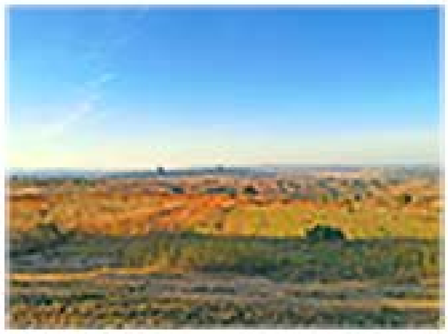

TRANSMISSION LINE OF 220 kV LOMAUM-HUAMBO AND ASSOCIATED SUBSTATIONS, ANGOLA

Environmental and Social Impact Assessment
Volume I – ESIA Report

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September, 2023

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TRANSMISSION LINE OF 220 kV LOMAUM-HUAMBO AND ASSOCIATED SUBSTATIONS, ANGOLA

Environmental and Social Impact Assessment

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LIST OF ABBREVIATIONS AND ACRONYMS

ACha - Haplic Acrisols

AI – Amnesty International

AIDS – Acquired Immunodeficiency Syndrome

BFD - Bird flight diverters

BSR – Business for Social Responsibility

CBO – Community-Based Organisation

CHA – Critical Habitat Assessment

CIA – Central Intelligence Agency (of the United States of America)

CIESIN – Centre for International Earth Science Information Network

COP21 – 21st Conference of the Parties of the Convention on Climate Change

CMIP6 – 6th Phase of the Coupled Model Intercomparison Project

CRU – Climatic Research Unit of University of East Anglia

DAI - Direct Area of Influence

DD – Data Deficient Species

DIHR – The Danish Institute for Human Rights

DW – Development Workshop

ECI – Economic Complexity Index

EISA – Electoral Institute for Sustainable Democracy in Africa

EN - Endangered Species

EP – Equator Principles

EPA – Environmental Protection Agency

ESA/CCI – European Space Agency Climate Change Initiative

ESIA – Environmental and Social Impact Assessment

FRha - Haplic Ferrasols

FRxa - Xanthic Ferralsols

GDP – Gross Domestic Product

GIS - Geographic Information Systems

HDV – Heavy duty vehicle

HIV – Human Immunodeficiency Virus

HRIA – Human Rights Impact Assessment

IAI - Indirect Area of Influence

IBA – Important Bird Area

ICNF – Instituto para a Conservação da Natureza e das Florestas

ICOMOS - International Council on Monuments and Sites

IFC - International Finance Corporation

ILO - International Labour Organization

INE – *Instituto Nacional de Estatística* [National Institute of Statistics]

INRH – National Water Resources Institute of Angola (Instituto Nacional de Recursos Hídricos de Angola)

IPCC – Intergovernmental Panel on Climate Chance

IT – Interim Target

ITCZ – Intertropical Convergence Zone

IUCN – International Union for Conservation of Nature

GCM – Global climate Model

GHG – Greenhouse Gas

Km – Kilometre (unit of measurement)

L_{eq} – Equivalent continuous sound level

L_{max} – Maximum continuous sound level

L_{min} – Minimum continuous sound level

LPeu - Eutric Leptosols

LPli - Litric Leptosols

LULUCF – Land Use, Land Use Change and Forests

LXha - Haplic Lixisols

m – metre (unit of measurement)

MINAGRIP – *Ministério da Agricultura e Pescas* [Ministry of Agriculture and Fisheries]

MINDCOM – *Ministério da Indústria e Comércio de Angola* [Ministry of Industry and Commerce of Angola]

NGO – Non-Government Organization

OECD – Organisation for Economic Co-operation and Development

OHTL - Over Head Transmission Line

PM – Particulate matter

PM_{10} – Particulate matter with diameter of 10 µm or less

$PM_{2.5}$ – Particulate matter with diameter of 2.5 µm or less

PPP – Purchasing Power Parity

PS – Performance Standards

RCP – Representative Concentration Pathways

RNT EP – *Rede Nacional de Transporte de Electricidade, Empresa Pública* [National Electricity Transmission Grid, Public Company]

RoW – Right of Way

SEP – Stakeholder Engagement Plan

SSP – Shared Socioeconomic Pathways

TCFD – Task Force on Climate-related Financial Disclosures

UCLG – United Cities and Local Government

UNEP – United Nations Environment Programme

UNESCO - United Nations Educational, Scientific and Cultural Organization

UNFCCC – United Nations Climate Change Convention

VOC – Volatile organic compound

VU - Vulnerable Species

WEI – Water Exploitation Index

WHO – World Health Organization

WV – World Vision International

Executive summary

This Environmental and Social Impact Assessment (ESIA) Report presents an assessment of the potential environmental, social and community health impacts associated with the proposed construction and operation of the Transmission Line of 220 kV Lomaum-Huambo and associated substations in Angola ("the Project") to ensure that environmental and social issues are diligently considered and managed during the Project lifecycle. The report has been prepared for Elecnor Servicios y Proyectos, S.A.U, and presents the objectives, methodology and outcomes of the impact assessment that will be prepared as defined in Presidential Decree No. 117/20 of April 22nd, which regulates the environmental and social assessment process (ESIA). The ESIA report was done considering not only the relevant Angola legislation, but also the IFC Performance Standards and the Equator Principles.

The Project is part of the rural electrification Government objective, according to the National Development Plan and the Presidential Decree nº 256/11, to bring electricity to all townships in the country, increasing electrification rate from 35% (in 2017) to 50% in 2022.The objective of this project is the interconnection of the different sources of electricity generation in the country through a network of substations and transmission lines. The specific objectives are the following:

- To transport the energy produced by Lauca hydropower plant to the Benguela Province;
- Replace the electricity production of the current 334 MW diesel power stations in the cities of Benguela and Quileva with the significant reductions in fuel consumption and CO_2 emissions;
- Create a high voltage ring in the Central Region interconnecting the most important hydroelectric plants (Lauca, Cambambe, Matala, Gove, Lomaum and Biópio);
- Interconnect the West and Southern transmission networks in Angola to guarantee a continuous, stable, and balanced power supply and transporting energy service;
- Contribute to the national electrification plan by facilitating the construction of a new distribution network in the future;
- Contribute to the development of the province by providing infrastructures that provide an environment for attracting investment and generating

employment in sectors such as agriculture, commercial, hotel and industrial.

The Project includes the studies, design, manufacture, transport, insurance, construction, assembly, reception, and testing of works of the following components:

- New substation in Lomaum 220/60 kV;
- Expansion of the substation included in Lomaum hydroelectric plant (HP);
- 147.1 km HV transmission line of 220 kV connecting new Lomaum SS 220/60kV and Belém do Dango SS (Huambo) – LH line;
- 6.2 km HV Transmission line of 220 kV connecting new Lomaum SS 220/60kV and Lomaum HP 220 kV – LL line;
- 7.7 km section to the 220 kV intersections from new Lomaum SS 220/60kV to the transport line from Biópio HP (LT 220 kV Biópio HP - Lomaum HP) – LB line.

The Project is located in the centre of Angola, namely in the Provinces of Huambo and Benguela and extends for about 161 km, crossing seven municipalities and ten communes. The two municipalities in Benguela are Cubal (commune of Quendo) and Ganda (communes of Babaera and Ganda). In Huambo, five municipalities and seven communes are crossed by the project, namely:

- Municipality of Caála (Kaala and Kalenga);
- Municipality of Huambo (Huambo);
- Municipality of Longonjo (communes of Lepi and Longonjo);
- Municipality of Tchinjenje (commune of Chinjenje);
- Municipality of Ukuma (commune of Ukuma).

For the purposes of this impact assessment, the definition of Area of Influence given in IFC Performance Standard 1 is used. The area of influence encompasses:

- "The area likely to be affected by: (i) the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.

- Associated facilities are facilities that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted."

The project's area of influence spans over the middle west part of Angola, with a Köppen-Geiger **climatic classification** of tropical savannah (Aw) in the western lower altitude part and temperate dry winter warm summer (Cwa) in the eastern higher altitude part. A dry season (Cacimbo) occurs between May and September and the rainy season, controlled by the movement of the ITCZ, between October and April. The average annual **air temperature** in Angola decreases with increasing latitude and altitude and decreases with increasing distance to the sea and the mean annual **precipitation** is above 1200mm in the project's area of influence.

Considering the characteristics of the project and its influence area climate projections were carried out for the following climate variables: maximum temperature, minimum temperature, maximum of daily maximum temperature, precipitation and largest 1 day precipitation. The projections are assessed for two time periods, namely 2040-2059, corresponding to medium stage of project's lifetime, and 2060-2079, corresponding to end of project's lifetime.

The main sectors responsible for greenhouse gas (GHG) emissions in Angola are the energy, agricultural and livestock and waste sectors.

In terms of **geology** the Project's area encompasses some of the most ancient rocks in the country. The majority of the outcrops throughout the transmission lines route belong to the Precambrian basement of the country, which includes metamorphic and volcanic crystalline rocks. Some unconsolidated Quaternary sediments, mainly composed of sand, quartzitic sandstone, gravel and clay also occur.

Regarding **geomorphology,** the project encompasses 3 of the 11 geomorphological units in which Angola is commonly subdivided: the Escarpment zone, the Marginal Mountain Chain and the Acnient Plateau.

