-grid projects.

The current situation is characterized by a low level of electrification since little more than 42 % of Angolans have access to electricity, 37,8 % of which is connected to the national grid (ALER, 2022).

According to the same study, electricity consumption is divided into only two sectors: residential and industrial. As can be seen in Figure 3, between the years 1990-2019, the residential sector in Angola has always demonstrated a higher consumption of electricity than the industrial sector and its weight has remained relatively constant at 70 %.



Source: AIE, 2022 at *al*. (ALER, 2022)

Figure 3 – Change in total electricity consumption between 1990 and 2019, by sector, in Terajoules (top) and by % in total electricity consumed (bottom)

Angola's National Transmission Grid (NTG) is made up of four systems, with the Northern (where the province of Uíge is located) and Central Systems interconnected and the Southern and Eastern Systems independent, in an electricity park that extends over 5 235 kilometres (km) of transmission lines, with voltage levels of 400 kV, 220 kV, 150 kV, 132 kV and 110 kV. The northern grid has 400 kV, 220 kV and 110 kV lines

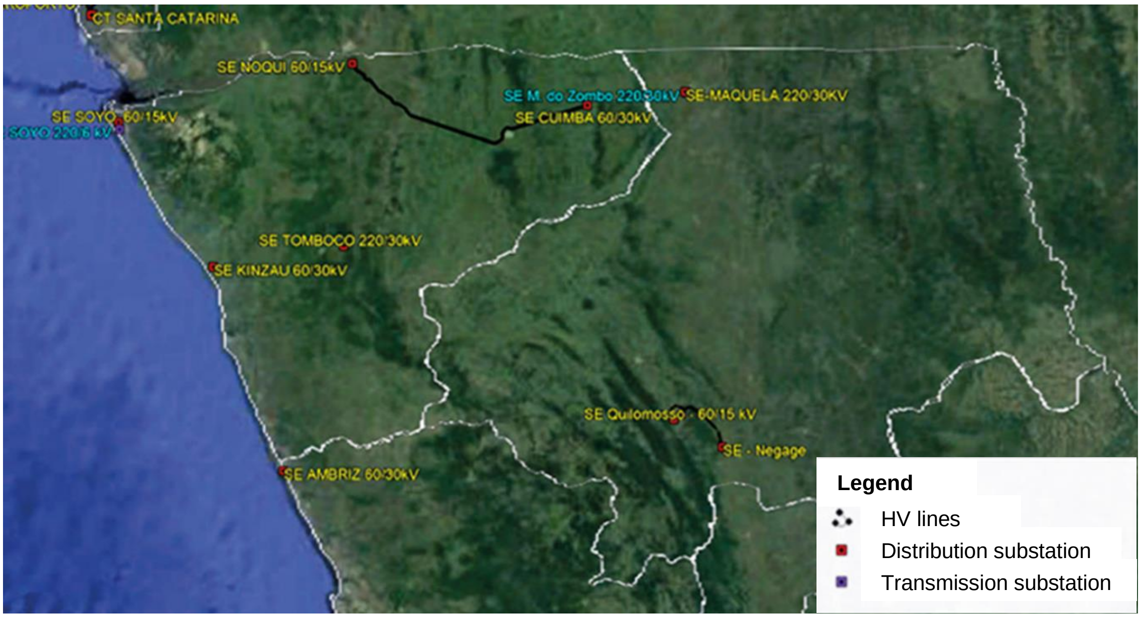
(ALER, 2022). The province of Uíge is crossed by a 220 kV line connected to the substations of Maquela do Zombo (to the north) and Uíge, also inland.

The National Electricity Distribution Network in Angola is operated by the "Empresa Nacional de Distribuição de Electricidade" (National Electricity Distribution Company) (ENDE), which over the last few years has directed all its commitment and resources towards pursuing the objectives and targets defined in the sector's Development Plan.

As a result, by 2022, more than ten million Angolans will benefit from access to the public electricity grid in 88 municipal centres, of which 55 are interconnected to the NTG, 28 by isolated systems provided by thermal, diesel or hybrid (thermal + solar) sources and five by the Namibian cross-border grid.

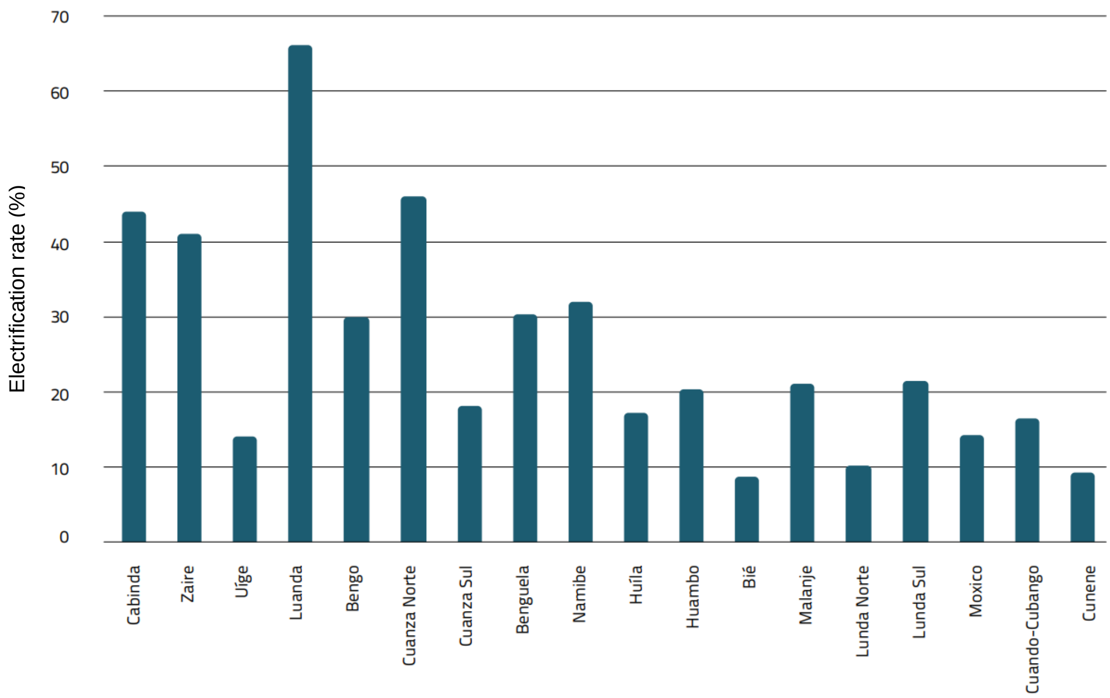
All these actions guarantee a national electrification rate of 41,83 % (ALER, 2022). The Uíge province has an electrification rate of around 14 % (Figure 5).

In the following figure, is presented maps of the assets of the national distribution system, according to the dominant high-voltage networks in the various regions.



Source: Adapted from ENDE, 2022 in (ALER, 2022)

Figure 4 - Distribution map of the distribution system assets in the Northern Region (partial)



Source: ENDE, 2022 in (ALER, 2022)

Figure 5 – Spatial distribution of electrification in Angola

As part of the World Bank's Angola Energy Sector Engagement programme, an analysis of the expansion of national electrification in Angola was carried out, according to which the target of 60% will only be reached in 2028.

The access expansion plan adverts the need for multiple options, densification of the existing network, expansion of existing infrastructure, development of mini-grids and initiation and expansion of Solar Home Systems (SSC).

Figure 6 provides a summary of this projected expansion to 2030.

Ligação Connection	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
População **Population**	6.908.769	7.129.565	7.357.493	7.592.786	7.835.685	8.086.438	8.345.303	8.612.544	8.888.436	9.173.263
Rede Nacional **National grid**	1.875.616	2.041.536	2.266.180	2.548.405	2.896.330	3.296.073	3.762.982	4.298.419	4.906.816	5.585.120
Sistemas solares caseiros **Solar Home Systems**	3.997	24.567	56.074	109.454	173.955	245.416	304.204	379.373	453.974	549.207
Mini-redes **Mini-grids**	0	0	162.828	278.669	391.441	486.871	509.900	567.158	682.827	930.732
Acesso total **Total access**	1.885.609	2,082.294	2.511.452	2.962.238	3.486.665	4.046.430	4.590.116	5.257.066	6.065.568	7.086.057
Rede nacional **National grid** (%)	27%	29%	31%	34%	37%	41%	45%	50%	55%	61%
Taxa de acesso **Access rate** (%)	28%	30%	34%	39%	44%	50%	55%	61%	68%	77%

Source: NRECA International, 2020 em (ALER, 2022)

Figure 6 - Projection of access to electrification by 2030 for Angola

1.4. Responsible team for the ESIA

Ambigest - Gestão Engenharia e Ambiente, SA is the company responsible for preparing the Environmental and Social Impact Assessment (ESIA) in collaboration with **NEMUS - Gestão e Requalificação Ambiental, Lda**.

The team responsible for the ESIA is a multidisciplinary team made up of the technicians indicated in the following table.

Table 3 – Technical team responsible for the ESIA

Name	Qualifications	Responsibilities
Pedro Bettencourt	Ph.D. in Sustainable Management Systems M.Sc. in Oceanography Bachelor in Geology	Project Director Team Leader / Environmental and Social Impact Assessment Specialist
Maria José Monteiro	Civil Engineer	Local ESIA coordination
Walter Neto	Civil Engineering Laboratory Technician	Field Officer: Socio-Economic Issues
Sónia Alcobia	M.Sc. in Applied Geology and Environment	Coordination Support Geology, Geomorphology, Topography. Mineral Resources and Hydrogeology. Natural Disasters
Claudia Fulgêncio	M.Sc. in Environmental Engineering; Quality Management	Environmental Engineering and Quality Management
Ângela Canas	Ph.D. in Environmental Engineering; M.Sc. in Environmental Engineering and Management; B.Sc. in Environmental Engineering	Surface water resources Climate and Climate Change
Celestino Chivela	Construction Technician / Construction Inspector	Field Officer; HSE Issues
Diogo Maia	Ph.D. in Development Studies; M.Sc. in Economy and Environmental Management; Bachelor. in Economics	Socioeconomics and human rights
Elisabete Teixeira	Post-graduation in Territory, Environment and Sustainable Development; Degree in Landscape Architecture	Legal and regulatory framework of reference
Gelson Neto	Geographical Engineer	Soils and Geographic Information Systems
Gisela Sousa	M.Sc. in Biology - specialising in Marine Animal Resources	Ecology

Name	Qualifications	Responsibilities
João Fernandes	Master in Environmental Engineering	Air Quality and Noise Geographic Information Systems
João Rodrigues	M.Sc. in Environmental Engineering	Climate and climate change
Joana Melo	M.Sc. in Economics - specialising in development economics	Socio-economy and human rights Description of the public participation process. Stakeholder engagement programme
João Pacheco	M.Sc. in Environmental Ecology	Legal and regulatory framework of reference
João Ramos	M.Sc. in Environmental Engineering	Air Quality and Noise Soil and Land Use
Maria Espírito Santo	M.Sc. in Conservation BSc in Biology	Ecology
Neto Sequeira	M.Sc. in Economics and Organisational Sociology; B.A. in Sociology	Socioeconomic
Renata Santos	Ph.D. in River Restoration and Management M.Sc. Environmental Engineering B.Sc in Engineering Sciences - Environmental Engineering	Soils and Land Use
Sofia de Melo Gomes	Postgraduate degree in Archaeology and Environment; Degree in History - Archaeology Variant	Cultural heritage. Project Description

1.5. General methodology of the ESIA

The methodology used in the ESIA followed the legislation applicable to the preparation of Environmental and Social Impact Assessments, i.e., Presidential Decree n. º 117/20 of 22 April.

The ESIA considered the following main components:

- Planning activities;
- Desk work;
- Field work and specialized studies;
- Preparation of the ESIA Report.

The activities corresponding to each of these components are described below.

1.5.1. Planning of activities

Aimed at understanding the specifics of the Project and clarifying issues related to it, the planning of activities included:

- Meetings between the team responsible for the ESIA, the design team, the proponent and the sponsors;
- Internal meetings of the team responsible for the ESIA;
- Planning of desk work, baseline studies, and specialised studies;
- Planning of the Public Consultation Process.

1.5.2. Desk work

It was conducted the collection and analysis of various different references on the project and the implementation area, namely maps, orthophoto maps and photographs, as necessary.

The information obtained this way allowed the description of the affected environment that was complemented with detailed field studies.

The work focused on the biophysical environment and the socio-economic environment, and they were examined according to the type of project and the region in which it is included:

- Climate and climate change;
- Geology, geomorphology and topography;
- Mineral resources;
- Hydrogeology;
- Surface water resources;

- Soils and land use;
- Environmental quality (including air quality and noise);
- Ecology;
- Socioeconomics and human rights;
- Cultural heritage.

An analysis of the legal and institutional framework of the project in the context of Angolan legislation was also carried out.

1.5.3. Fieldwork and specialised studies

The fieldwork allowed the specialists to have direct contact with the Project area and an approach with institutions, formal and informal authorities, social groups with specific interests and individuals for data collection.

Based on the information collected in the field, the specialists, in addition to consolidating the information on the study area obtained in documentary references, identified the potential impacts of the Project. The particular relevance of the specialised studies carried out in the fields of ecology and socio-economics stands out.

1.5.4. Preparation of the ESIA Report

The preparation of the ESIA report included the following main activities:

- Description of the affected environment and development prospects;
- Preliminary identification of environmental aspects, i.e., elements of the project likely to result in environmental impacts;
- Identification and analysis of the main potential impacts of the project;
- Classification of impacts based on pre-established criteria for this purpose;
- Formulation of measures to mitigate negative impacts and measures to promote/potentiate the positive impacts identified;
- Preparation of an Environmental Management Plan containing environmental management measures and monitoring of impacts;
- Compilation of technical and/or knowledge gaps;

- Formulation of conclusions and recommendations based on the results of the ESIA.

1.5.5. Identification and assessment of potential impacts of the project and its mitigation measures

To assess the significance of the environmental, social and heritage impacts associated with the project on and around the site the following steps are considered:

- Definition of the nature of the potential impact;
- Classification of the potential impact;
- Determination of the overall significance of the impact.

Definition of the nature of the potential impact

Each potential impact is identified by its main cause (the project activity or action) that results in an impact (change in the current conditions, either positive or negative) on a receptor (the environmental aspect that is affected). The terms to define the nature of an impact are presented in the table below.

Table 4 – Terms to define the nature of an impact.

Terms	Definition
Positive impact (benefit)	An impact that is considered an improvement over the baseline situation or introduces a positive change.
Negative impact	An impact that is considered an adverse change from the baseline situation or that introduces a new undesirable factor.
Direct impact	Impacts that result from a direct interaction between the planned project activity and the receiving environment/receptors (for example, between the occupation of a site and pre-existing habitats or between an effluent discharge and the quality of the receiving water).
Indirect impact	Impacts that result from other activities that are encouraged to take place because of the project (e.g., immigration for employment inducing a demand for resources).
Cumulative impact	Impacts that act in conjunction with other impacts (including those from competing or planned future activities of third parties) to affect the same resources and/or receptors as the project.

Classifying the potential impact

Each potential impact is ranked based on a set of criteria, including its spatial and temporal scales, intensity and likelihood. A scale is used for each criterion ranging from null or negligible impact to major impacts. The magnitude of the impact is a function of these criteria.

Table 5 – Criteria for impact classification

Magnitude of impact - the degree of change caused in the receptor	
Spatial scope	• On-site - impacts that are limited to within the boundaries of the site; • Local - impacts that affect an area within a 2km radius of the site; • Regional - impacts that affect regionally important resources or are experienced at a provincial or regional scale; • National - impacts that affect nationally important resources or affect an area that is nationally important/ or has macroeconomic consequences; • Transboundary/International - impacts that extend beyond the country's borders or affect internationally important resources.
Duration	• Temporary - impacts are predicted to be of short duration and intermittent/occasional; • Short-term - impacts that are predicted to last only during the construction period; • Long-term - impacts that will continue during the life of the Project but cease when the Project ceases to operate; • Permanent - impacts that cause a permanent change to the affected receptor or resource (e.g., removal or destruction of ecological habitat) that last substantially beyond the life of the Project.
Magnitude	Biophysical environment - the magnitude can be considered in terms of the sensitivity of the receptor • Negligible - the impact is not detectable • Low - the impact affects the environment in such a way that natural functions and processes are not affected; • Medium - where the affected environment is altered, but natural functions and processes continue, albeit in a modified form; • High - where natural functions or processes are altered in such a way that they cease temporarily or permanently.
	Socio-economic environment - magnitude can be considered in terms of the ability of the people/communities affected by the project to adapt to changes brought about by the project • Negligible - there is no noticeable change in people's livelihoods or health;

Magnitude of impact - the degree of change caused in the receptor	
	• Low - people/communities are able to adapt with relative ease and maintain livelihoods and pre-impact health; • Medium - Able to adapt with some difficulty and maintain pre-impact livelihoods and health, but only with a degree of support; • High - Affected people will not be able to adapt to changes and continue to maintain livelihoods and pre-impact health.
Probability of occurrence	
Unlikely	Impact is unlikely to occur.
Likely	Impact is likely to occur under most conditions.
Certain	The impact will occur.

Determination of overall significance

After determining the magnitude and likelihood, the figure below is used to determine the significance of the impact. An impact can be negative or positive, with the final significance rating being colour coded as visible below.

Negative	Significance	Positive
	Null or Negligible	
–	Low	+
–	Moderate	+
–	High	+

Figure 7– Colour codes for the classification of significance used in the impact assessment.

Table 6 – Criteria for impact significance

Significance criteria	
Negligible significance	*In an impact of negligible significance, the magnitude is negligible or low and the likelihood of the impact is unlikely, or the magnitude is negligible and the likelihood of the impact is likely or certain.*
Low significance	*In a low significance impact the magnitude of the impact is low, but the likelihood is likely or certain, or the magnitude is medium, but the likelihood of occurrence is unlikely.*
Moderate significance	*In a significant impact the magnitude is medium and the probability of the impact occurring is likely or certain, or the magnitude is high and the probability is unlikely.*
High Significance	*In a very significant impact, the magnitude of the impact is high and the likelihood of the impact occurring is also likely or certain.*

Subsequently, feasible and cost-effective measures and procedures are proposed to prevent, minimise, restore damaged areas, enhance and compensate any significant environmental and/or social impacts.

At the end, a final matrix (summary table) is drawn up with an overall assessment of the overall impacts of the different phases of the project.

1.6. Description of the public participation process (Uíge, Negage, Puri, Quitexe)

1.6.1. Description of the public participation process

The public consultation process aims to inform about the project and to ensure that the concerns and issues raised by Interested and Affected Parties (I&APs), organisations or individuals are taken into account during the ESIA procedure, both at the Environmental Pre-Feasibility Study and Scoping (EPDA) stage and at the ESIA stage.

Stakeholder participation aims to involve, inform and consult different stakeholders in planning, management and other decision-making activities.

The process encourages and provides opportunities for stakeholders to express their views, for governments and agencies to learn about the views of other stakeholders and to find opportunities to build bridges.

The participation of different stakeholders in such activities is a dynamic group process and should always encourage actions that build trust and credibility for the process and among the participants (UNEP, 2017).

According to IFC (2007), eight concepts and principles are fundamental:

- **Stakeholder identification and analysis** - identify and prioritise stakeholders and assess their interests and concerns;
- **Information dissemination** - communicate information to stakeholders early in the decision-making process in a meaningful and accessible way, and continue this communication throughout the life of the project;
- **Stakeholder consultation** - plan each consultation in an inclusive manner, document the process and communicate follow-up;
- **Negotiation and partnerships** - for contentious and complex issues, enter into good faith negotiations that satisfy the interests of all parties.
- **Complaints management** - establish accessible and responsive means for stakeholders to raise concerns and complaints;
- **Stakeholder engagement in project monitoring** involves affected stakeholders monitoring project impacts, mitigation and benefits, and external monitors where they can enhance credibility;
- **Stakeholder reporting** - reporting to stakeholders, both those consulted and those with wider interests in the project;
- **Management functions** - build and maintain sufficient capacity within the company to manage stakeholder engagement.

Based on the principles listed above, this ESIA stakeholder engagement plan will follow a four-step approach, as the one below in Figure 8.

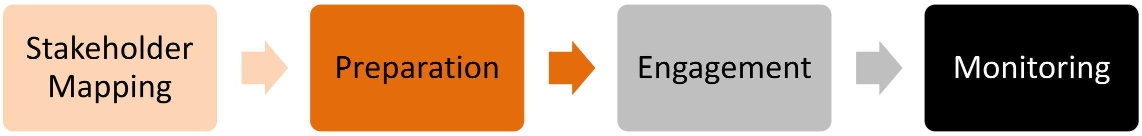


Figure 8 - Approach to stakeholder engagement plan

1.6.2. Stakeholder mapping

Stakeholder mapping is the first step in the stakeholder engagement plan. It involves identifying the relevant groups, organisations and people in relation to the project; understanding how stakeholders may affect (or be affected by) the project; examining their relationships and objectives; and prioritising stakeholders according to their relevance (BSR, 2012) (see Figure 9).

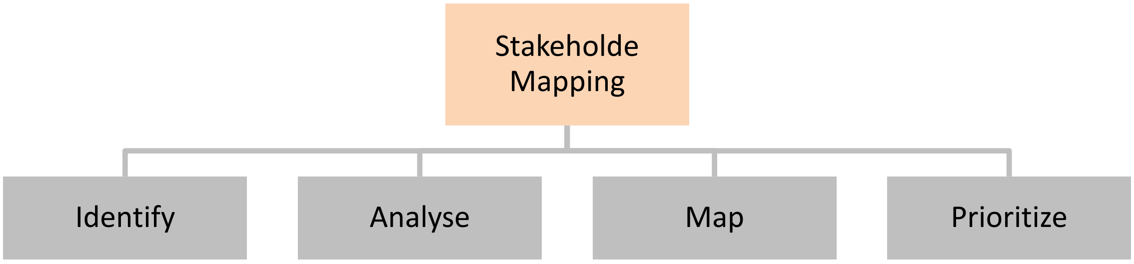


Figure 9 - Stakeholder mapping methodology

The identification of key stakeholders follows from the institutional analysis. Here, it is necessary to comprehensively identify institutions and groups, such as national, regional and local government structures, community associations, NGOs; locally based organisations, and research institutions.

Subsequently, it is important to carry out further analysis to better understand their relevance and the perspective they offer, in order to understand their relationship with the project.

Five criteria can be used in this task (BSR, 2012):

- **Contribution**: Does the stakeholder have information that could be useful?
- **Legitimacy**: How legitimate is the stakeholder's claim to involvement?
- **Willingness to engage**: To what extent is the stakeholder willing to engage?
- **Influence**: How much influence does the stakeholder have?
- **The need for involvement.**

Subsequently, mapping allows visualising the complex interplay of issues and relationships in order to gauge where stakeholders stand when assessed by the same key criteria and compared to each other.

Finally, it is important to select the most important stakeholders, as it is not practical to engage all stakeholder groups at the same level of intensity all the time.

Therefore, it is imperative to define strategies and be clear with “who to involve' and 'why”.

1.6.3. Preparation

The next phase of stakeholder involvement is the preparation phase which includes the groundwork for information dissemination and the construction of the consultation plan.

The dissemination of information should be done at an early stage of the process, with objective and meaningful data and ensuring accessibility to all. Communicating such information in a way that is understandable to stakeholders is crucial.

Perhaps one of the most important steps in the preparation phase is to create a stakeholder consultation plan. This task should indicate which stakeholders need to be included in any subsequent activities and how.

The consultation plan should be / include (IFC, 2007):

- **Objective**: consultations should be planned for the main stakeholders, considering the analysis carried out in the initial phase;
- **Requirements**: must comply with legal and regulatory requirements.
- **Stakeholders**: according to their issues and interests;
- **Priority issues**: key issues should be addressed with special attention (e.g., Monitoring and Evaluation Systems);
- **Techniques should be adapted to the issues and to each stakeholder involved**;
- **Responsibilities**: should be clearly defined (who is responsible for what).
- **Documentation: how consultations will be documented** (video, audio; paper records).

Another important issue is the differentiation of techniques, methods, approaches and calendars, according to the local situation and the type of stakeholder consulted. The geographical and regional context of the area and the accessibility of the chosen sites should also be considered.

In fact, there are several options for transmitting information, each with a different level of commitment:

- **Public hearings**: an open meeting of agents and citizens, in which citizens are allowed to offer comments.
- **Briefings**: Meetings where agents give information or data.
- **Round tables**: some stakeholders and agents gather for a conference and discussion.
- **Workshops**: seminar or series of meetings with interaction and exchange of information between a small number of stakeholders and agents.
- **Focus groups**: a meeting of deliberately selected stakeholders participating in a planned discussion on an issue/topic.
- **Web-based sessions**: communications between agents and stakeholders/citizens using social networks.
- **Surveys**: a standard form with questions to collect information about the opinions of stakeholders.

1.6.4. Engagement and monitoring

1.6.4.1. Engagement

The next stage of stakeholder involvement is the engagement phase, which includes the implementation of all activities prepared at the previous stage, including consultations.

At this stage, it is important to cooperate in good faith with the affected parties, leading them with an open mind and willingness to get involved in the process. This requires transparent consultations, taking into account the available time of the negotiating parties.

For consultations, it is crucial to document the process and its results and to inform stakeholders about what has happened and what the next steps will be.

1.6.4.2. Monitoring

At this stage, it is important to promote a participatory monitoring mechanism, including the physical presence of affected individuals when monitoring takes place and using significant methods and indicators for stakeholders through group discussions and participatory techniques.

1.7. Stakeholder engagement programme

This process covers only the planning phase before construction.

After analysing the main populations included in the study area and the key entities for this project, contacts were established with a field visit made in July 2022.

The ESIA is developed in three phases: phase 1 - work plan; phase 2 - initial phase and scope definition; phase 3 - detailed assessment of environmental and social impacts and risks.

Each of these phases has stakeholder engagement activities as presented in Table 7 and further specified in the following sections.

Table 7 - Stakeholder involvement during the ESIA

Phase	Activities	Stakeholder
Phase 1 - work plan	Kick-off meeting with project sponsors	Proposers Funder (UKEF)
	Launch meeting with local government	Municipal, county and lower-level authorities
Phase 2 - initial and scoping phase	Interviews with key informants	• Key ministries • Provincial authorities • Municipal and communal authorities • And government agencies
	Focus Group Discussions	At least five (one per municipality), with: • OC • Local NGOs

Phase	Activities	Stakeholder
		• Traditional authorities (soba) • Other community representatives (including vulnerable groups)
Phase 3 - detailed assessment of environmental and social impacts and risks	Public consultation	One per province (2 events), with all stakeholders listed

1.7.1. Phase 1 – Work plan

During the first phase of the ESIA (July 2022), project kick-off meetings were held with the project developer and the municipal and lower-level authorities. These kick-off meetings had the following objectives

- Establish first contact with local government entities to facilitate the next moments of engagement;
- Present the project and anticipate significant environmental and social impacts;
- Informing about upcoming phases and activities, including expected stakeholder engagement activities;
- Obtain feedback on key issues relating to project impacts.

1.7.2. Phase 2 - Initial and Scoping Phase

In this phase, primary data was collected from local populations, particularly through two activities:

- Key informant interviews;
- Focus group discussions.

1.7.2.1. Interviews with key informants

Interviews were conducted with key information advisors for the assessment of the project's impact on human rights. These information advisors include provincial authorities, municipal and commune authorities and government officials.

The following informants were consulted:

- **Quitexe municipal administration** - including a committee representing the municipality and a municipal police officer, on 12th July 2022;
- **Negage municipal administration** - including the deputy administrator, the office secretary and the Municipal Director for Energy and Water, on the 13th of July 2022;
- **Uíge municipal administration** - including the municipal administrator and the Municipal Director for Energy and Water, on the 13th July 2022;
- **Puri municipal administration** - including the office director and the infrastructure director, the 18th of July 2022;
- **Regedorias de Dambi, Piqui, Calumbo and Quiongua** - including a technician from the energy and water department of the municipal administration of Uíge, regedores and sobas, the 20th of July 2022.

Figure 10 – Interviews with key informants in Puri

1.7.2.2. Focus Group Discussions

The purpose of conducting community discussion groups - focus groups - is to collect qualitative information from a small group (e.g., 6 to 12 participants) in a systematic and structured format; participants interact with a facilitator who presents participants with questions designed to provide insight into current or desired outcomes in relation to a specific topic or problem (Watkins, Meiers, & Visser, 2012).

These community focus groups facilitated the assessment of the impacts of the project on local communities and the socio-economic environment.

In the context of this project, the focus groups talked about the positive impacts and how to maximise them, the negative impacts and how to minimise them, and how electrification may impact on economic activities in the region.

Six discussion groups were organised in the following locations:

- **Aldeia Viçosa** (Quitexe municipality) on 12th July 2022;
- **Cangundo** (Negage municipality) on 13th July 2022;
- **Kibunga Lau** (Púri municipality) on the 18th of July 2022;
- **Dambi and Piqui** (Uíge municipality), community discussion included traditional authorities on 20th July 2022;
- **Calumbo** (Úige municipality), community discussion included traditional authorities on 20th July 2022;
- **Quionga** (Uíge municipality), community discussion included traditional authorities on 20th July 2022.

It should be noted that the selection of participants for focus group discussions is very important. Thus, those from the affected communities should be chosen, if possible, on a random basis.

It is also proposed that a significant proportion of the participants should be women from the communities, to facilitate the collection of information from this target audience.

Source: Nemus, 2022

Figure 11– Discussion group at Kibunga Lau

Source: Nemus, 2022

Figure 12– Discussion group at Calumbo

1.7.3. Phase 3 – Detailed assessment of environmental and social impacts and risks

Dissemination of the ESIA will involve national, provincial and local stakeholders.

The ESIA disclosure process requires consultation with affected communities and stakeholders to ensure that their views and concerns are considered in the preparation of the final ESIA document. It is also necessary to ensure that they are informed about the activities and timing of the project.

Dissemination of the ESIA will be in a culturally and technically adapted manner to each stakeholder group. The presentation to local communities of the project activities and their associated impacts will be in non-technical language to ensure their full understanding

Stakeholder comments will be integrated into the ESIA, which will be adapted if necessary.

For the kick-off meetings to be held during phase 3, the following tools will be used: attendance sheet; presentation of key issues for discussion; event log sheet (to record the main occurrences and participations); photographic record.

The ESIA will be disseminated in advance (through municipal and provincial authorities), and the presentation will describe the main findings of the ESIA in a culturally and technically adapted way for each stakeholder group.

2. Legal and regulatory framework of reference

2.1. Introduction

This Chapter details the institutional and legislative framework with which the proposed project will comply, and the national (Angolan) laws considered relevant for the successful implementation of all environmental components of the proposed project.

Where local norms do not exist, applicable directives for international loaning organisations are taken into consideration, specifically those presented in the Performance Standards of the International Finance Corporation (IFC) on Environmental and Social Sustainability (2012), the IFC Environmental, Health and Safety (EHS) Guidelines and the applicable requirements of the Equator Principles (EP4, July 2020), principles 1 to 10, especially the requirements around human rights and climate change assessment [(Equator Principles Association, 2020a) (Equator Principles Association, 2020b)].

2.2. Brief political and administrative background

2.2.1. Brief political framework

In Angola, legislation is the main source of law. However, in many areas of the country, customary law still plays an important role. Since the new constitution was adopted in 2010, the Angolan political system is a presidential republic, in which the President of Angola is both Head of State and Head of Government, and a multiparty system. Executive power is exercised by the government and elections are held every five years. Legislative power is delegated to the President, the government and the parliament, which has 220 members, also elected every five years The Constitution defines environmental rights under the Article 39, stating that every citizen has the right to live in a healthy and unpolluted environment, and the duty to defend and preserve it.

Therefore, the State must adopt the necessary actions to protect the environment and the species of flora and fauna throughout the national territory, to maintain the ecological balance, to define the correct location of economic activities and to guarantee the rational use and exploitation of all natural resources, ensuring sustainable development and respecting future generations.

2.2.2. Administrative Division

Angola has a three-tier administrative structure, as follows:

- Province (provinces): administratively, Angola consists of 18 provinces, seven of which are along the coast. Each of these provinces is headed by a provincial governor;
- Municipality (município): Angola has a total of 164 municipalities; and
- Commune (comuna). The lowest administrative level is the commune. Angola has a total of 518 communes.

The provincial government has a special body (Provincial Council for Stakeholder Involvement and Social Coordination) that aims to provide support at provincial level in terms of discussion and decision making on relevant socio-economic policies for the province.

This council includes, among others, local authorities, religious institutions, the private sector, labour organisations, professional organisations, civil society representatives and a member of the Provincial Youth Council.

Each provincial level is headed by the provincial governor, the municipal administrator and the communal administrator. All of them are appointed by and accountable to the central government

2.2.3. National regulatory framework

The following table summarises the main national legal texts relevant to the Project.

Table 8 – National Legislation relevant to the project

General
Constitutional Court ruling n. º 111/2010 (30/01/2010) - Constitution of the Republic of Angola
Environmental management
Law n. º 5/98 (19/06/1998) - Environmental Framework Law
Decree n. º 59/07 (13/07/2007) - Environmental Licensing
Decree n. º 51/04 (23/07/2004) - About Environmental Impact Evaluation
Decree n. º 1/10 (13/01/2010) - Environmental Audit
Executive decree n. º 92/12 (01/03/2012) - Terms of Reference for the Development of Environmental Impact Studies
Biodiversity
Law n. º 6/17 - Forestry and Wildlife Law
Environmental Pollution
Presidential Decree n. º 194/11 (07/07/2011) - Liability for Environmental Damage
Health and security
Decree n. º 31/94 (05/31/94) - Occupational Hygiene and Safety System
Work
Law No. 7/15 (15/06/15) - General Labour Law
Waste management
Presidential Decree n. º 190/12 (12/08/2012) - Solid Waste Management
Presidential Decree n. º 160/14 (18/06/2014) - Medical Waste and Health Services
Energy
Law n. º 14-A/96 (31/05/1996) - General Law on Electricity
Decree n. º 47/01 (20/07/2001) - Regulation of Electricity Production
Decree n. º 41/04 (02/07/2004) - Regulation on Production Licensing
Water
Law n. º 6/02 (21/06/2002) - Water Law
Presidential Decree n. º 82/14 (12/04/2014) - Regulation on the General Rules for the Use of Water Resources
Presidential Decree n. º 261/11 (6/10/2011) - Regulation on Water Quality
Presidential Decree n. º 126/17 (13/06/2017) - National Water Plan
Presidential Decree n. º 83/14 (22/04/2014) - Regulation on Public Water Supply and Wastewater Sanitation
Soil use
Law n. º 9/04 (09/11/2004) - Land Law
Law n. º 3/04 (25/07/2004) - Law on Regional Planning and Urbanism
Decree n. º 58/07 of July 13, 2007 - General Regulation of Land Concession

Law n. º 2.030 of June 22, 1948 - Expropriation Law
Presidential Decree n. º 117/16 of May 30, 2016 for the Regulation of Resettlement Operations
Decree n. º 43,894 - Regulation for the Occupation and Concession of Land
Decree n. º 41/04 of 2 July 2004 - Regulation for Licensing and Safety of Electrical Installations
Decree n. º 46.847 of 1966 - Regulations for the Protection of High Voltage Transmission Lines
Cultural heritage
Law n. º 14/05 (07/10/2005) - Cultural Heritage Law

2.2.4. Relevant policies and plans

There are a number of relevant documents that are important for the development of energy projects in Angola, including:

- The **National Biodiversity Strategy and Action Plan** (NBSAP) approved through Resolution n. º 42/06 of 26 July 2006. This strategy incorporates measures for the conservation and sustainable use of biological diversity/resources into development policies and programmes.
- The **National Policy for Forests, Wildlife and Protected Areas** approved by Resolution no. 1/10 of 14 January focuses on four main axes, namely economic, social, institutional and environmental.
- The economic axis aims to promote the economic use and profitability of forests, the social axis advocates the establishment of mechanisms for the participation of local communities, the private sector and civil society in managing and sharing the benefits resulting from the sustainable exploitation and use of forests, while the institutional axis aims to establish institutional capacity building mechanisms to ensure efficiency, transparency, professionalism and trust in the fulfilment of the mandate related to the management of forest areas. The environmental axis aims to contribute to the conservation and protection of terrestrial biodiversity, with a view to national sustainable development.
- The **Strategic Plan for New Environmental Technologies** approved through Presidential Decree n.º 88/13 of 14 June 2013 focuses on its guiding and framework principles, axes and programmes, namely the

cross-cutting axis, including the promotion of environmental technologies, and incentives for investment in environmental technologies, and the sectoral axis, including the sectors of urban planning and construction, agriculture and forestry, and environmental technologies, in the sectors of industry, energy and water, petroleum and transport, and the implementation of the plan

Other plans that address issues specifically related to spatial planning will be discussed in the following section.

2.3. International treaties and conventions

Angola has signed and ratified several multilateral environmental and social agreements over the past 30 years.

A list of the multilateral environmental and social agreements that the Government of Angola has signed, acceded to or joined as a member, and which are relevant to the project analysed here, is presented in the following table.

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Table 9 – List of Multilateral Environmental Agreements Ratified by Angola

International Convention	Applicability to the Project
General	
CDAA Commercial protocol	The Protocol aims to further liberalise intra-regional trade by creating mutually beneficial trade arrangements, thereby improving investment and productivity in the region. It recommends that Member States remove barriers to trade, facilitate customs procedures, harmonise trade policies based on international standards, and prohibit unfair trading practices. The Protocol should be considered when developing the activities of the Project.
Environment	
Convention on the Conservation of Migratory Species of Wild Animals	This ESIA considered any potential impacts on migratory species.
United Nations Convention on Biological Diversity (CBD) (1992)	The CBD objectives have been considered in this ESIA.
Convention on Wetlands of International Importance especially Waterfowl Habitat (*Ramsar Convention*, 1971)	This ESIA has in consideration any potential wetlands.
CDAA Protocol on Wildlife Conservation and Law Enforcement (1999)	The principles and guidelines of the CDAA Protocol should be considered when developing plans and programmes for wildlife management.

International Convention	Applicability to the Project
Dangerous Substances	
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)	The objectives of the Rotterdam Convention should be/were considered when developing plans and programmes for the management of relevant hazardous chemicals and pesticides.
Waste	
Basel Convention on Hazardous Waste (1989)	If applicable, obtain the consent of the receiving country prior to the transboundary movement of hazardous waste.
Bamako Convention (1991)	Consider the contents of the Bamako Convention (as well as the Basel Convention, above) if any hazardous wastes (broadly defined) are to be moved across national borders.
Heritage	
The World Heritage Convention (1972)	By applying international standards (such as IFC Performance Standard 8) to any identification and management of cultural heritage aspects during project development, the developer will meet the objectives of the convention.

International Convention	Applicability to the Project
Work	
Abolition of Forced Labour Convention, 1957 (n. º 105)	Ensure that forced labour is prohibited and that human resources (HR) policies and procedures are developed and implemented to ensure this.
Minimum Age Convention, 1973 (n. º 138)	Ensure that employment policies include prohibitions on child labour and that such policies are followed.
Worst Forms of Child Labour Convention, 1999 (n. º 182)	Ensure that employment policies include prohibitions on child labour and that such policies are followed.
Freedom of Association and Protection of the Right to Organise Convention, 1948 (n. º 87)	Ensure that the Project recognises freedom of association and protection of the right to organise.
Discrimination (Employment and Occupation) Convention, 1958 (n. º 111)	Discrimination in the field of employment and occupation should be expressly prohibited.
Human rights	
International Convention on the Elimination of All Forms of Racial Discrimination: 1969	All racial discrimination in the workplace should be expressly prohibited.
Convention on the Elimination of All Forms of Discrimination against Women: 1981 (CEDAW)	Ensure that non-discrimination against women is preserved in HR policies and practices for the proposed project.
Convention Against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment: 1987	Torture in any workplace should be expressly prohibited.

International Convention	Applicability to the Project
Convention on the Rights of the Child: 1990	Ensure that employment policies include prohibitions on child labour.
International Covenant on Economic, Social and Cultural Rights 1976	Ensure that economic, social and cultural rights are respected in the proposed Project.
International Covenant on Civil and Political Rights 1976	Ensuring that civil and political rights are respected in the proposed Project.
All of the above in the context of Human Rights	When applying international principles such as Principle 2 of the Equator Principles (Environmental and Social Assessment) the ESIA includes an assessment of potential adverse human rights impacts, referring to the UN Guiding Principles on Business and Human Rights. This methodology ensures that the above conventions have been followed.
Climate change	
Paris Agreement under the United Nations Framework Convention on Climate Change.	Assessing emissions associated with the design, construction and operational phases of the Project and the climate transition risks associated with the Project. Proposing measures to reduce greenhouse gas emissions and, where necessary, retrofitting the Project to build resilience to climate change.
Vienna Convention for the Protection of the Ozone Layer (1985)	Implement appropriate measures to protect human health and the environment from adverse effects resulting or likely to result from human activities that may modify the ozone layer.

International Convention	Applicability to the Project
Energy	
CDAA protocol for energy	The Protocol aims to promote the harmonious development of national energy policies and matters of common interest for the balanced and equitable development of energy throughout the SADC Region. The Protocol should be considered when developing the Project activities.
Water	
Revised CDAA Protocol on Shared Watercourses	The Protocol stresses the importance of adopting a river basin-scale approach rather than emphasising the principle of territorial sovereignty. The Protocol also sets out specific objectives, including improving cooperation to promote the sustainable and coordinated management, protection and use of transboundary watercourses. The Protocol should be taken into account when developing project activities.
Forests	
Silviculture CDAA Protocol	The Protocol promotes the development, conservation, management and sustainable use of all types of forests and trees; the trade in forest products and the effective protection of the environment, and safeguards the interests of present and future generations. The Protocol shall be taken into account in the development of project activities.

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3. Project Description

3.1. Location and Geographical Setting

The Uíge Electrification Project is located in the Northern Region of Angola, in the Uíge Province and includes a small area of the Bengo Province (Figure 13).

The **project stretches about 230 km**, crossing several municipalities and communes of the **Uíge Province:**

- Uíge Municipality, Uíge Commune;
- Negage Municipality, Kisseke, Negage and Dimuca Communes;
- Municipality of Puri, Puri Commune; and
- Quitexe Municipality, Communes of Quifuafua, Quitende and Quitexe.

In the **Bengo Province** it includes:

- Dembos Municipality, Kibaxe Commune.

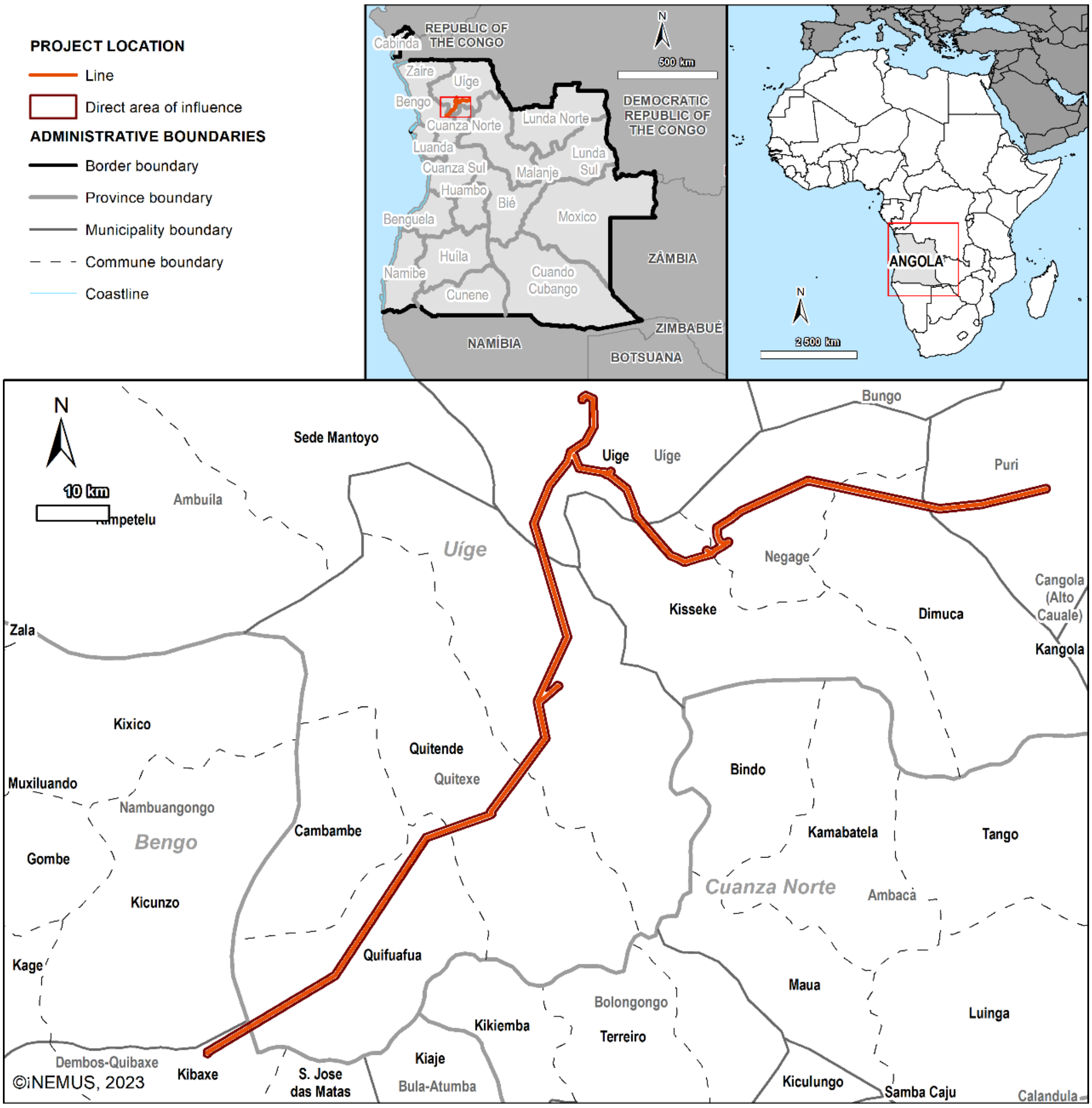


Figure 13 – Location of the Uíge Province Electrification Project - Lot 1, Phase 1

3.2. Implementation and general characteristics of the project

The project includes the **extension of 2 existing substations and the construction of 3 new ones**, the **construction of 230 km of transmission lines** (110; 60 and 30 kV) and **5 000 household connections and public lighting.**

The project includes the studies, design, manufacture, transport, insurance, construction, assembly, reception and test works of the following components (Electronor, 2021) - Table 10 and Figure 14:

Table 10 – Project components

	Designation	Specification
Substations (SS)		
New	SS of Aldeia Viçosa	110/60/30 kV (1x40 MVA)
	SS of Dange River	60/30 kV
	SS of Puri	60/30 kV
Expansion	SS of Uíge	2 x 60 kV line panels
	SS of Negage	2 x 110 kV line panels and 1 60 kV line panel
Transport Lines		
110 kV	Uíge - Aldeia Viçosa (55 km)	Single circuit with ACSR 326 mm^2 BEAR
60 kV	Aldeia Viçosa - Dange River (75 km)	Single circuit with ACSR 326 mm^2 BEAR
	Negage - Puri (55 km)	
30 kV	Aldeia Viçosa - Quitexe (15 km)	Single circuit with ACSR 157,92 mm^2 Partridge
	Interconnection between Negage and the villages of Cangundo, Piqui, Dambi, Calumbo and Quiongua (30 km)	
Household connections and public lighting		
-	Quitexe and adjoining villages	1 500 household connections
-	Aldeia Viçosa	500 household connections and public lighting
-	Cangundo, Piqui, Dambi, Calumbo and Quiongua villages	2 000 household connections
-	Puri and adjoining villages	1 000 household connections and public lighting

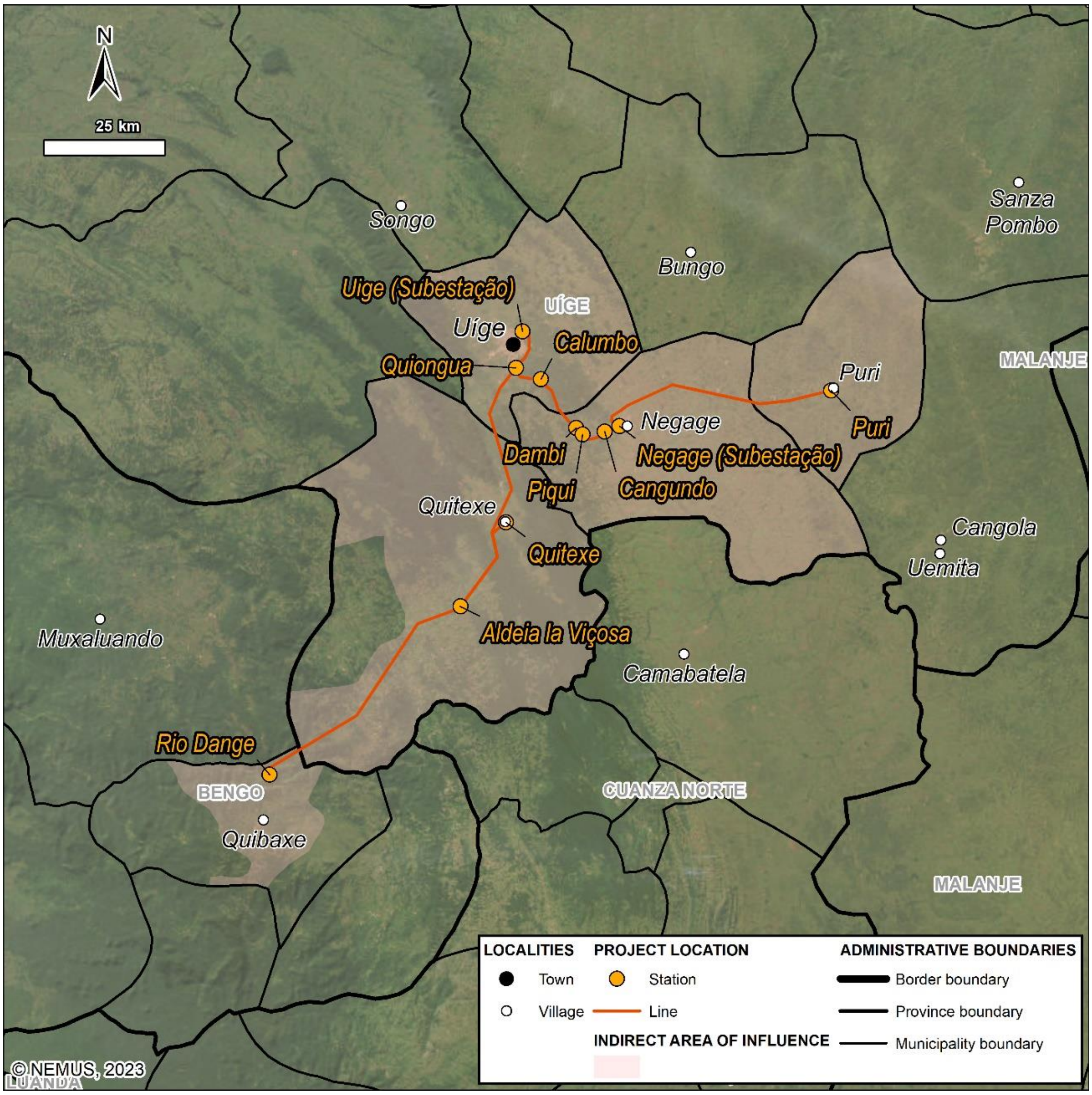


Figure 14 – Implementation and components of the Uíge Province Electrification Project - Lot 1, Phase 1

3.3. Framework of development policies and land use plans

3.3.1. Historical Context

After decolonization (1975), Angolan cities grew significantly and sometimes in a disorganized manner due to the dispersion of urban areas and the unbalanced growth of areas inhabited by refugees. There was a large population exodus during this phase, resulting in great pressure on existing infrastructure and equipment, a proliferation of informal neighbourhoods and settlements, traffic congestion, and the urban and aesthetic disqualification of the country's urban centres.

In the territory under analysis, the conflicts of the last decades of the XX century were a factor that caused the involuntary displacement of populations to the country's capital and to other safer urban areas, consequently causing urban disruption and chaos in the host locations.

After the end of the civil war in 2002, the accelerated process of urbanisation caused further urban disruption and several social, environmental and economic problems.

In the case of the province in general and the city of Uíge in particular, the urban structure reflects the historical evolution described (Almeida, 2013)The central core of the city of Uíge maintains the original colonial rectangular grid, with a more recent expanded urban network of less structuring and progressively less consolidated peripheral neighbourhoods.

3.3.2. Territorial Planning System

The Law on Spatial Planning and Urbanism, n. º 3/04 of 25 June 2004, establishes the territorial planning system, making it the State's responsibility to promote and guide spatial planning policies and to make them compatible with development policies.

This system is articulated through urban and rural spatial management instruments and associated policies. This law also regulates coordination with other instruments such as the general regime for defence, occupation and use of the soil, and establishes that the use of the soil must comply with the provisions of the municipal and special territorial plans that result from it.

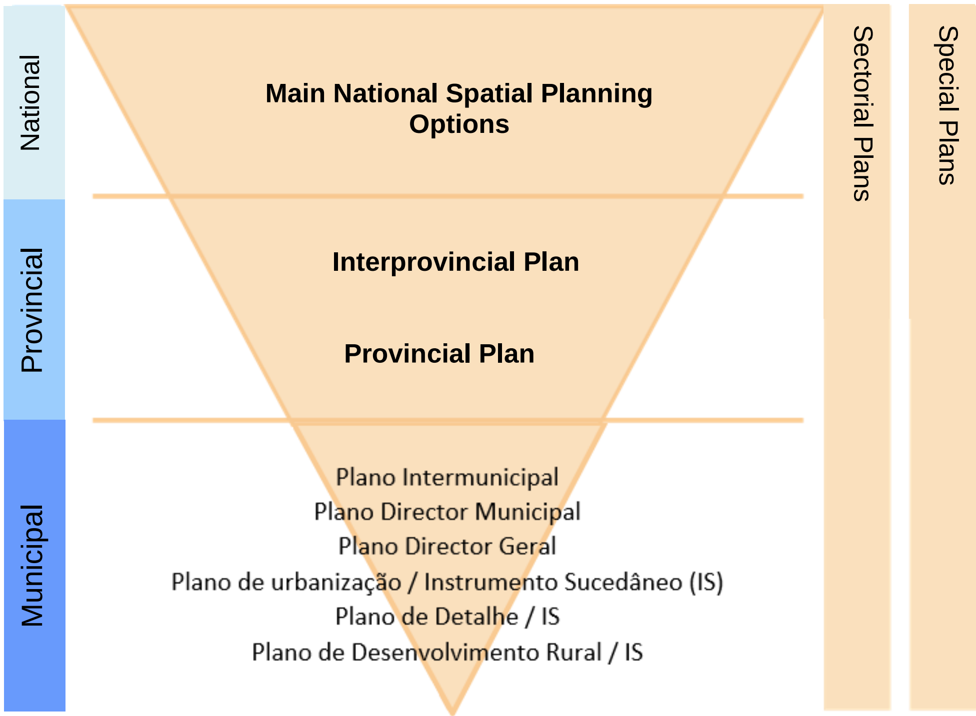
These instruments can be established by bodies at various levels, namely:

- Political bodies such as the National Assembly or the Government - through the Ministry of Urbanism and Housing and the Interministerial Commission for Spatial Planning and Urbanism;
- Participatory bodies such as national, provincial or municipal Consultative Commissions;
- Technical bodies at central, provincial or local level; and
- Local political-administrative bodies at provincial (provincial government) or local (municipal administration) level.

At central level, the implementation of public policies for the territorial planning and management process is articulated by the National Institute for Spatial Planning and Urbanism.

In an equivalent manner to the Territorial Planning bodies, territorial plans are articulated according to their scope at the level:

- National: they establish national spatial planning policies through instruments such as the Main Options for National Spatial Planning, National Policy for Spatial Planning and Urbanism or the National Development Plan 2018-2022;
- Provincial or interprovincial: instruments such as Provincial or Interprovincial Spatial Planning Plans define strategic options for the territory of one or several provinces, integrate the national planning level with local planning instruments;
- Municipal: plans that cover the territory at the scale of the municipality, and may extend to several municipalities, such as Municipal Master Plans, Intermunicipal Land Management Plans, Urbanisation Plans, Rural Land Management Plans, Detailed Plans and General Master Plans for large cities.



Source: Martins (2016)

Figure 15 – Organisation of the land planning system in Angola

3.3.3. Strategic Framework

General strategic instruments such as the National Development Plan or the National Strategic Plan for Territorial Administration, although they are not management plans, establish central guidelines for land use planning instruments.

The National Development Plan 2018-2022 (Governo de Angola, 2018) includes Axis 5: Harmonious Development of the Territory with the underlying policies of Territorial Development and Spatial Planning and Urbanism.

The priorities of harmonious development and creation of economically dynamic and competitive territories through strategic investments and coordination of sectoral actions in aspects such as energy for the development of the urban network stand out in the context of the project under evaluation.

The National Development Plan (NDP) establishes a set of general strategic guidelines that are then detailed at the provincial level.

The NDP's strategic bets for Bengo province focus on the strengthening of the existing productive, industrial and logistical capacities, given the province's integration in the concept of the Luanda Metropolitan Region, the country's capital.

For the interior of the province, where the study area is located, priority is given to investment in the road network and in basic infrastructure for water supply and sanitation, electricity, and social services.

The NDP foresees for the province of Uíge strategic investments in the area of agricultural and forestry productivity and commercial and industrial articulation, establishing investment priorities in housing, agricultural development, industrial promotion and development of economic, transport, school and health services and expansion of the electricity grid.

The National Strategic Plan for Territorial Administration 2015-2025 (Governo de Angola, 2015) defines a strategic vision that reflects the guiding principles of the then Ministry for Territorial Administration and establishes a set of programmes to achieve its strategic objectives, focused on strengthening territorial administration services.

The “Plano Nacional Estratégico da Administração do Território “ (National Strategic Plan for Territorial Administration) (PLANEAT) 2030 version is currently in force, a plan aligned with the updates to the country's strategic framework, namely the Angola Strategy 2025 and the National Development Programme 2013-2017 in the context of the Sustainable Development Goals 2030, the *Southern African Development Community* (SADC) Regional Indicative Plan and the African Union's Agenda 2063 (Portal de Angola, 2016).

The National Spatial Planning Status Report is presented by the line Ministry every two years to the National Assembly, and summarizes the main options for spatial planning and urbanism and analyses the causes and degrees of their implementation (Jornal de Angola, 2017). This portfolio is currently in the hands of the Ministry of Public Works and Territorial Planning (Governo de Angola, 2022).

These public instruments for planning urban growth have proven to be inadequate and incapable of solving the problems, which have worsened over time, reaching unsustainable dimensions for the affected populations. Therefore, there are no planning instruments available for the generality of the territory.

Decree n. º 2/06 of 23 January 2006 establishes the General Regulation for Territorial, Urban and Rural Plans, which defines the legal basis for the territorial planning system.

This system has as its general objectives the programming of the rational use of actual and potential resources of the physical space, and the coordination of territorial planning policies with economic, environmental and nature conservation, education and culture, social welfare and quality of life policies.

3.3.4. Planning Instruments

The state of planning in the Angolan territory is still relatively incipient (Chissola, 2015) (Martinho, 2021), having only been able to identify the existence of the following instruments in the area of indirect influence of the project under assessment, without information available in sufficient resolution and reading for a more detailed analysis:

- Ratified, only in Uíge province:
- Negage MDP: ratified by Presidential Dispatch n. º 175/21 of 22 October (Governo de Angola, 2021);
- MDP of Uíge: ratified by Presidential Dispatch no. 88/21 of 7 July (Governo de Angola, 2021).
- No information about:
- Bengo province:
  - Dembos-Quibaxe.
- Uíge Province:
  - Puri;
  - Quitexe.

In general, the approval of the MDPs for Uíge and Negage aimed to organise and plan the cities through the requalification of existing urban and road spaces (Wizi-Kongo, 2020).

Through their regulations, these plans establish the municipal territorial development strategy, the classification and qualification of the soil and the rules of occupation, use and transformation of the soil and rules relating to the programming and execution of interventions.

With regard to the project's theme, both MDPs refer to the category of Administrative Servitude and Restriction of Public Utility for electrical infrastructures, defining an adjacent strip of protection of 30 m for each side classified as a partial reserve under the terms of Law 9/04 of 9 November.

The territorial planning system also foresees the possibility of Rural Management Plans, but none have yet been documented in the study area.

3.4. Technological and location alternatives considered

3.4.1. Technological alternatives

No technological alternatives are considered.

3.4.2. Alternative locations for transmission lines and new substations

At present no project alternatives are being considered.

3.5. Characterisation of the project

3.5.1. New Substation of Aldeia Viçosa

The new 110/60/30 kV Substation, will include the supply, installation, testing and commissioning of an air-insulated substation. Table 11 provides the technical details of the new substation.

Table 11 - Characteristics of the new substation in Aldeia Viçosa

Zone	Details
110 kV zone	1 110/60/30 kV Transformer panel (1x40 MVA)
	1 Single busbar with bypass
	1 "Line" equipped switchgear
	1 Busbar triple-pole earth disconnector

Zone	Details
	3 Busbar Voltage Transformers
60 kV zone	1 single busbar with bypass
	1 Equipped "Line" switchgear
	1 Busbar earthing three-pole disconnector
	3 Busbar Voltage Transformers
30 kV zone	7 MV Cells at 30 kV
	1 Auxiliary Services Transformer (AST)
Technical buildings	1 Command Building (CB) including control panels and auxiliary services equipment
Auxiliary Services Network	1 SSAA transformer, 50 Hz, Vcc 4 %, DY connection
	1 Alternating current auxiliary services switchboard
	1 Direct current auxiliary service board
	1 Accumulator and accumulator charger
	1 Auxiliary services emergency generating set

3.5.2. New Rio Dange Substation

The construction of the new 60/30 kV Substation will include supply, installation, testing and commissioning of an air-insulated substation. Table 12 provides the technical details of the new substation.

Table 12 - Characteristics of the new substation in Rio Dange

Zone	Details
60 kV zone	1 60/30 kV Transformer panel (1x20 MVA)
	1 Single busbar with bypass
	1 equipped "Line" switchgear
	1 Busbar earthing three-pole disconnector
	3 Busbar Voltage Transformers
30 kV zone	7 30kV Medium Voltage Cells
	1 Auxiliary Services Transformer (AST)
	1 Three-phase 30/0,4 kV distribution transformer (11 kVA)
Technical buildings	1 Command Building (CC) including control panels and auxiliary services equipment
Auxiliary Services Network	1 SSAA transformer, 50 Hz, Vcc 4 %, DY connection
	1 Alternating current auxiliary services switchboard
	1 Direct current auxiliary service board

Zone	Details
	1 Accumulator and accumulator charger
	1 Auxiliary services emergency generating set

3.5.3. New Puri Substation

The construction of the new 60/30 kV Substation, will include the supply, installation, testing and commissioning of an air-insulated substation. The following table provides the technical details of the new substation.

Table 13 - Characteristics of the new substation in Puri

Zone	Details
60 kV zone	1 60/30 kV Transformer panel (1x20 MVA)
	1 Single busbar with bypass
	1 equipped "Line" switchgear
	1 Busbar earthing three-pole disconnector
	3 Busbar Voltage Transformers
30 kV zone	6 30kV Medium Voltage Cells
	1 Auxiliary Services Transformer (TSA)
Technical buildings	1 Command Building (CB) including control panels and auxiliary services equipment
Auxiliary Services Network	1 SSAA transformer, 50 Hz, Vcc 4 %, DY connection
	1 Alternating current auxiliary services switchboard
	1 Direct current auxiliary service board
	1 Accumulator and accumulator charger
	1 Auxiliary services emergency generating set

3.5.4. Control buildings and outdoor lighting in new substations

The substations of Aldeia Viçosa, Rio Dange and Puri will each be equipped with a control building.

Each control building will respond to an urban-industrial design of low visual impact based on a floor and technical floor. The building includes one (1) control room, protection and SSAA cabinets, one (1) 30 kV cell room, one (1) WC and one (1) warehouse. The maximum plant area does not exceed 200 m^2.

The control building will be equipped with a fire detection system, exterior CCTV and an anti-intrusion system.

It is also planned to build two (2) rooms to protect the auxiliary services transformer and the emergency generator.

The exterior lighting shall consist of permanent security lighting and functional work lighting. The lighting system shall take into account:

- environmental factors - energy saving, reduction of light pollution;
- human factors - safety of persons, functional needs during inspections or night works;
- technical factors - safety and maintenance of the equipment; and architectural integration.

3.5.5. Enlargement of Uíge and Negage Substations

The Uíge and Negage substations extension consists of the construction of 110 kV and 60 kV line panels, including supply, installation, testing and commissioning.

Table 14 - Characteristics of the changes in the Uíge and Negage SSs

Substation	Details
Uíge	2 x 110 kV line panels
	1 60 kV Line panel
	Installation of metallic structures, anchor bolts and structures for MV cable end boxes, etc.
	Installation of exterior work and circulation lighting.
Negage	2 x 60 kV Line panels
	Installation of metallic structures, anchor bolts and structures for MV end cable boxes, etc.
	Installation of outdoor working and traffic lighting.

Figure 16 – Current situation of the Uíge Electricity Substation

Figure 17 – Negage Substation Current Status

3.5.6. Transmission line

The project of 110 kV, 60 kV and 30 kV transmission lines and distribution networks, Lot 1, totals 230 km.

The general criteria of the project are presented in the following tables.

Table 15 - Characteristics of the 110 kV transmission line, Uíge - Aldeia Viçosa

Details	
Extension	55 km
Number of circuits	1
Number of phase conductors	1
Type of conductor	ACSR 326 mm^2 BEAR
Number of guard cables	1
Fibre guard cable	OPGW 48 FO
Type of structure	Metal lattice supports
Insulators	Tempered glass
Dampers	Stockbridge type
Earthing circuit	According to local characteristics
System details	
Nominal tension	110 kV
Maximum tension	123 kV
Frequency	50 Hz

Table 16 - Characteristics of the 60 kV transmission line, Aldeia Viçosa - Rio Dange and Negage - Puri

Details	
Aldeia Viçosa Extension - Rio Dange	75 km
Negage - Puri Extension	55 km
Number of circuits	1
Number of phase conductors	1
Type of conductor	ACSR BEAR
Fibber-guarded cable	OPGW 48 FO
Type of structure	Metal lattice supports
Insulators	Tempered glass
Foundations	Monoblock and four feet
System details	
Earthing system	Earth direct connection
Nominal voltage	60 kV
Maximum voltage	72,5 kV
Frequency	50 Hz

Table 17- Characteristics of the 30 kV transmission line, Aldeia Viçosa - Quitexe and Negage - Cangundo, Piqui, Dambi, Calumbo and Quiongua villages

Details	
Viçosa - Quitexe Village Extension	15 km
Negage - Cangundo, Piqui, Dambi, Calumbo and Quiongua villages extension	30 km
Number of circuits	1
Number of phase conductors	1
Type of conductor	ACSR PARTRIDGE
Type of structure	Metal lattice supports
Insulators	Tempered glass
Foundations	Monoblock
Earthing system	Direct earthing
System details	
Nominal voltage	30 kV
Maximum voltage	36 kV
Frequency	50 Hz

The transmission towers shall be composed by conventional latticed metal structures, composed by L-shaped profiles with guide flaps connected directly to each other or by plates and bolts (example in Figure 18).

The foundations of the reticulated supports will consist of four independent concrete blocks, step footing, prismatic chimney and steel reinforcement. The foundations of the line supports will be dimensioned to the other efforts that are communicated to them by the steel structure, considering all the combinations and actions.

The suspension and mooring structures will consist of column-span and pile-type foundations.

Figure 18 – Example of 110 kV transmission towers

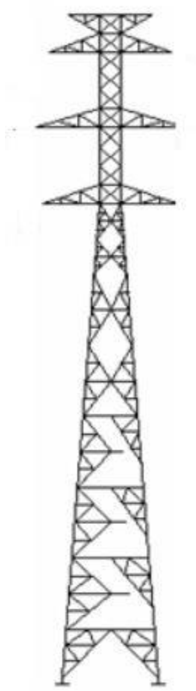


Figure 19 – Example of 60 kV transmission towers

All supports will be properly marked in a visible place on the ground with a "Danger of Death" sign, the support order number on the line and an identification plate with the name (abbreviation) of the line and telephone number of the responsible department.

To allow for aerial inspections, plates will also be placed on the top and each side of the supports with the support order number. This signage will be placed every 10 supports.

The beacons considered are white and red (or orange), to be placed alternately at GW and OPGW. The distance between the beacons should be between 30 m and 40 m.

The safety distances of the cables from the ground and from obstacles are in accordance with the technical specification ET -E-119-ed. A of MINEA, presented in the table below:

Table 18 – Cable safety distances

Obstacles	Distance (m)	
	110 kV line	60 kV line
Soil	9	8,5
Trees	4	4

Buildings	4	4
Roads	10	9,5
Electrified Railways	13,5*	13,5*
Railways non-electrified	10	9,5
Other overhead lines	3,7	3,5*
Miscellaneous obstacles	3,7	3,5

* Considering the crossing point to be 200 m from the nearest support

3.5.7. Distribution networks

Distribution networks are considered to be low voltage (LV) lines, public lighting, transformer stations and household connections. The distribution networks of the project are detailed below.

Table 19 – Distribution Network Detail

Distribution network	Details
Quitexe and adjoining villages	1 500 single-phase home connections
	24 km of LV network with 800 concrete posts (50 % with public lighting)
	5 overhead 250 KVA transformer stations 1 single-block transformer station of 400 kVA 1 single-block transformer station of 650 kVA
Negage and adjoining villages	2000 single-phase home connections
	32 km of LV network with 1 068 concrete posts (50 % with public lighting)
	4 overhead 250 kVA transformer stations 2 monoblock transformer station of 400 kVA 2 single-block transformer station of 650 kVA
Aldeia Viçosa	500 single-phase home connections
	8 km of LV network with 268 concrete posts (50 % with public lighting)
	3 overhead 250 kVA transformer stations
Puri and adjoining villages	1 000 single-phase connections
	16 km of LV network with 534 concrete posts (50 % with street lighting)

Distribution network	Details
	2 overhead 250 KVA transformer stations 1 monoblock transformer station of 400 kVA 1 single-block transformer station of 650 kVA

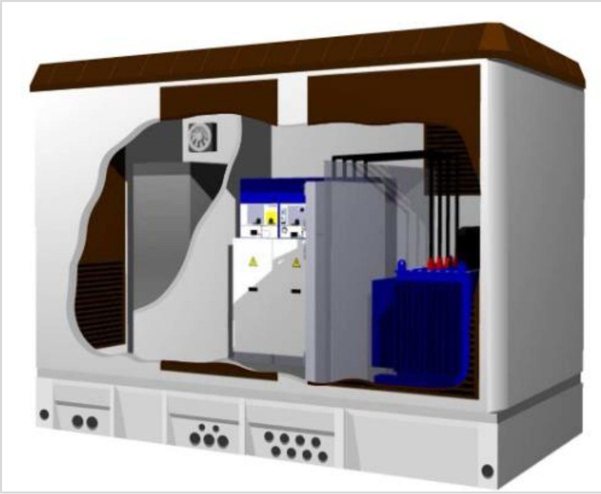
For the electricity supply a low voltage overhead distribution network is proposed, fed by a 400 V three-phase line from the transformation centres.

The domestic load will be 1 kW and other consumption associated with service buildings such as hospitals, schools, police stations, etc. will vary between 10 kV (e.g., school) and 18 kV (e.g., water tank). Street lighting from lampposts will have an independent 230 Volt circuit.

The 400 kVA and 630 kVA monoblock transformer stations are to be installed outside and have 3 individualized spaces, namely the medium voltage power station compartment (QMT), the power transformer compartment and the general low voltage power station (QGBT).

Aerial transformer substations are concrete pole mounted electrical installations that receive medium voltage power and distribute it in low voltage for end use.

The spacing between supports of the Medium Voltage line will be about 70 to 100 m, according to a typical situation.



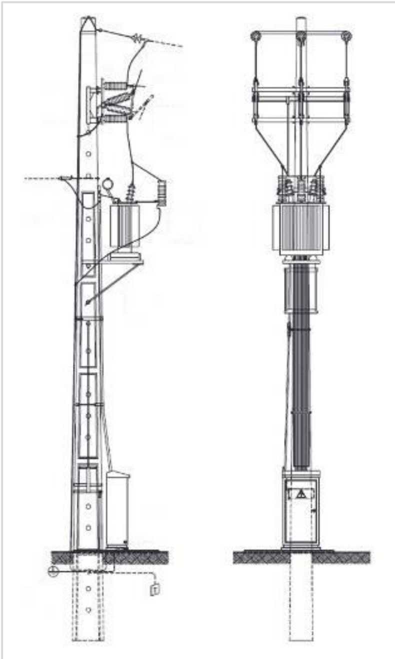


Figure 20 – Monoblock transformer station

Figure 21 – Aerial transformer

The single-phase meters proposed for the household connection are in accordance with the requirements of Ministry of Energy and Water (MINEA's) ET-E-405 and will be pre-payment meters. The boards are of the Ready Board type, to be installed coupled to the meter units.

Figure 22 – Ready Board type

3.6. Actions associated with the phases of the project

3.6.1. Staging of activities

The main activities included in the life cycle of the transmission lines and substations are described below, divided into phases: Detailed Project Design, Construction Phase, Operating Phase and Decommissioning.

The **detailed design phase** corresponds to the detailing of the specialities that make up the project,

In the **construction phase**, the main construction activities will be as follows

- **New Substations Vila Viçosa, Rio Dange and Puri**:
  - Moving, excavation and levelling of substation platform, in a maximum of 6 200 m^3 for each SS;
  - Deforestation of the substation areas, in a maximum of 3 300 m^2 for each substation;
  - Creation of a platform, to a maximum of 9 800 m^3 for each substation;
  - Landfill of the platform, to a maximum volume of 15 600 m^3 for each substation;
  - Digging and covering trenches for the execution of the earth network;
  - Placing the SS boundary fence, spreading a layer of gravel over the entire area of the SS, construction of all the massifs and structures to support equipment and cementing the 110/60/30 kV transformer;
  - Construction of an underground oil storage tank connected to the transformer foundations (to control oil losses to the outside);
  - Construction of the Command Building, including all structural works, water, sewage, electricity, roads and architectural finishes;
- **Substations of Uíge and Negage**:
  - Removal of existing gravel, storage and subsequent reuse;
  - Removal of the existing line posts in the area for extension and relocation of the same;
  - Making of trenches (opening and closing) for connecting equipment and metallic structure to the existing earth network;
  - Laying of a gravel layer in the entire area of the extended platform;
  - Construction of equipment support structures.

- **Aerial electricity distribution lines**:
  - Establishment of the protection strip;
  - Reconnaissance, signposting and opening access routes;
  - Deforestation;
  - Opening of the protection strip;
  - Topography works;
  - Implementation of the foundations, including:
    - Excavation of the hollows;
    - Construction of the foundation blocks and assembly of the bases;
  - Assembly of structures;
  - Laying the cables.

The **operation phase** will include, apart from the general operation of the network and the supply of electricity for public lighting and general consumption by economic activities, public services and the general population, regular maintenance of equipment, structures and also of the service and protection strip (thinning or occasional felling of trees that do not respect the minimum safety distance to the conductors and thus may pose a danger to the line and its constituents).

The **decommissioning phase** is not clearly defined in the project and is fraught with great uncertainty. Given the lack of concrete information for this phase, the scenario that will be assumed for the purposes of impact assessment corresponds to the cessation of activity, including the dismantling of associated infrastructure and equipment.

3.6.2. Machinery and Manpower

As regards the machinery to be used in the construction phase, in general terms, heavy equipment such as excavators, telescopic handlers, bulldozers and compactors will be used, as well as the usual light construction equipment.

It is also planned to use heavy transport vehicles to supply materials to the site and concrete mixers to supply concrete (foundations of the line supports), in addition to the usual light equipment for civil construction works.

As for labour, for the construction of household connections and street lighting, the average monthly estimate is 46 workers. The greatest labour needs occur between months 8 and 14, with a monthly need for 66 to 70 workers.

For the construction of the remaining equipment, it is estimated that there is an average monthly need of 124 workers. From month 5 onwards there is an increase in manpower, with an estimated 167 workers, with peak work being months 8 and 9 with 211 workers.

3.6.3. Schedule for the construction phase

The **total construction period (Lot 1) is estimated at 15 months**. The construction period for the various equipment, from the design phase to commissioning, is as follows:

- The 110 kV Uíge- Aldeia Viçosa transmission line - 452 days;
- New substations at Puri, Dange River and Aldeia Viçosa, and the expansion of the Uíge and Negage substations - 452 days;
- 60 kV Negage - Puri transmission line - 424 days;
- 60 kV Aldeia Viçosa - Rio Dange transmission line - 250 days;
- Aldeia Viçosa- Quitexe 30 kV transmission line - 221 days;
- 30 kV transmission line to connect Negage to the villages of Cangundo, Piqui, Dambi and Calumbo to Quiongua - 265 days.

3.7. Consumption, waste and emissions

This sub-chapter analyses the production of effluents, waste and emissions (noise, atmospheric emissions, etc.) during the construction and operation phases of the project.

It is considered that, in the case of the decommissioning of the project, the resulting environmental impacts will be generally the same as described for the construction phase, although duly adapted to the scale of the actions to be developed and the need for processing of the component materials.

3.7.1. Consumption

In the **construction phase**, in addition to construction materials and conductor cables, consumption of fossil fuels necessary for operation of construction site equipment and vehicles and access to the site, as well as electricity (used for lighting and operation of some equipment and the construction yard) and water (supply for human consumption, washing and concrete production) are expected.

The data presented in the following table are dimensioned to the general electrification project of Uíge:

Table 20 – Consumption forecasts

Consumption	SGR	SGE	Total
Diesel Fuel	51 038	12 404	63 442 (L)
Petrol Fuel	376 (L)	202 (L)	578 (L)
Electricity	4 487 (kWh)	2 181 (kWh)	6 668 (kWh)
Water	35	268	303 (m^3)
Paper	27 (kg)	34 (kg)	61 (kg)
Waste RP+RNP*	1 769 (kg)	3 597 (kg)	5 366 (Kg)

*RP+RNP: Hazardous waste and non-hazardous waste

In the **operation phase**, periodic maintenance actions will have the same type of consumption, but in much smaller quantities.

3.7.2. Wastes

During the **construction phase**, the largest quantities of **waste** are expected to be deforestation products and surplus soil resulting from the installation of the line supports. Both components should be disposed of in an environmentally correct way, and burning of waste is forbidden.

The construction yard must have a temporary waste storage area, equipped with properly identified and prepared containers for storing each type of waste, including waterproofing and establishing retention basins under containers for storing hazardous waste or fluids, if necessary.

The main liquid effluents concern the wastewater coming from the sanitary and social facilities of the construction yard and from the maintenance of the motor vehicles and generators. The residual liquids will be transported to Elecnor's construction yard in Viana, where they will be later collected by a company certified for the management of this type of waste.

In order to guarantee environmental sustainability, measures will be adopted to protect the drainage systems for liquid effluents and rainwater, as well as minimizing the production of liquid effluents, these being:

- Periodic control of water consumption, in order to prevent, identify and correct any leaks, losses or poor use of water;
- Waste from chemical products (solvents and concentrated detergents) shall not be discharged into the sewage or storm water networks of the region.

In order to protect the environment and comply with the requirements of current legislation on waste management (Presidential Decree no. 190/12 of 24 August), Elecnor has drawn up a Waste Management Plan for the Uíge Electrification Project, Phase I - Lot 1. This Plan is based on the principles of waste minimisation at source, pointing out and describing the actions relating to management, including aspects relating to the reduction of waste production, reuse, segregation and internal packaging.

In the **operation phase**, only the materials left over from the periodic cleaning of the protection strip and the repair/replacement of supports, cables and other equipment are marked.

3.7.3. Atmospheric emissions

The estimation of atmospheric emissions is a complex process that depends on a multitude of factors of high variability, such as activity levels, weather conditions (e.g., humidity and wind) and the type and condition of vehicles and equipment to be used.

During the **construction and decommissioning phases**, dust emissions are expected, associated with earthmoving and other activities to be carried out during the project. In addition to these, emissions of pollutants associated with the combustion engines of the equipment and vehicles that will be directly or indirectly involved in the construction work are also expected.

The suspension of dust is a typical impact of civil construction works. In the case of this contract, dust emissions will be associated with the excavation of trenches, the preparation of the bases for laying the pipework, the laying of pavements, as well as the movement of vehicles and machinery assigned to the work.

There will be gas emissions resulting from the operation of combustion engines, associated with the circulation of heavy and light vehicles and equipment - machinery assigned to the work, resulting from the burning of fuel. The common gases are carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NOx), volatile organic compounds (VOCs), particles and black smoke.

The data presented in the table below are based on the Uíge general electrification project.

Table 21– Prevision of CO_2 emissions

Source	kg	Ton
Fuel Diesel	389 342	389
Fuel Gasoline	2 993	3

During the **operation phase**, no direct emissions are emitted into the atmosphere.

3.7.4. Noise and vibration sources

In the **construction phase**, the main noise and vibration emissions should arise from:

- Operation of the construction yard and work front;
- Movement and operation of machinery necessary for the execution of the planned work;
- Traffic of heavy vehicles transporting materials with origin and/or destination in the project's area of intervention.

The potential levels of noise and vibration generation from construction activities will be closely related to the construction method, type and number of machineries used.

Table 22 presents the average sound levels generated by different types of machinery normally used in construction works. As such, it is expected that the equipment used in the construction phase of this project will present noise generation levels similar to those described

Table 22 – Average sound levels at source produced by different types of machinery and equipment commonly used in construction works

Operation/Equipment		Noise Level dB(A) at 15 m									
		60	65	70	75	80	85	90	95	100	105
Land movements	Compactors										
	Loaders										
	Backhoe Loaders										
	Tractors										
	Graders										
	Asphalt Pavers										
	Trucks										
Transport of materials	Excavators										
	Mobile Cranes										
	Tower Cranes										
Stationary equipment	Pumps										
	Generators										
	Compressors										
Impact machinery	Demol. hammers										
	Hammers Drills										
Others	Vibrators										
	Saws										

Source: Adapted from Sociedad Española de Acústica (1991)

Elecnor, within the scope of the project implementation, has defined a Noise Monitoring Programme, which is presented in section 8.3.1.

During the **operation phase**, noise may be emitted due to the wind action on the lines, the corona effect and the operation of the transformation units in the substations.

3.8. Construction yard

It is planned to use the existing construction yard located on the main road to Uíge airport, on the grounds of the “Lar São José”, “Bairro Papelão” Z-3, in the city of Uíge.

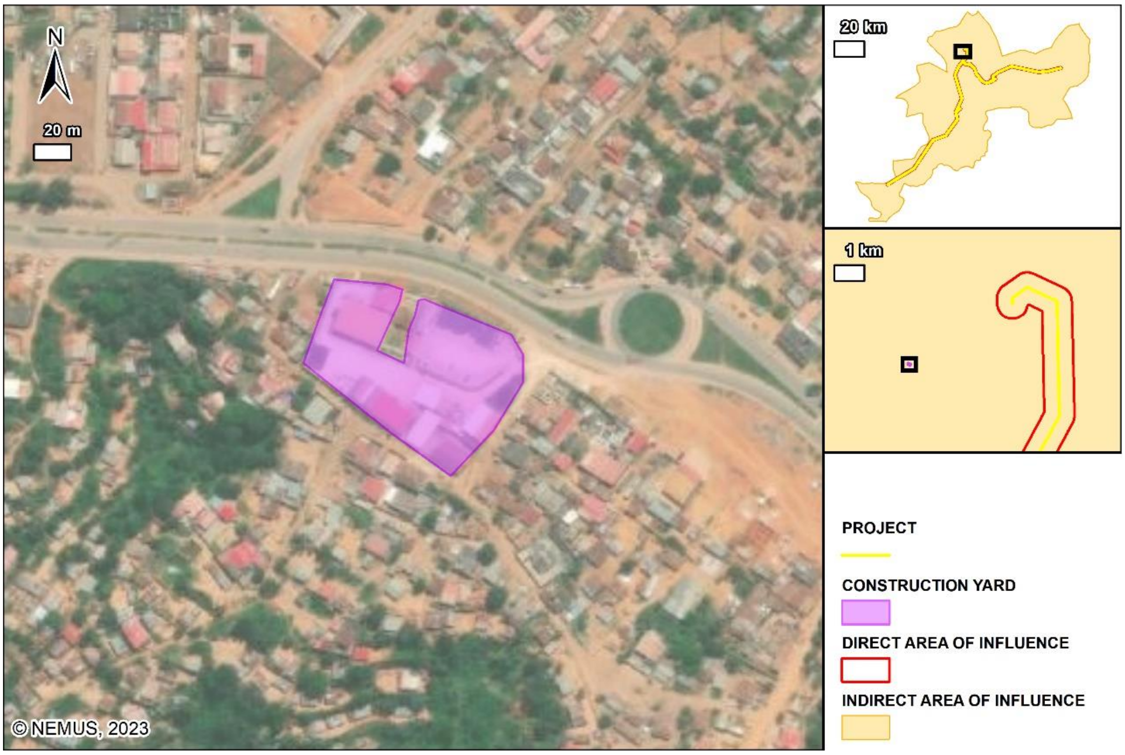


Figure 23 – Construction yard

3.9. Project cost

According to Elecnor (2022) [1] the investment cost for the project, estimated in US dollars (USD), is seventy-four million seven hundred and eighty-nine thousand seven hundred and twenty-eight dollars and forty-seven cents (USD$ 74 789 728,47).

[1] Correspondência dia 17/10/2022

4. Project Influence Areas

The study focuses on the areas potentially affected, either directly or indirectly, by the interventions and activities to be developed under the project.

To define these areas, the following were taken into account:

- The impacts presumed to occur in view of the typology of the activities to be developed;
- The characteristics of the current situation of the physical, biotic and socio-economic environments under analysis.

4.1. Project design guidelines

The Project final layout was projected based on both national and international regulations and best practices.

4.1.1. National requirements

The Land Law (2004) in its article 27.º defines a right of way (*faixa confinante*) of 30 m either side of the transmission line, which makes a 60 m wide corridor. MINEA recommendation for this type of project is to avoid, as far as possible, houses / structures inside the 60 m corridor.

Minimal vertical distances between conductors and obstacles are defined by MINEA – ET-E-102-Ed.A and are summarised in **Erro! A origem da referência não foi encontrada.**.

Description	Distance (m)
Soil	**12**
Trees	**5**
Buildings	**6**
Roads	**12**
Electrified railway lines	**15***
Non-electrified railways	**12**
Other airlines	**5***
Various obstacles	**5**

*Considering the crossing point 200 m from the nearest support

4.1.2. International guidelines - IFC Guidelines

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. The EHS Guidelines contain the performance levels and measures that are normally acceptable to the IFC and World Bank, and measures that are generally considered to be achievable in new facilities at reasonable costs by existing technology. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phases of a project or facility.

When host country (*e.g.* Angola) regulations differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in the view of specific project circumstances, a full and detailed justification for any proposed alternatives is required. General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to this Project.

In addition to the General EHS Guidelines, sector-specific guidelines have also been developed. Sector specific guidelines deemed applicable to the Project will be considered in the EIA process. The Guidelines of relevance to the Project and the EIA process are IFC EHS *Guidelines for Electric Power Transmission and Distribution*.

4.1.3. Applicability of IFC-PS7 – Indigenous Peoples

IFC-PS 7 recognizes that Indigenous Peoples are often among the most marginalized and vulnerable segments of the population, thus being more susceptible to the impacts of project development than non-indigenous communities. Although a universal definition is lacking, the term "Indigeneous People" can be used to refer to (IFC, 2012):

- Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- Customary cultural, economic, social, or political institutions that are separate from those of the mainstream society or culture;
- A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.

Contrastingly with international standards, the Government of Angola does not recognize the concept of Indigenous Peoples as presented in international law and standards, having no specific references to indigenous peoples nor minorities in the Constitution, nor in other domestic law. In addition, and there are no specific references to Indigenous Peoples or minorities in the Constitution, nor in other domestic law. Hence, a number of core human rights remain unrealized to the country's Indigenous Peoples ((IWGIA - International Work Group for Indigenous Affairs, 2023; Mikkelsen & Stidsen, 2015).

The assessment of whether indigenous people could potentially occur in the project's area of influence was largely based on the reports provided by the International Work Group for Indigenous Affairs (IWGIA), a global human rights organization dedicated to promoting, protecting and defending Indigenous Peoples' rights (IWGIA - International Work Group for Indigenous Affairs, 2023).

According to this source and published reports, the indigenous peoples of Angola include the San and Himba, as well as other possibly Khoe-San descendent groups (including Kwisi and Kwepe) and groups with similarities to the Himba (including Kuvale and Zemba), located in Angola's southern provinces (hence outside the project's area) and representing, in total, approximately 0.1% of Angola's current population (Mikkelsen & Stidsen, 2015).

Based on the stakeholder engagement conducted within the framework of the Resettlement and Livelihood Restoration and ESIA, it was considered unlikely that Indigenous Peoples, as defined in IFC-PS7, are present in the project area. Therefore, this standard is not applicable to the project. However, if during the public consultation phases or during the implementation of the livelihood restoration plan, new information suggests otherwise, the applicability of this criterion should be reassessed. In such cases, mitigation measures tailored to Indigenous Peoples should be developed, drawing from the measures proposed for vulnerable groups under the Resettlement and Livelihood Restoration Framework of Uíge.

4.1.4. IFC EHS Guidelines for Electric Power Transmission and Distribution

As the basis for design evaluation, the IFC EHS Guidelines for Electric Power Transmission and Distribution (April 30, 2007) were followed in the development of the Project (TDS-V3) with specific reference to the mitigation of potential electric and magnetic field (EMF) health risks. The discussion that follows provides a summary of the approach taken in line with the requirements of the IFC EHS Guidelines.