The **topography** is variable across the Project's area. In the Benguela province, the ground surface ranges from 500 to 1,250 m. Gradually, as progress to Huambo, increasing altitudes are quite noticed until reaching almost a maximum of 2,000 m high. The nearby area around the transmission lines mainly presents gentle slopes, while the project's indirect area of influence shows some areas with moderate to steep and extremely slopes.

Angola presents a significant potential for **mineral resources,** most of it related to the Precambrian basement. three exploitation areas were identified on the Project's indirect influence area, but there are no available data regarding mining concessions or quarries foreseen on the project area.

It is possible to identify two different types of **hydrogeological** units: Fractured aquifers, related to the basement crystalline rocks, and Porous aquifers, related to unconsolidated Quaternary sediments/alluvial.

In terms of **natural disasters**, the most relevant and likely to occur in the Project's area is the hazard of landslide.

Regarding **hydrology**, the project's area of influence is inserted partially in the Cunene River Basin, in the Huambo Province, and partially in the Catumbela River Basin, in the Huambo and Benguela provinces. Concerning **surface water resources use**, both Cunene and Catumbela rivers are used for hydroelectric production, irrigation, fishing, general domestic uses and human consumption. Benguela and Huambo provinces are noted for occurrence of important **flood** events, while **drought** events occur in the South of Angola, namely in Benguela Province.

The predominant **soil** types in the Project's area are Xanthic Ferralsols and Haplic Ferrasols. Haplic Acrisols are also present in the western part of the area. Other soil types locally present in small areas are also found. The predominant **land uses** are grassland, cropland, tree cover areas and shrubs cover areas.

The project area covers mainly rural areas, where emission sources for **air pollution** are scarce and less likely to cause local air quality degradation. However, urban settlements can be found along the transmission line. Around these areas, air quality may be affected by road traffic on unpaved, biomass burning in domestic activities, and open fires.

it is possible to identify two typologies of **noise** environment in the study area, namely in: rural and forest areas and urban and peri-urban areas. Noise monitoring was carried out and averaged measured day-time L_{eq} surpassed the IFC guidelines for residential areas during day-time, on half of the selected monitoring locations. The most common noise sources were cars and motorcycles passing by, people talking, domestic animals and background noise from natural sources.

The provinces of Benguela and Huambo, include and span three **ecoregions**: Angolan Scarp Savanna and Woodland; Angolan Montane Forest-Grassland Mosaic; and Angolan Miombo Woodland. The following habitats were inventoried in the study area: Miombo woodland; Wetlands; Wooded grasslands and agricultural areas; Areas of *Eucalyptus* sp.; and Artificial areas. A total of 49 species of **flora** and plus 3 taxa only identified to the genera are listed for the study area. During both field visits (June 2022 and April 2023), low numbers of **fauna** were observed, however, a list of fauna species that occur in the study area was developed.

In terms of **cultural heritage**, the Project's area includes three traditional cemeteries, some boabs, as well as relevant **archaeological** sites.

A demining exercise along the proposed alignment corridor is needed in order to allow full access to undertake further ground-based studies and enable alignment finalisation. Should significant change to specific sections of the alignment be needed, this could result in alteration of the Direct Area of Influence in specific parts and thereby require additional focused baseline data and update to the impact assessment beyond what is presented here. Information gaps and how they will be addressed due to the need to first conduct a demining exercise will be captured in a Design Management Process.

Considering the characteristics of the area, the Project's impacts are presented in the table below.

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Table 1 – Summary of environmental and social impact assessment.

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
CLIMATE							
Emissions of GHG	Construction	Negative	Definite	Low	Low	►	Low
Reduction of carbon sinks	Construction	Negative	Definite	Medium	Moderate	►	Low
Reduction of GHG emissions from electricity consumption in Benguela Province	Operation	Positive	Likely	High	High	►	High
Increased risk of reduction of transmission efficiency of lines during heat waves	Operation	Negative	Undetermined	Low	Negligible	►	Negligible
Increased risk of damage to transmission towers and SS in extreme weather events (floods, windstorms, wildfires)	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
GEOLOGY, GEOMORPHOLOGY AND TOPOGRAPHY							
Changes in local morphology	Construction	Negative	Definite	Medium	Moderate	►	Low
Surplus soil	Construction	Negative	Likely	Low	Low	►	Negligible

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Local erosion	Construction	Negative	Likely	Low	Low	►	Negligible
HYDROGEOLOGY							
Groundwater contamination	Construction	Negative	Unlikely	Low	Negligible	►	Negligible
Groundwater use	Construction	Negative	Likely	Low	Negligible	►	Negligible
Reduction of recharge	Operation	Negative	Definite	Low	Negligible	►	Negligible
Risk of groundwater contamination	Operation	Negative	Definite	Low	Negligible	►	Negligible
NATURAL DISASTERS							
Slope instability	Construction	Negative	Likely	Low	Negligible	►	Negligible
Seismic event	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
SURFACE WATER RESOURCES							
Increased turbidity and total suspended solids in river and streams	Construction	Negative	Unlikely	Low	Negligible	►	Negligible
Faecal bacteria and organic matter contamination in rivers and streams	Construction	Negative	Likely	Low to Medium (Lomaum SS)	Low to Moderate (Lomaum SS)	►	Negligible
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	Construction	Negative	Unlikely	High (watercourses' intersections)	Moderate	►	Low

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	Operation	Negative	Unlikely	Low (SS) to High (watercourses' intersections)	Negligible to Moderate	►	Negligible to Low (watercourses' intersections)
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	Definite	Medium	Moderate	►	Low
Permanent removal of vegetation, including crops	Construction	Negative	Definite	Medium	Moderate	►	Low
Permanent land restrictions	Operation	Negative	Definite	Medium/Low	Moderate/Low	►	Low
AIR QUALITY							
NO_2 exhaust emissions	Construction	Negative	Definite	Low/Negligible	Low/Negligible	►	Negligible
PM and Dust emissions	Construction	Negative	Definite	Medium/Low	Moderate/Low	►	Low
NOISE							
Noise emission	Construction	Negative	Definite	Medium/Low	Moderate/Low	►	Low
Operation of the substations	Operation	Negative	Definite	Negligible	Negligible	►	Negligible
Wind effect on cables and Corona Effect	Operation	Negative	Definite	Negligible	Negligible	►	Negligible
ECOLOGY							
Loss of vegetation and flora	Construction	Negative	Definite	Medium/Low	Low to High	►	Low to Moderate (native vegetation)

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Loss and fragmentation of habitats for faunal communities	Construction	Negative	Definite	Medium/Low	Low, moderate, high	►	Negligible, low (wetlands) to moderate (miombo woodlands)
Disturbance of faunal communities	Construction	Negative	Definite	Medium/Low	Low, moderate, high	►	Negligible, low (miombo woodlands) to moderate (wetlands)
Habitat contamination with hazardous materials	Construction	Negative	Unlikely	Low	Low	►	Low
Degradation of ecosystem services	Operation	Negative	Likely	Medium	Low (wetlands) to moderate (miombo woodlands)	►	Low (wetlands and miombo woodlands)
Degradation of the habitats' conservation status (Alien Flora)	Operation	Positive	Definite	Low	Low	►	Low
Degradation of the habitats' conservation status (Natural habitats)	Operation	Negative	Definite	Medium	Moderate	►	Low
Disturbance and mortality of avifauna and bats	Operation	Negative	Likely	High	High / Moderate	►	Moderate (natural areas) / Low (modified areas)

SOCIOECONOMICS AND HUMAN RIGHTS							
Creation of temporary employment opportunities	Construction	Positive	Definite	Low	Low	►	Moderate
Boost of the regional economy and improvement of living conditions	Construction	Positive	Definite	Low	Low	►	Moderate
Impact on the safety of local communities	Construction	Negative	Likely	Medium	Moderate	►	Low
Impact on the health of local communities	Construction	Negative	Likely	Medium	Moderate	►	Low
Increase disease transmission	Construction	Negative	Likely	Medium	Moderate	►	Low
Loss of livelihoods, mostly temporary	Construction	Negative	Definite	Medium	Moderate	►	Low
Potential resettlement during construction	Construction	Negative	Unlikely	High	Moderate	►	Low
Impacts on workers' health and safety	Construction	Negative	Likely	Medium	Moderate	►	Low
Local employment opportunities	Operation	Positive	Likely	Low	Low		-
Provision of electrical capacity and related benefits	Operation	Positive	Definite	High	High		-
Permanent loss of livelihoods	Operation	Negative	Definite	Medium	Moderate	►	Low
Increased community safety after demining	Operation	Positive	Definite	Medium	Moderate		-
Benefits to local settlements from road infrastructure improvements	Operation	Positive	Definite	Low	Low		-

CULTURAL HERITAGE							
Interference with traditional cemeteries	Construction	Negative	Likely	Medium / High	Moderate / High	►	Low
Interference with Lumpi settlement	Construction	Negative	Likely	Low	Low	►	Null
Interference with Nganda settlement	Construction	Negative	Likely	High	High	►	Low

Prior to **mitigation measures**, the identified impacts with *high significance* are: Loss of vegetation and flora; loss and fragmentation of habitats for faunal communities, disturbance of faunal communities, interference with traditional cemeteries and interference with Nganda settlement, during the construction phase, and the disturbance and mortality of avifauna and bats was considered, during the operation phase.

Once the proposed mitigation measures have been put in place, the significance ratings of the negative impacts are reduced to acceptable levels. The project also includes *high significance* positive impacts, in the provision of electrical capacity and related benefits, in the operation phase reduction of GHG emissions from electricity consumption in Benguela Province.

The report includes an **Environmental and Social Management Plan (ESMP),** which identifies the information needed to guide management decisions. The contractor must follow it during the project construction and operation to effectively implement mitigation and compensatory measures. Thus, the ESMP identifies the goals/objectives, activities, schedules, and budget allocation to ensure a good balance between environmental and social costs and benefits associated with the Project. It includes:

- Occupation Health and Safety, including a list of hazards associated to the Project and respective mitigation measures;
- Preliminary Waste Management Plan;
- Stakeholder Engagement Plan;
- Attribution of Responsibilities for Reporting and Review;

The ESIA includes a **Resettlement Action Plan (RAP)**, which specify procedures and necessary actions to avoid, minimise and compensate affected people and communities for their losses or other negative social impacts arising from involuntary resettlement, establishing the basis for the agreement with the Project Affected Persons. The ultimate goal of a RAP is to restore or minimize livelihood disruption and enable those displaced by a project to improve their standard of living. Given the Project's direct area of influence's low population density, physical displacement is expected to be almost completely avoidable by fine adjusting of the project and route of the transmission line.

The **Stakeholder Engagement Plan (SEP) 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 such, 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. The SEP will build on engagement undertaken to date and specify interactions with communities and other stakeholders, as well as finalising the grievance procedure to be used throughout the project.

The **Final ESIA conclusions** point out to no significant negative environmental and social impacts from the implementation of the Transmission Line of 220 kV Lomaum-Huambo and associated substations. Some negative impacts of moderate significance have been identified in the construction and operation phases, but these can be adequately mitigated by the suggested measures, alongside a rigorous implementation of the Environmental and Social Management Plan. These are mainly related to social and economic issues (Permanent restrictions on land use and Permanent loss of livelihoods) and ecological issues (Degradation of the habitats' conservation status and Disturbance and mortality of avifauna and bats).

Positive impacts are expected in the social context, mainly in terms of local employment opportunities (construction) and economic development (operation), improvement of the local road networks (operation). The replacement of electricity generated from fossil fuels (diesel) by electricity generated from hydroelectric plants which have lower GHG emissions is also an important positive impact. This consequence is in line with the objectives established in the Nationally Determined Contribution of Angola (2021), required under the Paris Agreement, which sets the target to achieve (unconditionally) a 14% reduction of GHG emissions by 2025, as compared to the base year of 2015.

1. Introduction

1.1. Purpose of this report

This Environmental and Social Impact Assessment (ESIA) Report presents an assessment of the potential environmental, social and community health impacts associated with the proposed construction and operation of the Transmission Line of 220 kV Lomaum-Huambo and associated substations in Angola ("the Project") to ensure that environmental and social issues are diligently considered and managed during the Project lifecycle.

The report has been prepared for Elecnor Servicios y Proyectos, S.A.U (Elecnor)[1], and presents the objectives, methodology and outcomes of the impact assessment that will be prepared as defined in Presidential Decree No. 117/20 of April 22, which regulates the environmental and social assessment process (ESIA).

1.2. Project overview

The Project includes the studies, design, manufacture, transport, insurance, construction, assembly, reception, and testing of works of the following components:

- New substation (SS) in Lomaum 220/60 kV;
- Expansion of the substation included in the Lomaum Hydroelectric Plant (HP);
- 147.1 km of 220 kV high voltage transmission line connecting the new Lomaum SS 220/60 kV and Belém do Dango SS (Huambo) - LH line;
- 6.2 km of 220 kV HV transmission line connecting new Lomaum SS 220/60 kV and Lomaum HP 220 kV - LL line;
- 7.7 km of the new Lomaum SS 220/60 kV to the Biópio HP transmission line (LT 220 kV Biópio HP - Lomaum HP) - LB line.

The project is administratively located in the Provinces of Benguela and Huambo, in the Centre Region of Angola (Map Geo1, Volume II).

[1] Address of Elecnor: Estrada de Catete s/n- Campo INE - Maristas Luanda - Angola

1.3. Impact assessment scope

Impact identification and assessment was done based on stakeholder engagement, the existing baseline conditions and professional knowledge and experience during the whole process. Cross-sectoral issues considered included: Climate; Topography and Hydrogeology; Natural disasters; Surface water resources; Land use; Ecology; Socioeconomics; Cultural heritage.

This document is the ESIA Report (Volume I), which also includes the Non-Technical Summary, the Appendices of the ESIA Report (Volume II) and the Environmental and Social Management Plans (Volume III).

Besides the present introductory chapter, this Report includes:

- Description of the project and the alternatives considered
- Area of influence of the Project
- Legal and regulatory framework
- Impact assessment methodology
- Biophysical and socio-economic description
- Stakeholder Engagement
- Identification and Evaluation of Environmental and Social Impacts
- Mitigation and Compensation Measures
- Biodiversity Management Plan and Action Plans
- Environmental and Social Management Plan
- Summary of the Resettlement Action Plan
- Overall assessment
- Knowledge gaps
- Conclusions and recommendations

1.4. ESIA Team

Ambigest – Gestão Engenharia e Ambiente, SA is the company in charge of the preparation of the Environmental and Social Impact Assessment (ESIA), in collaboration with NEMUS – Gestão e Requalificação Ambiental, Lda. The team responsible for the ESIA will be a multidisciplinary team composed of the experts listed in the following table.

Table 2 – Technical team responsible for the ESIA.

Name	Background	Responsibilities
Pedro Bettencourt	Ph.D in Sustainable Management Systems M.Sc in Oceanography Degree in Geology	Project Director Team leader / ESIA Expert
Maria José Monteiro	Civil Engineering	Local Coordinator
Carlos César Jesus	Ph.D. in Geosciences M.Sc. in Applied Geology Post-graduate in Coastal Areas Sciences M.Sc. in Biology and Geology	Project Coordinator
Walter Neto	Civil Engineering Laboratory Technician	Socioeconomy; Field Officer
Celestino Chivela	Civil Construction Technician / Construction Inspector	HSE issues; Field officer
Claudia Fulgêncio	M.Sc. in Environmental Engineering; Quality Management	Environmental Engineering Expert & Quality Management
Ângela Canas	BSc in Environmental Engineering; M.Sc. in Technology Engineering and Management; PhD in Environmental Engineering	Environment and Natural Resources Expert; Climate Change Assessment
Catarina Coutinho	M.Sc. in Conservation Biology and BSc in Biology	Ecology and Biodiversity Expert
Gisela Sousa	M.Sc. in Biology – specialized in Marine Animal Resources	Ecology and Biodiversity Expert

Name	Background	Responsibilities
Neto Sequeira	MSc in Economics and Organization Sociology; Degree in Sociology	Socioeconomy Expert
Diogo Maia	Ph.D. Development Studies; M.Sc. in Environmental Economics and Management; Degree in Economics;	Environmental economist
Maria Grade	M.Sc. in Geographic Information Systems; Degree in Environmental Engineering;	GIS lead and Soils Expert
Sónia Alcobia	MSc in Applied Geology and Environmental Geology	Geology and Hydrogeology Expert
Maria Espírito Santo	M.Sc. in Conservation and BSc in Biology	Ecology and Biodiversity Expert
Renata Santos	M.Sc. in Environmental Engineering	Soils and land use Expert
João Fernandes	M.Sc. in Environmental Engineering	Spatial Planning and GIS Specialist
João Ramos	M.Sc. in Environmental Engineering	Environmental Quality Expert
Pedro Félix	M.Sc. in Natural Resources Conservation BSc in Energy and Environmental Engineering	GIS Specialist

2. Description of the project and the alternatives considered

2.1. Need and objective of the project

The Government of Angola, through this Project, intends to leverage the development of the region by providing infrastructures which, in addition to boosting the agricultural, commercial, hotel, industrial and mining sectors, will also significantly improve the conditions of the population in the region, especially providing an environment for attracting investment and job creation.

In many regions of Angola, industrial and agro-industrial poles have emerged as the implementation of policies to leverage this sector. Benguela and Huambo provinces have been privileged with these policies for their enormous potential, attracting significant and considerable private investment.

The Project is part of the rural electrification Government objective, according to the National Development Plan and the Presidential Decree nº 256/11, to bring electricity to all townships in the country, increasing electrification rate from 35% (in 2017) to 50% in 2022. According to the Long-Term Vision for the Electrical Sector, "*Angola Energia 2025"*, the infrastructures here studied appear as planned for 2017. The Project was then included in the Priority One List of Projects in the 2018-2022 Action Plan of MINEA.