IFC EHS Guideline Recommendation	Project
"Evaluating potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure".	For the 220 kV TL (30 m servitude either side) maximum electric field strength is around 1.7 kV/m and maximum magnetic field strength of 11.6 A/m around 1.8 m from ground in the middle of a 450 m hop, maximum current, on flat earth. There is compliance against ICNIRP reference levels at maximum values directly under transmission lines (for frequency of 50 Hz), as these are 5 kV/m and 160 A/m, respectively.
"Considering siting new facilities so as to avoid or minimize exposure to the public. Installation of transmission lines or other high voltage equipment above or adjacent to residential properties or other locations intended for highly frequent human occupancy, (e.g. schools or offices), should be avoided".	Route optimization undertaken to minimise the impact on the number of households that were present in the previous project design versions.

The above attributes are summarised in Figure 1 and **Erro! A origem da referência não foi encontrada.**.

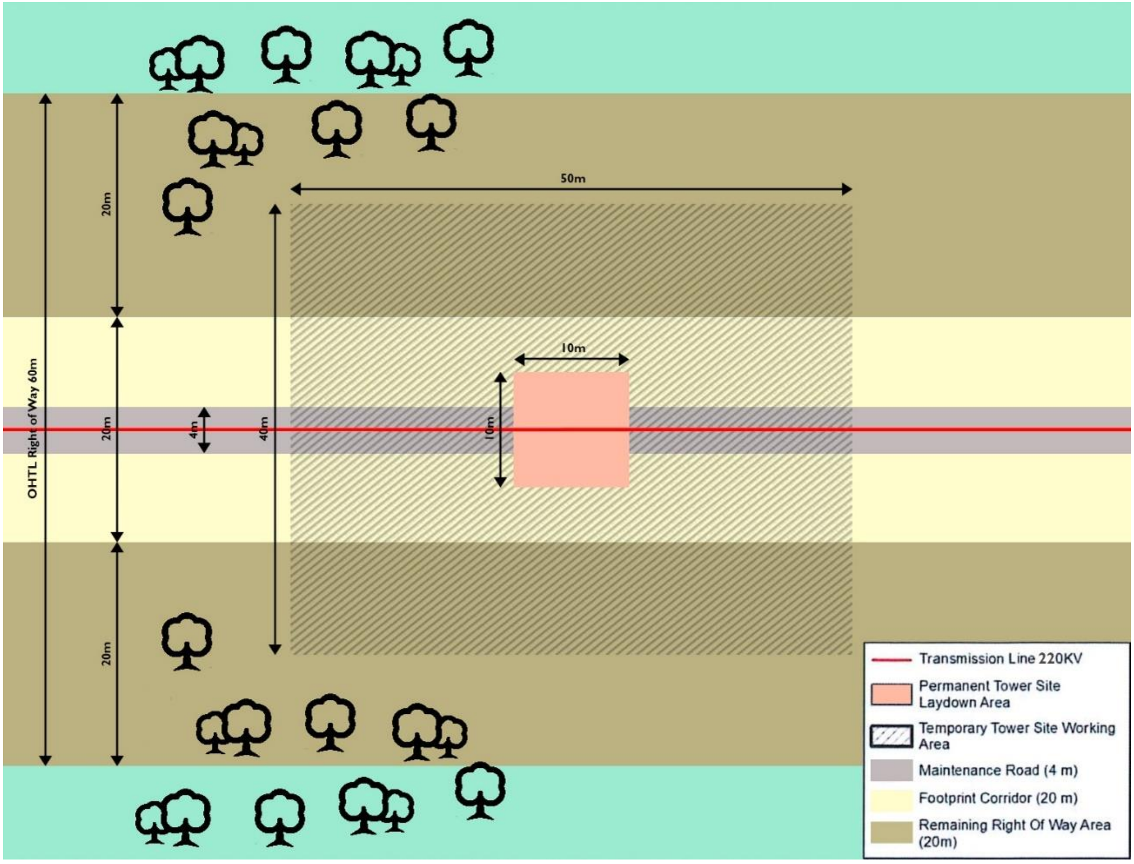


Figure 1 – Restrictions Considered.

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4.1.5. Areas of influence for analysis

The **directly affected area (DAA)** is the area of direct impacts of the project on the natural environment (flora, pollution, physiographic changes, among others) and on the socio-economic environment (land use, local and regional development, among others). This area corresponds to the OHTL Right of Way, consisting of 60 metres corridor (30 m on each side), where the effects of the presence and operation of these actions are felt directly, as presented in table above.

Besides these limits, it is also considered, for most descriptors, an **area of direct influence (ADI)** of the project, corresponding to a 500 m surroundings around the directly affected area mentioned above. This area includes a strip of 30 m on each side of the route, corresponding to the protection strip of structures and cables, classified as a partial reserve under Law 9/04 of 9th November.

It should be noted that depending on whether we are dealing with 110 kV, 60 kV or 30 kV lines, there may be different assignments of soil, vegetation, roads, buildings or other infrastructure to maintain space and ensure safety distances.

In the ESIA, for the evaluation of potential impacts on descriptors such as ecology and socio-economy, corridors with widths of 60 m/30 m either side of the line for 110 kV lines, corridors with widths of 20 m/10 m either side of the line for 60 kV lines, and corridors with widths of 10 m/5 m either side of the line for 30 kV lines were considered.

Finally, an **area of indirect influence (AII)** is considered, corresponding to a larger area defined to analyse the influences of the proposed activities, not directly, but through the possible secondary effects that may result from the project. Thus, the AII includes a wider area, including the area of all the communes crossed by the project.

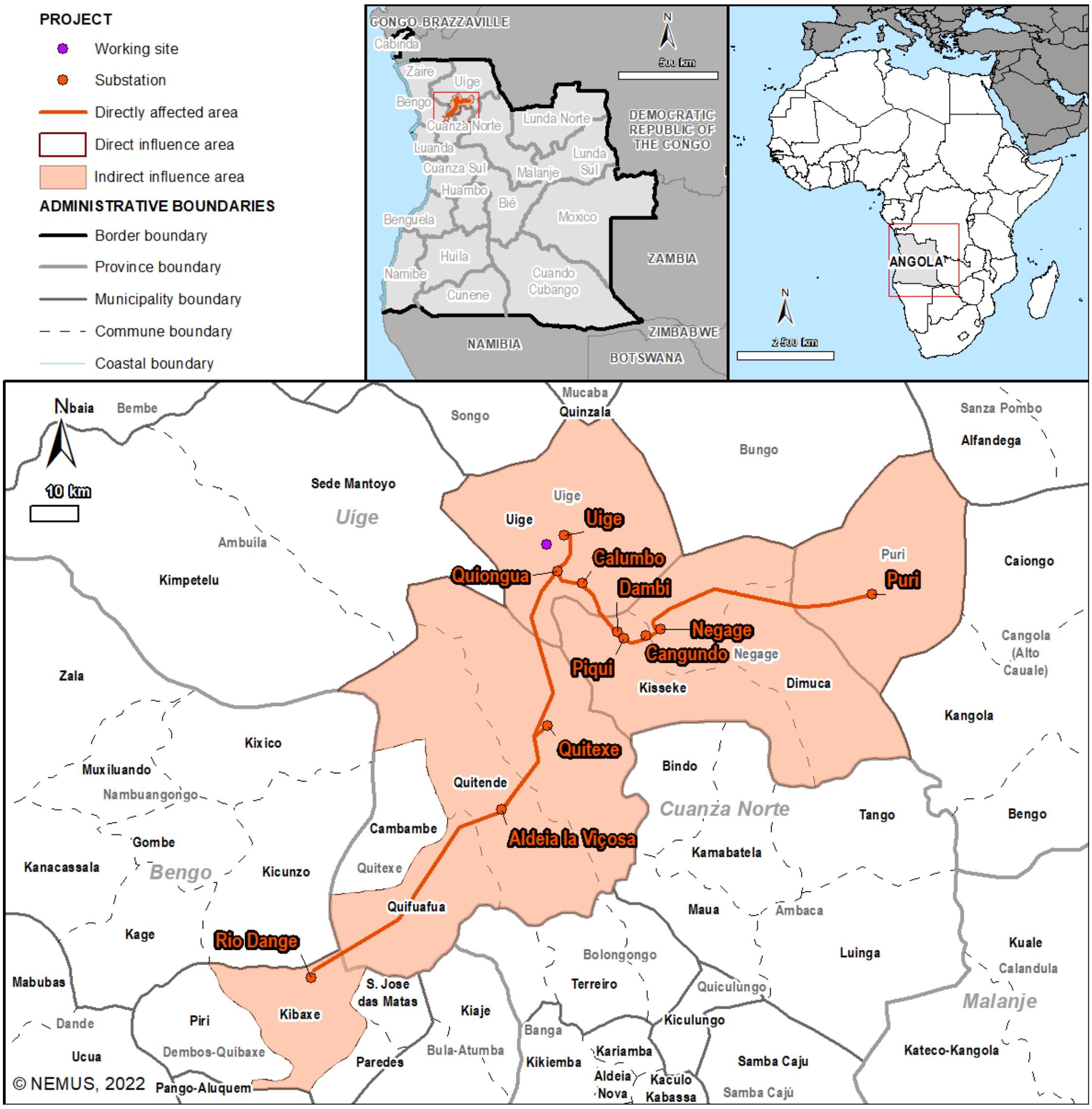


Figure 24 – Project catchment areas

4.2. Design Management Process

The engineering team will take into consideration the global impact of the future transmission line, being a fundamental premise of the design to avoid resettlements of people.

Elecnor will hire two different subcontractors to have information about the future path of the transmission line. One of the companies will survey the area creating a cloud of dots in a 200-meter width corridor that is used by Elecnor as one of the bases for the design. The second company will classify the area of the project using satellite imagery, creating square parcels indicating if inside those parcels there are houses, crops or any kind of facilities.

With the data gathered with site surveys and analyses of satellite imagery, the engineers will have gathered sufficient information to have a precise idea of the areas where there are cities, villages, buildings and different types of crops. Based on the gathered data, the engineering team will create the first iteration of the transmission route, considering not only practical aspects (such as the total length of the line or the possibility of having a line that runs parallel to an existing road), but also environmental and social aspects.

For instance, once an existing construction is identified (such as a house, a village, or church), the designer will modify the pathway to minimize the impact as much as possible, making sure that the line does not go over the existing structure and therefore the impact to local communities is minimized and resettlements are avoided.

Once a design is finished, it will be submitted to the Angolan authorities for review and approval. Once the authorities approve the design, Elecnor still has room for making some minor changes to adjust the pathway if recommended.

5. Description of the affected environment and development prospects

5.1. Introduction

In this Chapter a biophysical and socio-economic characterisation of the affected environment in the study area is presented. The following descriptors are addressed:

- Climate and climate change;
- Geology, geomorphology and topography (including seismicity and instability/natural disasters);
- Mineral resources;
- Hydrogeology;
- Surface water resources (including floods and droughts);
- Soils;
- Land use;
- Environmental quality;
- Ecology;
- Socioeconomics;
- Cultural heritage.

5.2. Climate and climate change

5.2.1. Introduction

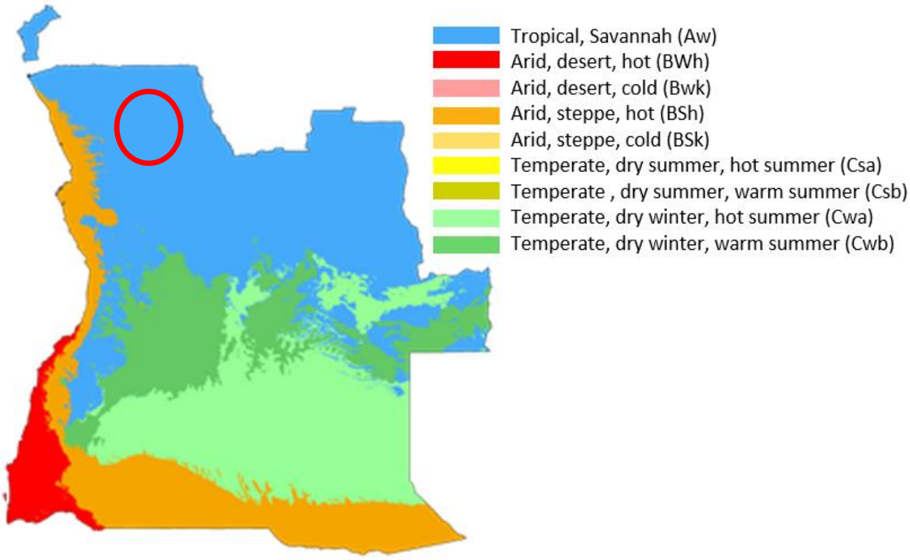
This section presents the characterization of the area of influence of the project in relation to climate change, based on the analysis of statistical and bibliographical information, accounting also the information collected in the technical field visit occurred in July 2022, concerning present climate, climate change, adaptation and mitigation to climate change.

5.2.2. Current climate

The main factors influencing the climate of Angola are geography, namely the proximity of the South Atlantic Ocean, altitude, including the influence of the central plateau, and the proximity of the ocean, especially the cold Benguela current, together with the movement of the Intertropical Convergence Zone (ITCZ), an area where northern and southern air masses converge (Carvalho *et al.*, 2016).

The project's area of influence is located in northern Angola, namely the Uíge province. This study area is classified with a tropical Savannah (Aw) climate, according to the Köppen-Geiger climate classification (Figure 25).

A tropical Savannah climate is characterized by having average temperature values in the coldest month greater than 18 °C and precipitation value in the driest month less than 60 mm and less than 100-(average annual precipitation)/25 (Beck *et al.*, 2018). The summer months (May to September) in Uíge province are particularly dry due to high temperatures and low precipitation values. The winter months (October to April) are characterised by high precipitation in the province (Carvalho *et al.*, 2016).

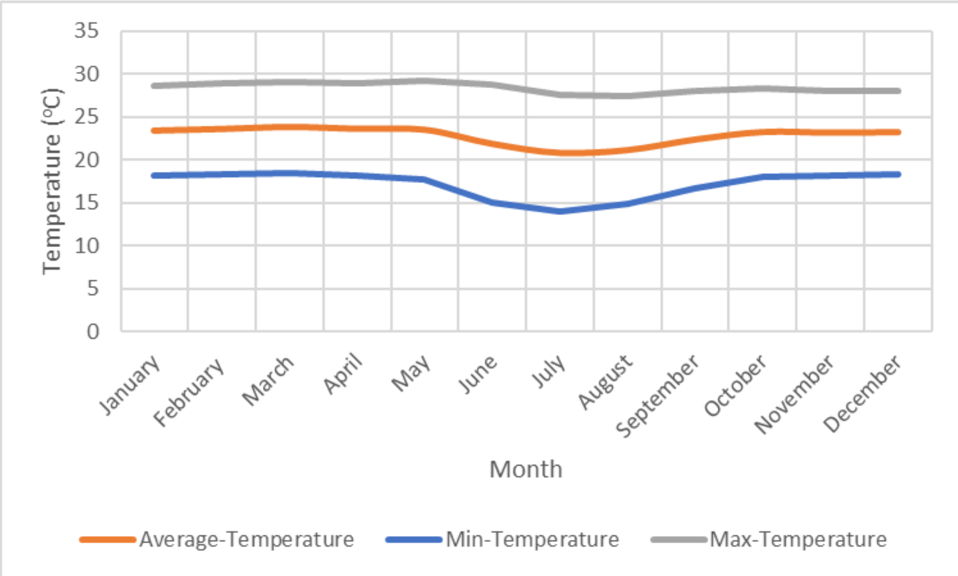


(Location of the project's area of influence in red)
Source: adapted from Beck *et al.*, 2018

Figure 25 – Köppen-Geiger climate classification for the period 1980-2016

Meteorological data collection in Angola has been very limited since 1974, with a severe lack of observations over long periods of time (Carvalho *et al*., 2016). In the climatological assessment for the project's area of influence, the analysis of data observed by the Climate Research Unit of the University of East Anglia (CRU) was considered (World Bank, 2021).

Monthly average **air temperature** in Uíge (Figure 26) varies between 20 ºC and 25 ºC for the reference period 1991-2020. For the same reference period, maximum average temperature is observed in the month of May, reaching a value of 29.27 ºC. On the other hand, the minimum monthly average temperature reached a value of 14,05 ºC, in the month of July. The months of June, July and August have the lowest values because they have a higher temperature range compared to the other months.



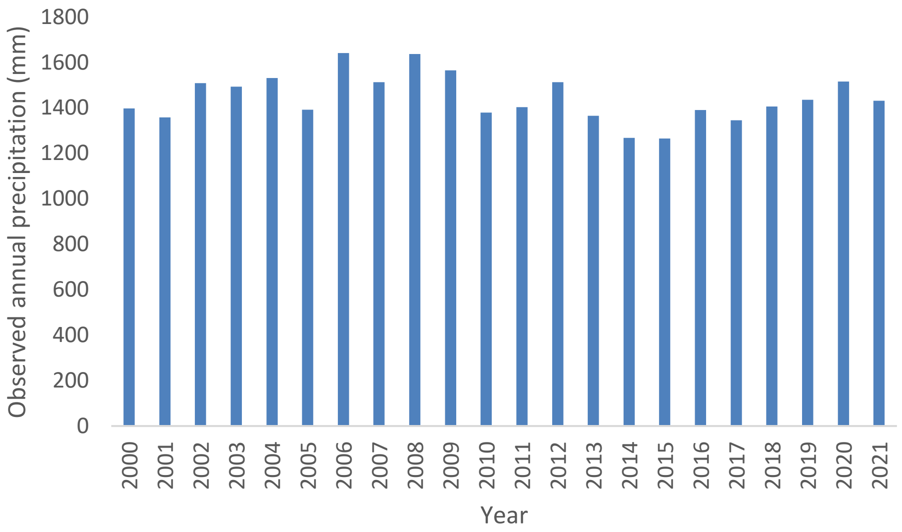
Source: World Bank Group, 2021

Figure 26 – Average monthly temperature in Uíge, Angola, for the period 1991-2020

Figure 27 shows the average annual rainfall observed for the period 2000 to 2021. The average annual value for this period was approximately 1 443 mm in the province of Uíge.

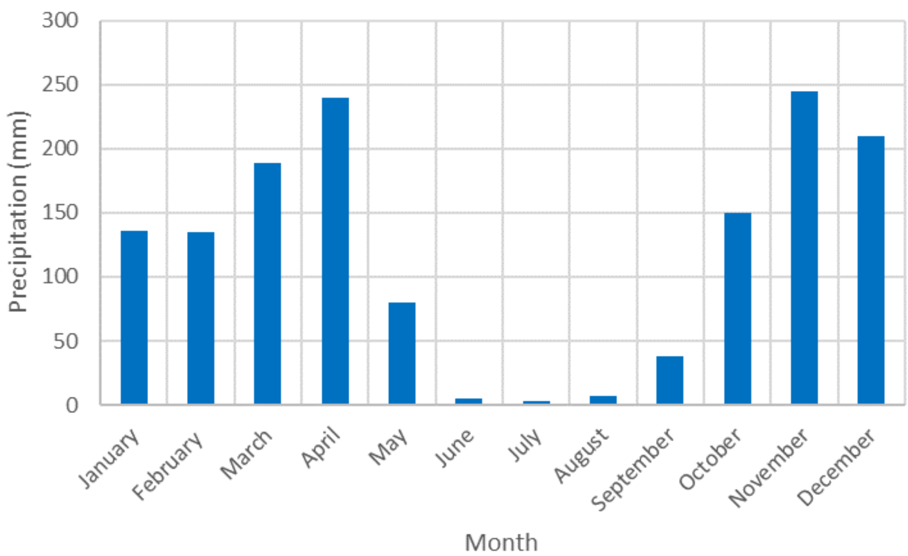
For Uíge province, the average monthly rainfall is higher in the months of October to May. The extreme values of monthly precipitation were reached in the months of November, with a maximum of 244,94 mm, and July, with a minimum of 3,12 mm.

In the period 1991-2020, the months of June to September registered significantly lower precipitation values compared with the other months (Figure 28), thus being characterized as dry months.



Source: World Bank Group, 2021

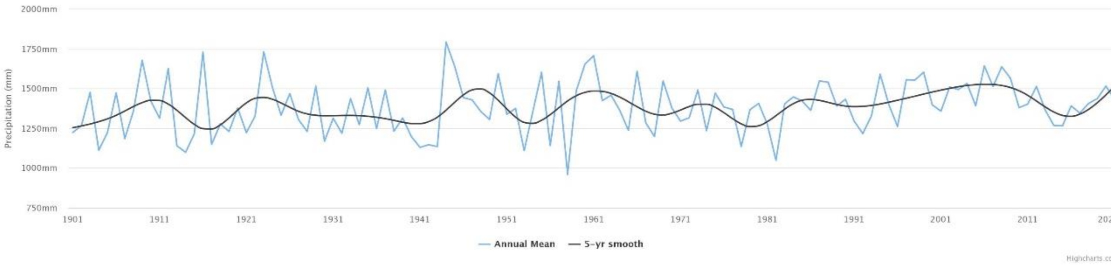
Figure 27 – Observed annual rainfall (mm) in Uíge



Source: World Bank Group, 2021

Figure 28 – Average monthly precipitation in Uíge, Angola, for the period 1991-2020

The time series of evolution of the average annual rainfall observed in the Uíge province (Figure 29) shows an important inter-annual variability, and the occurrence of years of average annual maximum/minimum rainfall approximately every 5-10 years.



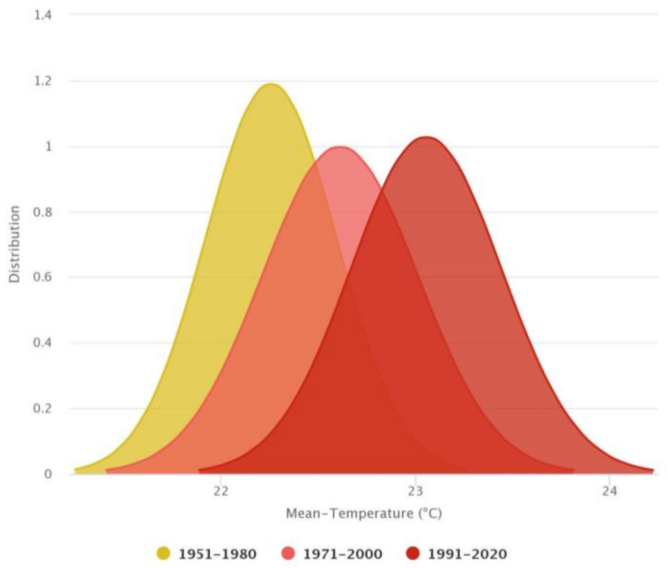
Source: World Bank Group, 2021

Figure 29 – Evolution of the average annual precipitation observed (blue line) in the period 1901-2021

5.2.3. Climate Change

CRU's analysis of observed data for Uíge province (World Bank, 2021) suggests an increasing trend in air temperature since 1951, as observed in the changing distributions in Figure 30, although no trend is observed for precipitation (Figure 29, previous section).

Although the results may be partially affected by the lack of regular meteorological monitoring in recent decades, these results may signal the establishment of a trend of climate change in the project's area of influence.



Source: World Bank Group, 2021

Figure 30 – Change in average air temperature in Uíge, Angola, for the period 1951-2020

Given the uncertainty related to climate assessment at global and regional level following international guidelines (TCFD, 2021; EBRD, 2018), the assessment of the likely effects of climate change in the project's area of influence is carried out considering a scenario analysis, considering two Shared Socioeconomic Trajectories (SSP, related to the previous Representative Concentration Trajectories - RCP), composed of radiative forcing levels and socio-economic storylines (IPCC, 2021), used in the compilation of the global climate model (GCM) of the Sixth Phase of the Coupled Model Intercomparison Project (CMIP6), aligned with the latest IPCC Assessment Report (IPCC, 2021):

- Current GHG trend: the worst-case scenario represented by SSP5-8.5, with GHG emissions roughly doubling current levels by 2050;
- Desired GHG trend: the best reasonably possible scenario represented by SSP2-4.5, with GHG emissions remaining around current levels until mid-century, approaching the goal of limiting warming to less than 1,5 °C by 2100 set by the Paris Agreement (with a probability of ≥ 50 %).

In order to account for uncertain climate change projections, climate change is assessed for the project's area of influence using the CMIP6 multi-model ensemble derived from 11 MCG simulations at 100 km x 100 km resolution (Table 23).

Nevertheless, higher resolution projections for the project's area of influence would be desirable, however there are no regional experiences available to downscale the CMIP6 MCG projections, and the lack of climate data places constraints on the interpretation of regionalised results.

Considering the characteristics of the project and its area of influence, climate projections are presented for the following climate variables: maximum temperature, minimum temperature, maximum daily temperature, precipitation, and greatest 1-day precipitation.

The projections are evaluated for two time periods, namely 2040-2059, corresponding to the middle phase of the project's life, and 2060-2079, corresponding to the end of the project's life.

Table 23 - Global climate models considered in the CMIP6 multi-model dataset

Model
cams-csm1-0
canesm5
cnrm-esm2-1
ec-earth3-veg
fgoals-g3
gfdl-esm4
ipsl-cm6a-lr
miroc-es2l
miroc6
mri-esm2-0
ukesm1-0-ll

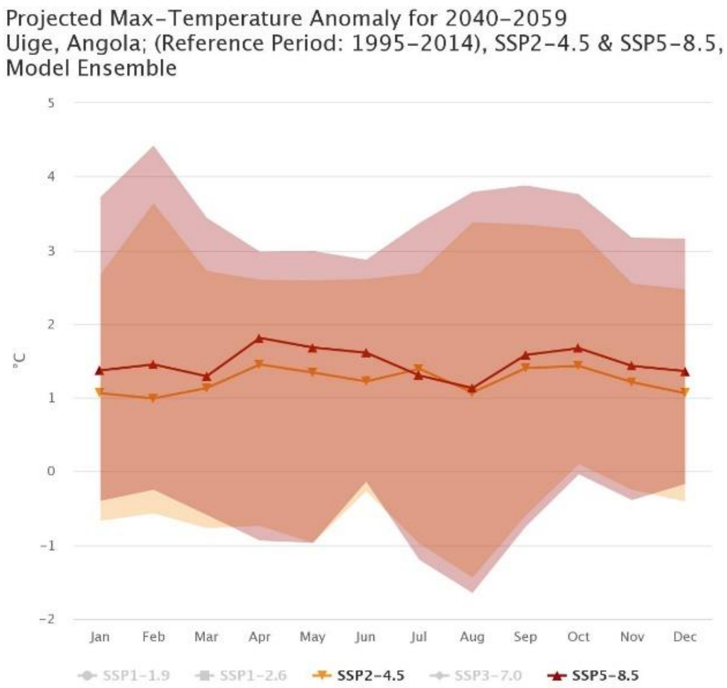
Source: World Bank, 2021

In Figure 31 it can be observed the projections of the monthly anomalies of maximum air temperature for the two periods under study based on the reference period 1995-2014. It can be seen that the anomalies of maximum air temperature projected are positive in both time periods considered.

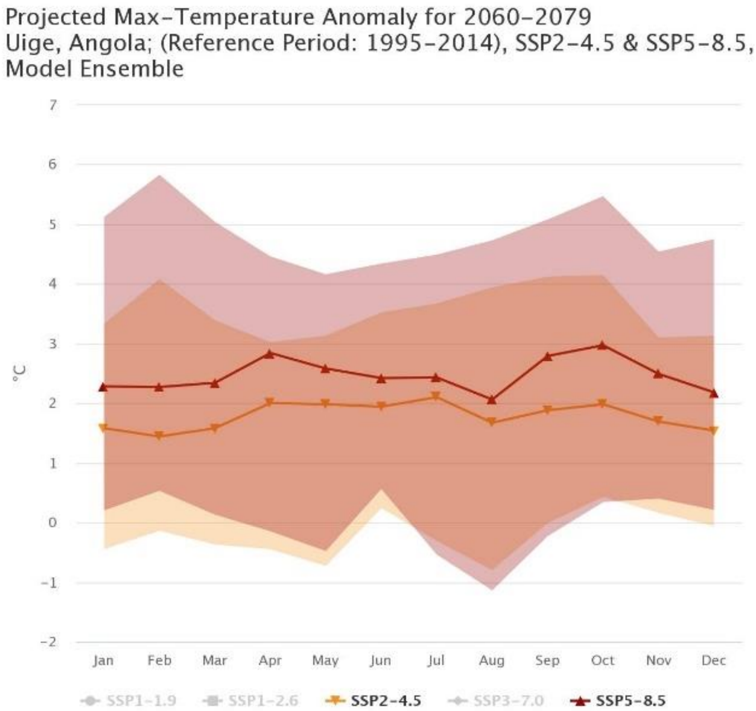
The positive anomaly means that an increase in temperature will occur, being more accentuated in the months of February and October.

The median value of the different scenarios projects a maximum value of 1,5-2 ºC in April for the period 2040-2059. For the 2060-2079 study period, the maximum value is more accentuated and varies between 2-3 ºC in the month of October.

Regarding the dispersion of the model results, it is large in relation to the median, showing a large uncertainty: the anomaly in some MGCs may reach 4-4,5 ºC in 2040-2059 and 5 - 6 ºC in 2060-2079 in the SSP5-8.5 scenario.



(a)



(b)

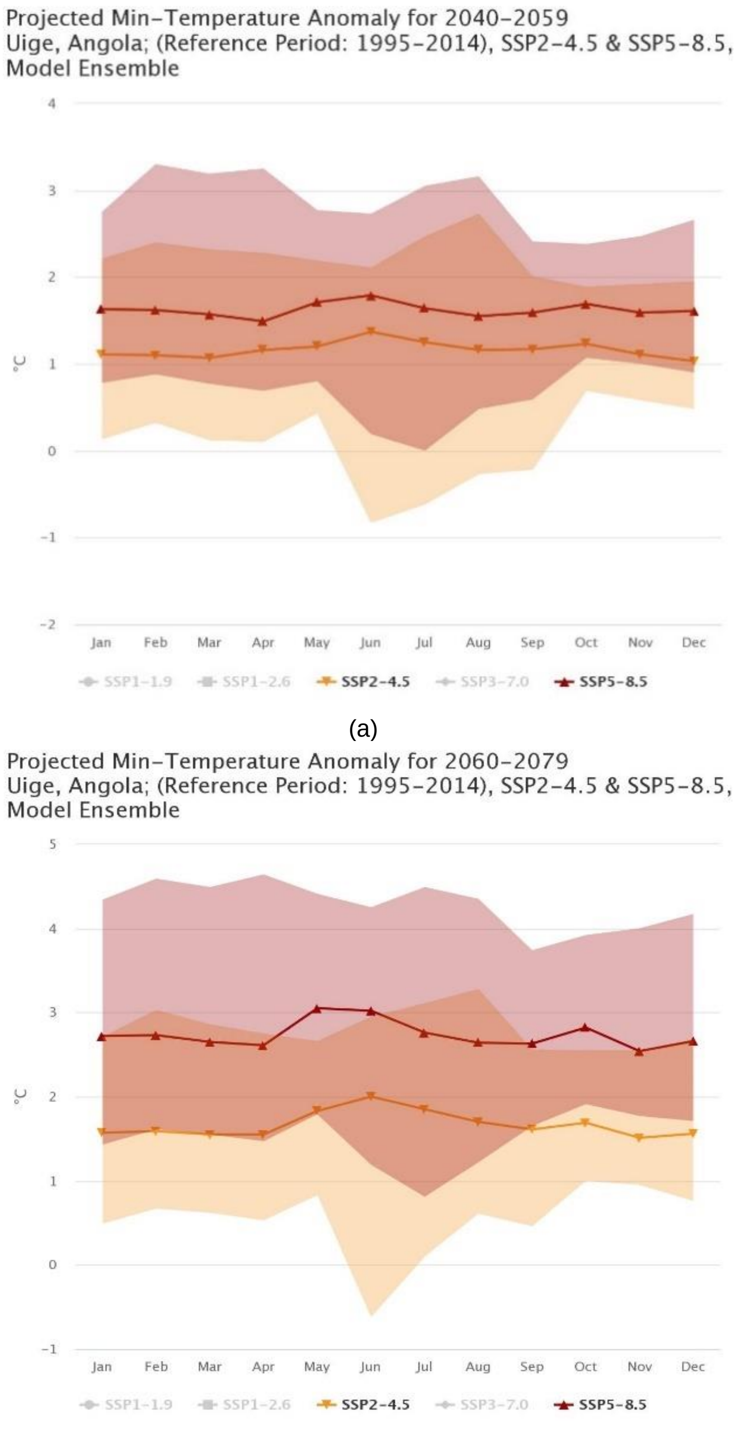
Source: World Bank Group, 2021

Figure 31 – Projected anomalies in maximum air temperatures for the periods 2040-2059 (a) and 2060-2079 (b) relative to the 1995-2014 reference period (CMIP6 multi-model ensemble)

The monthly minimum air temperature anomaly projections for the periods 2040-2059 and 2060-2079 (Figure 32), estimate an increase in minimum air temperature compared to the baseline period.

The median anomaly from the ensemble of various models is between 1 °C and 2 °C for 2040-2059 and between 1.5 °C and 3 °C for 2060-2079, almost 1,5 °C higher in the SSP5-8.5 scenario compared to SSP2-4.5, suggesting an overall increase in minimum temperature over present values, more distributed over the year than maximum air temperature.

Together with the maximum air temperature, these results indicate the occurrence of a consistent increase in air temperature during the project lifetime, more pronounced in autumn and spring.



(b)

Source: World Bank Group, 2021

Figure 32 – Projected anomalies in minimum air temperatures for the periods 2040-2059 (a) and 2060-2079 (b) relative to the 1995-2014 reference period (CMIP6 multi-model ensemble)

The results for the Uíge province daily maximum air temperature extremes are presented in Figure 33. As for the period 2040-2059, the median of the multi-model ensemble is within the 1 - 2 °C ranges (for the two SSPs considered) of the reference period values, with the anomaly remaining approximately constant throughout the year.

Some MGCs present anomalies up to 3 - 3,5 ºC (for the SSPs considered), signalling an important uncertainty regarding the extreme temperature.

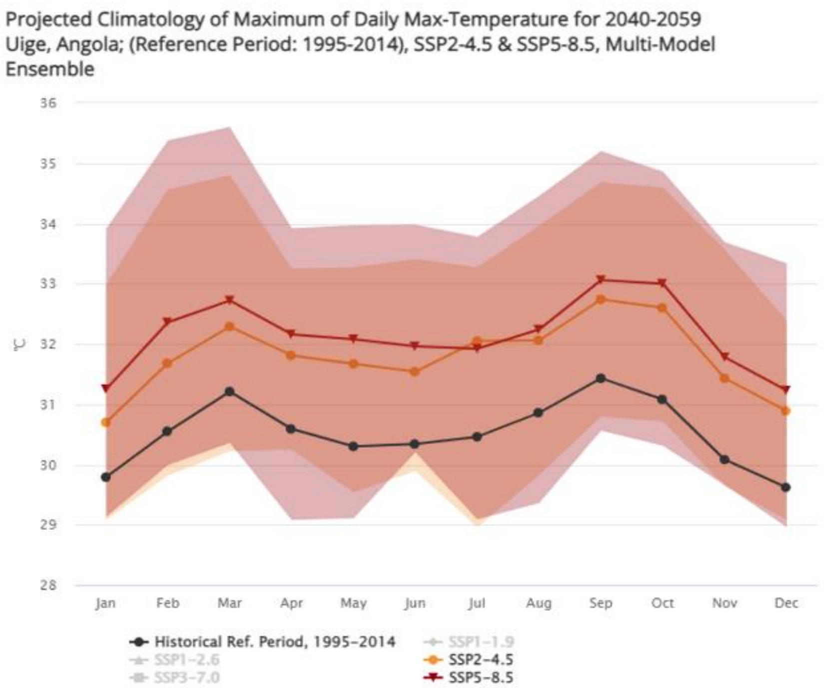
Regarding the period 2060-2079, the median of the ensemble of several models is within the range of 2-3 ºC (for the two SSPs considered) of the values of the reference period.

Some GCMs present anomalies up to 3 - 5 ºC (for the two SSPs considered), evidencing an important uncertainty regarding the extreme temperature values.

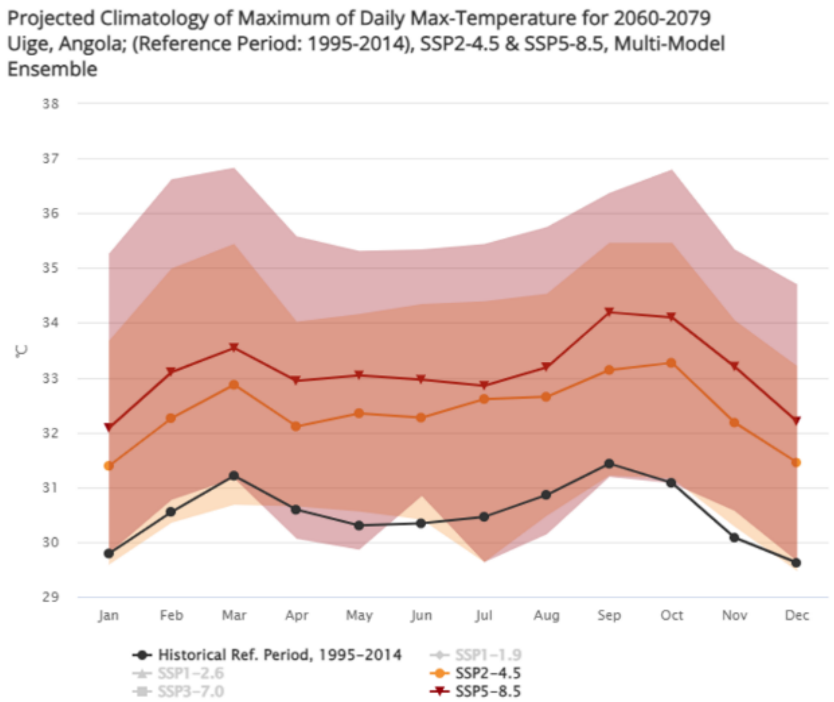
Almost all results from MGCs indicate an increase in the maximum daily maximum temperature, indicating good confidence in this projection.

Regarding rainfall, the projection results for rainfall change in Uíge are presented in Figure 34 for the periods 2040-2059 (a) and 2060-2079 (b). They indicate a reduction in rainfall (up to 25 %) in the months of May to October, and a slight increase (less than 15 % in 2040-2059 and 25 % in 2060-2079) in rainfall in the months of December and January.

However, the uncertainty in these projections is high.



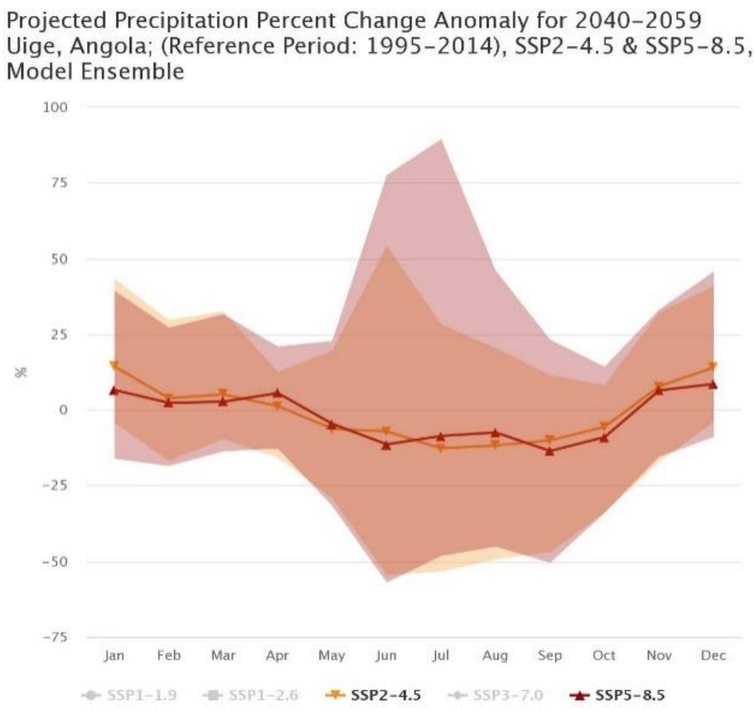
(a)



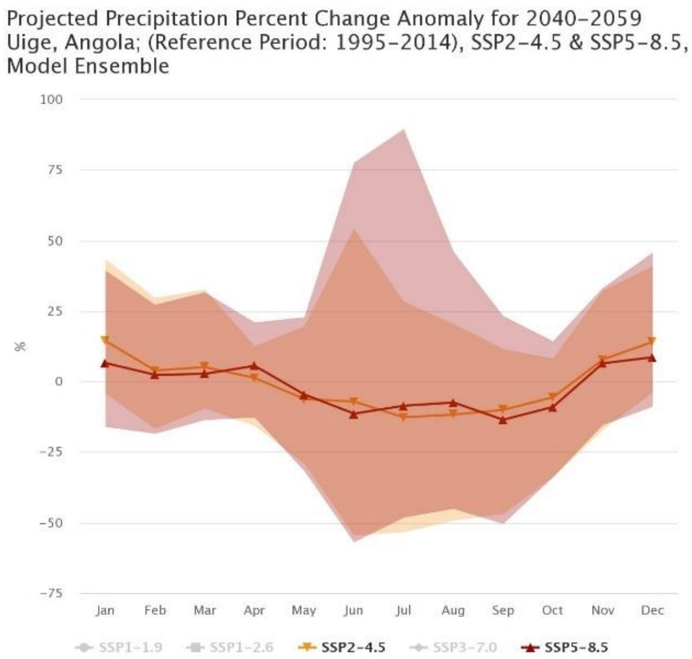
(b)

Source: World Bank Group, 2021

Figure 33 – Projected maximum daily air temperature for the periods 2040-2059 (a) and 2060-2079 (b) relative to the 1995-2014 reference period (CMIP6 multi-model ensemble)



(a)



(b)

Source: World Bank Group, 2021

Figure 34 – Projected change in rainfall (%) for the periods 2040-2059 (a) and 2060-2079 (b) relative to the 1995-2014 reference period (CMIP6 multi-model ensemble)

Table 24 presents the results for the change from the 1-day return period of greatest rainfall to 100-year return period events in the historical period for Uíge. These results show that extreme precipitation events with a 100-year return period are expected to be more frequent towards the end of the century and in the SSP5-8.5 scenario.

Table 24 – Return period of greatest 1-day precipitation (years) data from the ensemble of several CMIP6 models for the historical period (1985-2014) and scenarios SSP2-4.5 and SSP5-8.5

Province	History	SSP2-4.5		SSP5-8.5	
	1985-2014	2035-2064	2060-2089	2035-2064	2060-2089
Uíge	100*	48,84 (29,55-109,09)	39,65 (20,90-93,98)	42.12 (21,84-83,91)	27,29 (11,60-66,36)

Notes: * corresponds to 86,23mm; 10º and 90º percentile in brackets.
Source: World Bank, 2021

The change in these climatic parameters (temperature and precipitation), as can be observed in the previous figures, has a negative impact on the agriculture sector. These variations in climate can increase the vulnerability of the agricultural sector.

The increase in temperature and the variations in precipitation provide negative impacts on existing crops and the hydrological cycle (Governo de Angola, 2011). According to the National Adaptation Programme of Action (NAPA), these variations in climate also have consequences on the construction materials of buildings as well as on the existing infrastructures in the country.

5.2.4. GHG Emissions

The GHG emissions inventory is only available at the national level for Angola.

The first inventory was presented for the years 2000 and 2005 in the Initial National Communication of Angola to the United Nations Framework Convention on Climate Change (Governo de Angola, 2014).

In the Second National Communication of Angola (Government of Angola, 2021b) a new inventory is presented for the period 2005-2018, following an improved IPCC (2006) methodology, considering the contributions of the main sectors:

- Energy: production and consumption of fuels and energy from biomass;

- Industrial processes and product use: existing industries;
- Agriculture and livestock: agricultural activity;
- Waste: waste production and treatment and sewage system;
- Land use, land use change and forestry (LULUCF): deforestation and charcoal production.

Total GHG emissions for Angola for 2005-2018 are presented in Table 25, considering or not the emissions resulting from the LULUCF sector. It is observed that GHG emissions have grown up to 100,5 million tons of CO_2 eq. in 2018 and there has been an increase of 79 % since 2005.

The majority of emissions are related to CO_2 (83 % in 2018), followed by CH_4 (15 % in 2018). Emissions related to USAUSF are dominant representing 70 % of total emissions in 2018.

Table 25 – GHG emissions inventory for Angola (2005-2018): total GHG emissions

Year	Total with LULUCF (1000-ton CO_2 eq.)				Total without LULUCF (1000-ton CO_2 eq.)
	CO_2	CH_4	N_2O	Total	Total
2005	45 966,60	8 698,434	1 405,84	56 070,883	16 008,278
2010	52 907,19	7 623,838	1 353,54	61 884,581	21 567,414
2015	88 801,7	9 542,122	1 711,8	100 055,77	29 695,331
2018	83 624,9	14 585,58	2 338,5	100 549,05	30 575,351

Source: Government of Angola, 2021b

The contribution by sector is presented in Table 26. It is clear that, apart from the USAUSF sector, emissions result mainly from the energy sector which reached 19% in 2018 (118 % increase since 2005), followed by the agriculture and livestock (7 % increase since 2005) and waste (124 % increase since 2005) sectors, accounting for 6 % and 4 % in 2018, respectively.

Industrial processes and product use contribute the least to national GHG emissions, but there was the most significant growth, 369 %.

Table 26 – GHG emissions inventory for Angola (2005-2018): total emissions by sector

Year	Sector (1000-ton CO_2 eq.)					Total of Angola (1000-ton CO_2 eq.)
	Energy	Agriculture and livestock	Waste	Industrial process	LULUCF	
2005	8 638,891	5 291,684	1 685,496	360,940	40 062,605	56 039,61
2010	12 881,31	5 950,088	2 094,430	578,663	40 189,886	61 694,37
2015	18 115,62	6 544,911	3 151,339	1 819,919	70 360,442	99 992,23
2018	18 820,386	5 650,619	3 776,480	1 693,582	70 409,590	100 350,65

Source: Government of Angola, 2021b

The most relevant sectors by GHG are (Government of Angola, 2021b):

- CO_2: energy (road and air transport), USAUSF, industrial processes and product uses (cement production);
- CH_4: waste (solid waste treatment category) and agriculture and livestock (enteric fermentation, associated with livestock farming);
- N_2O: agriculture and livestock (management of direct emissions from soil, associated with fertilisation).

The sectors that contributed most to the growth in GHG emissions in 2005-2018 in absolute terms were road transport (16 % increase), air transport (80 % increase), cement production (9 % increase), direct land emissions management (21 % increase) and domestic wastewater treatment (33 % increase; Government of Angola, 2021b).

Regarding the evolution of GHG emissions of the sectors in 2005-2018, the following is also worth mentioning (Government of Angola, 2021b):

- Energy: a considerable increase in national production levels of hydrocarbons, including natural gas, has occurred;
- Industry: energy supply to industries comes mainly from five hydroelectric power plants, which have underutilised supply capacity due to distribution problems; due to electrical instability, industries need to use alternative energy sources; in addition to emissions from cement production, relevant industries as GHG sources include iron alloy (especially since 2014), glass production and ceramics;
- LULUCF: between 2003 and 2018, 200 000 ha of forests were replaced by pastures; there was also a 7 % loss of flooded areas and an increase

in urban areas and agricultural land of 3 % and 5 %, respectively; deforestation by fires reached 783 500 ha in the period 2000-2015.

In a business-as-usual scenario, Angola's GHG emissions are projected to increase gradually between 2015 and 2050, with the energy sector remaining a major source of GHG emissions and the largest increases in emissions projected in the agriculture and livestock, industry and waste sectors (Government of Angola, 2021a):

- Agriculture: intensification of agriculture and livestock production will lead to increased CH_4 emissions, while mechanisation of agriculture will lead to increased CO_2 emissions;
- Industry: increase in CO_2 emissions, especially if the adoption of self-production and cogeneration of renewable energy is small; the oil production industry is expected to reduce emissions due to the use of gas and decrease its production;
- Waste: increasing population and consumption will result in increases in CH_4 emissions.

According to this scenario, national GHG emissions are expected to increase to 108 million tonnes CO_2 eq. in 2025 (Government of Angola, 2021b).

In the project's area of influence, GHG emissions result from the following sources:

- Use of coal, firewood, gas and diesel as energy sources for domestic use in settlements;
- Road transport with fuel combustion;
- Production of charcoal;
- Bush clearing fires;
- Forest fires and burning (for land clearing, hunting, to stimulate the germination of grasses as a source of food for animals);
- Fertilised agriculture.

Also of note is the widespread occurrence of deforestation (in the Ecology section), especially for coal production, which contributes to GHG emissions by removing carbon sinks.

As mentioned in the Socioeconomics section, the lack of infrastructures for access to the public power grid affects the majority of Angolan populations. The population with access to the power grid varies between 8 % and 20 % and, in order to provide an alternative to this limitation, many houses have fossil fuel generators (Governo de Angola, 2011).

In the specific case of Uíge province, only 17 % of the population has access to the electricity grid and in rural areas people use lanterns for lighting (in the Socioeconomics section).

5.2.5. Adaptation to Climate Change

According to World Bank analysis, in Angola it has been possible to observe climate risks throughout the period between 1900 and 2018. These climate risks are related to food-related phenomena, health risks, occurrences of droughts and landslides (World Bank Group, 2021).

Given the climate change projections for the Uíge province and the characteristics of the project's area of influence, **the physical climate risks** foreseen for the project include (Government of Angola, 2021a):

- Increased soil instability and landslides;
- Increased susceptibility to desertification and soil erosion;
- Erosion of river beds;
- Increased frequency and intensity of extreme precipitation and flood events;
- Increased frequency and intensity of droughts and water scarcity;
- Degradation of assimilation and purification of watercourses;
- Increased frequency and intensity of heat waves, increased frequency and intensity of rural fires;
- Alteration/loss of biodiversity;
- Health risks and disease transmission.

Angola's National Strategy for Climate Change Mitigation and Adaptation 2020-2035 (2017) includes strategic **adaptation** initiatives for different strategic areas that act against these risks, including:

- Agriculture and fisheries:
  - A1 – Sustainable agriculture;
  - A2 – Sustainable food;

    - A3 – Sustainable fisheries;
- Forests, ecosystems, biodiversity:
    - A5 – Protection of forests, ecosystems, biodiversity;
- Water resources:
    - A6 – River basin management;
    - A7 – Drought risk management;
    - A8 – Flood risk management;
    - A9 – Drinking water availability
- Health:
    - A10 – Tropical disease prevention and monitoring;
    - A11 - Sanitation
- Infrastructure:
    - A12 – Resilient buildings

5.2.6. Climate Change Mitigation

Angola ratified the United Nations Convention on Climate Change (UNFCCC) and the Kyoto Protocol, respectively in 2000 and 2007, and completed its National Adaptation Action Plan in 2011. In 2015, fulfilling the requirements of the Paris Agreement, adopted at the 21st Conference of the Parties to the Convention (COP21), Angola submitted its Intended Nationally Determined Contribution and, in 2020, ratified the Paris Agreement.

In Angola's Intended Nationally Determined Contribution (2021) required under the Paris Agreement, a goal of achieving (unconditionally) a 14 % reduction of GHG emissions by 2025 compared to the baseline year of 2015 is set.

Angola's Nationally Determined Contribution (2021) also states that there is a possibility of achieving the goal of (conditionally) reducing GHG emissions by 10 % by 2025, compared to the base year of 2015.

This conditional reduction is a projection based on international aid and funds. If this international aid were to exist, Angola could achieve a 24 % reduction in GHG emissions. The combination of these two types of efforts is equivalent to a reduction of approximately 26,5-million-ton CO_2 eq.

In Angola several studies have already been conducted in order to minimize the impacts resulting from climate change. Angola is motivated to make a positive contribution to the reduction of GHG emissions. "Angola Energy 2025 - Long-term vision for the Energy Sector" and the National Strategy for Climate Change Angola (2018-2030) are examples of documents that demonstrate this contribution.

One of the pillars of the Angola National Strategy for Climate Change (ENAC in Portuguese) 2018-2030 is the mitigation of climate change, presenting mitigation measures to be applied by the various sectors of activity:

- Energy:
    - M1 – Low carbon electricity generation;
    - M2 – Access to low carbon energy in rural areas;
    - M3 – Regulation of the electricity sector;
    - M4 – Low carbon transport (air, sea, rail, road)
    - M5 – Energy efficiency;
    - M6 – Low carbon public lighting;
    - M7 – Reducing fugitive emissions from oil and gas exploration and production;
- Agriculture, forestry, other land use:
    - M8 – Low carbon agriculture;
    - M9 – Forestry and other land use management;
- Industry:
    - M10 – Energy efficiency;
- Waste:
    - M11 – Waste management.

From these initiatives and given the characteristics of the project under evaluation and its area of influence, it is worth highlighting some mitigation measures, such as M1 - Low carbon electricity generation, M2 - Access to low carbon energy in rural areas, M8 - Low carbon agriculture and M9 - Management of forests and other land uses.

Under M1 - Low carbon electricity generation, to meet the target of reaching 70 % of installed renewable energy by 2025, the following measures, among others, are proposed:

- M1.4 – Continue to promote the interconnection of Angola's electricity systems and the electrification of rural areas.

As for M2 - Access to low carbon energy in rural areas, the following measures are proposed:

- M2.1 – Implement small-scale isolated projects based on solar, wind and hydro power, providing electricity in rural areas;
- M 2.2 - Extend the "Solar Villages" project so that by 2025 there will be at least 500 villages with access to these programmes;
- M 2.3 - Distribute at least 500 000 solar lanterns in rural areas by 2025;
- M 2.4 - Implement biodigester projects in villages without access to electricity, mainly in areas with greater livestock activity.

Regarding M8 - Low carbon agriculture, with the aim of having agricultural communities with renewable solutions implemented, it is relevant to mention the following measures:

- M 8.1 - Promote sustainable and low carbon agricultural practices to help combat desertification and the unsustainable use of agricultural land, which contribute to improving food security and domestic supply in Angola;
- M 8.2 - Regulating the use of fertilisers;
- M 8.3 - Developing a fire prevention and control programme, a practice widely used in the preparation of agricultural land, which also takes into account public awareness and sensitisation;
- M 8.4 - Promote the modernisation of traditional agriculture on a sustainable basis, applying agricultural practices that ensure the reduction of GHG emissions but enable producers to increase their income;
- M 8.5 - Facilitate the purchase of agricultural machinery that uses renewable energy or less polluting fuels through special financing programmes for this purpose.

With regard to M9 - Management of forests and other land uses, the following measures, among others, are proposed:

- M 9.1 - Ensuring sustainability in forest management;
- M 9.2 - Promotion of the reforestation of degraded areas;
- M 9.3 - Implement a tool based on a geographical information system that allows inventorying and monitoring of forest and land use changes.

The measures proposed in the ENAC also go in line with the different Sustainable Development Goals, namely SDG 13 ("Action against global climate change: Take urgent action to combat climate change and its impact") and SDG 15 ("Earth life: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss").

In the project's area of influence the livelihood of the population is highly dependent on activities with important GHG emissions, such as domestic use of fossil fuels (especially coal), fertilized agriculture and animal production and deforestation, which relate to the main national GHG emitting sectors, namely energy, agriculture and LULUCF.

Due to the lack of electricity supply in communes, low income and poor soil fertility (in the. Baseline Land and Land Use Assessment), the necessary transition to a less carbon intensive way of life to meet the Paris Agreement is currently difficult.

In addition, the implementation of the strategic mitigation measures proposed by the National Climate Change Strategy 2018-2030 in the project's area of influence is expected to be slow due to the rural context and lack of funding.

The population of the project's area of influence is considered very vulnerable to the following **climate transition risks**:

- Costs and technological difficulties of adopting alternative climate-sustainable energy sources for livelihoods;
- Food production costs;
- Costs of building materials and agricultural supplies (fertilisers, livestock feed).

5.2.7. Evolution prospects in the absence of the project

The evolution of the climate is expected to be determined by the implementation of the changes, probably following the predicted trends of increasing average annual temperature and decreasing dry season precipitation, as well as increasing the frequency of extreme precipitation events.

According to the Socioeconomics descriptor, the population of the five municipalities covered by the catchment area has increased in recent years. If this trend continues in the following years, local GHG emissions from domestic processes of power generation and road transport are expected to increase, as well as the capacity of forests to sequester carbon is expected to decrease as deforestation continues.

In the absence of the project, it is expected that the planned climate change adaptation measures will only be partially implemented and the mitigation measures will be difficult to achieve, contributing to the continued vulnerability of the population to physical climate risks and to the risks of climate transition.

5.3. Geology, geomorphology and topography

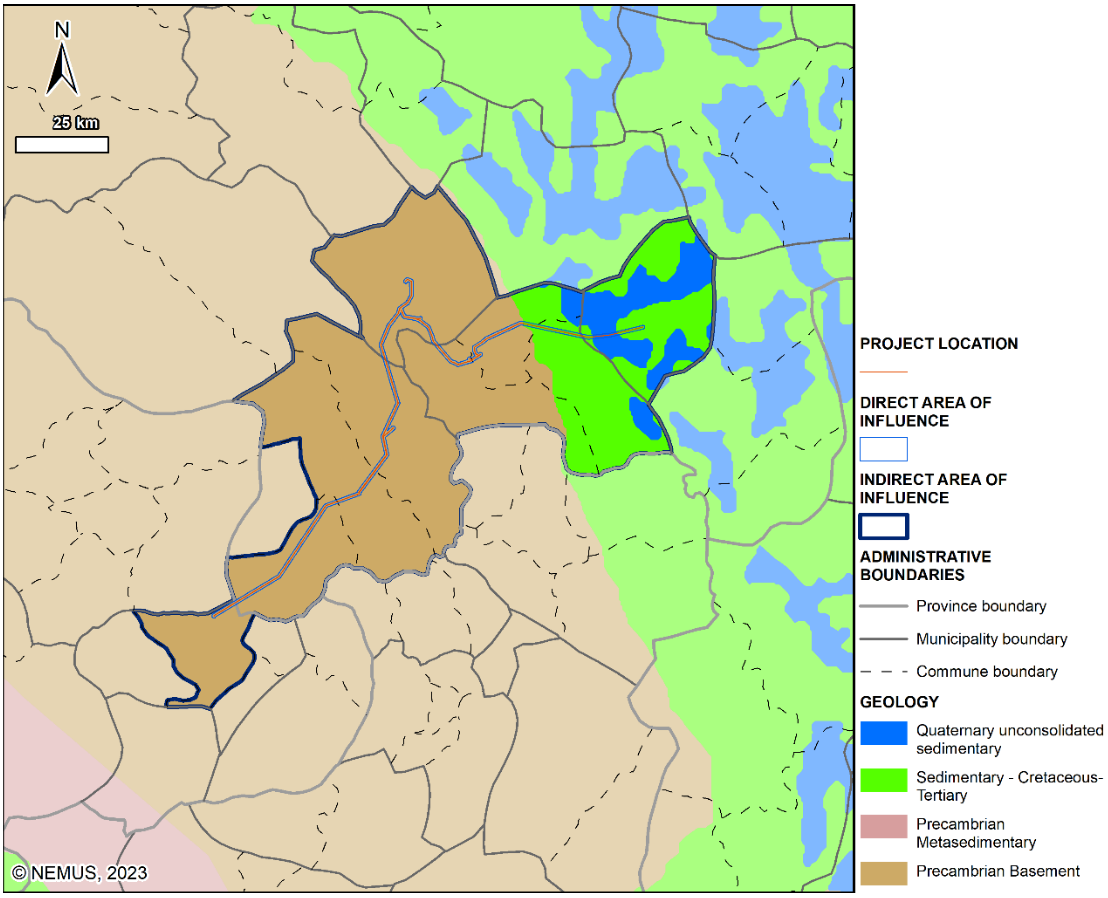
5.3.1. Introduction

Within the scope of the Environmental and Social Impact Assessment, the geological, geomorphological and topographic characterisation is supported by data from the available bibliography and technical-scientific cartography, as well as by the results of fieldwork carried out by Nemus in July 2022 to reconnoitre the region where the project is located.

The information consulted included the Geological Map of Angola, prepared by the British Geological Survey (BGS, 2019) for the Groundwater Atlas of Africa, and data from the Shuttle Radar Topography Mission (NASA, 2022), a high-resolution digital topographic database of the Earth obtained by NASA that allowed for the characterisation of the altimetry and slopes of the region under study (areas of direct and indirect influence of the development).

5.3.2. Geological framework

Mostly, the route covers some of the oldest rocks in the country, namely **Pre-Cambrian** metasedimentary rocks (83 %), such as gneisses, schists, quartzites, migmatites and amphibolites. To the northeast, between Cauenda and Puir, the project crosses **sedimentary rocks** ranging in age **from Mesozoic** (Cretaceous) **to Tertiary** (13 %), which lie on Precambrian bedrock, as well as **Quaternary** detrital sedimentary rocks (3%), deposited along the main watercourses.



Source: (BGS, 2019) Based on the map described by *Persits et al.* 2002 / Furon and Lombard 1964 Geology of Angola at 1:5 million scale.

Figure 35 – Geology

The intense vegetation cover, as is the case in certain stretches of the Uíge or Quitexe region, and the flattened relief resulting from detrital geological formations, as in Negage, do not generally allow for the observation of geological outcrops.

However, occasionally, in areas of crystalline rocks with greater resistance to erosion, rocky outcrops stand out in the landscape. On the other hand, along the slopes of roads or in areas marked by terrain ravines, outcrops of detrital rocks are sometimes observed.

Figure 36 – Spot rock outcrop in the Uíge region

Figure 37 – Aspect of detrital rock slope in the Negage region

Figure 38 – Ravine in Negage with exposure of detrital rocks

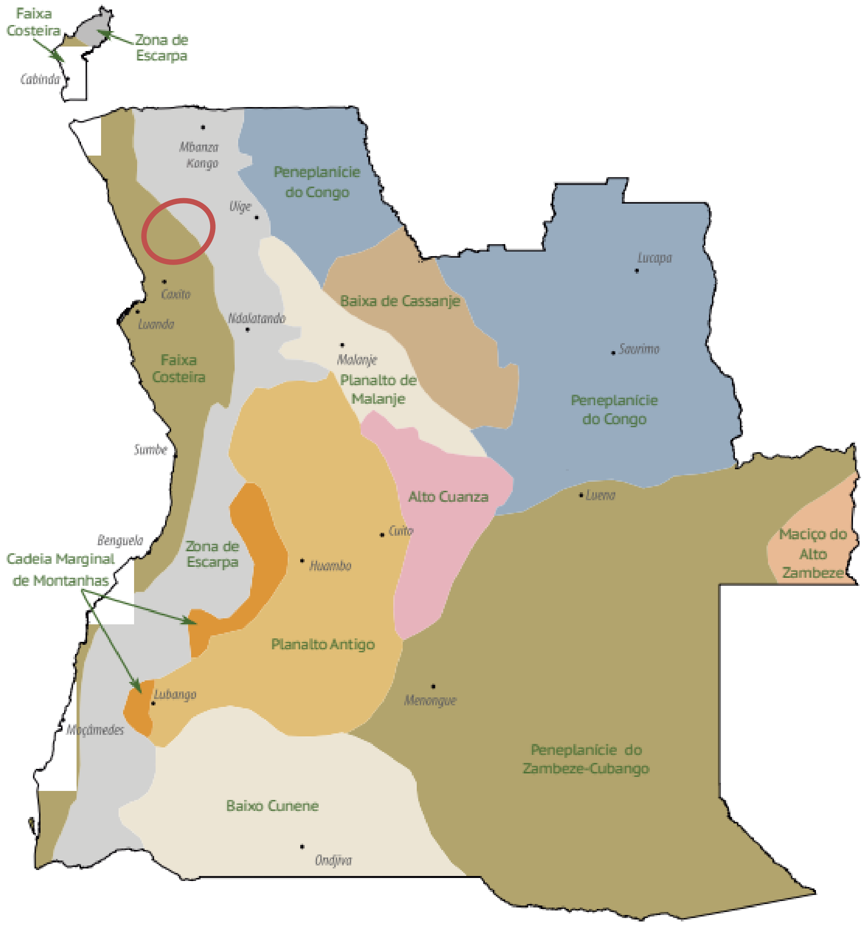
5.3.3. Geomorphology

The project covers **2 of the 11 geomorphological units** into which Angola is usually subdivided:

- **Escarpment Zone** - corresponding to a broad strip of transition developed between the coastal plains and the inland plateaus. The Escarpment Zone includes very mountainous terrain, with mountainous belts, to the north, and some inselbergs, to the south, being the Serra da Neve the most prominent at 2 489 m height.

- **Congo Peneplain** - vast sandy peneplain, dissected by the many parallel tributaries flowing to the north from the Congo Basin. This unit, with altitudes varying between 800 and 1 100 m, is localised to the north-east, coinciding with the outcrop of sedimentary rocks ranging in age from the Cretaceous to the Tertiary.

The indirect area of influence also covers the **Malanje Plateau**, a gently undulating plateau with an altitude varying between 1 000 and 1 250 m



Source: (Huntley, 2019)
The red circle indicates the approximate project area

Figure 39 – Geomorphological units of Angola

5.3.4. Topography

The project will be developed in a high-altitude region, where 85 % of the territory is at an altitude of more than 700 m.

From the southwest to the northeast, approximately between the Dange River and the Negage substation, the elevations gradually rise, from values of 700 to 1 200 m.

Between Negage and Puri a flattened area is defined, with elevations between 1 200 and 1 300 m. After these localities, to the north-east, the levels drop to between 1 100 and 1 200 m.

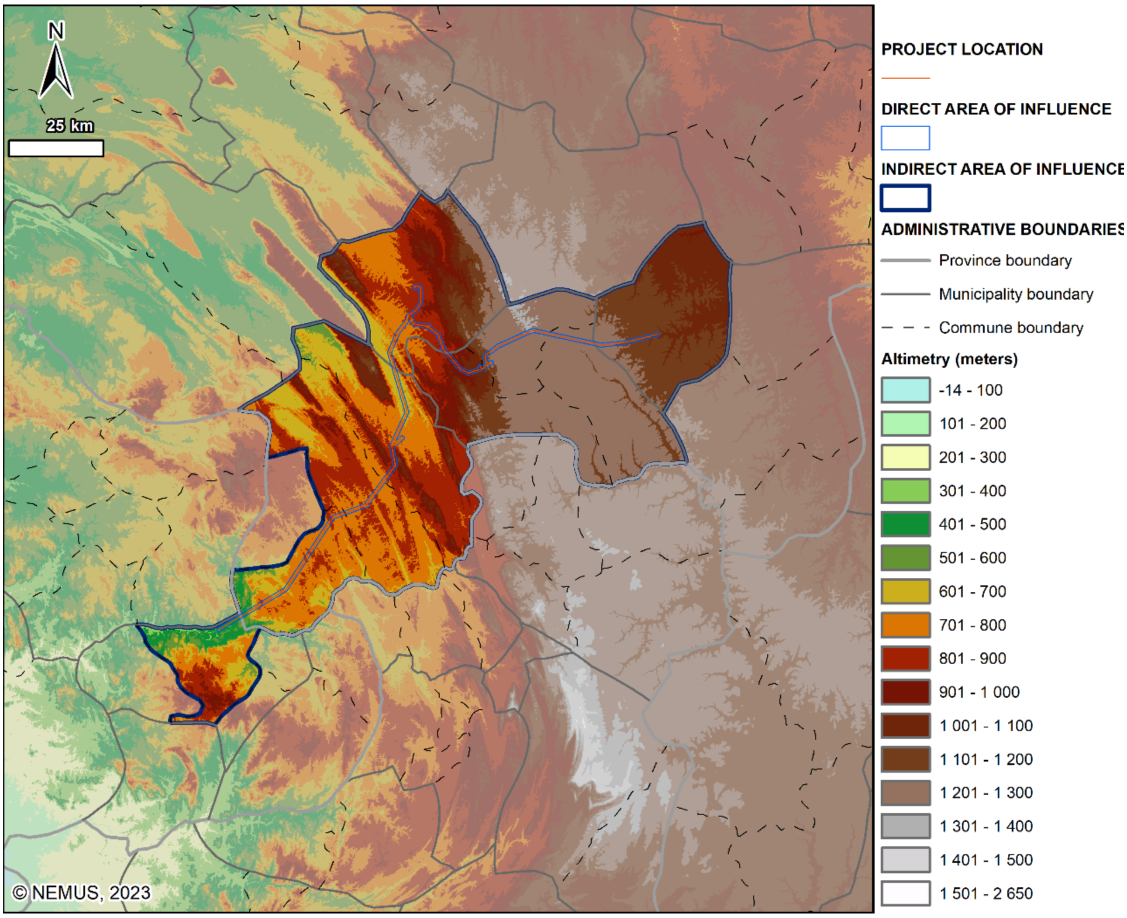


Figure 40 – Altimetry

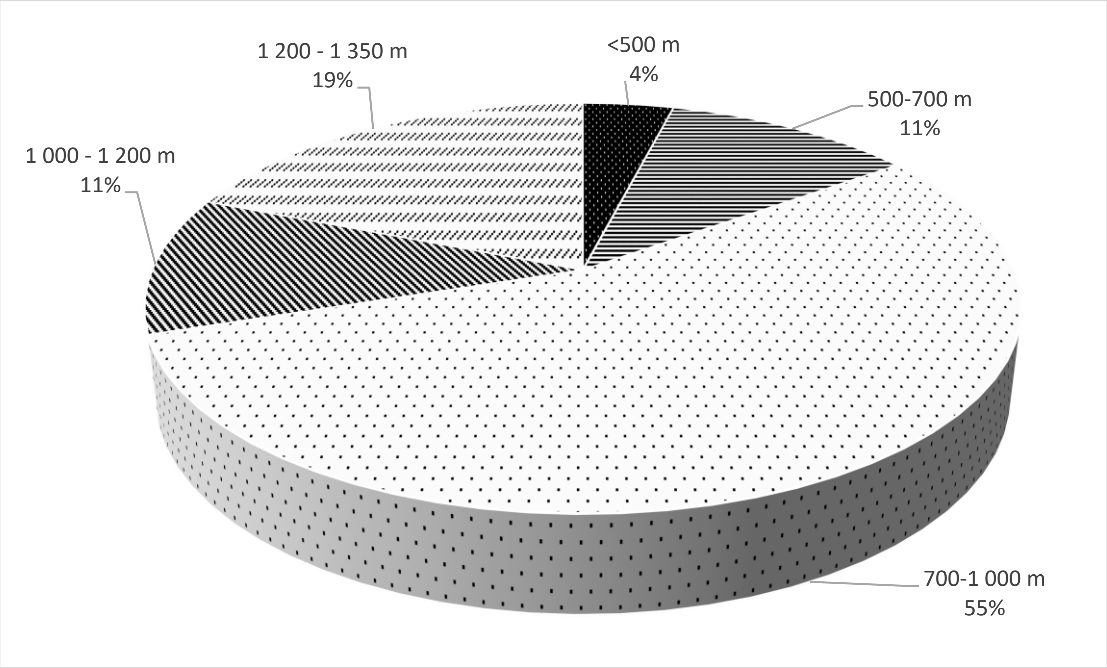


Figure 41 – Distribution of altimetry in the study area

The route between Aldeia Viçosa and Uíge crosses a set of subparallel reliefs with a NW-SE orientation, at elevations between 800 and 900 m, which are separated by lower areas at elevations of around 600 and 700 m.

Figure 42 – Aspect of the subparallel reliefs in the Quitexe area

Figure 43 – Flattened relief in the Puri region

Approximately 67 % of the study area has a gentle (3 % to 8 %) to undulating (8 % to 16 %) relief. Flat areas occupy approximately 23 % of the territory under study, while 10 % moderately steep (16 % to 25 %) to steep (> 25%). The areas with steeper slopes correspond to the reliefs previously referred to as parallel to each other, with a NW-SE orientation and elevations between 800 and 900 m.

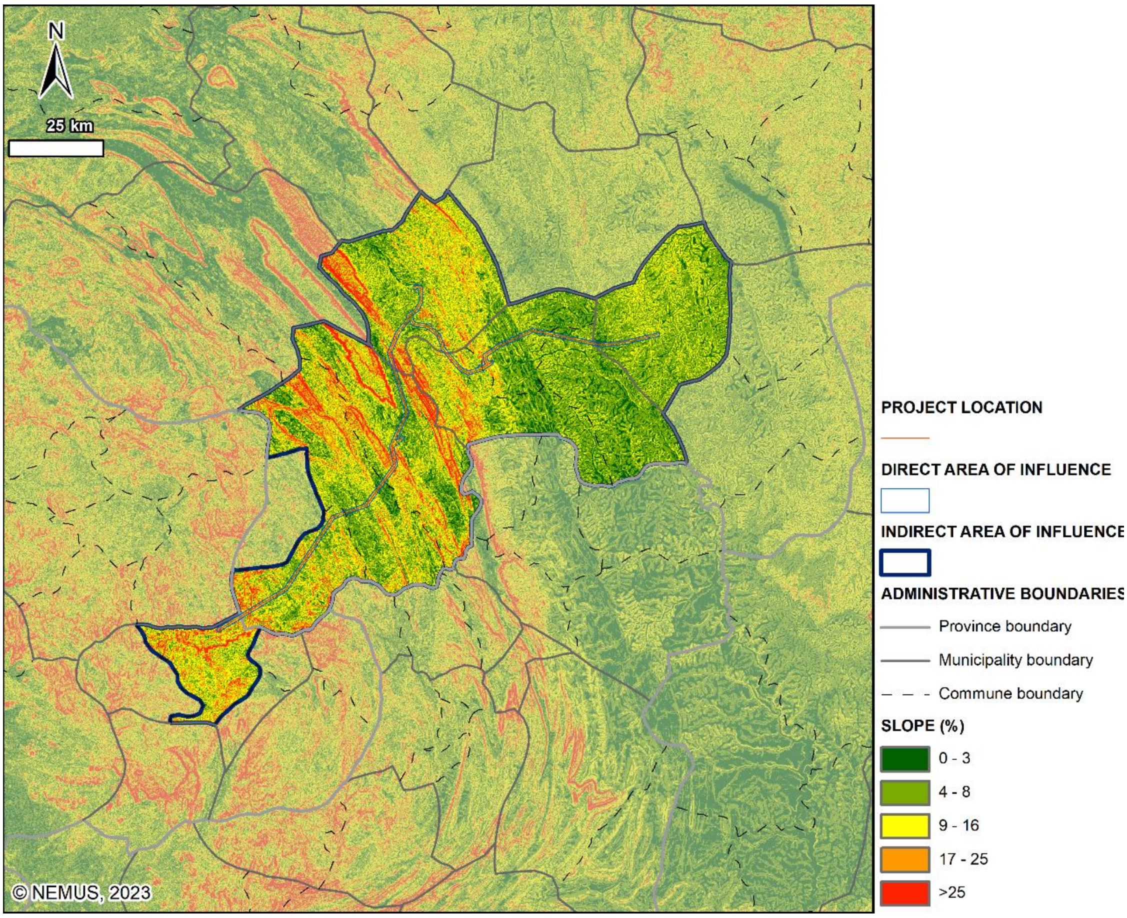


Figure 44 – Slopes

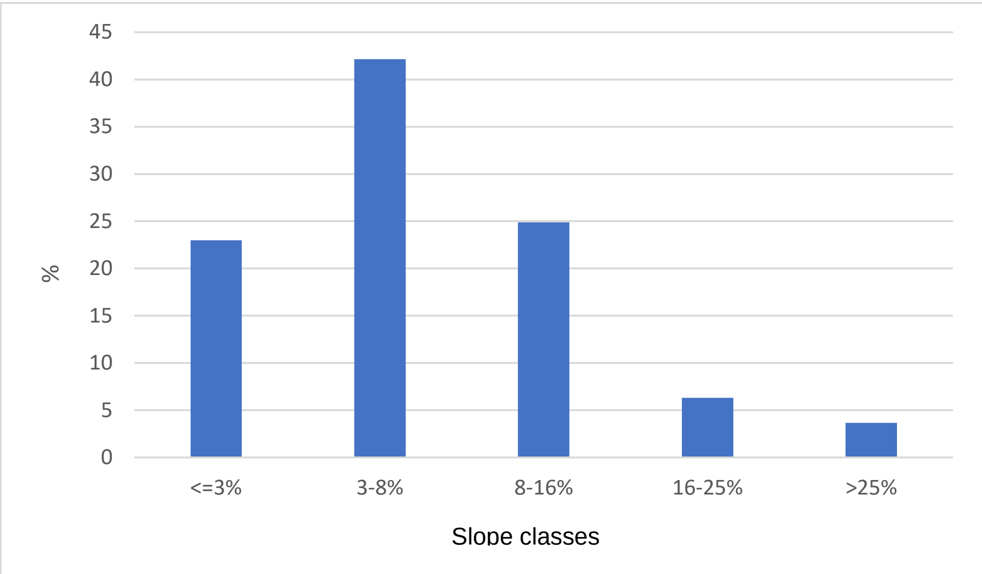


Figure 45 –Slope distribution in the study area

5.3.5. Seismicity

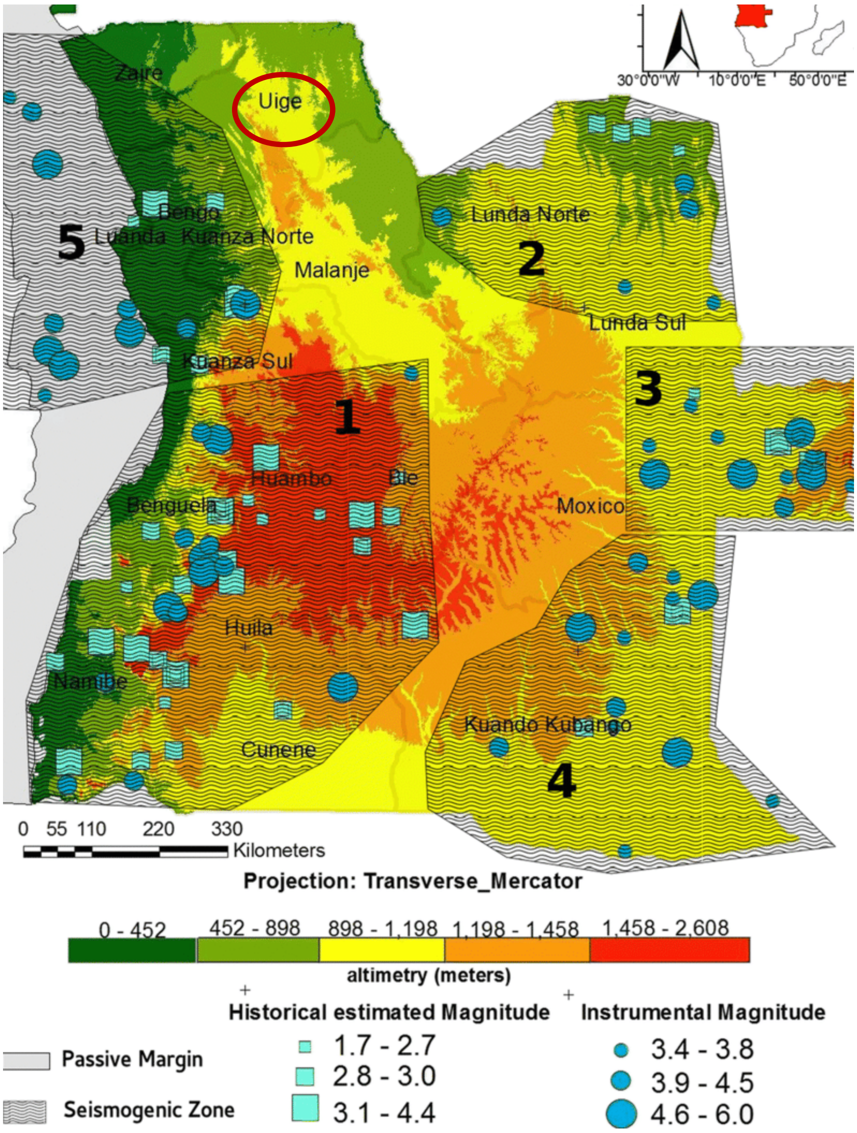
Angolan territory is located on the Southwest African Plate, in a region with reduced seismic activity.

The known earthquake with the highest magnitude was 6,0 Ms. Events with magnitude 4.5 have a return period of about 10 years. Events with magnitude 5 and higher occur with a return period of about 20 years (Neto, França, Condori, & Marotta, 2018)

Considering the last 10 years, the United States Geological Survey (USGS) identifies a single earthquake in Angola of significant magnitude. This earthquake occurred in 2014, at a depth of 15 km, had an epicentre 73 km NW of Longonjo and a magnitude of 4,1.

According to “ThinkHazard!” a project developed by the Global Facility for Disaster Reduction and Recovery (GFDRR), which provides information on the potential impacts of disasters on new development projects, Angola can be generally classified as having a moderate risk.

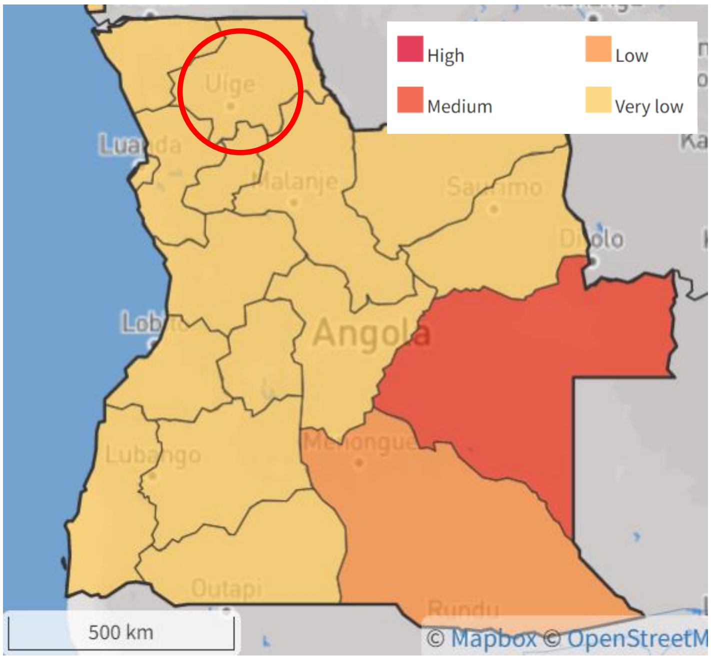
This means that the possibility of potentially damaging earthquakes occurring in the country in the next 50 years is 10 %. (Neto, França, Condori, & Marotta, 2018) identified five main seismic zones in Angola, and the area where the project is located does not cover any of them. In the seismic catalogue presented by these authors, for the period 1914/2014, it is found that in 100 years, no significant earthquakes were recorded.



Source: (Neto F, France, Condori, Sant'Anna Marotta, & Chimpliganond, 2018)

Figure 46 – Angola's seismicity map

According to ThinkHazard! the probability of potentially damaging earthquakes occurring in Uíge and Bengo provinces in the next 50 years is only 2 %.

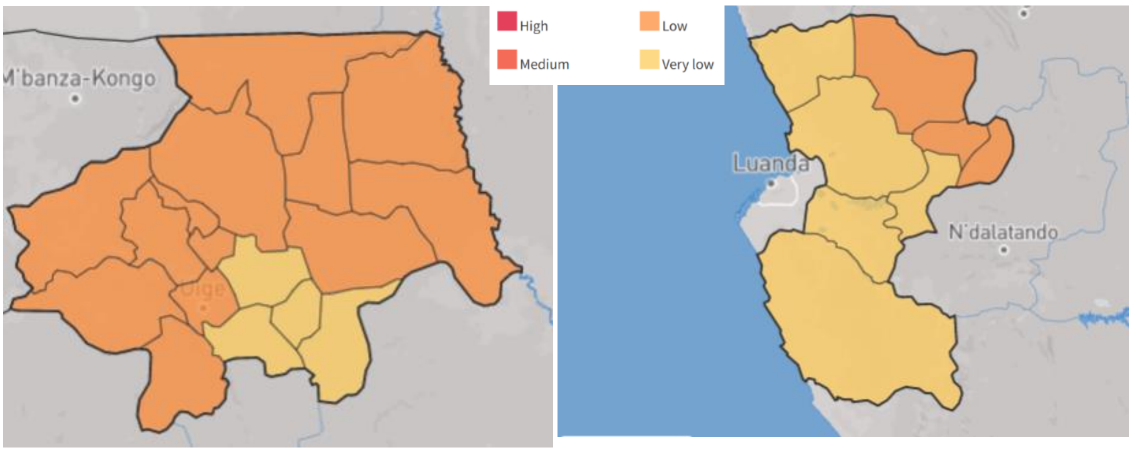


Source : https://thinkhazard.org/en/report/8-angola/EQ (2022)

Figure 47 –Seismic hazard

5.3.6. Slope instability

Susceptibility to slope instability depends on several factors, including geological and soil characteristics, rainfall patterns, slope, ground cover thickness and seismic activity. In the case of the provinces covered by the project, susceptibility to slope instability is generally low to very low.



a) b)

Source: https://thinkhazard.org/en/report/8-angola/LS (2022)

Figure 48 – Danger of slope instability in Uíge (a) and Bengo (b)

Along the project's route, the relief is mostly gentle to undulating, not enhancing situations of slope instability. Occasionally, on the steepest slopes, above 25%, there may be instability of rock blocks caused by the fracturing of the massifs supported by Precambrian crystalline rocks.

5.3.7. Evolution prospects in the absence of the project

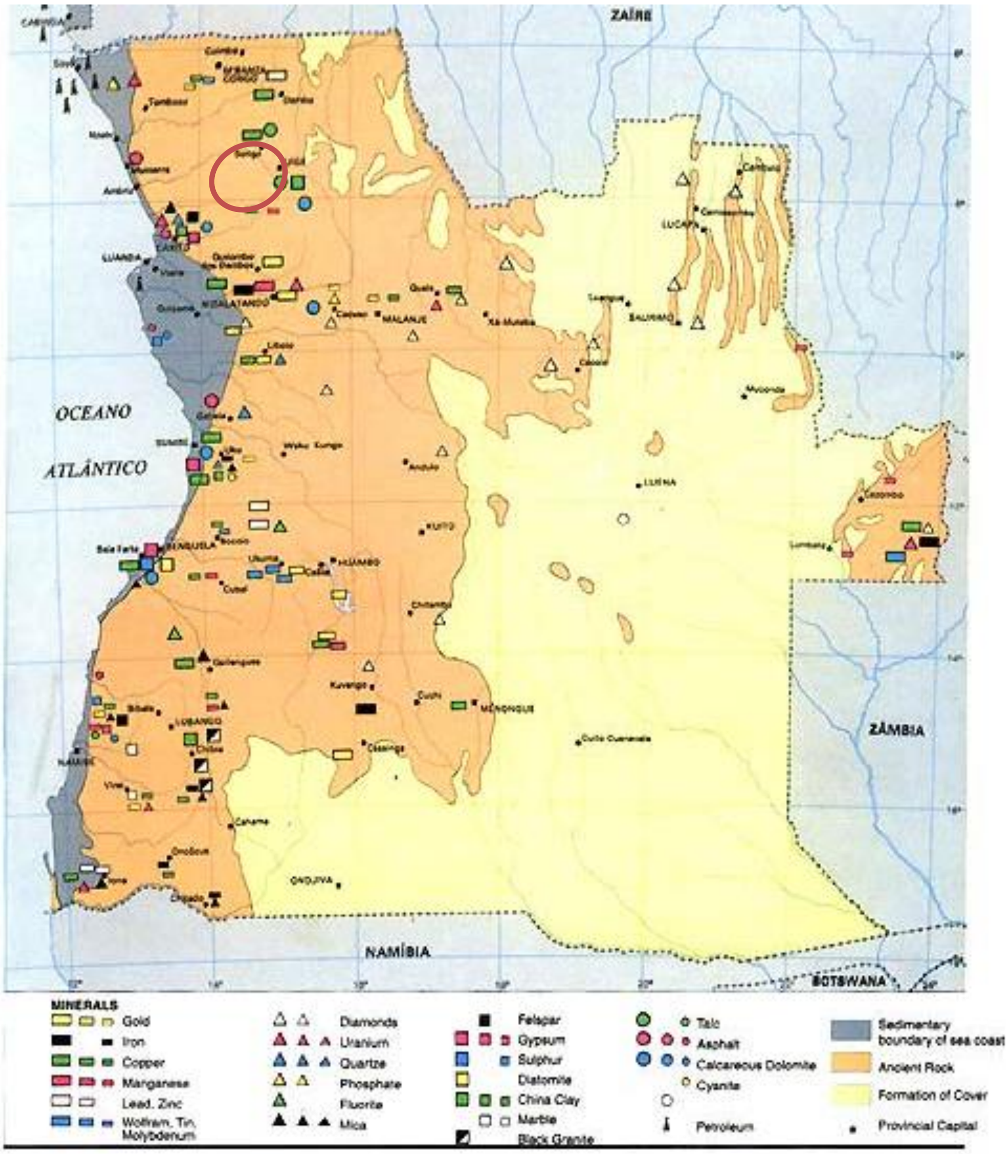
In the absence of the project no other interventions are known that could alter the current geological, geomorphological and topographical conditions.

5.4. Mineral resources

5.4.1. Geological resource potential

Although there is no detailed information on the distribution of mineral resources, Angolan territory has significant and diversified mining potential. Oil, gas and diamonds are the most important mineral resources.

A map with Angola's main mineral reserves is presented on the website of the Angolan Embassy in India. According to this source, in the region where the project is located there are mineral reserves of **manganese, talc and kaolin**.



Source: http://www.angolaembassyindia.com/about/map3.html
The red circle indicates the approximate project area

Figure 49 – Angola's main mineral reserves

5.4.2. Evolution prospects in the absence of the project

In the absence of the project no effects on the region's geological resources are expected.

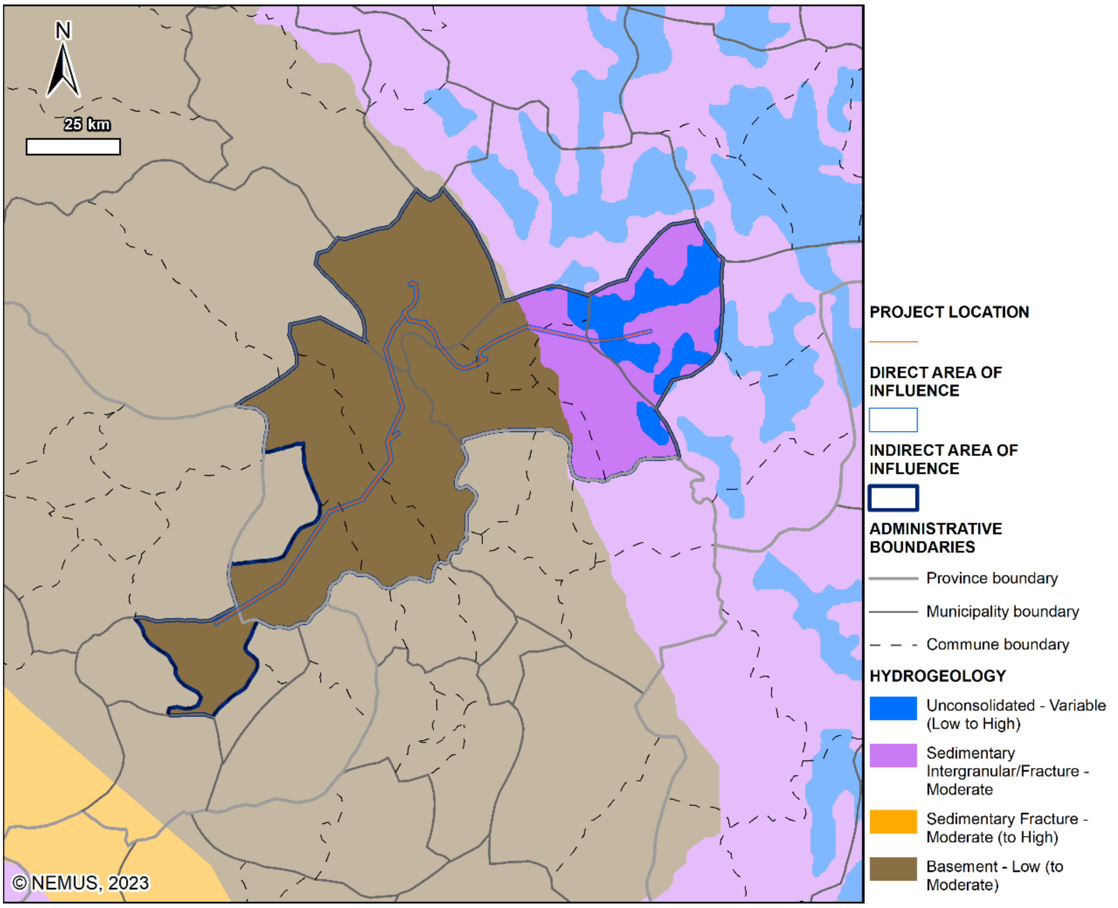
5.5. Hydrogeology

5.5.1. Hydrogeological framework

The geological context of Angola accounts for aquifers with varying productivity. According to the Groundwater Atlas of Africa (BGS, 2019) the project area encompasses two different types of hydrogeological units:

- **Fractured aquifers**, associated with the crystalline rocks of the basement. These aquifers have low to moderate productivity, depending on the degree of fracturing of the metamorphic and volcanic rocks.

- **Porous/fractured aquifers**, associated with consolidated sediments from the Cretaceous to the Tertiary. In general, these aquifers present moderate productivity, depending on the degree of consolidation of the sedimentary rocks.



Source: (BGS, 2019). Based on the map described by Persits et al. 2002 / Furon and Lombard 1964 Geology of Angola at 1:5 million scale.

Figure 50 – Aquifer units

Although surface water is the main source of water for human consumption, the use of groundwater is locally important in supplying populations, and some boreholes have been identified in the areas where the project is located. These boreholes are used by local populations for various purposes.

Figure 51 – Borehole in Uíge

Figure 52 – Borehole in Negage

A close correlation can be established between the lithology of aquifers and their potential vulnerability to pollution by a pollutant located on the ground surface.

Both fractured and porous sedimentary aquifers have their vulnerability to pollution dependent on porosity and permeability. The more extensive the fracturing and alteration of crystalline rocks, the greater the infiltration surface area and therefore the greater the likelihood of groundwater being polluted.

In the case of porous aquifers, the hydraulic connection to surface waters is a factor of vulnerability to pollution. However, the capacity to mobilise pollutants at depth depends on the thickness of the sedimentary deposits and the percentage of clay.

Considering the geology covered by the project, it is possible to consider that the main aquifers present **low to variable vulnerability to pollution**.

5.5.2. Evolution prospects in the absence of the project

In the absence of the project, no interventions generating impacts on groundwater resources are known.

5.6. Surface Water Resources

5.6.1. Introduction

This chapter presents the characterisation of surface water resources in the project's area of influence, including the following aspects:

- Hydrology;
- Water uses;
- Water quality.

The characterisation is based on information from the Angolan National Water Resources Institute (INRH in Portuguese) and relevant bibliography, complemented with additional information collected during a field visit in July 2022.

5.6.2. Hydrology

The area of influence of the project falls partially within the following river basin (INRH, 2020) (Figure 53 and Figure 54):

- Dande, integrated in the Dande Hydrographic Unit and North-western Hydrographic Region;
- Loge and M'Bridge, integrated in the Northwest Hydrographic Unit and Northwest Hydrographic Region;
- Baixo Kwanza, as part of the Baixo Kwanza hydrographic unit and Cuanza hydrographic region;
- Zaire/Congo, as part of the Cuango hydrographic unit and the Congo/Zaire hydrographic region.

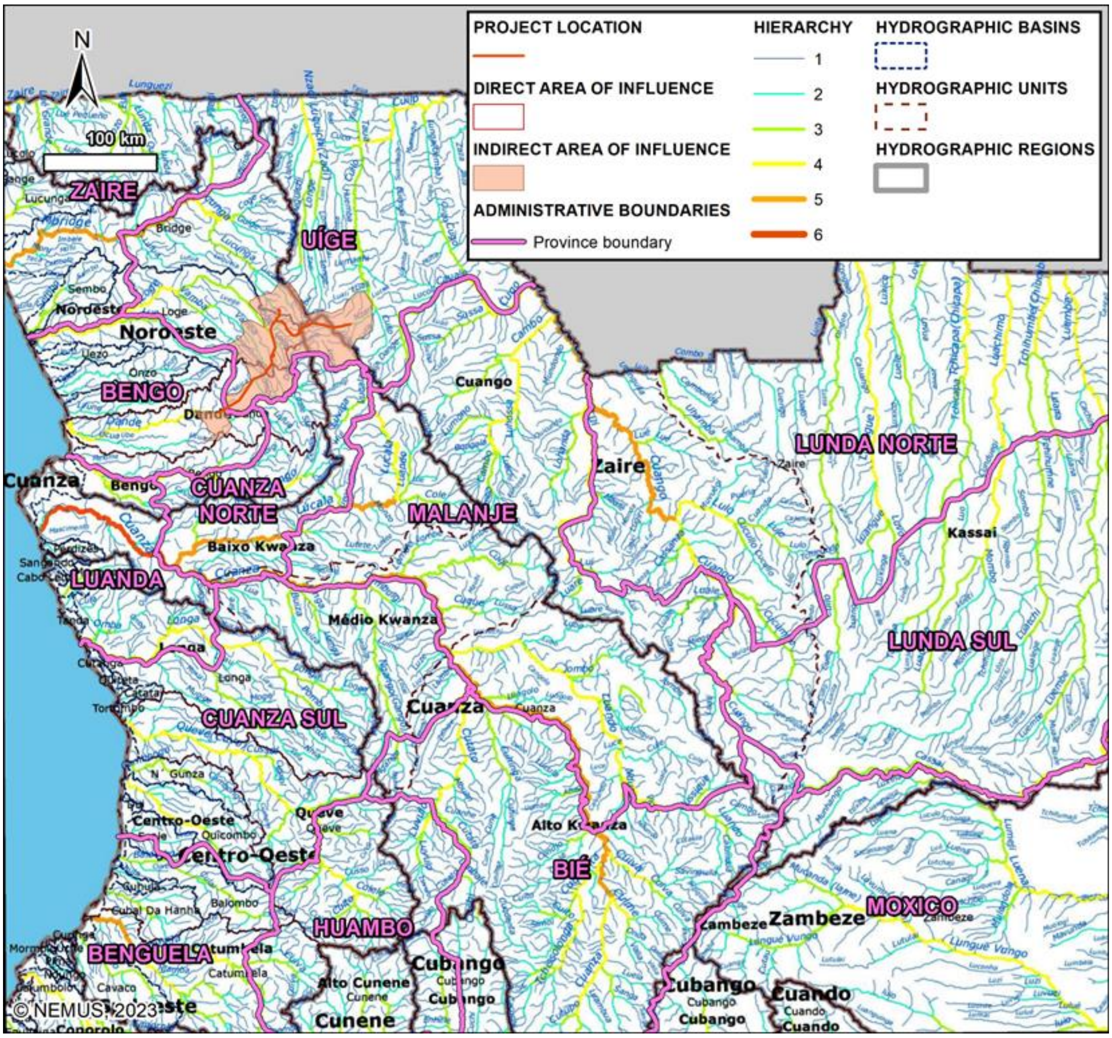
The Dande, North-Western and Lower Kwanza hydrographic units are part of the Atlantic Ocean drainage basin, while the Cuango hydrographic unit is part of the drainage basin of the Zaire River (Governo de Angola, 2017).

The Dande River starts in the municipality of Negage, in the province of Uíge, where it is called the Dange River, running along an east-west axis for 371 km in the provinces of Cuanza Norte and Bengo, flowing into the Atlantic Ocean about 45 km north of Luanda (Calçada, Magina, Castro, Carneiro, & Oliveira, 2021). The total area of the basin is 8.820 km^2. The project's ADI intersects two tributaries of the Dande River, namely the Luíca and Lombo rivers in the municipalities of Dembos-Quibaxe and Quitexe. The Dande River is located in the AII. The main characteristics of the Dande Hydrographic Unit are presented in Table 27.

The Loge and M'Bridge rivers flow east to west from Uíge province into Bengo and Zaire provinces, flowing into the Atlantic Ocean near Ambriz (Bengo province) and N'zeto (Zaire province) respectively. The project's ADI intersects the Loge River and two tributaries, Luege and Vamba, in the municipality of Quitexe, and another tributary of the Loge River, Luanga, in the municipality of Uíge. The Lucunga River (M' Bridge basin), in the municipality of Uíge, is located in the AII.

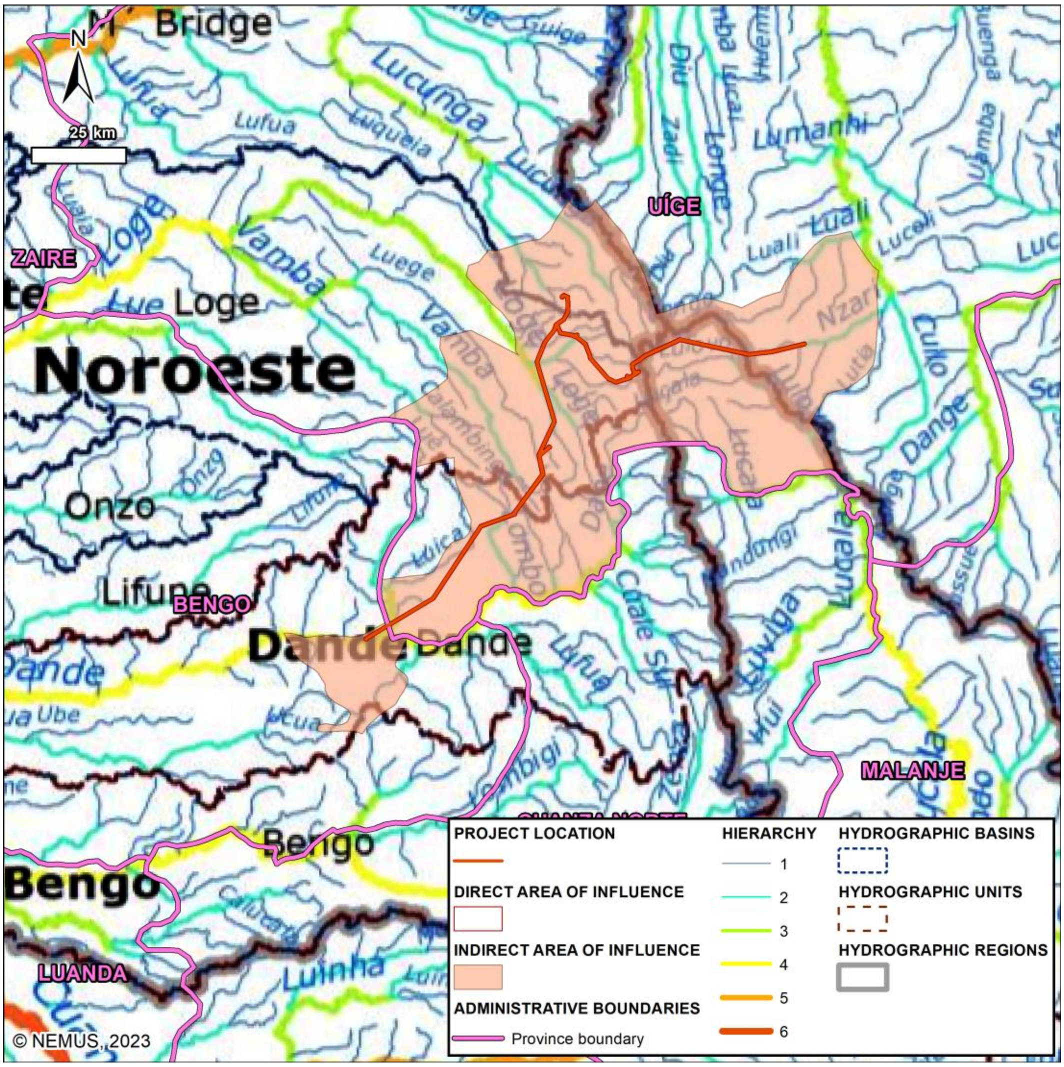
In the Loge River basin at Quitexe the “Lagoa do Feitiço” (AII) is also noted, a water resource with cultural importance (in the Cultural Heritage descriptor). The main characteristics of the North-West hydrographic unit are presented in Table 27.

The Kwanza River is the largest river exclusively in Angola and runs from south to north from the province of Bié, through the provinces of Malanje, Kwanza Sul and Kwanza Norte, turning westwards and flowing into the Atlantic Ocean south of the city of Luanda in the province of the same name. Its basin covers a total area of 151.246 km^2, divided between the Upper Kwanza, Middle Kwanza and Lower Kwanza hydrographic units (INRH, 2020). The project's ADI intersects an unidentified stream, a tributary of the Nucala River (tributary of the Kwanza) in the municipality of Negage, in the Baixo Kwanza Hydrographic Unit. The main characteristics of the Baixo Kwanza Hydrographic Unit are presented in Table 27.



Source: adapted from (INRH, 2020)

Figure 53 – Hydrographic regions, hydrographic units and provinces of Angola within the project's area of influence.



Source: adapted from (INRH, 2020)

Figure 54 – Hydrographic units and main surface water resources in the project's area of influence

The Zaire/Congo River is an international perennial river with a length of 4 700 km and its source in the Rift Valley at an altitude of 1 430 m, south of Lake Tanganica, in the Republic of Zambia. In Angola, its basin extends over the provinces of Lunda Sul, Lunda Norte, Malange, Uíge and Zaire.

The Zaire/Congo River flows into the Atlantic Ocean on the border between Angola and the Democratic Republic of Congo (INRH, 2022). The total basin area is 3 699 100 km^2, about 287 619 km^2 in Angola, in the Kassai and Cuango hydrographic units (INRH, 2022) (Governo de Angola, 2013).

The main characteristics of the Cuango Hydrographic Unit are presented in Table 27.

a)

b)

Source: NEMUS, 2022

Figure 55 – Main surface water resources in the project's area of influence: a) Dande River (AII), b) tributary of the Loge River (ADI)

Source: NEMUS, 2022

Figure 56 – Main surface water resources in the project's area of influence: Feitiço lagoon, Quitexe municipality (AII)

a)

b)

Source: NEMUS, 2022

Figure 57 – Main surface water resources in the project's area of influence: a) Luanga River (AII), b) Lucunga River (AII)

Table 27 – Main characteristics of the hydrographic units in the area of influence of the project

Hydrographic Unit	Area (km^2)	Mean annual precipitation (mm)	Flow (mm)		
			Mean year	Dry year	Very dry year
Dande	9 829	1071	110	60	35
Noroeste	54 206	1102	123	80	57
Baixo Kwanza	34 706	1048	125	80	57
Cuango	132 978	1406	250	169	126

Source: (Governo de Angola, 2013)

The average yearly runoff in the hydrographic units of the project's area of influence is between 110 mm (Dande) and 250 mm (Cuango). Average annual precipitation and runoff are significantly higher in the Cuango hydrographic unit, being among the highest in the country. There is an important variability in runoff between average and dry years, which is more accentuated in the Dande River Hydrographic Unit.

Seasonal variability is also marked, occurring, as in general in Angola, very reduced runoff between the months of May and September (Governo de Angola, 2017), information also highlighted by the population in the field visit made for the present study in July 2022. The rivers Cuango, Dande and Cuanza have a permanent regime (Governo de Angola, 2013).

The intersections of water lines by the project lines are summarised in the following table. It can be seen that most of the water lines intersected by the project fall within the Dande and North-West hydrographic units, corresponding in general to tributaries of the Dande and Loge rivers.

Table 28 – Water courses crossing by the project.

Water Courses	Hidrographic Unit	km - Line	Municípality	Commune
Luíca River	Dande	4900 – Aldeia Viçosa – Rio Dange	Dembos-Quibaxe	Kibaxe

Water Courses	Hidrographic Unit	km - Line	Municípality	Commune
Luíca River	Dande	5 250 - Aldeia Viçosa – Rio Dange	Dembos-Quibaxe	Kibaxe
Luíca River	Dande	5 425 - Aldeia Viçosa – Rio Dange	Dembos-Quibaxe	Kibaxe
Luíca River	Dande	7 350 - Aldeia Viçosa – Rio Dange	Quitexe	Vista Alegre (Quifuafua)
Luíca River	Dande	7 650 - Aldeia Viçosa – Rio Dange	Quitexe	Vista Alegre (Quifuafua)
Luíca River	Dande	7 750 – Aldeia Viçosa – Rio Dange	Quitexe	Vista Alegre (Quifuafua)
Stream of Luíca River	Dande	37 250 – Aldeia Viçosa – Rio Dange	Quitexe	Vista Alegre (Quifuafua)
Lombo River	Dande	46 150 – Aldeia Viçosa – Rio Dange	Quitexe	Aldeia Viçosa (Quitende)
Vamba River	Noroeste	60 600 – Uíge-Aldeia Viçosa 4800 – Aldeia Viçosa - Quitexe	Quitexe	Aldeia Viçosa (Quitende)
Luege River	Noroeste	54 650 – Uíge-Aldeia Viçosa 10800 Aldeia Viçosa - Quitexe	Quitexe	Quitexe
Loge River	Noroeste	22 050 – Uíge-Aldeia Viçosa	Quitexe	Quitexe
Luanga River	Noroeste	17 150 – Negage - Quionga	Uíge	Uíge
Ribeira sem nome	Baixo Kwanza	32 050 – Negage - Puri	Negage	Dimuca

5.6.3. Floods and droughts

The occurrence of **floods and inundation** is frequent along the Kwanza and Dande rivers in Bengo province, downstream of the project (Governo de Angola, 2013). At a local level, flooding is also reported along the water lines in the municipality of Uíge in the rainy season, due to the urban occupation of the banks (Barros, Silva, & Carvalho, 2020) (in the Figure 57 b).

The phenomenon of **drought** is not frequent in the study area, being more characteristic of the southern region of the country. However, the effects of drought can be felt occasionally in the province of Uíge, as happened in 2008, with the affectation of some agricultural crops (Governo de Angola, 2017).

5.6.4. Water uses

The consumptive uses of water in the hydrographic units where the study area is located comprise human supply, irrigation and livestock (Table 29). Within these, urban water supply predominates in all hydrographic units, except in the Dande Hydrographic Unit, where the main use of water is for irrigation.

Livestock use (animal desedentation) is a minority in all hydrographic units, and the use for industrial supply is very insignificant, less than 0,3 hm^3/year (Governo de Angola, 2017).

Table 29 – Water needs (hm^3/year) per main consumptive use in 2014-2015.

Hydrographic Unit	Human Supply (2014)			Irrigation (2015)	Cattle raising (2015)
	Total	Urban	Rural		
Dande	3,77	1,82	1,94	9,4	0,8
Noroeste	18,21	10,50	7,71	1,4	1,7
Baixo Kwanza	120,79	115,89	4,90	53,6	3,9
Cuango	18,29	11,35	6,94	7,1	2,6

Source: (Governo de Angola, 2017).

In urban areas supply use includes domestic use, commercial and service use, industrial use, consumption by the state, public sector and institutions (schools, health facilities, etc.) and municipal community use. In rural areas the supply use includes domestic use (drinking, cooking, personal hygiene, sanitation and washing) (Governo de Angola, 2017).

According to information obtained during the field visit in July 2022, in the area under study, following what was verified in the generality of the province of Uíge, human supply is essentially made from surface water resources, These are processed by manual capture by the population in water lines close to the villages (Aldeia Viçosa/ Quitende, Kibunga Lau, Calumbo, Piqui and Dambi) or by centralized capture in gravity supply systems (Piqui and Dambi, Quiongua) or with pump (Cangundo) to supply reservoirs and fountains (Figure 58 a).

In general, the existing water supply systems have operational problems, caused by under-dimensioning and degradation of the infrastructure (Piqui and Dambi, Calumbo) or lack of energy for pumping (Viçosa/ Quitende Village).

Also, in the city of Uíge the rivers are used as sources of water supply for human consumption, since most of the population does not have a public water supply, due to limitations in the size and ruptures in the public supply system (Manuel, Leitão, & Boaventura, 2018).

During the July 2022 field visit, the *in natura* use of water in the water lines in the project's area of influence was also observed, namely for bathing and domestic washing (Figure 58 b). In all localities visited access to water was highlighted as one of the main concerns of the population.

The use for irrigation (Figure 59) assumes greater expression in the Kwanza River basin, with the Middle Kwanza Hydrographic Unit, upstream of the study area, and the Lower Kwanza Hydrographic Unit having in 2015 18 % and 8,8 % of the national irrigated area, respectively (Governo de Angola, 2017).

With regard to non-consumptive uses, it is worth noting the production of electricity by water in the Dande Hydrographic Unit with the Mabubas plant, downstream from the project (Bengo province), and in the Middle Kwanza Hydrographic Unit, upstream from the project, with the Capanda (Malanje province) and Cambambe I and Laúca (Kwanza Norte province) plants (Governo de Angola, 2017).

With regard to environmental uses, concerning ecological needs, the assessment carried out in the National Water Plan (Governo de Angola, 2017) concluded that the general uses of water are compatible with environmental uses, verifying an "almost natural" state, with little modification of the habitat and riparian gallery.

Although not reported in the field visit conducted for this study in July 2022, artisanal fishing is known to be practiced in the Uíge province (Mawunu, et al., 2020), highlighting in this field some rivers located in the project's area of influence, namely the Lucunga River (M'Bridge River basin) and Loge, Luege and Vamba Rivers (Loge River basin) (AIPEX, 2022).

The current water balance in the hydrographic units of the study area is assessed in the National Water Plan (Governo de Angola, 2017) as Excellent, in average, dry or very dry years, with little or no management activity being required to ensure consumptive uses of water.

It can be seen that the Cuango Hydrographic Unit has the highest water availability in relation to its uses, while the Lower Kwanza Hydrographic Unit has the lowest availability, even though it is classified as excellent.

a)

b)

Source: NEMUS, 2022

Figure 58 – Uses of surface water resources in the project's area of influence: a) public supply from a water collection system (Cangundo, Negage municipality), b) bathing and domestic washing in a tributary of the Loge River (Uíge)

Source: NEMUS, 2022

Figure 59 – Uses of surface water resources in the project's area of influence: crop irrigation (Puri)

Table 30 – Water exploitation index (WEI): ratio between the mean annual consumptive use volume and the annual water availability.

Hydrographic unit	WEI (%)		
	Mean year	Dry year	Very dry year
Dande	0,5	0,5	0,6
Noroeste	0,1	0,1	0,2
Baixo Kwanza	0,9	1,5	1,1
Cuango	0,0	0,0	0,0

Notes: WEI ≤ 5% - Excellent, none or little management actions are required; 5% < WEI ≤ 10% - Confortable, can occur situations requiring specific management measures in the basin; 10% < WEI ≤ 20% - Worrisome, integrated management of the hydrographic unit necessary, requiring medium size investments; 20% < WEI ≤ 40% - Critical, demanding intense management activity and large investments; WEI > 40%, Very critical.
Source: (Governo de Angola, 2017).

5.6.5. Water quality

The water quality regulation in Angola is established by Presidential Decree n. º 261/11 of 6th of October (Water Quality Regulation), which provides quality standards for water intended for human consumption and for aquiculture, cattle raising, irrigation and bathing.

There is no regular water quality monitoring data available for the hydrographic units in the study area (Governo de Angola, 2017). The assessment conducted under the National Strategic Programme for Water 2013-2017 (Governo de Angola, 2013) with scarce data concluded good water quality in general in the country, especially in rural areas.

In the province of Uíge in recent years there has been a significant incidence of water-borne diseases which are likely to be associated with the quality of water used by the population.

In fact, a study of water sources for human supply in the city of Uíge with sampling in the Loé River (AII, Table 31), concluded by bacteriological contamination and ammonia nitrogen problems in the rainy season, indicating pollution originating from domestic sewage (Manuel, Leitão, & Boaventura, 2018). The high concentration of dissolved iron could be related to the soils of the region.

Table 31 – Water quality sampling in Loé River (Uíge city, AII, M'Bridge basin).

Parameter	July/ August 2014 (Dry Season)	November/ December 2014 (Wet season)	Presidential Decree n. º 261/11)	
			Drinking water standard	Minimum quality standard
Ammoniacal nitrogen (mg/l NH_4^+)	0,02	0,47	0,05	1
Dissolved iron (µg/L)	218	206	100	-
Turbidity (UNT)	15,4	24,5	-	-
Escherichia coli	Present	Present	Absent	-

Source: (Manuel, Leitão, & Boaventura, 2018).

In Angola the existing public sanitation systems exist in only a small number of cities (Luanda, Huambo, Namibe, Lobito and Benguela), with a service area restricted to the city centres and a general lack of wastewater treatment (only Luanda, Lobito and Benguela had wastewater treatment in 2013), the quality of surface water resources is mainly pressured by domestic wastewater pollution.

The majority of the urban population uses septic tanks and dry latrines, but part of the population has no sanitation facilities whatsoever (Governo de Angola, 2013).

Inadequate disposal of domestic solid waste can also be an important source of pollution of surface water resources (Governo de Angola, 2017).

Compared to domestic sources, industrial and agricultural activities are less important sources of pollution of surface water resources in most parts of the country (Governo de Angola, 2017).

In fact, although agricultural activity predominates in the area under study, it is essentially carried out on a subsistence basis and with the prospect of low use of fertilizers (Baumgärtel, et al., 2022).

The risk of erosion in the project's area of influence varies between high (between the Dange River and Quitexe, between Negage and Puri and in part of the stretch between Uíge and Negage) and very high (between Quitexe and Uíge and in part of the stretch between Uíge and Negage), with soil erosion triggered by rainfall, slopes and land use (in the Soils and land use section).

Thus, soil erosion is an important source of pollution of surface water resources, increasing turbidity and concentration of total suspended solids and of some metals present in soils, such as iron.

Roads can also be a source of pollution of surface water resources in the area of influence of the project at the intersections of water lines due to the run-off of pollutants (hydrocarbons, metals and organic substances) derived from oils and fuels spilled on the ground into water lines after heavy rainfall events.

5.6.6. Evolution prospects in the absence of the project

The future water balance for the hydrographic units under study was estimated under the National Water Plan (Governo de Angola, 2017), for a balanced socio-economic growth scenario with growth in water consumption for irrigation and livestock until 2025 and for industry and energy production from 2025 to 2035.

In this context, a reduction in water availability is predicted, especially in the Lower Kwanza Hydrographic Unit, in which the Current Use Index is downgraded from Excellent to Comfortable, in which situations requiring specific management measures at basin level can occur in dry and very dry years (Table 32).

Table 32 – Water exploitation index (WEI): for the C4 scenario in 2040.

Hydrographic unit	Water availability (hm^3)	Water needs (hm^3)	WEI (%)		
			Mean year	Dry year	Very dry year
Dande	2 705	100	3,7	4,0	4,4
Noroeste	17 097	403	2,4	2,5	2,7
Baixo Kwanza	36 388	1.758	4,8	6,0	7,0
Cuango	65 099	206	0,3	0,3	0,3

Notes: WEI ≤ 5% - Excellent, none or little management actions are required; 5% < WEI ≤ 10% - Comfortable, can occur situations requiring specific management measures in the basin; 10% < WEI ≤ 20% - Worrisome, integrated management of the hydrographic unit necessary, requiring medium size investments; 20% < WEI ≤ 40% - Critical, demanding intense management activity and large investments; WEI > 40%, Very critical.
Source: (Governo de Angola, 2017).

The National Water Plan (Governo de Angola, 2017) includes for the period up to 2040 investments related to water uses in the hydrographic units of the Kwanza, Dande, North-West and Cuango rivers, including flow regulation, equipping areas for irrigation and new hydroelectric plants, as well as improving the water supply and sewage collection networks.

The investments related to flow regulation consist of the construction and rehabilitation of dams on the Kwanza River (2025-2040): Carianga Dam (Lower Kwanza), Quissonde Dam (Middle Kwanza), Salamba Dam (Upper Kwanza).

The equipping of areas for irrigation will involve an increase of 38 992 ha in the Dande Hydrographic Unit, 219 786 ha in the Northwest Hydrographic Unit, 431 073 ha in the Lower Kwanza Hydrographic Unit and 113.127 ha in the Cuango Hydrographic Unit.

The implementation of new hydroelectric schemes (HS) is planned for the Kwanza River, downstream of the project area:

- Upper Kwanza Hydrographic Unit: HS Salamba, AH Banza-Tamba, HS Dando (Bié);
- Middle Kwanza Hydrographic Unit: HS Zenzo and HS Caculo Cabaça (North Kwanza), HS Quissonde (Bié), HS Túmulo do Caçador (South Kwanza);
- Baixo Kwanza Hydrographic Unit: HS Cambambe II, HS Bembeze, HS Carianga (North Kwanza).

The planned measures concerning water supply and sanitation include the extension and strengthening of water supply to provincial capitals, water supply to municipalities, urban water supply and sanitation systems, rural water supply and sanitation systems, rehabilitation and construction of urban and peri-urban drainage systems and construction of small-scale community water supply and sanitation systems in suburban and rural areas.

The implementation of these investments, which may be delayed due to lack of funding, could lead to an increase in water consumption in the hydrographic units of the project's area of incidence, if alternative sources to surface water resources are not explored, through the increased use of water for irrigation and human supply, which could affect more sensitive uses such as environmental uses and fishing.

At the same time, water quality may be improved by better control of domestic pollution.

5.7. Soil and land use

5.7.1. Introduction

This section describes the types and land uses existing in the study area, considering the Area of Direct Influence (ADI) and the Area of Indirect Influence (AII).

The information was based on the Soil Atlas of Africa (Jones, *et al*., 2013) and the Land Use and Occupancy cartography (ESA/CCI, 2015).

5.7.2. Soil types in the study area

The map of soil types is represented in Figure 60. The predominant soils in the study area are the Umbric Ferralsols, the Xanthic Ferralsols and the Ferralic Arenosols. Other soil types are present locally in small areas, in the ADI and AII.

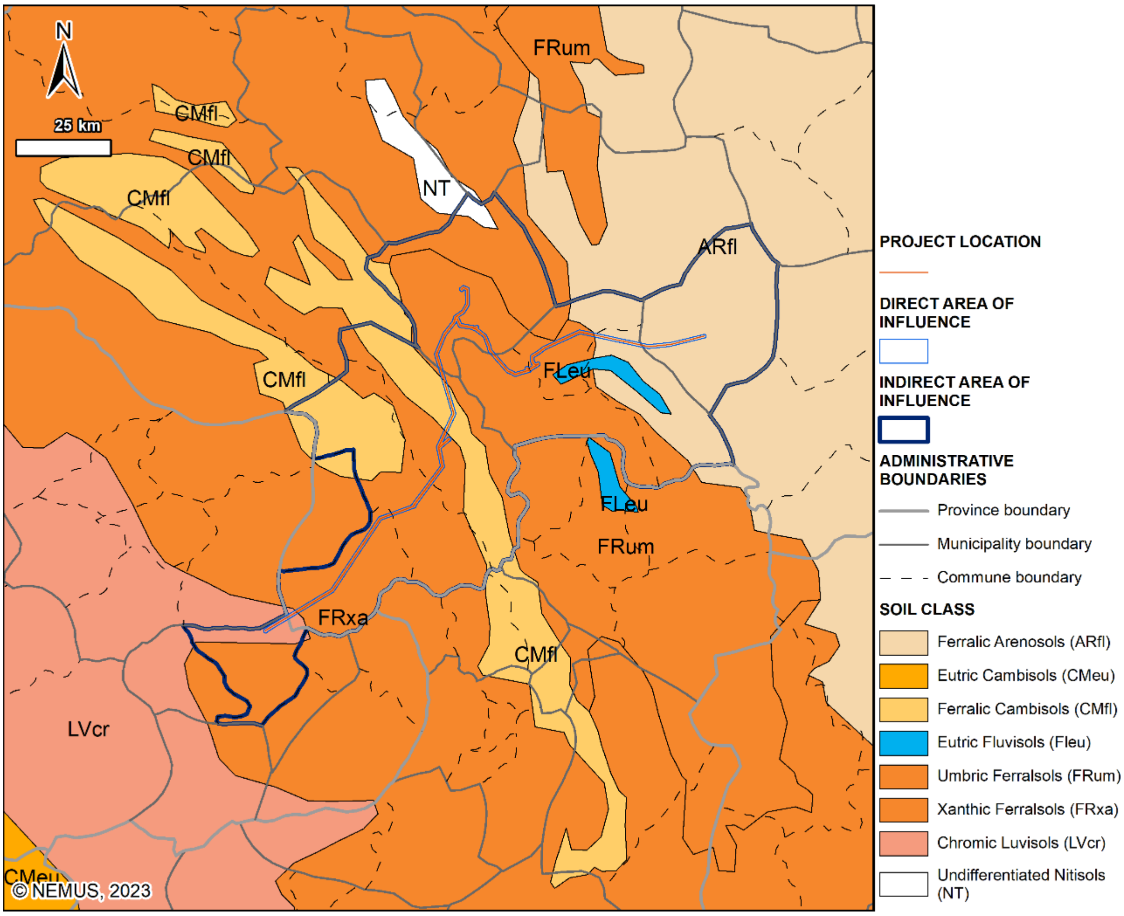


Figure 60 – Soil classes in the study area

Table 33 – Distribution of soil types along the Transmission Line (ADI and AII)

Soil classes	Area	
	hectares	%
ADI		
Umbric Ferralsols (FRum)	7 377	37
Xanthic Ferralsols (FRxa)	7 042	36
Ferralic Arenosols (ARfl)	2 992	15
Ferralic Cambisols (CMfl)	1 421	7
Chromic Luvisols (LVcr)	998	5
Total	**19 830**	**100**
AII		
Xanthic Ferralsols (FRxa)	268 100	34
Umbric Ferralsols (FRum)	204 816	26
Ferralic Arenosols (ARfl)	183 107	23
Ferralic Cambisols (CMfl)	111 254	14
Chromic Luvisols (LVcr)	15 315	1,9
Eutric Fluvisols (Fleu)	11 966	1,5
Undifferentiated Nitisols (NT)	4 743	0,6
Total	**799 301**	**100**

Ferralsols are characterised by the occurrence of ferral horizons - sub-surface horizons that are much less affected by organic matter than surface horizons. They represent the strongly altered yellow and red soils of the humid tropics.

The argillaceous fraction is dominated by clays of low activity (mainly kaolinite) and a high percentage in iron and aluminium sysiloxides. They are strongly altered soils, with low mineral reserves, typical of the humid tropics and are generally found on flat or undulating landscapes (WRB, 2006).

Most Ferralsols have good physical properties, with good depth permeability, but low water holding capacity, and a stable microstructure that make them less susceptible to erosion than most other strongly altered tropical soils. They are not very fertile soils; alterable minerals are scarce or absent and the cation retention capacity of the mineral fraction is low. Plant-available nutrients are mostly allocated to the organic matter, which is present mainly in the superficial horizons.

Umbric Ferralsols have a dark colour and acidic surface horizon, rich in organic matter and Xanthic Ferralsols have a yellow colouration (Jones, *et al*., 2013).

Arenosols include sandy to sandy loam soils, strongly altered, derived from unconsolidated materials. They have high permeability and a low capacity to retain water and nutrients, the nutrients being mainly allocated to the biomass and organic matter of the soil.

In tropical climates these soils should remain under natural vegetation. Although easy to cultivate, intensive cultivation of annual crops requires large investments that in most cases are not economically justified (WRB, 2006).

In the absence of vegetation, they are soils easily erodible by wind.

Ferralic Arenosols are characterised by the presence of high levels of iron (Jones, et al., 2013).

Ferralic Cambisols are soils moderately developed, strongly altered with low nutrient retention capacity.

They generally do not show differentiation of horizons, exhibiting only minor evidence of soil formation through variations in colour, change in structure or the presence of clay minerals (Jones, *et al*., 2013).

Their texture varies from medium to fine. They are soils for agricultural use, generally poor in nutrients, but richer than the Ferralsols and generally have a higher cation exchange capacity.

The most acidic Cambisols, although less fertile, are also used for agriculture and pasture (WRB, 2006). In steeply sloping areas they are susceptible to erosion and should remain under vegetation cover (Jones, *et al.*, 2013).

The Chromic Luvisols have high clay content in the subsoil. The clay fraction is dominated by clays of high activity and high base saturation, with a high capacity to retain nutrients.

Generally, they have a well-developed structure and good water retention capacity. They are productive soils if properly handled. In steep slope areas they are susceptible to erosion (Jones, et al., 2013; WRB, 2006).

Fluvisols are poorly developed soils derived from alluvial deposits and visible stratification (presence of multiple layers of soil), which occur in periodically flooded areas. They are generally fertile soils with great agricultural potential.

Eutric Fluvisols have a base saturation greater than or equal to 50 % (Jones, *et al*., 2013; WRB, 2006).

Nitisols are well developed tropical soils, with weak differentiation of horizons, but with clear and shiny macro aggregates in the B horizon and angular block structure.

These are deep soils, with good drainage and red colouring. They have a clayey or very clayey texture, with low activity clay. They are suitable for a wide variety of crops.

On slopes are susceptible to erosion (Jones, et al., 2013; WRB, 2006).

Figure 61Figure 61 – illustrates some of the soil types found in the study area.

Figure 61 – Ferralic Arenosols in the Municipality of Puri (left) and Umbric Ferralsols in the Municipality of Negage (right)

Considering the overlap between the project area and the Erosion Risk Map (ESDAC,2022), three levels of erosion risk have been identified in the ADI.

In the section between the new Dange River substation and the town of Quitexe (municipal seat), the risk of erosion is "High" (level 5), with the main causes of risk being slopes and rainfall erosion.

The same risk sub-factors, but in a more accentuated manner, raise the risk of erosion to "Very High" (level 8) in part of the section between Quitexe and the city of Uíge, and in part of the section between Uíge and Negage.

On the remaining stretch of road, namely between Negage and Puri and part of the stretch between Uíge and Negage, the risk of erosion is also "High" (level 6). The main causes of erosion risk on these stretches are rainfall erosion and soil occupation.

Figure 62 identifies the project area on an extract from the Erosion Risk Map of Angola.

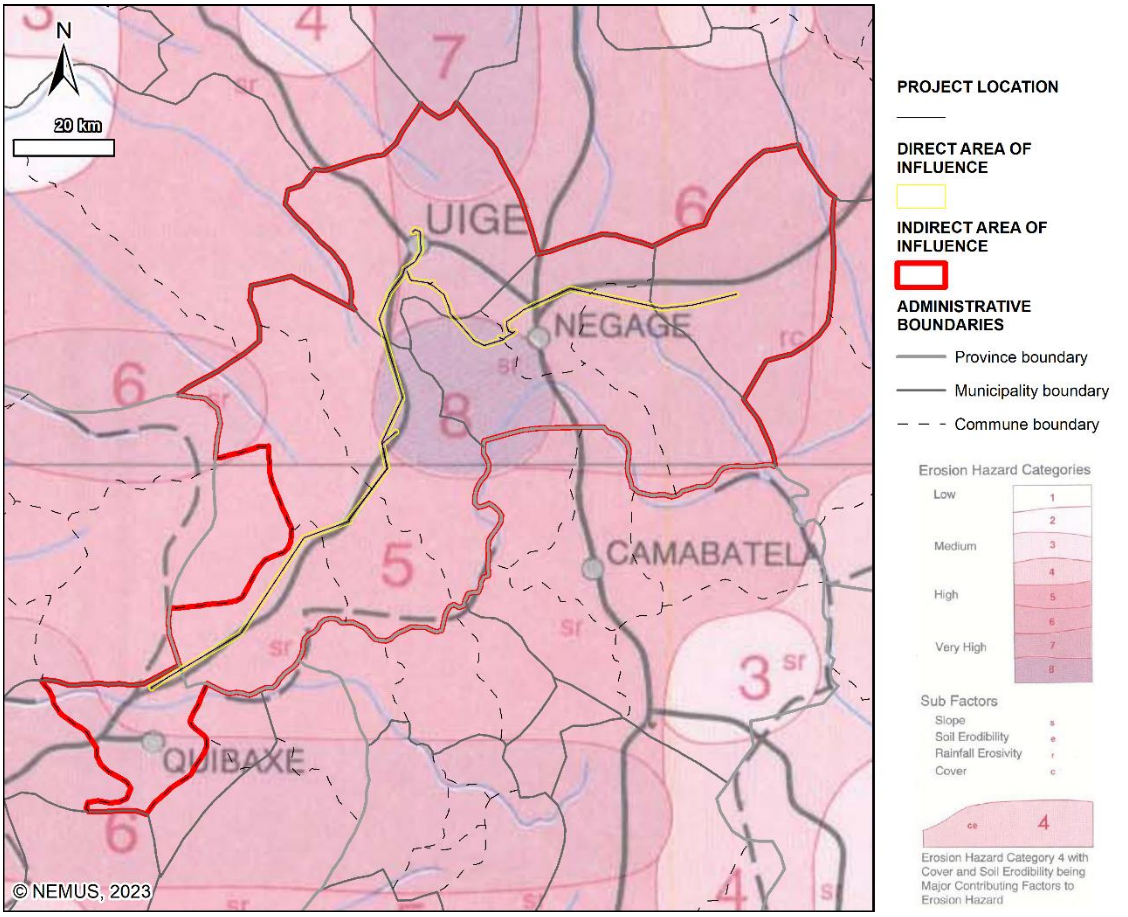


Figure 62 – Project area on the Erosion Risk Map of Angola

5.7.3. Land use and land cover in the study area

The land use and land cover map are represented in Figure 63. The predominant land use classes in the study area are the areas of tree cover and grassland, distributed according to Table 34 . There are also classes with less spatial expression, namely built-up areas, areas of shrub cover and cultivated land.

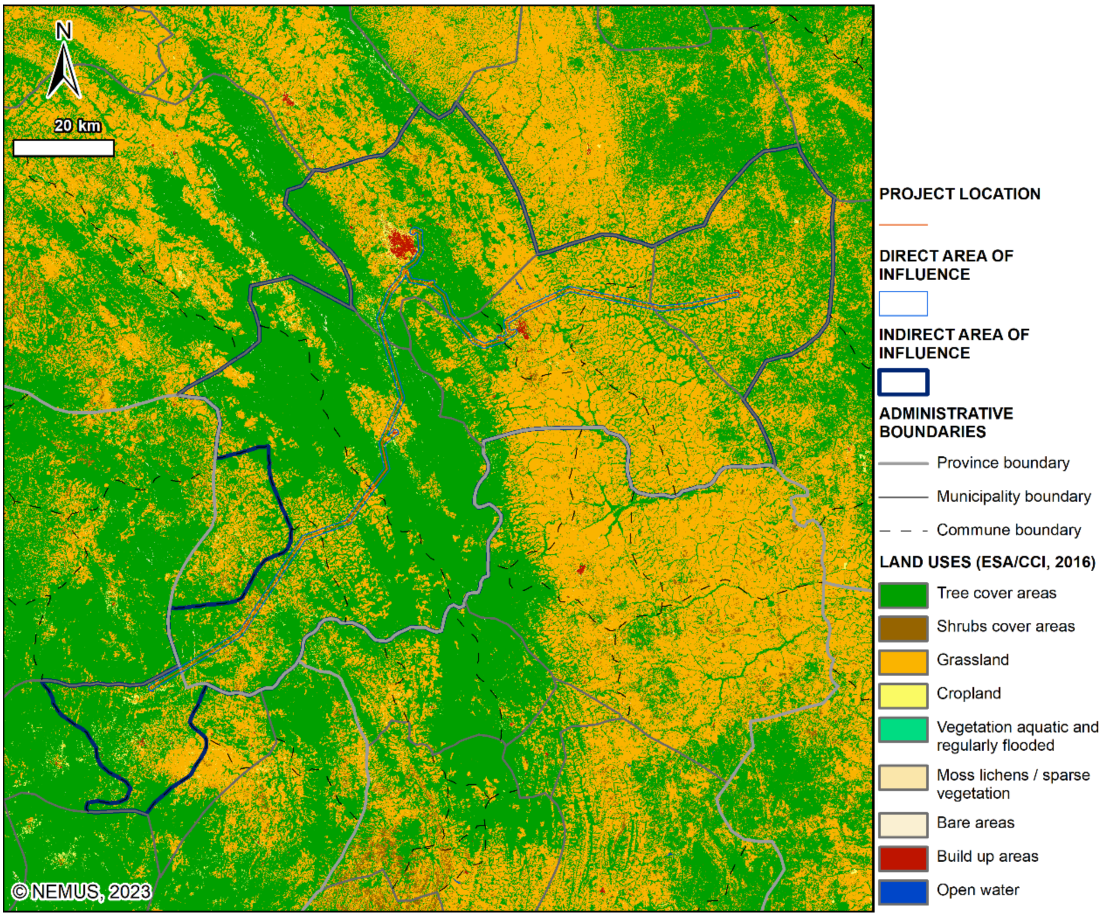


Figure 63 – Land use and Land cover in the study area

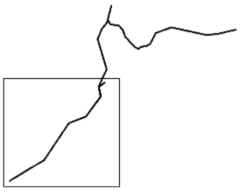
Table 34 – Distribution of land occupation along the ADI and AII

Land use classes	Area	
	hectares	%
ADI		
Tree cover areas	10 915	55
Grassland	7 356	37
Cropland	599	3,0
Built up areas	515	2,6
Shrubs cover areas	424	2,1
Bare areas	11	0,1
Vegetation aquatic or regularly flooded	9	0,0
Moss lichens / sparse vegetation	1	0,0
Total	**19 830**	**100**
AII		
Tree cover areas	472 758	59
Grassland	302 483	38
Shrubs cover areas	11 361	1,4
Cropland	8 482	1,1
Built up areas	3 367	0,4
Bare areas	608	0,1
Open Water	97	0,0
Vegetation aquatic or regularly flooded	93	0,0
Moss lichens / sparse vegetation	25	0,0
Total	**799 274**	**100**

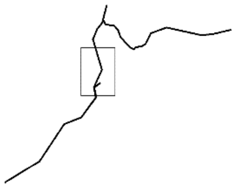
The areas of vegetation cover are mainly located in the western part of the project area, namely in the municipalities of Uíge and Quitexe. On the eastern border, particularly in the municipalities of Negage and Puri, the predominant land use typology is grassland.

Figure 64 – Various types of Land Use and Land Cover in the study area

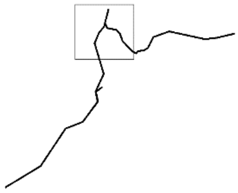
Table 35 – Summary of the classification of erosion risk and factors affecting soil erosion along the transmission line (ADI).

Section of the transmission line	Erosion hazard (sub-factor)	Land Use	Slope	Soil type
Dange River - Quitexe 	5 - High (Slope; Rainfall erosivity)	Tree cover areas; grassland; cropland; built up areas	Little or no slope to gentle slope (54,9 % of the area), moderate slope (28,8 % of the area), steep or fairly steep slope (16,3 % of the area)	Ferralsols

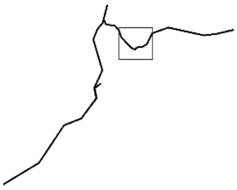
The predominant vegetation is grassland and tree vegetation; some areas with scattered vegetation

Section of the transmission line	Erosion hazard (sub-factor)	Land Use	Slope	Soil type
Quitexe 	8 - Very high (Slope; Rainfall erosivity)	Tree cover areas; grassland; cropland; built up areas	Little or no slope to gentle slope (84,1 %), moderate slope (15,4 %), steep or fairly steep slope (0,4 %)	Ferralsols Cambisols

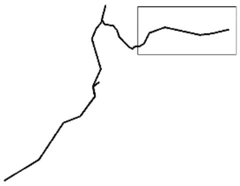
The predominant vegetation is grassland and trees; some areas with scattered vegetation; some agricultural areas are well managed

Section of the transmission line	Erosion hazard (sub-factor)	Land Use	Slope	Soil type
Uíge 	5/6 - High (Slope; Rainfall erosivity; Land cover)	Built up areas, cropland, tree cover areas, grassland	Little or no slope to gentle slope (61,1 %), moderate slope (26,9 %), steep or fairly steep slope (12,0 %)	Ferralsols

Predominant vegetation are grasslands and trees, high population and construction density, in the city of Uíge; the main cultivated products are coffee, banana, cassava, beans and ginguba (peanuts)

Section of the transmission line	Erosion hazard (sub-factor)	Land Use	Slope	Soil type
Negage 	8 - Very high (Slope; Rainfall erosivity)	Tree cover areas; grassland; cropland; built up areas	Little or no slope to gentle slope (48,8 %), moderate slope (40,2 %), steep or fairly steep slope (11,0 %)	Ferralsols

Predominant vegetation are grasslands and tree vegetation; steeper slopes. The main crops are coffee, banana, cassava, beans, and ginguba

Section of the transmission line	Erosion hazard (sub-factor)	Land Use	Slope	Soil type
Negage – Puri 	6 - High (Rainfall erosivity; Land cover)	Grassland; cropland; built up areas, tree cover areas	Little or no slope to gentle slope (87,7 %), moderate slope (12,3 %), steep or fairly steep slope (0,1 %)	Ferralsols Arenosols

Predominant vegetation are grasslands and cultivated fields (cassava, beans, ginguba, potatoes, coffee, and bananas)

5.7.4. Evolution prospects in the absence of the project

In the absence of the project, the soil characteristics identified in the baseline are considered to be maintained in the long term, as no significant topographical changes are expected to occur.

It should be noted that, at the evolutionary level, the pedological characteristics of the region will normally depend on the intensity of action of the soil formation factors.

Regarding land use, in the absence of the project, it is expected that the global characteristics currently identified will be maintained, in accordance with what is foreseen for the territory through the various planning instruments in place.

5.8. Environmental Quality

5.8.1. Air quality

5.8.1.1. Introduction

Air pollution is among the main environmental risks threatening human health (WHO, 2016). This chapter aims to characterise the air quality of the areas affected by the project, from a local and regional perspective. This analysis includes a description of the **main air pollutants**, their respective **sources** and **effects**, the identification of receptors sensitive to air pollution and a characterisation of the levels of pollutants in the project area.

As there are no representative air quality monitoring programmes, either at local, regional or national level, the information collected by the **World Health Organisation** (WHO) and the **World Bank** was used as support for the characterisation of air quality in the project area. This general information was complemented with the results provided by the monitoring station at ISCED – "Instituto Superior de Ciências da Educação" (Higher Institute of Education Sciences) in Huambo, which will be operational in October 2022.

Angola does not have a specific technical and legal framework for the assessment and analysis of air quality and air pollution. Therefore, the characterization of air quality in this paper is done using the Air Quality Guidelines developed by the World Health Organization. These guidelines include recommended limit values for the most common air pollutants, namely inhalable Particullate Matter (PM) (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), tropospheric ozone (O_3) and carbon monoxide (CO).

The table below presents the WHO air quality guidelines and interim targets (values set to support planning for incremental milestones towards cleaner air, particularly for cities, regions and countries struggling with high levels of air pollution).

Table 36 – Interim guidelines and targets for air quality

Pollutant	Exposure time	MP 1	MP 2	MP 3	MP 4	Guideline
SO_2 (µg/m^3)	24 h	125	50	-	-	40
	10 min	-	-	-	-	500
NO_2 (µg/m^3)	Annual	40	30	20	-	10
	24 h	120	50	-	-	25

Pollutant	Exposure time	MP 1	MP 2	MP 3	MP 4	Guideline
PM_{10} (µg/m^3)	Annual	70	50	30	20	15
	24 h	150	100	75	50	40
$PM_{2,5}$ (µg/m^3)	Annual	35	25	15	10	5
	24 h	75	50	37,5	25	15
O_3 (µg/m^3)	High Season	100	70	-	-	60
	8 h	160	120	-	-	100
CO (mg/m^3)	24 h	7	-	-	-	4

Source: (WHO, 2021)

5.8.1.2. Atmospheric pollutants and respective emission sources

The global assessment of ambient air pollution and its effects, for the year 2014, conducted by WHO in 2016, established that the average concentration of $PM_{2.5}$ in rural areas of Angola is about 27 µg/m^3, with concentrations ranging between 8 and 95 µg/m^3. In urban areas, $PM_{2.5}$ concentrations can range from 9 to 182 µg/m^3, with a median value of 42 µg/m^3 (WHO, 2016). Table 37 summarizes these results.

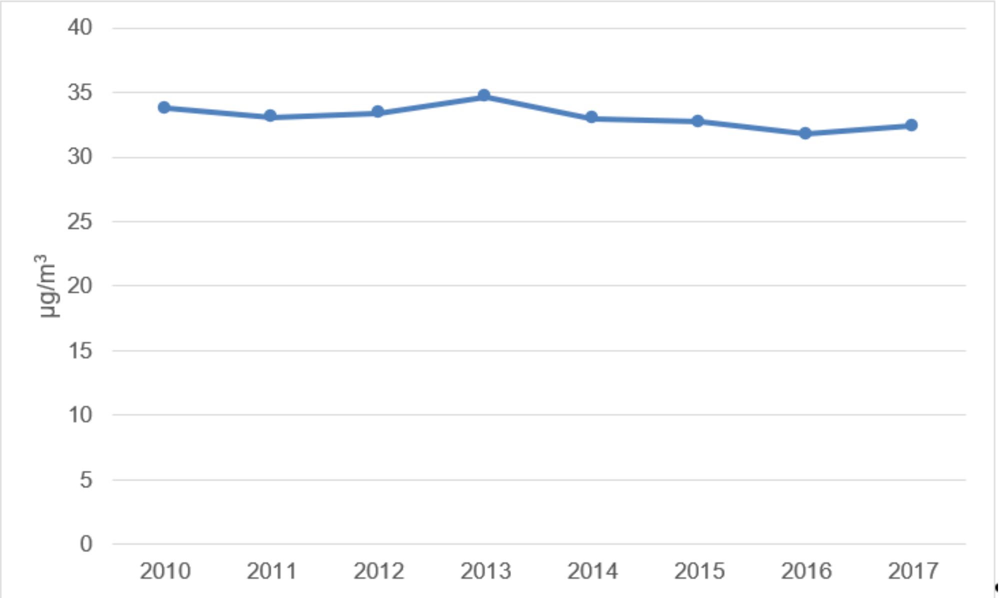
Table 37 – $PM_{2.5}$ concentrations in rural and urban areas, in Angola

Country	$PM_{2,5}$ (µg/m^3) rural and urban areas			$PM_{2,5}$ (µg/m^3) urban areas		
	Median	Minimum	Maximum	Median	Minimum	Maximum
Angola	27	8	95	42	9	182

Source: (WHO, 2016)

The levels recorded do not meet the quality standards set by the WHO guideline for the annual concentration of $PM_{2.5}$ (5 µg/m^3). However, the results from the combination of urban and rural areas meet the first interim target (35 µg/m^3), showing that in rural areas air quality is at more favourable levels.

The most recent World Bank data, collected between 2010 and 2017, show a relatively constant average annual concentration of $PM_{2.5}$ in Angola, ranging from 31,8 µg/m^3 (in 2016) to 34,7 µg/m^3 (in 2013). The global average is set at 33,1 µg/m^3, as shown in Figure 65Figure 65 –. It is important to note that the verified concentrations are more than 6 times higher than the 5 µg/m^3 limit recommended by the WHO.

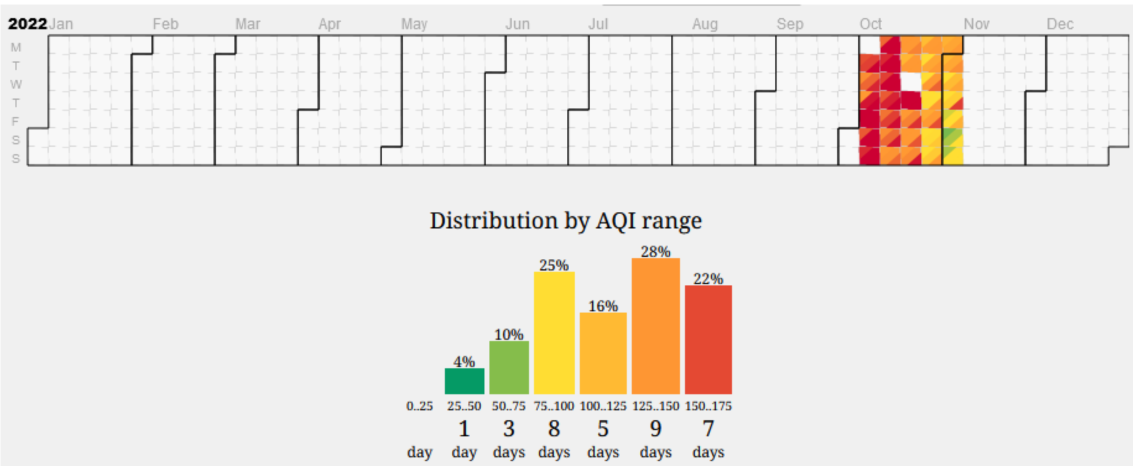


Source: (World Bank, 2022)

Figure 65 – Annual average concentration of $PM_{2.5}$ in Angola

Air quality data monitored at the Huambo ISCED Station since 4 October 2022 is available in the Air Quality Index system (AQUICN, 2022). This index is calculated from results for the $PM_{2.5}$ parameter and meteorological variables of relative humidity, temperature and wind intensity.

As represented in Figure 66 –, the results obtained for the parameter $PM_{2.5}$ indicate a great variability, with higher frequency of days with concentration between 75 and 100 μg/m^3 (9 days) and 125 and 150 μg/m^3 (8 days). These results seem to confirm the effect of urban context on ambient air quality.



Source: (AQUICN, 2022)

Figure 66 – $PM_{2.5}$ concentration at Huambo ISCED station

The WHO indicates that, on average, about 8 million people die annually from causes associated with poor air quality (WHO, 2021).

Specifically in Angola, 50 out of every 100 000 people die from causes associated with poor ambient air quality, which makes Angola the country with the highest mortality rate associated with air pollution among Portuguese-speaking countries (Lusa, 2016)

In the study area, the main sources of air pollution are automobile traffic (cars, motorbikes, buses, etc.), which not only emit exhaust gases by burning fuels, but also promote the resuspension of dust and particles by circulation on unpaved roads. In addition, in rural areas, with limited access to electricity, the burning of biomass and the use of fuel electric generators are common sources of energy, activities responsible for the emission of atmospheric pollutants.

These activities are responsible for the emission of pollutants such as inhalable airborne particles ($PM_{2.5}$ and PM_{10}), sulphur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), carbon dioxide (CO_2) and volatile organic compounds (VOC). These pollutants, in addition to having negative effects on human health and the environment, can also react with other components in the atmosphere to form secondary pollutants such as tropospheric ozone (O_3).

The table below presents a summary of these pollutants, identifying their main characteristics, sources and effects.

Table 38 – Characterisation of atmospheric pollutants

Pollutant	Description, sources and effects
Carbon monoxide (CO)	**Description:** Primary pollutant, colourless and odourless toxic gas that has a high affinity for haemoglobin, with which it is associated, to the detriment of oxygen. **Sources:** incomplete combustion of fossil fuels, natural processes (e.g., volcanic eruptions), other indirect emission sources (fires or biological processes). **Effects:** affects the cardiovascular and nervous systems; high concentrations of CO can create dizziness, headaches and fatigue; extreme concentrations inhibit the blood's ability to exchange oxygen with vital tissues and can cause death.
Ozone (O_3)	**Description:** A bluish gas, which is characterised by its high oxidising power. In the stratospheric layer of the atmosphere, ozone plays an important role, since it is responsible for absorbing ultraviolet solar radiation, which is harmful to life on earth. In the tropospheric layer, it is a pollutant with harmful effects on human health and the environment. **Sources:** appears in the troposphere as a secondary pollutant from various precursors of anthropogenic and biogenic origin through the influence of light, mainly compounds such as nitrogen oxides (NOx), volatile organic compounds (VOC) and carbon monoxide (CO). **Effects:** on human health, the effects depend on various aspects (concentration in the atmosphere, duration of exposure, volume of air inhaled and degree of sensitivity to the pollutant, which varies from individual to individual) and manifest as irritation of the eyes, nose and throat, headaches, respiratory problems, chest pain or coughing; on vegetation, ozone can be responsible for the loss or damage to individual tree species, as well as various species of natural vegetation, since it reduces photosynthetic activity; degradation of various materials, such as rubbers, textiles and paints.

Pollutant	Description, sources and effects
Nitrogen oxides (NO_x)	**Description:** Nitrogen oxides include nitrogen dioxide (NO_2) and nitrogen monoxide (NO). NO_2 is a toxic gas, easily detectable by smell, very corrosive, and a strong oxidizing agent. It has a yellow-orange colour at low concentrations and reddish-brown for higher concentrations. **Sources:** combustion of fossil fuels and electrical discharges to the atmosphere or microbial transformations. **Effects:** NO_2 can cause damage to bronchi and lung alveoli and increase reactivity to natural allergens; NOx can also cause harmful effects on vegetation when present in high concentrations, such as damage to leaf tissue and reduced growth; damage to materials due to high NOx concentrations in the atmosphere (natural and synthetic polymers are most affected).
Sulphur dioxide (SO_2)	**Description:** Colourless gas, with an intense smell of sulphur when in high concentrations. It is an acidifying gas, very soluble in water, and can give rise to sulphuric acid, H_2SO_4. **Sources**: industrial sector, especially refineries and boilers burning fuels with high sulphur content. **Effects**: irritation of the mucous membranes of the eyes and respiratory tract (which can cause acute and chronic health effects, especially on the respiratory system); respiratory problems such as asthma or whooping cough (in more sensitive groups such as children); formation of acid rain, with the consequent acidification of water and soil, damage to plants and degradation of materials.
Volatile Organic Compounds (VOCs)	- Volatile Organic Compounds (VOCs), depending on their chemical composition, can be classified into non-aromatic hydrocarbons, oxygenated organic compounds and aromatic organic compounds **Sources**: there is a wide range of VOCs in the troposphere, of both natural and anthropogenic origin. Emissions from motor vehicles and certain industrial activities (refineries, petrochemicals, construction, for example) are the main anthropogenic sources of VOC emissions. Road transport and evaporation of petrol are mentioned as the main sources of aromatic compounds. **Effects**: they are very reactive compounds and are considered to be precursors of ozone and substances known to be carcinogenic, such as benzene.

Pollutant	Description, sources and effects
Inhalable particles	- Particulate matter is one of the main pollutants as regards effects on human health. **Sources**: the main sources are related to vehicle traffic, burning of fossil fuels/biomass and industrial activities such as cement industry, steel plants and quarries, chemical reactions in the atmosphere and natural sources. **Effects**: particles, especially the smallest ones, as they are inhalable, penetrate the respiratory system where they can cause damage; there are also negative consequences on vegetation (inhibition of gas exchanges) and on the built heritage (deterioration of materials); at climatic level, this pollutant can intervene in the formation of clouds, fog, precipitation or alter the absorption of solar radiation; it can also increase the effects caused by other pollutants. Smaller particles with an aerodynamic diameter of less than 10 µm (PM_{10}) are generally more harmful because they are deposited at the level of the functional units of the respiratory system. Particles with a diameter of less than 2.5 µm ($PM_{2,5}$) can even reach the lung alveoli and enter the blood system.

The study area covers mainly rural areas, where emission sources are scarce and less likely to cause degradation of local air quality. However, urban settlements can be found along the transmission line.

Around these areas and the roads that connect them, air quality can be affected by increased sources of pollution, such as road traffic on unpaved or degraded roads, biomass burning in domestic activities and open fires, as shown in the figures below.

Figure 67 – Unpaved Road in the ADI

Figure 68 – Open burning in the ADI

5.8.1.3. Sensitive receptors

Receptors sensitive to air pollution are defined as certain land occupations that may be affected by air emissions from activities in the area under analysis. The main concern, however, is the presence of sensitive human occupation, i.e., places where people live or stay.

Considering the linear nature of the project under assessment, the sensitive receptors identified are the residents, workers and users of public spaces in general distributed along the ADI of the project (500 m around the intervention area).

5.8.2. Noise

5.8.2.1. Introduction

This section develops the noise characterisation of the study area, which includes the project intervention area, as well as the sensitive receptors and noise sources in its surroundings, defined as the project's ADI.

Noise pollution is one of the main factors in the degradation of people's comfort and well-being, especially in urban areas. This degradation may translate into negative effects on human health, such as the aggravation of hearing problems (from fatigue to trauma), psychological problems (such as stress, irritability, difficulty concentrating) and physiological problems (sleep disturbance), among others.

The background noise of a given site can be defined as the ambient noise existing at that site before a particular acoustical disturbance or pressure source is introduced, which may be temporary or permanent.

No specific norms or legal framework were identified in Angola that regulate the issue of noise on national territory, so international standards and guidelines were considered, such as the Environmental, Health and Safety Guidelines of the International Finance Corporation (IFC, 2007) that include reference values for daytime (07h00 - 22h00) and night-time (22h00 - 07h00) noise for different types of areas (residential, institutional, educational, commercial and industrial). These reference values were established by the WHO, and are set out in the table below.

Table 39 – Reference values for environmental noise

Receptor	Daytime (7h00 – 22h00)	Night time (22h00 – 7h00)
Residence, Institutions, Education	55 dB(A)	45 dB(A)
Commercial, industry	70 dB(A)	70 dB(A)

Source: (IFC, 2007)

In order to preserve the well-being of the population, noise levels must not exceed the values indicated in the table above or result in impacts on nearby receivers that cause a differential of 3 dB(A) or more in relation to background noise levels.

5.8.2.2. Noise sources

The planned route for the electricity distribution lines mainly follows a path in relative proximity to population centres and existing roads, passing mainly through rural and forested areas. The relationship between the corridors where the project is being developed and the roads connecting the villages can be seen in Drawing GEO1 (Geographical Setting), Volume 2.

This way and supported by field reconnaissance, it was possible to identify two typologies of acoustic environment in the study area, namely in: rural and forest areas and urban and peri-urban areas.

In rural and forest areas, the acoustic environment is disturbed mainly by road traffic and some rural human activities (domestic, agricultural and livestock) essentially during the daytime period. During night time, noise levels are more stable and are characterised by the sound of wind and vegetation.

In urban and peri-urban areas, noise levels are generally higher, when compared with those of rural areas. In these areas, in addition to road traffic, commercial activity is perceptible, as well as noise emissions resulting from the concentration and movement of the population.

5.8.2.3. Noise monitoring

Noise monitoring points were selected along the defined corridor for the transmission lines, where access was possible at the time. The selected points cover various land uses in order to assess different noise backgrounds such as a substation, open areas and nearby sensitive receptors such as houses.

Figure 69 shows the location of the noise monitoring points on the project plan. Figures 5 to 9 show the exact location of each point. Point RU5 was located outside the project area next to a high voltage pole in order to investigate the isolated noise emitted from such a pole.

Monitoring was carried out using a Convergence Instruments NSRT MK3 sound level meter, configured to measure dB(A) with a 24 kHz band and a recording interval of 1 minute. Each measurement lasted between 15 and 30 minutes. The equipment was placed about 1,5 m above the ground and at least 3,5 m from reflecting surfaces, as illustrated in the figures below.

The results of the monitoring are presented in Table 40.

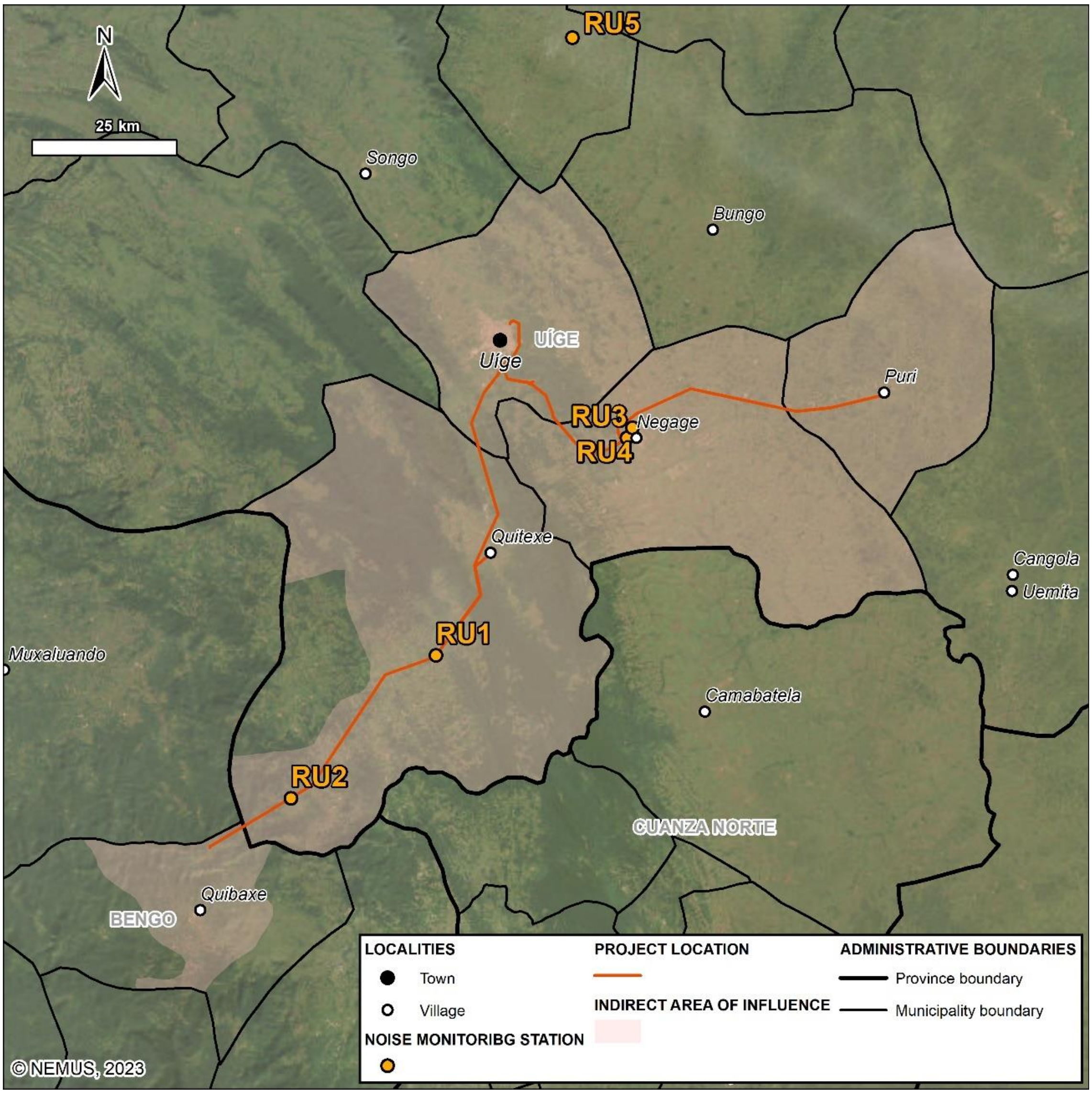


Figure 69 – Noise monitoring points

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Figure 70 – Monitoring point 1

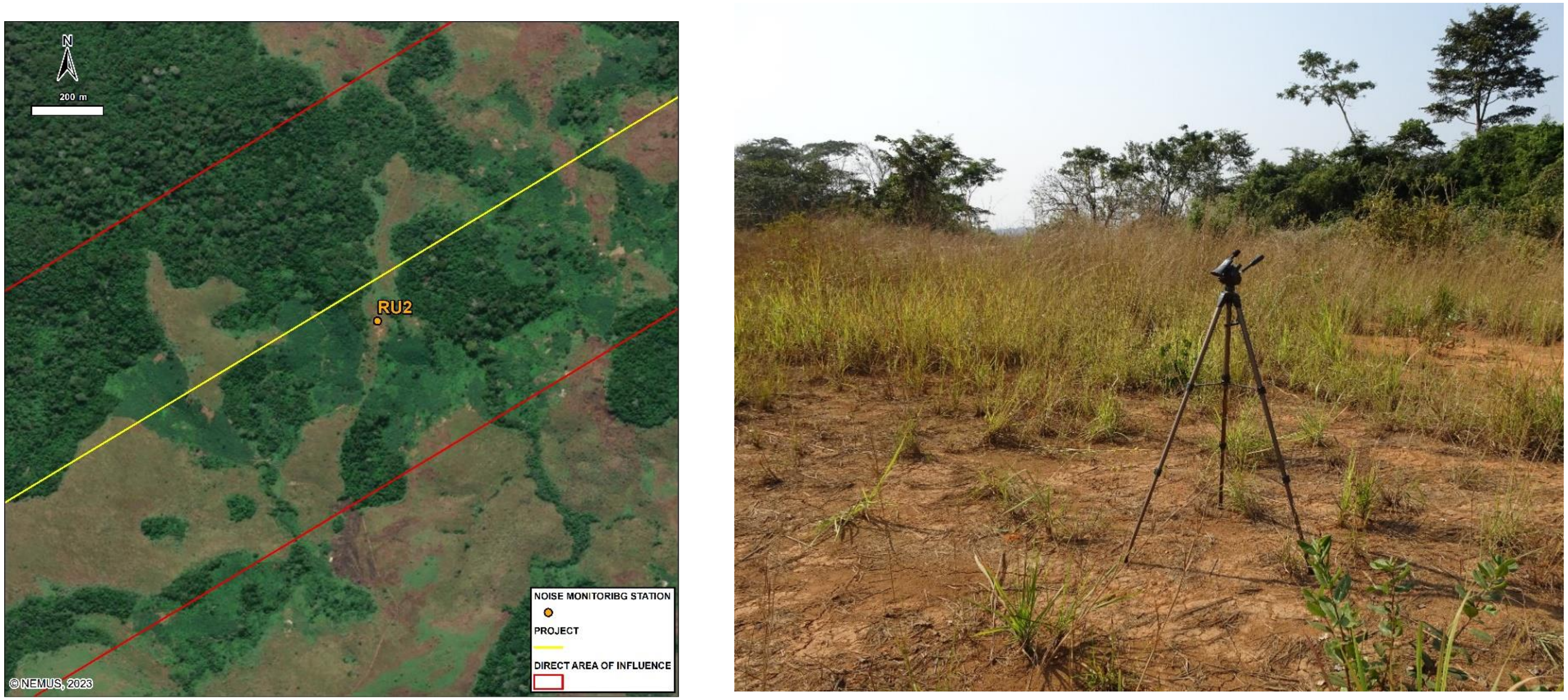


Figure 71 – Monitoring point 2

Figure 72 – Monitoring point 3

Figure 73 – Monitoring point 4

Figure 74 – Monitoring point 5

Table 40 – Results of noise monitoring

Point	Local	Date	Hour	Duration	Noise level dB(A)			Noise sources
					L_{eq}	L_{max}	L_{min}	
RU1	Aldeia Viçosa, next to houses	12/07/2022	11:46	25 min	**65,6**	**83,2**	49,5	Traffic on the national road People talking (group interview) Music
RU2	Along the road between Quitexe and the Dange River	12/07/2022	14:40	17 min	54,3	**68,0**	42,4	People talking Drone
RU3	Negage, next to SS	13/07/2022	11:40	20 min	**70,7**	**82,6**	**56,3**	Traffic (cars and motorbikes) People talking Music Truck manoeuvring at about 30 m Substation (crown effect)
RU4	Negage, road in the city centre	18/07/2022	16:28	30 min	**70,8**	**84,2**	54,3	Traffic (cars, motorbikes, trucks) Transients. Horns
RU5	Next to a high-tension pole, outside the study area	15/07/2022	09:07	20 min	**55,4**	**69,5**	38,0	Traffic on the national road Crown effect (pole) Wind Footsteps in vegetation

* Numbers in bold represent exceedances of the IFC guidelines [55 dB(A) for residential areas during the day].

The noise environment at the monitoring stations is influenced by the daily activities taking place in the nearby villages. The most common noise sources were passing cars and motorbikes, people talking and music.

The noise level L_{eq} obtained varied from 54,3 dB(A) at RU2 to 70,8 dB(A), at RU4. All selected sites showed high noise levels, with only RU2 showing a L_{eq} (marginally) below the IFC limits for residential sites during the day (55 dB(A)).

This point was located in a non-moving area, away from dwellings and constant noise sources and aims to provide a noise characterisation in the absence of fixed noise sources.

The monitoring shows that even without the influence of the project activities, the study area is already a noisy zone.

The point RU5, made outside the study area, aims to understand the noise emitted by a high voltage pole. The average value of L_{eq} is influenced by other noise sources such as traffic on the adjacent road or steps in the vegetation near the sound level meter.

Still, it is possible to observe that the pole is a noise source with some importance since the L_{min} was close to 40 dB(A).

Noise monitoring was carried out exclusively during the daytime, as no significant noise emissions associated with the project are expected during the night.

5.8.2.4. Sensitive receptors

Similar to the case for air pollution, noise sensitive receptors are defined as certain land occupations that may be affected by noise from activities in the area under analysis. The main concern is the presence of sensitive human occupation, i.e., places where people live or stay, taking into account special places such as schools, hospitals and other more sensitive areas.

According to the noise sources described above, as well as the project's area of intervention, the sensitive receptors identified are the residents, workers and users of public spaces, generally distributed throughout the project's direct area of influence.

These recipients are concentrated in the main urban centres where the project will focus, such as Uíge, Negage, Quitexe and Puri.The importance of noise in the villages that will be electrified, such as Dambi, Piqui, Cangundo, Quiongua and Calumbo, is also highlighted, as these are typically less noisy places than the large urban centres, and where there will be activities close to the dwellings and other sensitive receptors.

5.8.3. Evolution prospects in the absence of the project

In the absence of the project, it is estimated that the levels of local air quality and noise disturbance from the same sources described above will remain at approximately the same intensity, namely:

- Air quality: road traffic on unpaved or paved roads, vegetation control and energy generation from biomass and other fuels;
- Noise environment: road traffic, rural and urban human activities.

5.9. Ecology

5.9.1. Introduction

This chapter characterises the ecological component of the area under analysis, based on the characterisation of the habitats (natural and semi-natural), the vegetation, the flora and the fauna present, as well as the functions they sustain and their state of conservation/degradation.

The characterisation also includes an inventory of the areas classified for the protection of biodiversity, seeking to ensure compliance with the respective objectives, if applicable.

This analysis will allow the identification of critical ecological values, i.e., sensitive and susceptible to be affected by the project in its different phases.

The study area defined for the analysis of the ecological component corresponds to the Area of Direct Influence (ADI), the transmission and distribution lines between the Dange and Puri rivers, and its substations, associated with a buffer zone of 500 meters. Where justified, the analysis is extended to the Area of Indirect Influence (AII), corresponding to the territory of the districts crossed by the project (c.f., Chapter 4)

5.9.2. Methodology

Considering the biological and ecological aspects of the study area, the following components will be characterized as potentially susceptible to impacts generated by the project development:

- Habitats;
- Vegetation and flora;
- Fauna:
    - Amphibians;
    - Reptiles;
    - Birds;
    - Mammals.
- Ecosystem Services

The characterization work followed the guidelines of the performance standard No. 6 of the International Finance Corporation (IFC-PS6), referring to "Conservation of biodiversity and sustainable management of living natural resources (2012)" (IFC, 2012).

The field work performed complemented in most cases the bibliographic reviews and desktop studies performed, being of essential importance to the completeness of the present study.

Habitat assessment

As defined in IFC-PS6 (IFC, 2012), a habitat is a terrestrial, freshwater or marine geographical unit that supports communities of living organisms and their interactions with the abiotic environment.

Taking into account that the structure and composition of vegetation are indicators of the abiotic conditions of the environment, it is generally considered that these offer an appropriate method of characterising habitats. Thus, the characterisation of the habitats in the study area focuses essentially on the **macro habitats** resulting from the main forms of land cover.

The identification and classification of habitats took the following steps:

- Bibliographic research, interpretation of orthophotos and satellite imagery;
- Field reconnaissance to verify the preliminary habitat classes, their composition and level of human intervention.

To assess habitats within the study area, survey points were defined prior to the field visits made during the dry and wet season. Points were marked based on the interpretation of orthophotos and satellite imagery. Survey points were selected based on the following criteria:

- **Coverage** - the point is expected to cover the environmental variability of the area affected by the project. The points were repeated throughout the study area to account for intra-habitat variability, and to assess habitat continuity throughout the ADI;
- **Representativity** - Each point is expected to cover a small representative fraction of the habitats identified prior to the field visit. Areas with expectably higher ecological value i.e. semi-natural and natural habitats

were selected. Nevertheless, survey points were placed in artificial areas to confirm the extent of anthropogenic pressures;

- **Accessibility and Safety** - Survey points were placed in accessible areas, with nearby roads, or in flight range of the drone (18 kms, see below). This minimized the risk of crossing areas with land mines, ensuring the safety of the technical team.

For the fieldwork performed in July 2022 (dry season), 15 points were surveyed, whereas during the October 2023 (wet season) field visit 16 points were analysed. Between field visits, some points had to be adjusted and added to meet alterations made to the project (Drawing ECO1, Volume II). Note that only the wet season survey points are marked in the habitat mapping.

At each point, the following tasks were carried out:

- Image collection, by means of photographs and drone flights (model: DJI Mini 3 Pro, see methodology bellow);
- Identification of the type of habitat with the help of field guides;

Information gathered during focus groups with local communities contributed to an informed characterisation of the habitats present and the identification of existing pressures, threats and ecosystem services in the region.

The data collected was analysed in a GIS environment, from which resulted the identification of five natural and semi-natural habitats (in addition to the artificialized areas), represented in the Habitats Map (Drawing ECO1, Volume II), namely:

- Forests;
- Grasslands and herbaceous savannahs;
- Wooded savannahs and scrublands;
- Cultivated areas;
- Wetlands.

The macro-habitats of the area under analysis occur interspersed or in mosaics, each cartographic unit having been classified according to its dominant vegetation pattern.

Vegetation and flora

The assessment of vegetation and flora was jointly performed by reviewing specialised literature (scientific articles, flora compendiums, national government reports/documents; books, and other relevant information) and consulting databases such as: GBIF (GBIF, 2023), the IUCN Red list of species (IUCN, 2023) and iNaturalist (iNaturalist, 2023) through validated records.

Satellite imagery and ortho maps were also consulted to assess vegetation. This step also contributed to the criteria used for the survey point selection mentioned above. Collected information during this stage was later complemented/confirmed by the field work conducted.

During the field visits, the following parameters were assessed:

- Number and density of each stratum;
- Estimated age structure, including height assessment;
- Dominant floristic species composition;
- Land use;
- Pressures observed.

For this task a drone was employed (DJI Model 3 Pro). Two drone flights were conducted in opposite directions (one in each direction) of the marked survey points, parallel to the projected transmission line. In segments deprived of roads, the drone was deployed closest to the last accessible area and flown to the study area by using GPS, and in-flight instruments such as drone distance from the operator and the compass. The drone's altimeter was used to measure the height of the different vegetation stratum.

Dominant flora species present within sight of each point inside the ADI were photographed and recorded through direct observations. Binoculars were sporadically used to identify some of the species that were further away. Drone videos were later analysed to identify any remaining dominant species, as well as, characterise the vegetation. Transects throughout the ADI were not performed due to land mine risk.

Information gathered during focus groups with local communities also contributed to the identification of the use and presence of flora species.

Information obtained from the initial literature review, field work and local communities was incorporated into the current report and biodiversity baseline.

Fauna

The Fauna assessment was based on the consultation of fauna with concurrent distributions within the ADI. Their distribution was consulted primarily in the IUCN Red List of Species (IUCN, 2023) and complemented by consulting the following biodiversity data bases:

- Global Biodiversity Information Facility (GBIF, 2023);
- BirdLife International Datazone (BirdLife International, 2023);
- iNaturalist, through validated records (iNaturalist, 2023).

Data extracted from these databases enabled the elaboration of a preliminary list of species occurring within the study area and their respective conservation statuses. Gathered information from these sources was later complemented with data gathered in the field.

Throughout the field work, no targeted/specific field analysis were performed for amphibians, reptiles, mammals or birds. Nonetheless, opportunistic sightings throughout the field visits were recorded. Signs of their presence were also recorded and photographed when found (dormitories, nests, faeces, feeding areas, etc.), for further analysis.

The field work enabled the team to determine which species are confirmed to occur within the ADI. Further field records of the faunal groups helped improve the accuracy of the information gathered during the literature review for the current description.

Ecosystem services

The ecosystem services were primarily assessed by performing a specialized literature review, in which an initial compendium was developed.

During July 2022, public consultations with focal groups within the local communities and interviews were conducted. From these, resulted the confirmation of ecosystem services previously identified during the literature review and the addition of further ecosystem services.

These consultations in conjunction with the literature review, enabled a clear and complete assessment of the ecosystem services affected by the project.

5.9.3. Areas designated for the protection of biodiversity

Angola's network of terrestrial conservation areas dates back to 1936 and covers, as of 2011, 12,98 % of the national territory, including nine (09) National Parks, one (01) Regional Park and four (04) Reserves, according to the Ministry of Environment (Ministério do Ambiente, 2017)

With regard to international instruments, the Ramsar Convention - Convention on Wetlands (Ramsar, Iran, 1971) - came into force in Angola in October 2021 (RAMSAR, 2022), but there are still no designations in this area. There are, however, 23 important bird areas (IBAs) (BirdLife International, 2022) and 23 Key Biodiversity Areas (KBA) which encompass the IBAs.

The corridor under analysis **does not cross any areas designated** under national or international instruments (Figure 75).

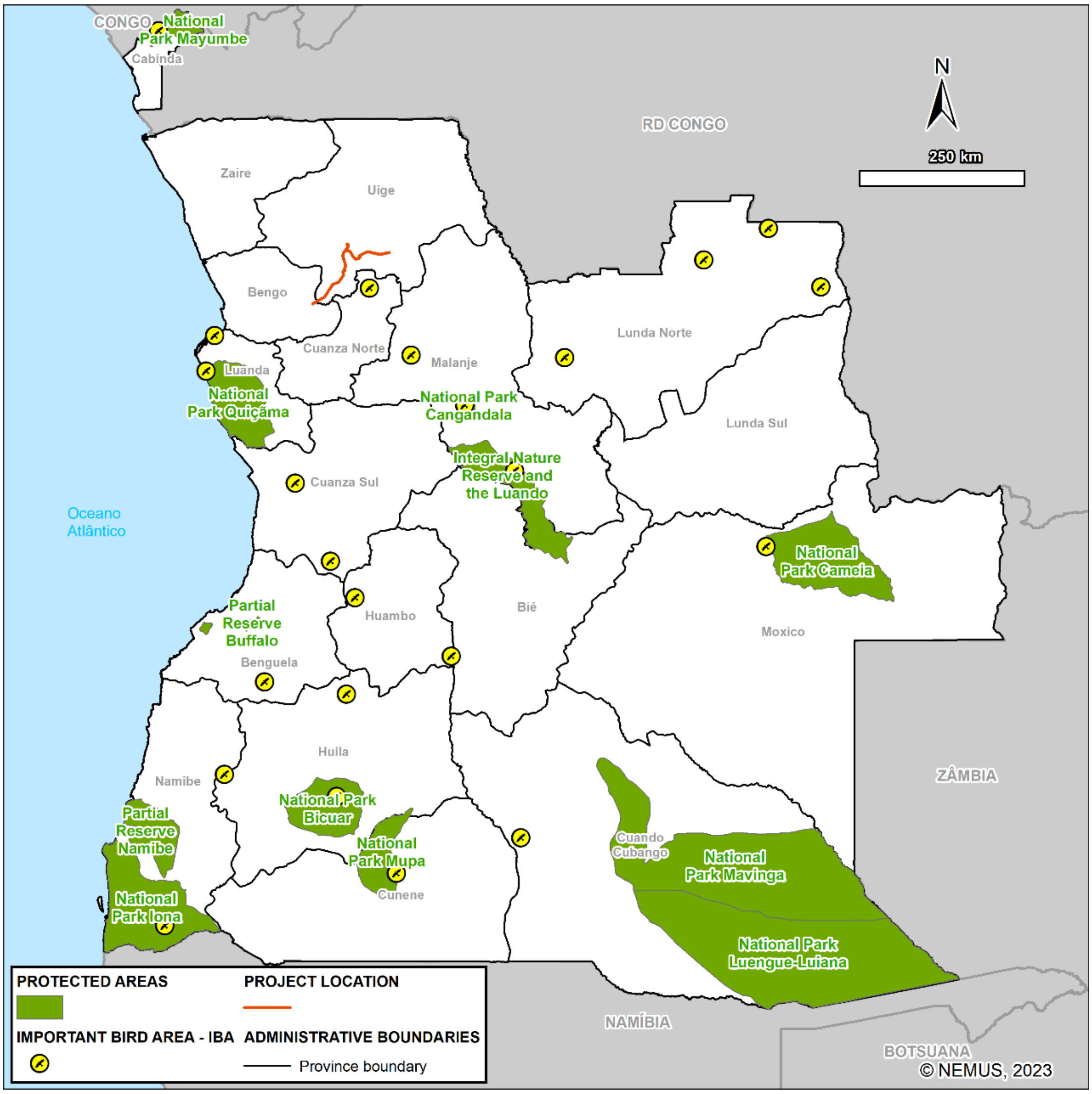


Figure 75 – Inclusion of the project in the network of classified areas in Angola

In response to the identification of gaps and imbalances in the coverage of the current system, the Strategic Plan for the System of Protected Areas of Angola (Ministério do Ambiente, 2017) proposes the classification of 11 new sites. This list includes Serra do Pingano, which will then be the first classified area in Uíge province.