The objective of this project is the interconnection of the different sources of electricity generation in the country through a network of substations and transmission lines. The specific objectives are the following:

- To transport the energy produced by Lauca hydro plant to the Benguela Province. At this moment Lauca generated power arrives at Huambo as the final destination through a 400 kV line. The new 220 kV Lomaum-Huambo line will continue the 400 kV line to extend the power transportation infrastructure to the Central Region, delivering Lauca electricity to the main consumption centres in the region, Benguela and Huambo cities;
- Replace the electricity production of the current 334 MW diesel power stations in the cities of Benguela and Quileva with the significant reductions in fuel consumption and CO_2 emissions;
- Create a high voltage ring in the Central Region interconnecting the most

important hydroelectric plants (Lauca, Cambambe, Matala, Gove, Lomaum and Biópio);

- Interconnect the West and Southern transmission networks in Angola to guarantee a continuous, stable, and balanced power supply and transporting energy service;
- Contribute to the national electrification plan by facilitating the construction of a new distribution network in the future (Benguela Province Electrification Project), including more than 50,000 new housings connections in Alto Catumbela, Ganda, Cubal, Caiambambo and other cities;
- Contribute to the development of the province by providing infrastructures that provide an environment for attracting investment and generating employment in sectors such as agriculture, commercial, hotel and industrial.

2.2. Project location

The Project (Transmission Line of 220 kV Lomaum-Huambo and associated substations, Angola) is in the centre of Angola, namely in the Provinces of Huambo and Benguela (Figure 1).

The Project extends for about 161 km, crossing seven municipalities and ten communes. The two municipalities in Benguela are Cubal (commune of Quendo) and Ganda (communes of Babaera and Ganda). In Huambo, five municipalities and seven communes are crossed by the project, namely:

- Municipality of Caála (Kaala and Kalenga);
- Municipality of Huambo (Huambo);
- Municipality of Longonjo (communes of Lepi and Longonjo);
- Municipality of Tchinjenje (commune of Chinjenje);
- Municipality of Ukuma (commune of Ukuma).

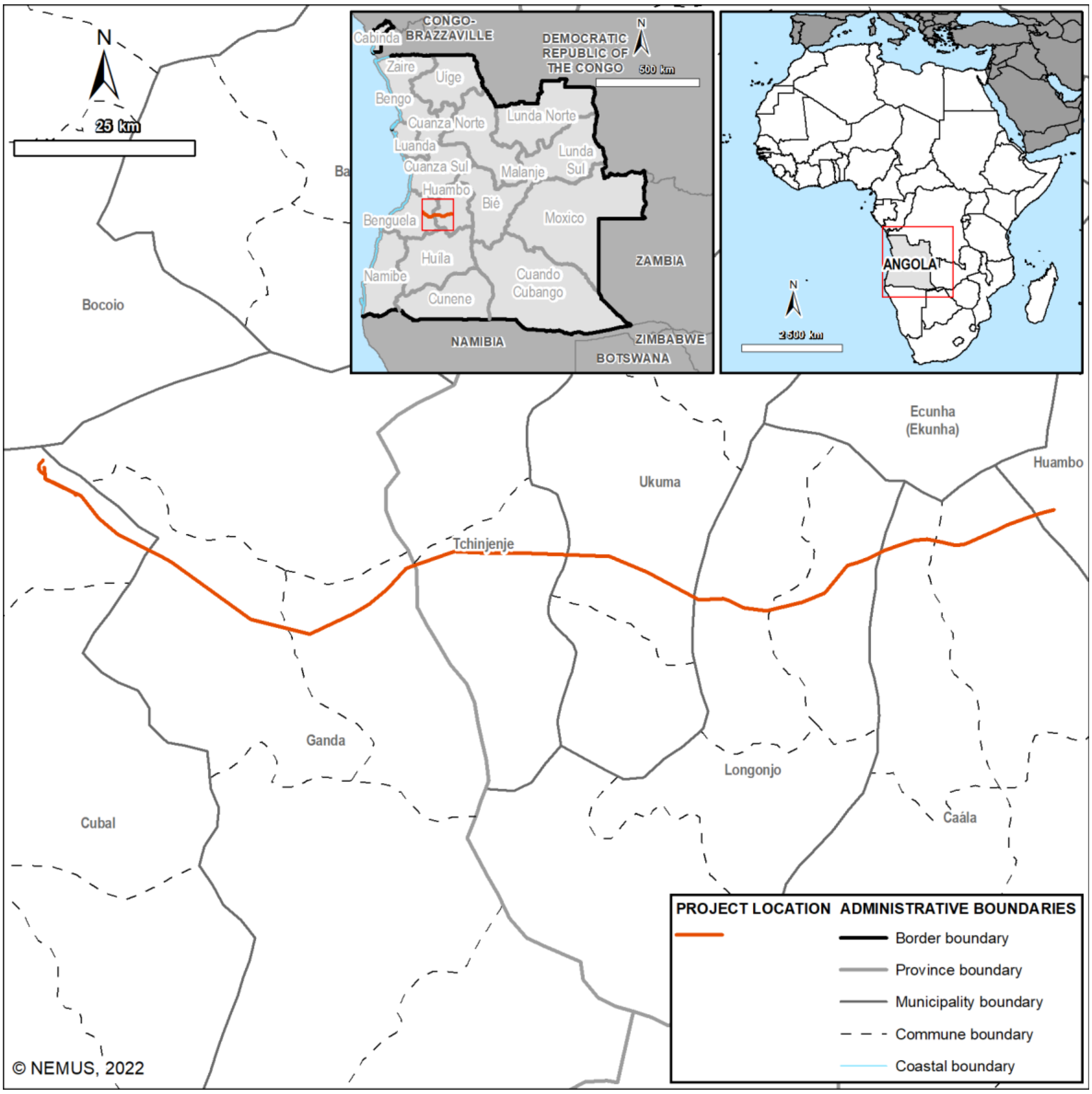

Figure 1 – Administrative framework.

The new substation in Lomaum 220/60 kV and the expansion of the substation included in the Lomaum hydroelectric plant (HP) are located in the commune of Quendo, Municipality of Cubal, Province of Benguela. The Belém do Dango substation is located in the commune of Huambo, Municipality of Huambo, Province of Huambo.

2.3. General characteristics

The Project includes the studies, design, manufacture, transport, insurance, construction, assembly, reception, and testing of works of the following components:

A. New Substation in Lomaum 220/60 kV;

B. Expansion of the substation included in Lomaum HP;

C. 147 km HV Transmission line of 220 kV connecting new Lomaum SS 220/60kV and Belém do Dango SS (Huambo) – Line LH;

D. 6.2 km HV Transmission line of 220 kV connecting new Lomaum SS 220/60kV and Lomaum HP 220 kV – Line LL;

E. 7.7 km section to the 220 kV intersections from new Lomaum SS 220/60kV to the transport line from Biópio HP (LT 220 kV Biópio HP – Lomaum HP) – Line LB.

2.4. New Substation in Lomaum 220/60 kV

The new Substation (component A) will occupy an area of approximately 32,700 m^2 and its location is shown in Figure 2.

Table 3 provides the technical details of the new substation in Lomaum.

Table 3 – New Substation in Lomaum 220/60 kV characteristics.

Zone	Details
220 kV zone:	Six (6) Line bays
	One (1) 220/60/30 kV Transformer Bay
	One (1) docking bay
60 kV zone:	Four (4) Line bays
	One (1) 220/60 kV Transformer Bay
	One (1) docking bay
30 kV zone	A set of Distribution Cells

The civil construction works for the new Substation are fundamentally the following:

- Deforestation of the entire intervention area;
- Stripping of land (average thickness of 0,30 m), with use of the soil for later covering of slopes;

- Earthworks, including excavations and embankments, for the construction of the platform and the access path. Whenever possible, the embankments made should allow for direct foundations (using “sapatas”);

- Construction of the general drainage network of the platform and access path;

- Execution of fencing on the Substation limits, including the supply and assembly of access gates and annex walls. The property boundary fence will also be built;

- Construction of service networks for technical buildings - water supply (the installation of a buried reservoir is planned), drainage, storm sewers and domestic sewage. In the general domestic sewage network, it is foreseen the installation of a Septic Tank, followed by an infiltration well, or alternatively, a Compact Mini-WWTP;

- Construction of underground piping infrastructure and manholes for future installation of a fiber optic communications network;

- Opening and covering of trenches for the execution of the earth network inside the platform, on the outer periphery of the fence and respective connections to the massive equipment and metallic props of the fence;

- Construction of reinforced concrete blocks for transformers, fire walls, gantries and switchgear supports;

- Execution of gutters for cable passage;

- Construction of Technical Buildings - Command Building, Auxiliary Services House and Panel Houses, including all structural, water, sewage, electricity, air conditioning and architectural finishing works;

- Construction of interior circulation routes - main route for the transformers, peripheral circulation routes and preferential access to the panels;

- Laying of a surface layer of gravel;

- Execution of the new access to the existing road, including excavations, embankments, drainage, pavements, paintings, placement of vertical signs, etc., which can be carried out independently of the works related to the platform.

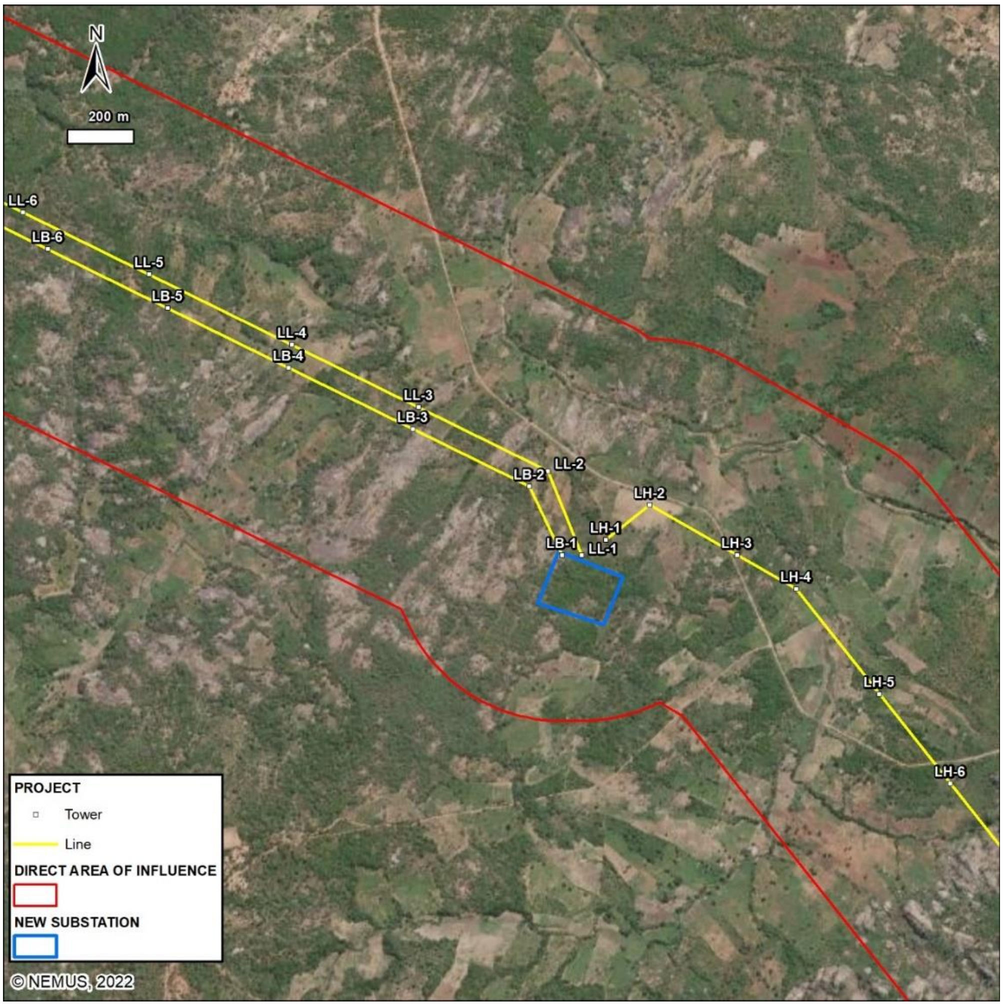

Figure 2 – New Substation in Lomaum 220/60 kV

For the construction of the new Substation two construction camps are foreseen:

- In the initial phase of the work, one construction site will be implanted in an external location, attached to the future fence of the Substation, during the earthmoving works and until the construction of the Substation platform and its fence;
- Another, already inside the Substation, will be implemented for the execution of the remaining civil construction and electrical installation works.

2.5. Expansion of the substation included in Lomaum HP

The expansion of the Lomaum HP substation includes installing new transformers, as shown in Table 4.

Table 4 – Expansion of the substation included in Lomaum HP.

Details
Two (2) Capacitive Voltage Transformers 220kV
Four (4) Capacitive Voltage Transformers 220kV

For the expansion of the Lomaum HP two construction camps are foreseen:

1. One will be exterior to the fence of the future SS; will be used in the initial phase of the work, during the earthmoving works and until the construction of the Substation platform and its fence;

2. Another, already inside the Substation, for the execution of the remaining civil construction and electrical installation works.

2.6. Transmission lines

Component C of the project, the **power line between the new Lomaum SS and Belém do Dango SS** (Figure 3), has a total length of 161 km, has a double circuit, and is equipped with a phase-based conductive cable type AAAC 470 mm^2 YEW and with two guard cables (one Optical Ground Wire type and the other conventional in Alumoweld 19Nº9AWG) (see Table 5).

Table 5 – Transmission line connecting new Lomaum SS and Belém do Dango SS.

Details
Estimated longitude: 161 km
Number of three-phase circuits: 2
Number of conductors per phase: 1 conductor cable per phase, type AAAC Yew
Number of guard cables: 2, one of the Optical Ground Wire type and one conventional in Alumoweld 19No9AWG, or aluminium alloy equivalent
Rated voltage: 220 kV
Maximum Service Voltage: 240 kV

Details
Conductor layout: Vertical treadmill.

Figure 3 – Belém do Dango SS (Huambo).

The technical details for the following components of the project (transmission line connecting new Lomaum SS and Lomaum HP; intersections from new Lomaum SS to the transport line from Biópio HP) are presented in

Table 6 – Transmission line connecting new Lomaum SS and Lomaum HP.

Details
Estimated longitude: 6.2 km
Number of three-phase circuits: 2
Number of conductors per phase: 1 conductor cable per phase, type AAAC Yew
Number of guard cables: 2, one of the Optical Ground Wire type and one conventional in Alumoweld 19No9AWG, or aluminium alloy equivalent
Rated voltage: 220 kV
Maximum Service Voltage: 240 kV
Conductor layout: Vertical treadmill.

Table 7 – Intersections from new Lomaum SS to the transport line from Biópio HP.

Details
Estimated longitude: 7.7 km
Number of three-phase circuits: 2
Number of conductors per phase: 1 conductive cable per phase, type AAAC Crow
Number of guard cables: 2, one of the Optical Ground Wire type and one conventional in Alumoweld 19No9AWG, or aluminium alloy equivalent
Rated voltage: 220 kV
Maximum Service Voltage: 240 kV
Conductor layout: Vertical treadmill.

The transmission towers are to be composed of conventional trussed metal structures, consisting of L profiles connected directly or through plates and screws (as seen in Figure 4).

The number of transmission towers and the distance parameters between them are listed in the table below.

Table 8 – Number of supporting structures and distance parameters between them

	LB	LH	LL	In total
Nº of structures	24	365	19	**408**
Mean distance (m)	322	403	328	**395**
Minimum distance (m)	50	58	59	**50**
Maximum distance (m)	564	623	536	**623**

LH – Transmission line connecting new Lomaum SS and Belém do Dango SS; LL – Transmission line connecting new Lomaum SS and Lomaum HP; LB – Transmission line connecting Lomaum SS and Biópio HP

The foundations of the reticulated supports will be made up of four independent concrete footings, tubular or stepped, prismatic chimney and steel reinforcement.

Figure 4 – Transmission towers.

2.7. Project design guidelines

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

2.7.1. 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 Table 9.

Table 9 – Minimal vertical distances between conductors and obstacles (ET-E-102-Ed.A)

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

2.7.2. 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*.

2.7.2.1. 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 (Table 10).

Table 10 – Management of EMF within Project Design.

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.

IFC EHS Guideline Recommendation	Project
"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 5 and Table 11.

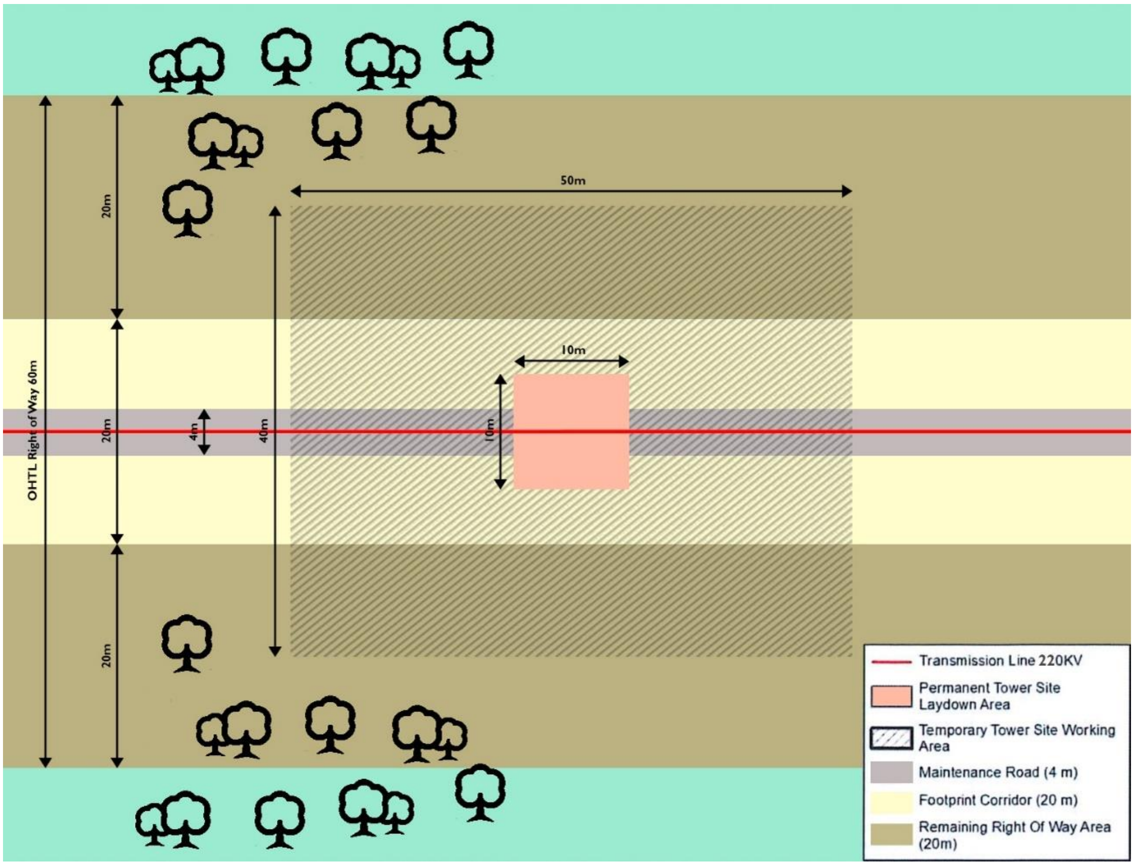

Figure 5 – Restrictions Considered.