There is no official delimitation of this area as yet, however, the Serra do Pingano is located approximately 2,5 km to the west of the project's direct area of influence, crossing the Ambuila and Quitexe districts (Figure 76).

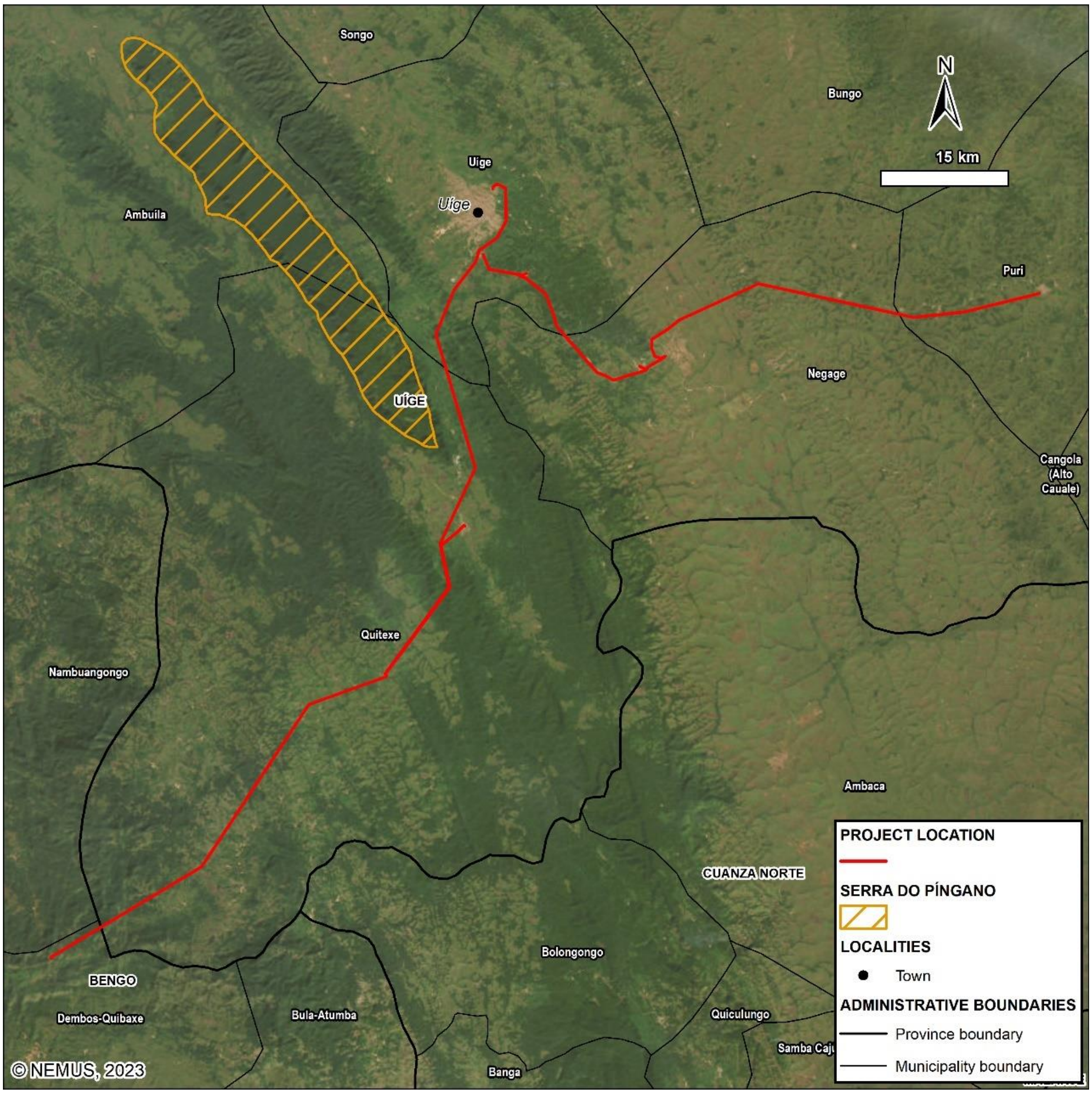


Figure 76 – Location of the Serra do Pingano in relation to the project

With about 35 000 ha, the proposed area is representative of the Guineo-Congolese biome, housing, according to the Ministry of Environment (2017), the "last remaining large block of humid forest in Angola" (cf. section 5.9.5, Vegetation and flora)

5.9.4. Habitats

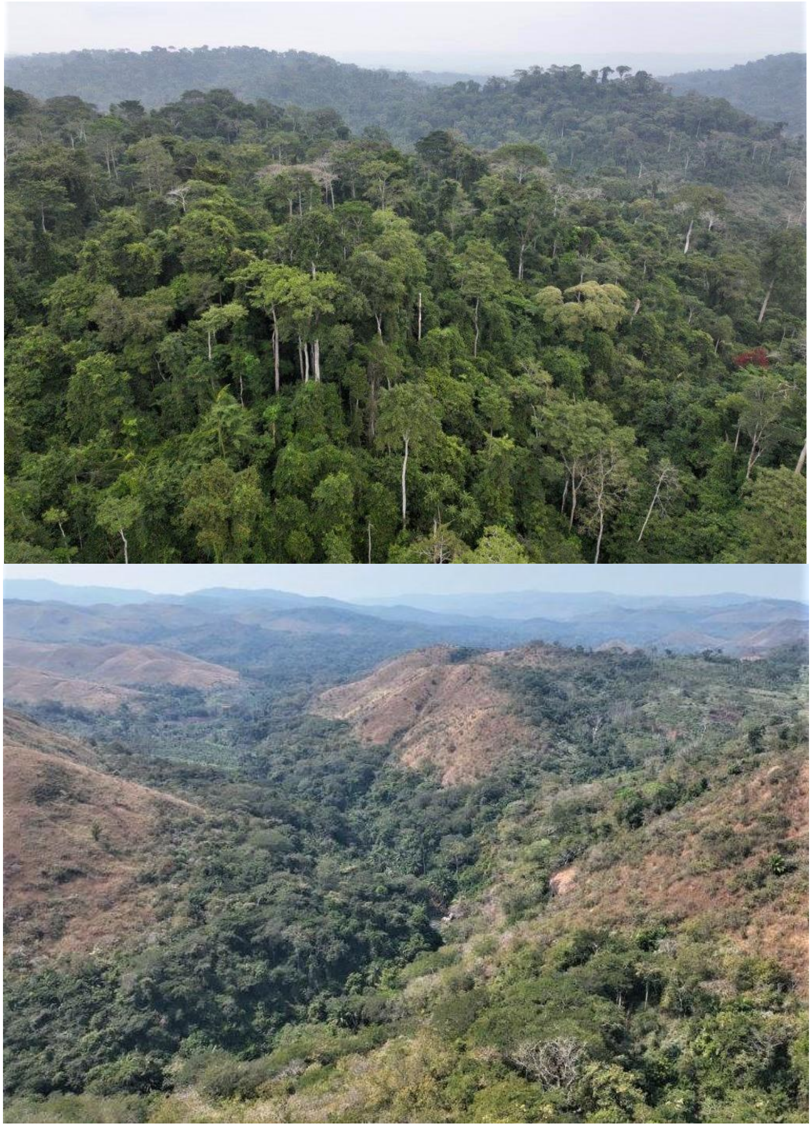
This section characterises the mosaic of habitats existing in the direct area of influence that are likely to be affected by the implementation of the project.

Uíge province includes the escarpments and plateaus of the Western Congolese Forest-Savana Mosaic ecoregion (ecoregion 43), according to the classification by Burgess, et al. (2004). This global-scale classification reflects directly on the habitats found throughout the study area, which in turn reflect biodiversity at the local scale.

5.9.4.1. Habitat characterization

Forest

The **forest** covers 6 013.93 ha, or 29.41 % of the direct area of influence, and is the most complex natural habitat in the corridor.



Source: Nemus, 2022

Figure 77 – General aspects of the forest (municipality of Quitexe)

Data collected during the field visits revealed that the forest is a vegetation typology that presents itself - in its primary stage - as **a closed multi-stratum formation**, of high to very high height. It has a typically high structural complexity, being constituted by well-developed tree (more than one), shrub and epiphytic strata, and a sparse herbaceous stratum.

Two types of potential forest occur in the Uíge province (Beernaert, 1997; White, 1983; Huntley & Matos, 1994), namely:

- Peripheral and semi-deciduous formations of the **Guineo-Congolese humid fog forest**; they appear in the form of isolated spots on the plateaus and ridges of the escarpment area, in the municipalities of Quitexe and Uíge;
- Edaphic formations, i.e., gallery forest ("muxitos"), which develop in the valleys of the corridor under study, in response to the higher soil water content; gallery forests occur throughout the area, being most visible in the municipalities of Púri and Negage, where they cut through the savannah matrix along the river valleys and their tributaries.

Emphasis is placed on the ecological functions of the forest, which translate into the provision or support of ecosystem services such as (see section 5.9.7. Ecosystem Services):

- Supporting habitat for a diversified fauna; in the humanised context of the region under study, the forest patches represent islands of habitat particularly relevant for the conservation of biodiversity; the forest is used, namely, by the white-bellied pangolin;
- Carbon removal and storage;
- Climate regulation;
- Regulation of the hydrological cycle;
- Erosion control.

In addition to the functions listed above, forests are a source of raw materials for local communities, either for internal consumption or marketing (Lautenschläger & Neinhuis, 2014). This was also confirmed by the locals during public consultations. It highlights:

- Harvest of wild fruits such as safu (e.g., *Dacryodes edulis*);
- Wood cutting for construction (e.g., *Milicia excelsa*, *Khaya senegalensis, Pterocarpus erinaceus*); and production of charcoal and wood;
- Collection of leaves, bark and roots with medicinal properties or for fibres (e.g., *Ceiba pentandra*).

Source: Nemus, 2022

Figure 78 – Examples of the use of forest resources

The dependence of populations on forest resources implies the continued exploitation of the remaining patches of original forest - through burning, cutting down trees, gathering medicinal plants and planting coffee, banana or manioc in the overgrowth - which are being degraded.

In addition to the exploitation of floristic resources, in a similar way to the rest of the forest, due to the soil properties, the natural distribution zones of the gallery forest are often occupied by food crops.

Thus, both typologies are quite degraded in the corridor under study, being evident during the field surveys, both presenting lower than expected height and density, and a specific composition far from the original (Lautenschläger & Neinhuis, 2014).

Source: Nemus, 2022

Figure 79 – Examples of deforestation for manioc and banana cultivation (Quitexe municipality)

Grasslands and herbaceous savannahs

The **grassland**, or **herbaceous savannah**, follows, covering 2 124.24 ha, or 10.39 % of the corridor under study. The term savannah is not clearly defined (White, 1983), designating, in the present context, formations with a dominant, continuous herbaceous stratum, with the shrub and tree strata present in a sparse manner.

In grasslands, the herbaceous stratum is typically dominated by medium to tall species, which may reach up to 2 m in height, with a high degree of coverage.

Source: Nemus, 2022

Figure 80 – General aspect of grassland / herbaceous savannahs

During field surveys it was evident that the **savannah** was dominated by tall Gramineae of the genera *Hyparrhenia*, *Pennisetum*, *Loudetia* and/or *Imperata* accompanied by non-graminoid herbaceous and fire-tolerant shrubs such as *Pteridium centrali-africanum*, *Aframomum alboviolaceum* (jinguenga) and *Hymenocardia acida*.

Source: Nemus, 2022

Figure 81 – Herbaceous savannah vegetation; on the left, a grassland dominated by *Pteridium centrali-africanum*; on the right, the specie *Aframomum alboviolaceum*

Savannah vegetation in the study area is the result of the interaction of complex environmental and anthropogenic factors, and it is not possible to easily discern where ecological filters dominate - such as the low water content of the sandy soils of the peneplain, which prevents the development of more structurally complex vegetation (Beernaert, 1997) - and where degradation by man overlaps (Rees, 2022).

With regard to anthropic influence, this vegetation is regularly subjected to fires that interrupts ecological succession, keeping the structure simple (Gohre, *et al*., 2016). Fire is used as a management tool in order to stimulate the bursting of herbaceous plants for grazing, to clear land before cultivation, to keep grass off roads and open paths, and to direct animals during hunting. These factors were witnessed by the technicians during both field visits.

Source: Nemus, 2022

Figure 82 – Active and recent fire marks in the grasslands

Although these are formations of lower structural and floristic complexity - compared to forest environments - they provide a variety of goods to local communities (Gohre, *et al*., 2016), including fruits such as jinguenga (*Afromomum alboviolaceum*), edible plants (such as seedlings of *Pteridium aquilinum* subsp. *africanum*), fodder for livestock, and traditional medicine (such as *Sarcocephalus latifolius*, see section 5.9.5). These uses were also confirmed during the focal group discussions performed during the public consultations.

<u>Wooded savannahs and scrubland</u>

In the transition between forest patches and herbaceous savannas, secondary formations develop with a varying structural complexity between these two. These patches were mapped as wooded savannas and scrublands, and occupy 5 279.05 ha, or 25.82 % of the corridor under analysis.

Source: Nemus, 2022

Figure 83 – Different aspects of scrublands and wooded savannahs

Data from the field revealed that the density of woody vegetation (trees and shrubs) is variable, but typically remains between 10% and 40%. The Height also varies considerably, with the herbaceous stratum reaching up to 2 m as well, and the shrub and tree strata remaining below 7-8 m.

These are very uncharacterised areas, in which the vegetation present is the result of a history of anthropic disturbances. These include fallow areas, areas cleared in the past and areas under recovery, among others, and are colonised by pioneer forest species, ruderal and invasive species forming scrub, generalist species, fruiting species propagated from neighbouring humanised areas, and pyrophytic species (field data).

Wetlands

Wetlands are areas where water covers the ground, or is present at or near the soil surface throughout the year or for varying periods of time.

In the study area this habitat comprises rivers, streams, ponds and wet grasslands that are permanently flooded or are inundated during the wet season but have little or no water in the dry season.

The mapped wetlands cover 209.35 ha, or 1.02 % of the assessed area. Field data revealed that these areas correspond mainly to ponds and wet grasslands, as the rivers and streams are colonised by dense arboreal vegetation, mapped as forest.

Source: Nemus, 2022

Figure 84 – Different wetlands in the project area: watercourses with and without emergent aquatic vegetation

Source: Nemus, 2022

Figure 85 – Different wetlands in the project area: lagoons in the municipalities of Uíge (left) and Quitexe (right, lagoa do feitiço)

Likewise, field data has shown that the vegetation formations of the humid grasslands are dominated by the herbaceous stratum, not containing woody species, except occasionally where conditions allow, since the cyclical saturation of the soil prevents the colonisation by shrub and tree species.

In areas of lesser coverage by emergent macrophytes, floating macrophytes attached to the substrate such as *Nymphae* spp. and submerged macrophytes appear.

As expected, grasses and cyperaceous of variable size dominate, typically dominated by the species *Cyperus papyrus*.

Source: Nemus, 2022

Figure 86 – Wetland comprising a monospecific *Cyperus papyrus* grassland

Wetlands are extremely important components in the context of the local landscape. The ecological functions of wetlands include:

- Regulation of the hydrological cycle;
- Erosion control;
- Regulation of water quality;
- Refuge of biodiversity; the high productivity of the vegetation, together with the richness of nutrients, form ideal conditions for ichthyofauna and avifauna;
- Provision of fisheries, fodder and construction resources for local communities.

Regarding the conservation status of these habitats, most of the observed watercourses are fragmented by human infrastructures such as roads, are used for fishing, bathing and washing clothes, and have their banks deforested and invaded by cultivation as witnessed during the field surveys.

Similarly, the ponds are invariably surrounded by cultivated fields and show evidence of recent fire.

Source: Nemus, 2022

Figure 87 – Active fire and evidence of recent fire in different wetlands

Wetlands are also threatened by deforestation in the basin (which increases runoff and sedimentation).

No avifauna was observed in the wetlands visited, which is potentially associated with human influence, omnipresent in the areas visited.

Cultivated areas

Non-mechanised or irrigated cultivation, whether for subsistence or income, occupies 6 320.31 ha, or 30.91 %, of the corridor under study.

As seen during the field surveys, cultivated areas are semi-natural habitats where the vegetation is of anthropic origin and requires human intervention for its maintenance. The structural and floristic complexity of these formations is less than that of potential and secondary forest formations, typically presenting themselves as a mosaic of patches of herbaceous or shrub vegetation of low to medium size, monospecific, with a very sparse tree cover, maintained on purpose according to its usefulness.

These units are often - but not always - associated with dwellings or settlements.

Traditional agricultural fields in the vicinity of Púri (source: Nemus, 2022)

Cassava field in Negage municipality (source: Nemus, 2022)

Figure 88 – Different aspects of agricultural crops

The crops most mentioned in the interviews with focal groups during the fieldwork were beans, cassava, bananas, potatoes and "ginguba" (peanuts), while sugar cane, maize, sweet potatoes and pumpkins are also grown in the region.

Considering that the cultivated areas result from the replacement of the original vegetation by formations of lower diversity, with a predominance of introduced vegetation (non-autochthonous), and that it does not support the original faunal values, they are considered to have a low ecological value.

<u>Artificialized areas</u>

As observed during the field visits, the **artificialized areas** correspond to the villages and towns in the study area, and occupy 500.8 ha, or 2.45 % of the study area. They present a high degree of alteration, and as such the floristic and faunistic values are almost totally distant from the original ones. In the larger urban centres, the degree of soil sealing can be high.

Source: Nemus, 2022

Figure 89 – General appearance of the artificial areas

The territory is occupied by anthropic structures, with sparse vegetation cover, resulting from the planting of squares and pavements, small vegetable gardens and ruderal vegetation. The vegetation essentially consists of introduced, ornamental, nutritional or ruderal species.

Source: Nemus, 2022

Figure 90 – Example of ornamental vegetation in urban areas

During field visits it was noticeable, the frequent presence of mango trees (*Mangifera indica*), the oil palm tree (*Elaeis guineensis*), the baobab (*Adansonia digitata*), and eucalyptus (*Eucalyptus* sp.). Other fruit trees such as papaya (*Carica papaya*) and citrus are also common.

5.9.5. Vegetation and flora

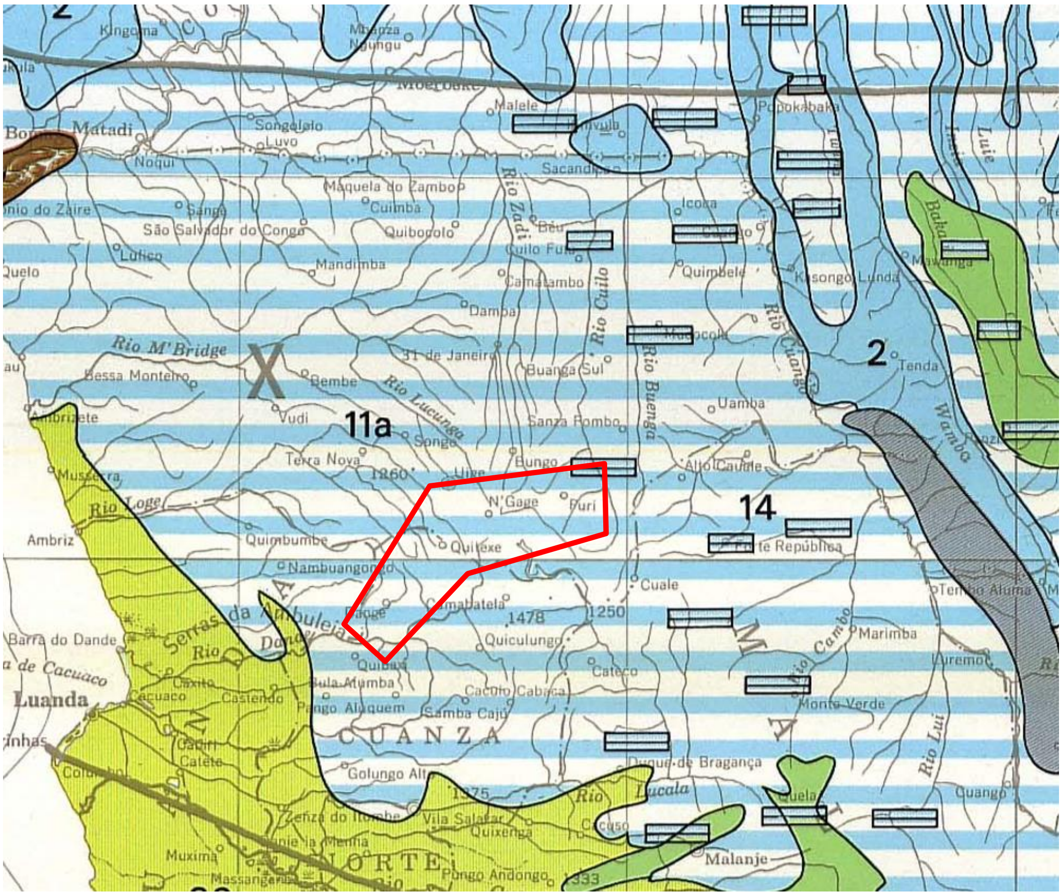
The Angolan territory presents one of the most **diverse combinations of ecoregions** on the African continent (Burgess, et al., 2004). The rich biogeographic composition of the country is closely linked to the climatic, edaphic and physiographic variability of the territory, the latter of which encompasses coastal lowlands, escarpments, highlands and plateaus (Huntley *et al*., 2019).

Based on literature, the project falls within the **western Congolese forest-savannah mosaic ecoregion** (ecoregion N.43) (Burgess, et al., 2004), and - in floristic terms - within the transition **region between the Zambezian and Guineo-Congolese endemism** centre of White (1983).

This is a transition zone between distinct climatic regions and has particular geomorphological and soil characteristics - i.e., the Escarpment Zone and the Congo

Peneplain (cf. 5.3.3 Geomorphology), where the most recent glacial periods have caused the expansion of savannahs to the detriment of forest vegetation (Burgess, et al., 2004).

As evidenced during both field visits, this is an essentially ecotonal zone between the humid tropical forest region to the north and the arid Zambezian region to the south. It is characterised by a mosaic of secondary savannahs with varying density of tree and/or shrub cover (and may even form denser thickets), containing species from the regional centre of Zambezian endemism, and peripheral forest formations, with species characteristic of the humid forests of the interior of the Congolese region (White, 1983; Burgess*, et al*., 2004) (Figure 91).



Project location marked in red, units X (Guineo-Congolese/Zambezian regional transition zone) and 11a (Guineo-Congolese humid forest and secondary grassland mosaic) (White, 1983)

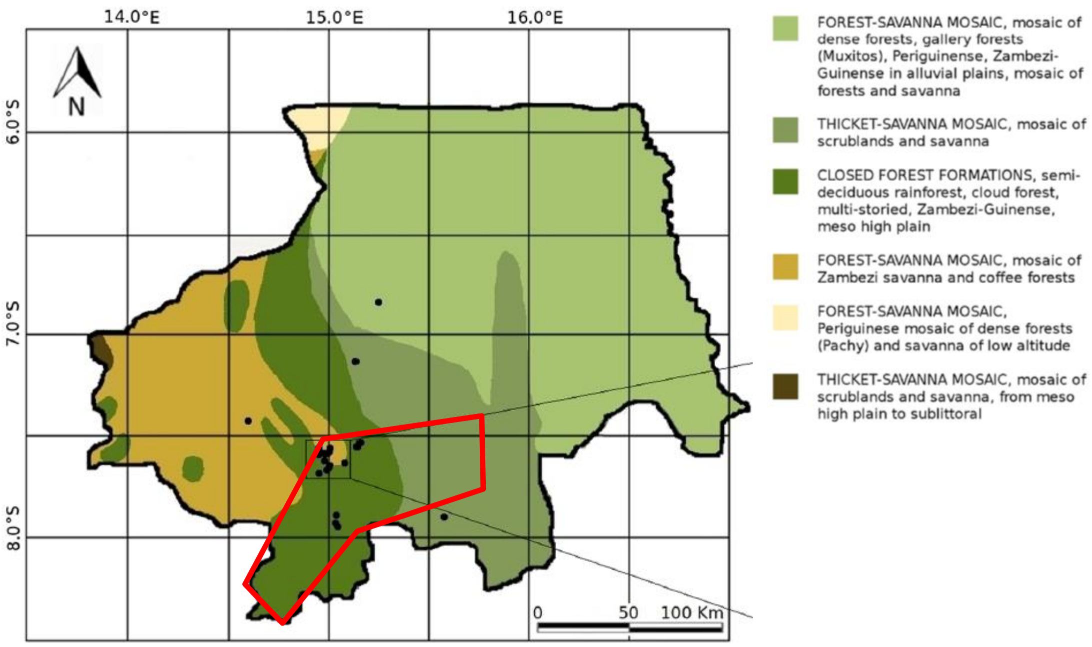
Source: UNESCO, 1981

Figure 91 – Detail of Africa Vegetation Map

Added to these **physical modellers** of vegetation is the history of **anthropic intervention**, namely, the traditional use of forest products, logging, agriculture and fire management, which has shaped the landscape over the past centuries and is considered an inseparable component of numerous vegetation systems on the African continent.

Currently, the region is largely dominated by savannah vegetation, maintained by fire (Gohre, et al., 2016) or by the reduced water-holding capacity of the sandy soil, especially in the peneplain (Beernaert, 1997). These factors were also confirmed during the field surveys.

As evidenced during the field surveys, here (in the eastern portion of the corridor under study), gallery forests cut through the savannah matrix along the river valleys and their tributaries, while to the south of Uíge, in the escarpment region, secondary forest formations appear (e.g., coffee forests) and remnants of closed, semi-caducifolic rainforest, with particular expression in the Uíge and Pingano mountain ranges, where anthropic pressure is felt less intensely.



Source: Gohre, et al., 2016

Figure 92 – Vegetation of Uíge province according to Barbosa (1970, in Gohre, et al., 2016

Along the road network, and as the distance to villages and towns decreases, the expression of species of ruderal and/or invasive character and cultivated species increases.

In order to identify **flora** with special conservation value, commercial value, legally protected, or those with the potential to become nuisance (e.g., invasive), a compilation of the species potentially occurring in the area under analysis was carried out, based on the fieldwork performed during both field visits and on specialty bibliography (Lautenschläger & Neinhuis, 2014; Mawunu, *et al.*, 2020; Ministério do Ambiente, 2018; Gohre, *et al*., 2016; Huntley & Matos, 1994).

The list is given in Annex 1, and is composed of 193 taxa, 11 of which are identified only down to genus, belonging to 66 families. The leguminous family (Fabaceae) is the most represented in number of species, with 14%, followed by the composites (Asteraceae), with 8%, the euphorbaceous (Euphorbiaceae), with 6.7%, the malvaceous (Malvaceae), with 6.2%, and the grasses (Poaceae), with 5.7%.

Regarding global extinction risk according to IUCN (2022), 77 species are considered of low concern (LC, 39.9%), three (3) are near threatened (NT, 1.55%), four (4) are vulnerable (VU, 2.07%), one (1) is endangered (EN, 0.5%), five (5) do not have sufficient information for classification, and 103 (53.4%) are not listed.

Regarding extinction risk at national level, according to the Ministry of Environment (2018), 19 (9.8%) are vulnerable, and five (5) (2.6%) are considered invasive.

Table 41 lists the species of greatest relevance to this assessment because they are in one of the IUCN categories of threat of extinction, on the national list, or because they are considered a risk factor for local biodiversity.

Table 41 – Flora with threatened or potentially invasive status

Species	IUCN	MA	Invasive
Adansonia digitata	-	VU	-
Ageratum conyzoides	LC	-	Inv.
Albizia glaberrima	LC	VU	-
Antiaris toxicaria subsp. *welwitschii*	-	VU	-
Autranella congolensis	EN	VU	-
Brachystegia spiciformis	LC	VU	-
Ceiba pentandra	LC	VU	-
Celtis mildbraedii	LC	VU	-
Chlorophora excelsa	NT	VU	-
Chromolaena odorata	-	-	Inv.
Dalbergia latifolia	VU	VU	-

Species	IUCN	MA	Invasive
Diospyros mespiliformis	LC	VU	-
Entandrophragma angolensis	NT	VU	-
Entandrophragma utile	VU	VU	-
Gambeya africana	LC	VU	-
Gnetum africanum	NT	VU	-
Khaya anthoteca	VU	VU	-
Libidibia ferrea var. *leiostachya*	-	VU	-
Pterocarpus angolensis	LC	VU	-
Ricinodendron heudelotii	LC	VU	-
Ricinus communis	-	-	Inv.
Santalum album	VU	VU	-
Solanum mauritianum	-	-	Inv.
Tithonia diversifolia	-	-	Inv.

Cultivars observed during the field visits include banana (*Musa* sp.), sugarcane (*Saccharum officinarum*), cassava (*Manihot esculenta*), groundnut or "ginguba" (*Arachis hypogea*), beans (*Phaseolus vulgaris*), okra (*Phaseolus vulgaris*), cotton (*Phaseolus vulgaris*), and potato (*Phaseolus vulgaris*).

Local communities have a close relationship with the surrounding landscape. As mentioned above (**Erro! A origem da referência não foi encontrada.**), the forests and savannahs of the Uíge region are the source of numerous products traditionally used mainly for food and for medicinal purposes.

In particular, the consumption of fruits like the jinguenga (*Afromomum alboviolaceum*), the seedlings of *Pteridium aquilinum* subsp. *africanum*, the leaves of N'fumbua (*Gnetum africanum*), and various parts (roots, stem, leaves or seeds) of species like *Sarcocephalus latifolius, Bridelia ferruginea, Gardenia ternifolia,* and *Erythrina abyssinica*.

Coffee - *Coffea arabica* and *Coffea canephora* - is an important product of the region (although it has fallen in popularity and production in recent decades), and is typically grown in the forest understory.

Source: Nemus, 2022

Figure 93 – Coffee production

5.9.6. Fauna

In order to identify fauna with special conservation value, commercial value, legally protected - on which to focus the impact assessment of the project - a compilation of the species potentially occurring in the area under analysis was carried out, based mainly on specialised bibliography (detailed in each section). For every faunal group, opportunistic sightings were observed, registered and added to the species compendium, presented in this chapter. However, merely, bird species were identified.

Given the preponderance of terrestrial habitats in the corridor under analysis, and the nature of the project, this characterisation focused on the following groups of fauna: herpetofauna (reptiles and amphibians), avifauna and mammals.

Amphibians

The group of amphibians has a high taxonomic diversity and a wide distribution globally, and performs important ecological functions. Amphibian communities are excellent bio-indicators of the conservation status of ecosystems due to their ecological requirements, which condition their occurrence at a local level.

The inventory of amphibian species with potential occurrence in the study area was based on the most recent and comprehensive works focused on herpetofauna (Huntley, et *al*., 2019; Marques, et *al*., 2018) that list more than 100 amphibian species for Angola.

However, this is thought to be an underestimate, given the richness of the country's unexplored habitats, particularly in the forests of northern Angola.

From the aforementioned bibliography, it was considered as potentially occurring in the study area those species whose distribution covers the same area and whose habitat preferences coincide with the biotopes present.

The list of amphibians lists **25 species**, belonging to **12 families** and **13 genera** (Annex 1). The family Hyperoliidae comprises the largest number of species (eight [8]), mostly represented by species from the genus *Hyperolius*. The second most represented family is Ptychadenidae which has five (5) species, while the remaining families are represented up to a maximum of two species.

Regarding conservation status according to the IUCN, 25 of the listed species are classified with the status of least concern (IUCN, 2022). None are on the Red List of Species of Angola. Among the species listed as potentially present in the study area, two (2) are considered endemic, namely: *Leptopelis anchietae* and *Amietia angolensis*.

Reptiles

Reptiles show a preference for warm and exposed habitats - e.g., such as rocky areas - so these tend to support a higher diversity of species compared to other types of habitats, such as forests.

However, part of Angola's reptile diversity can only be found in the forests of the northern provinces, where the study area is located.

The list of reptile species potentially occurring in the study area was based on specialized literature (Marques, et *al*., 2018; Ernst, et *al*., 2020; Huntley, et *al*., 2019). Species were included whose distribution has been recorded in the area under analysis and which, given their ecological preferences, may occur in the habitats available there.

In this way, **81 species** are listed in Annex 1, belonging to **22 families** and **47 genera**. The most representative family in number of species is the family Colubridea, with **20 species** (24 %) (snakes of the order Squamata, scaled reptiles), typically associated with forest and savannah environments.

The vast majority of the cast is composed of species with conservation status of little concern (75; 92,6 %), while one (1) has near threatened status, *Python sebae*, and three (3) have vulnerable status, namely *Osteolaemus tetraspis*, *Bitis heraldica* (endemic species), and *Bitis nasicornis*, according to the IUCN Red List of Threatened Species (IUCN, 2022). The species *Crocodylus niloticus* has the vulnerable status at national level, according to the Red List of Species of Angola (Ministério do Ambiente, 2018).

<u>Birds</u>

The diversity and richness of habitats in Angola translates into its birdlife diversity, being the sixth country with the greatest number of bird species on the African continent.

Amongst resident, nesting and migratory birds, Angola has over 940 confirmed species, 29 of which are endemic.

According to Dean **(BirdLife International, 2022)** much of Angola's bird richness is due to the presence of the Guineo-Congolese forest biome, particularly in Cabinda, and the gallery forests of the northeast.

The elaboration of the list of avifauna with potential occurrence in the study area was based on the consultation of specialized bibliography such as "The List of Birds of Angola" **(Mills & Melo, 2013)** and the chapter "The Avifauna of Angola: Richness, Endemism and Rarity" (Dean, Martim, & Mills, 2019).

A total of 357 species were listed whose distribution covers the study area, and whose habitat preferences coincide with the existing biotopes (Appendix 3). The listed species belong to 80 families, the most represented in number of species being the families Accipitridae (26; 7,3 %), Estrildidae (19; 5,3 %), and Cisticolidae (18; 5%). These families are typically associated with terrestrial environments, especially forests and savannahs.

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In terms of conservation status, namely the Angola Red List of Species (Ministério do Ambiente, 2018), three (3) have vulnerable status – Angolan flycatcher, *Batis minulla*, the sooty flycatcher, *Bradornis fuliginosus*, and the red-crested turaco, *Tauraco erythrolophus.*

According to the IUCN assessment (2022), 98,3 % of the cast is considered of little concern. One (1) species is near threatened, and four (4) are effectively endangered, namely: the Braun's bush-shrike, *Laniarius brauni*, the martial eagle, *Polemaetus bellicosus*, the secretarybird, *Sagittarius serpentarius*, and the bateleur, *Terathopius ecaudatus*.

The Braun's bush-shrike was the only species with relevant conservation status identified during the October 2023 field survey.

Mammals

Currently, in Angola, about 291 species of mammals are inventoried, of which 12 are endemic. In the Red List of Species of Angola (Ministério do Ambiente, 2018) 37 species are listed, 19 classified as endangered and 18 as vulnerable.

Through specific bibliography, namely the chapter "The mammals of Angola" (Beja, et al., 2019), species whose distribution includes the study area and whose habitat preferences coincide with the available biotopes were included in the list.

The cast of mamofauna is composed of 91 species belonging to eight (8) orders and 27 families. The most representative orders in number of species are the order Chiroptera (bats, with 27 species), Rodentia (rodents, with 22 species) and Carnivora (felids, canids, and mustelids mainly, with 18 species).

During the field reconnaissance work, mainly domesticated "companion" species such as dogs and cattle were recorded.

Traditional poultry farming is the most common, and chickens have been observed in most villages and the surrounding area, circulating and feeding freely on the available vegetation.

The species *Galagoides kumbirensis*, *Aethomys bocagei* and *Otomys cuanzensis*, are the only Angolan endemic species with potential occurrence in the study area.

With regard to conservation status, of the species included in the Red List of Species of Angola (Ministério do Ambiente, 2018), ten (10) have potential for occurrence in the study area, of which three (3) have endangered status, and the rest have vulnerable status.

According to the IUCN Red List of Threatened Species (IUCN, 2022), most species are of low concern (79; 87 %), and six (6) are near threatened. Five (5) species are classified with threat status, four (4) are vulnerable - the African golden cat, *Caracal aurata*, the blue monkey, *Cercopithecus mitis*, *Colobus angolensis*, and the Angolan talapoim, *Miopithecus talapoin* - and one (1) is endangered, *Phataginus tricuspis*, the white-bellied pangolin. All have affinities with forest environments.

Source: Jansen, et al., 2020

Figure 94 – White-bellied pangolin, *Phataginus tricuspis*

5.9.7. Ecosystem services

Following IFC-PS6 guidelines, whenever a project is likely to adversely impact ecosystem services, a review of priority ecosystem services should be conducted. Ecosystem services can be defined as “the benefits that people, including businesses, obtain from ecosystems”, and can be divided into four major categories (IFC, 2012; Millenium Ecosystem Assessment, 2005):

- Provisioning ecosystem services, including, for instance (i) agricultural products, wild food, and plants for medicinal use; (ii) water for drinking, irrigation and industrial purposes; and (iii) forest areas, providing the basis for biopharmaceuticals, construction materials, and biomass for renewable energy.

- Regulating ecosystem services, including (i) climate regulation and carbon storage and sequestration; (ii) waste decomposition and detoxification; (iii) air and water purification; (iv) pest and disease control; (v) pollination; and (v) natural hazard mitigation.

- Cultural services, which may include, (i) spiritual and sacred sites; (ii) recreational purposes (sports, hunting, fishing, ecoturism); (iv) scientific and education purposes (including scientific expeditions and environmental education).

- Supporting services, which are the natural processes that maintain the previously mentioned ecosystem sciences (provisioning, regulating, and cultural); these can consist of (i) nutrient capture and recycling; (ii) primary production, and (iii) pathways for genetic exchange.

For all the above-mentioned categories of ecosystem services, a prioritization should be made based on: (i) the project’s likelihood to have an impact on the service; and (ii) the project’s direct management control or significant influence over that service.

IFC-PS6 “will not apply in instances where a client, through its project, does not have direct management control or significant influence over such services, whose benefits are received on a global scale (for example, local carbon storage that could contribute to mitigation of global climate change)” (IFC, 2012). This would be the case for carbon sequestration in the miombo and wetland areas.

The identification of ecosystem services within the Project’s area started with a preliminary literature review (Table 42), which was then validated with the ecological survey, community discussion groups and interviews conducted in July 2022, during the dry season field site visit (Table 43).

For the natural habitats occurring within the Project's area, a total of three provisioning ecosystem services were identified for forests and wooded savannahs and scrublands:

- Provision of non-wood forest products (including fruit trees such as cassava);
- Provision of wood for construction and handcraft;
- Provision of medicinal plants.

- Contacts with local administrations and community discussion groups were conducted in the municipalities of the Project's Direct Area of Influence in July 2022 (in parallel with the dry season field visit), thus complementing the desktop literature review on ecosystem services in the identified habitats within the project's area of influence.

Table 42 – Main ecosystem services identified for the study area which are prone to be impacted by the project's activities

ES identified	ES Category	Habitats	References
Non-wood forest products (NWFP), such as fruit trees	Provisioning	Cultivated areas	(Monizi, 2018; Mawunu, et al., 2020)
Wood for construction and handcraft	Provisioning	Forest - Wooded savannahs and scrubland	(Monizi, 2018)
Medicinal plants	Provisioning	Forest	(Lautenschläger, et al., 2018; Göhre, Toto-Nienguesse, Futuro, Neinhuis, & Lautenschläger, 2016)

One of the main goals of these sessions was to collect feedback on communities' views and concerns about the Project's environmental and social impacts and risks, including on mitigation and enhancement measures. These sessions were conducted during the field visit, as part of both the Environmental and Social Impact Assessment (ESIA) and Stakeholder Engagement Plan (SEP) for the Electrification of Uíge, Lot 1, Phase I.

Overall, public participation (Figure 95) highlighted the importance of fruit trees and subsistence agriculture, particularly of *cassava*, in people's livelihoods. Other crops, such as beans, *gingula* (peanut) and banana were also mentioned.

Table 43 – Summary of the contacts with communities (excluding contacts with administration, which are also presented in the meeting minutes in ESIA Vol. IV).

Town	Comune	Municipality	Contact date	Contact type
Aldeia Viçosa (head office)	Aldeia Viçosa	Quitexe	12.07.2022	- Administration - Community discussion group
Cangundo	(traditional leadership)	Negage	13.07.2022	- Administration - Community discussion group
Kibunga Lau	Púri	Púri	18.07.2022	- Community discussion group
Dambi and Piqui	(traditional leadership)	Uíge	20.07.2022	- Community discussion group, including traditional authorities
Calumbo	(traditional leadership)	Uíge	20.07.2022	- Community discussion group, including traditional authorities
Quiongua	(traditional leadership)	Uíge	20.07.2022	- Community discussion group, including traditional authorities


Community discussion group in Cangundo


Community discussion group in Kibunga Lau


Community discussion group in Calumbo

Figure 95 – Community discussion groups held in Uíge.

5.9.8. Fatal issues and critical habitats, natural and modified

Following the guidelines contained in the IFC-PS6 standard (IFC, 2012), the habitats found in the study area can be further classified according to whether they are:

- Natural habitats: areas composed of viable associations of plant and/or animal species of essentially native origin, and/or where human activity has not modified the primary ecological functions and species composition of the area;
- Modified habitats: areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified the primary ecological functions and species composition of an area.

Considering the habitats identified and characterised above, the correspondence between both classifications is presented in Table 44.

Table 44 – Natural and modified habitats in the study area (IFC-PS6 criteria).

Habitat units	IFC-PS6 Classes	Description
Forests	Natural	The forest is a natural habitat, impacted in different degrees of intensity by anthropic pressure (logging, deforestation, etc.)
Grasslands and herbaceous savannahs	Natural	Grasslands and herbaceous savannahs are natural habitats originated (or not) by human influence over the last centuries, but which maintain a native floristic cast, and perform important ecological functions.
Wooded savannahs and scrublands	Natural	Wooded savannas are semi-natural habitats resulting from the degradation of native vegetation, but which maintain a predominantly native floristic cast - although with generalist, pioneer species, and some representation of non-native species - and which maintain some important ecological functions.
Wetlands	Natural	Wetlands are natural habitats impacted to varying degrees by human action (such as cultivation, deforestation, and resource exploitation).
Croplands	Modified	Cultivated areas result from the replacement of native vegetation by non-native species for the most part, and depend on human management for their maintenance.

Habitat units	IFC-PS6 Classes	Description
Artificial areas	Modified	Artificial areas include rural and urban settlements, roads and other artificial infrastructure resulting from human expansion. The vegetation present is ornamental, of commercial importance or ruderal.

The IFC-PS6 standard defines not only natural and modified habitats, but also critical habitats, which are areas with high biodiversity value:

- habitats of significant importance for Critically Endangered and/or Endangered species;
- habitats of significant importance for endemic and/or restricted distribution species;
- habitats that support globally significant concentrations of migratory and/or gregarious species;
- highly threatened and/or unique ecosystems; and/or
- areas associated with key evolutionary processes.

Additionally, Annex V of Presidential Decree 117/20 of 22 April (on the regulation of ESIA and environmental licensing procedures) lists fatal issues that must be assessed in ESIA processes. Fatal issues are total protection areas and areas that meet one of three criteria, and where no activity potentially causing significant negative impacts is authorised.

The question of protection areas does not arise. For the second point, the following criteria are established:

a) **Presence of Critically Endangered and/or Endangered Species**, encompassing habitat necessary to sustain 10 per cent of the global or national population of a Critically Endangered and/or Endangered species, species/subspecies where there are known, regular occurrences of the species and that where that habitat could be considered a discrete management unit for the species; or habitat with known regular occurrences of the Critically

Endangered or Endangered species where that habitat is one of 10 or fewer discrete management sites globally for that species;

b) **Presence of a range of Endemic/Restricted Species**, namely habitat known to support 95 per cent of the world or national population of an endemic or limited range species, where the habitat could be considered a discrete management unit for the species (e.g., single endemic site);

c) **Presence of Migratory/Congregational Species**, integrating habitat known to support, on a cyclical or otherwise regular basis 95 per cent of the world or national population of a migratory or congregational species at any point in the species' life cycle, where that habitat could be considered a discrete management unit for those species.

In this respect, the following table presents the taxa requiring a fatal issue analysis.

Table 45 – Endemic or endangered taxa, and requiring analysis of fatal issues

Species	Group	Endemicities	IUCN
Autranella congolensis	Flora	-	EN
Leptopelis anchietae	Amphibian	Endemic	LC
Amietia angolensis	Amphibian	Endemic	LC
Bitis heraldica	Reptile	Endemic	VU
Galagoides kumbirensis	Mammal	Endemic	NT
Aethomys bocagei	Mammal	Endemic	LC
Otomys cuanzensis	Mammal	Endemic	LC
Phataginus tricuspis	Mammal	-	EN
Platysteira albifrons	Bird	Endemic	NT
Laniarius brauni	Bird	Endemic	EN
Polemaetus bellicosus	Bird	-	EN
Sagittarius serpentarius	Bird	-	EN
Terathopius ecaudatus	Bird	-	EN

Based on the information available in the literature - assessments by IUCN (IUCN, 2022), Bird Life International (BirdLife International, 2022; Dean W. R., n.d.) and specialist literature such as Svensson, *et al.,* (2017) and Jansen, *et al.*, (2020) - **only one fatal issue** situation has been identified, that of the **Braun's bush-shrike**.

This species - ***Laniarius brauni*** - is **endemic, globally endangered**, and has a very **restricted known distribution**, crossed by the project (see Section 6.8.2.ii). According to BirdLife International (2022) it prefers forest habitats, usually using gallery forest and secondary and degraded forest. It tolerates some degree of human disturbance. This species was visually confirmed during the second ecological survey, during the wet season (October 2023).

A Critical Habitat Assessment was performed, following IFC-PS6 guidelines, to complement the analysis of fatal issues and critical habitats. This assessment is presented in ESIA Vol. II. Accordingly with the results of this assessment, where *Laniarius brauni* was also identified as a trigger species, a separate Biodiversity Action Plan, targeting bird species, was developed.

5.9.9. Evolution prospects in the absence of the project

In the absence of project implementation, the natural modellers of the floristic and faunal communities are expected to be maintained, i.e., climatic and edaphic conditions.

These are factors of negligible evolution in the temporal scope of the present analysis, so that no significant evolution of the biological communities will occur according to natural processes (i.e., according to ecological successions).

On the other hand, as a result of the trend of increasing human population, it is expected that there will be an intensification of anthropic pressure at regional level - traditional use of forest products, exploitation of wood as fuel and for construction, cultivation, grazing and hunting.

This pressure will expectably translate into the gradual degradation of forest formations, the maintenance of savannahs, and the expansion of cultivated areas. At the same time, the pressure on fauna communities will intensify, particularly on mammals that are poached for their own consumption and commercialisation.

5.10. Socioeconomics and human rights

5.10.1. Introduction

This section presents the socioeconomic characterization of the intervention area, based on the analysis of statistical and bibliographical information, as well as primary data collected.

The project's Direct and Indirect Area of Influence covers the municipalities of Uíge, Negaje, Puri and Quitexe (Uíge Province) and Dembos-Quibaxe (Bengo Province).

The socioeconomic characterization is presented at the municipality level and compared to the realities of the respective provinces and the country of Angola.

This section will examine the following aspects: administrative structure; demography; land use and ownership; economy and employment; income and livelihoods; health; education; infrastructure and services; vulnerable groups; and human rights.

The following subsection presents the overall methodology employed.

5.10.2. Methodology

5.10.2.1. General methodology

The socioeconomic study was carried out through the following steps:

- Review of relevant data sources, such as population and housing census and employment and health surveys, project reports, annual reports and Government databases, and aerial imagery, among others;
- Site visit to determine a baseline assessment approach, including mapping of social infrastructures, contacts with relevant stakeholders (including local institutions and local authorities) and data collection;
- Baseline study, comprising the characterisation of these issues for the project site and surrounding area; this was supported by a set of key indicators to be calculated using a variety of information sources (documentary, statistical and qualitative);
- Impact assessment to evaluate how project activities will affect socioeconomics and the health and safety of the local community at all stages;

- If significant negative impacts are identified, propose possible mitigation measures and monitoring actions.

5.10.2.2. Specific methodology and content of the human rights assessment

According to Principle 2 of the Equator Principles (Environmental and Social Assessment), an ESIA is expected to include an assessment of potential adverse human rights impacts, referring to the UN Guiding Principles on Business and Human Rights. Accordingly, the ESIA incorporates a Human Rights Impact Assessment (HRIA, Annex 2).

Human Rights Impact Assessment (HRIA) examines the effects of business activities on rights holders such as workers, local community members, consumers and others.

HRIA follows a human rights-based approach, which integrates human rights principles such as non-discrimination into the assessment process. The HRIA (integrated into the ESIA methodology) will follow the guidelines and methods provided by the Association of the Equator Principles (2020a) and the Danish Institute for Human Rights (2020).

Consequently, the ESIA will be developed through several phases or stages, all of which are included to ensure a comprehensive assessment, specifically:

- **Planning and scoping** – defining the parameters for the HRIA by collecting preliminary information about the impact area of the project or business activities;
- **Data collection and baseline development** – includes field research on the human rights of workers, community members and other relevant rights holders. The data collection phase emphasises fieldwork, interviews, and different types of stakeholder engagement;
- **Impact Analysis** – analysis of the data collected to identify any business-related impacts and assess their severity, involving drawing on the normative content of international human rights standards and principles, comparative projects, results of stakeholder engagement, etc;
- **Impact mitigation and management** – the ESIA team, with stakeholder input, will create a plan to prevent and address human rights impacts. All human rights impacts will be addressed, with the most serious impacts being prioritised;
- **Reporting and evaluation** – this detailed ESIA report should be available and accessible to all stakeholders to promote dialogue and accountability by

documenting the impacts (including human rights impacts) identified and the measures taken to address them.

Since stakeholder engagement is critical in HRIA (including in ESIA), this will be carried out at all stages presented above.

5.10.3. Administrative structure

As of 2016, Angola is divided into 18 provinces (Law No 18/16 of 17 October – Political-Administrative Division Law). These are further divided into 164 municipalities and 518 communes (including 44 urban districts) (ABANC, n.d.).

A new process of adjustment of the Political-Administrative Division was initiated in 2021 (Presidential Dispatch no. 104/21 of 8 July). A proposal for the creation of five new provinces and 27 additional municipalities is under discussion (Vanguarda, 2022).

The governors of the provinces are appointed by the national government, and the municipal administrators are appointed by the governor of the province in which the municipality is located. The municipal administrator appoints the administrators of the communes. There are no formal institutions below the commune.

The provinces are responsible for the promotion and guidance of socio-economic development, provincial planning, social support, education, health care, environmental protection and other issues. They also play a role in the implementation of decisions taken by central authorities on regional/local issues and supervise institutes and public enterprises of provincial/local importance (OECD/ UCLG, 2016).

Municipalities have been independent budget units since 2007 and are responsible for municipal and urban planning, agriculture and rural development, primary health care, municipal police, and sanitation. Municipalities rely on municipal administrators to plan and implement policies at community level (OECD/ UCLG, 2016).

In the communities (administratively below the communes), local leadership is provided by the soba or community coordinator whose role is to liaise with commune administrators on community issues. Sobas are selected by the community they represent.

Communes are administrative units divided into sectors, neighbourhoods and/or blocks. In rural areas, these subdivisions are also called communes or villages, while in peri-urban areas it is more usual to find references to neighbourhoods. Peri-urban neighbourhoods are located near urban centres and present a mix of urban and rural characteristics.

In Angola, traditional leadership plays an important role in local governance. The traditional chief, known as the soba, is the local governing authority in rural and most peri-urban areas. The soba is chosen by the eldest of the line of chiefs. The soba is often backed by a secretary who supports local management.

Sobas serve as the means of communicating community problems to the Communal Administrations, particularly those that go beyond their powers. As traditional authorities, they are community leaders, informing, sensitising and guiding their communities according to the local development programme.

On the other hand, as traditional authorities are the real community leaders and those who have knowledge related to ancestors' beliefs and customs, connoisseurs of culture, they are also advisors to local government, facilitating the adaptation of policies to the culture of a particular region.

These authorities participate in the exercise of governance for local development, bringing the assistance of local government to the most remote communities in matters of health, education, agriculture, sanitation, sports, and many other social and legal problems (Costa, 2017).

In areas where the soba is no longer the main local authority, which is more the case in and around peri-urban areas, there are other positions that play the role of liaison between the commune and the municipal local authorities, such as coordinators, who work as social mobilisers.

There may also be coordinators of neighbourhood committees and residents' commissions (Santin & Teixeira, 2020). Coordinators are appointed by the commune government and are usually chosen from among the local party leaders.

5.10.4. Demography

Angola's current population is estimated at 33 million, seven million more than the population identified by the 2014 national census (INE, 2014; INE, 2022). The province of Uíge has an estimated population of about 1,9 million in 2022 (37 000 more than in 2014).

Based on data from the National Institute of Statistics for the first General Census of Population and Housing conducted after National Independence (INE, 2016), the 2014 and 2022 population (projection) for all municipalities in the project scope are presented in the table below.

Table 46 – Total population and per Municipality in the Project area

Province/ Municipalities	Population 2014 (10^3)	Population 2022* (10^3)
Uíge (total)	**1 488**	**1 867**
Uíge	521	654
Negage	138	173
Puri	38	48
Quitexe	34	43
Total (4 Mun.)	731	918
Bengo (total)	**370**	**498**
Dembos-Quibaxe	31	42
Total (5 Mun.)	**762**	**960**

Note: * - INE projection
Source: (INE, 2016)

Uíge is the municipality with the biggest population in the project's area of influence (around 654 000 inhabitants), followed by Negage (with 173 000).

Table 47 shows demographic indicators for the province of Uíge in 2022. In relation to average life expectancy at birth, women present a higher value than men (about three years more). The infant mortality rate is still quite significant in Uíge, particularly for men in relation to women (58 % vs. 44 %). Furthermore, this province has a high level of demographic growth, as can be seen by the 37 % birth rate compared to the mortality rate of only 7 %, which is reflected in a low aging index.

Table 47 – Demographic Indicators, 2022

Indicator	Uíge

Average life expectancy at birth – total	64,2
Men	62,4
Women	65,9
Infant mortality rate - total	51
Men	58,3
Women	43,7
Mortality rate	7,3
Birth rate	36,9
Aging index	6,4

Note: the aging index refers to the number of elderlies in the population (aged 65 years and over) per 100 individuals under 14 years of age.
Source: (INE, 2016)

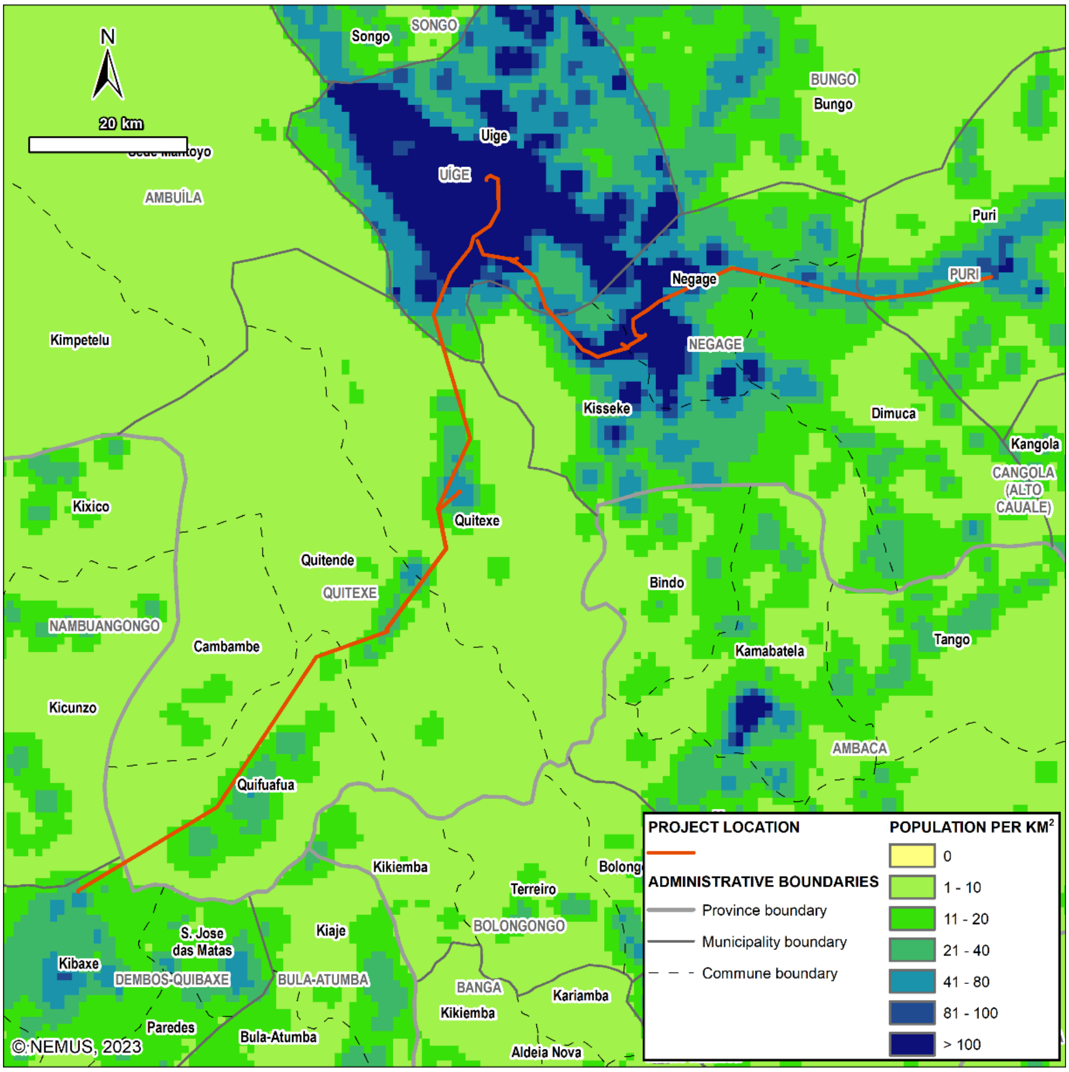
Looking at the following table, which represents the urban and rural population in 2022 in Uíge based on estimates made by INE, one can see that Uíge is a mostly rural province. According to INE estimates, the rural population will grow faster than the urban population and, therefore, the urban population is not expected to exceed the rural population in this province in the next three decades.

Table 48 – Total Rural and Urban Population in the Project Area

Province	Rural		Urban	
	Number (10^3)	Proportion (%)	Number (10^3)	Proportion (%)
Uíge	1 138 557	61 %	728 600	39 %

Note: * - INE projection for 2022.
Source: (INE, 2016)

Figure 96 presents the population density adjacent to the project. The municipality of Uíge has a higher population density in project's surroundings, which was already expected given that this municipality is the capital of the Uíge province.



Source: (Bondarenko, Kerr, Sorichetta, & Tatem, 2020)

Figure 96 – Population density in the project's surroundings (estimate for 2020 according to UNDP methodology)

It is estimated that about 28,4 thousand people were living in the direct area of influence of the project in 2020 (CIESIN; 2021). Their distribution by municipality can be seen in the following table.

Of the total number of people living in DAI, almost 21 thousand lived in the municipality of Uíge (73 %) and 5,7 thousand lived in the municipality of Negage (20 %). Only 113 people lived in DAI in Bengo province, an almost insignificant percentage of 0,4 %. Of the 28,4 thousand people living in the project's DAI, it is estimated that only 6 % live within the project's 60 metre right of way (1,8 thousand people).

Table 49 – Distribution of the population in the project's direct area of influence and the 60 m right of way (2020)

Province/ Municipalities	Population in DAI	Population in the 60m right of way
Uíge		
Uíge	20 616	1 274
Negage	5 731	381
Puri	611	37
Quitexe	1 332	102
Bengo		
Dembos-Quibaxe	113	6
Total (7 Mun.)	28 403	1800

Source: Calculations based on data from Centre for International Earth Science Information Network (2021).

5.10.5. Land use and ownership

5.10.5.1. Land ownership

Under the Angolan Constitution, all land is State property and may be classified as either State land of the Public Domain or State land of the Private Domain. State land of the Private Domain is considered "conferred" land to which ownership rights may be transferred.

The land issue in Angola has gone through several phases. In recent decades, important and innovative policies and laws have been passed in the country, designed in part to better shape rural livelihoods by strengthening people's land rights, especially those most vulnerable in rural areas.

Law No. 9/04 of 9 November – the Land Law – guarantees the right of communities to remain on the land of their customary occupation and the power to decide on the management of their natural resources (land, fauna, forests, pastures, rivers, lakes, etc.).

Rural community lands are considered part of the "Public Domain" and are therefore not conferrable, unless otherwise determined by traditional authorities that allow for the alteration and granting of rural community lands.

The exercise of customary rights is free and right holders are exempt from payments and fees of any kind (WV & DW, 2016).

With more than half of Angola's population living in urban and peri-urban areas and informal settlements, land tenure is insecure and under threat.

Land conflict is an issue affecting urban, rural and peri-urban areas and poor communities affected by the expansion of cities and towns are particularly vulnerable (Cain, 2019).

Although the State is the formal owner of all land, in practice, there is an informal land market and growing conflicts affecting communities, smallholders and families.

While the existing land law recognises customary law, i.e., a custom-based right that has gained legal value, ownership and inheritance are poorly protected (Cain, 2019). The results of the focus group discussions held in the communities under study point to the same conclusion.

In rural areas, due to low population density, all families are entitled to a plot of land for individual agricultural use and a plot for residential use. Inheritance is the main source of access to rural land, but, as stated above, land can also be accessed in the informal land market.

The soba also allocates land to individuals and households, taking into account household size and land availability when defining plot size (Foley, 2007).

In general, in urban/peri-urban areas, access to land is less dependent on inheritance and distribution by the soba and more dependent on the land market. Consequently, land is more valuable in urban and peri-urban areas and the pressure on space is greater (Foley, 2007). This is mainly because urban land values have increased in recent decades as a result of the large influx of people into urban areas.

Most rural households in Angola have their own plot of land, unlike in urban areas, as shown in the table below.

Moreover, although in Uíge a large proportion of families received their land through inheritance (57 %), purchase (4 %) or occupation of a plot (12 %) is still quite common. In Uíge 79 % of the families have land tenure.

Table 50 – Land tenure indicators, 2018-19

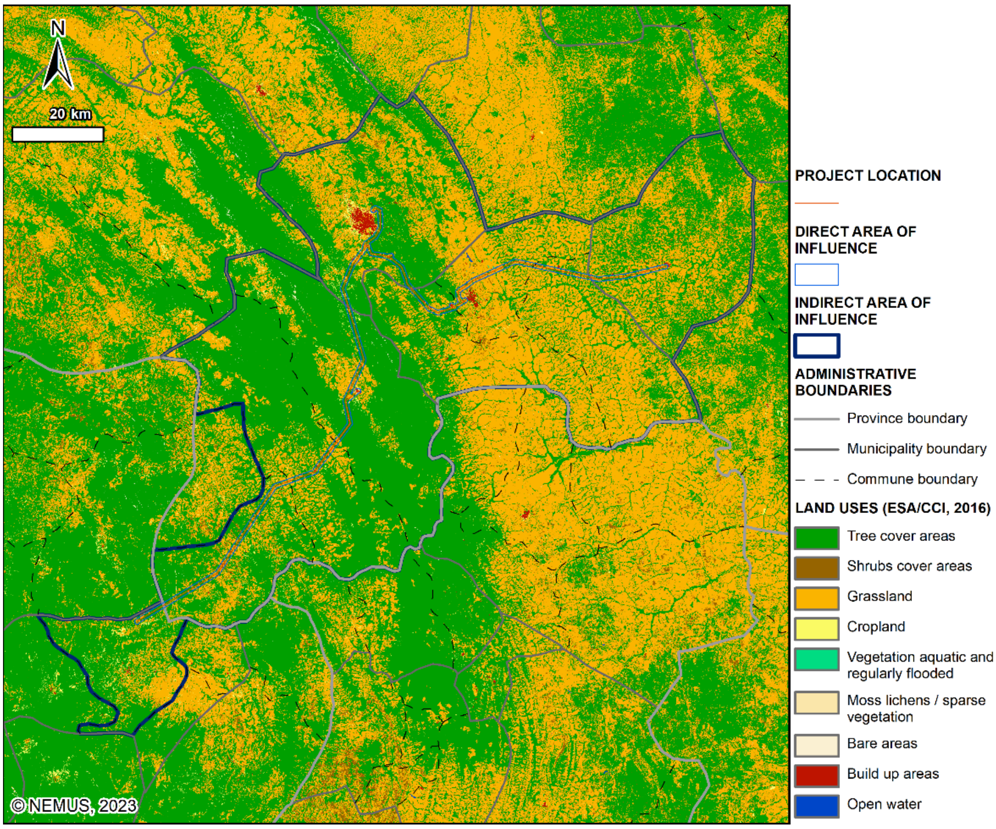
Indicator	Angola – urban	Angola – rural	Uíge
Families who own land	27,3 %	88,3 %	78,8 %
Land occupation regime			
Provided by local authorities/government	6,6 %	9,3 %	0,4 %
Offered free of charge by others	30,9 %	23,1 %	26,1 %
Inheritance	30,8 %	36,5 %	56,8 %
Purchased	11,9 %	3,8 %	4,2 %
Rented	3,1 %	0,6 %	0,4 %
Occupied	15,7 %	25,7 %	12,1 %
Other	1,0 %	1,1 %	0,0 %

Source: (INE, 2020)

5.10.5.2. Land use

Figure 97 Figure 97 – shows the land uses in the study area. The DAI includes several land uses. In Uíge province 97 % of households use the land for cultivation, which is above rural areas (93.5 %).

The predominant land uses are grassland, tree cover areas, cropland and shrubs cover areas. The tree cover areas are mainly located in the western part of the study area, namely in the municipalities of Dembos-Quibaxe and Quitexe. Grassland is predominant in the eastern part, Negage and Puri municipalities. In the municipality of Uíge there is also a considerable zone of built-up areas.



Source: (ESA/ CCI, 2015).

Figure 97 – Land Use in the surroundings of the project

In the ADI (Table 51), the most common land coverage is tree cover areas, which covers 58% of the entire DAI (112 km^2), followed by grassland, which occupies 36 % of the DAI, extending over 70 km^2. Cropland, built-up areas and shrubs cover areas only occupy 5 % of the DAI (2%, 1 % and 2 %, respectively).

Table 51 – Distribution of land use in the DAI (2015)

Land Use	Area (km^2)	%
Tree cover areas	111,8	58 %
Shrubs cover areas	3,4	2 %
Grassland	69,6	36 %
Cropland	4,7	2 %
Built-up areas	1,6	1 %
Total	191,2	100%

Source: (ESA/ CCI, 2015)

In the project's right of way (60 metre corridor), land use is identical to that of the DAI, with tree cover areas and grassland occupying most of the land (occupying 60 % and 36 % of the project's right of way, respectively).

Table 52 – Distribution of land use in the right of way of 60 m (2015)

Land Use	Area (km^2)	%
Tree cover areas	7,9	60 %
Shrubs cover areas	0,2	2 %
Grassland	4,7	36 %
Cropland	0,3	2 %
Built up areas	0,1	1 %
Total	13,3	100 %

Source: (ESA/ CCI, 2015)

5.10.6. Economy and employment

5.10.6.1. Economic activities

Angola's economy is mainly driven by the oil sector. Oil production and its supporting activities constitute about half of GDP, over 70 % of government revenues, and over 90 % of the country's exports. Diamonds constitute another 5% of exports.

Although agriculture accounts for only about 9% of Angola's GDP, subsistence agriculture is the main livelihood for most of the population. However, more than half of the country's food is still imported (CIA, 2022).

In general, because the import basket is highly diversified and composed mainly of complex products (e.g., machinery, transport products, chemicals), and given the overwhelming importance of oil exports, Angola's economy is greatly exposed to international commodity markets and is very volatile.

Angola ranks 116 (out of 127) in the economic complexity index, which reveals the modest development of Angolan industry. Nominal GDP per capita was about $2,1 thousand in 2021, and GDP per capita growth has been negative since 2014 as a result of continued low oil prices, the depreciation of the Kwanza, and slower than expected non-oil GDP growth (World Bank, 2022; CIA, 2022).

As depicted in Table 53, poverty is still a major issue in Angola, with around half of the country living on less than US$1,90 per day.

Table 53 – Economic indicators for Angola

Indicator	Year	Value
GDP per capita (US$, current prices)	2021	2,137
GDP per capita, PPP ($, current international prices)	2021	6,581
Agriculture, forestry and fishing, value added (% of GDP)	2021	9.0%
Industry (including construction), value added (% of GDP)	2021	43.4%
Services, value added (% of GDP)	2021	47.5%
Index of Economic Complexity (IEC)	2020	Rank 116 de 127
Main exports	2020	Oil derivatives (92.2%)
Main imports	2020	Boilers, machinery and mechanical devices (16.4%)
Poverty rate of US$ 1.90 per day (PPP 2011) (% of population)	2018	49.9%

Sources: (World Bank, 2022; CIA, 2022; OEC, 2022).

Uíge concentrates about 2 % of the companies in activity in Angola, but concentrates over 4 % of the companies in agriculture, livestock production, hunting, forestry and fishing, which reflects the rurality of this province.

However, it is wholesale and retail trade and vehicle repair that concentrates the highest number of active companies in Uíge, with 67 % of all companies in Uíge integrated in this sector whilst only 8% of active companies in the agriculture sector.

Table 54 – Active companies by sector of economic activity in Uíge and as a proportion of all companies in Angola (2018)

CAE Rev2 section	No. of active companies	Proportion of total companies active in	
	Uíge	Uíge	Angola
Agriculture, livestock, hunting, forestry and fishing	92	8,40 %	4,40 %
Mining and quarrying	4	0,40 %	0,90 %
Manufacturing	47	4,30 %	1,60 %
Electricity, gas, steam, hot and cold water and cold air	0	0,00 %	0,00 %
Collection, purification and distribution of water; sanitation, public hygiene and similar activities	0	0,00 %	0,00 %
Construction	47	4,30 %	1,60 %
Wholesale and retail trade; repair of motor vehicles and motorbikes	733	67,20%	2,80 %
Transport and storage	12	1,10 %	0,70 %
Accommodation and food service activities (restaurants and similar)	45	4,10 %	0,90 %
Information and communication activities	7	0,60 %	1,20 %
Financial and insurance activities	5	0,50 %	0,50 %
Real estate activities	0	0,00 %	0,00 %
Consulting, scientific and technical activities	18	1,70 %	0,70 %
Administrative and support service activities	18	1,70 %	0,70 %
Education	6	0,60 %	0,50 %
Human health activities and social work activities	16	1,50 %	1,20 %
Arts, entertainment, sports and recreation	0	0,00 %	0,00 %
Other service activities	40	3,70 %	2,00 %
Total	1090	100,00%	2,10 %

5.10.6.2. Employment

The employment rate of the population aged 15 and above in Angola is substantial, 87 % overall and more than 90 % in rural areas. There are important differences between urban and rural areas (with rural areas having a higher activity rate).

The province of Uíge (89 %) has an activity rate slightly above the Angolan average. However, the unemployment rate in this province exceeds the Angolan average by ten percentage points (62 %).

Table 55 – Employment indicators, 2018-19

Indicator	Angola			Uíge
	Total	Urban	Rural	
Employment rate	86,9 %	84,6 %	90,7 %	89 %
Unemployment rate	29,0 %	36,5 %	17,1 %	62 %

Source: (INE, 2020).

In spite of 62 % of the population in Angola living in urban areas (in 2014) and of the growing trend towards increasing urbanisation, the agriculture, livestock production, hunting, forestry and fishing sector (hereafter referred to as the agriculture sector) is the largest employer in Angola.

The trade and vehicle repair sector also employs a significant proportion of the total in Angola, 21 %.

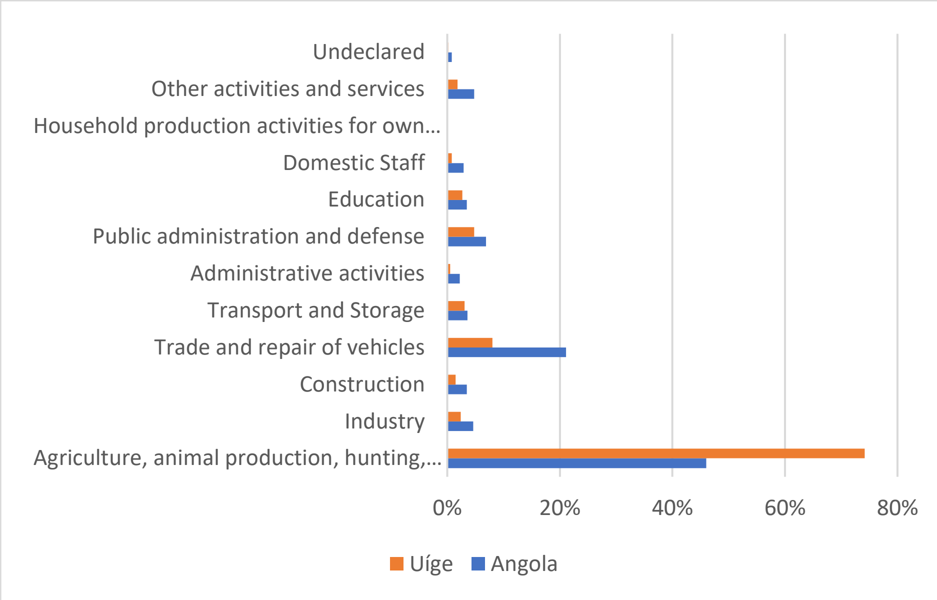
All other sectors of the economy employ less than 10 % of the employed population.

As expected, in rural areas, the agricultural sector is dominant, accounting for a total of 84% of employment in 2018-2019.

In Angola's urban areas, trade and vehicle repair comprises 34 % of total employment, with the public sector being the third most important employer at 11 %.

In the province under study, the agricultural sector is also the most important and occupies an even higher percentage of the population, with 74 % of the entire employed population in this province engaged in this activity (Figure 98). This indicator reflects the large rurality of this province.

The trade and vehicle repair sector (8 % of the employed population) and the public administration and defence sector (5 % of the employed population) are also important sectors of activity in the province of Uíge.



Source: (INE, 2020)

Figure 98 – Employed population by economic sector of activity in Angola and Uíge (2018-2019)

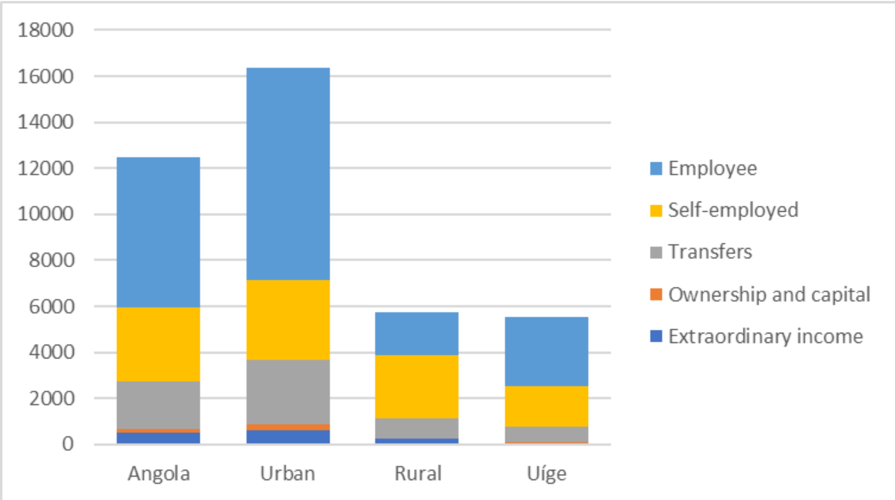
5.10.7. Income and means of subsistence

5.10.7.1. Sources of income and occupation

Self-employment is more usual in rural areas and income from employment for someone else (company, government, etc) is more common in urban areas in Angola. As Uíge is a mostly rural province, the main source of household income is self-employment.

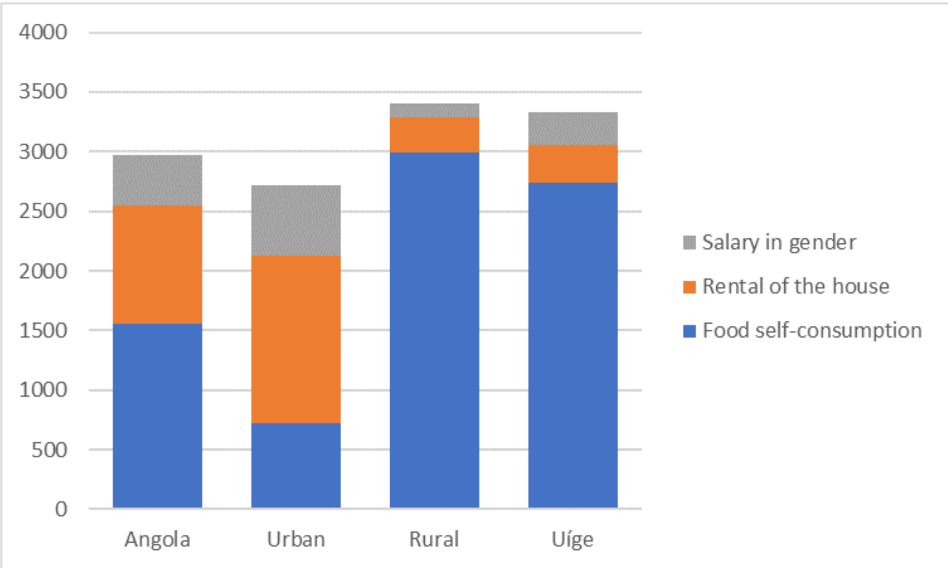
Figure 99Figure 99 – compares the average monthly monetary income (and its sources) in Angola (for rural and urban households) and Uíge, for 2018-2019. The average income in urban areas was much higher than that observed in rural areas as in urban areas labour income is higher (16 thousand Kwanzas vs. 6 thousand Kwanzas, respectively). Regarding the area of study, the province of Uíge, observed an average monetary income per person of 5,8 thousand Kwanzas, lower than the monthly monetary income per person in Angola overall.

Regarding non-monetary income (as seen in Figure 100), the differences observed between different areas and household types are less significant. Contrary to monetary income, average non-monetary income was higher in rural areas compared to urban areas due to the high value of self-consumed food. This is justified by the high values of subsistence agriculture in these regions. Uíge also recorded a higher average non-monetary income per person than Angola due to high self-consumption of food.



Source: (INE, 2019)

Figure 99 – Average monthly monetary income per person according to household sources of income

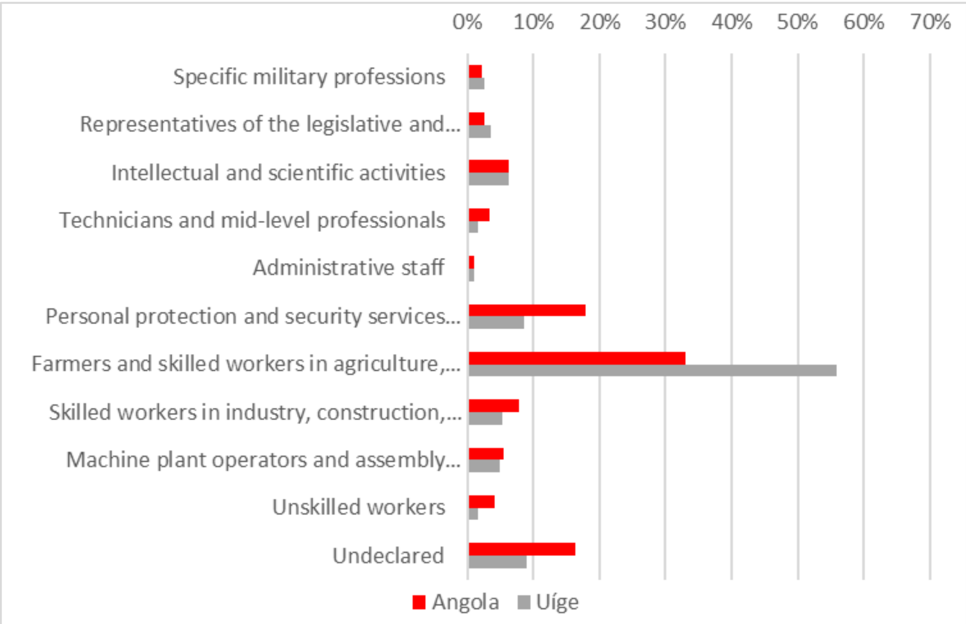


Source: (INE, 2019)

Figure 100 – Average monthly non-monetary income per person according to household sources of income

Farmers and skilled workers in agriculture, fisheries and forestry are the most common household heads in the country, particularly in rural areas in both male and female headed households. In urban areas, workers in personal services, protection and security services and vendors are the most common (25 %).

In Uíge, agriculture is also the most common occupation among household heads (Figure 101), with more than half of all heads of household in this province engaged in this activity (57 %).



Source: (INE, 2020)

Figure 101 – Main occupation of the head of household in Angola and Uíge (2018-2019)

5.10.7.2. Poverty and inequality

Levels of inequality are relatively high in Angola, as shown in Figure 102 (Gini coefficient of 0.60). The income quintiles observed also show the great disparity between the fourth and the fifth quintile (since the latter is more than three times higher).

In relation to Uíge, income disparity is relatively low (Gini Coefficient of 0,52). This results from the fact that incomes are generally lower in Uíge and from less diverse sources (given the more rural character of the province).

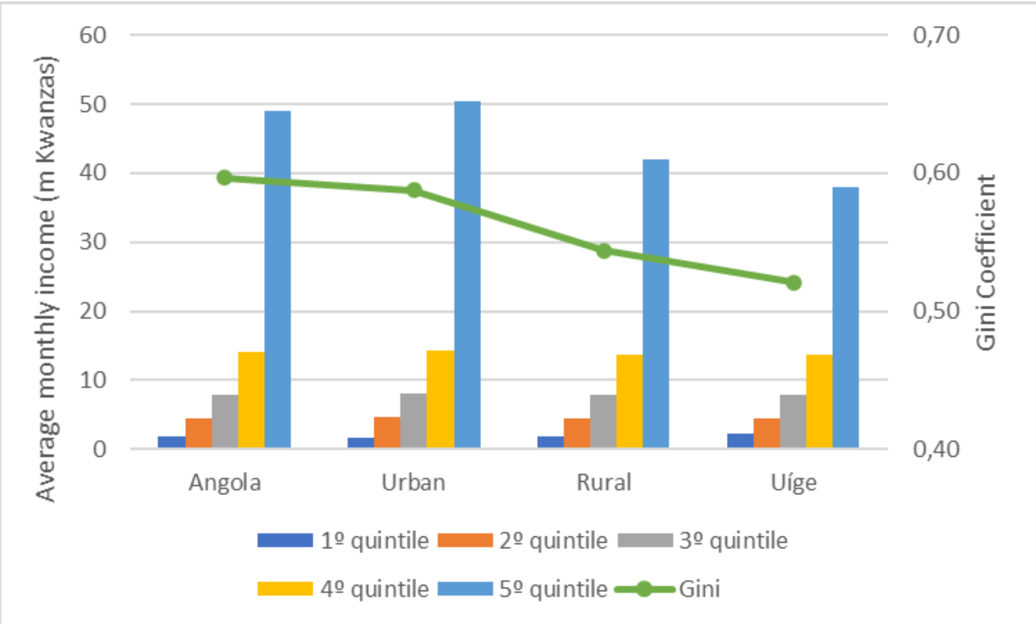
Low-income levels (particularly in urban areas) are also correlated with food insecurity and food scarcity, as shown in Table 58. In the Uíge province, 79 % of households were concerned about food shortages and 76 % experienced food insufficiency in 2018-19. In Angola, 56 % of households experienced food insufficiency in this period, a high percentage but almost 20 percentage points lower than the percentage in Uíge. Thus, food scarcity and food insufficiency affect the majority of Angola's population, but are a particularly relevant problem in this province.

Table 56 – Households according to concern about food shortages and food insufficiency in the last 12 months (2018-19)

Indicator	Angola			Uíge
	Total	Urban	Rural	
Concerned about food scarcity	67,90 %	71,00 %	63,10 %	79,0 %
Had food insufficiency in the last 12 months	55,80 %	57,60 %	52,70 %	75,5 %

Source: (INE, 2020).

Income levels in the first quintile are very low in all the subsets considered in Angola (rural or urban), around 1 700 to 1 850 Kwanzas per month on average.



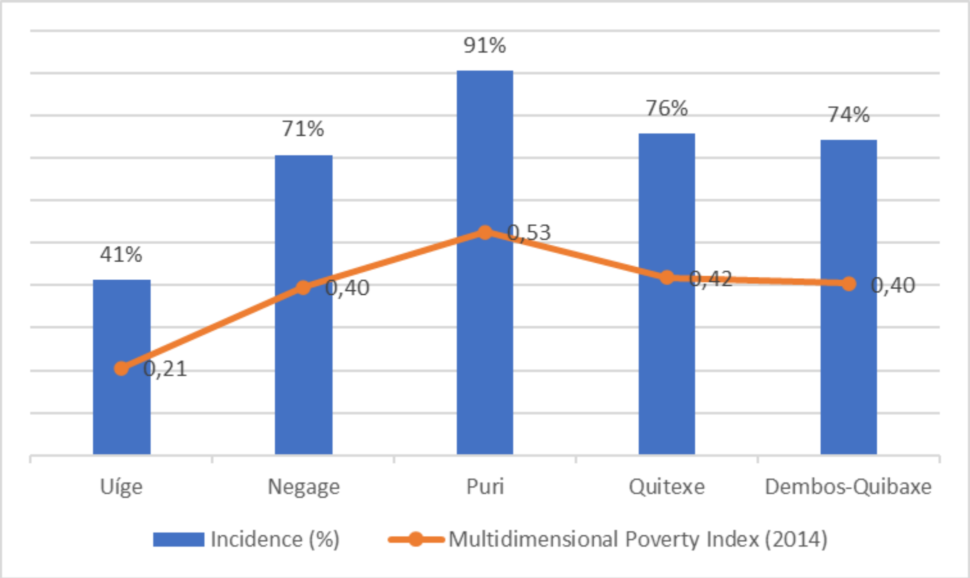
Source: (INE, 2019)

Figure 102 – Inequality (average monthly income per person according to income quintile and Gini coefficient)

Of the municipalities under study, Puri has the highest level of multidimensional poverty (which considers the dimensions of health, education, housing and employment) in 2014 (Census data), as can be seen in Figure 103.

It is also in this municipality where the incidence of poverty is the highest, with 91 % of all people in this municipality being considered poor.

The lack of electricity in the municipalities contributes between 13 % and 16 % to poverty in these municipalities, a relevant percentage.



Source: (INE, 2019)

Figure 103 – Multidimensional Poverty Index – Municipalities (2014))

Ownership of durable goods is a good proxy for poverty and income levels. According to the latest available data (2018-2019), cookers were the most common durable goods in Angola (see Table 57), although with accentuated marked asymmetries: only about 11 % of rural households had a cooker at home compared to 75 % in the case of urban households. All other durable goods considered, show significant asymmetries between rural and urban households.

The proportion of households in Uíge province that have durable goods is lower than the national average. Given that Uíge province is mostly rural, one would expect the proportion of households with durable goods to be similar to the average for rural households in Angola.

However, the proportion of households in this province that own durable goods is significantly higher than the rural average, as can be seen, for example, in the 20 % of households in Uíge that own a cooker, compared to an average of 11 % in rural households in Angola.

Table 57 – Durable goods ownership in Angola (2018-2019)

Durable Goods	Proportion of houses with durable goods in Angola			
	Total	Urban	Rural	Uíge
Cooker	49,1 %	75,2 %	10,5 %	20,3 %
Fridge	12,4 %	20,2 %	0,7 %	2,3 %
Freezer	26,1 %	42,1 %	2,5 %	10,2 %
Microwave	3,7 %	6,2 %	0,1 %	0,7 %
Washing Machine	10,4 %	17,1 %	0,6 %	2,6 %
Iron	27,0 %	41,7 %	5,3 %	18,7 %
Air-conditioning	5,6 %	9,2 %	0,3 %	0,3 %
Generator	9,3 %	11,5 %	6,0 %	6,9 %

Source: (INE, 2020).

5.10.7.3. Agriculture

As presented above, agriculture (including cattle breeding) is the most important activity in the area under analysis, not only for self-consumption, but also for sale.

In Uíge, about 97 % of households with a plot of land cultivated agricultural products in 2018-2019. About 3 % of households with available land, however, did not use it for agricultural, pasture or other economic uses, which is well below the national average of 7,6%. Livestock farming was also common, with 53 % of households with land in Uíge using it for this purpose.

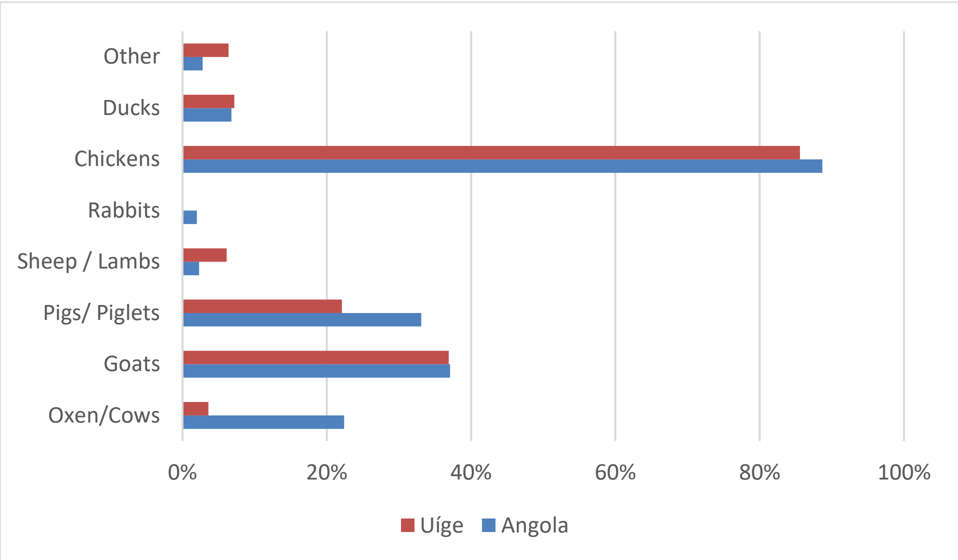
Table 58 shows agricultural crops as a percentage of the sown area in the province of Uíge in 2018-19. The predominant agricultural crops in Uíge are manioc, with more than half of all sown land in Uíge devoted to this crop (52 %), maize (13 %), peanuts (12 %), beans (7 %), bananas (6 %) and sweet potatoes (5 %).

Regarding animal production in the province of Uíge the most common animals are the following: chickens (present in 86 % of the families with animal production), goats (37 % of the families) and pigs (22 % of the families).

Table 58 – Proportion of agricultural crop plantation in the total sown area in 2018-19 in Uíge

Agricultural Crops	Sown Area (ha)
Manioc	51,8 %
Corn	13,2 %
Peanut	12,3 %
Bean	7,0 %
Banana	6,0 %
Sweet potato	4,9 %
Potato	1,5 %
Mango	0,7 %
Other vegetables	0,6 %
Rice	0,5 %
Pineapple	0,5 %
Citrus	0,5 %
Tomato	0,2 %
Avocado	0,1 %
Cabbage	0,1 %

Source: (MINAGRIP, 2020)



Source: (INE, 2019)

Figure 104 – Possession of animals or birds in Angola and Uíge (only houses practising livestock activities) (2018-2019).

5.10.8. Health

Public health services are critical for Angolans, particularly those living outside Luanda and other major cities, and in rural areas.

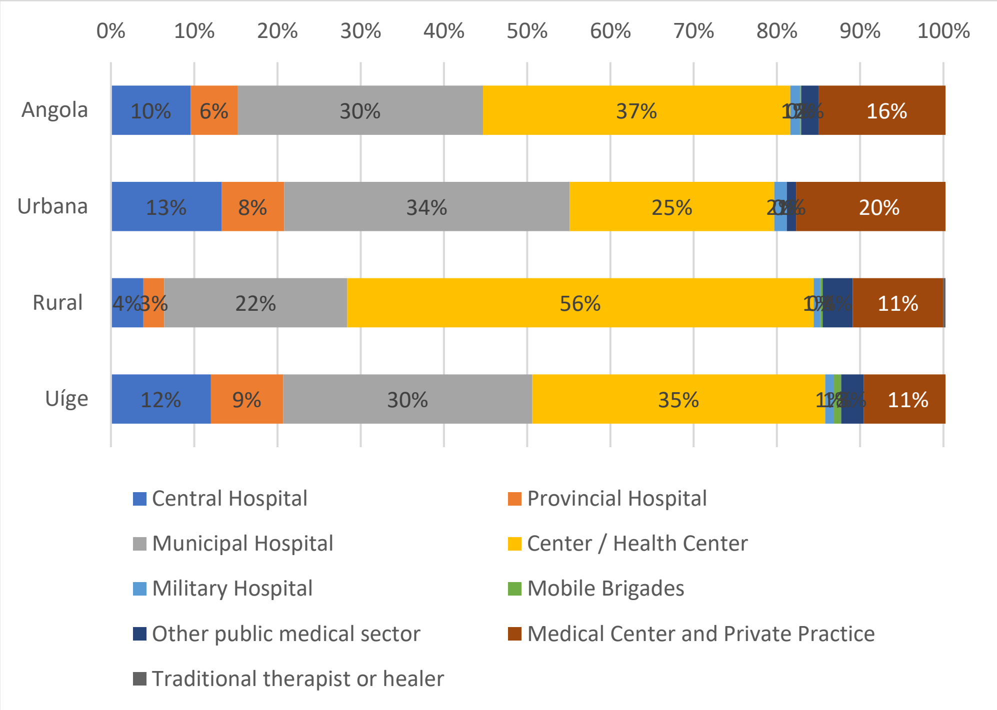
Almost 85% of people in Angola use public health services, and this proportion is even higher in rural areas (89%), and in the province under study (88 %) (INE, 2020).

But access to health services remains a challenge, particularly in isolated rural areas, with 71 % of households that do not use them stating that these facilities are either non-existent (40,7 %) or too far away (30,1 %).

In Uíge, 34 % of the families that do not use the health services stated that these units are too far from their residence. However, 24 % of the families do not use these services because of the lack of medicines.

Nevertheless, of the people who had an accident or were ill, 61 % received medical support in Uíge (in 2018/2019), a proportion lower than the national (72 %) and the rural (65 %) average.

In this province, only 35 % of the people who had an accident or were ill and then obtained medical support used public health centres/posts (Figure 105). Municipal hospitals received 30 % of the people who sought medical help after an accident or illness.



Source: (INE, 2020)

Figure 105 – Distribution of the population who were ill and had consultations within 30 days, according to the location of the consultation in Angola and Uíge (2018-2019)

Table 59 – Distribution of the population who had a routine consultation or hospitalisation in the last 12 months (2018-2019)

Indicator	Proportion of population in Angola			
	Total	Urban	Rural	Uíge
Routine consultation	1,5 %	1,7 %	1,1 %	1,2 %
Hospitalisation	3,6 %	3,3 %	4,2 %	8,7 %

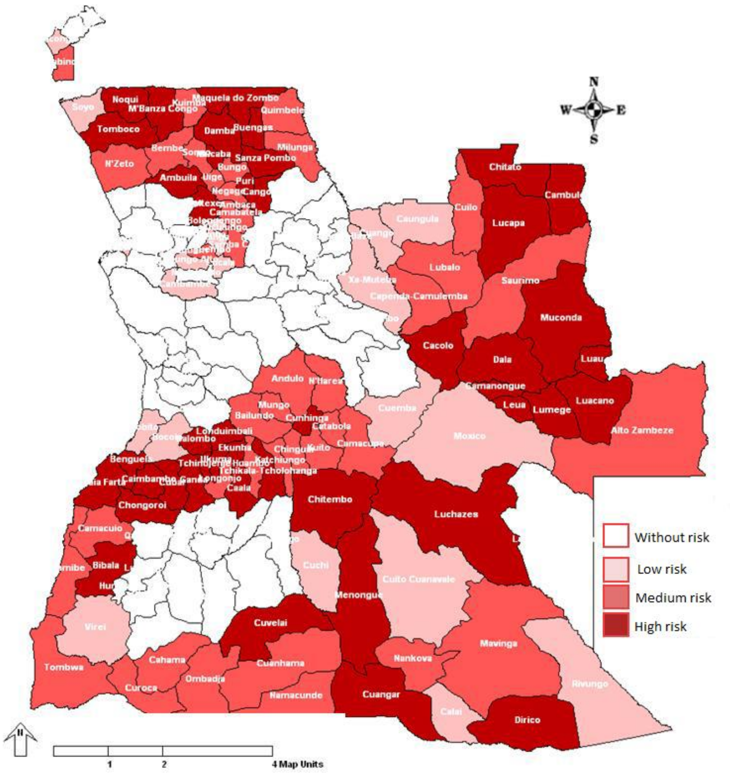
Source: (INE, 2020)

Uíge was the province with the most hospital admissions as a percentage of the population in 2018-19, with 8,7 % of the entire population having a hospital admission this year. Uíge is a province with a high incidence of malaria and, this year, was the province with the most malaria cases as a percentage of the provincial population. Thus, it is likely that the high level of hospital admissions is a consequence of the increase in malaria cases.

The most common communicable diseases in Angola in 2019 were the following: malaria (66,5 %), severe acute respiratory syndrome (SARS) (10,4 %), influenza syndrome (8,2 %), typhoid fever (4,1 %), diarrhoea with dehydration (3 %) and dysentery (2,2 %) (INE, 2022).

Regarding the stratification of risk of morbidity from respiratory diseases, Uíge province has a high risk and constitutes the Angolan province with more municipalities at higher risk (Figure 106).

All municipalities under analysis in the province of Uíge have a medium or high risk of morbidity from respiratory diseases (Puri with a high risk and Uíge, Negage and Quitexe with a medium risk) according to (Manuel, Freitas, & Lamezón, 2020). Only the Dembos-Quibaxe municipality (Bengo province) does not present a risk of morbidity from respiratory diseases.



Source: (Manuel, Freitas, & Lamezón, 2020).

Figure 106 – Stratification of morbidity risk for respiratory diseases in Angola (2019)

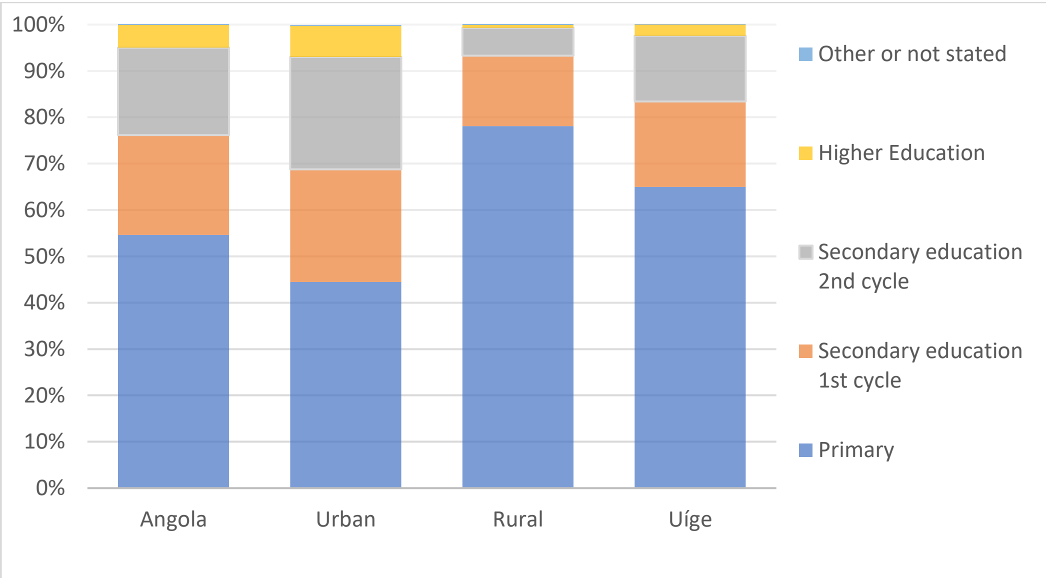
5.10.9. Education

Regarding literacy rates in Angola, there are significant differences between each area and between genders (with men generally having higher literacy rates, particularly in rural areas).

In Uíge, the literacy rate of the population aged 15 years and above was 64 % in 2018-2019, lower than the national literacy rate (69 %) but higher than in rural areas (46 %).

Regarding the level of education attained (Figure 107), as expected, urban areas presented more people with secondary education (24 % with 1st cycle secondary education, 24 % with 2nd cycle secondary education).

In the rural areas of Angola, only about 22 % of the population (aged 5 years or more) has at least secondary education. In Uíge, 33 % of the population has at least secondary education.



Source: (INE, 2020)

Figure 107 – Distribution of the population aged 5 years or more according to the level of education obtained, in Angola and Uíge (2018-2019)

School attendance shows large differences at national level, in particular between rural and urban areas. Children in rural areas tend to leave school earlier than in urban areas, on average.

However, despite Uíge being a largely rural province, the proportion of children enrolled and attending school is at the levels of an urban area of Angola and above the Angolan average.

In this province, about 80% of the population between the ages of 6 and 17 attended school in 2018.

Table 60 – Distribution of the population aged 6 to 17 years according to school attendance in the academic year 2018

Indicator	Proportion of population in Angola			
	Total	Urban	Rural	Uíge
Enrolled	73.6%	82.5%	59.7%	82.5%
Attends school	71.7%	80.8%	57.7%	80.2%

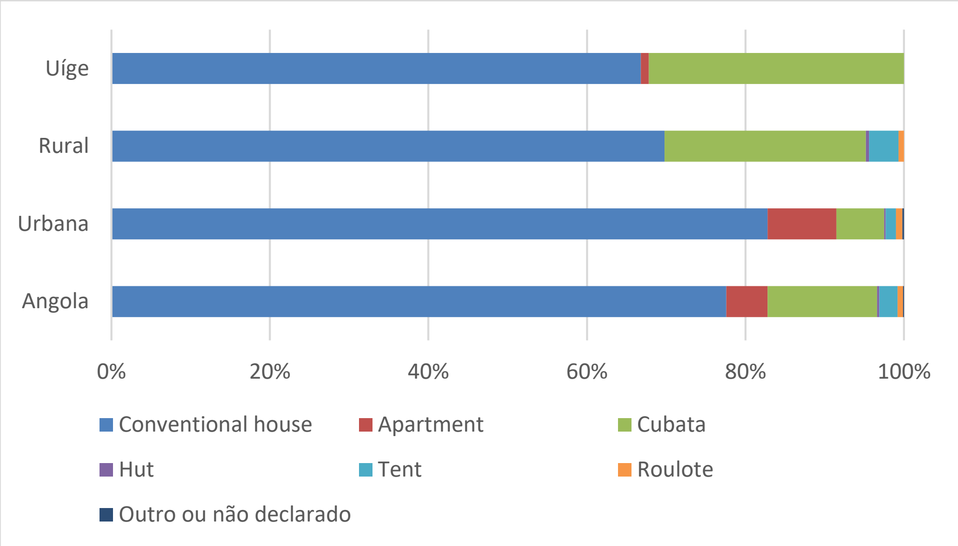
Source: (INE, 2020)

5.10.10. Infrastructures and services

5.9.10.1. Housing

The majority of Angolan households, rural and urban, were living in conventional houses in 2018-19.

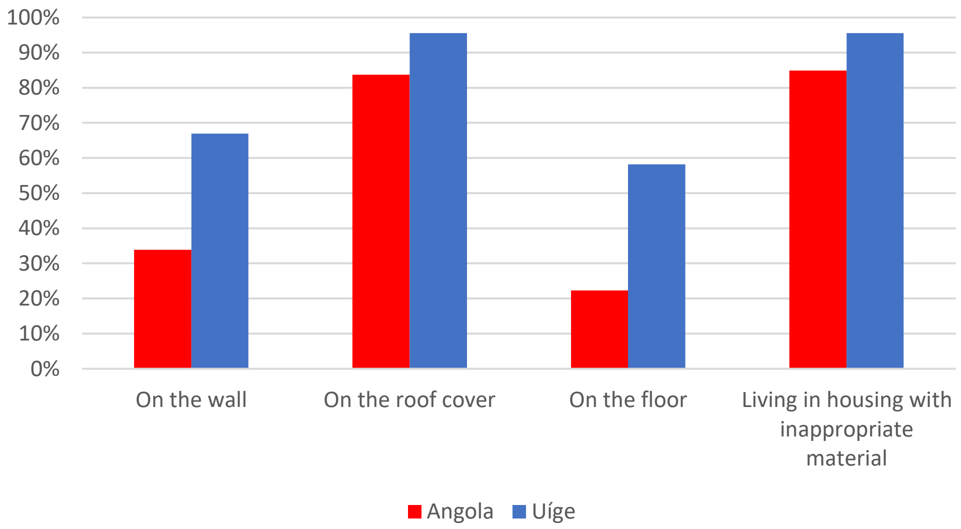
In Uíge province, there were two predominant types of housing, conventional villa or houses, which accounted for 67 % of households, and *cubatas*, which represented 32%.



Source: (INE, 2020)

Figure 108 – Distribution of households by type of house in Angola, Uíge (2018-2019)

Overall, houses built with inadequate materials (e.g., earthen floors) were the overwhelming majority in Angola in 2018-2019, particularly in rural areas, as shown in Figure 109. In Uíge, 96 % of the houses were constructed with inappropriate materials, mainly in the roofing, where the most common construction materials used were zinc and capim grass.



Source: (INE, 2020).

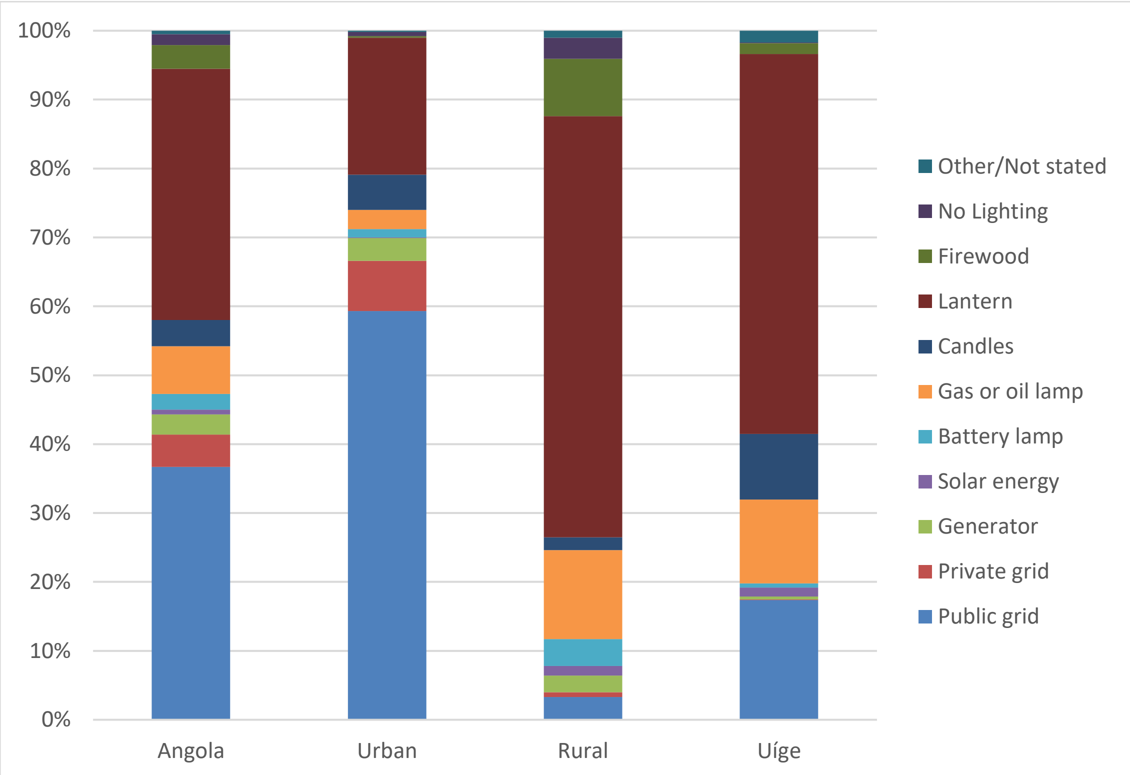
Figure 109 – Distribution of households residing in urban areas according to inadequate construction materials in Angola and Uíge (2018-2019)

5.10.10.2. Energy

Energy infrastructures are still uncommon in most provinces of Angola, particularly in rural areas and isolated urban settlements. Gas is only used for cooking by 46% of Angolan households, and 72 % of households in urban areas (in 2018-2019). In rural areas, firewood was still the most common fuel used for cooking. In Uíge, firewood and charcoal are the most commonly used fuels for cooking (40,1 % and 40,7 %, respectively).

Regarding the sources of lighting (Figure 110), access to the public electricity grid was quite common in urban areas (59 %), but not in rural areas, where only 3 % of households have a connection to the public grid.

In Uíge, only 17 % of the population of this province has access to the public power grid and uses energy as a source of lighting, which is substantially lower than the national average of 37 %. Similar to what happens in rural areas, over 55 % of families use lanterns as their main source of lighting.



Source: (INE, 2020).

Figure 110 – Distribution of households by main source of lighting, in Angola and Uíge (2018-2019)

5.10.10.3. Access to water

With respect to access to fresh water sources, Angola is a quite diverse country. In urban areas, as expected, the public water network provides water to 44 % of households (own house or a neighbouring house connected to the water network) (INE, 2020).

However, other sources are still widely used in urban areas, such as (protected) wells and tanker trucks. In rural areas, almost no household is connected to a water distribution network, with rivers, lakes, ponds and streams being the source of fresh water for most households (50 %).

While in Uíge, the majority of the population uses non-appropriate water sources for drinking, this is not the case for Angola in general, where more than 50 % of households use appropriate sources.

In Uíge province, about 63 % of the water supply is from inappropriate sources, such as rivers, lakes, ponds and streams the source of fresh water (61 %).

Only 23% of households in Uíge are connected to the public supply network, mostly through a public fountain (14 %). Only 3 % of families have a tap inside the house connected to the public network, a much lower percentage than the national average of 14 %.

Table 61 – Distribution of families according to the main source of drinking water supply, in Angola and Uíge (2018-2019)

Indicator	Angola	Uíge
Appropriate source of drinking water		
Inside the house	14 %	3 %
At the neighbour's house	13 %	6 %
In the building	0 %	0 %
Public fountain	7 %	14 %
Cacimba / Protected well	13 %	14 %
Borehole with pump	3 %	1 %
Protected spring	1 %	0 %
Bottled/ Mineral water	1 %	0 %
TOTAL	**52 %**	**38 %**
Non appropriate source of drinking water		

Indicator	Angola	Uíge
Cistern truck	14 %	0 %
Cacimba / Unprotected well	8 %	2 %
Unprotected spring	1 %	0 %
Rainwater / Chimpacas	1 %	0 %
River / Lake / Pond / Stream / Irrigation channel	24 %	61 %
Other	1 %	0 %
TOTAL	**48 %**	**63 %**

Source: (INE, 2020)

A significant number of households in Angola take more than 30 minutes to collect drinking water (34 % of households without a water connection, or 30 % overall). In Uíge, 49 % of households take more than 30 minutes to reach their main source of drinking water.

5.10.11. Vulnerable groups

Vulnerability relates to the ability of individuals and groups to adapt to socioeconomic or biophysical changes. Social vulnerability refers to potential harm to people. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or society.

Social vulnerability refers to the characteristics of a person or group in terms of their ability to anticipate, cope with, withstand and recover from the impact of a natural hazard (Wisner, Gaillard, & Kelman).

Vulnerable individuals and groups are therefore more susceptible to negative impacts and/or have limited capacity to take advantage of positive impacts. Vulnerability is a pre-existing status that is independent of the project and may be reflected in the existing low level of access to key socio-economic or environmental resources, or lack of access to information and decision-making.

Socially vulnerable groups can encompass the following dimensions: poverty, ethnicity, religion, gender, age (children or elderly), disability, health, literacy or education, household characteristics such as single parents, among others.

In the Area of Study, vulnerability was identified and linked to the following factors:

- **Households with particularly low incomes and high dependence on land for subsistence and income generation** – in Uíge most households depend on self-employment and a large part of these households depend on agricultural products for living (self-consumption, but also for income). Furthermore, income levels are quite low in the first four quintiles (80 % lived on less than 14 000 Kwanzas per month in 2019 – about US$30);
- **Female- and/or child-headed households** – these households are particularly vulnerable in the study area - not only do female- and child-headed households have lower incomes than male-headed households, but they are also more dependent on self-employment and with greater reliance on land for subsistence and income generation. In addition, female- and child-headed households have more challenges regarding land tenure rights, access to education, among other dimensions;
- **Elderly** – households headed by the elderly have lower incomes (on average 10% lower than the average) and also rely more on self-consumption (77 % more than the average), which puts this group at risk of land tenure conflicts. In addition, these families have more difficulties adapting to new contexts, and the impacts of displacement can be particularly difficult;
- **People with disabilities** – those who lack physical mobility or who have mental health problems may be more vulnerable to change and have more difficulty adapting to new contexts. The impacts of displacement related to restricted access to land or the need to replace housing can be exceptionally demanding.

In the study area, the level of vulnerability is high, and it is estimated that approximately 80% of households in project-affected settlements are socially vulnerable, as most are heavily dependent on land for subsistence and income generation, and have low monetary incomes (in the first four quintiles).

5.10.12. Human Rights

The current state of human rights in Angola is better than before. However, according to updated human rights reports from several international NGOs and recent news reports, human rights abuse continues to occur in Angola (CMI, 2021).

Angola is at “medium risk” due to “abusive enforcement” and “restrictions on freedom of the press”. The 2020 Democracy Index depicts the same trend (EIU, 2022). With the

Covid-19 pandemic and the state of emergency, political and civil rights were also eroded by the constitutional use of emergency laws.

Regarding economic, social and cultural rights, there have been some, but small, developments.

With regard to corruption and embezzlement of public funds, for example, in June 2021, the General Prosecutor announced the arrest of 24 senior military officials from the State Security Affairs Office, accused of embezzling large sums of funds from the State coffers (AI, 2022).

With regard to the right to an adequate standard of living (food, housing, medical care, among others), there are growing challenges. There are reports of illegal occupation by commercial farmers of communal pastures, which erodes the ability of pastoralist communities to produce food for themselves (AI, 2022). Food insecurity is still very prevalent and extreme events raise this issue to alarming levels.

According to the results of the stakeholder engagement activities (focus group discussions and key informant consultations) and the baseline data collected (including statistics, reports, studies, among others), the most important human rights issues in the study area are the following: gender rights, right to an adequate standard of living (including access to health care, food and adequate housing), right to education, and workers' rights.

5.10.12.1. Right to an adequate standard of living

As described throughout this report, living standards in Angola, and in rural areas in particular (e.g., the area of study), are unsatisfactory.

Access to health services is limited and in rural areas is even more difficult (the results of focus group discussions underline this point, with one local community stating that "there are no medicines, materials, nurses; the [health] centres have no capacity").

Housing is generally inadequate (with local leaders stating in a focus group discussion that "it rains inside the houses. There are storms that tear the roofs off").

Furthermore, given the dependence of local communities on land for their livelihoods, the lack of formal land tenure registration puts families at risk of conflict and land grabbing. As one local leader stated in a focus group discussion, “land is inherited, in a traditional way, and so there are no documents.” As a result, their right to property is also at risk.

5.10.12.1. Labour rights

The legal framework governing labour and employment in Angola is the general labour law (Law No. 7/15 of 15 June), which establishes procedures and guidelines for employment. Angola also has a Health and Safety at Work System (Decree No. 31/94) which establishes the principles that promote safety, hygiene and health at work. (Ahmad & Barros, 2021).

The General Labour Law of Angola stipulates that workers are allowed to form independent trade unions, to bargain collectively, and to strike. Anti-union discrimination is prohibited under this law. However, these rights are limited in practice.

In 2022, the minimum wage in Angola is set at 32 181,15 Kwanzas per month under Presidential Decree No. 54/22 of 17 February (about US$75 at the time of writing).

The Presidential Decree also sets the minimum wage by economic groups, namely for groups in the commerce and extractive industry sectors in the amount of 48 271,73 Kwanzas (US$113), for groups in the transport, services and transformation industry in the amount of 40 226,44 Kwanzas (US$94), and for the agricultural group in the amount of 32 181,15 Kwanzas (US$75).

The government has likewise adjusted basic salaries for the civil service, with the lowest salary reaching 67 807 kwanzas (US$159) in 2022. (Simão, 2022).

5.10.13. Development prospects in the absence of the project

In a situation where the project under analysis does not materialise, it is expected that the situation of reference and the main trends described in the previous sub-sections will continue, in particular:

- Continued population growth due to the high birth rate in relation to the mortality rate;

- Rural population growth faster than the urban population one, with Uíge remaining a rural province with most of the population engaged in agriculture;
- Continued risk of morbidity from respiratory diseases;
- Persistence of poor infrastructures with a large part of the population living in houses with inadequate materials and generalised use of alternative energy sources for lighting, such as lanterns;
- Persistence of high levels of poverty and social vulnerability of the population due to the strong dependence on land and low monetary income.

5.11. Cultural Heritage

5.11.1. Introduction

The aim of the cultural heritage analysis is to find out about the heritage realities existing in the study area, so as to understand the components of the historic landscape from the definition of its attributes.

Heritage is thus assumed as a territorial resource, which reflects the growing need to reconcile the economic and social progress of the regions with the collective memory of their inhabitants, materialised in testimonies of the human presence in the territory.

"The economic and social development must have Culture as a starting point and as an obligatory and permanent reference. Development will only be sustainable if it has Man as its first and last beneficiary." (Presidential Decree No. 15/11 of 11 January).

Cultural heritage is protected by the current legal framework in force, not only the material heritage, which includes the architectural and archaeological heritage, but also the intangible heritage, which covers areas as vast as art, tradition, beliefs, among others (Presidential Decree No. 15/11 of 11 January 11).

Architectural and archaeological heritage are considered in the present study (material heritage) and traditional cemeteries, graves, forests, trees and sacred trunks (immaterial heritage).

The information presented is based on specialised bibliography and on fieldwork carried out by the Nemus team, including focus groups with the populations covered by the project.

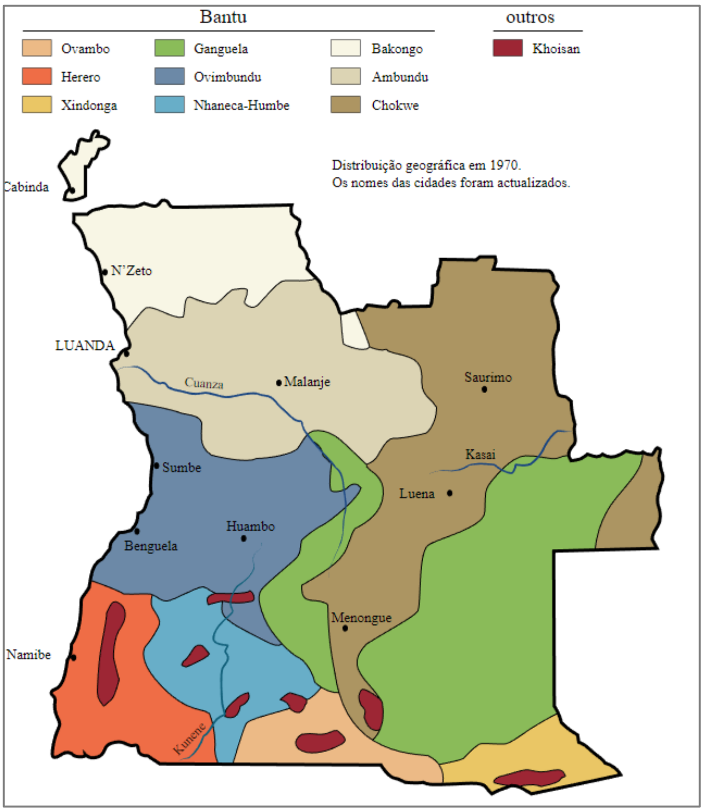
5.11.2. State of the Question

5.11.2.1. Uíge Province

A. From pre-history to pre-colonial times

As Africa is the cradle of humanity, the current territory of Angola was traversed by Man from early on. Although archaeological materials of Olduvense and Acheulse nature are known, produced initially by Australopithecus (1 600 000 years old), and later produced by Homo Erectus, the traces of human presence are mainly from the Iron Age, being represented both in fortified settlements and in rock art stations (Barham & Mitchell, 2008).

The Angolan people have their origins in several Bantu ethnic groups, which were mixed with local groups, assuming specific local characteristics. The existing ethnic group in the region of Uíge is the Bakongo.



Source: Angola_Ethnic_map_1970-pt.svg

Figure 111 – Ethnic groups of Angola

From the 12th century onwards, this territory saw the growth of the Congo Kingdom (Wizi-Kongo.com, s.d.). The Congo was a kingdom with a centralised political system that extended over the present-day republic of Angola, the Republic of the Congo and the Democratic Republic of the Congo. The territory held large reserves of precious metals, fertile land and a high population density.

Legend: 1) Kingdom of the Congo (XIII-XV century); 2) Kingdoms of Matamba and Ndongo (XVI-XVII century); 3) Kingdom of Kissama (XVI-XVII century); 4) Kingdoms of the Plateau (XVI-XVIII century); 5) Kingdom of Kassange (XVI-XVII century); 6) Kingdoms of Lunda Tchokwé (XVI-XIX century); 7) Kingdoms of Sahel (XVI-XIX century). XVI-XVIII); 5) Kingdom of Kassange (XVI-XVII century); 6) Kingdoms of Lunda Tchokwé (XVI-XIX century); 7) Kingdoms of the Southwest (XVI-XVII century); 8) region of communities without kingdom grouping.

Source: (Universidade Aberta, 2022)

Figure 112 – Historic kingdoms on Angolan territory

Politically, the noble elite dominated power and administered through the collection of taxes. Their power included submission through a regime of interdependence or economic and military subservience of the kingdoms and microreigns with which they bordered (Caregnato, 2011).

Despite the existence of these subdivisions in the political configuration of the Congo, the king, known as Mani Kongo, had the right to receive tribute from each of the dominated provinces, which could be in zimbo and in kind, such as ivory or slaves (Pacheco, Costa, & Tavares, 2018).

In the kingdom there were several Mbanzas (cities) and Lubatas (villages). In each there was a Soba who had local authority and jurisdiction over people and property. In the Lubatas production was based on the family structure, while in the Mbanzas economic power was centred on the nobility.

Society in the 16th century was quite hierarchical, in personal/family relations and in the tasks/duties assigned to them. As can be seen in Figure 113, the king would have almost absolute power, the aristocracy collected taxes and recruited people for various services. The people include the poorest community, not differentiating between free people and slaves.

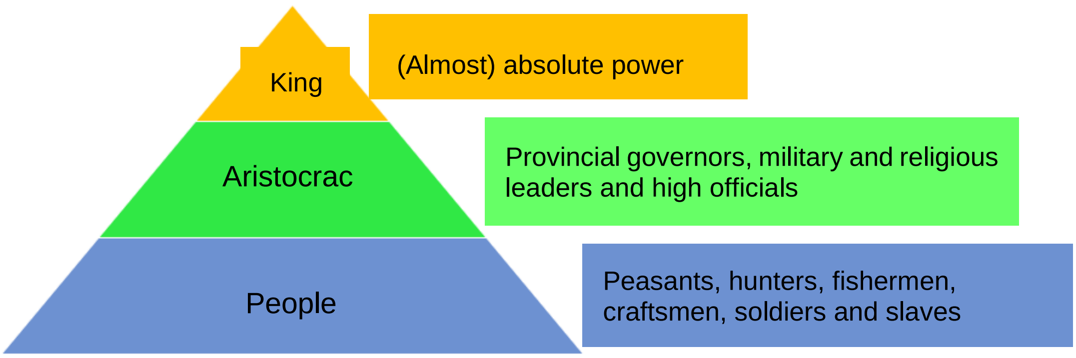


Figure 113 – Social hierarchy in the Kongo kingdom

The main economic activity involved the commercialisation of salt, metals, fabrics and animal products. The commercial practice could be done through barter (exchange) or with the adoption of the nzimbu, a kind of shell found exclusively in the region of Luanda (Sousa, s.d.). There was also cross-border trade that required the use of a common currency, the zimbo.

B. From colonization to independence

At the beginning of the 15th century, when the Portuguese arrived, the Kongo kingdom held a fairly strong political and economic hegemony.

Maritime expansion was justified at the time by the spirit of missionisation and expansion of the Catholic faith, but dominated by economic concerns and material interests. Initially, it was based on the foundation of trading posts, in order to establish trade with local people.

In 1482 Diogo Cão goes up the river Zaire, comes in contact with the kingdom of Congo and in the following year he covers all the Angolan coast. The regions near the Atlantic were occupied early on, but much of the interior only became subjected in the late 19th and early 20th centuries.

An example of this is the stories associated with the fort of S. José de Encoge, built in 1759, near Pedras de Encoge, which by the end of the 19th century was already in ruins. At this time, despite the fact that there were chiefs who had been taken over by the Portuguese crown, many still remained independent and were in constant hostility with the Portuguese.

However, it is worth mentioning that many of the so-called "*avassalados*" were only so because of a real absence of Portuguese authority and not because of a real submission. Examples of this group are the dembes of Quitexe, Dambi Angola, Ambuíla.

Many of the riots resulted from the collection of straw tax.

The Quitexe military post dates from 1917, and the Quitexe delimitation was made in 1918. The military post of Uíge was founded a few months after the Quitexe post. Portuguese authority would only be established in Dembos in 1919 (Garcia, 2012).

The region went under a colonial administration with an economy based on agriculture and the export of raw materials. In the second quarter of the 20th century, nationalist movements were born and gained political dimension in the 1950s, giving rise to armed conflict and culminating in the independence of Angola on 11 November 1975 (Ponte, 2006).

Angola currently has more than 250 classified monuments and sites, and more than two thousand inventoried areas, many in an advanced state of degradation. Of the set, a site classified as a World Heritage Site (by UNESCO, in 2017) stands out: Mbanza Kongo (capital of the province of Zaire).

The province of Uíge has a rich historical and cultural heritage, based on pre- and post-colonial constructions, including the Maquela Fort, the São José do Encoje Fort, the Bembe Fort, the Council Administration Palace, the São José Church, the Quisadi and Cabala rock figurines and the Tunda stone ([s.n.], 2022).

Table 62 – Registered heritage in Uíge Province

Heritage	Designation
Architecture	Old Administration of the Municipality (Uíge)
Architecture	Old State Houses
Architecture	Bembe Fourtress (20th century)
Architecture	São José church and fortress, near the stones of Encoje (18th century)
Archaeological	Kisadi rick figures (pre-history)
Archaeological	Ruin of Fortim de Maquela
Immaterial	Mufututo lagoon
Immaterial	Mysterious lagoon
Immaterial	Stone of Kakula Quimanga
Immaterial	Stone of Nzinga N´zambi (Toto)
Immaterial	Stone of Tunda, Negage (where justice and death to criminals were carried out)
Immaterial	Magical Bridge over the river Vamba Wa Mbamba
Material	Bust of Hero N`bemba, (in the neighbourhood N'Bemba N'Gango, Uíge)
Material	Tomb of the Ancient Mekabango
Material	Tomb of the Grat King and Warrior Mbianda-Ngunga

It stands out as a classified heritage site:

- Fort of S. José de Encoge, classified as a National Monument by Provincial Decree on 28 May 1925;
- Former "Colonial Repression Jail in Uíge", classified as National Historical and Cultural Heritage, by executive decree 61/18 - this jail was built in the municipality of Uíge in the second half of the 20th century and the decree recognises that "several nationalists who dedicated themselves to the anti-colonial struggle in that region were imprisoned there", mainly between the 1960s and 1970s;

- Former Colonial Repression Complex of Kikaia Still in the capital of Uíge province, classified as a National Historic Site, through executive decree 60/18.

In all three cases of classification, the decrees define that it is up to the organs and services of the Local State Administration to "take measures for the effective protection and enhancement" of the heritage sites now classified, as well as their Protection Zone (Lusa, 2018).

5.11.2.2. Project area

A. Immaterial heritage

Cultural heritage is not only monuments, but also traditions, living expressions inherited from ancestors and transmitted as oral traditions, performing arts, social customs, rituals, festive acts, knowledge and practices related to nature and the universe, knowledge and techniques linked to local crafts (UNESCO, 2003).

Immaterial cultural heritage represents not only traditions inherited from the past, but also contemporary rural and urban practices in which diverse cultural groups participate. The importance of intangible cultural heritage is not the cultural manifestation itself, but the wealth of knowledge and skills that is transmitted through it from one generation to the next.

The social and economic value of this transmission of knowledge is relevant for minority groups and major social groups within a state. It contributes to social cohesion by encouraging a sense of identity and responsibility that helps individuals to feel part of a group or community, i.e., to feel part of society at large.

Immaterial cultural heritage is not only valued as a cultural good on a comparative basis for its exclusivity or exceptional value. Heritage has to develop at the base of communities, depending on those who possess the knowledge of traditions and customs and who pass on their knowledge to the community and from generation to generation.

A particular expression can only be considered intangible cultural heritage when it is recognised by the group or community as a heritage and transmitted through traditional channels, usually associated with orality.

B. Knowledge and practices associated with nature and the universe

This heritage domain is closely linked to the know-how, practices and representations developed by the community in interaction with the environment. The way they view the universe is reflected in their identity and consequently in their way of life, in the social practices and rituals that are activities that structure the life of a community. These practices are important because they reaffirm the identity as a group of those who practise them.

With regard to the aquatic elements with a strong religious character, the "Lagoa do Feitiço" (spell lake) was recorded in the study area, next to the EN120, between Aldeia Viçosa and Aldeia Quitexe. Oral sources state that there used to be a village, Ngungo Indua, prior to the presence of the Portuguese in the Congo, and that it was submerged after a short rainfall, transforming it into a lagoon.

The site is surrounded by an almost absolute silence and its landscape is very attractive.

Access is unrestricted, but certain rituals must be observed by traditional authorities who pour wine, champagne, "maruvo" (an alcoholic drink) and soft drinks into the water and pronounce certain words addressed to the "spirits that dwell in the lagoon" (Quimbanze, 2013).

Figure 114 – Lagoa do Feitiço (spell lake)

The natural spring Maria Kiazolo, 1 km from Senga and next to the EN220, is also known. The spring, despite being very close to the national road, is traditionally preserved. In this place no cultural activities can be performed without the elders first making an invocation to the mermaids of the place (Gomes, 2018)

With regard specifically to sacred trees and forests, rural communities tend to conserve them on the basis of customary norms, practices and traditions based on economic and spiritual reasons. Protection is based on myths and beliefs that obey strict rules that determine their use.

The preservation of sacred forests is intended to protect traditional family or community burial grounds, these being managed by individual families or clans or by the local community.

Some of the basic rules for the use of sacred forests are: no burning, no entering the sacred forest without permission, no cutting down fruit trees, restriction on the exploitation of resources and prohibition on the sale of forest resources

Figure 115 – Cemetery in the vicinity of Puri identified by the ESIA team

Also called immaterial heritage is the relationship of the population with one of the trees of greater symbolic value, the African baobab (*Adansonia digitata)*. The baobab is popularly known as the *sacred tree* or *tree of life*.

It is laden with mystery, spirituality and tradition across Africa, and provides both food, water, medicine and shelter for those who inhabit forests and savannahs. It has a sacred association with childbirth on the African continent, and is considered by many tribes as the resting place of their ancestors. They are revered spaces and serve as ceremonial altar, source of advice and the spiritual centre of the community.

In the area affected by the project, some African baobab have been identified, such as the one in Figure 116 in Uíge, which can reach 1 000 to 2 000 years old.

Figure 116 – African baobab, a tree of cultural importance, which can be a place of rituals

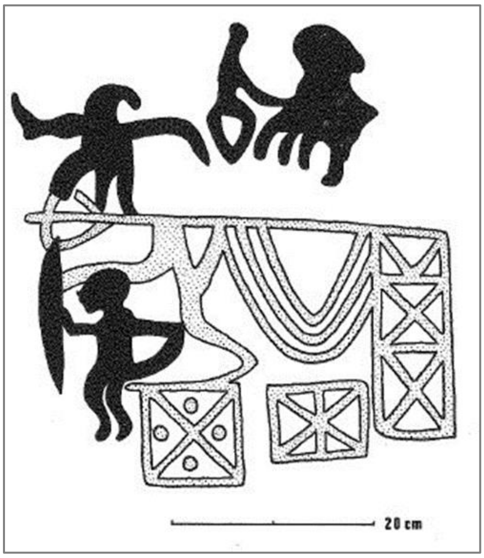
The African baobab is classified on Angola's Red List as vulnerable (VU) (Ministério do Ambiente, 2018) due to threats from man himself who exploits it in all its traditional aspects not realising that it is an asset that is also depleting and must be protected.

C. Archaeological Heritage

In the Uíge region, several sites of heritage value are known, particularly of archaeological value, however there are no recent studies. The sites known in the region are (see Drawing PAT1):

- Cave paintings of Quissádi;
- Quibaxes tombs.

The Quissádi rock paintings are located near Negage. It is a vertical panel about 5 m long by 2 m high, where there are about 100 paintings, mostly red, in various shades. The majority are geometric and there are only three (3) black naturalistic representations. The figures are Bantus decorative elements. At the base of the rock there is a cave where several ceramic fragments were collected (Ervedosa, 1980).



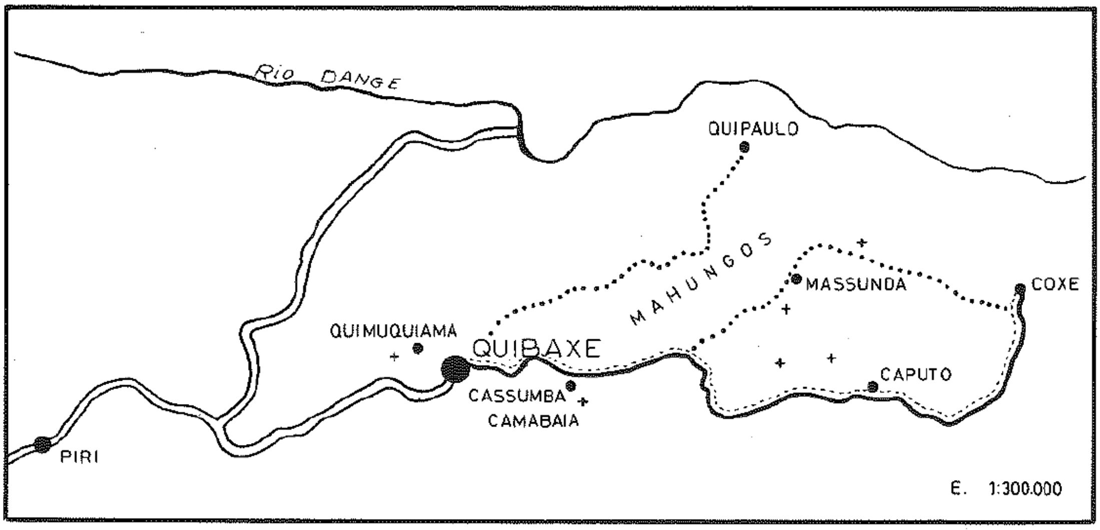
Source: (Ervedosa, 1980)

Figure 117 – Geometric, anthropomorphic and animalistic figures of Quissádi

Source: (As pinturas rupestres de Kabala, 2016)

Figure 118 – Quissadi panel

In the region surrounding Quibaxe, several "moroiços" were identified with associated fragments of Bantu ceramics and remains of slag, attributed by researchers to the Maquixi community. In Figure 119 and in drawing PAT 1 the approximate location of these occurrences is shown.

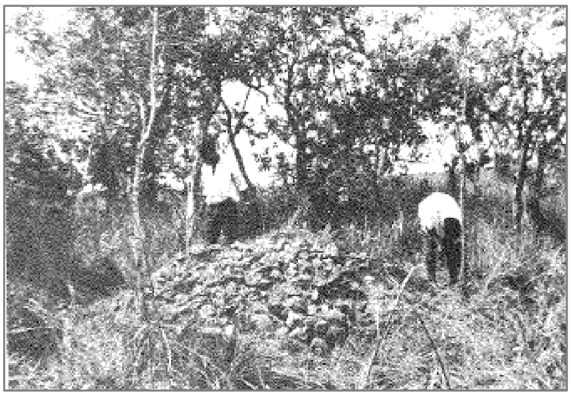


Source: (Ervedosa, 1980)

Figure 119 – Map showing the approximate location of the tombs in Quibaxe

According to the bibliography, the maquixi community is one of the oldest in the region, and there are numerous legends surrounding them, namely that they practice anthropophagy. They were expelled from the region by the Zumblule.

The tombs are made up of two parts, the underground one (coval) and the surface one (mamoa), and can take simple shapes (Figure 120) or more complex ones (Figure 121). Usually, various objects such as clay containers, millstones, among others, were placed inside. This type of tomb was also detected among the muxicongo community of the Negage municipality.



Source: (Ervedosa, 1980)

Figure 120 – Simple Maquixi Tomb

Source: (Ervedosa, 1980)

Figure 121 – Maquixi Tomb with side compartment

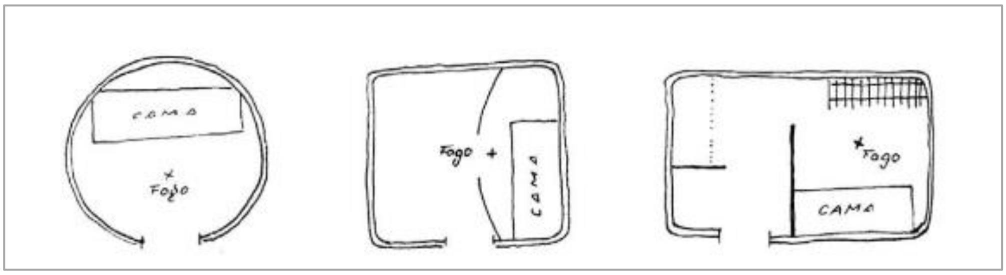
D. Built Heritage

The built heritage is relevant to the understanding, permanence, and construction of national identity and the democratization of culture. They are assets that bear witness to the value of civilization or culture.

The built heritage integrated into the environment, results from the interaction between people and places over time, acting as a factor of differentiation and territorial enhancement that must be preserved and bequeathed to future generations

Its conservation, valuation, and promotion have a potential for local, regional, national, and, in specific cases, worldwide projection, with the capacity to attract different audiences due to the various aspects associated with its fruition.

In general, three types of architecture can be distinguished: vernacular, colonial and contemporary. In the present analysis, the focus is on vernacular architecture, the “cubatas” (covered house), because they are dwellings with ancestral roots (Figure 122).



Source: (Daniel, 2019)

Figure 122 – Cubata Plant Evolution

It is characterized by the common use of organic (vegetable) materials, which have evolved in techniques, becoming quite efficient. The thatched roofs that replaced banana leaves reflect this evolution, as they allow for greater durability of construction and waterproofing.

For wall construction, abobe bricks or clay bricks reinforced by a structure of stiff sticks tied together (pau-a-pique) are often used. In the study area, massive wall materials, such as adobe and rammed earth, are mostly used.

Figure 123 – Adobe brick manufacturing

Nowadays, there is a trend towards rectangular plan houses, with an area of 20 to 30 m2, divided into 2 to 3 compartments.

Figure 124 shows Puri, where the cubatas are rectangular. From what can be seen, the dimensions of most cubatas in Puri suggest 3 compartments - kitchen and bedroom flanking the central room. In some cases, the houses have roofing with culm, but most are made of sheet metal.

The cubatas are organized in family nuclei facing the courtyard where domestic activities such as cooking in the open air, threshing, and drying grains, which are common moments in the life of a farming community in rural Angola, take place.

The remaining cubatas are smaller, square, most likely single compartment.

Figure 124 – Puri

5.11.3. Evolution prospects in the absence of the project

In terms of heritage, the he local characterisation in the absence of the project should remain similar to the current one, i.e., with no knowledge of any heritage occurrences in the project's direct area of incidence. The remains of buried heritage that may exist will be maintained.

6. Identification and Evaluation of Environmental and Social Impacts

6.1. Climate and Climate Change

6.1.1. Introduction

In support of the objectives of the 2015 Paris Agreement, and in accordance with Principle 2 of the Equator Principles (Equator Principles Association, 2020a), on Environmental and Social Assessment, and given the characteristics of the project, a Climate Change Risk Assessment (CCRA) is developed in the ESIA to identify and analyse the relevant potential or actual climate-related physical risks and, where applicable, transition risks associated with the impacts of the project, and propose measures to avoid the same impacts and risks where possible, or otherwise minimise and mitigate them during the project development lifecycle. Where residual impacts remain, measures to compensate/offset/remediate the risks and impacts will be proposed.

In this context, climate change risks refer to the climate physical risk and climate transition risk categories of the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD, 2021), namely:

- Risks related to the physical impacts of climate change; can be event-driven (acute) or longer-term shifts (chronic) in climate patterns;
- Risks related to the transition to a lower-carbon economy.

The CCRA, consisting of this section, the description of the affected environment and development prospects concerning climate and climate change and the related mitigation measures, follows, to the extent possible, the guidelines and methodologies provided by the Equator Principles Association (Equator Principles Association, 2020b), the Task Force on Climate-related Financial Disclosures (TCFD, 2021), the European Bank for Reconstruction and Development (European Bank for Reconstruction and Development, 2018) and the International Finance Corporation (IFC, 2012a) (IFC, 2012b), together with the GHG Protocol and applicable national legislation (including the Environmental Framework Law, n. º 5 of 1998 and Environmental Impact Assessment Law, n. º 117 of 2020) and policies, including the National Strategy for Climate Change 2018-2030 (Government of Angola, 2017). The OECD Common Approaches for

Officially Supported Export Credits and Environmental, and Social Due Diligence (OECD, 2022b) will also be followed.

In particular, the identification and evaluation of environmental impacts concerning climate transition risks, followed the GHG Protocol requirements of quantification of Scope 1 – direct emissions from fuels use, Scope 2 – indirect emissions from use of purchased electricity, heat or steam, and as relevant Scope 3 – indirect emissions not covered in Scope 2, for the construction and operation phases, as constrained by available data.

Emissions are quantified following IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). Due to data constraints, this quantification relies on Tier 1 methods of emission quantification using general emission factors. Although this could result in some uncertainty relating to GHG emissions quantification, it is considered that the results support an adequate identification and assessment of the significance of impacts related to the project.

Combined Scope 1, Scope 2 and relevant Scope 3 emissions related to the project, excluding land-use changes, are found below the considered 25,000 t CO_2 eq. / year threshold in construction and operation phases. As the combined yearly emissions are not expected to exceed the threshold of 100,000 t CO_2 eq., possible climate transition risks associated with the project are not assessed.

The significance of impacts is assessed based on the latest National Greenhouse Gases Inventory (Government of Angola, 2021b) and high-level commitments and strategies concerning climate change and energy, allowing the assessment of the project compatibility with these commitments.

6.1.2. Construction phase

During the construction phase of the project, activities likely to have an impact on climate and climate change are:

- **Deforestation** for construction areas of transmission towers, new substation areas in Aldeia Viçosa, Rio Dange and Puri, access roads: vegetation removal;

- **General operation of construction equipment and vehicles** in transmission tower construction areas, substation areas (new and existing), access roads, temporary tower laying and erection areas and construction camps: use of fuels;
- **Construction yard operation and moving construction personnel** around construction areas: fuel use for electricity generation, construction yard activities and transport;
- **General construction / assembly operations** of transmission towers and substations (new and existing): use of materials.

Considering the assessment of the baseline situation and its evolution considering climate and climate change, the following negative impacts are expected to result from these activities:

- **Emission of greenhouse gases (GHG):** from fuel consumption in equipment, vehicles and construction yard related to the construction phase - Scope 1 (direct emissions) and from electricity - Scope 2 (indirect emissions); from production of materials used in construction phase – Scope 3 (indirect emissions) (climate transition risk);
- **Reduction of carbon sinks**: deforestation/ clearance of vegetation (climate transition risk).

Considering GHG emissions, the information available from the project for emission sources in the construction phase is as follows:

- Direct emissions (Scope 1): total: fuel consumption in construction vehicles and mobile equipment is estimated at 81 390 l of diesel and 753 l of petrol, resulting in the emission of 229 t CO_2 eq. (emission factors 2,6882 kg CO_2 eq./l and 2,2495 kg CO_2 eq./l, respectively for diesel and petrol);
- Indirect emissions from the consumption of purchased electricity (Scope 2): a consumption of 8 674 kWh is estimated, resulting in the emission of 3 t CO_2 eq. (emission factor 0,2993 kg CO_2 eq./kWh);
- Indirect emissions from materials used (Scope 3): 12 571 tonnes of concrete and 1 497 tonnes of steel.

For the assessment of indirect emissions from the main materials used in the construction phase it is considered the base information presented in the following tables, following the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

Table 63 – Base information for calculation of indirect GHG emissions from concrete production

Material	Type	Specific weight of concrete (kg/m^3)	Cement content (kg/m^3)	Clinker incorporation in cement (%)	CO_2 emission factor (t/t clinker)
Concrete	C25/30	2,310	340	75%	0,52

Source: (IPCC, 2006); (SECIL, 2014)

Table 64 – Base information for calculation of indirect GHG emissions from steel production

Material	Process	CO_2 emission factor (t/t steel)
Steel	Basic Oxygen Furnace	1,46

Source: (IPCC, 2006)

Considering 5 442 m^3 as the concrete volume used (which is equivalent to 12 571 tonnes), indirect emissions from concrete used are estimated in 721.6 t CO_2. Accounting for 1 497 t of steel used, indirect emissions from steel used are estimated in 2 186 t CO_2.

Considering these results, the total GHG emissions estimated for construction phase are 3 139.2 t CO_2 eq., 7% resulting from direct emissions and 93% of indirect emissions related with construction materials used, mainly steel. This represents 0.01% of the current (2018) National GHG emissions.

Angola's GHG emissions are projected to increase gradually between 2015 and 2050, with the energy sector remaining a major source of GHG emissions and the largest increases in emissions projected in the agriculture and livestock, industry and waste sectors (Governo de Angola, 2021a).

According to this scenario, national GHG emissions are expected to increase to 108 million tonnes CO_2 eq. in 2025 (Governo de Angola, 2021b).

Compared to the emissions forecast for the project, these have a reduced contribution in the increase of Angola's GHG emissions.

The construction phase will have a *negative impact* for Climate and Climate Change because it goes against national commitments regarding the Paris Agreement, in particular Angola's Nationally Determined Contribution (Government of Angola, 2021a), and mitigation efforts proposed under the National Strategy for Climate Change 2018-2030 (Government of Angola, 2017). However, due to the amount of estimated GHG emissions, the impact is considered to be of *low intensity and significance*.

The negative impacts of GHG emissions are cumulative with other activities in the project's area of influence, namely as a result of the use of coal and diesel as a source of energy in settlements and road transport.

Table 65 – Impact assessment on "Climate and climate change (construction phase)": "GHG emissions

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct/Indirect
Extent	National/International
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

The removal of vegetation on the land in the project construction areas (transmission towers, new substation areas and access roads) will cause a **reduction in carbon sequestration/sinks**. Thus, this impact will also have *negative* consequences on climate and climate change.

Carbon sequestration by forests makes an important contribution to combating the impacts of climate change. Forests provide benefits to ecosystems that exist in the areas. Tropical forests play an important role in supporting existing biodiversity.

Relative to **reduction of carbon sinks**, the construction phase will involve the clearance of a total area of 20 447,69 ha, comprising 6 013,93 ha of forest, a relevant carbon sink. The base information for the calculation of the carbon content of the forest cleared area related with yearly biomass growth, according to the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006), is provided in the following table.

Table 66 – Base information for calculation of removal of carbon sinks (forest) emissions

Ecological zone	Natural forest	Yearly above-ground biomass growth (t d.m. / (ha.year)	Carbon fraction (t C / t d.m.)
Tropical moist deciduous forest	Africa tropical moist deciduous forest (>20 y)	1.3	0.47

Source: (IPCC, 2006)

For this information results that clearance avoids a yearly increase of carbon stock of 3 674 t C (accounting only above-ground biomass and excluding carbon in soil and dead organic matter), which is equivalent to 13 733 t CO_2. This value is 5 times the estimated CO_2 eq. emissions associated with the construction works and is especially relevant given the current importance of deforestation in the project influence area and in national climate change mitigation efforts (cf. baseline Climate Change study), being considered that the impact intensity is Medium and the significance is Moderate. The *impact is minimizable* with the afforestation of another area with similar characteristics close to the study area.

Table 67 – Climate and Climate Change impact assessment (construction phase): "Reduction of carbon sinks

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	National/International
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

6.1.3. Operation phase

Activities planned for the operation of the project likely to have an impact on the climate are as follows:

- **Transmission line and substation operation**: transmission of electricity from hydroelectric sources to Uíge Province and occurrence of corona discharges;
- **Maintenance of the transmission line and substations:** use of fuels.

The project is expected to cause the following positive impact on the climate in the operation phase:

- **Reduction of GHG emissions** from electricity consumption in Uíge Province: replacing electricity produced from fossil fuels (diesel) with electricity produced from hydroelectric plants with lower GHG emissions (climate transition risk)

Regarding **GHG emissions**, in the operational phase of the project the main contribution is expected to be the replacement in Uíge province of electricity currently supplied by domestic diesel generators and the energy obtained from wood and coal combustion with public grid electricity produced by hydropower plants, reducing the carbon intensity of electricity.

The reduction of GHG emissions is considered a positive and direct impact of the project. This positive impact is aligned with national commitments under the Paris Agreement and mitigation efforts, in particular under the M1 initiative - Low carbon electricity generation of the National Climate Change Strategy 2018-2030 (Governo de Angola, 2017)

It should be noted that this *impact is cumulative* with the negative impact related to GHG emissions expected to be generated by the project in the operation phase, related to the use of fuels in vehicles on transmission lines, maintenance of the SS and the annual maintenance of deforested forest areas.

Table 68 – Impact assessment on "Climate and climate change" (operation phase): "Reduction of GHG emissions by electricity consumption in the Uíge Province

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Indirect
Extent	National; International
Duration	Long Term
Likelihood	Certain
Intensity (or magnitude)	High
Significance (without mitigation)	High
Significance (expected post-mitigation)	High

There is no detailed information available on the maintenance activities of the project during the operation phase. However, GHG emissions from vehicles are expected to be considerably lower than annual GHG emissions during the construction phase, amounting to 229 t CO_2. Maintenance of the cleared forest area would imply avoidance of carbon sinks limited by the amount calculated for the construction phase (13 733 t CO_2).

It should also be noted the occurrence of other sources of GHG emissions related to fugitive emissions from the possible use of SF6, a potent GHG, in insulation and current breaking operations, and the occurrence of corona discharges. Leakage emissions due to SF6 have been estimated for Africa at 2,45 kg CO_2 eq. / MWh (US EPA, 2006). Corona discharge refers to the emission of N_2O in transmission lines, with an irregular occurrence, estimated to represent 1-3 kg CO_2 eq. / MWh (AURECON, 2020).

The direct and indirect GHG emissions associated with the use of fuel, electricity and materials during the operational phase of the project are therefore expected to be below the threshold of 25,000 tonnes of CO_2 equivalent per year. This is expected to be only a part of the GHG emission reduction caused by the positive impacts of the project, resulting in a positive cumulative impact.

Given the characteristics of the project, the realisation of climate change is expected to interfere with the project in the operation phase, mainly due to the following effects:

- Increase in air temperature;
- Reduced water availability;
- Increased frequency of extreme weather conditions (heat waves, floods).

Due to these effects, climate change could potentially involve the following negative impacts on project operation:

- **Increased risk of reduced transmission efficiency of lines** during heat waves (physical climate risk);
- **Increased risk of damage to transmission towers and substations in extreme weather events** (floods, fires) (physical climate risk).

Considering the anticipated increase in the frequency of extreme temperature and precipitation events, with the associated increase in the frequency of flooding, soil erosion and wildfires in a rural environment, there is an increased risk that the project infrastructure, including transmission towers and substations, will be affected by these events.

The occurrence of extreme temperatures, including in heat waves, may result in more frequent exceeding of the maximum operating temperature of transmission lines, resulting in a **reduction in the transmission efficiency of the lines** during these events, in possible association with a higher demand for electricity for cooling.

However, while the likely occurrence of this *essentially temporary impact* is difficult to assess due to the uncertainty of climate change projections, it is not considered likely due to the low demand currently in place.

Due to the temporary and eventual occurrence and the possible management of electricity demand during such events, the impact is considered to be of *low intensity and negligible significance*.

Table 69 – Climate and climate change impact assessment (operation phase): "Increased risk of reduced transmission efficiency of lines during heat waves

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Regional
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

Regarding the risk of **damage to transmission towers and substations in floods and forest fires**, the impact on the project operation is considered unlikely due to the location of the project's infrastructures relatively far from the main watercourses (in the Characterization of the affected environment - Surface water resources) and the vegetation protection areas considered by the project.

Due to the possible occurrence of these events, the impact is considered of *low intensity and negligible significance.*

Table 70 – Impact assessment on "Climate and Climate Change" (operation phase): "Increased risk of damage to transmission towers and substations in extreme weather events (floods, fires)"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

6.1.4. Decommission phase

In the decommissioning phase of the project, the activities likely to have an impact on the climate are similar to those that occur in the construction phase:

- **General operation of construction equipment and vehicles** in transmission tower foundation areas, substation areas (new and existing), access roads, temporary tower dismantling areas and construction yard: use of fuels;
- **Construction yard operation and personnel travel in the decommissioning areas**: use of fuels for electricity generation, construction yard activities and transport.

The project is expected to cause the following negative impact in the decommissioning phase:

- **GHG emissions**: from energy consumption in equipment, vehicles and construction yard related to the decommissioning phase.

All impacts are expected to be similar to those predicted in the construction phase, although of lesser intensity and significance.

6.2. Geology, geomorphology and topography

6.2.1. Construction phase

The implementation of a construction yard implies soil compaction in the direct surroundings of the works, contributing to changes in natural drainage and infiltration conditions, enhancing, albeit locally, **water erosion** phenomena due to increased surface runoff. The impacts associated with this project action are *null*, since the construction yard will be located in an already artificial area.

The actions to be carried out with potential interference in geological characteristics are mainly at the level of the construction phase of the infrastructure, particularly due to **changes in local morphology**. *Negative impacts* are expected, of *moderate magnitude*, but *not significant* due to the excavation of materials and the deposition of earth masses at the infrastructure implementation sites.

Table 71 – Impact assessment on "Geology, geomorphology and topography" (construction phase): "Changes in local morphology"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	Medium
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

At the current stage of the Environmental and Social Impact Assessment, the **volumes of earth** (excavation and landfill) resulting from land modelling operations are not known. Given the impacts resulting from this action of the project, it is particularly important to re-use the materials resulting from the excavations in the embankments to be carried out under this project. If it is not possible to absorb all the earth resulting from excavations in the embankments of the project, a detailed analysis must be carried out of the works or sites within a radius of action close to the project that could hold the volume of surplus materials.

Table 72 – Impact assessment on the "Geology, geomorphology and topography" (construction phase): "Land Balance"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Negligible

6.2.2. Operation phase

In the operation phase, *no negative impacts* on the physical environment associated with the occupation of the project are expected, and no actions leading to morphological change of the terrain are foreseen.

Considering the seismic tectonic framework of the country *no significant seismic events* are expected to occur during the construction and operational phases of the project.

As most of the region where the project will be developed has a gentle to undulating relief, episodes of *slope instability are not expected*. If they occur, they will be sporadic, with little significant effects for the project.

6.2.3. Decommission phase

The deactivation phase, not being clearly defined, can be understood as comprising the cessation of activity and, eventually, the removal of infrastructure. If this type of scenario materialises, *negative impacts* on the local morphology are expected, although these with a *low significance* and of *low magnitude* since they are restricted to the area of intervention.

6.3. Mineral resources

6.3.1. Construction phase

According to the information available, the project does not cover areas of exploitation of mineral resources or with significant potential that could be compromised by the project. Therefore, the impacts are *null*.

6.3.2. Operation phase

No impacts are expected at this stage of the project.

6.3.3. Decommission phase

No impacts are expected at this stage of the project.

6.4. Hydrogeology

6.4.1. Construction phase

No negative impacts on groundwater resources are expected as the construction yard will occupy an already impermeable area and no groundwater abstraction directly intercepted by the project has been identified.

There may be **occasional cases of contamination** associated with possible accidents or poor management of the work or construction yard, which, given the low permeability of the crystalline soils, will not spread in depth.

The impacts inherent to the installation and operation of the construction yard are therefore considered to be *null to negative*, *indirect*, albeit *temporary*, *localized*, *reversible*, and of *low significance* and *low magnitude*.

6.4.2. Decommission phase

In the operation phase, and despite the presence of the infrastructures contributing to the local reduction of the recharge area of the local aquifer units, no changes are expected in the water storage conditions at depth. The impacts are *negative*, with a *low significance* and *low magnitude.*

Table 73 – Impact assessment on "Hydrogeology" (construction phase): "Reduction of the recharge area"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

6.4.3. Decommission phase

No actions are considered to generate negative impacts in the decommissioning phase.

6.5. Surface Water Resources

6.5.1. Construction phase

Project activities in the construction phase that may cause impacts on surface water resources are as follows:

- Deforestation of the substation areas in Aldeia Viçosa, Rio Dange and Puri;
- Excavation and earthmoving works for construction of platforms, execution of the earth network, control buildings and underground tanks of the substations of Aldeia Viçosa, Rio Dange and Puri;
- Excavation and earthmoving works for connection to the existing earth network of the Uíge and Negage substations;
- Deforestation for the foundations of the transmission towers, access areas and temporary construction support areas;
- Operation of the construction yard and presence of workers at the work fronts: generation of sanitary effluents and solid waste;
- Operation of equipment and vehicles in the various construction areas.

Taking into account the characteristics of the project and the assessment of the baseline situation of surface water resources, the following negative impacts are expected during the construction phase:

- Increased turbidity and total suspended solids concentration in ADI water lines;
- Increased concentration of faecal bacteria and organic matter, as well as reduced dissolved oxygen concentration in ADI water lines;
- Risk of pollution of ADI water lines with hydrocarbons and other hazardous substances.

The **increase in turbidity and concentration of total suspended solids in water lines in ADI**, degrading the quality of water to support various uses such as human consumption, livestock, fishing and downstream environmental uses, is a negative impact that can occur as a result of deforestation, excavation and earthmoving activities on steep slopes near water lines following heavy rainfall events (temporary).

Considering the location of the project and the information on high to very high erosion risk and slopes (in the Soils and land use and Geology, geomorphology and topography sections), the impact could occur in transmission tower foundation works and access and temporary support areas near the intersections of the rivers Luíca, Luege and Loge, where the slope could reach 25 %:

- Between km 4 900 and km 7 750 of the Aldeia Viçosa-Rio Dange Line: Luíca River (Dande Hydrographic Unit), Kibaxe (Dembos-Quibaxe) and Quifuafua (Quitexe) communes;
- Km 54 650 of the Uíge-Aldeia Viçosa Line and km 10 800 of the Aldeia Viçosa-Quitexe Line: Luege river (North-West hydrographic unit), Quitexexe commune (Quitexe);
- Km 22 050 of the Uíge-Aldeia Viçosa line: Loge River (North-West hydrographic unit), Quitexe commune (Quitexe).

At the present moment, the location of the transmission towers has not yet been defined, however, it is expected that, due to the greater cost and difficulty of construction, areas with a high slope should be avoided, whenever possible. Under these circumstances and also considering the usual methods of construction of the tower foundations, which mobilise a reduced volume of earth, it is considered that the impact is generally unlikely and of *low intensity and negligible significance*. In cases where areas of high slope are intervened the impact may have *medium intensity and low significance, being minimizable*.

Table 74 – Assessment of impacts on "surface water resources" (construction phase): "Increased turbidity and concentration of total suspended solids in water courses in the ADI"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low to medium
Significance (without mitigation)	Negligible to Low
Significance (post-mitigation)	Negligible

The **increase in the concentration of faecal bacteria and organic matter and reduction in the concentration of dissolved oxygen in water lines in the ADI** may result from the operation of the construction yard and the presence of workers at the work fronts, if domestic effluent and solid waste are directed into water lines (direct) or deposited on the ground and then transported to water lines in situations of heavy rainfall (indirect), without appropriate management and disposal procedures being adopted. This is a *negative impact* that may affect downstream water uses, in particular the use for human consumption.

The project foresees those domestic effluents, from bathrooms, changing rooms, hand washing and kitchen, will be collected, including septic tanks on the construction yard, and transported to Elecnor's construction yard in Viana, from where they will be later sent to a company certified for the management of this type of effluents.

The project also provides for the adoption in the construction phase of procedures for the proper management of hazardous and non-hazardous waste, including on the construction yard, including proper storage and forwarding to companies certified for the management of hazardous and non-hazardous waste.

In this context, the impact is expected to be *unlikely*. If the generation of liquid effluents or waste occurs outside the planned sites, it is expected, given the distance of the sites with higher intensity of construction (new substations of Aldeia Viçosa, Rio Dange and

Puri and substations of Uíge and Negage) to water lines (minimum distance of 700 m in the case of the substation Rio Dange to the river of the same name), to be of *low intensity*. Thus, the impact is expected to be generally of *negligible significance*.

Table 75 – Assessment of impacts on "surface water resources" (construction phase): "Increase in the concentration of faecal bacteria and organic matter, and reduction in the concentration of dissolved oxygen in water lines in the ADI"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct/Indirect
Extent	Local
Duration	Short-term
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	-

Finally, **pollution of watercourses in the ADI with hydrocarbons and other hazardous substances** can result from accidental spills on land or watercourses of oils, fuels and other hazardous substances used by vehicles and equipment, as well as from black and soapy waters and from washing of containers with chemicals, resulting from the maintenance of motor vehicles and generators. This pollution potentially increases concentrations of hydrocarbons, PAHs, metals and other hazardous substances in affected waterways, resulting in a negative impact to the quality of surface water resources.

The project provides that waste chemicals such as solvents and concentrated detergents will not be discharged into the region's sewage or storm water system and includes procedures to manage pollution of soil and surface water resources in the construction yard, including:

- Generator sites, warehouses for chemicals and waste and machine shop with hydrocarbon retention basins and spill emergency kits (absorbent material, collection equipment and container to contain contaminated material) suitable and sufficient to handle spills up to 100 l;
- Hydrocarbon separation basin;
- Concrete mixer washing area, waterproofed and with wastewater collection and forwarding to a sediment separation tank;

- Plan for action in the event of spillages.

The fuelling of light or heavy vehicles on the construction yard is expected to be done at the fuel pumps in the city of Uíge, and will not occur on site. When refuelling the generator on the construction yard, any spillages should be promptly collected with sand or fine sand, including any soil that may have become contaminated and forwarded to an appropriate destination.

Due to accidental events, the impact is considered *unlikely*.

The intensity of the impact depends on the type and amount of substance spilled, but may be high with moderate significance at locations of intersections of water lines and road bridges due to risk to human health if water is used for human consumption. If risk management measures are implemented, reducing the likelihood, the *significance* should generally be *low.*

Considering that the risk cannot be totally eliminated, alternative locations for transmission lines and access roads further away from water lines, which can be considered in more advanced versions of the project, should be preferred to minimise impacts on surface water resources.

Table 76 – Avaliação de impactos nos "recursos hídricos superficiais" (fase de construção): "Risco de poluição de linhas de água na ADI com hidrocarbonetos e outras substâncias perigosas"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct/Indirect
Extent	Local
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	High (watercourses' intersections and road bridges)
Significance (without mitigation)	Moderate (watercourses' intersections and road bridges)
Significance (expected post-mitigation)	Low

6.5.2. Operation phase

The project activities in the operation phase that could cause impacts on surface water resources are as follows:

- Operation of transformers in the new substations and vehicle operation in the transmission towers, substation areas (Uíge substation and Negage substation and new substations of Aldeia Viçosa, Rio Dange and Puri) and access roads: potential accidental spillage of oils, fuels and other hazardous substances into the soil or water lines;
- Connection of part of the area of Aldeia Viçosa, Puri and adjoining villages, Quitexe and adjoining villages and Negage to the electricity grid.

Considering the characteristics of the project and the assessment of the baseline situation regarding surface water resources, the following negative impacts are expected to be generated in the operation phase:

- Risk of pollution of water lines in ADI with hydrocarbons and other hazardous substances;
- Increased consumption of surface water resources for domestic uses, due to the implementation/rehabilitation of public supply systems powered by electricity in the municipalities of Puri, Negage and Quitexe (Quitexe and Quifuafua communes).

Pollution of watercourses with hydrocarbons and other hazardous substances may result from the accidental spillage to land and watercourses of oils, fuels and other hazardous substances used in substation transformers and in vehicles used in the maintenance of the electricity grid. This pollution results in increased concentrations of hydrocarbons, PAHs, metals and other substances hazardous to human health and ecosystems and reduced dissolved oxygen concentration in affected water lines, resulting in a negative impact on the quality of surface water resources.

Regarding transformers used in substations, it is considered that during normal operation and maintenance only small spills may occur. Thus, significant spillage is expected to occur only in the event of a serious breakdown of the transformers, which is considered unlikely. As for vehicles used in grid maintenance, it is expected that spills will only occur as a consequence of accident situations, which is also considered to be an unlikely impact.

The intensity of the impact depends on the type and quantity of substance spilled and the use of spill containment systems and procedures. Considering that the project includes spill containment systems at the transformer sites in the substations, consisting of an underground tank for oil collection connected to the transformer foundations, with effluent decanting for water/oil separation, avoiding oil spillage to the exterior, it is considered that the intensity of the impact will generally be *low, with negligible significance*, if the containment systems are properly maintained.

However, it is considered that the intensity of the impact resulting from maintenance vehicles could be high, with *moderate significance* at the locations of intersections of transmission lines with water lines and road bridges due to the danger to human health if water is used for human consumption. If risk management measures are implemented, the significance of the impact is expected to be generally *low*.

Table 77 – Assessment of impacts on "surface water resources" (operation phase): "Risk of pollution of water courses in the ADI with hydrocarbons and other hazardous substances

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct/Indirect
Extent	Local
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	High (watercourses' intersections and road bridges) Low (SS)
Significance (without mitigation)	Moderate (watercourses' intersections and road bridges) Negligible (SS)
Significance (expected post mitigation)	Low (watercourses' intersections and road bridges) Negligible (SS)

The project foresees in the distribution networks of Quitexe, Negage, Aldeia Viçosa and Puri the supply of energy to water tanks. As presented in the description of the affected environment, the public supply systems in the project area generally present operating problems, sometimes related to lack of energy and under-dimensioning, with the population forced to collect water manually and highlighting access to water as one of their main concerns.

In this context, with the improvement of the energy supply to the communes it is likely that there will be an improvement in the water supply to the population. This situation may increase, due to the better access to water, the **consumption of local surface water resources** for domestic uses, such as bathing and domestic washing, replacing the use *in natura*, constituting an *indirect negative impact* on surface water resources. Additionally, if the systems are not properly maintained there may be an important volume of water that is lost in transport.

The intensity of the impact is difficult to predict at the present time because it depends on changes in the population's water consumption habits, the conditions of access to distributed electricity and the operating and maintenance conditions of the public supply systems (existence of losses).

Considering the situation of relative abundance, present and future, of surface water resources in the area under study and the limitation of consumption by seasonal water availability, it is considered that the impact could have a *low intensity*. In any case, the impact can be *minimised* by proper maintenance of the supply systems in order to limit water losses during transport.

Table 78 – Assessment of impacts on "surface water resources" (operation phase): "Increased consumption of surface water resources for domestic uses".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	Local
Duration	Long term
Likelihood	Probably
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post mitigation)	Low

6.5.3. Decommission phase

In the decommissioning phase of the project the activities that could generate impacts on surface water resources are similar to those that occur in the construction phase:

- Excavation and earth movement for the removal of the foundations of the transmission towers and underground tanks of the substations of Aldeia Viçosa, Rio Dange and Puri;
- Operation of construction yard(s) and presence of workers at the work fronts: generation of sanitary effluents and solid wastes;
- Operation of equipment and vehicles in the various decommissioning areas (Aldeia Viçosa, Rio Dange, Puri, Uíge and Negage substations, transmission towers, access roads and construction yard(s).

The project is expected to cause the following negative impacts in the decommissioning phase:

- Increased turbidity and total suspended solids concentration in ADI water lines;
- Increased concentration of faecal bacteria and organic matter, as well as reduced dissolved oxygen concentration in ADI water lines;
- Risk of pollution of ADI water lines with hydrocarbons and other hazardous substances.

All impacts are expected to be similar to those predicted in the construction phase, but of lesser intensity and significance.

6.6. Soils

6.6.1. Construction phase

The impacts identified on the soil during the construction phase are:

- Loss of soil resources due to erosion;
- Reduction in soil quality;
- Change in land use.

Loss of soil resources due to erosion

Possible direct physical impacts on soil due to project activities include soil erosion resulting from construction activities. Excavations and backfills for the construction of the substation platform, access roads, tower foundations, installation of project infrastructure and support areas can be highlighted as the most significant, as well as vegetation clearing along the transmission line and intervention areas.

Removal of soil and excavation of soil will disrupt soil cohesion and surface exposure (reduced resistance to soil erosion) and create a surplus of soil. If not properly restored or managed, soil will be at risk of erosion caused by surface water runoff and wind. Erosion can also present itself in the form of landslides on steeper slopes and rockslides during intense weather conditions.

The *direct negative impact* of excavations on soil cohesion and vegetation clearance increases the risk of erosion along the project's ADI. The impact is *likely*, but its extent will be *local* and *limited* to the ADI. Impacts of construction activities on soil erosion are expected to last for the duration of the construction phase (i.e., in the *short term*) and may extend into the future if not managed. The magnitude and significance of the impact, without mitigation, is expected to be *medium and moderate*, respectively, considering the combination of factors affecting soil erosion (Table 79).

The soil types existing in ADI are prone to erosion and should be carefully managed to prevent erosion, particularly in areas with steep slopes and less vegetation cover. With vegetation correction and soil restoration and management (post-mitigation), the magnitude and significance of the impact is expected to be *low*. The mitigation measures proposed to reduce soil erosion are in section 7.7.

Table 79 –Soil impact assessment (construction phase): Soil erosion.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short-term (Long-term in cases of mismanagement)
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post mitigation)	Low

Reduction in soil quality

Soil pollution due to accidental spills of hazardous materials (fuels and oils) can occur during construction, refuelling and maintenance activities of machinery and vehicles outside impermeable areas, namely during excavations, vegetation clearing and removal of houses and structures. These spills have the potential to affect terrestrial environments, leading to soil deterioration.

Accidental spills are low frequency, unlikely episodes and local in extent. The duration of the impact may be *short or long term*, depending on the volume spilled. The magnitude and significance of the impact, without mitigation, is expected to be *medium and low*, respectively, considering that the areas along the transmission line where land clearance activities will take place are natural areas. With adequate and timely soil removal or remediation (post mitigation), the magnitude and significance of the impact is expected to be *low*.

Table 80 – Soil impact assessment (construction phase): Soil pollution.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short to Long Term
Likelihood	Unlikely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Low
Significance (expected post mitigation)	Low

Changes in land use

Changes in land use during the construction phase will occur along the transmission line, substations and temporary work areas and will include temporary loss of access to land and permanent removal of vegetation in the transmission line corridor, including crops.

Temporary occupation of land during construction activities may lead to temporary loss of land or limited access to crops and forest products, some of which will be reinstated after construction (temporary working areas).

The magnitude and significance of the impact, without mitigation, is expected to be *medium and moderate*, respectively, considering the dependence on agriculture in the affected areas. With adequate compensation for crop loss and/or alternative access to land of equal productivity (post-mitigation), the magnitude and significance of the impact is expected to be *low*.

Table 81 – Land use impact assessment (construction phase): Temporary land take and loss of access to land.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Temporary (most cases) and permanent (for specific cases)
Likelihood	Very likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post mitigation)	Low

Permanent removal of vegetation in the transmission line corridor during the construction phase will lead to loss of trees/forest products as livelihood activities. The magnitude and significance of the impact, without mitigation, is expected to be *medium and moderate*, respectively. Given the amount of vegetation clearing, this effect will be minimised with adequate compensation for loss of forest products and/or alternative access to land of equal productivity (post mitigation), the magnitude and significance of the impact is expected to be *low*.

Table 82 – Land use impact assessment (construction phase): Permanent removal of vegetation, including crops.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct

Criteria	Assessment
Extent	Local
Duration	Long-term
Likelihood	Very likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post mitigation)	Low

6.6.2. Operation phase

Reduction in soil quality

Overall, the impacts of soil pollution due to accidental spills of hazardous materials (fuels and oils) during maintenance activities of transmission lines and substations are similar to those expected during the construction phase. These may occur during maintenance activities outside impermeable areas, such as maintenance operations to keep permanent tower settlement areas free of vegetation.

This is a *likely* impact in the operation phase, due to the high lifetime of the project. Yet, if it happens it will have a *direct* impact only at the *local* where the spill occurs. Assuming any spillage or runoff is detected and resolved promptly, the impact will be *temporary*. The intensity of the impact will depend on the amount and type of spill that exists, and could range from *low to medium*. Significance could range from low to moderate. Assuming mitigation measures, significance will be *low*.

Table 83 – Soil impact assessment (operation phase): Reduction in soil quality

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Temporary / Short-term
Likelihood	Very Likely
Intensity (or magnitude)	Medium / Low
Significance (without mitigation)	Moderate / Low
Significance (expected post mitigation)	Low

Permanent land use restrictions

Changes in land use will occur along the transmission line and substations, with permanent restrictions on land use due to the permanent occupation of land in the areas where the towers, maintenance corridor and substations are located.

The area affected by permanent restrictions is relatively small in the overall context of the land around the transmission line (ADI), however, the size and value of the property should be considered. As long as there is agreement from the owners and adequate land replacement, the magnitude and significance of the impact, without mitigation, is expected to be *medium/low* and *moderate/low*, respectively, depending on the value of the land, such as heritage value.

With adequate compensation for loss of land and forest products and/or alternative access to land of equal productivity (post-mitigation), the magnitude and significance of the impact is expected to be *low*.

Table 84 – Land use impact assessment (operation phase): Permanent land restrictions

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Very Likely
Intensity (or magnitude)	Medium / Low
Significance (without mitigation)	Moderate / Low
Significance (expected post mitigation)	Low

6.6.3. Decommissioning phase

Overall, the impacts of the project in the decommissioning phase are similar to those expected during the construction phase.

The general operation of equipment and decommissioning vehicles in transmission tower foundation areas, substation areas, access roads, temporary tower placement and erection areas and construction camps could have the following effects:

- Excavation and clearing of vegetation for operation of work camps and removal of transmission tower foundations: soil erosion;
- Potential accidental oil and fuel spills outside impermeable areas: reduction in soil quality.

All impacts are expected to be similar to those predicted in the construction phase, although of lesser intensity and significance. In the case of land use, in the decommissioning phase, the land will no longer be occupied by the infrastructures installed as part of the project, so the impacts will be similar to those felt in the operation phase, but of a *positive* nature.

6.7. Quality of the environment

6.7.1. Air quality

6.7.1.1. Construction phase

During the construction phase, the expected impacts on air quality are the emission of pollutants (CO, NO_X and SO_2 and PM) by vehicles associated with the works - especially heavy vehicles - and electricity generators, as well as the emission of suspended particles and dust resulting from land preparation and construction activities and traffic, particularly on unpaved roads.

The project includes an "Air Quality Monitoring Programme" (section 8.3.2) that establishes specific actions to "prevent dust emissions from exposed areas" and "control the emission of pollutant gases from vehicles, machinery and equipment". The residual impacts assessment (after measures) presented takes into account the implementation of this programme and the proposed additional mitigation measures.

It should be noted that impacts will only be relevant when they occur near sensitive receptors. In unoccupied areas, where there will be no impact on the population or the natural environment, the impacts will be *negligible*.

Exhaust gas emissions

The project area covers mainly rural areas. In these areas, open and with little car traffic, the baseline levels of the various exhaust gases are not expected to reach the limits recommended by the WHO.

Thus, the impact of exhaust emissions will be *negative*, with a *regional* extension, as it will be felt along the entire project corridor and its access roads. It is a certain and *direct* consequence of the project activities and will be a *short-term* impact, occurring only during the construction phase. Although there is no concrete number of vehicles that will be assigned to the project, it is expected that construction traffic will not be a significant source of the various exhaust gases, so the intensity of the impact is *low to negligible*. Considering the "Air Quality Monitoring Programme" and proposed mitigation measures, the significance of this impact is *negligible*.

Table 85 – Assessment of impacts on "air quality" (construction phase): "Exhaust gas emissions

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Regional
Extent	Direct
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low to Negligible
Significance (without mitigation)	Low to Negligible
Significance (expected post mitigation)	Negligible

Emissions of dust and inhalable particles (PM)

With the exception of the urban centres and the main national roads, most roads and access routes in the Uíge region consist of unpaved roads, or, in other cases, partially tarred roads in poor condition. Unpaved roads are therefore quite common in the project area.

In this regard, the road linking Uíge to Negage stands out, passing through several villages that will be directly affected (Quiongua, Calumbo, Dambi, Piqui and Cangundo).

In addition to the construction activities, the installation of the poles and substations, the project will also include preparatory work, such as the opening of paths, excavations, among others. All these activities, together with vehicle traffic, will promote the resuspension of atmospheric dust and particles, especially on unpaved roads and paths.

Impacts from dust and particulate emissions will be *negative* and will result directly from project activities. Traffic on unpaved roads may have a local extent, while other activities are limited to the project areas and implementation. Thus, the extent of particulate and dust emissions is considered *local*. These impacts are *certain*, but *temporary*, occurring occasionally during the construction phase.

The intensity of the impacts depends on the recipient. The most sensitive receptors are the elderly, infants and children as well as people with respiratory problems. Thus, the intensity of impact from dust and PM emissions will be *low to negligible* in unoccupied and agricultural areas, where people are present only for short periods of time.

In residential areas, where interventions will take place in close proximity to populations, the intensity of the impacts is *medium to high*, depending on the proximity of the receptors to the emission source (high intensity when receptors are less than 50 m from the emission source).

The significance of impacts is a product of the intensity of the impact and its likelihood of occurrence. The significance of dust and particulate emissions will be *low to negligible* in agricultural and lightly occupied areas, while in residential areas it will be *moderate to high*.

It is expected that with the implementation of the "Air Quality Monitoring Programme" and additional mitigation measures, the overall significance of dust and particulate emissions will be lowered to a *low* level. It should be noted that due to the need for land clearing and preparation and earthmoving, the activities with the highest potential for dust emissions are the construction of new substations and the expansion of existing ones.

In the case of the Uíge substation, this is located next to a residential area, as shown in Figure 125, whose access is via an unpaved road. In this sense, the impacts of dust and particulate emissions associated with the expansion activities of this substation will be *high* due to the proximity of sensitive receptors (dwellings less than 50 m from the substation).

Figure 125 – Surrounding the Uíge substation, next to a residential area

The Negage substation, which is also projected to be expanded, is also located close to houses, although at distances of more than 50 metres. Access is via a road, which is paved but is not in the best condition, with holes and traces of earth, as can be seen in Figure 126 .

Therefore, the impacts of dust and particulate emissions associated with the expansion activities of this substation will be *moderate*, due to the proximity of sensitive receptors (dwellings nearby, but more than 50 m from the substation).