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Table 11 – Summary of Restrictions Considered

<table>
<tr><th rowspan="2">Component</th><th rowspan="2">Width / Area</th><th rowspan="2">Description</th><th rowspan="2">Activities</th><th colspan="2">Restrictions</th></tr>
<tr><th>Construction phase (24 months)</th><th>Operation Phase (50 years)</th></tr>
<tr><td colspan="6">Over Head Transmission Line (OHTL) Right Of Way</td></tr>
<tr><td>OHTL Right of Way</td><td>60 m (30 m either side)</td><td colspan="4">• Corridor established for safety & security of high voltage transmission lines as required by Land Law (2004).
• The Right of Way (Faixa Confinante) of 30 m either side along 164.9 km line length.
• Construction of new houses and structures will not be allowed.
This corridor is subdivided into 3 smaller corridors each with different restrictions as follows:</td></tr>
<tr><td>Maintenance Road</td><td>4 m (2 m either side)</td><td>• Service / maintenance road under the line. Road will be totally cleared for maintenance during operation phase</td><td><u>Construction</u>:
• Demining of entire length of 4 m corridor;
• Land clearance. Removal of all trees and crops.
• Removal of all houses and structures.
<u>Operation</u>:
• Maintenance to keep it free of vegetation the area (mechanical);
• Land control / regular patrolling of the line for inspection and maintenance.</td><td>N/A</td><td>• No new trees or crops allowed
• No new houses/structures allowed</td></tr>
</table>

Component	Width / Area	Description	Activities	Restrictions	
				Construction phase (24 months)	Operation Phase (50 years)
OHTL Footprint corridor (wire zone)	20 m (10 m either side)	Safety corridor free of houses and trees. This is to avoid fires and deter potential for encroachment. If needed, routing should be considered to ensure minimization of physical resettlement.	Construction: • Demining of entire length of 20 m corridor; • Land clearance. Removal of all trees and crops; • Removal of all houses and structures. In the case of inhabited structures, the final decision will be done on a case-by-case basis and after careful assessment; • Land clearance. Removal of all trees. Operation: • Maintenance to keep permanent tower site laydown areas free of vegetation; • Pruning of remaining areas;	• Limitations to access agricultural areas during demining	• No construction of new houses or structures allowed • No planting of new trees allowed, only vegetation/crops of up to 6-7 meters high

Component	Width / Area	Description	Activities	Restrictions	
				Construction phase (24 months)	Operation Phase (50 years)
			• Land control / regular patrolling of the line for inspection and maintenance.		
Remaining OHTL right of way area (up to 30 m wide) / Border Zone	2 corridors of 20 m either side of the OHTL Footprint corridor	• Remaining area of the OHTL right of way where both houses/structures and trees/crops could be allowed.	Construction: • Demining of the entire length of the corridor. • Vegetation clearance (pruning of trees) to ensure safe operations (freeing radius of 8 m from the conductors). • Existing structures/buildings can remain provided the safety distances are respected (freeing radius of 8 m from the conductors). Case by case analysis. • No new buildings/structures allowed.	N/A	• No construction of new houses or structures allowed. • Crops allowed. • Trees allowed if clearance (8 m to conductors) is respected. • Clearances to the overhead conductors to be ensured for sale operation: • Buildings: 8m clearance for 400 kV; 6m to 220 kV

Component	Width / Area	Description	Activities	Restrictions	
				Construction phase (24 months)	Operation Phase (50 years)
			Operation: • Land control / regular patrolling of the line for inspection and maintenance. • No new buildings/structures allowed.		• Vegetation: 8m clearance for 400 kV; 5m to 220 kV
Project Components					
Temporary tower site working areas	Average 40 m x 50 m per site	• Area of storage (short period – 4 days), construction and erection of the towers. Total of 408 tower's sites located in the OHTL Footprint corridor.	Construction: • Land clearance. Removal of trees and crops. May be able to maintain trees in this area, outise of tower. footpring and 20 m footprint corridor. • Total land clearing of tower footprint (average 10x10 m).	• No access of unauthorized personnel (including communities). • No planting or harvesting allowed during all the construction period.	N/A
Permanent tower site laydown areas	Average 10 m x 10 m per site	• Total of 408 tower's sites located in the OHTL Footprint corridor.	Operation: • Maintenance to keep permanent tower site laydown areas free of vegetation.	N/A	• No new trees or crops allowed in the 10x10 m area.

2.8. Temporary infrastructures

2.8.1. Access roads

At this stage, there are no details on access roads to be used during the construction phase. Since the corridor is running near the National Road 260 in a considerable extension of the project only six or seven perpendicular access roads are foreseen, and it is expected that all of these are existing roads. For these the four metre right of way will be cleared and access roads re-established / constructed.

In addition, there will be an access road four metre wide along the corridor. For this reason, it is assumed that any new roads will be located within the direct influence area (cf. Chapter 3) and the inherent construction impacts should be similar to the impacts from general construction activities.

2.8.2. Temporary tower laydown and assembly areas

An area of approximately 40 m x 50 m on each site will be demarcated as a temporary tower laydown and assembly area to allow each tower to be installed.

2.8.3. Construction camps

As referred before, two construction camps in each substation (the new and the one expanded) are foreseen: one will be exterior to the fence of each SS; will be used in the initial phase of the works, during the earthmoving works and until the construction of the Substation platform and its fence; another, already inside each Substation, for the execution of the remaining civil construction and electrical installation works.

For the transmission towers, at this stage, it is only known that there will be two construction camps. Despite not having detailed information about each construction camp, they are expected to be equipped with, at least:

- Vehicle access;
- Pedestrian access;
- Guardhouse;

- Parking area for vehicles;
- Septic tank;
- Toilets and changing rooms;
- Offices;
- Canteen;
- Kitchen;
- Storages;
- Workshops;
- Waste area;
- Cement container;
- Water tank;
- Power generator.

The camps will thus be equipped to properly manage waste, wastewater and all subproducts, as well as ensure the safety of the workers and the surrounding environment.

2.9. Project phase activities

2.9.1. Main tasks

The main activities included in the life cycle of transmission lines and substations are described below divided per phase: Planning and detail design, Construction phase, Construction phase, Operational phase and Decommissioning.

These activities are of a technical nature and do not include any of the activities related to environmental and social management except for the payment of compensation.

- Planning and detail design
  - Design principles
  - Study plot
  - Topography survey (LiDAR)
  - Towers type design
  - Foundations type design
  - Substations extension design

- Plant and line profile
- Administrative project
- Access design
- Operational design
- Organization and mobilization

• Construction phase
  - Administrative management occupations
  - Payment of compensation
  - Demining 60m wide corridor
  - Access construction
  - Stakeout and staking
  - Geotechnical study
  - To adapt foundations
  - To adapt Plant and profile
  - Foundations
  - Grounding network
  - Supply of towers
  - Assembling and hoisting
  - Supply of insulators and accessories
  - Supply of conductors
  - Laying, cable stringing, stapled and regulation
  - Substation equipment supply
  - Mounting substation expansion
  - Commissioning
  - Control of works and As Built

• Operational phase
  - Maintenance (routine)

• Decommissioning

2.9.2. Schedule for the construction phase

The construction period is estimated to take 36 months. Transmission lines will take around 24 months, from demining to commissioning, and substations will take around 20 months, from earth movements to commissioning.

2.9.3. Construction phase activities

As stated above, there are several activities foreseen to take place during the construction phase. Below, two particularities are developed for which information is available.

2.9.3.1. Excavations

Foundation sizes are dependent on the soil conditions, tower type and height. According to the designer typical foundations for this project will be "Pila foundation type" using drillers and also "Coluna – Sapata" foundation type. Considering that 408 towers are foreseen in the Project, it is estimated that around 14,000 m^3 of soil will be excavated for this purpose. The total volume of landfill envisaged is 7,000 m^3, which results in another 7,000 m^3 of surplus soil.

It is expected that excess soil will be spoiled around the structure and excess dump rock will be uplifted and removed as required.

Other types of excavations may be requited as to build an access road along the corridor, or for the access roads perpendicular to the corridor to be cleared, re-established /constructed.

2.9.3.2. Construction staff

The estimate of the total, direct and indirect workforce is 550 workers, with an estimate of the local workforce of 430 workers (78%).