Figure 126 – Access Road to Negage substation

In the Municipality of Puri, the site indicated for the construction of a new substation is a site used only for agricultural purposes, with dirt tracks but no sensitive receptors in the immediate vicinity.

At this location, the impacts of construction activities will be *negligible*. In the Municipality of Quitexe, the construction of a substation in the vicinity of Aldeia Viçosa is also planned.

The selected site is accessible via a dirt track that runs through the village. The site for the substation is at a distance of more than 200 metres from the nearest residences, so the impact of construction activities on dust emissions is negligible.

The selected site is accessible via an unpaved road, which runs through the village. The site for the substation is at a distance of more than 200 metres from the nearest residences, so the impact of construction activities on dust emissions is *negligible*.

Even so, it should be noted that the heavy vehicle traffic will cross Aldeia Viçosa, promoting the emission of dust and particles near the houses, so its impact would be *high* without the application of the measures proposed by the "Air Quality Monitoring Programme" and by this study (see section 7.8).

The projected site for the substation to be built at the Dange River has some houses about 100 metres away, and access to the site is via an unpaved road that will still require preparation works before construction of the substation can begin. Therefore, the significance of the impacts from dust and particulate emissions is expected to be *moderate*.

Overall, the impact of the emission of dust and inhalable particles is summarised in the table below.

Table 86 – Assessment of impacts on "air quality" (construction phase): "Emissions of dust and inhalable particles

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Local
Extent	Direct
Duration	Temporary
Likelihood	Certain
Intensity (or magnitude)	Low to High
Significance (without mitigation)	Low to High
Significance (expected post mitigation)	Negligible to Moderate

Overall, the impacts of the construction phase of the project are cumulative with those of other sources of air pollutants, in particular CO, NO_X, SO_2 and PM, such as local traffic, biomass burning, open fires and other construction works that may occur in the ADI.

6.7.1.2. Operation phase

During the operation phase, the main source of atmospheric pollutant emissions will be the traffic associated with the operation and maintenance of the substations and electricity pylons and posts. However, these activities are occasional situations and with low traffic volumes, so the impacts of the project on air quality during the operation phase are considered *null.* The technology to be implemented in the new substations includes the use of sulphur hexafluoride (SF6), a particularly powerful greenhouse gas (effect over twenty thousand times more intense than CO_2). This gas will only be used in circuit breaker cutting chambers.

In the event of accidental destruction of a circuit breaker, this gas can leak into the atmosphere, but in small quantities. Furthermore, any emptying operation is designed to be carried out in a controlled manner in a tank for subsequent treatment of the gas. Taking this into account, the risk of SF6 leakage is *negligible*.

6.7.1.3. Decommissioning phase

The decommissioning phase refers to the reversal of project activities and will therefore also involve the same activities that generate impacts on air quality during the construction phase.

The impacts in the decommissioning phase will be similar to those identified in the construction phase, being cumulative with those of the other human activities with effects on air quality and evaluated globally as summarised in the table below.

Table 87 – Evaluation of impacts on "air quality" (decommissioning phase): "Emissions of atmospheric pollutants

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Regional
Extent	Direct
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low to High
Significance (without mitigation)	Low to High
Significance (expected post mitigation)	Negligible to Moderate

6.7.2. Noise

6.7.2.1. Construction phase

During the construction phase, the expected impacts on the noise environment are noise emissions from vehicle traffic (especially heavy vehicles) and site equipment, and from construction activities such as earthmoving, clearing and construction, among others.

Noise monitoring carried out during the fieldwork revealed that the project's area of influence can be noisy (up to L_{eq} of 70,8 dB(A)) due to road traffic and other human activities taking place in the settlements along the project corridor.

The Project includes a "Noise Monitoring Programme" (Appendix 1) which sets out specific actions to "control noise" by limiting hours of activities and maintaining good condition of vehicles and machinery and "reduce vibration" through the use of protective equipment and minimised use of tools in good condition. The residual impact assessment (after measures) presented takes account of this programme and the additional mitigation measures proposed by this study.

Construction activities may produce higher sound levels than those recommended by the IFC Guidelines. The noisiest activities envisaged are the installation of the transmission towers, particularly their foundations (since this activity includes the need for drilling and excavation), and the construction and expansion of substations. The towers will be assembled on the ground and installed using a mobile crane, the expected installation time is assumed to be relatively short. The installation and operation of the construction yard is also a relevant source of noise emissions, through the traffic of heavy and light vehicles, machinery and the operation of equipment and generators.

Construction activities and road traffic have a *certain* and *direct negative* impact on the background noise of the ADI. However, it should be noted that this effect is only relevant where there are noise-sensitive receptors, i.e., in populated areas. As such, the extent of the impact is considered *local*, where interventions coincide with human occupation. Examples of this are the locations of the Uíge and Negage substations, which will be expanded and are close to residential areas, or the placement of street poles and domestic lighting, which will directly affect localities.

In terms of duration, the impact of substation expansions and construction, as well as the installation and operation of the construction yard, are considered *short-term*, as they will be felt throughout the construction phase, but end when it ends. The installation of transport towers and lighting poles have *temporary* impacts, as the construction/installation time at each site is expected to be short.

The intensity of the impact depends on the proximity of the noise source. Close (less than 30 metres) to the source the intensity is considered *medium to high*. Further away from the noise sources, the impact is *low or negligible*.

The level of significance of impacts is obtained by combining the intensity of the impact with the probability of occurrence.

In the case of the Uíge substation, this is located next to a residential area, as shown in Figure 125 , which is accessed via an unpaved road. Here, the sensitive receptors are very close to the noise source, so the significance of the impact may be *moderate* to *high*. The same is true for the Negage substation, which is also located close to residential dwellings.

In the Municipality of Puri, the site indicated for the construction of a new substation is a site used only for agricultural purposes, with unpaved road, but no sensitive receptors in the vicinity. At this location, noise impacts will be *negligible*.

The construction of a substation in the vicinity of Aldeia Viçosa is also planned in the Municipality of Quitexe. This site is at a distance of over 200 metres from the nearest residences, so the noise impact from construction activities is *low* to *negligible*. Even so, it should be noted that heavy vehicle traffic will cross Aldeia Viçosa, causing noise disturbance near the residences, so its impact is *moderate*.

The projected site for the substation to be constructed at River Dange has some dwellings about 100 metres away, and access to the site is via an unpaved road, with ground preparation works still required before construction of the substation can commence. The significance of associated noise impacts is therefore expected to be *moderate*.

Considering the implementation of noise mitigation measures, the significance of residual noise impacts associated with the project is expected to be *negligible to low*.

It should also be noted that the identified impacts are cumulative with other noise sources such as local traffic, construction works that may occur in the ADI and other human activities taking place in the vicinity.

The table below summarises the overall impact of noise emissions during the construction phase.

Table 88 – Assessment of impacts on "noise" (construction phase): "Noise emission"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Local
Extent	Direct
Duration	Temporary

Criteria	Assessment
Likelihood	Certain
Intensity (or magnitude)	Low to Medium
Significance (without mitigation)	Low to High
Significance (expected post mitigation)	Negligible to Low

6.7.2.2. Operation phase

Operation of substations

During the operating phase, substations comprise several sources of noise emissions, the most significant being the continuous emission of audible discrete tones. Noise of this type is mainly generated by power transformers, reactors, emergency generators, and others.

The noise emitted by substations constitutes *negative*, *certain* and *direct impacts* on existing sensitive receptors. As the effects will be felt throughout the lifetime of the project, but are *reversible* if the project is decommissioned, the impacts are considered *long-term*.

Thus, it is important to understand where the operation of substations could affect sensitive receptors.

The Uíge and Negage substations are located close to residential settlements, so the noise from their operations is a relevant source of nuisance. However, these substations are already operational and, in the absence of the project, the disturbance to the population would continue to exist. Therefore, the assessment of the impacts of the project only takes into account the increase in noise due to the expansion of the substations.

The Uíge substation already transmits high voltage energy and is already a substation of considerable size. Therefore, its expansion is not expected to result in a significant increase in noise in the surroundings, so its impact, in the operation phase, is *negligible*.

The Negage substation is not currently equipped to receive 110 kV lines, and the substation expansion will enable the substation to receive and transmit this voltage. Therefore, the expansion of the Negage substation will contribute to an increase in noise emissions. Considering the proximity of the substation to sensitive receptors, it is considered that the increase in noise will have a *moderate* impact during the operation phase.

In the Municipality of Puri, the site indicated for the construction of a new substation has no sensitive receptors in the vicinity. At this location, noise impacts will be *negligible*.

The projected site for the Quitexe substation is about 200 metres away from the nearest residential area (Aldeia Viçosa), so the impact of the noise emitted by its operation will be *negligible*.

The projected site for the substation to be built on the Dange River has some dwellings less than 100 metres away, so its operation will have a *moderate* impact on the background noise of the site.

Table 89 – Assessment of impacts on "noise" (operation phase): "Operation of substations"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Local
Extent	Direct
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low to Medium
Significance (without mitigation)	Low to Moderate
Significance (expected post mitigation)	Low to Moderate

Crown effect (high-voltage lines)

Above-ground power transmission lines can themselves be sources of noise due to the effect of wind on the conductor cables and the corona effect (noise from electric discharges).

However, power lines mostly run through sparsely populated land and roads, so most sensitive receptors are at a safe distance from the source.

In addition, these noise sources are weather-related, with lines usually quieter during dry weather. During periods of wind and rain, ambient noise levels also tend to increase.

On balance, when lines directly overlap sensitive receptors, noise generated from power lines can be a relevant source of annoyance.

Thus, the significance of the noise emitted by the transmission lines is considered *low to moderate*, depending on the distance at which the high-voltage lines pass from the sensitive receptors, which is highly variable throughout the development of the project. With the application of mitigation measures, namely the optimisation of distances between infrastructure and inhabited areas, the resulting residual impacts will be of *negligible to low* significance.

Table 90 – Assessment of impacts on "noise" (operation phase): "Crown Effect

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Local
Extent	Direct
Duration	Long-term
Likelihood	Certain
Intensity (or magnitude)	Negligible to Low
Significance (without mitigation)	Low to Moderate
Significance (expected post mitigation)	Negligible to Low

Both identified impacts - resulting from the operation of substations and the corona effect of transmission lines - are cumulative with other existing noise sources in the area of influence, namely local traffic and other human activities.

6.7.2.3. Decommissioning phase

The decommissioning phase refers to the reversal of project activities, and will therefore also involve the same activities that generate noise during the construction phase.

The impacts in the decommissioning phase will be similar to those identified in the construction phase, and cumulative with the other noise sources.

Table 91 – Assessment of impacts on "noise" (decommissioning phase): "Noise emission"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Local
Extent	Direct
Duration	Temporary
Likelihood	Certain
Intensity (or magnitude)	Low to Medium
Significance (without mitigation)	Low to High
Significance (expected post mitigation)	Negligible to Low

6.8. Ecology

In this section we identify and assess the impacts arising from the implementation of the project on the biological component of the study area - i.e., habitats, flora and fauna - based on the reference situation previously characterized (description of the affected environment) and the existing knowledge about the actions planned in the various phases of the project.

These actions take place in three (3) sequential phases - (i) pre-construction (detailed project design) and construction phases, (ii) operation and (iii) decommissioning of the project - which have different impacts on the biological environment, and whose impacts will be assessed separately for each one.

6.8.1. Construction phase

In the construction phase, taking into account the characteristics of the project in this phase, the main actions likely to generate impacts on ecosystems and biodiversity are expected to be the following:

- Operation and movement of machinery and vehicles;
- Construction and/or assembly of the towers;
- Soil movement;
- Removal of vegetation for the:
    - Construction and extension of substations;
    - Installation of the construction yard;
    - Creation of protection strips and servitudes (where the tower installation sites are included);
    - Opening of the accesses for the installation of the towers.

These actions will incur direct or indirect impacts on existing habitats, flora and fauna, namely:

- Elimination/loss of habitats, vegetation and flora;
- Disturbance of faunal communities;
- Contamination of the habitat with hazardous materials (e.g., insulating oils/gas and fuels, as well as herbicides for the maintenance of the easement zone).

Elimination/loss of habitats, vegetation and flora

The project foresees the construction of new substations (Vila Viçosa, Rio Dange, and Puri), and the installation of overhead electricity distribution lines, which imply the deforestation of the substation area, and the clearing or thinning of vegetation.

The following criteria were considered for the assessment of associated impacts:

- Implementation of a temporary supports/towers' construction area, where no planting or vegetation gathering activities are allowed during the construction phase;
- Creation of new accesses, with a maximum width of 4 metres for access to the construction areas, perpendicular to the line.
- 110 kV lines:
    - Creation of a permanent site for the towers/supports, in the centre of the construction area, where no planting activity is permitted permanently;
    - Creation of a corridor with a maximum width of up to 4 metres (2 m each side of the line) for the installation of the towers and lines, and for their maintenance;
    - Creation of a 40 metres corridor (20 m each side of the line) where all trees must be removed for the protection of structures and cables;
    - Creation of a complementary corridor with a maximum width of 20 metres (a total of 10 m each side of the line), where vegetation may be thinned as necessary to protect the structures and cables;
- 60 kV lines:
    - Creation of a corridor with a maximum width of up to 4 metres (2 m each side of the line) for the installation of the towers and lines, and for their maintenance;
    - Creation of a corridor with a maximum width of up to 20 metres (10 m each side of the line), centred on the line and encompassing the 4 m strip, where vegetation can be thinned as necessary to protect structures and cables;
- 30 kV lines:
    - Creation of a corridor with a maximum width of 4 metres (2 m each side of the line) for the installation of the tower and lines, and for their maintenance;

- Creation of a corridor with a maximum width of 10 metres (5 m each side of the line), centred on the line and encompassing the 4 m strip, where vegetation can be thinned as necessary to protect the structures and cables.

It is assumed that no construction yards will be created along the line, and that construction activities will be exclusively served by the construction yard installed in the city of Uíge.

The installation points of the towers and supports are not yet defined, nor the places where new accesses will be opened. Therefore, the present evaluation will focus on the 4, 10, 20 and 60 m strips described above. The estimated areas of affectation of each habitat, for these different strips, are detailed in the following tables.

Table 92 – Estimate of the affected area of each habitat in the 4 m band (calculation made for the three-line tensions)

Habitat	Total area in ADI		4 m strip	
	ha	%	ha	%*
Forest	6 013,93	29,41	27,02	0,45
Grasslands and herbaceous savannahs	2 124,24	10,39	9,73	0,45
Wooded savannahs and scrublands	4 334,86	21,20	19,5	0,45
Mosaic of scrubland and cultivated land	1 888,39	9,24	7,66	0,41
Wetlands	209,35	1,02	1,00	0,48
Croplands	5 376,11	26,29	22,71	0,42
Artificial areas	500,8	2,45	1,16	0,23
Total	***20 447,69***	***100,00***	***88,78***	**---**

* Percentage of total habitat in ADI

Table 93 – Estimate of the area affected of each habitat by the 10, 20 and 60 m buffer strips (centred on the line, excluding the 4 m strip)

Habitat	10 m strip (30 kV lines)		20 m strip (60 kV lines)		60 m strip (110 kV lines)	
	ha	%*	ha	%*	ha	%*
Forest	12,77	0,21	55,73	0,93	63,84	1,06
Grasslands and herbaceous savannahs ▼	2,81	0,13	23,99	1,13	26,62	1,25
Wooded savannahs and scrublands ▼	-	-	23,60	0,54	129,31	2,98
Mosaic of scrubland and cultivated land ▼	-	-	-	-	106,87	5,66
Wetlands ▼	-	-	4,01	1,92	-	-
Croplands ▼	8,21	0,15	58,42	1,09	36,94	0,69
Artificial areas ▼	1,22	0,24	0,56	0,11	3,37	0,67
Total	***31,51***	**-**	***166,31***	**-**	***366,94***	**-**

* Percentage of total habitat in ADI. ▼ Dominant shrub and/or herbaceous habitats, where cutting and thinning of the tree stratum is expected to be reduced and will not significantly alter the ecological functions of the system.

With regard to the surface area of eliminated or degraded habitat, it can be observed that in the 4m strip the proportion of natural or semi-natural habitat eliminated - compared to the total mapped in the ADI - will be similar for each typology, between 0,41 % and 0,48 %.

In absolute terms, the habitat most affected by the opening of the 4 m strip (along the entire route) is forest, followed by cropland and wooded savannahs and scrublands, which together account for 77,98 % of the habitats available in the ADI.

In the remaining strips, a further 0,13 to 0,24 % of each habitat will be affected in the 10 m band (30 kV lines), a further 0,54 to 1,92 % in the 20 m band (60 kV lines), and a further 0,69 to 5,66 % in the 60 m band (110 kV lines). Expectably, in terms of overall size, there is a higher magnitude of allocation associated with the installation of the 110 kV lines, which correspond to 24 % of the total project length (55 km of the 230 km).

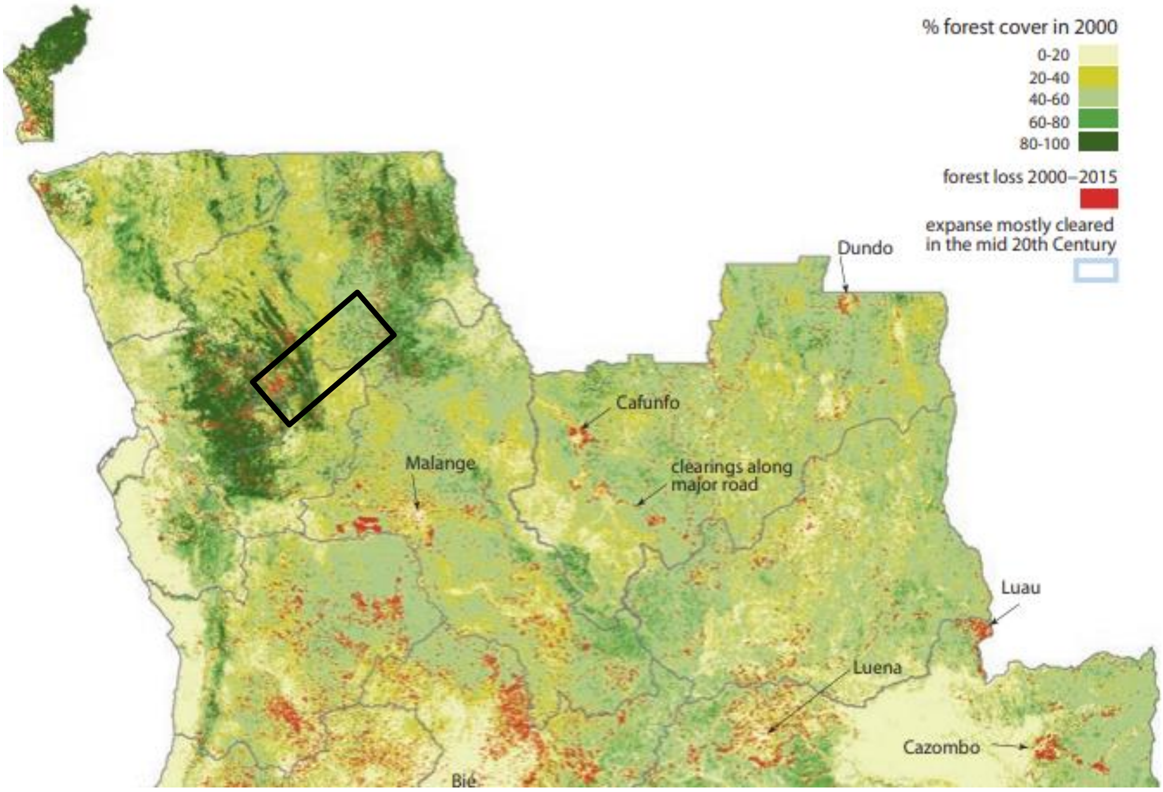
On the other hand, in these safeguard strips, it is considered that the vegetation will not be removed entirely, and that it will only be thinned, or the larger tree cover removed (i.e., except in the forest, where it is assumed that the removal will be total in all strips - a precautionary assumption that is unlikely to occur, but which allows a more conservative assessment of the impact). Thus, from the perspective of loss of ecological functions and processes, regardless of surface area, the magnitude of the impact is greater in forest environments, in all tracks, but mostly in the 110 kV sections (affectation greater than 1 %).

The valuation of impact significance varies according to the ecological value, the size of the allocation, and the characteristics of the habitat eliminated (which define the magnitude of the allocation, as detailed above). Thus,

- A **null significance** is attributed to habitats already intervened upon and/or with significant levels of human intervention ("modified" habitats according to the IFC classification), since the original ecological functions and processes are already altered; croplands and artificialized areas are included in this category;
- **Low significance** is assigned to habitats that retain natural or semi-natural features but have low or moderate structural complexity (height and density of the strata present); this category includes grasslands/herbaceous savannahs, scrubland/ wooded savannahs and wetlands;
- **Higher significance** (i.e., moderate) is assigned in habitats that:
    - preserve the natural or semi-natural characteristics and whose structural complexity implies that the clearing or thinning of the tree cover represents a considerable modification of the ecological components of the system, and subsequently of its functions, even if over an apparently reduced area; and/or that,
    - have biogeographic or phytogeographic relevance at regional or global scale;
    - forests are included in this category.

The elimination of vegetation is a cumulative impact with the deforestation trend and loss of natural areas felt at national level. The annual deforestation rate in Angola was about 0.8% between 2010 and 2020, making it the country with the fourth largest forest loss in this period globally (FAO, 2020). Removal of forest vegetation typically occurs for replacement with subsistence cultivation (small-scale), commercial cultivation (large-scale), timber production, and fuel production (fuelwood and charcoal) (Mendelsohn, 2019).

At the convergence between the provinces of Bengo, North Kwanza and Uíge, where the areas with the highest forest cover in 2000 were gathered (Figure 127), it is possible to observe a concentration of forest loss nuclei, which follow the main communication route between Luanda and Uíge, and intensify in urban centres, following the pattern observed on a national scale (Mendelsohn, 2019).



Source: (Mendelsohn, 2019), adapted from Hansen, et al., 2013

Figure 127 – Sites of forest or tree cover loss between 2000 and 2015 in northern Angola; project location indicated in black

It has been estimated that a total of 159.35 ha of forest (2,65 % of the total in ADI) will be affected (sum of all tracks). Assuming that total forest in Angola is 66 607,00x10^3 in 2020 (FAO, 2020), the loss resulting from the implementation of the project represents 2,39x10^{-4} % of the national total, which corresponds to a 0,03 % increase in deforested area at the annual average.

The disturbance of forest vegetation also implies the loss of floristic values with conservation relevance, such as *Autranella congolensis*, *Dalbergia latifolia*, *Entandrophragma utile*, *Khaya anthoteca* (Table 41). They may also occur in sparse or orderly form in the rural humanised matrix, having been selected or planted for their usefulness. The elimination of individuals of the listed species is assumed to be total in the strips of 4 m (the whole route), 10 m (30 kV) and 20 m (60 kV), but may be more reduced in the remaining area up to 60 m.

Finally, the elimination of forest vegetation in the 4 to 60 m strips is considered permanent in time, since, according to current knowledge in restoration ecology, it is not possible to fully restore the lost ecological structure and function.

Likewise, the natural regeneration of a habitat is a slow process and depends on several factors, such as the permanence or not of external pressures and the condition of the surrounding vegetation, among others. Expectably, in this case, the removal of the cover will promote colonisation by ruderal and/or infesting flora - ubiquitous in the area under study (see section 5.9.5) - given their opportunistic character and superior capacity to propagate seeds, compared to the original autochthonous flora, reducing the ecological value of the intervened areas.

The following table presents the classification of this impact, based on the assumptions presented above, and the information collected in the baseline characterisation.

Table 94 – Assessment of impact on ecology during the construction phase: "Elimination/loss of habitats, vegetation and flora"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Long-term
Likelihood	Certain

Criteria	Assessment
Intensity (or magnitude)	Low to Medium (restricted to forest habitats on all lines)
Significance (without mitigation)	Null (modified habitats), low (savannahs and wetlands) and moderate/significant (forests)
Significance (expected post mitigation)	Without possibility of mitigation

Disturbance of faunal communities

The activities to be carried out during the construction phase (movement and operation of machinery, clearing of land, digging of foundations, installation of towers and cables) will have a disturbing effect on the fauna existing on the site and the surrounding area.

Disturbance will be caused mainly by human presence (which will scare away some species) and noise emissions. The feeding and breeding behaviour of the animal's present will be potentially affected and it is expected that these will move to unaffected areas. The circulation of machinery and vehicles may also cause the mortality of species of reduced mobility (such as reptiles and amphibians), by being run over by cars.

A large part of the corridor under study passes through areas with a high level of human influence, such as artificial areas and cultivated areas (31 %). Here, the disturbance of fauna is not considered to differ significantly from the disturbance currently exerted, so the impact is *negligible*. This occurs in the case of substations, and especially in the sections between Uíge and Negage, and between Negage and Puri.

In areas of moderate sensitivity - areas of greater naturalness of the vegetation, but which maintain some degree of human presence and management, such as grassland/ herbaceous savannahs and scrubland/ wooded savannahs - the impact will be greater, although it will mainly affect generalist species with a greater degree of tolerance to human presence.

In areas of greater sensitivity, such as wetlands and forest - especially the forest patches that form an ecological continuum with the wet forests of the Píngano and Uíge Mountains (Figure 76)- this effect is estimated to be more harmful

As previously mentioned, seven (7) globally vulnerable species (reptiles and mammals), five (5) globally endangered (birds and mammals), three (3) nationally endangered (mammals), 11 nationally vulnerable (reptiles, birds and mammals), and nine (9) endemic species stand out from the list of fauna in the study area.

On the other hand, considering that this is an impact of the construction phase, and therefore of short duration, taking into account the mobility of the species in question and the existence of a more favourable habitat in the surrounding region, it is considered that the impact is generally of *moderate* significance.

Table 95 – Impact assessment on ecology during the construction phase: "Disturbance to faunal communities"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	Local
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low to Medium
Significance (without mitigation)	Null (modified habitats), low (savannahs and wetlands and forest)
Significance (expected post mitigation)	Null to low

<u>Habitat contamination</u>

All construction activities in general and the movement of machinery involve the use of oils and lubricants, fuels, among others, which may cause chemical contamination of the habitats present, through spillage or accidental dispersion.

The careful planning of activities and the implementation of adequate safety measures on site (Figure 128) will reduce the probability of these eventualities occurring, on the one hand, and reduce the harmful effects should they happen, on the other.

Source: ELECNOR, 2021 (in this case, the design of water distribution networks)

Figure 128 – Example of an action plan in the event of a chemical product spill to be implemented at the Elecnor construction yard

Table 96 – Ecological impact assessment during the construction phase: "Habitat contamination"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Temporary
Likelihood	Unlikely, provided the good practices implemented on site are respected
Intensity (or magnitude)	Low to medium, depending on the nature and quantity of the product(s) spilled/dispersed
Significance (without mitigation)	Low to moderate, depending on the nature and quantity of the product(s) spilled/dispersed
Significance (expected post mitigation)	Low

The **degradation of ecosystem services** during the construction phase will mostly translate into a reduction of provisioning services in forest areas, such as lower access to resources, particularly biomass for charcoal production and non-wood forest products (fruit trees and plants of commercial and medicinal importance, e.g., *Pterocarpus angolensis*).

In wetlands, the impact on water supply is expected to be low, as the main activities targeting this service will mostly occur in a reduced area (footprint corridor), hence being compatible with the use of water in the area by its populations. Nevertheless, special attention should be given in the implementation of mitigation measures to reduce the risk of contamination (by the use of machinery, for instance), as mentioned above.

As for the impacts on biodiversity (provisioning ecosystem service), they were previously considered, in the following impacts:

- Loss and fragmentation of habitats for faunal communities;
- Disturbance of faunal communities.

The loss of vegetation will be more pronounced in forest areas than in wetlands, resulting in a lower capacity of the first to capture CO_2; nonetheless, the implementation of mitigation measures, namely regarding the avoidance of native trees within the OHTL footprint corridor (ECO9 and ECO11), can reduce its impact in the identified ecosystem services, particularly in the miombo woodlands.

Ecological impact assessment during the construction phase: "Degradation of ecosystem services".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	On-site
Duration	Temporary
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Low (Wetlands) to moderate (Forests)
Significance (expected post-mitigation)	Low

6.8.2. Operation phase

During the operation phase of the transmission line, the main foreseeable impacts are related to a:

- Presence of electrified transmission lines;
- Operation of substations, with risk of oil spills;
- Maintenance activities of the transmission lines, towers and the easement zone of the lines.

Thus, in the phase under consideration, the following impacts expected to be generated on the biological component under study stand out:

- Degradation of conservation status, fragmentation and/or loss of habitats;
- Disturbance and deterioration of fauna populations.

<u>Degradation of conservation status, fragmentation and/or loss of habitats;</u>

The clearing of land during the construction phase is expected to promote the proliferation of ruderal species and infestations, deteriorating the conservation status of the natural habitats crossed.

At the same time, strip maintenance activities (either through thinning vegetation or total deforestation) will prevent this area from supporting the faunal communities it supported prior to the works. This effect will expectably be greater in areas of natural and/or more complex vegetation, such as forests.

Finally, the introduction and distribution of electricity is expected to promote the migration of people to the region. The intensification of human presence will translate into intensified deforestation for cultivation, and the exploitation of forest resources, <u>increasing pressure on habitats and natural resources on a regional scale</u>.

Similarly, it is expected that the opening (i.e., deforestation) of new accesses for the installation of the towers and cables, and the opening of the 4 m strip along its entire length, will facilitate access by local populations to the remaining forest formations.

With regard to the valuation of habitat degradation, fragmentation and/or loss, in the operation phase, this varies according to the ecological value and characteristics of the impacted habitat, namely:

- **Null significance** is assigned to habitats already intervened upon and/or with significant levels of human intervention, since the original ecological functions and processes are already altered; habitats without significant tree/shrub cover are covered, since their ecological processes are not dependent on these strata; croplands and artificialized, areas are included in this category;
- A **higher but still reduced significance** is attributed to habitats that preserve part of the original features (and thus part of the ecological functions and processes), and whose structural reference complexity is reduced or moderate, and whose current reference condition is already associated with a degree of anthropogenic interaction; savannahs (herbaceous and wooded) and wetlands are included in this category;
- **Higher significance** is attributed to natural habitats of greater complexity and lesser degree of anthropic intervention; forests are included in this category.

Table 97 – Assessment of impact on ecology in the operation phase: "Degradation of conservation status, fragmentation and/or loss of habitats

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct and indirect
Extent	Local e regional
Duration	Long-term
Likelihood	Likely
Intensity (or magnitude)	*Unknown*
Significance (without mitigation)	Null (modified habitats), low (savannahs and wetlands) and moderate/significant (forests)
Significance (expected post mitigation)	Without possibility of mitigation

Disturbance and deterioration of fauna populations~

With regard to the disturbance of fauna, the project's operational phase has impacts mainly on mammals and birds. These impacts may be direct or indirect, and essentially result from the following phenomena:

- **Indirect impacts**; increased human presence regionally due to the arrival of electricity, with consequent acceleration/intensification of the degradation of habitats and fauna populations:
    - Habitat reduction and fragmentation;
    - Increased wildlife/human interactions, potentially leading to increased conflicts and poaching/exploitation, not only due to the increased human population, but also due to easier access to forest habitat through vegetation cutting;
- **Direct impacts**; by direct interactions with the electrified line:
    - Electrocution: the installation of cables provides aerial routes of movement between forest patches for species of arboreal or flying habit; this use carries electrocution risks for animals, which can result in serious injury or death (IAR Costa Rica, 2019);
    - Collision: the presence of overhead cables constitutes a barrier to birds' flight and can result in serious injury or death.

i. Mammals

Among the fauna lists available for the area under analysis, four (4) vulnerable mammal species and one (1) endangered species were highlighted (cf. **Erro! A origem da referência não foi encontrada.**, Mammals)

The white-bellied pangolin, *Phataginus tricuspis*, the blue monkey, *Cercopithecus mitis*, the Angolan talapoim, *Miopithecus talapoin*, and the Angolan colobus, *Colobus angolensis*, are particularly sensitive to the intensification of human presence and consequent intensification of poaching (i.e., indirect impact), especially in forest areas between Uíge and Rio Dange (Teutlof, et al., 2021; Gonçalves, et al., 2019; de Jong, et al., 2020).

The African golden cat, *Caracal aurata*, is not typically the target of hunting, although it can be accidentally caught in traps. Still, the first observation of the species in Angola recorded in the literature (dated May 2018) is of a roadside game seller near the village of Dombe-ia-Gola in the study area (south of Quitexe) (De Beer, Nicolau, & Hunter, 2021). The African golden cat is mainly threatened by loss of habitat, the forest (Bahaa-el-din, et *al*., 2015).

With regard to direct impact on mammals, through interaction with live electricity cables, only species with arboreal behaviour are expected to be susceptible, such as the blue monkey.

Crossing - or being close to - areas of great sensitivity in terms of fauna with conservation value, such as the forested areas to the south of Uíge, and above all in the mountains, presupposes an impact of greater significance in this area (Table 98).

Table 98 – Impact assessment on the ecology during the operation phase: "Disruption and deterioration of fauna populations – mammals"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct and indirect
Extent	Local e regional
Duration	Long-term
Likelihood	Likely
Intensity (or magnitude)	*Unknown*
Significance (without mitigation)	High (forests south of Uíge); low on the rest of the route
Significance (expected post mitigation)	*Unknown*, due to the uncertainties associated with the proposed mitigation measures

ii. Birds

The assessment of the impact of the power line on birdlife was carried out by (i) prioritising birds according to their vulnerability and susceptibility to direct impacts (ICNF, 2019), and (ii) identifying sites of particular importance for birds, based on the literature, to assess indirect impacts (e.g., habitat loss).

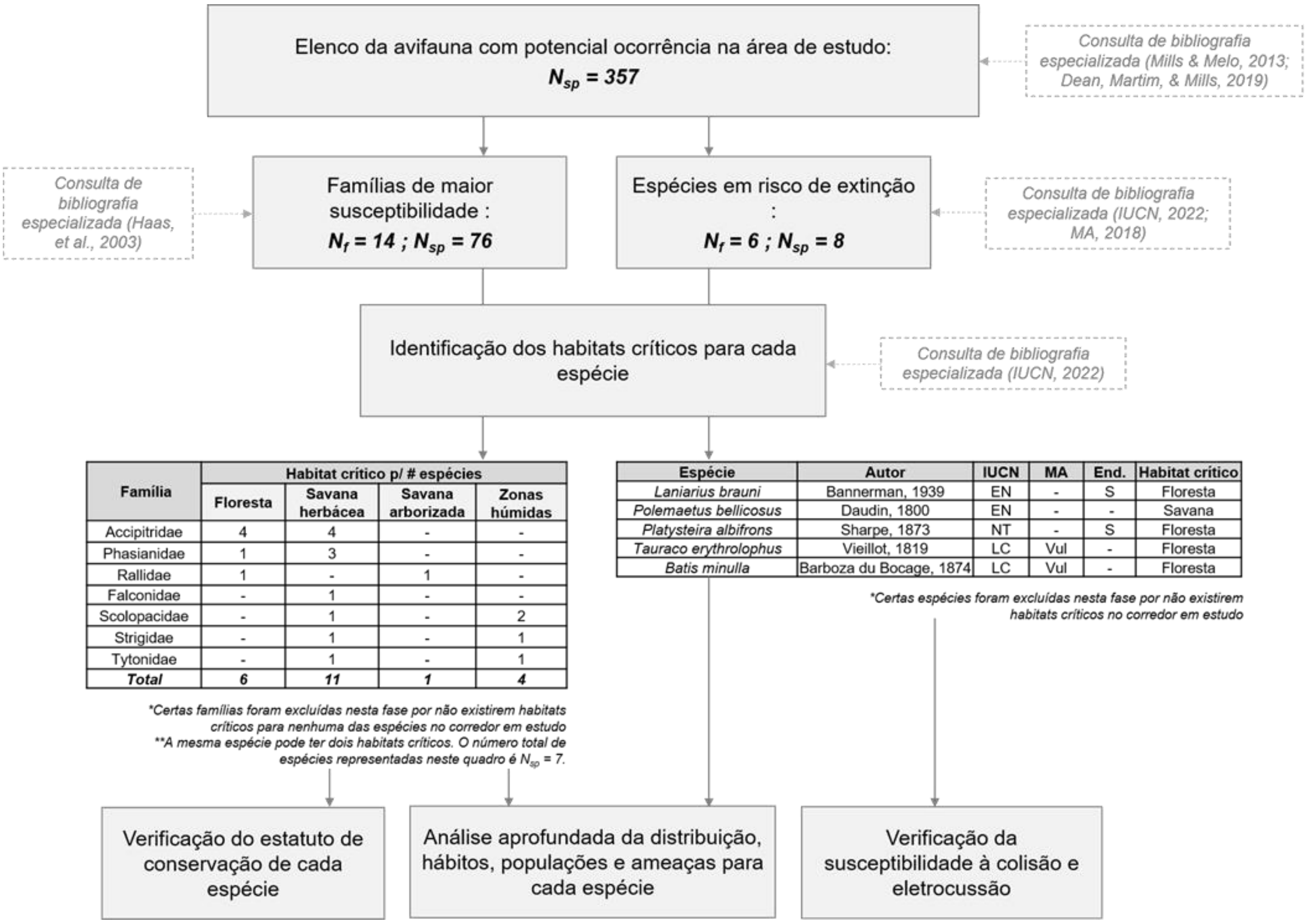
With regard to the assessment of direct impacts on the avifauna cast, direct interactions between animals and the lines are included, namely (ICNF, 2019):

- **Collision**: collision of the bird in flight with the tended cable; the risk is amplified when the cable section is smaller (making it less conspicuous), or when cables are installed in different planes, increasing the number of collision planes; this is a particularly important risk on 60 kV and 110 kV lines;
- **Electrocution**: circulation of significant electrical current through the animal's body; it occurs when it comes into contact with two conductive elements at different potentials; the risk is amplified, for example, when the cables are at shorter distances, thus facilitating contact by a stationary bird; this is a particularly important risk in MT lines;
- **Provision of support**: use of infrastructures as nesting sites by some species, increasing the probability of electrocution and collision.

These interactions can result in injury or even death of the bird, as well as system malfunctions, usually with interruption of supply. The susceptibility of birds to direct interactions depends on various factors, including the characteristics of the animals - morphology, behaviour, habits - the characteristics of the landscape, meteorological conditions and the characteristics of the infrastructures - distance between live parts, resting places, cable thickness and layout, among others. The characteristics that confer greater susceptibility are, namely:

- Medium or large size;
- Reduced flight mobility;
- Gregarious habit, flying in flocks;
- Crepuscular or nocturnal habit;
- Hunting activities;
- Migration.

Thus, each species runs different risks of collision and/or electrocution. In order to **focus the analysis** only on the most sensitive birds, as mentioned above, the evaluation of the impact of the lines on the avifauna was carried out through the steps presented in the following scheme.



Família	Habitat crítico p/ # espécies			
	Floresta	Savana herbácea	Savana arborizada	Zonas húmidas
Accipitridae	4	4	-	-
Phasianidae	1	3	-	-
Rallidae	1	-	1	-
Falconidae	-	1	-	-
Scolopacidae	-	1	-	2
Strigidae	-	1	-	1
Tytonidae	-	1	-	1
Total	***6***	***11***	***1***	***4***

**Certas famílias foram excluídas nesta fase por não existirem habitats críticos para nenhuma das espécies no corredor em estudo*
***A mesma espécie pode ter dois habitats críticos. O número total de espécies representadas neste quadro é N_{sp} = 7.*

Espécie	Autor	IUCN	MA	End.	Habitat crítico
Laniarius brauni	Bannerman, 1939	EN	-	S	Floresta
Polemaetus bellicosus	Daudin, 1800	EN	-	-	Savana
Platysteira albifrons	Sharpe, 1873	NT	-	S	Floresta
Tauraco erythrolophus	Vieillot, 1819	LC	Vul	-	Floresta
Batis minulla	Barboza du Bocage, 1874	LC	Vul	-	Floresta

**Certas espécies foram excluídas nesta fase por não existirem habitats críticos no corredor em estudo*

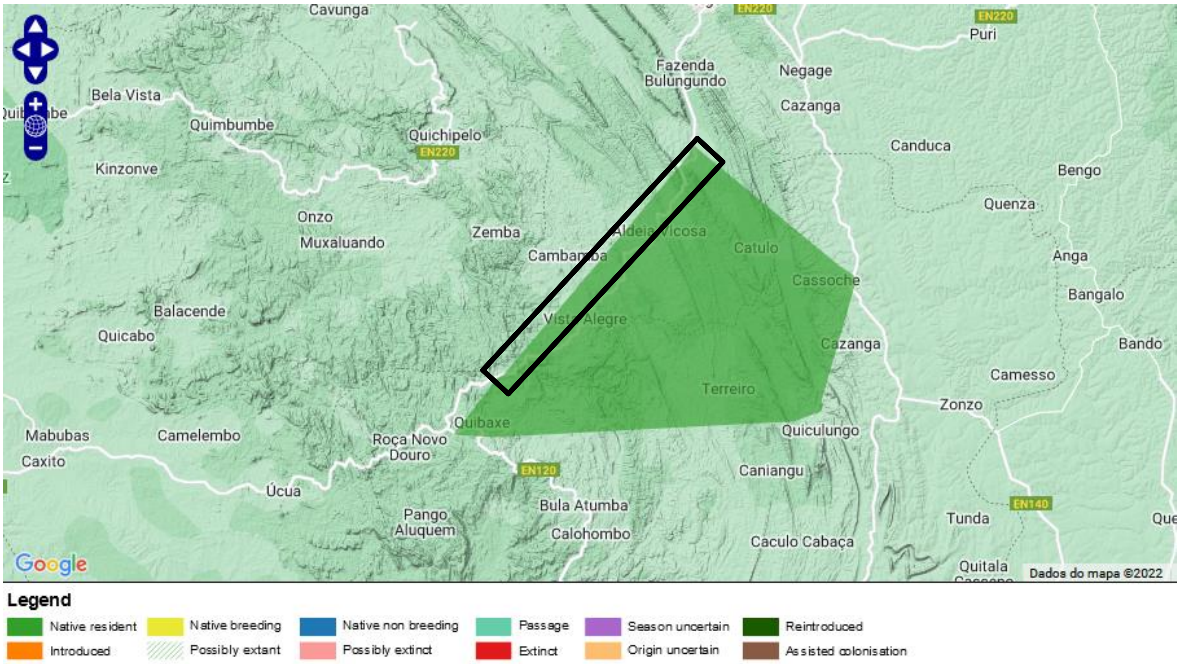
From the analysis carried out, the group with potentially the greatest susceptibility is that of birds of prey - Accipitridae, Falconidae, Tytonidae and Strigidae families. This group is above all a user of habitats with less tree cover, such as grasslands and savannahs, although some species such as *Pernis apivorus*, *Circaetus cinerascens* and *Accipiter melanoleucus* prefer the forest.

As a general rule, the raptor species concerned are classified as of **low concern** at national and global levels, and have very wide ranges that will be affected by the project (i.e., habitat fragmentation and increased risk of injury and death) by less than 0,003 % of their size.

The exception is the golden eagle, *Polemaetus bellicosus*, which is **globally endangered**. Even so, the location of the project at the edge of its distribution - outside its preferred biome (savanna biome) - and the proportion of the area affected (< 0,001%), reduce the significance of the impact for the conservation of this species.

As mentioned above in section 5.9.8 (Fatal issues and critical habitats, natural and modified), the situation of *Laniarius brauni*, an endangered, endemic species associated with the Guineo-Congolese biome and with a restricted distribution, stands out. This species prefers forest habitats, and tolerates some degree of human disturbance, and may use secondary and degraded forest. Furthermore, this species was observed during the wet season ecological survey, in forest areas.

Although it is a passerine of medium size - with a low degree of susceptibility to electrocution and moderate to collision (Haas, et al., 2003) - it is expected that the increased risk of injury or death in 15 % of its (reduced) range, could have a significant impact on the conservation of the species, if no mitigation measures are implemented. The same is true with regard to the loss of forest habitat in its area of distribution (Figure 129).



Source: BirdLife International, 2022

Figure 129 – Distribution of *Laniarius brauni* (green polygon); project location shown in black

The effectiveness of placing bird signalling against collision is proven (STRIX, 2016), so it is considered that the adoption of this measure mitigates the impact, reducing its significance. Still, the degree of effectiveness for this particular species, or for this region, is not certain, so it is also recommended that a '*robust monitoring and evaluation programme*' be implemented, as is even recommended in the IFC-PS6 standard.

Given that the currently mapped distribution lacks confirmatory studies (Mills, Borrow, & vaz Pinto, 2011), and that it is expected that it may be somewhat more or less extensive, it is not considered that moving the project corridor outside of the polygon shown in Figure 129 is justified. Furthermore, moving the transmission line would imply the construction of lengthier access roads, which in terms of environmental impacts would translate into a net loss of biodiversity, caused by habitat fragmentation.

Finally, the location of the project in the transition zone between the Guineo-Congolese biome and the Zambezian biome (Figure 91; section 5.9.5) and the importance of the remaining patches of humid forest in the Uíge and Pingano Mountains for the conservation of populations associated with this biome at the margins of its geographical distribution (Dean, Martim, & Mills, 2019; Dean n.d.), is highlighted.

Table 99 – Impact assessment on the ecology during the operation phase: " Disruption and deterioration of fauna populations – birds"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Long-term
Likelihood	Likely
Intensity (or magnitude)	Low to a High[1]; magnitude is considered high only for the species *Laniarius brauni*
Significance (without mitigation)	Low to High[2]; significance is high only in the forests south of Uíge
Significance (expected post mitigation)	Low to moderate in forests south of Uíge (STRIX, 2016); low in the rest of the route

[1] Classification made for each species, dependent on the range of the species assessed and the area of habitat critical to them in the ADI that will potentially become an area of increased risk.
[2] Classification made for each species, dependent on the magnitude (see above), susceptibility to collision and electrocution risks, national and global extinction risk, endemicity, and the species' association with the Guineo-Congolese biome.

6.8.3. Decommissioning phase

During the decommissioning phase of the project, and as in the construction phase, actions susceptible of causing impacts on the biological environment - habitats, fauna and flora - are foreseen, namely, the circulation of vehicles and machinery, the dismantling activities, and operations to recover the areas affected by the project.

The impacts expected to result from decommissioning activities are similar to those of the construction phase, namely, with regard to the contamination of habitats and the disturbance of faunal communities (Table 100; Table 101).

Table 100 – Ecological impact assessment in the decommissioning phase: "Habitat contamination"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local to regional (due to infiltration into the soil and surface run-off)
Duration	Medium-term
Likelihood	Unlikely, provided the good practices implemented on site are respected
Intensity (or magnitude)	Low to medium, depending on the nature and quantity of the product(s) spilled/dispersed
Significance (without mitigation)	Low to moderate, depending on the nature and quantity of the product(s) spilled/dispersed
Significance (expected post mitigation)	Low

Table 101 – Evaluation of impact on ecology during the decommissioning phase: "Disruption of faunal communities"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	Local
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low to Medium
Significance (without mitigation)	Null (modified habitats), low (savannahs and wetlands) and moderate (forest)

Criteria	Assessment
Significance (expected post mitigation)	Null (modified habitats), low (savannahs and wetlands) and moderate (forest)

Also, with regard to habitats and flora, after the decommissioning actions, if no preventive measures are taken, there are two (2) possible negative scenarios arising from the removal of the structures and the lifting of restrictions on land use:

- On the one hand, if the native vegetation of the region is not actively restored, these strips may be invaded by exotic and ruderal species, reducing their intrinsic ecological value;
- On the other hand, if there is no effective surveillance of these strips, local populations may occupy these areas for food production, giving rise to plant formations different from native vegetation.

By considering and cautiously managing these two scenarios, through the adoption of mitigation measures, it is expected that the regeneration of vegetation will improve the intrinsic ecological value of these areas, which represents a positive impact.

Active restoration through the elimination of exotic and invasive plants and the planting of native species will promote the ecological continuum of natural habitats, reducing fragmentation, and increase the available area of habitat for fauna, resulting in a greater dispersal area and a lower likelihood of fauna disturbance by human populations (Table 102).

Table 102 – Ecological impact assessment in the decommissioning phase: "Habitat restoration"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Indirect
Extent	Local
Duration	Long-term
Likelihood	Likely
Intensity (or magnitude)	Medium (areas of originally natural habitats)
Significance (without mitigation)	Low (modified habitats) to moderate (natural habitats)
Significance (expected post mitigation)	Low (modified habitats) to moderate (natural habitats)

6.9. Socioeconomics and human rights

6.9.1. Construction phase

The identified impacts regarding socioeconomics and human rights during the construction phase are the following:

- Creation of temporary employment opportunities;
- Boost of the regional economy and improvement of living conditions;
- Impact on the safety of local communities;
- Impact on the health of local communities;
- Increased disease transmission;
- Loss of livelihoods, mostly temporary;
- Impacts on workers' health and safety.

6.9.1.1. Creation of temporary employment opportunities

Firstly, regarding the socio-economic impacts, it is expected the creation of *temporary* employment opportunities (mainly low-skilled and semi-skilled labour). According to Elecnor, during the 15-month construction phase, it is expected the creation of about 280 jobs in total, 210 for the electrification of the municipalities and 70 for the home connections and public lighting (direct and indirect labour required).

Regarding local employment, the project is expected to create *direct and indirect* jobs, again mostly semi-skilled and low-skilled jobs, over a period of 15 months. However, this is fundamental for this impact to be considered of medium magnitude for the regional economies of the municipalities of Uíge, Negage, Puri, Quitexe and Dembos-Quibaxe.

Given that in most of these municipalities, employment outside of the agricultural and commercial sector is not frequent, and monetary incomes are very low, the creation of more than 200 jobs (even if temporary) has a *significant impact* if these jobs are created locally, and not filled by migrant workers from urban areas.

In interviews with the Provincial and Municipal authorities, it was clear that not hiring local workers is a major concern of project.

With an enhancement measure that ensures hiring of local labour, the impact "creation of temporary employment opportunities" is expected to be of *moderate significance*.

Table 103 – Impact assessment on "socioeconomics and human rights" (construction phase): "Creation of temporary employment opportunities"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct & Indirect
Extent	Local
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low
Significance (without enhancement)	Low
Significance (expected post-enhancement)	Moderate

6.9.1.2. Boost of the regional economy and improvement of living conditions

The economic impacts during the construction of the transmission line and associated substations will result in the acquisition of goods and services by the project and in the *direct* consumption of workers, which will boost *indirect* local employment. The total investment is estimated to be around US$ 74,7 million, with a part that should be directly invested in the regional economy through the acquisition of services and the hiring of workers.

The project will require the contracting of services such as water supply, solid waste management and catering for the construction workers. In this way, the use of local suppliers can contribute to the creation of local economic development opportunities during the construction period.

On the other hand, the economic impact of workers' spending on the local economy is expected to be moderate, as the construction camps will most likely provide food and other goods and services to workers.

The project construction workers will be present at the construction camps for a period of up to 15 months. As the construction camps are expected to be open, allowing relatively free movement of the workers, it is quite likely that there will be visits to local areas and urban centres close to the study area during the workers' free time. These visits may generate income in formal and informal service sector businesses, including local shops, bars, restaurants and coffee shops.

Finally, the project is expected to create some *long-term* benefits for local contractors and suppliers and their employees through capacity building and the acquisition of specific skillsets through on-the-job and formal training (spill-over effects). In Angola, urban development and associated construction are of great importance. Consequently, this skill set is transferable to other projects in the construction area after the completion of this project.

With a development measure providing for the contracting of local services, the impact "boost of the regional economy and improvement of living conditions" is expected to be of moderate significance (i.e., expected post-enhancement measure).

Table 104 – Impact assessment on “socioeconomics and human rights” (construction phase): “boost of the regional economy and improvement of living conditions”

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct & Indirect
Extent	Regional
Duration	Short-term
Likelihood	Certain
Intensity (or magnitude)	Low
Significance (without enhancement)	Low
Significance (expected post-enhancement)	Moderate

6.9.1.3. Impact on the safety of local communities

The construction activities planned for the 15-month period will have an impact on the safety of local communities. As presented above, it is estimated that there are 28 400 people living in the project's Direct Area of Influence.

During construction there will be increased movement of heavy machinery and light vehicles on the road along the transmission line route and on access roads to work areas. This will include water trucks, cement trucks, construction material transport, excavation machinery, among others, which is expected to increase the risk of traffic accidents and potential injuries or fatalities to other road users or pedestrians.

The increase in movement of vehicles during the construction phase may result in greater disturbance and decreased wellbeing for those communities closest to the working areas and along transportation routes and access roads.

Additionally, possible invasions trespassing on working areas could result in accidents leading to injuries or even fatalities.

The impact is a direct result of interaction with the increased traffic associated with construction activities, and the potential risk to community safety related to demining and construction activities.

This impact is *temporary and limited* to the project's Area of Direct Influence and the surrounding road network. Considering the potential risk to communities, the magnitude is considered *medium* and the *significance moderate* (given that the likelihood of the impact is probable).

The development, implementation and monitoring of a Community Health and Safety Management Plan, specified in section 7.10.1, is expected to mitigate the safety impact on local communities to a *low significance* impact (i.e., expected post-mitigation measure).

Table 105 – Impact assessment on "socioeconomics and human rights" (construction phase): "impact on the safety of local communities"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short-term
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

6.9.1.4. Impact on the health of local communities

A temporary decrease in the wellbeing of the affected population is expected. Activities such as land preparation and vehicle circulation, may be sources of dust emission, vibrations, and responsible for increased noise levels and waste generation, among others, in the project sites near settlements. As a result, air quality is likely to decrease and noise emissions are likely to increase, causing disturbance to local communities and affecting their health.

The impacts on environmental health during the construction phase are *temporary* in nature. Considering the temporary nature of the works and the sequential approach, the magnitude is considered *medium* and *the significance moderate* (given that the likelihood of impact is *likely*).

The development, implementation and monitoring of a Community Health and Safety Management Plan (proposed in section 7.10.1) is expected to mitigate the impact on the health of local communities to an impact of *low significance*.

In the Noise Monitoring program (section 8.3.1), Elecnor presents actions for prevention and control of noise and vibration, aiming to safeguard human health and wellbeing of the population in the ADI, namely:

- Construction activities will, whenever possible, be limited to normal working days and hours;
- Vehicles and machinery used in construction work will be kept in good condition and maintenance will be carried out;
- Workers will use the proper tools and not necessarily the fastest ones, and will check their state of maintenance;
- The time spent using tools with high noise and vibrations will be reduced and should be intercalated with other activities.

Table 106 – Impact assessment on "socioeconomics and human rights" (construction phase): "impact on the health of local communities"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short-term
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

6.9.1.5. Increase disease transmission

The concentration of workers in working and accommodation sites as well as their free movement and possible interaction with local communities, can lead to an increase in communicable diseases.

The profile of these diseases will be influenced by the type of diseases existing in the communities along the route and the type of diseases in the workers' areas of origin.

This is a particularly relevant risk given the current situation in Covid-19 and the fact that the study area has a high risk of respiratory disease morbidity in Puri and a medium risk in Uíge, Negage and Quitexe (Manuel, Freitas, & Lamezón, 2020).

The communicable diseases of most concern are likely to be diarrhoea, respiratory infections, typhoid fever and malaria. Children and the elderly will be the most vulnerable to these diseases. Furthermore, considering that the HIV/AIDS prevalence in Angola is relatively high, HIV transmission may also occur. Prostitution and pregnancies among young girls are also likely to increase.

Interaction between the project's workforce and local communities in the Direct Area of Influence is considered *likely* during the construction phase. However, given that the project workforce of 280 workers represents less than 1 % of the estimated settlement population in the Direct Area of Influence, the magnitude of this impact is *low* and the *significance moderate*.

With the mitigation measures included in the Community Health and Safety Management Plan specified in section 7.10.1,this impact is of *low significance*.

Table 107 – Impact assessment on "socioeconomics and human rights" (construction phase): "increase disease transmission"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short-term
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

6.9.1.6. Loss of livelihoods, mostly temporary

At the tower construction site, there may be a temporary loss of access to farming areas due to obstruction of roads to install the towers and the transmission line. The level of impact of the temporary loss of land will be determined by the proportion of land lost by individual households, and by their level of dependency on land, access to alternative land, livelihood activities and their current income levels.

Households that have little access to alternative livelihood activities and/ or are on a very low income, including subsistence farming, will experience a greater level of impact than those with access to alternative resources, including savings, and are therefore considered particularly vulnerable to potential land-related impacts.

Furthermore, the loss of land has the potential to not only affect the livelihoods of customary land owners, but also those involved in crop-sharing schemes on a particular plot owned by another household. These households are also vulnerable to the potential impacts from temporary loss of land given they do not have clear customary rights.

This impact is a *direct* result of the project's activities. The impact is *temporary* in most of the area, but *permanent* on some land. Considering that the agriculture area lost is expected to be relatively low, the magnitude is considered *medium* and the significance *moderate*.

Additionally, in the 110 kV transmission line section, trees and vegetation whose height interferes with the transmission line will be removed.

The cropland represents about 291 437 m^2, corresponding to about 2 % of the ADI.

With mitigation measures, the impact may be less significant (of *low significance*). It should be ensured that people are compensated for the loss of income opportunities from seasonal and permanent crops, as well as the loss of community resources, such as firewood and charcoal collection, a measure specified in section 7.10.1.

Table 108 – Impact assessment on "socioeconomics and human rights" (construction phase): "loss of livelihoods, mostly temporary"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local

Criteria	Assessment
Duration	Short-term & permanent
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

6.9.1.7. Impacts on workers' health and safety

Typical activities for the construction of the transmission lines include clearance of the right of way in vegetated areas, excavation work, erecting the towers, working at height, and stringing the transmission lines.

Workers conducting the demining activities are also exposed to land mine hazards during the preliminary land preparation phase. The locally hired workforce may face challenges in adapting to the safety standards and work practices, which will increase the severity of hazards to which the workforce are exposed.

Thus, during construction, if the *direct* interaction between the project and the workforce is not properly managed, there will be negative impacts on working conditions that can lead to potential permanent impacts on the health and safety of workers. The impact is considered short-term and continuous over the 15-month construction phase, resulting in a *medium* magnitude of the impact.

According to Elecnor, workers will be trained on the works they will carry out and health and safety measures will be imposed. Additionally, free personal protective equipment appropriate to the function of each worker will be provided, and the use of this equipment will be imposed by the employer.

Considering the level of previous training of the workforce, the magnitude of this impact is considered *medium*. Consequently, the impact is of *moderate significance*. With the application of mitigation measures (creation and execution of the Community Health and Safety Management Plan proposed in section 7.10.1), it is expected that the significance of the impact will become low.

Table 109 – Impact assessment on "socioeconomics and human rights" (construction phase): "impacts on workers' health and safety"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Regional
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

6.9.2. Operation phase

The identified impacts regarding socioeconomics and human rights during the operation phase are the following:

- Local employment opportunities;
- Provision of electrical capacity and related benefits;
- Permanent loss of livelihoods;
- Increased community safety after demining;
- Benefits to local settlements from road infrastructure improvements;
- Increased safety and comfort through public lighting

6.9.2.1. Local employment opportunities

Firstly, regarding socioeconomic impacts in the operation phase, it is expected the creation of permanent local employment opportunities for maintenance of the infrastructures and the corridor of the overhead transmission line (20 m wide) and for monitoring activities of the transmission lines.

Once construction is over, operation of the transmission line will be handed over to National Electricity Transmission Network Company, as the line operator.

Although the exact size of the workforce needed for the operation phase is not clear at this stage, recruitment is not expected to be extensive. NTN is a state-owned company, so hiring may be limited as NTN may not need to hire any additional workers.

The maintenance and monitoring of the line are expected to require a higher skill level while vegetation clearance will require a low skilled workforce.

Considering the above, the magnitude of the impact of "local employment opportunities" is considered *low* and of *low significance* (the probability of impact is certain).

Table 110 – Impact assessment on “socioeconomics and human rights” (operation phase): “local employment opportunities”

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

6.9.2.2. Provision of electrical capacity and related benefits

In addition to employment generation, another positive impact during the project's operation phase will be the increase in electrical capacity in Uíge. This increase in electrical capacity is expected to contribute to the improvement of the regional economy and livelihoods of the population through a more stable and safe supply of electricity to the households and businesses in the province of Uíge.

This project will enable the connection of 5000 households to the energy grid in Aldeia Viçosa (500 household connections), in Puri and neighbouring villages (1 000 household connections), in Quitexe and neighbouring villages (1 500 household connections) and in Negage (2 000 household connections). The lack of electricity in the municipalities contributes between 13 % and 16 % to the poverty of these municipalities, a relevant percentage. Thus, the electrification of these households could lead to a substantial decrease in poverty in these municipalities.

There is little trade and employment opportunities in the municipalities under analysis. The electrification of these municipalities can attract investment, job creation and development of some industries, such as manufacturing. The businesses need electricity to operate, and currently can only maintain their activities through fuel-powered generators. This energy source is quite unstable, volatile and costly.

Specifically, the improved and more stable supply may result in increased productivity and development of competitiveness of small businesses in the long term. Improved access to electricity is also expected to reduce the need for backup generators, which will lead to cost savings for electricity users, as well as improvements in community health due to reduced noise and air emissions from generators.

In the *focus groups*, the difficult access to information in rural communities was mentioned to be a problem, resulting from the impossibility of watching television due to the lack of electricity. Thus, the electrification of these areas can increase people's access to information.

Considering the above, the magnitude of the impact of the "provision of electrical capacity and related benefits" is considered *high* (taking into account the potentially affected population) and of *high significance* (the probability of the impact is certain).

Table 111 – Impact assessment on "socioeconomics and human rights" (operation phase): "provision of electrical capacity and related benefits"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct
Extent	Regional
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	High
Significance (without mitigation)	High
Significance (expected post-mitigation)	No possibility of enhancement

6.9.2.3. Permanent loss of livelihoods

During the operation phase, there will be a permanent loss of seasonal crops and fruit trees at the tower site. In addition, communities will lose forest areas and resources, such as firewood, charcoal and others, on the 110 kV transmission line.

Due to the heavy reliance on land-based activities and the small size of the plots, the level of impact of the permanent loss of land will be determined not only by the proportion of land lost by individual households, but also by their level of dependence on land, the access to alternative land and livelihood activities, and their current income levels.

The impact is a direct result of the project activities. However, considering that permanent loss of seasonal crops will occur only if the tower installation overlaps with cultivation areas and that this area will be relatively small, the magnitude is considered *low and of low significance*. With the mitigation measures proposed, the impact may be even *less significant*.

Table 112 – Impact assessment on "socioeconomics and human rights" (operation phase): "permanent loss of livelihoods"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without enhancement)	Low
Significance (expected post-enhancement)	Low

6.9.2.4. Increased community safety after demining

Upon completion of the construction phase, demining will have been carried out in all areas within the 60 meters right of way that had not been previously cleared of mines and did not have an associated clearance certificate. This clearance will result in greater security for households and land users moving in the area, and will also free up additional areas of land for cultivation. The impact is therefore positive.

Considering the above, the magnitude of the impact of "increased community safety after demining" is considered *medium* (taking into account the potentially affected population) and of *moderate significance* (the probability of the impact is certain).

Table 113 – Impact assessment on "socioeconomics and human rights" (operation phase): "increased community safety after demining"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	Medium
Significance (without enhancement)	Moderate
Significance (expected post-enhancement)	No possibility of enhancement

6.9.2.5. Benefits to local settlements from road infrastructure improvements

Road improvements can have a positive impact on community access to education, employment and services as well as on road safety. Communities in rural and remote areas currently lack quality roads and, thus, have the potential to be the most impacted by infrastructure improvements. The communities who benefit from the improvement and construction of new roads may also benefit from other positive impacts, such as improved access to markets for their local agricultural products, and access to services (education, health, transport, etc.).

As the project is expected to use mainly existing roads, these will need to be upgraded during the construction phase and maintained during the operation phase, resulting in a long-term positive impact for local communities.

In view of the above, the magnitude of the impact of "benefits to local settlements from road infrastructure improvements" is considered *low and of low significance* (the likelihood of the impact is certain).

Table 114 – Impact assessment on "socioeconomics and human rights" (operation phase): "increased community safety after demining"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Certain

Criteria	Assessment
Intensity (or magnitude)	Low
Significance (without enhancement)	Low
Significance (expected post-enhancement)	No possibility of enhancement

6.9.2.6. Increased safety and Comfort through public lighting

Public lighting will be installed in Aldeia Viçosa (Quitexe municipality) and in Puri and neighbouring villages. Public lighting is relevant for the reduction of crimes, increasing the sense of security of its inhabitants, which promotes sociability after dark and improves the wellbeing of the population.

In the *focus groups*, it was indicated that street lighting can lead to a decrease in delinquency. On the other hand, public lighting increases traffic safety, avoiding accidents between vehicles and trampling due to lack of visibility (Dutra, Sampaio, & Amorim, 2016).

The magnitude of this positive impact is *high* since the entire population residing in the areas that will be illuminated will benefit from this impact. Thus, the significance is *high* (the probability of the impact is certain).

Table 115 – Impact assessment on "socioeconomics and human rights" (operation phase): "Increased safety and comfort through public lighting"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct and Indirect
Extent	Local
Duration	Permanent
Likelihood	Certain
Intensity (or magnitude)	High
Significance (without enhancement)	High
Significance (expected post-enhancement)	No possibility of enhancement

6.9.3. Decommission phase

Overall, the project´s impacts in the decommission phase are similar to those expected during the construction phase, namely: creation of temporary employment opportunities; boost of the regional economy and improvement of living conditions; impact on the safety of local communities; impact on the health of local communities; increase disease transmission; loss of livelihoods, mostly temporary; impacts on workers' health and safety.

All impacts are expected to be similar to those foreseen in the construction phase with comparable intensity and significance.

6.10. Cultural heritage

This chapter assesses the potential impacts on heritage assets as a result of the development of the project in its construction phase, where the project components will be introduced, in its operation phase, where maintenance actions may be required, and in the decommissioning phase, where the removal of the structures is planned.

The impact assessment is based on the modification of the environment, which can be produced both in the physical and in the perceptual environment. The physical environment is understood as the presence of material traces, which may result either from previous human presence (archaeological sites) or from physical spaces of high value for the communities (traditional cemeteries).

Perceptual affect results from the modification of a landscape, such as sacred forests, which are fundamental as spaces of worship and livelihood for local communities.

6.10.1. Construction phase

In a comprehensive analysis of all the elements gathered, it is considered that the construction phase involves a set of works and interventions to be carried out in the area of direct influence of the project that could potentially generate negative impacts on cultural heritage, such as archaeological sites, traditional burial grounds and sacred forests.

Generally speaking, the main risks hanging over the heritage are in the construction phase and can be grouped according to the type of affectation.

Table 116 – Types of allocations resulting from actions carried out on site

Types of allocations	Actions carried out on site
Actions with a higher degree of allocation	- Excavations and earthmoving - Site preparation or equipment installation works
Less aggressive destructive actions	- Land clearing - Heavy machinery circulation

The identified heritage, namely the Lagoa do Feitiço, the Quibaxe tombs and the traditional cemetery will not be affected by the project.

It should be noted that traditional cemeteries may occur along the power transmission lines that have not been identified, namely due to their sacred nature. In these cases, and if they are in the affected corridor, the impact will be very significant for the local community, and site protection measures should be adopted (Chapter 6).

6.10.2. Operation phase

No impacts are expected in the operation phase, however, if removal or soil movement actions are required, the impacts are considered the same as those assessed in the construction phase.

6.10.3. Decommissioning phase

No impacts are expected in the decommissioning phase, however, if removal or soil movement actions are required, the impacts are considered the same as those assessed in the construction phase.

7. Mitigation and Compensation Measures

7.1. Introduction

Following the environmental and social impact assessment, a set of environmental measures is presented to be implemented in order to minimise or compensate the negative environmental impacts and potentiate the positive environmental impacts of the project.

The main objective of these measures is to implement the project in the most environmentally optimised way possible, safeguarding the interests of the population and the biophysical environment, mitigating or cancelling out potential significant negative impacts that may condition the project or have as a consequence a severe effect on any environmental descriptor considered in this study.

The set of measures for minimising negative/potentiating positive impacts applies to the different phases of the project and its implementation must be ensured by the different parties involved in order to strengthen or guarantee the project's environmental sustainability:

- Detailed design phase, comprising measures to be detailed by the design team;
- Construction phase, comprising measures to be implemented by the contractor during the construction of the project;
- Operation phase, comprising measures to be implemented by the Uíge Provincial Government, responsible for ensuring the line's operation during the project's operating phase.

Since the project actions to be developed in the decommissioning phase may have similar characteristics to those in the construction phase, the measures proposed for construction are generally applicable to this phase.

7.2. Climate and climate change

7.2.1. Detail design phase

The following measures are intended to minimise the impacts generated by the activities carried out during the construction and operation phases.

CLI1. The contractor and developer shall present, prior to construction, the **main commitments and measures to be implemented in the different phases of the project with a view to mitigating GHG emissions**;

CLI2. Preparation of **a proper plan and efficient use of materials** before the start of the construction phase of the project;

CLI3. Drafting of **a plan to minimise damage to transmission towers** from the impacts of climate change, such as floods, droughts and soil erosion;

CLI4. **Manage electricity demand in heat wave events** in order to avoid reducing the efficiency of transmission lines, taking into consideration the use of cooling transformers and heat dissipation equipment for conductors.

7.2.2. Construction phase

The following measures are intended to minimise the impacts generated by the activities performed during the construction phase.

CLI5. **Use of fuel-efficient vehicles and generators** during this phase;

CLI6. **Minimise the removal of vegetation cover** from construction areas and access roads;

CLI7. **Rehabilitation of soil and vegetation** temporarily disturbed during the construction phase;

CLI8. **Promote afforestation in the AII** with the same area of forest vegetation removed due to the project, considering a vegetation adapted to the local climate and efficient as a carbon sink;

CLI9. **Preference in the use of local materials** during the construction phase in order to minimize long distance transportation;

CLI10. **Using materials with care to avoid material damage**, in the different tasks (transport, storage);

CLI11. If possible, **use recycled materials**.

7.2.3. Operation phase

The following measures aim to minimise the impacts generated by the activities carried out during the operation phase, and it is therefore recommended that they be implemented by the Uíge Provincial Government, which is responsible for ensuring the operation of the line during the project's operational phase:

CLI12. **Use equipment and vehicles with low fuel consumption**;

CLI13. **Using materials with care to avoid material damage**, in the different tasks (transport, storage);

CLI14. Preparation of a proper plan and **efficient use of materials to avoid wastage**;

CLI15. If possible, **use recycled materials**.

CLI16. **Form rapid response maintenance teams to act when there is damage to project infrastructure** resulting from an occurrence of extreme weather events, limiting the impact on project operations.

7.3. Geology, geomorphology and topography

Considering the impacts identified, the following measure is proposed for the detailed design phase only:

GEO1. If there is surplus soil that cannot be reused in the area to be affected by the project, it is recommended that the materials be **deposited in deactivated quarries or used in the recovery of degraded areas in the project's surroundings.**

7.4. Mineral resources

No impacts on mineral resources have been identified, so no mitigation measures are envisaged.

7.5. Hydrogeology

No impacts were identified that would justify the proposal of mitigation measures.

7.6. Surface Water Resources

7.6.1. Detail design phase

To mitigate the impacts on surface water resources generated in the construction and operation phases, it is considered important to implement the measures provided for in the Soils and land use section.

In addition, the following recommendation is made:

SWR1. Where alternative locations for transmission lines and access roads are being considered, **give preference to those furthest from water lines**.

7.6.2. Construction phase

To mitigate the impacts on surface water resources generated during the construction phase, it is considered important to implement the soil protection measures provided for in the Soil and land use section.

Additionally, the following mitigation measures are proposed:

SWR2. **Installation at the work front of portable sanitary facilities** with collection of sanitary effluents and appropriate disposal by a company licensed for this purpose;

SWR3. Installation in the main construction areas of **systems for the collection of waste generated** and its forwarding to an appropriate licensed disposal site;

SWR4. Raising **workers' awareness** on the prevention of pollution of surface water resources in construction operations.

7.6.3. Operation phase

To mitigate the impacts on surface water resources generated in the operation phase, it is considered important to implement the containment measures provided for in the Soils and land use section.

Additionally, the following mitigation measures are proposed:

SWR5. **Regular inspection and proper maintenance of the vehicles used** in the project's maintenance operations so as to prevent road accidents and oil and fuel spills on soils or water courses;

SWR6. **Support for the rehabilitation of public water supply systems** in the communes of Quitexe, Negage, Aldeia Viçosa and Puri, to minimise water leaks.

7.7. Soils and land use

In order to minimise the negative impacts associated with the different phases of project implementation, the following set of general measures is proposed for adoption:

SOL1. SOL1. **Ensure the safety of construction activities** in the working areas without causing unnecessary clearing of vegetation;

SOL2. All workers should receive **environmental training** before working on site.

7.7.1. Construction phase

The following set of measures is proposed for the construction phase:

SOL3. **Clearing of vegetation and disturbance of topsoil** should be minimised and should not extend beyond the corridor or substation site;

SOL4. **Spread vegetation cover** generated from cleared indigenous vegetation on exposed soils;

SOL5. **Allow natural revegetation** of affected areas or replant with indigenous species;

SOL6. **Seeding, mulching and other soil conservation measures** implemented effectively during or immediately after each soil disturbing activity;

SOL7. **Separate topsoil from subsoil**. Soil storage sites located away from drainage lines, and protected from rain and wind erosion, and contamination;

SOL8. **Reintroduce the soil at the excavation sites** in the same order of removal in order to preserve the soil profile;

SOL9. **Topsoil should be spread evenly** over the cleared areas when reinstated;

SOL10. **Slope areas impacted by construction activity should be stabilised** to ensure erosion control;

SOL11. **Rehabilitate any areas damaged** by construction activities by clearing and reducing soil compaction;

SOL12. **Prevent soil erosion** (berms, etc.);

SOL13. **Prevent accelerated erosion** due to storm events (stormwater runoff management with velocity control measures);

SOL14. **Ensure regular maintenance of all vehicles** in an appropriate location;

SOL15. **Contain and immediately clean up all spills outside;**

SOL16. **Waterproofing areas destined for the maintenance of vehicles and equipment;**

SOL17. Waterproof trays should be used for **refuelling and servicing vehicles or equipment** when not on an impermeable surface;

SOL18. **Contaminated areas** will be **remediated** and a post remediation check will be carried out;

SOL19. Draw up and implement a **Spill Prevention and Response Plan**;

SOL20. **Rehabilitation of disturbed areas with temporary land restrictions, and landscape alterations**;

SOL21. **Improve or restore livelihoods**, including the provision of alternative land for cultivation with equal or better productivity.

7.7.2. Operating phase

The Uíge Provincial Government, which is responsible for ensuring the line's operation during the project's exploration phase, must implement the following mitigation measures:

SOL22. **Contain and clean up immediately any spills** that may occur during maintenance operations as well as during the normal operation of the infrastructure;

SOL23. **Contaminated areas will be remediated** and a post remediation check will be carried out;

SOL24. Draw up and implement a **Waste Management Plan** (storage, handling and disposal of hazardous waste);

SOL25. Draw up and implement a **Spill Prevention and Response Plan;**

SOL26. **Monitoring and providing the necessary follow-up** to support livelihood recovery throughout the operation phase;

SOL27. In case of changes in land values after construction, **provide monetary compensation** adjusted to the loss of land use in the most productive way.

7.8. Quality of the environment

The following tables summarise the mitigation and improvement measures contained in the "Air Quality Monitoring" and "Noise Monitoring" Programmes (Appendix 1) defined by the contractor and the additional measures proposed under this ESIA, separated according to the different phases of the project.

Table 117 – Mitigation measures for the detailed design phase

Impacts	Mitigation Measures
Air quality	
Emission of dust and inhalable particles	*Additional measures* QUAL1. **Plan activities with the greatest potential for emission** to take place as far away from the receptors as possible; QUAL2. **Maximise the distance between the new substations** to be built and the nearest dwellings.
Noise	
Noise emission	*Additional measures* NOI1. **Plan the activities with the highest potential emissions** to take place as far away from the receptors as possible; NOI2. **Maximise the distance between the new substations** to be built and the nearest dwellings; NOI3. **Construction of high-voltage poles at least 50 metres away from the nearest dwellings.**

Table 118 – Mitigation measures for the construction phase

Impacts	Mitigation Measures
Air quality	
Emission of exhaust gases, dust and particles	*Measures provided for in the project's Air Quality Monitoring Programme* QUAL3. Unpaved surfaces with frequent vehicle movements (such as roads and access to work fronts and within the construction yard, etc.) should be **dampened with a sprinkler truck or hand watering**, particularly during dry and windy periods, in order to minimise the emission of dust resulting from vehicle movements; QUAL4. **Avoid carrying out excavation, movement and transport activities under conditions of strong wind** that could give rise to dust; QUAL5. Piles for temporary storage of granular material should be regularly sprinkled with water to minimise dust emission; QUAL6. **Properly condition construction materials and site waste materials**, including covering aggregates and other materials to prevent wind drift; QUAL7. **Transport materials and waste** that may generate dust in vehicles with a **covered load**; QUAL8. **Control speed of circulation** of light and heavy vehicles in unpaved areas; QUAL9. Carry out the **maintenance** of the equipment and vehicles assigned to the work taking into account their **technical specifications**; QUAL1. **Rationalise the circulation of heavy and light vehicles** and the working time of machinery assigned to the works. *Additional measures* QUAL2. **Prevent local communities from potential air quality disturbance** and record all dust and air quality related complaints for investigation and resolution; QUAL3. Where roads are left with dirt tracks, use **wet road cleaning methods** to avoid resuspension of particles and dust; QUAL4. **Prohibit indiscriminate burning** of materials resulting from the removal of trees, bushes, combustible materials and waste.

Impacts	Mitigation Measures
Noise	
Noise emission	*Measures foreseen by the project's Noise Monitoring Programme* NOI4. Where possible, construction activities should be **limited to normal working days and hours**; NOI5. **Vehicles and machinery used in the works will be operated and maintained in good condition** and in accordance with their respective instruction manuals; NOI6. **The maintenance will be carried out and recorded to certify its veracity;** NOI7. **Workers must**: o use personal protective equipment (PPE); o check the maintenance status of the tool; o use the right tools and not necessarily the fastest ones; o reducing the time spent using the tool by interspersing work with other activities. *Additional measures* NOI8. **Prevent local communities from potential disturbance** and record all noise related complaints for investigation and resolution; NOI9. If construction work is to take place after working hours (overnight: 10pm-7pm), **all communities potentially affected by noise should be notified in advance;** NOI10. Stationary **noisy equipment should be placed as far away** as possible from, and facing away from, **sensitive receivers**; NOI11. Where possible, place noisy stationary equipment (e.g., electrical generators) in **enclosures**; NOI12. Ensure the adoption of **good driving practices**, such as: o Minimise the equipment's reversing manoeuvres to avoid the nuisance associated with reversing alarms; o Reduce unnecessary acceleration and braking when arriving and leaving sites; o Ensuring compliance with speed limits for all construction vehicles; and o Limit the use of noisy signals, including, horns, whistles, alarms and bells, to safety warnings only.

7.9. Ecology

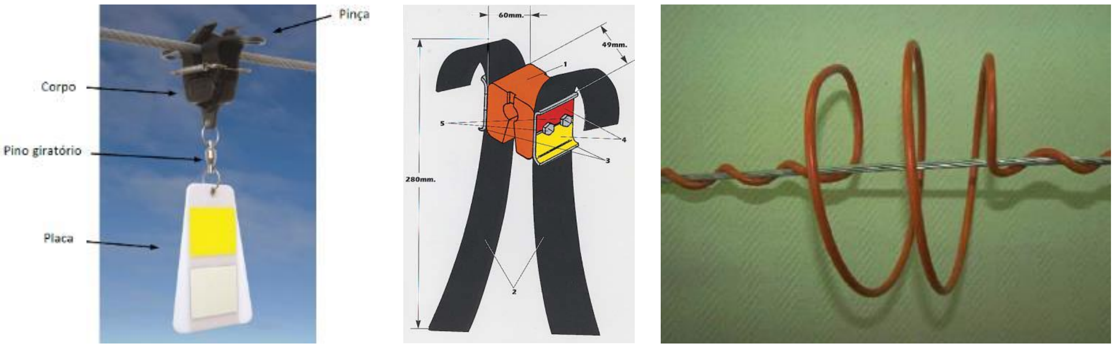
7.9.1. Detailed design phase

The following set of measures is proposed in the detailed design phase of the project:

ECO1. It is **recommended that the line be built as a priority in modified habitats**, without prejudice to the provisions of legislation relating to transmission lines, so as to minimise habitat fragmentation, ensuring spatial continuity of habitats;

ECO2. In order to reduce the risk of collision by avifauna, **the line should have the minimum height possible** - so as to minimize the probability of collision by avifauna, which still guarantees the safety of human populations;

ECO3. To reduce the risk of collision by birds, bird flight diverters (BFD) should be installed along the conductors, at a maximum distance of 20 m (but ideally less), and alternately placed from one conductor to the other. These signs may be white, or yellow, red or orange (alternating these colours); alternatively, rotating or ribbon fireflies may be used, which are more effective but more expensive (Figure 130). These markers should be installed in the most sensitive areas for birds of the Guinea-Congolese biome, and for Braun's shrike, *Laniarius brauni*, outlined in Figure 131 and in Table 119.



Source: Energias de Portugal, 2017

Figure 130 – Different signs for birdlife; on the left, fireflies; on the right, double spirals

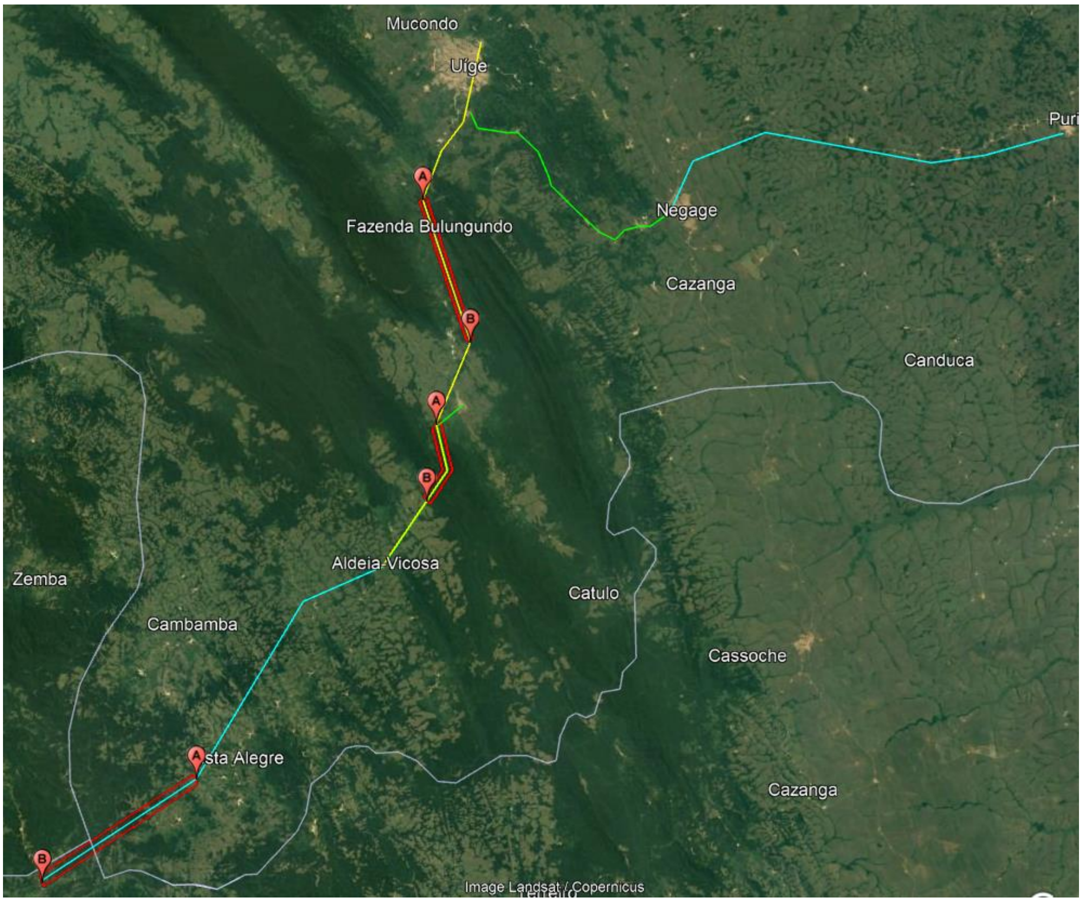


Figure 131 – Proposed segments for the installation of signposts for avifauna, in red; 60 kV lines, in blue; 30 kV lines, in green; 110 kV lines, in yellow

Table 119 – Coordinates of the start and end of the proposed segments for installing signposting for avifauna

Designation	Voltage (kV)	Start (A)	End (B)	Length (km)	Justification
Dange River – Vista Alegre	60	8°18'9.39"S; 14°45'52.71"E	8°24'0.63"S; 14°36'19.78"E	20,6	Range of Braun's shrike; forest cover
Dombe-ia-Gola - Quitexe	30; 110	7°57'42.33"S; 15° 0'59.15"E	8° 2'13.07"S; 15° 0'15.10"E	9,17	Forest cover; crossing an important patch of forest
Uíge - Quitexe	110	7°44'24.32"S; 15° 0'39.66"E	7°52'55.41"S; 15° 3'11.36"E	16,24	Proximity to the Serra de Pingano; location between important forested areas
			Total	***46,01***	

7.9.2. Construction phase

ECO4. With regard to scheduling, the **construction work should be carried out continuously** (once started, it should be finished without any significant breaks in between) in order to avoid fauna recolonising the area and relocating it.

ECO5. The occasional clearing, cleaning and blasting of the ground must be **limited to areas strictly necessary for the execution of the work** and carried out in phases on the ground.

ECO6. In forest areas, **work should be preceded by the scaring of animals - by a specialized technician (biologist)** - through the provocation of noise (for example, with horns or sirens) along a pre-defined route. The scare route should be defined so as to lead the animals towards the neighbouring area offering better conditions for shelter and food. It should therefore start at the section of greatest human influence (i.e., at the nearest edge of the road or of modified or artificial habitats), and end at the interface with neighbouring patches of larger natural habitat.

ECO7. Also, in forest areas - where there is a greater probability of occurrence of threatened species such as the endangered white-bellied pangolin - after the initial scaring, in order to avoid causing injury or death to fauna, an **active search of the treetops should be carried** out to **detect less mobile or vulnerable animals** (injured, injured or juvenile animals), for rescue.

ECO8. **Any maintenance operations** (washing, oil changes, replacement of parts, etc.) on machinery and equipment **at the work site should be forbidden.**

ECO9. The **implementation of a training and environmental awareness programme** for workers during the construction phase of the project under study is recommended. The programme in question should address issues such as the ecological framework of the natural values present in the area of intervention, as well as defining behaviours to be avoided and promoted, such as the exploitation or felling of certain tree species, or the poaching of mammals such as the white-bellied pangolin.

During deforestation actions, whenever possible, the felling or affecting of individuals of the following species, considered a priority in terms of biodiversity conservation, should be avoided: *Adansonia digitata*; *Albizia glaberrima*; *Antiaris toxicaria* subsp. *welwitschii*; *Autranella congolensis; Brachystegia spiciformis; Ceiba pentandra; Celtis mildbraedii; Chlorophora excelsa; Dalbergia latifolia; Diospyros mespiliformis; Entandrophragma angolensis; Entandrophragma utile; Gambeya africana; Gnetum africanum; Khaya anthoteca; Libidibia ferrea* var. *leiostachya; Pterocarpus angolensis; Ricinodendron heudelotii; Santalum album*.

ECO10. **Monitoring of direct impacts on fauna** during the construction phase of the project is recommended (see section 8).

7.9.3. Operating phase

The Uíge Provincial Government, responsible for ensuring the operation of the line during the project's operating phase, should take the following mitigation measures into consideration:

ECO11. During maintenance work in the project corridor, whenever possible, the **killing or affecting of individuals** of the following species, considered a priority in terms of biodiversity conservation, **should be avoided**: *Adansonia digitata; Albizia glaberrima; Antiaris toxicaria* subsp. *welwitschii; Autranella congolensis; Brachystegia spiciformis; Ceiba pentandra; Celtis mildbraedii; Chlorophora excelsa; Dalbergia latifolia; Diospyros mespiliformis; Entandrophragma angolensis; Entandrophragma utile; Gambeya africana; Gnetum africanum; Khaya anthoteca; Libidibia ferrea* var. *leiostachya; Pterocarpus angolensis; Ricinodendron heudelotii; Santalum album*.

ECO12. On the other hand, in areas of potential occurrence of primates with special interest for biodiversity conservation - *Cercopithecus mitis*, *Colobus angolensis*, and *Miopithecus talapoin* - i.e., in the forest areas south of Uíge, the **monitoring and maintenance of the line should be reinforced**; in particular, periodic pruning should be ensured in order to increase the distance between the conductor cables and the tree tops. Without proper thinning of the tree vegetation, these animals have easy access to the electrified line when moving within and between forest patches, incurring a high risk of electrocution and potentially death.

ECO13. Finally, impacts on fauna should be monitored during the first years of the operation phase (see section **Erro! A origem da referência não foi encontrada.**).

7.10. Socioeconomics and human rights

7.10.1. Construction phase

To enhance the positive impacts identified for the construction phase, it is recommended the implementation of the following **enhancement measures**:

SE1. Whenever possible, **hiring workers from rural communes** in the direct area of influence for the project's construction activities, contributing to a reduction of local unemployment and a boost of the local economies, while avoiding worker migration (and associated impacts). Hiring should be done through local leaders, such as sobas;

SE2. **Purchase products and services** (water supply, waste management, catering, cleaning services, among others) whenever possible **from the project's municipalities**, contributing to local economic development.

To mitigate the negative impacts identified for the construction phase, it is recommended the implementation of the following **mitigation measures**:

SE3. To mitigate the negative impacts on the health and safety of local communities, it is recommended that a **Community Health and Safety Management Plan** is implemented which should include:

- Provide training to all workers regarding Occupational Safety and Health;
- Provide housing to workers to minimize interaction with local communities and related health and safety impacts;
- Provide access to health care for those injured by the Project's activities;
- Fence all work sites and place placards advising people of the risks associated with trespassing;
- When work fronts are less than 100 metres from a settlement (small, medium, or large), employ security guards from the local communities to prevent trespassing;
- Create and execute a stakeholder engagement plan and consultation to educate local communities of the safety concerns around working sites;
- Create a plan to deal with emergencies;

  - Provide primary health care and first aid at construction camp sites to avoid pressure on local healthcare infrastructures;
  - Create and implement a traffic management plan with the following dimensions: safety, rules of behaviour, consumption of drugs and alcohol, operation hours and resting periods, training, accident reporting, among others;
  - Create and implement a demining safety plan with the following dimensions: safety measures and stakeholder engagement with local communities.

SE4. To mitigate the negative impacts associated with increased disease transmission, it is also recommended that the **Community Health and Safety Management Plan** includes:

  - Ensure all workers (including contractors and subcontractors) undergo pre-employment screening and regular health screening, including voluntary screening for transmissible diseases (including Covid-19);
  - Provide training on transmissible diseases, including sexually transmitted diseases and airborne diseases;
  - Provide workers with personal protective equipment (including masks).

SE5. To mitigate the negative impacts of the project, and only in case of occupation/impeded access to cropland, it is recommended that the people affected by this impact are duly **compensated for the loss of income from seasonal and/or permanent crops**, as well as the loss of community resources such as firewood and charcoal. This should be subsidised by the landowner, who will negotiate a fair compensation with each farmer.

7.10.2. Operation phase

To mitigate the negative impacts associated with the permanent loss of livelihoods during the operation phase, it is recommended the same mitigation measures recommended for the construction phase regarding the temporary loss of livelihoods due to occupation/impeded access to cropland, which in this phase should be ensured by the construction owner.

Specifically, it is recommended the compensation for losses associated with the operation of the transmission lines and support for these households, as well as ensuring a restoration activity with the participation of those affected, paying special attention to vulnerable groups.

Socioeconomics and human rights	
Interference with houses and infrastructures	• Adjustment of the project and the route of the transmission line
Creation of temporary employment opportunities	• Hire workers from communes in the IAI wherever possible for the project construction activities
Boost of the regional economy and improvement of living conditions	• Maximise local procurement, contracting local suppliers (in the municipalities of the project) for all possible services
Impact on the safety of local communities	• Community Health and Safety Management Plan • Stakeholder Engagement Plan
Impact on the health of local communities	
Increase disease transmission	
Loss of livelihoods, mostly temporary	• Compensate affected people for lost resources
Impacts on workers' health and safety	• Workers' Health and Safety Management System

7.11. Cultural heritage

7.11.1. Construction phase

The measures proposed for cultural heritage, to be applied during the construction phase, are in accordance with the IFC guidelines (PS8), always seeking not to interfere with the heritage value to ensure its preservation. If this is not possible, mitigation and heritage compensation measures should be adopted, to be applied to the heritage value and the affected community.

CUH1. Preparation of **Awareness-raising for workers** about cultural heritage. This should explain the different types of heritage that may be found in the area of the work, their cultural value, the actions leading to their destruction and the risks that their destruction will pose to the identity of the local community or the country itself.

CUH2. **Development of cultural awareness panels** covering key issues including the location and importance of cultural sites:

- The “sobas” of the local communities should be consulted for the creation of the panel contents;
- Signs should be made available to workers at easily visible locations on the construction yard.

CUH3. **Preparation of a *Procedural Guide*** to be applied whenever a grave is identified in the project area.

CUH4. **Seal off access to traditional burial grounds and sacred forests** that may be identified during the course of the work.

- Access to traditional burial grounds and sacred forests should be the exclusive preserve of the local community;
- Prohibition of movement of machinery and people from outside the community in the fenced space;
- Prohibition of using the space as a construction yard for construction materials;
- Prohibition of grave removal without prior consent of the local community and the required legal requirement.

7.11.2. Operating phase

No measures are envisaged for this phase.

8. Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) consists of a set of institutional measures to be taken during Project implementation and operation to eliminate adverse environmental and social impacts, offset or reduce them to acceptable levels, and also to enhance environmental benefits. **The different plans composing the ESMP are included in ESIA Vol. V.** The ESMP will include the following plans:

The ESMP will include:

- Biodiversity Management Plan (including a Fauna Monitoring Plan and a Participatory Reforestation Plan);
- Water Management Plan;
- Community Health and Safety Management Plan;
- Subcontractors Management Plan;
- Cultural Heritage Management Plan;
- Emergency Preparedness and Response Plan;
- Environmental Management Plan (including noise, air and water quality monitoring, a Greenhouse Gases (GHG) Management Plan, and an Environmental Awareness Plan);
- Occupation Health and Safety Plan, including a list of hazards associated with the Project and related mitigation measures;
- Traffic Management Plan;
- Training Plan;
- Waste Management Plan (including Oil Spill Response);
- Local Procurement Plan;
- Labour Management Plan;
- Stakeholder Management Plan (including the Grievance Mechanism).

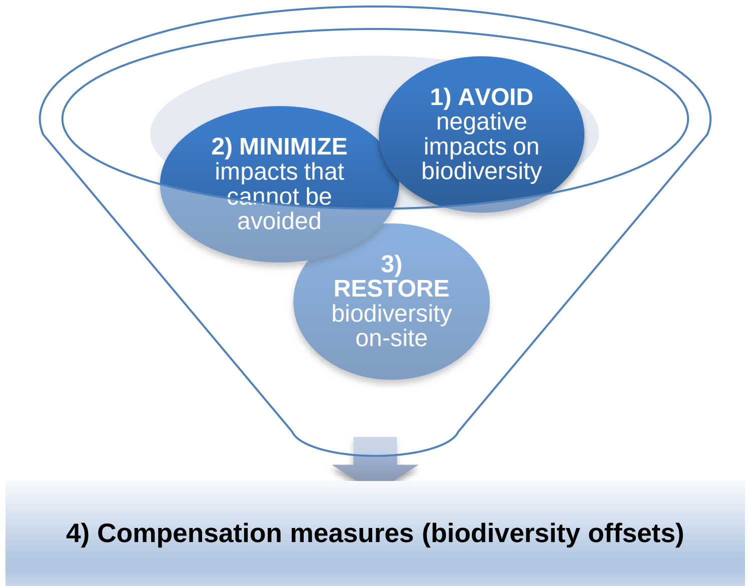
Overall, the ESMP identifies the information needed to guide management decisions. The contractor should follow it during project construction and operation to effectively implement mitigation and compensation measures. Thus, the ESMP identifies the objectives/goals, activities, timetables and budget allocation to ensure a good balance between the environmental and social costs and benefits associated with the Project.

8.1. Biodiversity Management Plan

The present Biodiversity Action Plan aims to tackle both the management of bird species (with a focus on *Laniarius brauni*) and native vegetation present in forest areas, under the scope of the Eletrification of Uíge in Angola, Lot 1, Phase 1, through the implementation of two Biodiversity Action Plans (BAPs). The full plan is included in ESIA Vol. V.

After the implementation of these plans, which should contemplate mitigation and rehabilitation measures for biodiversity, their efficacy should be monitored and evaluated periodically, to determine the need of adjustment or further measures. Following the mitigation hierarchy for the protection of biodiversity, the following objectives should be accomplished in parallel with the Project's implementation:

- **Avoid** crossing forest areas with native tree species;
- **Minimize** impacts on bird communities, by installing Bird Flight Diverters (BFDs) and monitoring bird collision through the implementation of a Biodiversity Action Plan focused on bird monitoring (**BAP-I**);
- **Restore** native vegetation and **compensate** residual impacts on biodiversity and natural resources through a Reforestation Plan in forest areas (**BAP-II**).



8.2. Water Management Plan

The Water Management Plan presented here is included in the Environmental and Social Management Plan framework of the Environmental and Social Impact Assessments for the Electrification of Uíge, Angola – Lot 1, Phase 1.

This plan was developed taking into account the national legislation on water resources in Angola ("Lei das Águas", Law no. 6/02 21st June), aiming to promote a responsible use of water towards sustainable development, safeguarding economic, social and environmental aspects.

The following plan comprises the information collected during the Environmental and Social Impact Assessments (ESIAs) of the Eletrification of Uíge – Lot 1, presented in two standalone documents: ESIA Vol. I for Lot 1, Phase 1, and ESIA Vol. I for Lot 1, Phase 2. The full plan is included in ESIA Vol. V and integrates the data and assessments presented in this ESIA, including:

- Baseline data;
- Impact assessment;
- Mitigation measures.

Elecnor has provided estimates for total water consumption for each phase of the Electrification of Uíge, Lot 1, as depicted in the following table.

Phase	Water consumption (m^3)			Total consumption
	Monthly	Duration	Total per phase	
1	161 m^3	15 months	2415 L	4185 L
2	118 m^3	15 months	1770 L	

8.3. Community Health and Safety Management Plan

The Community Health and Safety Management Plan (CHSMP) aims to minimize the impacts of the project on the health and safety of local communities in the project area. During the construction phase, the following mitigation measures are proposed to mitigate the impacts on the health and safety of local communities:

- Implement a stakeholder engagement and consultation plan to inform local communities of safety concerns around work sites;
- Provide an allowance to workers to cover for accommodation in nearby villages capable of housing them without disrupting the daily routine of the local communities;
- Fence all work sites and put signs advising people of the risks associated with trespassing. Where work fronts are less than 100 metres from a settlement, employ security guards from local communities to prevent trespassing;
- Prepare and implement a demining safety plan that includes the following dimensions: safety measures and stakeholder engagement with local communities;
- Ensure that all workers (including contractors and subcontractors) undergo pre-employment screening and regular health screening, including voluntary screening for communicable diseases;
- Educate workers about behavioural risks that can increase disease transmission, particularly HIV/AIDS, and distribute free condoms;
- Provide access to health care for those injured by the project activities;
- Provide primary health care and first aid at construction camp sites to avoid strain on local health care infrastructure.

Monthly reporting should be prepared by the construction supervisor including the total injured people among the community people distributed by age category, sex and area. The reported incidents should be investigated and corrective actions implemented. Contractors and subcontractors should be monitored and audited through site inspections to verify compliance with health and safety standards and with proposed mitigation measures.

In order to minimise the potential negative impacts on communities in the vicinity of the project, the following preventive measures are included in the Plan:

- The community will be informed about the work to be carried out, as well as the risks they represent, in order to avoid access to risk areas;
- Work areas must be demarcated and signposted;
- Alternative passageways should be provided and signposted where access is impaired by the works;
- A maximum speed of 20 km/hour will be used in the rural areas of the transmission line;
- All drivers will be trained in defensive driving and will have to pass a driving test;
- All workers will have the opportunity to sleep and rest through the use of work shifts and days off;
- Elecnor will carry out vehicle maintenance to minimise accidents;
- In the event of an accident in which a third party is injured or damage is caused to the community, Elecnor will take responsibility for transporting the injured person to an appropriate health centre capable of treating the injuries and will pay for the person's medical treatment, as well as carrying out an investigation into the accident in order to carry out improvement actions.

8.4. Subcontractors Management Plan

Elecnor's Subcontractors Specific conditions to be included in contracts with subcontractors, who must accept these conditions, such as environmental and energy standards, information and legal obligations regarding the prevention of occupational risks. Contracts should also include penalties for non-compliance or omissions.

The plan also sets out the specific documents that subcontractors must present before being hired, namely administrative documents (tax number, bank account certificate, among others), personal documents (identity card, occupational health certificate, driving license, among others) and vehicle/equipment documents (vehicle identification, compulsory insurance, among others).

To monitor the compliance of these procedures, Elecnor commits to do a minimum of one inspection every 825 hours of work of production subcontractors. Furthermore, at least one Health and Safety coordination meeting with contractors should be held every month.

The effectiveness of the implementation of these preventive measures will be monitored by verification:

- Minutes of meeting session with subcontractors;
- Inspections and the number of hours worked included in the monthly Health and Safety monthly report;
- Machine operator authorization records.

8.5. Cultural Heritage Management Plan

The Cultural Heritage Management Plan aims to protect and preserve significant cultural heritage sites, artifacts, or values that may be affected by the construction project.

The steps to be followed in the event of finding an object/site of cultural or archaeological interest:

1. Stop the activity immediately, whatever it is, and call the site supervisor and/or the environmental/social technician as soon as possible.
2. Signal the find: Mark and protect the area. No workers should handle the remains found.
3. The Environment/Social responsible will notify the archaeologist or the competent authority (Ministry of Culture - National Institute of Cultural Heritage).
4. Only when authorization is received from the archaeologist or the competent authority, will the activities be resumed.

Workers will be trained in what to do in the event of a cultural or archaeological find.

8.6. Emergency Preparedness and Response Plan

An Emergency Preparedness and Response Plan (EPRP) sets out the procedures to effectively respond to potential emergencies during construction activities, and to prevent and mitigate potential adverse environmental and social impacts that may be associated with these emergencies. The EPRP should include the following mitigation measures:

The Emergency Preparedness and Response Management Plan presents the measures to be adopted in case of emergency, including first aid, evacuation and fire response procedures. The Emergency Preparedness and Response Management Plan also includes the procedures to adopt when a work accident occurs, in line with the Ministerial Diploma No. 53/05 (15th August 2005).

First aid responses are a crucial first step to facilitate and reduce the recovery time in the event of a work accident. These should be provided by the nearest people to the injured, until a specialized team of doctors and/or nurses arrives to the site. Hence, guidelines on how to provide adequate first aid care should be marked and visible, and a first aid kit should be available at the construction site. After each use of the kit, the missing material should be restocked.

Whenever an emergency requires the evacuation of all workers, this procedure will be coordinated by the contractor's in-charge technician. All workers must safely head to the strategic site defined by the technician, where a count of workers will be performed before proceeding to next steps. Regarding specific procedures for fire emergencies, important recommendations include, among others:

- Report the fire to the Head of Emergency, members of the emergency team, and/or reception.
- Staying crouched and as close to the ground as possible, while protecting the nose and mouth with a wet tissue;
- In darkness and poor light conditions, approaching the walls and use them as a guide, staying together with other workers, and advance cautiously;
- Look for windows are other places to be visible to firefighter teams;
- Knowing the evacuation paths and always head towards the street.

8.7. Environmental Management Plan

Elecnor has an Environmental Management System certified by AENOR and in conformity with norm ISO 14001:2015 (GA-2000/0294), applying its requirements throughout the development of measures to counteract the environmental impacts that may arise from the project's activities, complementing the mitigation measures already presented.

8.7.1. Noise Monitoring Programme

Regarding Noise levels, the IFC/World Bank and World Health Organization (WHO) Standards establish the following for residential and industrial areas:

Table 120 - IFC Environment, Health and Safety DE Guidelines for Noise Levels

Receptor	One Hour L (dBA)	
	Daytime (07:00 - 22:00)	Night-time (22:00 – 07:00)
Residential; institutional; educational	55	45
Industrial, commercial	70	70

Source: WHO (1999)

The limit value of the environmental noise indicator (L_{Aeq}) in the project intervention area, which is characterised as a residential area, is 55 dB(A) during the daytime period (7:00-22:00) and 45 dB(A) at night. During the construction phase there will be frequent "temporary noisy activity" which will be carried out only during the daytime. It is forbidden on Sundays and public holidays, and during working days between 22h00 and 07h00. It may, However, in exceptional cases and duly communicated to the community, noise may be made on prohibited days and at prohibited times.

In order to establish a noise and vibration prevention and control regime aimed at safeguarding human health and the well-being of the population, mitigation measures will be implemented (Table 2).

Table 121 - Noise and Vibration Management Actions

Action	Description	Responsible	Implementation Schedule
Control the noise	Construction activities will, whenever possible, be limited to normal working days and hours. Vehicles and machinery used in construction works shall be operated and maintained in good conditions and in accordance with the respective instruction manuals. Maintenance will be carried out and recorded to attest its veracity.	Head of Works	Continuous
Reduce vibration	Workers must: - use personal protective equipment - check the maintenance status of the - condition of the tool, - use the right tools and not necessarily - not necessarily the fastest ones - reduce the time you use the tool - tool, interspersing work with other activities	All Workers	Continuous

8.7.2. Air and Water Quality Monitoring Program

The execution of the planned work may cause an increase in dust generation, especially during drier and windier times of the year.

Specific rules and procedures must be followed at work fronts, in areas of frequent passage and on site in order to mitigate environmental impacts that contaminate the air (Table 122).

Table 122 - Air Quality Monitoring Programme Actions

Action	Description	Responsible	Implementation Schedule
Prevent dust emission from exposed areas	Unpaved surfaces with frequent vehicle movements (such as roads and access to the work fronts and inside the building site, etc.) should be wetted with a sprinkler truck or watered by hand, particularly during dry and windy periods, in order to minimise the emission of dust resulting from vehicle movements; Avoid excavation, movement and transport of materials that could give rise to dust under conditions of strong wind; The piles for temporary storage of granular material should be regularly sprinkled with water to minimise the emission of dust; Properly secure construction materials and waste materials from the site, including covering aggregates and other materials to prevent wind drift. Transport materials and waste that may generate dust in vehicles with a covered load. Control the speed of light and heavy vehicles in unpaved areas.	Construction Foreman	Define at the beginning and during the work
Controlling the emission of pollutant gases from vehicles, machinery and equipment	Carry out the maintenance of the equipment and vehicles assigned to the work taking into account their technical specifications. Rationalise the circulation of heavy and light vehicles and the working time of the machines assigned to the construction work.	Construction Foreman	Define at the beginning and during the work

8.7.3. Greenhouse Gases (GHG) Management Plan

Elecnor will incorporate its Strategy on Climate Change in the current project, endorsed by the Science Based Targets initiative (SBTi), which defines and promotes best practice in science-based target setting. The main goal of this strategy is to reduce Greenhouse Gases (GHG) emissions by 38% until 2035, starting in 2020.

In order to minimize the environmental impacts driven by the project's GHG emissions, the following measures will be implemented:

- The use of any machinery, equipment or vehicle that shows signs of leaking or ruptures in fuel systems or catalyzers will not be permitted; to ensure this, a daily verification of machinery, vehicles and devices will be performed;
- The engine systems of the used machinery will be turned off whenever it is not being utilized, to reduce wasted energy and promote energy efficiency;
- Campfires will not be allowed.

In addition to the above-mentioned measures, whenever possible, the following procedures will also be adopted:

- Fleet renewal for more efficient and lower carbon-emission vehicles;
- Promote auto consumption from renewable energy sources in temporary facilities, during the construction phase.

The influence of these measures will be determined by quantifying GHG emissions through the carbon footprint, audited and certified by ISO standards (norm ISO 14064-1). Energy consumption (fuel and electricity), residuals' life, and the consumption of raw material (water and paper) will be quantified throughout the project. This data will be integrated in the carbon footprint of Elecnor's branch in Angola.

8.7.4. Environmental Awareness Program

Objective

The Environmental Education Programme aims at raising awareness and training all parties interested in this project on relevant environmental and social aspects. The project leaders shall ensure that the employees involved in the implementation of the project have adequate training and skills to carry out their functions, minimising the consequences for the environment and the communities in all phases of the project.

The local communities surrounding the project area are also stakeholders of the project. It is necessary to inform these populations of the tasks that will be carried out, as well as the risks and dangers related to the project.

Environmental and Social Management

The environmental and social management training is aimed at the institutions, namely Elecnor during the« construction phase, and the employees working on the different activities of the project. The training plan should:

- Raise awareness and commitment to the need to implement the Environmental Management Plan;
- Transmit knowledge and provide training to guarantee compliance with the stipulations of the Environmental Management Plan;
- Inform about other relevant issues within the scope of the project, including climate change, ecosystem services, protection of vulnerable groups and gender equality.

Prior to the construction phase, an assessment should be carried out of the employees who need training and the level of training (basic or advanced) and a training plan should be developed to meet the needs of the project. The level of detail of each training course is related to the functions that each party involved has to perform, from decision-makers to the workers on site.

This training plan should include the following subjects, adapted to each group of workers (administration, Environmental Management Plan team, human resources department, workers in general), to be updated with the detailed version of the project:

- Basic environmental awareness of cross-cutting environmental issues, including sustainability, climate change and mitigation and adaptation measures, efficient use of water and energy, protection of ecological and natural resources;
- Requirements of national legislation;
- Introduction to Environmental and Social Management Plan;
- Identification and assessment of environmental and social risks and impacts;
- Prevention of water, soil and air pollution, including prevention of erosive processes, response to accidental spills and submission of the project's Water Supply Plan, Storm Water Drainage Plan, Wastewater Plan, Air Quality and Noise Monitoring Programme and Waste Management Plan;
- Prevention of erosive processes;
- Stakeholder involvement;
- Monitoring of performance indicators;
- Working conditions and labour policies (hiring, non-discrimination, anti-harassment, remuneration, gender equality);
- Procedures for the management and resolution of complaints for workers and for worker-management interaction;
- Good Health and Safety at Work practices, including procedures for correct use of personal protective equipment, lifting and moving heavy loads safely, handling and storage of materials, among others;
- Accident Contingency Plan and first aid/emergency procedures, firefighting and emergency response procedures;
- Road Safety Management Plan, including procedures in case of accidents;
- Fire Plan and Construction Yard Evacuation;
- Code of conduct in interactions with communities, awareness raising and social responsibility, including training in protection of vulnerable groups and gender equality and respect for cultural sensitivities;
- Community Health and Safety Management Plan, including dissemination on transmission of sexually transmitted diseases;
- Procedure on the discovery and protection of cultural/ heritage resources.

In the construction phase the contractor shall promote training organised by the institution and shall carry out two types of training, initial and continuous. The initial training should be carried out before the beginning of the construction phase with the objective that all workers understand their environmental and social obligations, as well as the risks of each task and the respective mitigation measures to be put into practice by the Environmental Management Plan. A translator should be available if necessary.

Ongoing training of site personnel should be carried out throughout the construction phase, revisiting the topics covered in the initial training and addressing in detail the constraints of the contract, as well as incidents and issues that are relevant. Continuous training can be implemented with a format of discussion sessions, conducted interactively.

Signed records of the content of initial and ongoing training should be kept and made available to the competent authority upon request. The contractor shall monitor workers' performance against the training received and assess further training needs.

To reinforce these issues, a table with relevant information for the smooth running of the project should be available in the offices on the construction yard (Elecnor, 2021b). All project stakeholders can consult the following information on the information board:

- Elecnor Internal Policy;
- Useful contacts in case of emergency;
- Useful contacts for grievance;
- Organisational chart with all those involved in the work;
- Working hours;
- Awareness leaflets;
- Up-to-date information about work accident insurance;
- Evacuation plan;
- Code of Conduct rules.

If people from outside the project go to the project area, they should receive training on the tasks that are being carried out in the construction area and training on good health and safety practices at work.

It is then necessary to check that the people from outside the project have the appropriate PPE for moving around the site. Whenever possible, this group of people should be accompanied by an Elecnor employee so as to minimise the risks to which they may be subjected.

Community awareness-raising

In projects of this scope, it is necessary to provide training for the communities surrounding the areas of influence. The training must cover the different phases of the project, activities and the impacts it will have on communities, with the aim of helping to mitigate impacts and favour project performance. Records must be kept of the awareness-raising activities carried out.

This type of training should be carried out in appropriate places such as schools, hospitals, clinics and other community facilities where information can be easily disseminated by the inhabitants. This communication should be carried out through appropriate and available means of information in the communities such as distribution of pamphlets and leaflets, newspaper and radio announcements or school boards/posters and lectures.

The updating of this plan prior to the construction phase should identify the connection points for communication with the communities and the appropriate means for information dissemination. It is essential that children are included in the training and the points and means of connection should be adapted to them.

Awareness training for the communities surrounding the project should include the following information:

- Educate local communities about health concerns around workplaces, particularly with communicable diseases and sexually transmitted diseases;
- Presentation of the Community Health and Safety Management Plan, aimed at mitigating the health impact on the communities surrounding the project, such as providing access to health care for people injured by the project activities;
- Make local communities aware of the project's Stakeholder Engagement Plan and in which situations people should use the grievance mechanism;
- Raise awareness in the communities about the activities that will take place during the construction phase, such as demining the project areas, increased vehicle circulation and the risks existing on the construction yard and in the construction areas;
- Present the results of the monitoring plans included in the Environmental Management Plan to the communities surrounding the project;
- Announce to local communities the start date for electricity transmission;
- Efficient use of electrical energy by communities;

- Efficient use of water by communities, and the importance of leakage control in water supply systems;
- Good safety practices guide, behaviours to have or to avoid that may influence the performance of the project;
- Raising awareness about the protection of natural resources, in particular forest resources and the need to minimise deforestation;
- Raise awareness of climate change issues, including the effects of climate change on communities and adaptation strategies;
- To make known the impacts on the climate and climate change, as well as the mitigation measures adopted by the project.

8.8. Occupational Health and Safety Management Plan

8.8.1. Introduction

In a situation of lapse or gap in the construction or operation framework of the project (e.g., human failure to train or follow procedures, equipment failures) or due to an external event (e.g., natural disaster) accidents may occur at the project site.

In this context, it is important to plan an effective response to such situations in order to avoid and minimise any harm to workers, the surrounding community and the environment.

Prior to the construction phase, this plan should be updated considering the detailed version of the project, in order to constitute a detailed accident preparedness and response plan for the construction and operation phases, taking into consideration the relevant policies and implementation standards, instructions and procedures of Elecnor, including its Integrated Policy for Environmental Management, Quality, Safety and Health, Energy Management, RD&I Management and Information Security, and of NTG, including standards, instructions and recommendations regarding Quality, Safety, Health and Environment.

8.8.2. Hazard identification

Construction activities such as those involved in this project often present occupational health and safety risks for workers. Exposure to these risks can lead to physical injury and pain, chronic respiratory diseases (e.g., asthma), musculoskeletal disorders, noise-induced hearing loss and skin problems, among others (*World Health Organization*, 2017).

These represent not only a substantial component of the disease burden, but also a detrimental aspect for the general well-being of workers. Therefore, in order to minimise such risks and protect workers' health, this section focuses on the measures that should be taken for each identified risk situation.

Construction activities in general carry the risk of falling from heights or into pits and trenches, as well as the risk of being struck by falling rock fragments or objects.

These can cause serious or even fatal injuries. In addition to properly managing these activities, the contractor should provide safety training for workers (at least one session prior to the start of construction), communicating the safety practices that should be followed by workers (e.g. use of protective clothing and materials, compliance with directions for safe movement in construction areas), as well as the general measures implemented by the contractor (e.g. training sessions, working hours) and the rights and obligations of workers. In addition, the contractor should place appropriate signage and protective barriers in areas where the risks are highest. Worker supervision should complement these measures to ensure that workers follow them effectively.

The proximity of heavy machinery, such as cranes and excavators, and the movement of construction vehicles can also pose a threat to worker safety, potentially leading to injury, trauma or even death. In order to prevent such accidents, workers should be trained in the operation of heavy machinery and comply with safety circulation measures at workplaces.

Electrical wires can pose a hazard to construction workers when left exposed and improperly located, resulting in electric shock. Wires should therefore be properly labelled and insulated and should be kept away from occupied areas. Working on high voltage installations also carries a high risk of electrocution due to unprotected contact with transmission lines and towers.

In addition, workers will be exposed to dust, noise and air pollution, requiring appropriate personal protective equipment such as gloves, safety glasses and masks, and sound-blocking ear plugs.

Exhaustion and dehydration may also arise during construction activities when workers work under extreme conditions (e.g., heat, on long working days). This represents not only a detrimental effect on the well-being of individual workers, but can also lead to inattention, which in turn can result in accidents. Ensuring access to water and maintaining a balanced work schedule should mitigate these negative effects. In addition, supervision of workers will also be important in detecting such instances of exhaustion.

The project area encompasses areas that are not fully cleared of mines and therefore a mine clearance campaign will be undertaken prior to construction works. Despite this, the risk of interaction of workers, contractors or local communities with landmines is still significant. This risk can lead to permanent and/or fatal injuries. Ensuring a comprehensive demining campaign and clearly identifying demined areas will be important to minimise the risk.

Ensuring the safety of construction personnel thus requires the implementation of a series of safety procedures that will help mitigate occupational health and safety hazards. These hazards are presented in Table 22, together with proposed measures to be implemented by the contractor following national and international standards (IFC: ND 2). To ensure that these measures are effectively followed by all persons involved, a manual describing them should be distributed in an appropriate and accessible format at the workplace. In addition, the contractor should appoint a person/team that will be responsible for the implementation of the health and safety measures.

It should be noted that the measures presented in the table below are not intended to replace those required by Angolan legislation, namely the General Labour Law (Law no. 7/15 of 15 June) and the Occupational Health and Safety System (Decree no. 31/94 (31/05/94).

Other measures and rules should therefore be consulted in the referred documents.

In the Execution Project phase an extensive Health and Safety Plan will be developed, where the specific risk inherent to the works and the respective safety measures will be more detailed.

Table 123 – Occupational Health and Safety hazards and respective measures

Hazard	Measures
Falling from heights or into pits and trenches	• Providing safety training for workers • Implementing appropriate signage and guard rails • Providing and using personal protective equipment, such as safety belts, hard hats and safety shoes, along with supervising workers • Providing and ensuring supply of first aid equipment • Regular inspection of equipment (including ladders and scaffolding) • Fall victims will be treated with first aid at the site of their fall until possible injuries are identified, and she/he can be safely moved to the nearest medical facility for further treatment
Injuries from the projection of fragments of rocks or falling objects	• Providing safety training for workers • Providing and using personal protective equipment, such as hard hats, safety glasses and reflective waistcoats, along with supervising workers • Providing and maintaining first aid supplies
Slips, trips and falls (especially while carrying heavy loads)	• Train workers on how to lift and move heavy loads safely • Define spaces for storing hand tools and other equipment to maintain an organised work area • Providing and maintaining first aid supplies
Musculoskeletal injuries (especially of the back), resulting from lifting and moving heavy loads	• Train workers on how to lift and move heavy loads safely • Use mechanical aids to assist in lifting
Injuries caused by the circulation of vehicles	• Defining and delineating road and pedestrian access routes • Providing and using personal protective equipment, such as reflective waistcoats, along with worker supervision • If the accident is within the construction yard area, existing signage must be reviewed and methods used to reduce vehicle speeds • Providing and maintaining first aid supplies • In the event of a road accident involving Elecnor employees or contractors:

Hazard	Measures
	- The HSA Manager and the Police will be contacted immediately with details of the location and nature of the incident - The accident site will be cordoned off to keep the public at a safe distance from the scene and to allow easy access for first responders and emergency services - If it is safe to do so, first responders under the guidance of the HSE Manager will remove accident victims, and place them in an area where they can receive first aid treatment and assessment. Victims should be moved as little as possible until the extent of their injuries is determined - Vehicles involved in the accident should not be moved until police arrive - The victims will be transferred to a hospital or medical facility if necessary - If members of the public are involved in an accident that has occurred as a result of an Elecnor employee or contractor, the injured will be rescued and/or taken to the nearest hospital for treatment, depending on their injuries - Details of the accident, including how it was caused, number of people involved, police reports, etc., will be recorded by the HSA Manager
Hearing impairment/loss	• Provision and use of personal protective equipment, such as sound blocking ear plugs, by operators of noisy equipment, together with supervision of workers • Implementing regular equipment check-ups • Arranging initial and periodic medical examinations for workers exposed to the risk of noise-induced hearing impairment
Exposure to dust and air pollution	• Providing and using personal protective equipment such as safety glasses and masks • Adopting shorter excavation sections where possible • Irrigating construction sites frequently • Organising initial and periodic medical examinations • Carry out periodic indoor air quality monitoring campaigns in work areas within substations

Hazard	Measures
Chemical hazards from exposure to various chemicals	• Provision and use of personal protective equipment such as safety glasses and masks, and protective gloves • Providing and maintaining first aid supplies
Spillages onto the ground	• Place emergency kits for spill control, containing fine sand, a spill collection shovel and a specific disposal container, at the places where spills are likely to occur • Provide training for workers on how to act in case of a spill • In the event of a spill: - Identification of the spill - Place absorbent material to contain the spill - Containment of the spill - Clean up • Place the contaminated absorbent material in the container
Injuries from the operation of heavy machinery	• Provide safety training for workers, especially heavy machinery operators • Closely monitor heavy machinery operations • Restrict work areas to workers trained in safety • Implement regular equipment check-ups • Providing and maintaining first aid supplies
Minor accidents (scrapes, cuts, abrasions, etc.)	• Minor accidents will be dealt with by first aid • If an employee/worker becomes aware that he/she has been injured, however insignificant his/her perception, he/she shall stop the work being performed to seek first aid treatment • First aid boxes will be provided in all operational areas

Hazard	Measures
Medical health cases	• First aid treatment will be administered immediately • Management will be informed of the incident resulting in the medical emergency • The location and severity of the situation will be assessed • Other health or safety risks such as entering a dangerous or unstable area will be avoided • If an employee requires off-site emergency medical transport, the nearest Government Hospital or medical centre will be contacted for the transfer of the victim, who will be accompanied by a member of staff to provide pertinent information about the incident • In case of death, only a professional doctor can confirm the death. Immediate notification of management is required following the death of any employee due to a work-related incident.
Electrocution	• Establish a safety perimeter around installation sites for transmission towers • Label and isolate exposed electrical wires, keeping them away from occupied areas • No attempt to install or maintain electrical systems shall be made by anyone other than a qualified and trained technician familiar with electrical infrastructure and installations • All workers should wear appropriate insulating personal protective equipment (PPE) when handling or working with electrical equipment • At least two people will be present at all times when working on electrical equipment. No attempt will be made to service or adjust unless another person capable of providing first aid and CPR is also present. • Provide and maintain first aid materials. • Any accident will be reported immediately to the HSA Manager • In the event of an electrocution emergency: - Assess the situation and ensure your safety, that of the casualty and that of others - Disconnect the power

Hazard	Measures
	- If the power cannot be disconnected, stand on an insulated dry surface (rubber mat, etc.) and use a non-metallic object to move the victim away from the hazard, and - Once the victim has been moved out of harm's way, immediate medical response will be administered
Exhaustion and/or dehydration	• Providing an adequate supply of drinking water • Establishing adequate working hours • Supervise workers • Establish an open means of communication for *feedback* with the aim of continuously improving occupational health and safety guidelines
Fire or explosion	• Place fire-fighting equipment where it can occur (construction yard, substation sites) • Provide training in response to fires and explosions for workers • Develop evacuation plans with location of meeting points • In the event of an accident resulting in fire or explosion: - Notify the Plan Manager - Cut off electricity from the site - Determine if fire can be extinguished with local firefighting equipment - If equipment is sufficient, use to extinguish fire • If equipment is not sufficient, contact fire service, sound alarm and evacuate area
Exposition to land mines	• Mine clearance campaign in the project area prior to the construction phase • Identification of the places where the campaign was and was not carried out • Provide and maintain first aid materials • In case of activation of a landmine, the victim must be transported to the nearest hospital • In case of death, only a professional doctor can confirm death. Immediate notification of management is required following the death of any employee due to a work-related incident.

To ensure that these measures are effectively followed by all the people involved, a manual describing them should be distributed in an appropriate and accessible format in the main workplaces, namely the construction yard and substation sites at Uíge, Negage, Aldeia Viçosa, Rio Dange and Puri.

It should be noted that the measures presented in the table above are not intended to replace those required by Angolan legislation, namely the General Labour Law (Law no. 7/15 of 15 June) and the Occupational Health and Safety System (Decree no. 31/94 (31/05/94). Other measures and rules should therefore be consulted in the referred documents.

In the Execution Project phase an extensive Occupational Health and Safety Plan will be developed, where the dangers inherent to the works and the respective accident response measures will be more detailed.

The updated Occupational Health and Safety Plan shall include the updating of the emergency plan for the construction yard planned for use during the construction phase (construction yard for the Design and Construction of the Water Distribution Network and Household Connections in Peri-urban Areas of the city of Uíge) for the new use.

For the operation phase of the project, the accident contingency guidelines currently implemented at the Uíge and Negage substations are to be updated.

The updated guidelines should follow an initial review of current accident response practices and the identification and assessment of hazards arising from the new working environment (e.g., new operating systems and machinery), also taking into account the measures contemplated in the waste management plan. Accident contingency guidelines for the new substations at Aldeia Viçosa, Rio Dange and Puri will be developed based on this update.

Workers will also be exposed to the danger of accidents during maintenance work on the transmission lines; therefore, specific measures are also required to minimise such accidents. For these activities, significant hazards include falls from height and electrocution. The measures outlined in relation to these hazards, as well as those defined by Angolan legislation and international standards, are expected to reduce these risks and increase the response to accidents.

8.8.3. Responsibilities

Elecnor and the Contractor are responsible for the effective response to any accident situation related to the construction phase of the project. To ensure coordinated and effective response, a chain of command to be followed in the event of an accident was developed in the updated version of the plan, in section 10 of Elecnor's Occupation Health and Safety Plan.

8.8.4. Emergency communications

In the updated version of the plan to be developed at the beginning of the construction phase, a communications programme should be included to facilitate response to accident situations and to carry out adequate investigation of accidents that have occurred, and a list of emergency contacts so that the public emergency response entities can be contacted.

This list should include the contact details of the following entities, among others that may be relevant:

- Angola's National Institute of Medical Emergencies (INEMA);
- Integrated Public Security Centre (IPSC);
- Fire Fighters Departments;
- Uíge Provincial Hospital;
- National Police of Angola.

The contact list should be updated by the contractor at the beginning of the construction phase to ensure accurate contact information. The relevant emergency plans for each phase of the project and the emergency contact list should be maintained at easily accessible locations at the main project sites, including the construction yard, Uíge and Negage substations and the new substation sites at Aldeia Viçosa, Rio Dange and Puri.

8.9. Traffic Management Plan

A Traffic Management plan was developed by Elecnor to minimise traffic disruption and environmental impacts and to avoid the potential harm to people during construction.

The following prevention measures will be considered:

- Deliveries should preferably be scheduled for off-peak traffic times to avoid impacting passengers;
- Alternative access: where construction works obstruct existing access, temporary alternative access routes should be provided;
- Vehicle maintenance: Specific maintenance of each piece of equipment, including the establishment of a preventive maintenance programme for the fleet of vehicles and machinery, duly documented;
- Speed limits: Respect the speed limits established for vehicles circulating in populated areas (maximum speed of 40 km/h) and on building sites (maximum speed of 20 km/h);
- Irrigation: Where dust is deemed to impact human, plant or animal receptors, or where dust is likely to cause sedimentation of waterways/water bodies, or unacceptable levels of soil loss, Elecnor will apply water;
- Trucks carrying sand, earth or other loose material will be covered (tarpaulin trucks);
- Compliance with the Highway Code, approved by Decree-Law no. 5/08, of 29 September 2008;
- General training: Road safety campaigns will be organised for workers to make them aware of the importance of traffic rules;
- Information: Local communities will be informed about the circulation routes of the construction vehicles to make them aware of traffic risks;
- Signposting: Access to sites will be clearly signposted and should not be located in such a way as to create a hazard.
- Driver fatigue: Elecnor will ensure that driving shifts within the project provide employees with opportunities for sleep and rest between shifts and on time off.
- Injuries to Third Parties: In the event of an accident to a third party, Elecnor will take responsibility for transporting the injured person to a

suitable health centre capable of dealing with the injuries and shall bear the cost of medical treatment of the person.

- Vehicle Maintenance: Appropriate maintenance will be carried out in order to keep the vehicle in good condition and ensure good functionality.
- Compulsory compliance with the minimum road safety standards established for travel will be required, which for Elecnor Angola are as follows:
    - The maximum limit per route and driver will be 500 km / day.
    - On the route it is planned to arrive before 18:00 hours.
    - It will be obligatory to make 10 minute stops every two hours.
- GPS monitoring: All Elecnor vehicles are monitored by a satellite monitoring system for compliance with the measures set out in this Plan;
- Alcohol tests will be scheduled for all drivers involved in the project.
- Restrictions on hours of operation, and vehicle routing to avoid congested areas or sensitive locations;

Regularly monitor and report on the implementation of the Traffic & Transportation Management Plan to ensure compliance with the plan's measures and mitigation plans. Unusual traffic delays or accidents caused during construction, or any complaints received, should be reported in the monthly report prepared by the construction supervisor.

8.10. Training Plan

Elecnor has established and maintains a training process in order to have competent personnel based on quality, environmental and social education, training and awareness. Training is provided to workers at the start of construction and throughout the construction period, as provided in the attachments of Elecnor's Training Plan.

The training needs of locally hired workers will be assessed to ensure the recruitment of qualified workers for the construction phase of the Project.

The workers will be provided with:

- **Social and environmental programme**
  - Elecnor and project basic environmental issues
  - Emergency preparedness and response
  - Laying out and checking the state of extinguishers
  - Identification and use of dangerous products
  - Communication management (plan, procedures)
  - Code of Conduct
  - Cleaning and tidiness of the workplace
  - Detection and reporting of non-conformities
  - Management of environmental accidents
  - Waste management
  - Measures to prevent environmental impacts (traffic, noise, air quality, water courses)
  - Storage of dangerous products
  - Protection of local heritage (cultural finds)

- **Quality training programme**
  - Elecnor and project quality basics (policy, responsibilities)
  - Cleanliness and tidiness of the workplace
  - Detection and reporting of non-conformities
  - Understanding of monitoring & measuring equipment labels
  - Understanding and use of maintenance log
  - Materials reception process
- **Health and safety training**
  - Health and Safety Plan

- First Aid
- Emergency preparedness and response
- Disease prevention (sexually transmitted, transmitted by mosquitoes and other vectors, prevention of contagious diseases)
- Working at height
- Electrical risk
- Risks and preventive measures during assembly work
- Driving machinery
- Road safety

In addition, for monitoring purposes, all training sessions will be recorded by the technicians.

8.11. Waste Management Plan

8.11.1. Introduction

The main objective of a Waste Management Plan is to enable the correct management of the waste produced by identifying and classifying the waste planned for the construction and operation phases and describing the tasks to be performed and the responsibilities. The full plan is included in ESIA Vol. V.

Waste management encompasses operations related to the deposition, storage, collection, transport, sorting and treatment of waste, including the monitoring and planning of these operations. The Waste Management Plan should comply with public health, environmental and economic criteria, and be in line with the Ministerial Diploma No. 190/12 (24th August).

The present plan is focused on reducing waste production at its source, providing measures for a proper waste reduction, reuse, segregation, packaging, and management, thus safeguarding the environment. The responsibility of its implementation is shared by the proponent of the project (Provincial Government of Uíge) and Elecnor.

In summary, this management plan aims to accomplish the following objectives:

- Prevent environmental, company and civil responsibility risks, resulting from an inadequate management of construction residuals;
- Present the different typologies and quantities of expected residuals;
- Present procedures to treat and/or value the produced residuals;
- Present procedures to reuse, recycle and value residuals.

All the residuals resulting from the construction works, including removed vegetation, will be collected by workers with wheelbarrows and safely transported to the temporary construction facilities.

Certified and licensed waste management companies will be hired by local authorities of the municipialities of the Uíge and Bengo provinces, capable of ensuring the safe transportation and disposal of residuals, following local procedures. These companies must present to Elecnor a monthly report on the residuals and provide documentation on the type and amount of residuals received, as well as its final destination.

During the construction phase, no significant wastewater residuals are expected to be produced. In the case chemical sanitary facilities are installed at the construction site, they will be equipped with compartments to safely store wastewater residuals, and will be emptied according to national legislation from Mozambique. Regarding sanitary facilities, wastewater will be forwarded to biological septic tanks.

Elecnor will file an annual report on waste management and sent a manifest on the hazardous waste collected ANR (Agência Nacional de Resíduos). Overall, one of the main targets of this management plan is to reuse, recycle and value the produced residuals, complying with the principle of waste reduction and valuation.

8.11.2. Waste infrastructure

All waste produces during the life cycle of the project should be sent to appropriate final destination, taking into account the solutions provided by the Angolan waste management entities operating in the provinces of Uíge and Bengo.

8.11.3. Waste management measures

The next table presents a set of waste management measures to be included in the project's construction waste management plan. These measures focus on establishing a structured framework within which the project's waste flows will be predicted, prepared for, assigned within construction operations, and managed through.

Mitigation / Enhancement Measure	Environmental Impacts	Institution / Persons responsible for implementation
Project Design		
Estimate quantities of waste produced, by type.	Waste disposal	Elecnor
Consult local environmental organizations and waste management authorities on applicable waste management practices and available companies for correct handling and disposal.		
Construction phase		
Surplus land should be sent to a licensed landfill or for reuse in construction areas on the region, where needed	Waste disposal	Elecnor
Create a viable waste management system including worker training on storage, handling and disposal of wastes		
Consult local environmental and waste management authorities on applicable waste management practices and available companies for correct pickup and deposition		
Create a specific, clearly identified, waste collection area on the construction yards Ensure that containers have lids to prevent odours and to protect from natural events like rain		
In case of spill, clean up spills immediately after the spill using absorbent materials such as sawdust or fine gravel, that then must be properly managed	Oil spillage	
Machinery and vehicles' maintenance and refuelling activities should be performed only in adequate workshops to be located in a specific and equipped areas of the construction yards. Emergency repairs outside the yards should be performed using impermeable sheets or portable retention basins underneath machines/vehicles; absorbent material should be available. This type of waste must be stored correctly to be later sent to an appropriate final destination		
Machines to be installed in the substations will be on appropriate blocks with peripherical oil collection gutters, which will drain the oils to a retention tank. This waste must be later sent to appropriate final destination		

8.12. Local Procurement Plan

The aim of the Local Procurement Plan is to promote local economic development, create employment opportunities, encourage business development and accelerate the transfer of skills and technology. Local suppliers and workers are given priority in order to capture the positive economic benefits within the project's direct area of influence.

The Local Procurement Plan will be implemented through the following steps:

- A comprehensive database of local suppliers and contractors will be developed through market research, stakeholder consultations and engagement with local business associations;
- Whenever possible, workers will be recruited from the rural communities directly affected by project construction activities. In particular, all low-skilled jobs, such as vegetation clearance, security guards, cleaning, etc. can be filled by people from settlements along the transmission line;
- Recruitment requirements and contract terms should be fair and transparent, offering equal opportunities to all eligible local suppliers and contractors;
- Procurement opportunities should be widely advertised in the local settlements in a manner accessible to local communities;
- Hiring should be done in collaboration with local leaders, such as sobas;
- Purchase products and services (water supply, waste management, catering, cleaning services, etc.) from the project communities whenever possible, thereby contributing to local economic development;
- To maximise capacity building and knowledge transfer to local contractors and their employees, formal training programmes will be developed, as well as on-the-job training.

To ensure compliance with the Local Procurement Plan, monthly reports should be developed by the contractor including the workers employed during the previous month. Information should be segregated by type of work, workers, and the living area of the workers.

Based on these reports, Elecnor will be responsible for submitting regular reports to the local authorities to assess the effectiveness of the plan and make any necessary adjustments. The reports should include:

- Monitoring of the local recruitment process;
- Percentage of local versus non-local workers, as well as the number and range of employment opportunities created;
- Attendance records and outcomes of the capacity building and training.

8.13. Labour Management Plan

The Labour Management Plan outlines the measures and procedures to ensure the health and safety of workers during the construction of the transmission line. The full plan is included in ESIA Vol. V.

The following components are associated with the Labour Management Plan:

- Human Resources Policy, which outlines worker rights to be included in all contracts including restrictions on working hours, compensation including consideration of overtime, and holidays;
- Prohibit the use of alcohol or drugs, which could adversely affect the ability the employee to perform the work safely or adversely affect the health and safety of other employees, community members or the environment;
- Workers should be provided with the appropriate personal protection equipment for the work they are performing;
- Ensure that training on health and safety measures is provided to all construction workers prior to starting to work on the Project and that supervisors have adequate experience to deliver on their responsibilities;
- Implement regular health and safety checks and audits of workers, contractors and subcontractors and implementing sanctions in case of breaches of national standards and the project's specific standards. Such audits to include workplace health and safety, worker contracts, working hours, pay and conditions; housing and food standards;
- Provide primary health care and first aid at construction camp sites to avoid strain on local health care infrastructure;
- Develop and implement a Workers Grievance Mechanism for the project workforce including contractors and subcontractors.

Monthly reporting should be prepared by the construction supervisor including the total injured workers distributed by their type of work. The reported incidents should be investigated and corrective actions implemented. Regularly monitor and report on the compliance of workers, contractors, and subcontractors with the health and safety standards. This should include regular reporting to project management and relevant stakeholders, as well as periodic audits and inspections to ensure compliance.

8.14. Stakeholder Engagement Plan

8.14.1. Introduction

The stakeholder engagement programme is designed to cover all phases of the project. However, Elecnor will hand over the project to *Rede Nacional de Transporte de Electricidade* (RNT) once the construction of the transmission lines is completed. As so, Elecnor will have no responsibilities during the operation phase.

Therefore, all engagement activities during the operation will be managed and promoted by RNT. The general objectives of stakeholder engagement are outlined below, as well as the stakeholder engagement activities, per phase (Figure 2).

The SEP will build on engagement undertaken to date and specify interactions with community and other stakeholders, as well as finalising the grievance procedure to be used throughout the project.

Regarding the construction phase, the following approaches are proposed:

- Community awareness training – undertake a programme of stakeholder engagement and consultation to educate local communities of the risks of trespassing onto sites, the meaning of signs, and the dangers of playing on or near equipment or entering fenced areas. Special attention to be paid in primary and secondary schools along the transmission routes and in areas where towers will be built close to residential or school areas;
- Undertake stakeholder engagement with settlements along the transmission line route on a range of issues including changes to the visual environment, noise, air quality and socioeconomic concerns including interaction with workers;
- Announce locally the start date for electricity transmission and safety implications, using public announcement systems.

Planning and design phase [Elecnor]

Objectives
- Identify relevant stakeholders
- Inform stakeholders
- Obtain licenses and permits
- Obtain social license
- Record and address stakeholders concerns, issues and suggestions

Activities
- Appointment of Community Liaison Officers
- Engagement through ESIA and RAP
- Demining related engagement
- Resettlement and livelihood restoration engagement
- Disclose of grievance mechanism

Construction phase (36 months) [Elecnor]

Objectives:
- Update stakeholders on progress
- Renew licenses and permits
- Maintain social licence
- Address any grievances
- Sustain peaceful relations with stakeholders

Activities:
- Regularly engage with stakeholders
- Maintain grievance procedure
- Maintain stakeholder engagement plan
- Maintain engagement regarding the resettlement plan

Operation phase [RNT]

Objectives:
- Update stakeholders on progress
- Manage retrenchment process
- Renew any licenses and permits
- Address any grievances
- Sustain peaceful relations with stakeholders

Activities:
- Execute engagement related to operations
- Regularly engage with stakeholders
- Create and maintain RNT grievance procedure
- Maintain stakeholder engagement plan

Decommissioning phase [RNT]

Objectives:
- Update stakeholders on progress
- Manage retrenchment process
- Understand requirements
- Address any grievances

Activities:
- Inform stakeholders regarding decommissioning activities
- Definite and execute engagement activities

Figure 2 – Stakeholder engagement phases, objectives and activities.

8.14.2. Monitoring and reporting

Regarding the construction phase, all stakeholder engagement activities should be registered and reported. Elecnor should implement a data management and monitoring process as outlined below for that purpose.

8.15.2.1. Data Management

Stakeholder engagement activities should be documented and retained to track and refer to records when required and ensure delivery of commitments made to stakeholders.

The following stakeholder community dialogue records and documentation can be used and maintained by Elecnor during pre-construction and construction phases:

- Stakeholder list: ongoing updates to the list, including key contacts and contact details (telephone number, email address) as additional stakeholders are identified;
- Stakeholder engagement log: Used to store, analyse, and report on stakeholder dialogue activities. It will be populated with details on the information presented, audience questions, responses and actions, and meeting evaluation results, when appropriate. The database will also be used to track the frequency of meetings over the life of the project;
- Event record sheet: used to collect meeting minutes to be filed within the stakeholder database;
- Commitments register: commitments and actions recorded during community interaction activities should also be registered and regularly reviewed to ensure they are taken forward;
- Meeting minute template;
- Grievance log: official record of grievances with date, person(s) filling the grievance, nature of grievance, date of first review, date of initial investigation; suggested resolution(s) and date, feedback to the complainant(s) with date; grievance close-out and date of resolution.
- Media monitoring of press and radio stories relevant to the project and unconventional related issues and activities.

8.15.2.2. Reporting

Once consultation with stakeholders has taken place, stakeholders generally want to know which of their suggestions have been taken on board, what risk or impact mitigation measures will be put in place to address their concerns, and how, for example, the project's impacts are being monitored.

Given this, the following reports should be published:

- A Stakeholder Engagement Report with the description of objectives and activities to be developed during the construction and operation phases;
- A yearly report of stakeholder engagement activities (during the construction phase), with a detailed description of all stakeholder interaction and data points (see last section).

8.14.3. Grievance Mechanism

The **IFC Performance Standards** are a benchmark for good practice for environmental and social risk management in private sector developments. The IFC Performance Standards require that clients engage affected communities through disclosure of information, consultation, and informed participation, in a manner commensurate with the risks to and impacts of the project on the affected communities. According to PS1, a grievance mechanism must be established to receive and facilitate the resolution of affected communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project and have Affected Communities as its primary user.

The IFC's Good Practice Guide to addressing grievances from project-affected communities describes a grievance as (1) "…a concern or complaint raised by an individual or a group within communities affected by company operations. Concerns and complaints can result from either real or perceived impacts of a company's operations and may be filed in the same manner and handled with the same procedure." Furthermore, it describes a project-level grievance mechanism for affected communities as: "…a process for receiving, evaluating, and addressing project-related grievances from affected communities at the level of the company, or project." The community grievance mechanism should be broadly and regularly publicised, especially during the pre-construction and construction phase, to ensure that comments, questions, and grievances are appropriately channelled and registered.

Regarding the **requirements of the Equator Principles** (EP4, July 2020), Principle 6 (Grievance Mechanism) emphasises the importance of an effective grievance mechanism designed for use by affected communities and workers, as appropriate, to receive and facilitate the resolution of concerns and grievances about the project's environmental and social performance. Furthermore, grievance mechanisms are required to be scaled to the risks and impacts of the project and will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern.

Finally, the grievance mechanisms should not impede access to judicial or administrative remedies and affected communities and workers must be informed about the grievance mechanisms during the stakeholder engagement process.

With these standards in view, Elecnor should develop and maintain an effective grievance mechanism to be put in place in the construction phase of the project (and to be adapted and be maintained in the operation, and decommissioning phases). The grievance mechanism to be developed must describe the following procedures:

- Step 1: Grievance reception and registration;
- Step 2: Screening and prioritisation;
- Step 3: Grievance Investigation;
- Step 4: Resolution and feedback to the complainant(s);
- Step 5: Monitoring, grievance close-out and register update.

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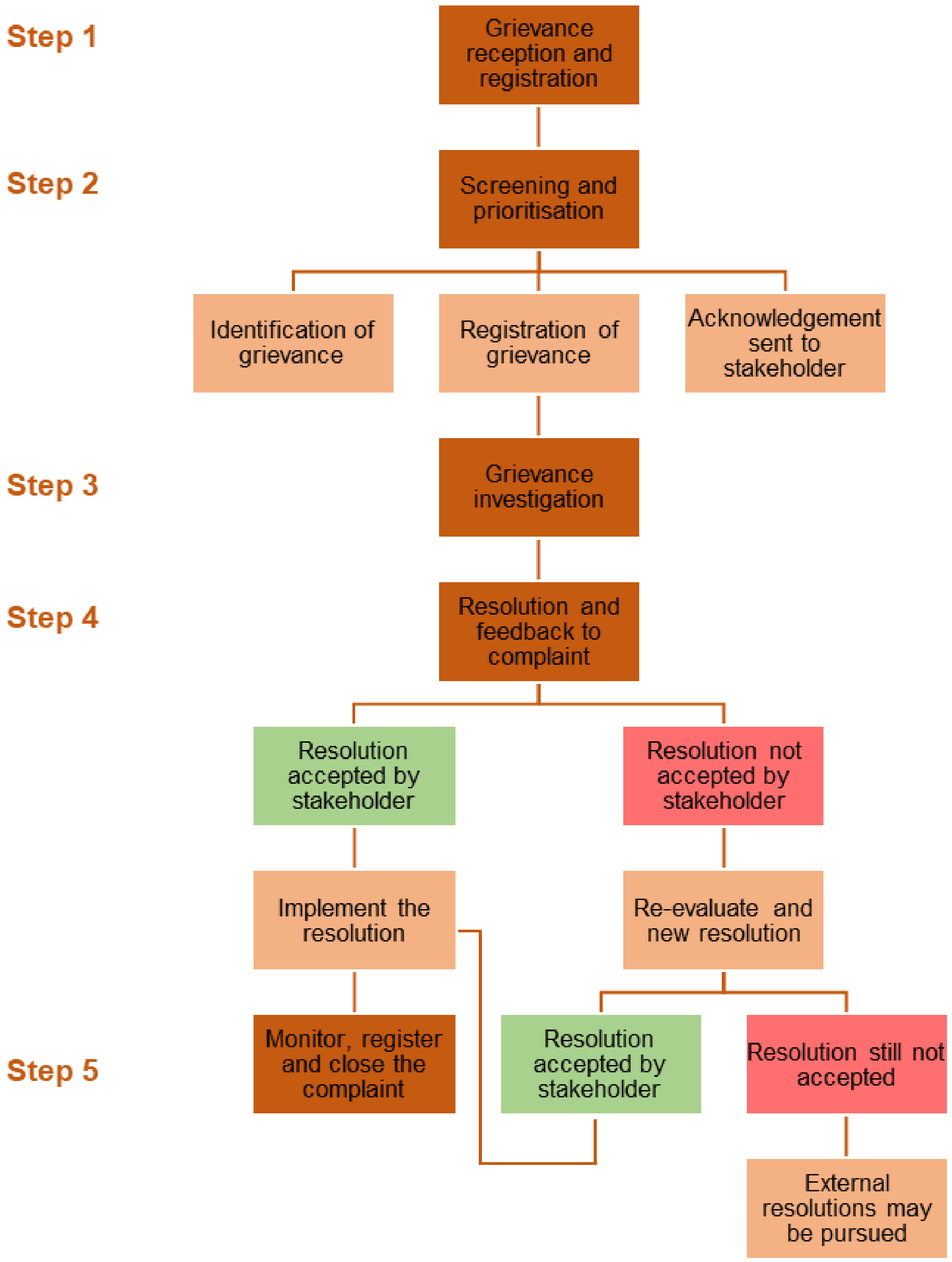

Figure 3 – Grievance Mechanism for workers and affected individuals/communities during construction phase

Step 1: Grievance reception and registration

The grievance redress mechanism should be accessible to all, including workers, individuals and affected communities, and can be done in a variety of ways, such as through the Soba, by telephone, by post, through a designated e-mail address or through a dedicated post box at project sites. In addition, the process should be clear, transparent, and easy to understand for people with different levels of literacy.

All grievances received will be forwarded to Elecnor, who will be responsible for registering them and assigning a reference number to the complaint for tracking and follow-up purposes.

Step 2: Screening and prioritization

The Community Liaison Team (CLT) Manager is responsible for reviewing the grievance and managing the resolution process. At this stage, the CLT Manager will determine the nature of the investigation, taking into account the type of complaint and the potential risks associated with it, and will determine the actions required to review and investigate the complaint.

Upon receiving the complaint, the CLT Manager will acknowledge the complaint within five working days, which should be communicated to the complainant along with the remaining steps in the process and the timeline.

Step 3: Grievance investigation

In this step, the CLT Manager will initiate an investigation of the grievance. This may include conducting site visits and inspections, interviewing relevant parties, and reviewing relevant documents and records.

The investigation should be conducted in a fair, transparent, and impartial manner with the aim of verifying the validity of the complaint and assessing the level of risk.

After investigating the complaint, corrective and/or preventive action will be identified to address the issue.

Step 4: Resolution and feedback to the complainant(s)

Once the investigation is complete, the CLT Manager will formally communicate the findings in writing to the complainant, as well as the corrective and/or preventive action taken to address the complaint. Grievance resolution should be provided to complainants within 21 days of receipt of the initial grievance.

If the complainant agrees with the proposed resolution of the grievance, the corrective and/or preventive actions should be implemented.

If the complainant does not agree with the proposed resolution of the grievance, the corrective or preventive action should be reviewed and corrected based on discussions and negotiations with the complainant.

If the complainant is still not satisfied with the reviewed corrective and/or preventive actions, the complainant should take the grievance to a dispute resolution mechanism outside the company's grievance procedure, namely through legal action.

Step 5: Monitoring, grievance close-out and register update

The implementation of the agreed-upon actions should be monitored to ensure that they are effectively carried out by Elecnor. The complainant and other relevant stakeholders will be kept informed about the progress of the implementation measures.

Once all agreed-upon actions have been effectively implemented and the complainant is satisfied with the response to their grievance, the CLT Manager will prepare a report summarising the complaint received, the investigation carried out, the findings, and actions implemented. This report will be shared with relevant stakeholders, including the complainant, Elecnor and other relevant parties.

8.15. Responsibilities for Reporting and Review

Elecnor will keep the relevant national and regional authorities informed on the environmental and social performance of the project, throughout the construction phase, while during the operation phase, these responsibilities fall under the operator of the network, namely Rede Nacional de Transporte de Electricidade – RNT. This should be attained through periodic status reports and face-to-face meetings.

The monitoring of the execution and implementation of mitigation measures should be achieved by: continuous monitoring of construction works and maintenance during operation (through internal inspection / monitoring); and periodical internal and external supervision by the environmental and social supervision team and the ESIA Authority, respectively.

Thus, the status reports can be divided into:

- Routine progress reports;
- Supervision reports, including inspection, monitoring programmes and training/certification records and other relevant reports, as required.

Elecnor will be required to provide **routine progress reports** during construction phase, as well as RNT will provide the same type of reports, as the manager of the substations and transmission lines' operation, synthesising the results of inspections, monitoring programmes and other relevant documents.

The periodical supervision of the project operation should result in **supervision reports**, summarising the project status, implementation and efficiency / efficacy of proposed measures and monitoring plans (a synthetic checklist of measures can be used as support for *in situ* supervision actions) and need of adjustment of any measures, with proper justification.

Monitoring programmes reports will present the main results from the implementation of each monitoring programme proposed.

Table 1 – Reporting responsibilities

Phase	Reports	Reporting responsibilities	Actions / Frequency
Construction	Routine progress reports	**Preparation / Submission**: Elecnor **Receiving/Review/Approval**: RNT	Site visit to ensure that the mitigation measures and actions defined in the ESIA are satisfactorily implemented during construction phase; Number of non-conformities registered, their severity and correction capacity Monthly
	Supervision reports	**Preparation:** Environmental and Social Supervision Team **Submission:** RNT (Environmental and Social Manager) **Receiving/Review/Approval:** ESIA Authority	Site visit to ensure project is implemented in a sustainable way, according with the requirements established in the ESIA during construction phase Monthly

Phase	Reports	Reporting responsibilities	Actions / Frequency
Construction / Operation	Monitoring programmes	**Preparation**: Elecnor staff or qualified technician / expert to be hired by Elecnor (construction phase) RNT staff or qualified technician / expert to be hired by RNT (operation phase) **Submission**: RNT **Receiving/Review/Approval**: MINEA	Monitoring programmes' implementation (see Section **Erro! A origem da referência não foi encontrada.**) Depending on each monitoring programme (monthly, quarterly or annually)
Operation	Routine progress reports	**Preparation / Submission**: RNT (Project Manager) **Receiving/Review/Approval**: RNT	Site visit to ensure that the mitigation measures and actions defined in the ESIA are satisfactorily implemented during operation phase; Number of non-conformities registered, their severity and correction capacity Quarterly
	Supervision reports	**Preparation:** Environmental and Social Supervision Team (ideally this should be an independent team, but it may also be a permanent E&S team from RNT) **Submission:** RNT **Receiving/Review/Approval**: ESIA Authority	Site visit to ensure project is implemented in a sustainable way, according with the requirements established in the ESIA during operation phase Annually

8.15.1. Roles and responsibilities

This section presents a detailed structure of the implementation team, including key Project staff, external support and contract staff required to develop and implement the proposed ESMP, including their roles and responsibilities. It is noted that the final size and composition of the field implementation team will be flexible in order to accommodate the needs of the Project.

Key roles and responsibilities are outlined in Table 2.

Table 2 – Implementation roles and responsibilities

Position	Role and Responsibility
Elecnor Project Manager (PM)	The Project Manager is the senior representative for the Site and, as such, is the ultimate authority on all matters including environmental and social management. Key responsibilities: • Ensure compliance with legal requirements; • Identify applicable production procedures and ensure compliance in the project; • Ensure that the implementation team has sufficient resources & the right capacity; • Control and distribute documentation: technical update (specifications, plans, etc.) and work documentation (procedures, instructions, etc.); • Managing non-conformities, complaints, communications, etc.; • Propose improvement actions; • Identify training needs; • Approval of suppliers and purchase of supplies that meet the technical and quality requirements of the project; • Ensure a sufficient budget and a realistic schedule;
Elecnor Site Manager (SM)	The Site Manager is responsible for the day-to-day operations of the construction, and may replace the Project Manager if required. Key responsibilities: • Ensure that all workers have the necessary competence; • Report to the Project Manager on all accidents and incidents and corrective and preventative measures;

Position	Role and Responsibility
	• Report to the Project Manager any public grievances or concerns raised by the local communities with respect to the project; • Manage non-conformities; • Propose improvement actions; • Disclose the rules of conduct; • Identify training needs; • Approval of subcontractors;
Quality and Environmental Manager	• Implement measures related to the environment; • Keep updated documents/records of non-conformities; • Propose improvement actions; • Support the treatment of detected anomalies; • Conduct training on the rules of behaviour/conduct; • Identify quality and/or environmental training needs; • Preparation and implementation of quality and/or environmental training; • Ensure that subcontractors and suppliers meet the quality and environmental requirements of the project; • Carry out formal and informal inspections; • Respond to environmental incidents and supervise corrective actions such as clean-ups; • Keep a record of Environmental incidents and complaints
Security Manager	• Implement measures related to health and safety; • Provide inductions on road safety for employees and subcontractors; • Carry out safety inspections; • Propose improvement actions; • Support the treatment of detected anomalies; • Keep documents/records of incidents/accidents up to date; • Identify health and safety training needs; • Preparation and implementation of health and safety training; • Ensure that subcontractors meet the health and safety requirements of the project;
Social Manager	• Registering anomalies detected and participating in their resolution; • Reporting accidents/incidents;

Position	Role and Responsibility
	• To control and verify the correct maintenance of the project vehicles; • Propose improvement actions; • Identify social training needs; • Preparation and implementation of social training; • Ensure that subcontractors meet the social requirements of the project; • Keep a record of social incidents and complaints; • Manage the grievance mechanism and grievance resolution process;
Workers and contractors	• Meet the requirements specified in the ESMP; • Report incidents; • Propose improvement actions; • Communicate to their superior if they find any object of cultural or archaeological interest;

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9. Overall assessment

9.1. Introduction

Following the identification and assessment of the impacts of the project and the recommendation of the respective measures to mitigate and enhance them, respectively, Chapters 6 and 7, this chapter aims to present an overall qualitative assessment of the environmental, social and heritage impacts.

This assessment is presented in the form of a **double-entry matrix**, relating the main project actions to the descriptors likely to be affected. The main interest of this format is thus the possibility of simultaneous presentation of information regarding all the variables involved, allowing easy reading and cross-referencing of data.

Although the matrix allows a quick view of the overall assessment of the project, its analysis and interpretation should take into account that it corresponds, by definition, to a simplified view of the impacts identified, and does not dispense with consulting the detailed analyses presented in the sectoral texts.

Note that the results presented in the impact matrix, in terms of significance, include a prediction of mitigation/enhancement possibilities, thus roughly corresponding to the significance of the residual environmental impacts.

However, there is always some uncertainty in predicting residual impacts, as it is difficult to determine the effectiveness of some measures, and these often depend on multiple factors that can also be of great variability.

Even the response of environmental factors for which possible changes have been predicted is not a linear process and therefore introduces an additional factor of complexity.

Given these limitations, the synthesis matrices should be considered primarily as an overview of the approximate balance of the project in terms of the significance of residual impacts.

A colour scheme has been added to allow an immediate perception of the overall significance of the impact after mitigation, using green tones for positive impacts and red for negative ones, increasing the intensity of the colour according to the severity of its degree of significance.

Table 124 – Colour codes for the significance classification used in the impact assessment

Negative	Significance	Positive
	Null or Negligible	
–	Low	+
–	Moderate	+
–	High	+

9.2. Impact matrix

The impact matrix is presented in the following table.

Table 125 – Summary of the environmental and social impact assessment

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
CLIMATE AND CLIMATE CHANGES							
Emissions of GHG	Construction	Negative	Certain	Low	Low	►	Low
Reduction of carbon sinks	Construction	Negative	Certain	Medium	Moderate	►	Low
Reduction of GHG emissions from electricity consumption in Uíge Province	Operation	Positive	Certain	High	High	►	High
Increased risk of reduction of transmission efficiency of lines during the heat waves	Operation	Negative	Unlikely	Low	Negligible	►	Negligible

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Increased risk of damage to transmission towers and SS in extreme weather events (flood, wildfires)	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
GEOLOGY, GEOMORPHOLOGY E TOPOGRAPHY							
Changes in local morphology	Construction	Negative	Certain	Medium	Low	►	Low
Surplus of soil	Construction	Negative	Likely	Medium	Low	►	Negligible
Slope instability	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
Seismic event	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
HYDROGEOLOGY							
Groundwater contamination	Construction	Negative	Unlikely	Low	Negligible	►	Negligible
Reduction of recharge	Operation	Negative	Certain	Low	Low	►	Low

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
SURFACE WATER RESOURCES							
Increased turbidity and total suspended solids in river and streams	Construction	Negative	Unlikely	Low to Medium	Negligible to Low	►	Negligible
Faecal bacteria and organic matter contamination in rivers and streams	Construction	Negative	Unlikely	Low	Negligible	►	Negligible
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	Construction	Negative	Unlikely	High (water courses intersections and bridges)	Moderate	►	Low
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	Operation	Negative	Unlikely	Low (SS) to High (water courses intersections and bridges)	Moderate (water courses intersections and bridges)	►	Low

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Increased consumption of surface water resources	Operation	Negative	Likely	Low	Low		Low
SOILS AND LAND USE							
Loss of soil resources due to erosion	Construction	Negative	Likely	Medium	Moderate	►	Low
Reduction of soil quality	Construction	Negative	Unlikely	Medium	Low	►	Low
Temporary land take and loss of access to land	Construction	Negative	Likely	Medium	Moderate	►	Low
Permanent removal of vegetation, including crops	Construction	Negative	Certain	Medium	Moderate	►	Low
Reduction of soil quality	Operation	Negative	Likely	Medium/Low	Moderate/Low	►	Low
Permanent land restrictions	Operation	Negative	Likely	Medium/Low	Moderate/Low	►	Low
AIR QUALITY							
Exhaust emissions	Construction	Negative	Certain	Low/Negligible	Low/Negligible	►	Negligible
PM and Dust emissions	Construction	Negative	Certain	Low/High	Low to High	►	Negligible/Moderate

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
NOISE							
Noise emission	Construction	Negative	Certain	Low/Medium	Low to High	►	Negligible/Low
Operation activities on substations	Operation	Negative	Certain	Low/Medium	Low to Moderate	►	Low to Moderate
Wind effects on cables and Corona Effect	Operation	Negative	Certain	Negligible/Low	Low to Moderate	►	Negligible/Low
ECOLOGY							
Loss of habitats, vegetation and flora	Construction	Negative	Certain	Low to Medium	Null (modified habitats), low (savannahs and wetlands) and moderate/significant (forests)	►	Without possibility of mitigation
Disturbance of faunal communities	Construction	Negative	Certain	Low/Medium	Null (modified habitats), low (savannahs and wetlands and forest)	►	Null (modified habitats), low (savannahs and wetlands and forest)
Habitat contamination with hazardous materials	Construction	Negative	Unlikely	Low to medium	Low to moderate	►	Low
Degradation of ecosystem services	Construction	Negative	Likely	Medium	Low (Wetlands) to Moderate (Forest)		Low

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Degradation of the habitats conservation, fragmentation and loss status	Operation	Negative	Likely	Unknown	Null (modified habitats), low (savannahs and wetlands) and moderate/significant (forests)	►	Without possibility of mitigation
Disturbance and mortality of mammals	Operation	Negative	Likely	Unknown	High (forests south of Uíge); low on the rest of the route	►	*Unknown*, due to the uncertainties associated with the proposed mitigation measures
Disturbance and mortality of avifauna	Operation	Negative	Likely	Low to High (*Laniarius brauni*)	Low to High; significance is high only in the forests south of Uíge	►	Low to moderate in forests south of Uíge (STRIX, 2016); low in the rest of the route
SOCIOECONOMICS AND HUMAN RIGHTS							
Creation of temporary employment opportunities	Construction	Positive	Certain	Low	Low	►	Moderate
Boost of the regional economy and improvement of living conditions	Construction	Positive	Certain	Low	Low	►	Moderate
Impact on the safety of local communities	Construction	Negative	Likely	Medium	Moderate	►	Low

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Impact on the health of local communities	Construction	Negative	Likely	Medium	Moderate	►	Low
Increase disease transmission	Construction	Negative	Likely	Low	Moderate	►	Low
Loss of livelihoods, mostly temporary	Construction	Negative	Likely	Medium	Moderate	►	Low
Impacts on workers health and safety	Construction	Negative	Likely	Medium	Moderate	►	Low
Local employment opportunities	Operation	Positive	Likely	Low	Low	►	Low
Provision of electrical capacity and related benefits	Operation	Positive	Certain	High	High		Enhancement not possible
Permanent loss of livelihoods	Operation	Negative	Likely	Low	Low	►	Low
Increase community safety after demining	Operation	Positive	Certain	Medium	Moderate	►	Enhancement not possible

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Benefits to local settlements from road infrastructure improvements	Operation	Positive	Certain	Low	Low	►	Enhancement not possible
Increase safety and comfortable with public illumination	Operation	Positive	Certain	High	High	►	Enhancement not possible

9.3. Overall impact and risk assessment of the construction phase

Most of the impacts identified in the construction phase are **negative**. These negative impacts are essentially associated with construction activities, namely: **land clearing, changes and restrictions in land use, excavations and landfills, operation of heavy machinery, truck traffic, among others**.

These actions will cause <u>negative impacts</u>, most of them temporary, on geology, geomorphology and topography, soil and land use, environmental quality (air quality and noise), water resources, on some socio-economic aspects and human rights, and with a contribution to climate change, highlighting:

- Changes in local morphology due to excavations and landfill and soil erosion
- Temporary loss of access to land and crops
- Elimination/loss of habitats, vegetation and flora
- Disturbance of faunal communities
- Noise and dust emission
- Emission of greenhouse gases and reduction of carbon sinks
- Pollution of surface and underground water resources, and of the soil due to possible accidental spillages of contaminating substances
- Different impacts on local communities (loss of livelihood due to occupation/impeded access to farmland, affected safety and health of people close to the works, and increased transmission of diseases in the local community due to increased interaction with workers)
- Interference with cultural heritage not currently inventoried and which may be identified during the works (e.g., traditional burial grounds)

Mitigation is possible for most of these impacts, meaning that most of them are of low or negligible significance following appropriate action and management.

In this context, it is particularly relevant to implement, in the detailed project design phase, the fine-tuning measures for the transmission lines and associated infrastructures to guarantee the minimum affected area, as well as the general mitigation measures proposed in the Environmental and Social Impact Assessment related to the construction activities, namely with the management of the construction yard, machine operation, transport and execution of the works.

Equally important are the specific mitigation measures proposed in the ESIA, of which we highlight, among others, those related to the management of surplus land, the rehabilitation and restoration of vegetation, the minimisation of the felling of priority species for the conservation of biodiversity, compensation for the loss of means of subsistence during the works, environmental education and awareness campaigns for workers, information for local communities regarding potential disturbance to air quality and noise and the protection of any cultural heritage that may be uncovered during the works.

The impacts of greatest concern during the construction phase are related to the disturbance of wildlife communities, due to human presence and noise emissions, and the elimination/loss of forest habitats along the tracks where the transmission lines are laid and safeguarded (with particular emphasis on the 110 kV lines). Forests stand out as vulnerable habitats with floristic values of conservation relevance, and there is no possibility of mitigating the impacts resulting from the elimination/cutting of vegetation.

Nevertheless, during the construction phase there will also be positive impacts, especially at the socio-economic level, namely through temporary job creation and new opportunities for local businesses in terms of local income, increased commercial activities, the empowerment of local contractors and suppliers, among other indirect benefits.

It should be noted that during the 15-month construction phase a total of 280 jobs are expected to be created, 210 for the electrification of the municipalities and 70 for the home connections and public lighting (direct and indirect labour required).

The project has the capacity to create some long-term benefits for local contractors and suppliers and their employees from increased capacity and the acquisition of specific skill sets through on-the-job training and formal training (spill over effects).

Considering the importance of Angola's urban development and associated construction, transport and storage sectors, these skill sets may be transferable to other construction-related projects in the area after construction is completed.

9.4. Overall impact and risk assessment of the operation phase

The operation phase will clearly bring the main positive impacts of the project, mostly associated with socio-economic aspects, but also some contributing to climate change mitigation. These impacts result from:

- Reduction of greenhouse gas emissions following the increase in electricity consumption in Uíge Province
- Increased local employment opportunity generated by the need to maintain the transmission line corridor and associated infrastructures
- Increased community safety following demining
- Increased safety and comfort of the population with public lighting
- Increased electrical capacity and benefits related to a more stable and secure electricity supply
- Benefits for local settlements arising from the improvement of road infrastructures by allowing greater road safety and better access to education, employment, health, among others

Regarding the project's contribution to climate change mitigation, it should be noted the importance of the replacement of electricity generated from fossil fuels (diesel) by electricity generated from hydroelectric plants, with lower greenhouse gas emissions. This is a positive impact, in line with national commitments under the Paris Agreement and climate change mitigation efforts, in particular under initiative M1 - Low carbon electricity generation of the National Climate Change Strategy 2018-2030 (Government of Angola, 2017).

In socio-economic terms, the permanent employment opportunities stand out, as well as the improvement of the regional economy and the livelihood of the population as a result of a more stable and secure supply of electricity to families and businesses in the province of Uíge. This project will allow the connection of 5 000 households to the power grid in Aldeia Viçosa (500 household connections), in Puri and adjoining villages (1 000 household connections), in Quitexe and adjoining villages (1 500 household connections) and in Negage (2 000 household connections).

In the operation phase of the project some negative impacts are expected:

- Degradation of the conservation status/fragmentation/loss of habitats in the area affected by the transmission line protection strip (with thinning and clearing of vegetation);
- Disturbance of fauna populations (mammals and avifauna) due to the risk of electrocution and collision with the transmission line and increased human pressure;
- Permanent restrictions to land use and loss of livelihood due to occupation/impeded access to farmland;
- Noise generated by substations and electrical discharges from transmission lines.

The negative impacts on the ecological component, particularly on forests, are of moderate/significant significance, with no possibility of mitigation as regards the state of conservation/fragmentation/loss of habitats, and high significance as regards the disturbance and deterioration of fauna populations, even with the minimisation measures proposed given the uncertainties as to their effectiveness in the case of mammals.

It is therefore very important that defined measures are implemented to mitigate the degradation of habitats and disturbance to birdlife and mammals, such as the definition of the minimum possible height for the line (and guaranteed safety conditions for human populations), the implementation of signposting for birdlife, but also that the fauna monitoring plan is implemented in order to follow the effects of the project and the need for new mitigation measures.

In the case of mitigation of negative impacts generated by permanent restrictions on land use and loss of livelihoods due to occupation/impeded access to farmland, compensation for loss of assets at replacement cost and loss of income opportunities from seasonal and permanent crops is of particular relevance.

10. Knowledge gaps

The knowledge gaps identified during the development of the Environmental and Social Impact Assessment (ESIA) are related, on the one hand, to the fact that the project has not yet been developed at the Execution Project level, with some aspects associated with its different components not being fully detailed, and, on the other hand, to the lack of in-depth studies or access to data made available in time during the development of the ESIA.

The following information gaps stand out:

- Climate and Climate Change
    - Meteorological and climate data for the project's area of focus;
    - Regionalised climate change projections for the latest SSP scenarios;
    - GHG emission factors for activities in Angola;
    - Inventory of GHG emissions at the provincial level;
- Geology, geomorphology, topography
    - Recent topographic survey of the transmission lines area
    - Absence of geological and geotechnical studies
    - Data on mining concessions or quarries in the municipalities covered by the project
- Hydrogeology
    - Inventory of borehole and groundwater quality data
- Surface Water Resources
    - Monitoring data on the quantity and quality of surface water resources in the project's area of influence
- Environmental quality
    - Regional information on air quality and noise with a high degree of representativeness

  - Unavoidable uncertainty associated to the activities and their temporal and spatial distribution

- Ecology
  - The assessment of the project's impact on ecological systems lacks detail with regard to the installation sites of the towers and supports, and the opening of access roads to the work site

- Cultural heritage
  - Difficulty in collecting oral information from the local communities who did not disclose the location of the traditional cemeteries and sacred forests. The cemetery recorded and presented in the present study was identified during fieldwork by Nemus technicians
  - Lack of recent work in this area. The lack of information about it in the present study does not mean that it does not exist, there being the possibility that the project may affect other sites in addition to those registered

Notwithstanding the gaps mentioned above, it is considered that, overall, the current level of knowledge, both of the interventions and the intervention area, is sufficient for the technical assessment of the project, providing adequate support for the general conclusions of the ESIA.

Gaps in knowledge were filled by using, whenever possible, estimates, field work and expert appraisals, and it is not considered that there are gaps in knowledge that are relevant to the fulfilment of the ESIA objectives or that limit the reliability of the impact assessment and the global conclusions obtained.

11. Conclusions

The Environmental and Social Impact Assessment (ESIA) of the Uíge Electrification Project - Lot 1, Phase 1 had the general objective of **analysing the potential interference of the project on the biophysical and socio-economic environment, and to propose mitigation measures** to enable its sustainable implementation.

The work carried out as part of the description of the affected environment allowed a detailed survey of the environmental conditions that currently exist in the project's location and its area of influence. This information served to evaluate the sensitivity of the areas of influence of the project, in global terms and, in particular, in relation to the project's actions.

Overall, the project is viable from an environmental point of view, presenting a set of **positive impacts of moderate to high significance**, constituting an opportunity for social and strategic development.

The positive impacts are mainly materialised in the operation phase for the socio-economy, due to the potential for job creation, the stimulation of economic activities, the increase in electricity capacity, and the benefits inherent in a stable and safe supply of electricity and public lighting, as well as the project's contribution to mitigating climate change.

The replacement of electricity generated from fossil fuels (diesel) by electricity generated from hydroelectric plants with lower greenhouse gas emissions is a positive impact of particular relevance. This consequence is in line with the objectives established in Angola's Nationally Determined Contribution (2021), required by the Paris Agreement, which sets the goal of achieving (unconditionally) a 14 % reduction in greenhouse gas emissions by 2025, compared to 2015 as the reference year.

Although **negative impacts** have been identified, **they are generally minimizable**.

The main conclusions of the environmental and social impact assessment point to a higher number of negative impacts during the construction phase, most of them temporary and of low significance with the implementation of the proposed mitigation measures. Most of the actions generating impacts are common to any construction work of this nature, such as the emission of noise and dust, as well as the local increase in traffic. Therefore, the adoption of the set of general mitigation measures usually applicable to construction works, as well as the implementation of specific measures proposed in the ESIA will be essential to ensure their implementation within a framework of environmental sustainability.

The most significant negative impacts result from the elimination/loss of forest habitats along the corridors used to protect the structures and cables, but also from the disturbance of fauna (mammals and birds) in the forest to the south of Uíge due to human presence and an increased risk of electrocution and collision with the lines.

In the operation phase there will also be negative impacts related to restrictions on land use and loss of livelihoods due to occupation/impeded access to farmland, which, however, will in most cases be mitigated.