2.10. Resources and construction material required during construction

At this stage, estimates of resources required refer only to water use and power and materials refer to concrete and steel. Monthly consumption and source for resources and total amounts for materials are indicated in the following table.

Table 12 – Resources and materials required during construction

Resource	Source	Monthly Average Consumption
Water	Public Network	200 m^3
Energy	Public Network	2,000 kWh
Construction Material		**Total Amount**
Concrete		7,000 – 8,000 m^3
Steel		400 – 500 tons (for towers)
Fuel		**Total Amount**
95% Diesel + 5% Gasoline		31,000 litres/month

Before the project starts, Elecnor representatives will reach out to the local administration to establish an agreement to manage raw water, which will be supplied by the public administration in tanker trucks, regardless of the region or the characteristics of the project. Regarding drinking water, Elecnor will distribute among its employees bottled water to satisfy the needs during working hours. It should be noted that no water will be extracted from pits or natural deposits.

The purchase of materials for the project (including the transmission towers, conductor cables, and iron fittings) is carried out outside Angola. These materials are sent from their places of origin to Angola (Port of Luanda) and transported by truck from the port to the construction site. The only inputs purchased locally are those used during the civil works stage: cement and aggregates.

Installation work in the field will be carried out by Elecnor personnel, without resorting to subcontractors. From deforestation to commissioning, including civil works and mechanical and electrical work, the work is carried out by Elecnor personnel. The only two subcontractors on the project (catering company and the security company that guards Elecnor's work centres) do not carry out field work.

The access roads used to get from existing roads (motorways and conventional roads) to the future layout of the project are not defined at this initial stage. These access roads, which are intended to be short, simple and few in number, will pass through areas that may currently be mined, so their exact location will be defined once demining has been completed. The transport of materials and people for the installation work is mainly carried out along the route of the line, taking advantage of the easement area, which allows the number of access roads to be reduced to a minimum.

2.11. Land requirement by the Project

The anticipated maximum land take for the Project is around 150 ha (temporary tower site + longitudinal access road + new ss + expansion of ss + construction camps) during the construction phase, and a maximum of around 80 ha during the operation phase (Table 13). It is important to note that not all the construction area will be required at the same time. The impact of the construction works will be progressive as this sequential work is completed on a consecutive lineal progress.

Table 13 – Anticipated land requirement by the Project

Component	Features	Land Required
Temporary		
OHTL Right of Way	(161 km of OHTL) * 60 metres wide	966 ha
OHTL Footprint corridor	(161 km of OHTL) * 20 metres wide	322 ha
Temporary tower site working areas	408 tower sites (40x50 metres per tower)	81.6 ha
Construction camps	Two construction camps	Not determined
New Lomaum SS	SS (3.3 ha) + construction camp	6.6 ha
Expansion of Lomaum HC	Expansion + construction camp	Not determined
Permanent		
Permanent towers	408 towers (10x10 metres per tower)	4.1 ha
Maintenance road	(161 km of OHTL) * 4 metres wide	64.4 ha
New Lomaum SS	Area for the new SS	3.3 ha
Expansion of Lomaum HC	Area for the expansion	Not determined

2.12. Project cost

According to Elecnor (2021)[2] the investment cost for the project, estimated in Euros (€), is eighty-nine million nine hundred fifty-four thousand eight hundred eighty-one and fourteen hundredths (89.954.881,14 €) Euros.

2.13. Alternatives considered

Three scenarios were considered for the analysis of alternatives for the transmission lines: Alternatives 1 and 2 (corresponding to different transmission line routes) were considered and a “no-go” scenario.

It should be noted that this project is part of the rural electrification Government objective, according to the National Development Plan and the Presidential Decree nº 256/11, to bring electricity to all townships in the country, increasing electrification rate from 35% (in 2017) to 50% in 2022. These infrastructures are foreseen in the Long-Term Vision for the Electrical Sector, “Angola Energia 2025”, and where then included in the Priority One List of Projects in the 2018-2022 Action Plan of MINEA.

Complementary, substantial investment is being allocated to the construction and rehabilitation of linear infrastructures to transport power produced in Lauca Hydro Plant to the Benguela Province.

Based on this scenario, the no-development option would mean that this component of the national strategy would not be fully implemented despite the energy generation upstream. In the short term, this scenario ensures the status quo in the biophysical and socio environment along the project area. The implications of this would be until a certain point no additional reliability and security of electricity supply to Benguela. The “no-go” option would mean no interconnection between the West and Southern transmission networks in Angola, and so the guarantee of a continuous, stable and balanced power supply and transporting energy service would be compromised. The area would continue experiencing unstable electricity supply associated with load shedding and outages due to demands exceeding supply. The proposed project is key in realization of one of the objectives of Angola Energy 2025. The No Project option will therefore in the medium

[2] Project Teaser (2021)

and long term dent the availability of electricity power in those urban and per urban areas, derailing the progress being made towards realization of vision 2025.

Given the nature of the project, and that the level of impacts associated with the project are low and that there is high probability of mitigation of these negative impacts, the "no-go" option is not the most viable option in this instance given the consequences for development in the Benguela area and the need to increase reliability and security of electricity supply to this area.

Taking into account the low population density that resides in the Project's Direct Area of Influence, physical displacement is expected to be almost completely avoidable by adjusting the Project and the route of the transmission line.

Hence, Elecnor optimised the pathway for the transmission line with the goal of minimizing resettlement needs, through:

- An analysis of existing structures in the different areas described in section 2.11, with the detailing of Project's adjustments to minimize resettlement needs;
- Stakeholder engagement with municipalities, community leaders and rural families along the pathway of the transmission line.

An analysis of existing structures in the different areas described in Section 2.11, was carried out using Geographic Information Systems tools and a cartographic survey (orthophoto maps) provided by Elecnor with the full coverage of the Project.

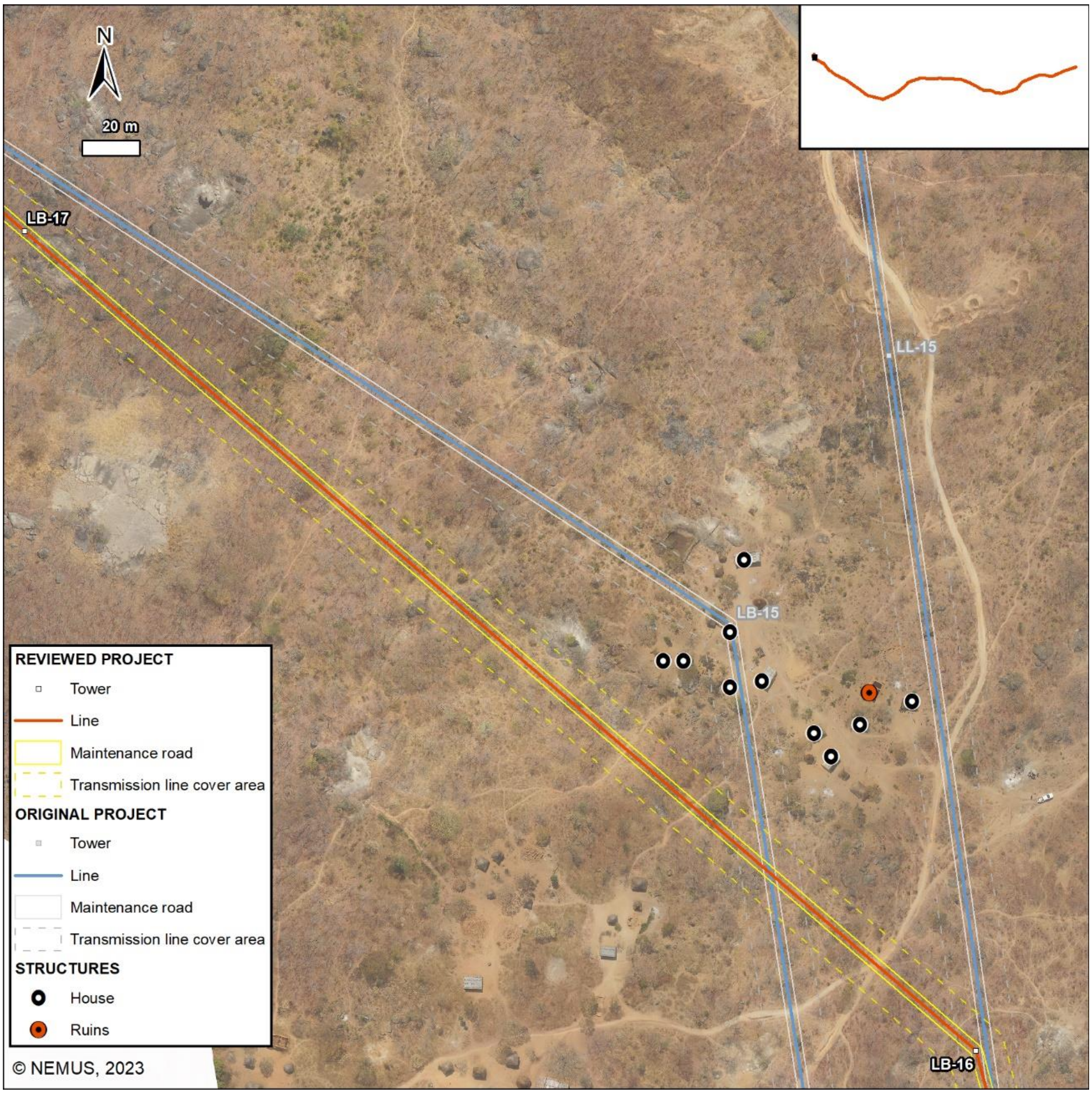
The structures identified intercept different areas of the project. Following the land requirements presented in Section 2.11, four areas were defined, namely:

- Maintenance road – 4-meter strip centred on the OHTL (2-meter buffer);
- OHTL footprint corridor – 20-meter strip centred on the OHTL (10-meter buffer);
- Permanent tower footprint – (10 x 10) meters, centred on the associated support tower.
- Temporary tower site working areas – (40 x 50) meters, centred on the associated support tower.