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ANNEXES

Annex 1 – List of flora and fauna potentially occurring in the study area

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Flora

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Acanthaceae	*Acanthus montanus*	(Nees) T.Anderson	-	-	LC	-	Herbaceous
Acanthaceae	*Brillantaisia owariensis*	P. Beauv.	-	Lemba lemba	LC	-	Herbaceous
Achariaceae	*Caloncoba welwitschii*	(Oliv.) Gilg	-	ndanzi atenga	LC	-	Tree
Amaranthaceae	*Dysphania ambrosoides*	(L.) Mosyakin & Clemens	*Chenopodium ambrosoides* L.	Santa maria; Nkavua	-	-	Herbaceous
Anacardiaceae	*Lannea antiscorbutica*	(Hiern) Engl.	-	Nkumbi	-	-	Tree; Shrub
Anacardiaceae	*Mangifera indica*	L.	-	Mangueira	DD	-	Tree
Anisophyllaceae	*Anisophyllea quangensis*	Engl. Ex Henriq	-	Mfungua; Bilasoba	-	-	Subshrub
Annonaceae	*Annona senegalensis*	Pers	-	Nlolo, Nlolo kambulu, Nlolopolo; Nloloa pequena, Mfuilu	LC	-	Tree
Annonaceae	*Monodora angolensis*	Welw.	-	-	LC	-	Tree
Annonaceae	*Monodora myristica*	(Gaertn.) Dunal	-	Peve, gipeve, gipehe	LC	-	Tree
Annonaceae	*Xylopia aethiopica*	(Dunal) A.Rich.	-	-	LC	-	Tree
Apiaceae	*Steganotaenia araliacea*	Hochst.	-	-	LC	-	Tree
Apocynaceae	*Landolphia lanceolata*	(K.Schum.) Pichon	-	-	-	-	Shrub
Apocynaceae	*Landolphia owariensis*	P. Beauv.	-	macongue; makonge	-	-	Herbaceous; Climbing
Apocynaceae	*Lanfolphia lecomtei*	Dewèvre	-	-	-	-	Shrub
Apocynaceae	*Mondia whitei*	(Hook.f.) Skeels	-	-	-	-	Liana
Araceae	*Amorphophallus angolensis*	(Welw. ex Schott) N.E.Br.	-		-	-	Herbaceous

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Araceae	*Colocasia esculenta*	(L.) Schott	-	Malanga; inhame	LC	-	Herbaceous
Araliaceae	*Cussonia angolensis*	(Seem.) Hiern	-		-	-	Tree
Arecaceae	*Elaeis guineensis*	Jacq.	-	Palmeira de dendé	LC	-	Tree
Arecaceae	*Raphia spp.*	-	-	-	-	-	Tree
Asparagaceae	*Dracaena camerooniana*	Baker	-	-	LC	-	Vines; Shrub
Asparagaceae	*Dracaena mannii*	Baker	-	kitondo	LC	-	Tree; Shrub
Asteraceae	*Acanthospermum* sp.	-	-	Makoloko	-	-	Herbaceous
Asteraceae	*Ageratum conyzoides*	(L.) L.	-	Kambwa katela, mbokatela, mbukata	LC	Invasive	Herbaceous
Asteraceae	*Baccharoides guineensis*	(Benth.) H.Rob.	-	Matita, matitita	-	-	Herbaceous
Asteraceae	*Bidens pilosa*	L.	-	Potajambua	-	-	Herbaceous
Asteraceae	*Chromolaena odorata*	(L.) R.M.King & H. Rob.	-	Kongo dia sika, Mululusaire, cromolena	-	Invasive	Shrub
Asteraceae	*Crassocephalum montuosum*	(S.Moore) Milne-Redh.	-	-	-	-	Herbaceous; subshrub
Asteraceae	*Crassocephalum rubens*	(Juss.ex Jacq.) S. Moore	-	Bungudia	-	-	Herbaceous
Asteraceae	*Emilia coccinea*	(Sims) G.Don	-	Malalulalu	-	-	Herbaceous
Asteraceae	*Galinsoga quadriradiata*	Ruiz & Pav.	-	Kabuata branca	-	-	Herbaceous
Asteraceae	*Gymnanthemum glaberrimum*	(Welw. Ex O.Hoff.) H. Rob	-	Nsalu, kisalu	-	-	Shrub
Asteraceae	*Helichrysum mechowianum*	Klatt	-	-	-	-	Herbaceous

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Asteraceae	*Melanthera scandens*	(Schumach. & Thonn.) Roberty	-	Kalahi, kalau, Makaila	-	-	Herbaceous; Climbing
Asteraceae	*Pleiotaxis rugosa*	O. Hoffm.	-	Ntelamakatexe, kakatiana	-	-	Herbaceous
Asteraceae	*Tithonia diversifolia*	(Hemsl.) A. Gray	-	Mululula	-	Invasive	Shrub
Asteraceae	*Vernonella subaphylla*	(Baker) H. Rob. & Skvarla	*Vernonia subaphylla* Baker	Makutula	-	-	Herbaceous
Asteraceae	*Vernonia perrottetii*	Sch.Bip. ex Walp.	*Polydora serratuloides* (D.C.) H. Rob	-	-	-	Herbaceous
Bixaceae	*Bixa orellana*	L.	-	Ndalamuenga	LC	-	Tree
Bixaceae	*Cochlospermum angolense*	Welw. ex Oliv.	-	-	-	-	Tree
Bromeliaceae	*Ananas comosus*	(L.) Merr.	-	Ananás	-	-	Shrub
Burseraceae	*Canarium schweinfurthii*	Engl.	-	Mbidi, gimbidi	LC	-	Tree
Burseraceae	*Dacryodes edulis*	(G. Don.) H. J. Lam	-	Safueiro	-	-	Tree
Cannabaceae	*Celtis mildbraedii*	Engl.	-	-	LC	VU	Tree
Cannabaceae	*Morus mezozygia*	Stapf	-	-	-	-	Tree
Cannaceae	*Canna indica*	L.	-	Chala (verde)	-	-	Herbaceous
Carcaceae	*Carica papaya*	L.	-	mamoeiro	DD	-	Tree
Caryophyllaceae	*Drymaria cordata*	(L.) Willd. Ex Schult.	-	Lumpwua	-	-	Herbaceous
Celastraceae	*Salacia pynaertii*	De Wild.	-	-	-	-	Herbaceous
Clusiaceae	*Allanblackia floribunda*	Oliv.	-	-	LC	-	Tree
Colchicaceae	*Gloriosa superba*	L.	-	-	LC	-	Herbaceous
Combretaceae	*Combretum spp.*	-	-	-	-	-	Tree
Commelinaceae	*Commelina diffusa*	Burm.F.	-	Ndakalaka	LC	-	Herbaceous

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Commelinaceae	*Pollia condensata*	C.B.Clarke	-	-	-	-	Herbaceous
Costaceae	*Costus afer*	ker Gawl.	-	Nsangalavula	-	-	Herbaceous
Crassulaceae	*Kalanchoe crenata*	(Andrews) Haw	-	Luikiaikuai	-	-	Herbaceous
Cucurbitaceae	*Cucumis melo*	L.	*Luffa cylindrica* (L.) M. Roem	Nzenga nzenga	-	-	Herbaceous; Climbing
Cucurbitaceae	*Cucumis metulifer*	E.Mey. ex Naudin	-	-	-	-	Herbaceous; Climbing
Cucurbitaceae	*Cucumis sativus*	L.	-	-	-	-	Herbaceous
Cucurbitaceae	*Cucurbita maxima*	Duchesne	-	-	-	-	Herbaceous
Cucurbitaceae	*Momordica charantia*	L.	-	Lumbuzam-buza, nlumbuzu-buzua	-	-	Herbaceous
Cyperaceae	*Cyperus papyrus*	L.	-	-	LC	-	Herbaceous
Dennstaedtiaceae	*Pteridium aquilinum subsp. centrali-africanum*	(Hieron.) Alston	-	Manguelele, mizili, manzelele	-	-	Herbaceous
Dioscoreaceae	*Dioscorea alata*	L.	-	Soko	-	-	Herbaceous
Dioscoreaceae	*Dioscorea bulbifera*	L.	-	-	-	-	Herbaceous; Climbing
Dioscoreaceae	*Dioscorea dumetorum*	(kunth) Pax	-	-	-	-	Climbing
Ebenaceae	*Diospyros mespiliformis*	Hochst. ex A.DC.	-	Ebano	LC	VU	Tree
Euphorbiaceae	*Alchornea cordifolia*	(Schumach. & Thonn.) Müll.Arg.	-	muwunze, luunze	LC	-	Tree
Euphorbiaceae	*Bridelia ferruginea*	Benth.	-	Nkankati, muindu, windu, nkalakala	LC	-	Tree; Shrub

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Euphorbiaceae	*Euphorbia cotinifolia*	L.	-	-	LC	-	Tree
Euphorbiaceae	*Euphorbia hirta*	L.	-	-	-	-	Herbaceous
Euphorbiaceae	*Euphorbia pulcherrima*	Willd. Ex Klotzsch	-	-	LC	-	Tree
Euphorbiaceae	*Euphorbia thymifolia*	L.	-	Mayene mankombo	-	-	Herbaceous
Euphorbiaceae	*Jatropha curcas*	L.	-	Mpuluka	LC	-	Tree; Shrub
Euphorbiaceae	*Macaranga monandra*	Müll.Arg.	-	Nsasa	LC	-	Tree
Euphorbiaceae	*Manihot esculenta*	Crantz		Mandioca; madioko	-	-	Shrub
Euphorbiaceae	*Neoboutonia melleri*	(Mull.Arg.) Prain	-	Kiunze, luunze	LC	-	Tree
Euphorbiaceae	*Plukenetia conophora*	Müll.Arg.	-	-	-	-	Shrub; Climbing
Euphorbiaceae	*Ricinodendron heudelotii*	(Baill.) Heckel		Monguela, munguela	LC	VU	Tree
Euphorbiaceae	*Ricinus communis*	L.	-	Mamona	-	Invasive	Shrub
Fabaceae	*Albizia glaberrima*	(Schumach. & Thonn.) Benth.	-	-	LC	VU	Tree
Fabaceae	*Albizia gummifera*	(J.F.Gmel.) C.A.Sm.	-	-	LC	-	Tree
Fabaceae	*Arachis hypogea*	L.	-	Nguba; amendoim	-	-	Herbaceous
Fabaceae	*Bauhinia variegata*	L.	-	-	LC	-	Tree
Fabaceae	*Brachystegia spiciformis*	Benth.	-	Mupanda	LC	VU	Tree
Fabaceae	*Cajanus cajan*	(L.) Huth	-	Wandu	-	-	Shrub
Fabaceae	*Calopogonium mucunoides*	Desv.	-	-	-	-	Herbaceous; Climbing

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Fabaceae	*Canavalia gladiata*	(Jacq.) DC.	-	Nzimamanu	-	-	Herbaceous; Shrub; Climbing
Fabaceae	*Dalbergia latifolia*	Roxb.	-	Pau preto	VU	VU	Tree
Fabaceae	*Desmodium velutinum*	(Willd.) DC.	*Polhillides velutina* (Willd.) H.Ohashi & K.Ohashi	Malamalama	-	-	Herbaceous; Shrub; Climbing
Fabaceae	*Entadopsis abyssinica*	(Steud. ex A.Rich.) G.C.C.Gilbert & Boutique	Entada abyssina Steud. ex A.Rich.	-	-	-	Tree
Fabaceae	*Eriosema glomeratum*	(Guill. & Perr.) Hook.f.	-	Zila wando	-	-	Herbaceous
Fabaceae	*Eriosema psoraleoides*	(Lam.) G.Don	-	-	-	-	Herbaceous
Fabaceae	*Erythrina abyssinica*	Lam.	-	Mulungulungo; mugomangoma; nlungwa kwma	LC	-	Tree, Shrub
Fabaceae	*Inga edulis*	Mart.	-	Ingá	LC	-	Tree
Fabaceae	*Libidibia ferrea* var. *leiostachya*	(Benth.) L.P.Queiroz	*Caesalpinia leostachya* (Benth.) Ducke	Pau ferro	-	VU	Tree
Fabaceae	*Millettia nudiflora*	Welw. ex Baker	-	-	-	-	Tree
Fabaceae	*Millettia versicolor*	Baker	-	Pau ferro, mbota,mbandu	LC	-	Tree
Fabaceae	*Mimosa pudica*	L.	-	-	LC	-	Tree
Fabaceae	*Phaseolus vulgaris*	L.	-	Feijão	LC	-	Herbaceous; Climbing
Fabaceae	*Piliostigma thonningi*	(Schumach.) Milne-Redh.	-	-	-	-	Tree

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Fabaceae	*Piptadeniastrum africanum*	(Hook.f.) Brenan	-	-	LC	-	Tree
Fabaceae	*Pterocarpus angolensis*	DC.	-	Tacula	LC	VU	Tree
Fabaceae	*Scorodophloeus zenkeri*	Harms	-	-	LC	-	Tree
Fabaceae	*Senna alata*	(L.) Roxb.	-	-	LC	-	Tree
Fabaceae	*Senna occidentalis*	(L.) Link	-	Maniokanioka	LC	-	Herbaceous; Shrub
Fabaceae	*Tephrosia vogelii*	Hook.f.	-	-	LC	-	Tree
Gnetaceae	*Gnetum africanum*	Welw.	-	N´fumbua	NT	VU	Vine
Hyperaceae	*Harungana madagascariensis*	Lam. Ex Poir.	-	Ntunu	LC	-	Tree
Hypericaceae	*Psorospermum febrifugum*	Spach	-	Nlengula, kilengula, pau preto	LC	-	Tree
Iridaceae	*Eleutherine bulbosa*	(Mill.) Urb.	-	-	-	-	Herbaceous
Lamiaceae	*Alvesia rosmarinifolia*	Welw.	-	-	-	-	Tree
Lamiaceae	*Clerodendrum formicarum*	Gurke	-	Lomba a mvula	LC	-	Tree; Shrub
Lamiaceae	*Hyptis suaveolens*	(L.) Poit.	*Mesosphaerum suaveolens* (L.) Kuntze	Kinsaquati	-	-	Herbaceous
Lamiaceae	*Ocimum gratissimum*	L.	-	Mazudizudi	-	-	Herbaceous; subshrub
Lamiaceae	*Vitex madiensis*	Oliv.	-	Mafilu, mfilumfilu	LC	-	Tree
Loganiacieae	*Strychnos cocculoides*	Baker	-	-	LC	-	Tree
Loranthaceae	*Phragmanthera sp.*	Tiegh	-	Kinama, nama	-	-	Shrub

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Malvaceae	Abelmoschus esculentus	(L.)	*Hibiscus esculentus* L.	Quiabo	-	-	Herbaceous
Malvaceae	*Adansonia digitata*	L.	-	Kibaba, embondeiro	-	VU	Tree
Malvaceae	*Ceiba pentandra*	(L.) Gaertn.	-	-	LC	VU	Tree
Malvaceae	*Cola acuminata*	(P.Beauv.) Schott & Endl.	-	Coleira	LC	-	Tree
Malvaceae	*Glyphaea brevis*	(Spreng.) Monach.	-	-	LC	-	Tree; Shrub
Malvaceae	*Gossypium barbadense*	L.	-	Algodeiro, husu	LC	-	Tree; Shrub
Malvaceae	*Gossypium herbaceum*	L.	-	Algodoeiro	DD	-	Shrub
Malvaceae	*Sida acuta*	Burm. F.	-	Lumzumzu	-	-	Herbaceous
Malvaceae	*Sterculia quinqueloba*	(Garcke) K.Schum.		-	-	-	Tree
Malvaceae	*Triumfetta cordifolia*	A. Rich.	-	Kingongi, luvunga	-	-	Shrub
Malvaceae	*Triumfetta rhomboidea*	Jacq	-	Ginsunsu branco	-	-	Shrub
Malvaceae	*Urena lobata*	L.	-	Mpunga; makolokosso; gingonge, ginsunsu	LC	-	Herbaceous
Marantaceae	*Hypselodelphys poggeana*	(K.Schum.) Milne-Redh.	-	-	-	-	Herbaceous
Melastomataceae	*Tristemma mauritianum*	J.F.Gmel.	-	-	-	-	Herbaceous; Shrub; Climbing
Meliaceae	*Azadirachta indica*	A. Juss.	-	Neem	LC	-	Tree
Meliaceae	*Entandrophragma angolensis*	(Welw.) C.DC.	-	-	NT	VU	Tree
Meliaceae	*Entandrophragma utile*	(Dawe & Sprague) Sprague	-	Munguba	VU	VU	Tree

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Meliaceae	*Khaya anthoteca*	(Welw.) C.DC.	-	Undianuno, Kibaba	VU	VU	Tree
Moraceae	*Antiaris toxicaria* subsp. *welwitschii*	(Engl.) C.C.Berg	*Antiaris welwitschii* Engl.	N'dulo-Ako	-	VU	Tree
Moraceae	*Artocarpus altilis*	(Parkinson ex F.A.Zorn) Fosberg	-	Fruta pão	-	-	Tree
Moraceae	*Chlorophora excelsa*	(Welw.) Benth. & Hook.f.	Milicia excelsa (Welw.) C.C.Berg	iroko	NT	VU	Tree
Moraceae	*Treculia africana*	Decne. ex Trécul	-	-	LC	-	Tree
Musaceae	*Musa sp.*	-	-	Bananeira	-	-	Tree
Myritaceae	*Psidium guajava*	L.	-	Goiabeira	LC	-	Tree; Shrub
Myritaceae	*Syzygium guineense*	(Willd.) DC.	-	Nkizu	LC	-	Tree; Shrub
Myrtaceae	*Eucalyptus* sp.	-	-	Eucalipto	-	-	Tree
Ochnaceae	*Ochna afzelii subsp. mechowiana*	(O. Hoffm.) N. Robson	-	Coxianti	-	-	Tree
Orobanchaceae	*Sopubia lanata*	Engl.	-	Diamba dia kana	-	-	Subshrub
Oxalidacaceae	*Oxalis latifolia*	Kunth	-	Banana folha	-	-	Herbaceous
Passifloraceae	*Passiflora edulis*	Sims	-	Maracujá	-	-	Herbaceous; Climbing
Phyllanthaceae	*Bridelia micrantha*	(Hochst.) Baill.	-	mukalakala	LC	-	Tree
Phyllanthaceae	*Hymenocardia acida*	Tul.	-	Luvete	LC	-	Shrub
Phyllanthaceae	*Hymenocardia ulmoides*	Oliv.	-	Nkalangangula	LC	-	Tree
Piperaceae	*Piper guineese*	Schumach. & Thonn.	-	-	LC	-	Tree
Poaceae	*Andropogon spp.*	-	-	-	-	-	Herbaceous

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Poaceae	*Cenchrus purpureus*	(Schumach.) Morrone	*Pennisetum purpureum* Schumach.	Ndiadia	LC	-	Herbaceous
Poaceae	*Cymbopogon densiflorus*	(Steud.) Stapf	-	-	-	-	Herbaceous
Poaceae	*Hyparrhenia spp.*	-	-	Capim, maxinde, musoki	-	-	Herbaceous
Poaceae	*Imperata cylindrica*	(L.) Raeush.	-	Kindonga	LC	-	Herbaceous
Poaceae	*Loudetia spp.*	-	-	-	-	-	Herbaceous
Poaceae	*Panicum spp.*	-	-	-	-	-	Herbaceous
Poaceae	*Pennisetum spp.*	-	-	-	-	-	Herbaceous
Poaceae	*Saccharum officinarum*	L.	-	Mukuku	-	-	Herbaceous
Poaceae	*Setaria megaphylla*	(Steud.) T. Durand & Schinz	-	Makangaya, madianga	-	-	Herbaceous
Poaceae	*Zea mays*	L.	-	Masangu; milho	LC	-	Herbaceous
Rubiaceae	*Coffea canephora*	Pierre ex A.Froehner	-	-	LC	-	Shrub
Rubiaceae	*Gardenia ternifolia*	Schumach. & Thonn.	subso. Jovis.tonantis (Welw.) verd.	lemba nzau; kilemba nzau;kidia	LC	-	Shrub
Rubiaceae	*Morinda lucida*	Benth.	-	Mazige, nsiki	LC	-	Tree; Shrub
Rubiaceae	*Mussaenda arcuata*	Poir.	-	Nsilu-nsilu	-	-	Shrub; Climbing
Rubiaceae	*Mussaenda erythrophylla*	Schumach. & Thonn.	-	-	LC	-	Tree
Rubiaceae	*Sarcocephalus latifolius*	(Sm.) E.A.Bruce	*Nauclea latifolia* Sm.	Kelolo, kilolwa grande	-	-	Tree; Shrub
Rutaceae	*Zanthoxylum gilletii*	(De Wild.) P.G.Waterman	-	Ndansia tenga	LC	-	Tree
Santalaceae	*Santalum album*	L.	-	Sandalo Africano	VU	VU	Tree
Sapotaceae	*Autrenella congolensis*	(De Wild.) A.Chev.	-	Kungulo-Mukungulo	EN	VU	Tree

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Sapotaceae	*Gambeya africana*	(A.DC.) Pierre	-	Longui	LC	VU	Tree
Smilacaceae	*Smilax anceps*	Willd.	-	Gipolo, mpolo, mukulu	-	-	Shrub; Climbing
Solanaceae	*Datura metel*	L.	-	-	-	-	Herbaceous
Solanaceae	*Solanum aculeastrum*	Dunal	-	Mabumi, gituno	LC	-	Tree; Shrub
Solanaceae	*Solanum americanum*	Mill.	-	Lundumbo, ndumbo	-	-	Herbaceous
Solanaceae	*Solanum incanum*	L.	-	-	LC	-	Herbaceous; Shrub
Solanaceae	*Solanum mauritianum*	Scop.	-	Malulua branca, daniele	-	Invasive	Herbaceous
Solanaceae	*Solanum melongena*	L.	-	Beringela	-	-	Herbaceous
Solanaceae	*Solanum nigrum*	L.	-	Gizue, lundunbo, windangonge	-	-	Herbaceous
Solanaceae	*Solanum tuberosum*	L.	-	Batata rena	-	-	Herbaceous
Urticaceae	*Musanga cecropioides*	R.Br. ex Tedlie	-	Musengasenga	LC	-	Tree
Verbenaceae	*Lippia multiflora*	Moldenke	-	Bulukutu	-	-	Shrub
Verbenaceae	*Stachytarpheta cayennensis*	(Rich.) Vahl	-	Kalangue	-	-	Herbaceous; subshrub
Vitaceae	*Cayratia gracilis*	(Guill. & Perr.) Suess.	-	Nlembuzi	-	-	Herbaceous; subshrub; Climbing
Vitaceae	*Cissus rubiginosa*	(Welw. Ex Baker) Planch	-	Nkokelakai, Mukokelakai	-	-	Herbaceous; subshrub; Climbing

Family	*Species*	Authority	Synonyms	Common name	LV	MA	Habit
Zingiberaceae	*Aframomum alboviolaceum*	(Ridl.) K.Schum.	-	Ntundulu	LC	-	Herbaceous
Zingiberaceae	*Aframomum angustifolium*	(Sonn.) K.Schum.	-	-	LC	-	Herbaceous
Zingiberaceae	*Aframomum melegueta*	K.Schum.	-	Ndungu-zanzo	DD	-	Herbaceous
Zingiberaceae	*Aframomum stanfieldii*	Hepper	-	-	LC	-	Herbaceous
Zingiberaceae	*Zingiber officinale*	L.	-	Tanga-wisi	DD	-	Herbaceous; Shrub

Legend:
LV: extinction risk according to the IUCN Red List of Threatened Species (IUCN, 2022); LC - low concern; NT - near threatened; VU - vulnerable; EN - endangered; DD - data deficient..
MA: at risk of extinction in Angola according to the Angolan Red List of Species (Ministério do Ambiente, 2018): VU – vulnerable.
Sources: Lautenschläger & Neinhuis, 2014; Huntley & Matos, 1994; Gohre, et al., 2016; Ministry of Environment, 2018; Mawunu, et al., 2020; IUCN, 2022.

Family	Species	Author	IUCN	MA	End.	CITES
AMPHIBIA						
Anura						
Arthroleptidae	*Leptopelis anchietae*	Bocage, 1873	LC	-	End.	-
Arthroleptidae	*Leptopelis bocagii*	Günther, 1865	LC	-	-	-
Brevicipitidae	*Breviceps cf. adspersus*	Peters, 1882	LC	-	-	-
Bufonidae	*Sclerophrys funerea*	Bocage, 1866	LC	-	-	-
Sclerophrys pusilla	*Sclerophrys pusilla*	Merten's 1937	LC	-	-	-
Dicroglossidae	*Hoplobatrachus occipitalis*	Günther, 1858	LC	-	-	-
Hemisotidae	*Hemisus guineensis*	Cope, 1865	LC	-	-	-
Hyperoliidae	*Afrixalus osorioi*	Ferreira, 1906	LC	-	-	-
Hyperoliidae	*Hyperolius bocagei*	Steindachner, 1867	LC	-	-	-
Hyperoliidae	*Hyperolius cinnamomeoventris*	Bocage, 1866	LC	-	-	-
Hyperoliidae	*Hyperolius dartevellei*	Laurent, 1943	LC	-	-	-
Hyperoliidae	*Hyperolius nasutus*	Günther, 1865	LC	-	-	-
Hyperoliidae	*Hyperolius parallelus*	Günther, 1858	LC	-	-	-
Hyperoliidae	*Hyperolius platyceps*	Boulenger, 1900	LC	-	-	-
Hyperoliidae	*Kassina senegalensis*	Duméril & Bibron, 1841	LC	-	-	-
Phrynobatrachidae	*Phrynobatrachus natalensis*	Smith, 1849	LC	-	-	-
Pipidae	*Xenopus andrei*	Loumont, 1983	LC	-	-	-
Pipidae	*Xenopus petersii*	Bocage, 1895	LC	-	-	-
Ptychadenidae	*Ptychadena anchietae*	Bocage, 1868	LC	-	-	-
Ptychadenidae	*Ptychadena oxyrhynchus*	Smith , 1849	LC	-	-	-
Ptychadenidae	*Ptychadena porosissima*	Steindachner, 1867	LC	-	-	-
Ptychadenidae	*Ptychadena taenioscelis*	Laurent, 1954	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Pyxicephalidae	*Amietia angolensis*	Bocage ,1866	LC	-	End.	-
Ranidae	*Amnirana lepus*	Andersson, 1903	LC	-	-	-
REPTILIA						
Crocodylia						
Crocodylidae	*Crocodylus niloticus*	Laurenti, 1768	LC	Vul	-	II
Crocodylidae	*Osteolaemus tetraspis*	Cope, 1861	VU	-	-	I
Squamata						
Agamidae	*Agama agama*	Linnaeus, 1758	LC	-	-	-
Amphisbaenidae	*Monopeltis vanderysti*	De Witte, 1922	LC	-	-	-
Atractaspididae	*Atractaspis congica*	Peters, 1877	LC	-	-	-
Atractaspididae	*Atractaspis reticulata*	Sjöstedt, 1896	LC	-	-	-
Atractaspididae	*Polemon collaris*	Peters, 1881	LC	-	-	-
Atractaspididae	*Xenocalamus mechowii*	Peters, 1881	LC	-	-	-
Chamaeleonidae	*Chamaeleo dilepis*	Leach, 1819	LC	-	-	II
Chamaeleonidae	*Chamaeleo gracilis*	Hallowell, 1844	LC	-	-	II
Colubridae	*Crotaphopeltis hotamboeia*	Laurenti, 1768	LC	-	-	-
Colubridae	*Dasypeltis palmarum*	Leach, 1818	LC	-	-	-
Colubridae	*Dasypeltis scabra*	Linnaeus, 1758	LC	-	-	-
Colubridae	*Dipsadoboa shrevei*	Loveridge, 1932	LC	-	-	-
Colubridae	*Dispholidus typus*	A. Smith, 1828	LC	-	-	-
Colubridae	*Hapsidophrys smaragdinus*	Schlegel, 1837	LC	-	-	-
Colubridae	*Philothamnus angolensis*	Bocage, 1866	LC	-	-	-
Colubridae	*Philothamnus carinatus*	Andersson, 1901	LC	-	-	-
Colubridae	*Philothamnus dorsalis*	Bocage, 1866	LC	-	-	-
Colubridae	*Philothamnus heterodermus*	Hallowell, 1857	LC	-	-	-
Colubridae	*Philothamnus heterolepidotus*	Günther, 1863	LC	-	-	-
Colubridae	*Philothamnus hoplogaster*	Günther, 1864	LC	-	-	-
Colubridae	*Philothamnus ornatus*	Bocage, 1872	LC	-	-	-
Colubridae	*Philothamnus semivariegatus*	A. Smith, 1840	LC	-	-	-
Colubridae	*Telescopus semiannulatus*	A. Smith, 1849	LC	-	-	-
Colubridae	*Thelotornis kirtlandii*	Hallowell, 1844	LC	-	-	-
Colubridae	*Thrasops flavigularis*	Hallowell, 1852	LC	-	-	-
Colubridae	*Thrasops jacksoni*	Günther, 1895	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Colubridae	*Toxicodryas blandingii*	Hallowell, 1844	LC	-	-	-
Colubridae	*Toxicodryas pulverulenta*	Fischer, 1856	LC	-	-	-
Elapidae	*Dendroaspis jamesoni*	Traill, 1843	LC	-	-	-
Elapidae	*Elapsoidea guentherii*	Bocage, 1866	LC	-	-	-
Elapidae	*Elapsoidea s. semiannulata*	Bocage, 1882	LC	-	-	-
Elapidae	*Naja nigricollis*	Reinhardt, 1843	LC	-	-	-
Elapidae	*Naja) subfulva*	Laurent, 1955	LC	-	-	-
Elapidae	*Naja melanoleuca*	Hallowell, 1857	LC	-	-	-
Elapidae	*Pseudohaje goldii*	Boulenger, 1895	LC	-	-	-
Gekkonidae	*Hemidactylus longicephalus*	Bocage, 1873	LC	-	-	-
Gekkonidae	*Hemidactylus mabouia*	Moreau de Jonnès, 1818	LC	-	-	-
Gekkonidae	*Hemidactylus paivae*	Agarwal, Marques & Bauer Bauer, 2020	-	-	-	-
Gerrhosauridae	*Gerrhosaurus multilineatus*	Bocage, 1866	LC	-	-	-
Gerrhosauridae	*Gerrhosaurus nigrolineatus*	Hallowell, 1857	LC	-	-	-
Grayiidae	*Grayia ornata*	Bocage, 1866	LC	-	-	-
Grayiidae	*Grayia smithii*	Leach, 1818	LC	-	-	-
Lacertidae	*Holaspis guentheri*	Gray, 1863	LC	-	-	-
Lacertidae	*Ichnotropis b. bivittata*	Bocage, 1866	LC	-	-	-
Lamprophiidae	*Boaedon angolensis*	Duméril, Bibron & Duméril, 1854	LC	-	-	-
Lamprophiidae	*Boaedon fuliginosus*	Boie, 1827	LC	-	-	-
Lamprophiidae	*Boaedon olivaceus*	Duméril, 1856	LC	-	-	-
Lamprophiidae	*Lycophidion multimaculatum*	Boettger, 1888	LC	-	-	-
Lamprophiidae	*Lycophidion ornatum*	Parker, 1936	LC	-	-	-
Lamprophiidae	*Mehelya poensis*	A. Smith, 1849	LC	-	-	-
Leptotyphlopidae	*Leptotyphlops kafubi*	Boulenger, 1919	LC	-	-	-
Natricidae	*Limnophis bicolor*	Günther, 1865	LC	-	-	-
Natricidae	*Natriciteres olivacea*	Peters, 1854	LC	-	-	-
Prosymnidae	*Prosymna ambigua*	Bocage, 1873	LC	-	-	-
Psammophiidae	*Psammophis angolensis*	Bocage, 1872	LC	-	-	-
Psammophiidae	*Psammophis mossambicus*	Peters, 1882	LC	-	-	-
Psammophiidae	*Psammophylax acutus*	Günther, 1888	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Pythonidae	*Python anchietae*	A. Smith, 1840	LC	-	-	II
Pythonidae	*Python sebae**	Gmelin in Linnaeus, 1789	NT	-	-	II
Scincidae	*Feylinia currori*	Gray, 1845	LC	-	-	-
Scincidae	*Panaspis cabindae*	Bocage, 1866	LC	-	-	-
Scincidae	*Sepsina angolensis*	Bocage, 1866	LC	-	-	-
Scincidae	*Trachylepis affinis*	Gray, 1838	LC	-	-	-
Scincidae	*Trachylepis b. bayoni*	Bocage, 1872	LC	-	-	-
Scincidae	*Trachylepis maculilabris*	Gray, 1845	LC	-	-	-
Scincidae	*Trachylepis striata*	Peters, 1844	LC	-	-	-
Typhlopidae	*Afrotyphlops angolensis*	Bocage, 1866	LC	-	-	-
Typhlopidae	*Afrotyphlops lineolatus*	Jan, 1864	LC	-	-	-
Typhlopidae	*Letheobia praeocularis*	Stejneger, 1894	LC	-	-	-
Varanidae	*Varanus niloticus*	Linnaeus, 1758	LC	-	-	II
Viperidae	*Atheris squamigera*	Hallowell, 1854	LC	-	-	-
Viperidae	*Bitis arietans*	Merrem, 1820	LC	-	-	-
Viperidae	*Bitis heraldica*	Bocage, 1889	VU	-	End.	-
Viperidae	*Bitis nasicornis*	Shaw & Nodder, 1792	VU	-	-	-
Viperidae	*Causus bilineatus*	Boulenger, 1905	LC	-	-	-
Viperidae	*Causus maculatus*	Hallowell, 1842	LC	-	-	-
Viperidae	Causus resimus	Peters, 1862	LC	-	-	-
Testudines						
Pelomedusidae	*Kinixys belliana*	Gray, 1831	-	-	-	II
Pelomedusidae	*Pelusios rhodesianus*	Hewitt, 1927	LC	-	-	-
AVES						
Accipitriformes						
Accipitridae	*Accipiter badius*	Gmelin, 1788	LC	-	-	II
Accipitridae	*Accipiter castanilius*	Bonaparte, 1853	LC	-	-	II
Accipitridae	*Accipiter melanoleucus*	Smith, 1830	LC	-	-	II
Accipitridae	*Aquila spilogaster*	Bonaparte, 1850	LC	-	-	II
Accipitridae	*Aviceda cuculoides*	Swainson, 1837	LC	-	-	II
Accipitridae	*Buteo auguralis*	Salvadori, 1865	LC	-	-	II
Accipitridae	*Buteo buteo*	Linnaeus, 1758	LC	-	-	II
Accipitridae	*Circaetus cinerascens*	von Müller, 1851	LC	-	-	II
Accipitridae	*Circaetus cinereus*	Vieillot, 1818	LC	-	-	II
Accipitridae	*Circaetus pectoralis*	A. Smith, 1829	LC	-	-	II

Family	Species	Author	IUCN	MA	End.	CITES
Accipitridae	*Dryotriorchis spectabili*	Schlegel, 1863	LC	-	-	II
Accipitridae	*Elanus caeruleus*	Desfontaines, 1789	LC	-	-	II
Accipitridae	*Gypohierax angolensis*	Gmelin, 1788	LC	-	-	II
Accipitridae	*Haliaeetus vocifer*	Daudin, 1800	LC	-	-	II
Accipitridae	*Hieraaetus ayresii*	Gurney, 1862	LC	-	-	II
Accipitridae	*Kaupifalco monogrammicus*	Temminck, 1824	LC	-	-	II
Accipitridae	*Lophaetus occipitalis*	Daudin, 1800	LC	-	-	II
Accipitridae	*Macheiramphus alcinus*	Westermann, 1851	LC	-	-	II
Accipitridae	*Micronisus gabar*	Daudin, 1800	LC	-	-	II
Accipitridae	*Milvus aegyptius*	J.F. Gmelin, 1788	LC	-	-	-
Accipitridae	*Milvus migrans*	Boddaert, 1783	LC	-	-	II
Accipitridae	*Pernis apivorus*	Linnaeus, 1758	LC	-	-	II
Accipitridae	*Polemaetus bellicosus*	Daudin, 1800	EN	-	-	II
Accipitridae	*Polyboroides typus*	Smith, 1829	LC	-	-	II
Accipitridae	*Terathopius ecaudatus*	Daudin, 1801	EN	-	-	II
Accipitridae	*Urotriorchis macrourus*	Hartlaub, 1855	LC	-	-	II
Pandionidae	*Pandion haliaetus*	Linnaeus, 1758	LC	-	-	II
Sagittariidae	*Sagittarius serpentarius*	Miller, 1779	EN	-	-	II
Anseriformes						
Anatidae	*Alopochen aegyptiaca*	Linnaeus, 1766	LC	-	-	-
Anatidae	*Anas capensis*	Gmelin, 1789	LC	-	-	-
Anatidae	*Anas erythrorhyncha*	Gmelin, 1789	LC	-	-	-
Anatidae	*Anas sparsa*	Eyton, 1838	LC	-	-	-
Anatidae	*Anas undulata*	Dubois, 1839	LC	-	-	-
Anatidae	*Dendrocygna bicolor*	Vieillot, 1816	LC	-	-	III
Anatidae	*Dendrocygna viduata*	Linnaeus, 1766	LC	-	-	-
Anatidae	*Nettapus auritus*	Boddaert, 1783	LC	-	-	-
Anatidae	*Plectropterus gambensis*	Linnaeus, 1766	LC	-	-	-
Anatidae	*Pteronetta hartlaubii*	Cassin, 1859	LC	-	-	-
Anatidae	*Sarkidiornis melanotos*	Pennant, 1769	LC	-	-	II
Anatidae	*Thalassornis leuconotus*	Eyton, 1838	LC	-	-	-
Bucerotiformes						
Bucerotidae	*Ceratogymna atrata*	Temminck, 1835	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Bucerotidae	*Lophoceros fasciatus*	Shaw, 1811	LC	-	-	-
Bucerotidae	*Tockus alboterminatus*	Roberts, 1930	LC	-	-	-
Phoeniculidae	*Phoeniculus purpureus*	Miller, 1784	LC	-	-	-
Phoeniculidae	*Rhinopomastus aterrimus*	Stephens, 1826	LC	-	-	-
Upupidae	*Upupa epops*	Linnaeus, 1758	LC	-	-	-
Caprimulgiformes						
Apodidae	*Apus affinis*	Gray, 1830	LC	-	-	-
Apodidae	*Apus apus*	Linnaeus, 1758	LC	-	-	-
Apodidae	*Cypsiurus parvus*	Lichtenstein, 1823	LC	-	-	-
Caprimulgidae	*Caprimulgus fossii*	Hartlaub, 1857	LC	-	-	-
Charadriiformes						
Burhinidae	*Burhinus capensis*	Lichtenstein, 1823	LC	-	-	-
Charadriidae	*Charadrius forbesi*	Shelley, 1883	LC	-	-	-
Charadriidae	*Charadrius hiaticula*	Linnaeus, 1758	LC	-	-	-
Charadriidae	*Charadrius pecuarius*	Temminck, 1823	LC	-	-	-
Charadriidae	*Charadrius tricollaris*	Vieillot, 1818	LC	-	-	-
Charadriidae	*Vanellus albiceps*	Gould, 1834	LC	-	-	-
Charadriidae	*Vanellus senegallus*	Linnaeus, 1766	LC	-	-	-
Glareolidae	*Cursorius temminckii*	Swainson, 1822	LC	-	-	-
Glareolidae	*Glareola cinerea*	Fraser, 1843	LC	-	-	-
Glareolidae	*Rhinoptilus chalcopterus*	Temminck, 1824	LC	-	-	-
Jacanidae	*Actophilornis africanus*	Gmelin, 1789	LC	-	-	-
Laridae	*Chlidonias leucopterus*	Temminck, 1815	LC	-	-	-
Laridae	*Larus cirrocephalus*	Vieillot, 1818	LC	-	-	-
Laridae	*Rynchops flavirostris*	Vieillot, 1816	LC	-	-	-
Rostratulidae	*Rostratula benghalensis*	Linnaeus, 1758	LC	-	-	-
Scolopacidae	*Actitis hypoleucos*	Linnaeus, 1758	LC	-	-	-
Scolopacidae	*Calidris minuta*	Leisler, 1812	LC	-	-	-
Scolopacidae	*Gallinago media*	Latham, 1787	LC	-	-	-
Scolopacidae	*Gallinago nigripennis*	Bonaparte, 1839	LC	-	-	-
Scolopacidae	*Tringa glareola*	Linnaeus, 1758	LC	-	-	-
Scolopacidae	*Tringa nebularia*	Gunnerus, 1767	LC	-	-	-
Scolopacidae	*Tringa ochropus*	Linnaeus, 1758	LC	-	-	-
Scolopacidae	*Tringa stagnatilis*	Bechstein, 1803	LC	-	-	-
Turnicidae	*Turnix nanus*	Sundevall, 1851	LC	-	-	-

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Turnicidae	*Turnix sylvaticus*	Desfontaines, 1787	LC	-	-	-
Ciconiiformes						
Ciconiidae	*Anastomus lamelligerus*	Temminck, 1823	LC	-	-	-
Ciconiidae	*Ciconia abdimii*	Lichtenstein, 1823	LC	-	-	-
Ciconiidae	*Ephippiorhynchus senegalensis*	Shaw, 1800	LC	-	-	-
Ciconiidae	*Mycteria ibis*	Linnaeus, 1766	LC	-	-	-
Coliiformes						
Coliidae	*Colius striatus*	Gmelin, 1789	LC	-	-	-
Columbiformes						
Columbidae	*Aplopelia larvata*	Temminck, 1809	LC	-	-	-
Columbidae	*Columba iriditorques*	Cassin, 1856	LC	-	-	-
Columbidae	*Columba unicincta*	Cassin, 1860	LC	-	-	-
Columbidae	*Oena capensis*	Linnaeus, 1766	LC	-	-	-
Columbidae	*Streptopelia capicola*	Sundevall, 1857	LC	-	-	-
Columbidae	*Streptopelia semitorquata*	Rüppell, 1837	LC	-	-	-
Columbidae	*Treron calvus*	Temminck, 1808	LC	-	-	-
Columbidae	*Turtur afer*	Linnaeus, 1766	LC	-	-	-
Columbidae	*Turtur tympanistria*	Temminck, 1809	LC	-	-	-
Coraciiformes						
Alcedinidae	*Ceryle rudis*	Linnaeus, 1758	LC	-	-	-
Alcedinidae	*Corythornis cristatus*	Pallas, 1764	LC	-	-	-
Alcedinidae	*Corythornis leucogaster*	Fraser, 1843	LC	-	-	-
Alcedinidae	*Halcyon albiventris*	Scopoli, 1786	LC	-	-	-
Alcedinidae	*Halcyon chelicuti*	Stanley, 1814	LC	-	-	-
Alcedinidae	*Halcyon leucocephala*	Müller, 1776	LC	-	-	-
Alcedinidae	*Halcyon malimbica*	Shaw, 1811	LC	-	-	-
Alcedinidae	*Halcyon senegalensis*	Linnaeus, 1766	LC	-	-	-
Alcedinidae	*Ispidina leconte*	Cassin, 1856	LC	-	-	-
Alcedinidae	*Ispidina picta*	Boddaert, 1783	LC	-	-	-
Alcedinidae	*Megaceryle maxima*	Pallas, 1769	LC	-	-	-
Coraciidae	*Coracias caudatus*	Linnaeus, 1766	LC	-	-	-
Coraciidae	*Coracias garrulus*	Linnaeus, 1758	LC	-	-	-
Coraciidae	*Coracias naevius*	Daudin, 1800	LC	-	-	-
Coraciidae	*Eurystomus glaucurus*	Müller, 1776	LC	-	-	-
Coraciidae	*Eurystomus gularis*	Vieillot, 1819	LC	-	-	-
Meropidae	*Merops bullockoides*	Smith, 1834	LC	-	-	-

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Meropidae	*Merops gularis*	Shaw, 1798	LC	-	-	-
Meropidae	*Merops persicus*	Pallas, 1773	LC	-	-	-
Meropidae	*Merops pusillus*	Müller, 1776	LC	-	-	-
Cuculiformes						
Cuculidae	*Centropus anselli*	Sharpe, 1874	LC	-	-	-
Cuculidae	*Centropus grillii*	Hartlaub, 1861	LC	-	-	-
Cuculidae	*Cercococcyx mechowi*	Cabanis, 1882	LC	-	-	-
Cuculidae	*Cercococcyx olivinus*	Sassi, 1912	LC	-	-	-
Cuculidae	*Ceuthmochares aereus*	Vieillot, 1817	LC	-	-	-
Cuculidae	*Chrysococcyx caprius*	Boddaert, 1783	LC	-	-	-
Cuculidae	*Chrysococcyx cupreus*	Shaw, 1792	LC	-	-	-
Cuculidae	*Chrysococcyx klaas*	Stephens, 1815	LC	-	-	-
Cuculidae	*Clamator jacobinus*	Boddaert, 1783	LC	-	-	-
Cuculidae	*Clamator levaillantii*	Swainson, 1829	LC	-	-	-
Cuculidae	*Cuculus canorus*	Linnaeus, 1758	LC	-	-	-
Cuculidae	*Cuculus clamosus*	Latham, 1801	LC	-	-	-
Cuculidae	*Cuculus gularis*	Stephens, 1815	LC	-	-	-
Cuculidae	*Cuculus solitarius*	Stephens, 1815	LC	-	-	-
Falconiformes						
Falconidae	*Falco ardosiaceus*	Vieillot, 1823	LC	-	-	II
Falconidae	*Falco cuvierii*	Smith, 1830	LC	-	-	II
Falconidae	*Falco naumann*	Fleischer, 1818	LC	-	-	II
Falconidae	*Falco peregrinus*	Tunstall, 1771	LC	-	-	I
Galliformes						
Phasianidae	*Coturnix delegorguei*	Delegorgue, 1847	LC	-	-	-
Phasianidae	*Pternistis afer*	Müller, 1776	LC	-	-	-
Phasianidae	*Scleroptila finschi*	Barboza du Bocage, 1881	LC	-	-	-
Phasianidae	*Synoicus adansonii*	Verreaux & Verreaux, 1851	LC	-	-	-
Gruiformes						
Heliornithidae	*Podica senegalensis*	Vieillot, 1817	LC	-	-	-
Rallidae	*Amaurornis flavirostra*	Swainson, 1837	LC	-	-	-
Rallidae	*Crex egregia*	Peters, 1854	LC	-	-	-
Rallidae	*Gallinula angulata*	Sundevall, 1851	LC	-	-	-
Rallidae	*Porphyrio alleni*	Thomson, 1842	LC	-	-	-
Rallidae	*Sarothrura elegans*	Smith, 1839	LC	-	-	-
Rallidae	*Sarothrura pulchra*	Gray, 1829	LC	-	-	-

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Musophagiformes						
Musophagidae	*Musophaga rossae*	Gould, 1852	LC	-	-	-
Musophagidae	*Tauraco erythrolophus*	Vieillot, 1819	LC	Vul	-	II
Musophagidae	*Tauraco schalowi*	Reichenow, 1891	LC	-	-	II
Otidiformes						
Otididae	*Lissotis melanogaster*	Rüppell, 1835	LC	-	-	II
Passeriformes						
Acrocephalidae	*Acrocephalus arundinaceus*	Temminck & Schlegel, 1847	LC	-	-	-
Acrocephalidae	*Acrocephalus rufescens*	Sharpe & Bouvier, 1876	LC	-	-	-
Acrocephalidae	*Acrocephalus schoenobaenus*	Linnaeus, 1758	LC	-	-	-
Acrocephalidae	*Hippolais icterina*	Vieillot, 1817	LC	-	-	III
Acrocephalidae	*Iduna natalensis*	Smith, 1847	LC	-	-	-
Alaudidae	*Mirafra rufocinnamomea*	Salvadori, 1865	LC	-	-	-
Alaudidae	*Pinarocorys nigricans*	Sundevall, 1850	LC	-	-	-
Calyptomenidae	*Smithornis capensis*	Smith, 1840	LC	-	-	-
Campephagidae	*Campephaga flava*	Vieillot, 1817	LC	-	-	-
Campephagidae	*Campephaga petiti*	Oustalet, 1884	LC	-	-	-
Cisticolidae	*Apalis binotata*	Reichenow, 1895	LC	-	-	-
Cisticolidae	*Apalis jacksoni*	Sharpe, 1891	LC	-	-	-
Cisticolidae	*Apalis rufogularis*	Fraser, 1843	LC	-	-	-
Cisticolidae	*Camaroptera harterti*	von Zedlitz, 1911	LC	-	-	-
Cisticolidae	*Camaroptera superciliaris*	Fraser, 1843	LC	-	-	-
Cisticolidae	*Cisticola anonymus*	von Müller, 1855	LC	-	-	-
Cisticolidae	*Cisticola brachypterus*	Sharpe, 1870	LC	-	-	-
Cisticolidae	*Cisticola bulliens*	Lynes, 1930	LC	-	-	-
Cisticolidae	*Cisticola chiniana*	Smith, 1843	LC	-	-	-
Cisticolidae	*Cisticola erythrops*	Hartlaub, 1857	LC	-	-	-
Cisticolidae	*Cisticola melanurus*	Cabanis, 1882	DD	-	-	-
Cisticolidae	*Cisticola natalensis*	Smith, 1843	LC	-	-	-
Cisticolidae	*Eremomela badiceps*	Fraser, 1843	LC	-	-	-
Cisticolidae	*Eremomela icteropygialis*	Lafresnaye, 1839	LC	-	-	-
Cisticolidae	*Eremomela scotops*	Sundevall, 1850	LC	-	-	-
Cisticolidae	*Prinia bairdii*	Cassin, 1855	LC	-	-	-
Cisticolidae	*Prinia subflava*	Gmelin, 1789	LC	-	-	-

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Cisticolidae	*Schistolais leucopogon*	Cabanis, 1875	LC	-	-	-
Corvidae	*Corvus albus*	Müller, 1776	LC	-	-	-
Emberizidae	*Emberiza flaviventris*	Stephens, 1815	LC	-	-	-
Emberizidae	*Emberiza tahapisi*	Smith, 1836	LC	-	-	-
Estrildidae	*Amandava subflava*	Vieillot, 1819	LC	-	-	-
Estrildidae	*Clytospiza monteiri*	Hartlaub, 1860	LC	-	-	-
Estrildidae	*Estrilda astrild*	Linnaeus, 1758	LC	-	-	-
Estrildidae	*Estrilda melpoda*	Vieillot, 1817	LC	-	-	-
Estrildidae	*Estrilda paludicola*	Heuglin, 1863	LC	-	-	-
Estrildidae	*Estrilda perreini*	Vieillot, 1817	LC	-	-	-
Estrildidae	*Lagonosticta rubricata*	Lichtenstein, 1823	LC	-	-	-
Estrildidae	*Mandingoa nitidula*	Hartlaub, 1865	LC	-	-	-
Estrildidae	*Nigrita bicolor*	Hartlaub, 1844	LC	-	-	-
Estrildidae	*Nigrita canicapillus*	Strickland, 1841	LC	-	-	-
Estrildidae	*Nigrita fusconotus*	Fraser, 1843	LC	-	-	-
Estrildidae	*Nigrita luteifrons*	Verreaux & Verreaux, 1851	LC	-	-	-
Estrildidae	*Parmoptila woodhousei*	Cassin, 1859	LC	-	-	-
Estrildidae	*Pyrenestes ostrinus*	Vieillot, 1805	LC	-	-	-
Estrildidae	*Spermestes bicolor*	Fraser, 1843	LC	-	-	-
Estrildidae	*Spermestes cucullata*	Swainson, 1837	LC	-	-	-
Estrildidae	*Uraeginthus angolensis*	Linnaeus, 1758	LC	-	-	-
Estrildidae	*Vidua macroura*	Pallas, 1764	LC	-	-	-
Estrildidae	*Vidua obtusa*	Chapin, 1922	LC	-	-	-
Fringillidae	*Crithagra capistrata*	Finsch, 1870	LC	-	-	-
Fringillidae	*Crithagra mozambica*	Müller, 1776	LC	-	-	-
Hirundinidae	*Cecropis abyssinica*	Guérin-Méneville, 1843	LC	-	-	-
Hirundinidae	*Cecropis semirufa*	Sundevall, 1850	LC	-	-	-
Hirundinidae	*Cecropis senegalensis*	Linnaeus, 1766	LC	-	-	-
Hirundinidae	*Delichon urbicum*	Linnaeus, 1758	LC	-	-	-
Hirundinidae	*Hirundo angolensis*	Barboza du Bocage, 1868	LC	-	-	-
Hirundinidae	*Hirundo dimidiata*	Sundevall, 1850	LC	-	-	-
Hirundinidae	*Hirundo nigrita*	Gray, 1845	LC	-	-	-
Hirundinidae	*Hirundo rustica*	Linnaeus, 1758	LC	-	-	-
Hirundinidae	*Hirundo smithii*	Leach, 1818	LC	-	-	-

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Hirundinidae	*Petrochelidon rufigula*	Bocage, 1878	LC	-	-	-
Hirundinidae	*Petrochelidon spilodera*	Sundevall, 1850	LC	-	-	-
Hirundinidae	*Psalidoprocne pristoptera*	Rüppell, 1836	LC	-	-	-
Hirundinidae	*Riparia cincta*	Boddaert, 1783	LC	-	-	-
Hirundinidae	*Riparia paludicola*	Vieillot, 1817	LC	-	-	-
Laniidae	*Lanius collaris*	Linnaeus, 1766	LC	-	-	-
Laniidae	*Lanius collurio*	Linnaeus, 175	LC	-	-	-
Laniidae	*Lanius mackinnon*	Sharpe, 1891	LC	-	-	-
Leiotrichidae	*Turdoides jardineii*	Smith, 1836	LC	-	-	-
Locustellidae	*Schoenicola brevirostris*	Sundevall, 1850	LC	-	-	-
Macrosphenidae	*Macrosphenus flavicans*	Cassin, 1859	LC	-	-	-
Macrosphenidae	*Melocichla mentalis*	Fraser, 1843	LC	-	-	-
Macrosphenidae	*Sylvietta virens*	Cassin, 1859	LC	-	-	-
Malaconotidae	*Chlorophoneus bocage*	Reichenow, 1894	LC	-	-	-
Malaconotidae	*Chlorophoneus multicolor*	Gray, 1845	LC	-	-	-
Malaconotidae	*Dryoscopus angolensis*	Hartlaub, 1860	LC	-	-	-
Malaconotidae	*Dryoscopus cubla*	Shaw, 1809	LC	-	-	-
Malaconotidae	*Laniarius brauni*	Bannerman, 1939	EN	-	S	-
Malaconotidae	*Nilaus afer*	Latham, 1801	LC	-	-	-
Malaconotidae	*Tchagra australis*	Smith, 1836	LC	-	-	-
Malaconotidae	*Tchagra senegalus*	Linnaeus, 1766)	LC	-	-	-
Malaconotidae	*Telophorus viridis*	Vieillot, 1817	LC	-	-	-
Monarchidae	*Terpsiphone batesi*	Chapin, 1921	LC	-	-	-
Monarchidae	*Terpsiphone rufiventer*	Swainson, 1837	LC	-	-	-
Monarchidae	*Terpsiphone rufocinerea*	Cabanis, 1875	LC	-	-	-
Monarchidae	*Terpsiphone viridis*	Müller, 1776	LC	-	-	-
Monarchidae	*Trochocercus nitens*	Cassin, 1859	LC	-	-	-
Motacillidae	*Anthus pallidiventris*	Sharpe, 1885	LC	-	-	-
Motacillidae	*Macronyx croceus*	Vieillot, 1816	LC	-	-	-
Motacillidae	*Motacilla aguimp*	Dumont, 1821	LC	-	-	-
Motacillidae	*Motacilla flava*	Linnaeus, 1758	LC	-	-	-
Muscicapidae	*Bradornis boehmi*	Reichenow, 1884	LC	-	-	-
Muscicapidae	*Bradornis comitatus*	Cassin, 1857	LC	-	-	-
Muscicapidae	*Bradornis fuliginosus*	Cassin, 1855	LC	Vul	-	-

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Muscicapidae	*Cercotrichas hartlaubi*	Reichenow, 1891	LC	-	-	-
Muscicapidae	*Cichladusa ruficauda*	Hartlaub, 1857	LC	-	-	-
Muscicapidae	*Cossypha natalensis*	Smith, 1840	LC	-	-	-
Muscicapidae	*Fraseria caerulescens*	Hartlaub, 1865	LC	-	-	-
Muscicapidae	*Fraseria griseigularis*	Jackson, 1906	LC	-	-	-
Muscicapidae	*Fraseria plumbea*	Hartlaub, 1858	LC	-	-	-
Muscicapidae	*Muscicapa cassini*	Heine, 1859	LC	-	-	-
Muscicapidae	*Muscicapa striata*	Pallas, 1764	LC	-	-	-
Muscicapidae	*Oenanthe familiaris*	Wilkes, 1817	LC	-	-	-
Muscicapidae	*Saxicola torquatus*	Linnaeus, 1766	LC	-	-	-
Nectariniidae	*Chalcomitra rubescens*	Vieillot, 1819	LC	-	-	-
Nectariniidae	*Cinnyris bifasciatus*	Shaw, 1811	LC	-	-	-
Nectariniidae	*Cinnyris chloropygius*	Jardine, 1842	LC	-	-	-
Nectariniidae	*Cinnyris cupreus*	Shaw, 1811	LC	-	-	-
Nectariniidae	*Cinnyris superbus*	Shaw, 1811	LC	-	-	-
Nectariniidae	*Cinnyris venustus*	Shaw, 1799	LC	-	-	-
Nectariniidae	*Cyanomitra bannermani*	Grant & Mackworth-Praed, 1943	LC	-	-	-
Nectariniidae	*Cyanomitra cyanolaema*	Jardine & Fraser, 1851	LC	-	-	-
Nectariniidae	*Cyanomitra olivacea*	Smith, 1840	LC	-	-	-
Nectariniidae	*Cyanomitra verticalis*	Latham, 1790	LC	-	-	-
Nectariniidae	*Deleornis fraseri*	Jardine & Selby, 1843	LC	-	-	-
Nectariniidae	*Hedydipna collaris*	Vieillot, 1819	LC	-	-	-
Nicatoridae	*Nicator vireo*	Cabanis, 1876	LC	-	-	-
Oriolidae	*Oriolus auratus*	Vieillot, 1817	LC	-	-	-
Oriolidae	*Oriolus nigripennis*	Verreaux & Verreaux, 1855	LC	-	-	-
Oriolidae	*Oriolus oriolus*	Linnaeus, 1758	LC	-	-	III
Paridae	*Melaniparus leucomelas*	Rüppell, 1840	LC	-	-	-
Paridae	*Melaniparus rufiventris*	Barboza du Bocage, 1877	LC	-	-	-
Passeridae	*Passer griseus*	Vieillot, 1817	LC	-	-	-
Pellorneidae	*Illadopsis rufipennis*	Sharpe, 1872	LC	-	-	-
Phylloscopidae	*Phylloscopus trochilus*	Linnaeus, 1758	LC	-	-	-
Platysteiridae	*Batis erlangeri*	Neumann, 1907	LC	-	-	-
Platysteiridae	*Batis minulla*	Barboza du Bocage, 1874	LC	Vul	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Platysteiridae	*Batis molitor*	Küster, 1850	LC	-	-	-
Platysteiridae	*Dyaphorophyia ansorgei*	Hartert, 1905	LC	-	-	-
Platysteiridae	*Dyaphorophyia castanea*	Fraser, 1843	LC	-	-	-
Platysteiridae	*Platysteira albifrons*	Sharpe, 1873	NT	-	S	-
Platysteiridae	*Platysteira peltata*	Sundevall, 1850	LC	-	-	-
Ploceidae	*Amblyospiza albifrons*	Vigors, 1831	LC	-	-	-
Ploceidae	*Euplectes albonotatus*	Cassin, 1848	LC	-	-	-
Ploceidae	*Euplectes ardens*	Boddaert, 1783	LC	-	-	-
Ploceidae	*Euplectes capensis*	Linnaeus, 1766	LC	-	-	-
Ploceidae	*Euplectes hordeaceus*	Linnaeus, 1758	LC	-	-	-
Ploceidae	*Euplectes macroura*	Gmelin, 1789	LC	-	-	-
Ploceidae	*Malimbus malimbicus*	Daudin, 1802	LC	-	-	-
Ploceidae	*Malimbus rubricollis*	Swainson, 1838	LC	-	-	-
Ploceidae	*Ploceus cucullatus*	Müller, 1776	LC	-	-	-
Ploceidae	*Ploceus nigerrimus*	Vieillot, 1819	LC	-	-	-
Ploceidae	*Ploceus nigricollis*	Vieillot, 1805	LC	-	-	-
Ploceidae	*Ploceus tricolor*	Hartlaub, 1854	LC	-	-	-
Ploceidae	*Ploceus xanthops*	Hartlaub, 1862	LC	-	-	-
Ploceidae	*Quelea erythrops*	Hartlaub, 1848	LC	-	-	-
Pycnonotidae	*Baeopogon indicator*	Verreaux & Verreaux, 1855	LC	-	-	-
Pycnonotidae	*Bleda syndactylus*	Swainson, 1837	LC	-	-	-
Pycnonotidae	*Chlorocichla falkensteini*	Reichenow, 1874	LC	-	-	-
Pycnonotidae	*Chlorocichla simplex*	Hartlaub, 1855	LC	-	-	-
Pycnonotidae	*Eurillas curvirostris*	Cassin, 1860	LC	-	-	-
Pycnonotidae	*Eurillas gracilis*	Cabanis, 1880	LC	-	-	-
Pycnonotidae	*Eurillas latirostris*	Strickland, 1844	LC	-	-	-
Pycnonotidae	*Eurillas virens*	Cassin, 1858	LC	-	-	-
Pycnonotidae	*Neolestes torquatus*	Cabanis, 1875	LC	-	-	-
Pycnonotidae	*Stelgidillas gracilirostris*	Strickland, 1844	LC	-	-	-
Remizidae	*Anthoscopus caroli*	Sharpe, 1871	LC	-	-	-
Scotocercidae	*Pholidornis rushiae*	Cassin, 1855)	LC	-	-	-
Stenostiridae	*Elminia longicauda*	Swainson, 1838	LC	-	-	-
Sturnidae	*Creatophora cinerea*	Meuschen, 1787	LC	-	-	-
Sturnidae	*Lamprotornis nitens*	Linnaeus, 1766	LC	-	-	-
Sturnidae	*Lamprotornis splendidus*	Vieillot, 1822	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Sturnidae	*Poeoptera lugubris*	Bonaparte, 1854	LC	-	-	-
Sylviidae	*Sylvia borin*	Boddaert, 1783	LC	-	-	III
Turdidae	*Neocossyphus poensis*	Strickland, 1844	LC	-	-	-
Turdidae	*Stizorhina fraseri*	Strickland, 1844	LC	-	-	-
Turdidae	*Turdus pelios*	Bonaparte, 1850	LC	-	-	-
Vangidae	*Bias musicus*	Vieillot, 1818	LC	-	-	-
Vangidae	*Megabyas flammulatus*	Verreaux & Verreaux, 1855	LC	-	-	-
Zosteropidae	*Zosterops senegalensis*	Bonaparte, 1850	LC	-	-	-
Pelecaniformes						
Ardeidae	*Ardea alba*	Linnaeus, 1758	LC	-	-	-
Ardeidae	*Ardea cinerea*	Linnaeus, 1758	LC	-	-	-
Ardeidae	*Ardea goliath*	Cretzschmar, 1827	LC	-	-	-
Ardeidae	*Ardea melanocephala*	Vigors & Children, 1826	LC	-	-	-
Ardeidae	*Ardea purpurea*	Linnaeus, 1766	LC	-	-	-
Ardeidae	*Bubulcus ibis*	Linnaeus, 1758	LC	-	-	-
Ardeidae	*Butorides striata*	Linnaeus, 1758	LC	-	-	-
Ardeidae	*Nycticorax nycticorax*	Linnaeus, 1758	LC	-	-	-
Pelecanidae	*Pelecanus onocrotalus*	Linnaeus, 1758	LC	-	-	-
Pelecanidae	*Pelecanus rufescens*	Gmelin, 1789	LC	-	-	-
Scopidae	*Scopus umbretta*	Gmelin, 1789	LC	-	-	-
Threskiornithidae	*Plegadis falcinellus*	Linnaeus, 1766	LC	-	-	-
Threskiornithidae	*Threskiornis aethiopicus*	Latham, 1790	LC	-	-	-
Piciformes						
Indicatoridae	*Indicator exilis*	Cassin, 1856	LC	-	-	-
Indicatoridae	*Prodotiscus insignis*	Cassin, 1856	LC	-	-	-
Lybiidae	*Pogoniulus bilineatus*	Sundevall, 1850	LC	-	-	-
Lybiidae	*Pogoniulus chrysoconus*	Temminck, 1832	LC	-	-	-
Lybiidae	*Pogoniulus scolopaceus*	Bonaparte, 1850	LC	-	-	-
Lybiidae	*Pogonornis bidentatus*	Shaw, 1798	LC	-	-	-
Lybiidae	*Pogonornis minor*	Cuvier, 1816	LC	-	-	-
Lybiidae	*Trachylaemus purpuratus*	Verreaux & Verreaux, 1851	LC	-	-	-
Lybiidae	*Tricholaema hirsuta*	Swainson, 1821	LC	-	-	-
Picidae	*Campethera abingoni*	Smith, 1836	LC	-	-	-
Picidae	*Campethera caroli*	Malherbe, 1852	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Picidae	*Campethera nivosa*	Swainson, 1837	LC	-	-	-
Picidae	*Dendropicos fuscescens*	Vieillot, 1818	LC	-	-	-
Picidae	*Dendropicos xantholophus*	Hargitt, 1883	LC	-	-	-
Picidae	*Jynx ruficollis*	Wagler, 1830	LC	-	-	-
Picidae	*Verreauxia africana*	Verreaux & Verreaux, 1855	LC	-	-	-
Podicipediformes						
Podicipedidae	*Tachybaptus ruficollis*	Pallas, 1764	LC	-	-	-
Psittaciformes						
Psittacidae	*Agapornis pullarius*	Linnaeus, 1758	LC	-	-	II
Psittacidae	*Poicephalus fuscicollis*	Kuhl, 1820	LC	-	-	II
Psittacidae	*Poicephalus gulielmi*	Jardine, 1849	LC	-	-	II
Strigiformes						
Strigidae	*Asio capensis*	Smith, 1834	LC	-	-	II
Strigidae	*Bubo africanus*	Temminck, 1821	LC	-	-	II
Strigidae	*Bubo lacteus*	Temminck, 1820	LC	-	-	II
Strigidae	*Bubo poensis*	Fraser, 1853	LC	-	-	II
Strigidae	*Ptilopsis granti*	Kollibay, 1910	LC	-	-	II
Strigidae	*Strix woodfordii*	Smith, 1834	LC	-	-	II
Tytonidae	*Tyto alba*	Scopoli, 1769	LC	-	-	II
Tytonidae	*Tyto capensis*	Smith, 1834	LC	-	-	II
Suliformes						
Anhingidae	*Anhinga rufa*	Daudin, 1802	LC	-	-	-
Phalacrocoracidae	*Microcarbo africanus*	Gmelin, 1789	LC	-	-	-
Trogoniformes						
Trogonidae	*Apaloderma narina*	Stephens, 1815	LC	-	-	-
MAMMALIA						
Carnivora						
Canidae	*Canis adustus*	Sundevall, 1847	LC	Vul	-	-
Felidae	*Caracal aurata*	Temminck, 1827	VU	-	-	II
Felidae	*Felis lybica*	Forster, 1780	LC	Vul	-	-
Felidae	*Leptailurus serval*	Schreber, 1776	LC	Vul	-	II
Herpestidae	*Atilax paludinosus*	G.[Baron] Cuvier, 1829)	LC	-	-	-
Herpestidae	*Herpestes ichneumon*	Linnaeus, 1758	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Herpestidae	*Herpestes sanguineus*	Rüppell, 1835	LC	-	-	-
Herpestidae	*Ichneumia albicauda*	G. Cuvier, 1829	LC	-	-	-
Herpestidae	*Mungos mungo*	Gmelin, 1788	LC	-	-	-
Hyaenidae	*Crocuta crocuta*	(Erxleben, 1777)	LC	Aex	-	-
Mustelidae	*Genetta maculata*	Gray, 1830	LC	-	-	-
Mustelidae	*Hydrictis maculicollis*	Lichtenstein, 1835	NT	-	-	II
Mustelidae	*Ictonyx striatus*	Perry, 1810	LC	-	-	-
Mustelidae	*Lutra maculicollis*	(Lichtenstein, 1835)	NT	Vul	-	-
Mustelidae	*Mellivora capensis*	(Schreber, 1776)	LC	Vul	-	III
Mustelidae	*Nandinia binotata*	Gray, 1830	LC	-	-	-
Mustelidae	*Poecilogale albinucha*	Gray, 1864	LC	-	-	-
Viverridae	*Civettictis civetta*	(Schreber, 1776)	LC	Vul	-	III
Cetartiodactyla						
Bovidae	*Cephalophus dorsalis*	Gray, 1846	NT	-	-	II
Bovidae	*Cephalophus silvicultor*	Afzelius, 1815	NT	-	-	II
Bovidae	*Cephalopus nigrifrons*	Gray, 1871	LC	-	-	-
Bovidae	*Philantomba monticola*	Thunberg, 1789	LC	-	-	II
Bovidae	*Redunca arundinum*	Boddaert, 1785	LC	-	-	-
Bovidae	*Sylvicapra grimmia*		LC	Aex	-	-
Bovidae	*Tragelaphus scriptus*	Pallas, 1766	LC	-	-	-
Suidae	*Phacochoerus africanus*	Gmelin, 1788	LC	-	-	-
Chiroptera						
Emballonuridae	*Taphozous mauritianus*	É. Geoffroy, 1818	LC	-	-	-
Hipposideridae	*Hipposideros ruber*	Noack, 1893	LC	-	-	-
Molossidae	*Chaerephon chapini*	J.A. Allen, 1917	LC	-	-	-
Molossidae	*Mops condylurus*	A. Smith, 1833	LC	-	-	-
Nycteridae	*Nycteris arge*	Thomas, 1903	LC	-	-	-
Nycteridae	*Nycteris hispida*	Schreber, 1775	LC	-	-	-
Nycteridae	*Nycteris macrotis*	Dobson, 1876	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Nycteridae	*Nycteris nana*	K. Andersen, 1912	LC	-	-	-
Nycteridae	*Nycteris thebaica*	É. Geoffroy, 1818	LC	-	-	-
Pteropodidae	*Eidolon helvum*	Kerr, 1792	NT	-	-	-
Pteropodidae	*Epomophorus wahlbergi*	Sundevall, 1846	LC	-	-	-
Pteropodidae	*Epomops franqueti*	Tomes, 1860	LC	-	-	-
Pteropodidae	*Hypsignathus monstrosus*	H. Allen, 1861	LC	-	-	-
Pteropodidae	*Megaloglossus woermanni*	Pagenstecher, 1885	LC	-	-	-
Pteropodidae	*Micropteropus intermedius*	Hayman, 1963	LC	-	-	-
Pteropodidae	*Micropteropus pusillus*	Peters, 1868	LC	-	-	-
Pteropodidae	*Myonycteris torquata*	Dobson, 1878	LC	-	-	-
Pteropodidae	*Rousettus aegyptiacus*	É. Geoffroy, 1810	LC	-	-	-
Vespertilionidae	*Glauconycteris argentata*	Dobson, 1875	LC	-	-	-
Vespertilionidae	*Glauconycteris beatrix*	Thomas, 1901	LC	-	-	-
Vespertilionidae	*Glauconycteris variegata*	Tomes, 1861	LC	-	-	-
Vespertilionidae	*Hypsugo crassulus*	Thomas, 1904	LC	-	-	-
Vespertilionidae	*Mimetillus moloneyi*	Thomas, 1891	LC	-	-	-
Vespertilionidae	*Myotis bocagii*	Peters, 1870	LC	-	-	-
Vespertilionidae	*Neoromicia capensis*	A. Smith, 1829	LC	-	-	-
Vespertilionidae	*Neoromicia nana*	Peters, 1852	LC	-	-	-
Vespertilionidae	*Scotophilus dinganii*	A. Smith, 1833	LC	-	-	-
Eulipotyphla						
Soricidae	*Crocidura nigrofusca*	Matschie, 1895	LC	-	-	-
Soricidae	*Crocidura olivieri*	Lesson, 1827	LC	-	-	-
Soricidae	*Crocidura parvipes*	Osgood, 1910	LC	-	-	-
Soricidae	*Crocidura turba*	Dollman, 1910	LC	-	-	-
Soricidae	*Suncus megalura*	Jentink, 1888	LC	-	-	-
Pholidota						
Manidae	*Phataginus tricuspis*	Rafinesque, 1821	EN	-	-	I
Primates						

Family	Species	Author	IUCN	MA	End.	CITES
Cercopithecidae	*Cercopithecus ascanius*	Audebert, 1799	LC	-	-	II
Cercopithecidae	*Cercopithecus mitis*	Wolf, 1822	VU	-	-	II
Cercopithecidae	*Chlorocebus cynosuros*	Scopoli, 1786	LC	-	-	II
Cercopithecidae	*Colobus angolensis*	P. Sclater, 1860	VU	Aex		II
Cercopithecidae	*Miopithecus talapoin*	Schreber, 1774	VU	-	-	II
Cercopithecidae	*Papio kindae*	Papio kindae	LC	-	-	-
Galagidae	*Galagoides demidoff*	G. Fischer, 1806	LC	-	-	II
Galagidae	*Galagoides kumbirensis*	Svensson, Bersacola, Mills, Munds, Nijman, Perkin, Masters, Couette, Nekaris & Bearder, 2017	NT	-	End.	-
Lorisidae	*Perodicticus edwardsi*	Bouvier, 1879	LC	-	-	-
Rodentia						
Anomaluridae	*Anomalurus derbianus*	Gray, 1842	LC	-	-	-
Gliridae	*Graphiurus kelleni*	Reuvens, 1890	LC	-	-	-
Hystricidae	*Hystrix africaeaustralis*	Peters, 1852	LC	-	-	-
Muridae	*Aethomys bocagei*	Thomas, 1904	LC	-	End.	-
Muridae	*Gerbilliscus leucogaster*	Peters, 1852	LC	-	-	-
Muridae	*Gerbilliscus validus*	Bocage, 1890	LC	-	-	-
Muridae	*Lemniscomys striatus*	Linnaeus, 1758	LC	-	-	-
Muridae	*Lophuromys angolensis*	Temminck, 1853	LC	-	-	-
Muridae	*Mastomys natalensis*	Smith, 1834	LC	-	-	-
Muridae	*Oenomys hypoxanthus*	Pucheran, 1855	LC	-	-	-
Muridae	*Otomys cuanzensis*	Hill & Carter, 1937	LC	-	End.	-
Muridae	*Pelomys campanae*	Huet, 1888	LC	-	-	-
Muridae	*Pelomys fallax*	Peters, 1852	LC	-	-	-

Family	Species	Author	IUCN	MA	End.	CITES
Muridae	*Praomys coetzeei*	Van der Straeten, 2008	LC	-	-	-
Muridae	*Praomys jacksoni*	de Winton, 1897	LC	-	-	-
Muridae	*Zelotomys hildegardeae*	Thomas, 1902	LC	-	-	-
Nesomyidae	*Cricetomys ansorgei*	Thomas, 1904	LC	-	-	-
Nesomyidae	*Cricetomys emini*	Wroughton, 1910	LC	-	-	-
Nesomyidae	*Dendromus nyikae*	Wroughton, 1909	LC	-	-	-
Sciuridae	*Funisciurus bayonii*	Bocage, 1890	DD	-	-	-
Sciuridae	*Funisciurus congicus*	Kuhl, 1820	LC	-	-	-
Sciuridae	*Funisciurus pyrropus*	F. Cuvier, 1833	LC	-	-	-
Tubulidentata						
Orycteropodidae	*Orycteropus afer*	Pallas, 1766	LC	Vul	-	-

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Annex 2 – Human Rights Impact Assessment (HRIA)

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Electrification of Uíge, Angola – Lot 1, Phase 1

Human Rights Impact Assessment (HRIA)

nemus

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Gestão, Engenharia
e Ambiente, SA

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1. Introduction

Under Principle 2 of the Equator Principles (Environmental and Social Assessment), an ESIA is expected to include an assessment of potential adverse human rights impacts, with reference to the *United Nations Guiding Principles on Business and Human Rights*. Therefore, the ESIA includes a Human Rights Impact Assessment (HRIA).

The UN Guiding Principles on Business and Human Rights state that companies must establish effective mechanisms to prevent adverse human rights impacts. When such impacts do occur, they have a responsibility to address them and provide appropriate compensation.

A Human Rights Impact Assessment (HRIA) analyses the impact of business activities on rights-holders such as workers, local community members, consumers, and others. HRIA is a human rights-based approach that integrates human rights principles, such as non-discrimination, into the assessment process.

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2. Methodology

The HRIA (integrated into the ESIA methodology) will follow the guidelines and methodologies provided by the Equator Principles Association (2020a) and DIHR (2020). Therefore, the HRIA will be developed through several phases or steps, all of which will be included to ensure a comprehensive assessment.

Step 1 – Planning and scoping

The first step of the HRIA is to define the parameters by gathering preliminary information about the impact area of the business project or activities. HRIA scoping should include the following:

1. Business projects or activities that consider areas of business activity not typically addressed in ESIAs. These include the consideration of the labour rights of employees, workers and contractors; safety and human rights issues, including impacts on women; and human rights impacts related to revenue;
2. Human rights context, which includes legal analysis and practical information that provides insight into the reality of human rights on the ground;
3. Relevant stakeholders for the HRIA, including duty-bearers such as the company operating the project or business activities, rights-holders such as workers, families, community members, and other relevant parties such as government organisations, NGOs, academia, and other organisations.

Step 2 – Data collection and human rights baseline development

This step involves field research into the human rights of workers, community members and other relevant rights-holders. The data collection phase focuses on fieldwork, interviews and various forms of stakeholder engagement. In addition, during this phase, human rights indicators, both qualitative and quantitative, should be selected to inform the data collection.

Step 3 – Analysing impacts

This step involves analysing the data collected to identify any business-related impacts and assess their severity, drawing on the normative content of international human rights standards and principles, comparative projects, stakeholder engagement results, etc.

Step 4 – Impact mitigation and management

The ESIA team, with stakeholder input, will prepare a plan to prevent and address human rights impacts. All human rights impacts will be addressed, with priority given to the most serious impacts.

Step 5 – Reporting and evaluation

The human rights risk assessment should be available and accessible to all stakeholders to promote dialogue and accountability by documenting the impacts identified (including human rights impacts) and the measures taken to address them.

Because Stakeholder Engagement is critical in HRIA (including in the ESIA), it will be performed in all the phases presented above.

Limitations

The human rights assessment has some limitations.

Firstly, it is an ex-ante assessment, carried out before construction starts. Therefore, all impacts identified in the assessment are potential, and many of the mitigation measures developed are preventive. This assessment will not evaluate actual human rights impacts after construction activities have begun.

In addition, the implementation of the mitigation measures recommended as well as their monitoring may be limited.

3. Local context

3.1. Angola's legislation on human rights

Table 126 summarizes the relevant laws and legislations relating to human rights in Angola.

Table 126 – Angola's legislation on human rights

Angola's legislation	Applicability to the Project
Constitution of Angola 2010	Contains provisions related to fundamental human rights, including the right to life, liberty, equality, non-discrimination, freedom of expression, and freedom of religion.
Law on the Promotion and Protection of Human Rights: Law No. 14/11 2011	Outlines the principles of equality, non-discrimination, and respect for human dignity, and provides for the establishment of national institutions, such as the National Human Rights Commission, to promote and protect human rights.
Labour Law: Law No. 7/15 2015	The right to fair and just working conditions, freedom of association, and protection against discrimination in employment. The Occupational Health and safety system (Decree No. 31/94) promotes safety, hygiene, and health in the workplace.

3.2. International Conventions and Country Status

Other than the National laws and legislations relevant to human rights, in Table 127 below are the summary of applicable international standards and guidelines.

Table 127 – Multilateral human rights agreements ratified by Angola

International Convention	Applicability to the Project
International Convention on the Elimination of All Forms of Racial Discrimination 1969	All workplace racial discrimination should be expressly forbidden.
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)	Ensure that non-discrimination against women is preserved in HR policies and practices for the proposed Project.

International Convention	Applicability to the Project
1981	
Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1987	Torture in all workplace should be expressly forbidden.
Convention on the Rights of the Child 1990	Ensure that employment policies include prohibitions on the employment of children.
International Covenant on Economic, Social and Cultural Rights 1976	Ensure that economic, social and cultural rights are respected in the proposed Project.
International Covenant on Civil and Political Rights 1976	Ensure civil and political rights are observed in the proposed Project.
All the above in the context of Human Rights	By applying international principles like Principle 2 of the Equator Principles, the ESIA includes an assessment of potential adverse Human Rights impacts, referring to the United Nations Guiding Principles on Business and Human Rights. This methodology guarantees that the above conventions were followed.

3.3. Country Overview

According to updated human rights reports by various international NGOs and to recent news reports, human rights violations are still taking place in Angola (CMI, 2021). Although the promotion and protection of human rights exists in law and policy, the government has made little progress in implementing and defending human rights in practice.

Angola is at “medium risk” due to “abusive law enforcement” and “restrictions on media freedom” (V-Dem, 2020). The Democracy Index 2020 shows the same trend (EIU, 2022). With the Covid-19 pandemic, the state of emergency, political and civil rights have also been undermined by the constitutional use of emergency laws.

Regarding **economic, social, and cultural rights**, some but small developments occurred. With regards to corruption and misappropriation of public funds, for example, in June of 2021, the General Public Prosecutor announced the arrest of 24 senior military officials from the Office of the Head of State Security Affairs, accused of embezzling large sums of funds from state coffers (AI, 2022).

With regard to **right to adequate standard of living** (food, housing, medical care, among others), there are rising challenges. There are reports of unlawful occupation by commercial farmers of communal grazing land, which erodes the ability of pastoral communities to produce food for themselves (AI, 2022). Food insecurity is still very prevalent and extreme events raise this issue to alarming levels.

Covid-19 and its associated restrictions aggravated the effects of decades of underfunded services. This was most visible in the health sector. A public outcry from the Angola Doctors Union went unanswered and according to the union, despite the Covid-19 pandemic, the most common causes of death were malaria, malnutrition, acute diarrhoeal diseases, lack of medicines and, among health workers, overwork. The pandemic's economic and social impact caused an exponential increase in the large numbers of sick people using hospitals that were unable to meet demand (AI, 2022).

According to the results of our stakeholder engagement activities (focus group discussions and key informant interviews) and the baseline data collected (including statistics, reports, studies, among others), the following are the most important issues regarding human rights in the study area: gender rights, right to adequate standard of living (including access to healthcare, food, and adequate housing), right to education, workers' rights and human trafficking.

3.3.1. Gender rights

Female-headed households face a number of challenges in terms of their economic and social way of life: their income is lower than that of average households; female-headed households are more dependent on self-employment and self-consumption; women's rights remain incomplete with regard to land ownership and inheritance; female-headed households are at high risk of food shortages; female-headed households have a lower share of ownership of durable goods; access to health services is more difficult than for average households; women's educational attainment is also lower than that of men.

In the rural areas studied, land rights are particularly important for women. Women are less aware of their land rights than men. In practice, while the existing land law recognises customary land use (housing, traditional agriculture and access to water), customary traditions are practised in different regions and cultures of the country, and women's ownership and inheritance rights are weakly protected and often not recognised. (Cain, 2019).

Women in Angolan society face threats to their health, safety and lives from gender-based violence (GBV). According to the latest Multiple Indicator and Health Survey, 34% of Angolan women have been physically or sexually abused by their husbands or partners, 8% will be sexually abused at some point in their lives, and 32% have been physically abused since the age of 15 (Kitombe & Pacatolo, 2023).

According to the UNDP 2021 Gender Inequality Index, Angola is ranked in 136th out of 170 countries, due to its high maternal mortality rate, the large adolescent birth rate, and the low access to education.

In 2021, in Angola there were 241 deaths per 100,000 live births and 138.4 births per 1,000 women aged 15 to 19. The female population aged 25 or older that had at least some secondary education was only 28.2% (compared to 51% in men).

3.3.2. Right to adequate standard of living

As described in the ESIA, living standards in Angola, particularly in rural areas (e.g. the study area), are unsatisfactory. Access to health services is limited and in rural areas even more challenging (the results of the focus group discussions stress this point, with a local community stating that “there are no medicines, no materials, no nurses; [health] centres have no capacity”). Housing is generally inadequate (with local leaders stating in a focus group discussion that “it rains inside the houses. There are storms that rip off roofs”).

Furthermore, given the dependence of local communities on land for their livelihoods, the lack of formal registration of land ownership puts families at risk of land conflicts and land grabbing. As one local leader explained in a focus group discussion, “land is inherited in a traditional way, so there are no documents”. As a result, their right to property is also at risk.

3.3.3. Access to education

The level of education in rural areas of Angola is very low, as it is in the study area. Access to formal education beyond the first level (primary school) is not widespread for various reasons (lack of infrastructure, lack of incentives or need to help in the family business or farm).

Regarding literacy rates in Angola, there are significant differences between each area and between genders (with men generally having higher literacy rates, particularly in rural areas). In Uíge, the literacy rate for the population aged 15 years and older was 64% in 2018-2019, lower than the national literacy rate (69%) but higher than in rural areas (46%).

3.3.4. Labour rights

The institution concerned with the management of formal employment in Angola is the Ministry of Public Administration, Employment and Social Security (MAPESS). The legal framework governing labour and employment in Angola is the general labour law (Law no 7/15 of June 15th), which establishes procedures and guidelines for employment. Angola also has an Occupational Health and Safety System (Decree n. º 31/94) establishing the principles that promote safety, hygiene, and health at work. In order to maintain Occupational Safety and Health (OSH), employers must design facilities and work processes seeking to eliminate risks or reduce them as much as possible; integrate within the management of the business the necessary OSH activities; comply with and enforce all rules regarding OSH; establish a joint commission to prevent work related accidents; create OSH services and occupational medicine; develop the prevention programme for the purpose of raising awareness and provide training and information to workers. All companies with 50 or more workers must organize an OSH service and provide it with technical personnel (occupational safety technicians) with the proper training (Ahmad & Barros, Angola - Decent Work Check 2021, 2021).

Angola’s General Labour Law stipulates that workers are allowed to form independent unions, to collectively bargain, and to strike. Anti-union discrimination is banned under this law. Nevertheless, these rights are constrained in practice. In particular, a minimum percentage (30%) of workers from a specific sector at the provincial level must be involved to establish a union, and authorities must grant an authorization for it to be legal. Government restrictions may also affect workers' right to strike (ILO, 2017; Ahmad & Barros, Angola - Decent Work Check 2021, 2021).

General labour law states that an employment agreement does not need to be made in writing. Nevertheless, there are some cases where a written employment agreement is required, such as employment agreements entered into with foreign employees, traineeship agreements, employees hired to render work on vessels or domestic employees. Also, regarding foreign nationals, a company needs to ask the government's permission to hire expatriates, only in the event that no locals qualify for the position. This practice is intended to promote local hiring and boost local employment and the national economy (Ahmad & Barros, Angola - Decent Work Check 2021, 2021).

The law prohibits all forms of forced or compulsory Labour and sets penalties commensurate with those for analogous serious crimes. However, the government does not effectively enforce the law due in part to an insufficient number of inspectors and to corruption.

As of 2022, the minimum wage in Angola is set at 32,181.15 Kwanzas per month under Presidential Decree No. 54/22, of February 17 (roughly US$ 75 at the time of writing). The Presidential Decree also sets minimum wages by economic groupings, namely for groups in the commerce and extractive industry sectors in the amount of 48,271.73 Kwanzas (US$ 113), for groups in transport, services, and the manufacturing industry in the amount of 40,226.44 Kwanzas (US$ 94), and for the agriculture grouping in the amount of 32,181.15 Kwanzas (US$ 75). The Executive also made adjustments to the basic salaries of the Civil Service, with the lowest salary reaching 67,807 kwanzas in 2022 (US$ 159) (Simão, 2022).

However, although labour rights are protected by law, there are still major problems of abuse of labour rights in Angola, particularly in relation to working conditions and discrimination in the workplace.

B) Working conditions

The legal framework in Angola does not meet good international industry practice for labour rights, labour management and working conditions as required by IFC PS2 in the following areas (Ahmad & Caminha Barros, 2021):

- There is no requirement to hire workers on fixed-term contracts for permanent jobs;
- Employers are not required to provide paid sick leave, and workers' jobs are not secure during periods of illness;
- There is no provision for free medical care in the event of sickness or accidents at work;
- There are no unemployment benefits;
- There are no strict measures against sexual harassment in the workplace.

C) Discrimination

The Constitution and the law prohibit discrimination in employment on the basis of race, sex, religion, disability or language. The government is generally seen as effective in enforcing these rules in the formal sector. However, the constitution does not address discrimination based on political beliefs, ethnicity, sexual orientation or gender identity. (U.S. Department of State, 2022).

3.3.5. Human Trafficking

According to a 2017 Human Rights in Angola report, forced labour occurred among men and women in agriculture, construction, domestic service and artisanal diamond mining. Migrant workers were subjected to passport confiscation, threats, denial of food and confinement.

According to the Trafficking in Persons Report, the most common trafficking crimes in Angola are sex trafficking and labour trafficking in the construction sector. Although the minimum age for work in Angola is 14, this law only applies to children with labour contracts. Current legislation in Angola does not criminalise child labour without a contract (U.S. Department of State, 2022).

Effective enforcement of labour laws, particularly those prohibiting forced labour, was hampered by systemic corruption among labour officials and a lack of resources. Beyond routine labour inspections, the government had no policy to monitor and control the recruitment of workers. However, labour inspections did not uncover any cases of forced or underage labour (U.S. Department of State, 2022).

The government employed 266 labour inspectors trained in human trafficking who conducted 9,088 inspections in 2021, an increase from the 5,461 inspections conducted in 2020. Efforts to prevent forced and child labour were hampered by a lack of funds to cover the travel costs of labour inspectors and a restriction of inspections to the formal economy, where only a quarter of Angolans are employed (U.S. Department of State, 2022).

4. Human rights risks and mitigation measures

The construction work will rely heavily on the use of contractors, which may make it difficult for Elecnor to control all elements of the conditions set for workers. Strong prevention and mitigation measures must be in place to ensure that contractors and subcontractors do not negatively impact the human rights of workers and communities when working for Elecnor. This will require additional efforts to regulate, train and monitor contractors and their subcontractors.

It is therefore essential that Elecnor ensures effective dialogue with workers and provides access to an effective grievance mechanism for its own employees and contractors.

The table below is a summary of the project's main human rights risks and mitigation measures.

Table 128 – Human rights risks and mitigation measures

Human Rights Issues	Risks	Mitigation measures	Risk level
Gender-based violence	• Influx of foreign workers into the study area can lead to an increase in gender-based violence, prostitution and pregnancy among young girls. • In the worst case, the large influx of male workers could increase exploitative sexual relationships and human trafficking by forcing women and girls into forced sex work.	• Hire local rural workers to minimize large influxes of outside workers. • Provide housing for workers to minimize interaction with local communities. • Implement and strengthen the Grievance Redress Mechanism to effectively address gender-based violence, including sexual and abuse complaints. • The contractor must develop and implement a project Code of Conduct, to be signed by each staff member. In case of misconduct, workers should be held accountable, and potentially fired. The Code of Conduct should include: prevention of GBV and prohibition of sexual involvement by employees with persons under the age of 18.	Medium

Human Rights Issues	Risks	Mitigation measures	Risk level
Working Conditions	• Risk of occupational accidents. • Unsafe working areas.	• Provide Occupational Safety and Health training to all workers. • Workers should be provided with the appropriate personal protection equipment for the work they are performing. • Ensure that the construction site is regularly visited by a labour inspector to verify compliance with labour laws. • Document all workplace accidents and provide workers with paid sick leave in the event of a workplace accident.	Low to medium
Working Conditions	• Risks associated with precarious contracts, excessive working hours and low wages.	• Hiring requirements and contract conditions should be clear, transparent, and properly disclosed before the recruitment process begins, and met by the contractor. • Recruitment should be based on the qualifications and experience of the candidates and should be non-discriminatory (in terms of gender, minorities, political beliefs...). • The contractor should avoid overtime hours as much as possible and appropriately compensate extra working hours when they are unavoidable. • Allow workers to form and join labour union and association, in accordance with Angolan law.	Low to medium

Human Rights Issues	Risks	Mitigation measures	Risk level
	• Poor living conditions due to bad accommodation, which can also lead to the spread of communicable diseases among workers.	• Ensure adequate safe and clear accommodations, proper sanitation and provide access to health facilities.	Low to Medium
Human Trafficking	• Risk that labour recruiters or contractors may resort to forced or child labour to increase their revenues.	• Prohibit child labour and foreign persons who are not legally employed. • Check the age of the workers. • Ensure that the construction site is regularly visited by a labour inspector to verify compliance with labour laws.	Low to Medium
Local community impacts	• Risks to the health and safety of local communities, arising from the construction activities, such as generation of dust, vibration, and noise, increased traffic movement and potential increase in disease transmission. These impacts are further discussed in Section 8.10. of the ESIA.	• Implement a Community Grievance Mechanism. • Provide housing for workers to minimize interaction with local communities (and potential disease transmission). • Create and execute a stakeholder engagement plan and consultation to educate local communities of the safety concerns around working sites. • Fence all work sites and place placards advising people of the risks associated with trespassing. • When work fronts are less than 100 metres from a settlement (small, medium, or large), employ security guards from the local communities to prevent trespassing.	Medium

Human Rights Issues	Risks	Mitigation measures	Risk level
		• Create and implement a demining safety plan with the following dimensions: safety measures and stakeholder engagement with local communities. • Create a plan to deal with emergencies. • Provide primary health care and first aid at construction camp sites to avoid pressure on local healthcare infrastructures. • Provide access to health care for those injured by the Project's activities. • Ensure all workers (including contractors and subcontractors) undergo pre-employment screening and regular health screening including voluntary screening for transmissible diseases. • Provide training on transmissible diseases, including sexually transmitted diseases and airborne diseases.	

Human Rights Issues	Risks	Mitigation measures	Risk level
Local community impacts	• Loss of livelihoods and potential resettlement. These impacts are further discussed in the RAP.	• Provide compensation for loss of assets at replacement cost and for the loss of income opportunities from seasonal and permanent crops. • Provide compensation for the loss of community resources such as firewood and charcoal collection. • Ensure that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • Pay particular attention to the needs of vulnerable groups, including female and child headed households, elderly households, households with disabled persons. • Provide continued support to households to restore livelihoods and monitor to demonstrate achievements of IFC principles (e.g., relocation assistance in nature and/or in kind, provision of land preparation allowance, etc.).	Medium to high

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5. Elecnor practices for the management of human rights risks

5.1. Policies

Elecnor has a Human Rights Policy (2019) that is in line with its Corporate Social Responsibility Policy and Code of Ethics. The Group's Human Rights Policy is aligned with the following policies:

- United Nations Universal Declaration of Human Rights;
- UN Global Compact and the SDGs;
- International Labour Organisation's Declaration of Fundamental Principles and Rights at Work;
- OECD Guidelines for Multinational Enterprises.

5.2. Procedures

Elecnor will not participate in actions that compromise the universal human rights recognised in national and international laws. The Elenor promotes the following principles in all of its activities:

- To demand respect for human rights from all its professionals and partners.
- To ensure that there is no discrimination on the basis of gender, age, race, disability or any other form of discrimination by promoting equal opportunities and respect for diversity.
- To reject forced labour in all its forms and any abuses of power, as well as the use of child labour.
- To protect the health and safety of its professionals by making safety an non-negotiable value and by undertaking a commitment to causing zero accidents and damage to the health of the people.
- To respect the rights of local communities with particular attention to more vulnerable groups, such as ethnic minorities and indigenous communities, by promoting initiatives and ongoing dialogue.
- To reject corruption in all its forms by committing to the highest ethical standards and compliance with the law and implementing a principle of zero tolerance towards malpractice.

- To have complaints procedures in order to deal with possible cases of human rights violations.
- To recognise the freedom of association and affiliation of their employees.
- To ensure the confidentiality and right to privacy of all persons who interact with the company and to use all the data it possesses appropriately.

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