It should be noted that these four areas overlap and a structure may be located in only one area or in all four, depending on its location.

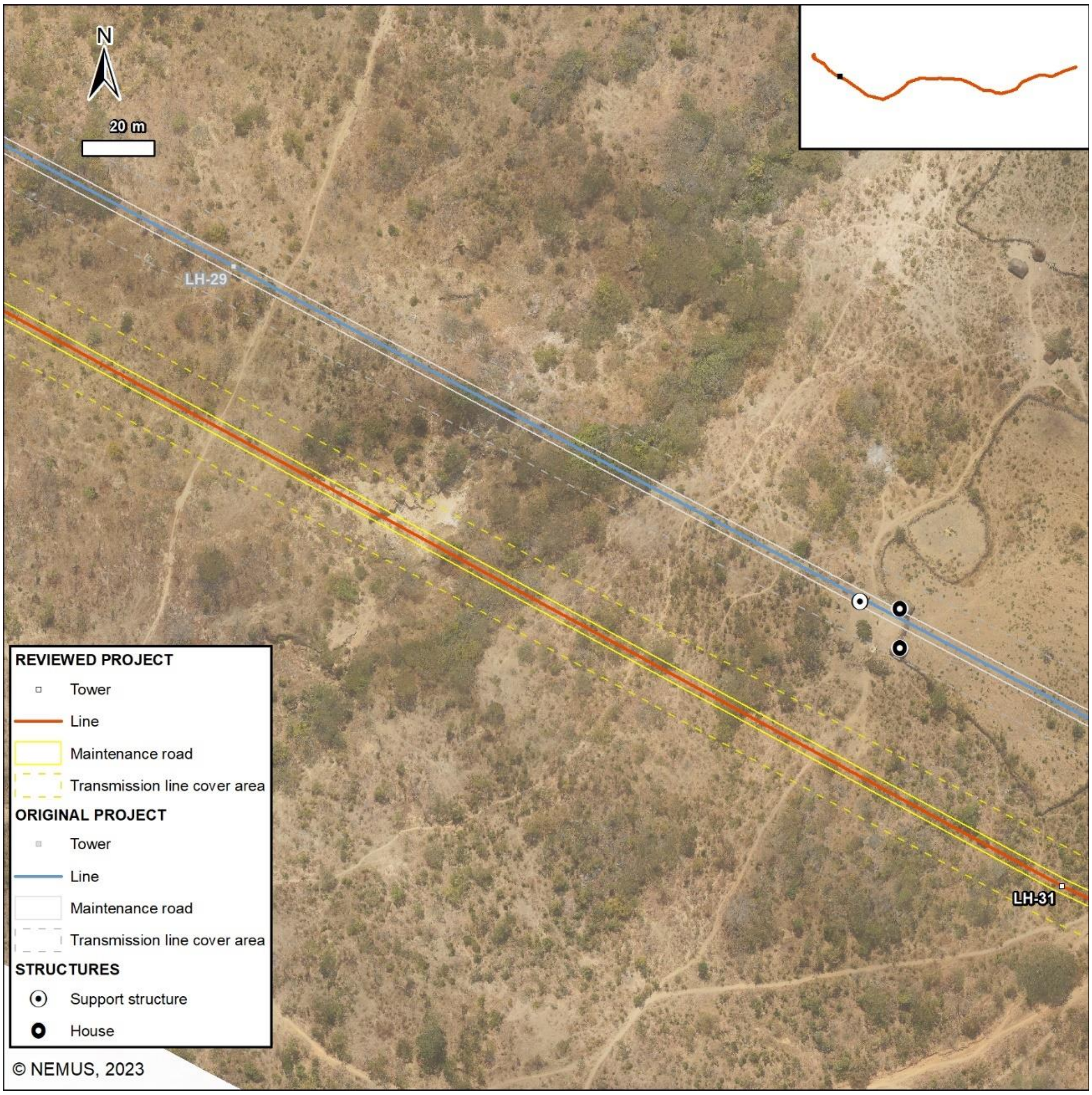
The analysis of the first version of the transmission line route (**Alternative 1**), provided by Elecnor, identified 65 structures located in at least one of the four project areas. However, following feedback from Nemus, Elecnor adjusted the route of the transmission line to minimise resettlement (**Alternative 2**).

Figure 6 to Figure 8 show three examples of locations where the adjustment of the transmission line has allowed resettlement to be minimised by reducing interference with structures.



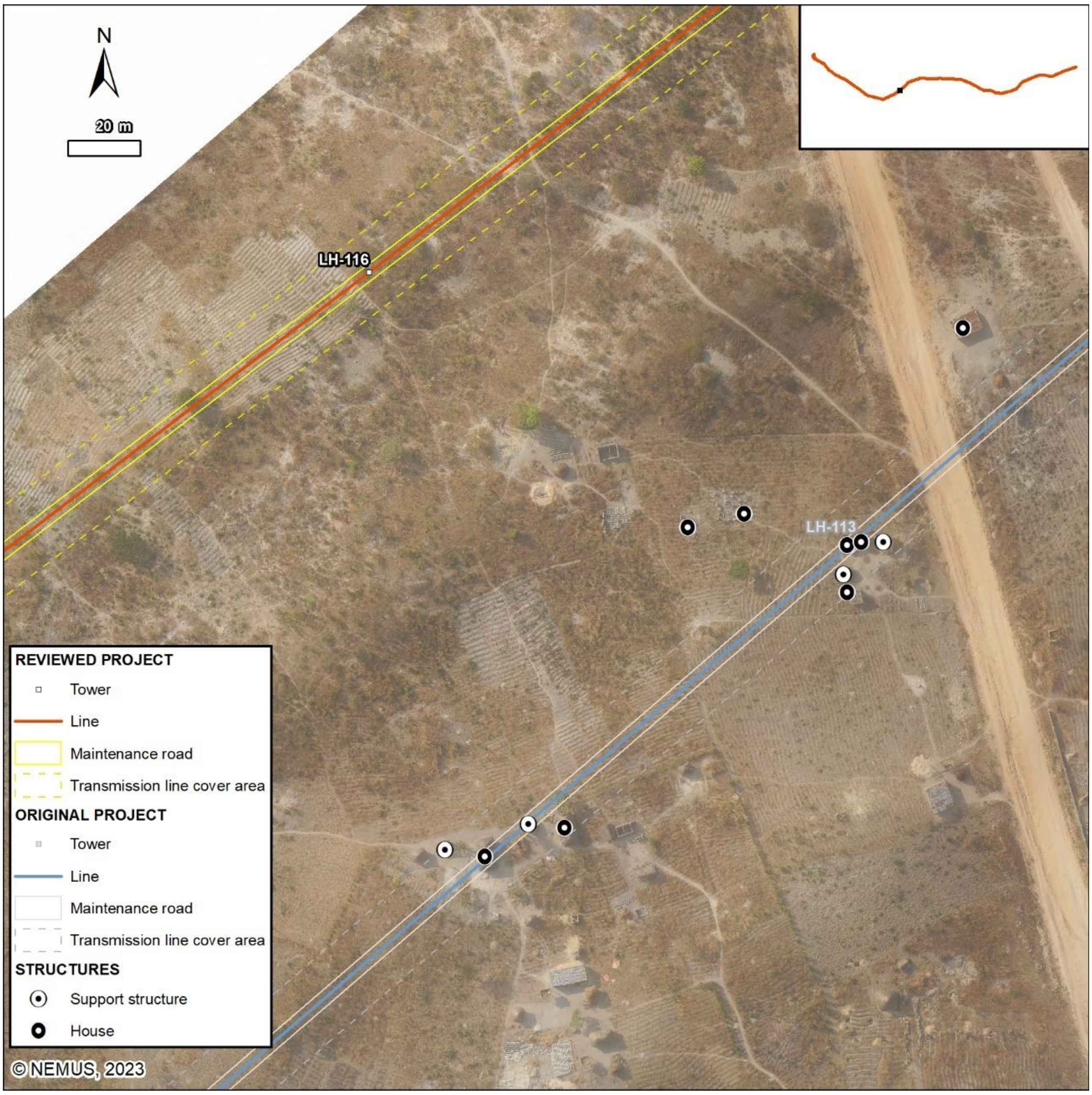
Source: NEMUS (2023)

Figure 6 – Transmission Line route adjustments to minimize resettlement (1).



Source: NEMUS (2023)

Figure 7 – Transmission Line route adjustments to minimize resettlement (2).

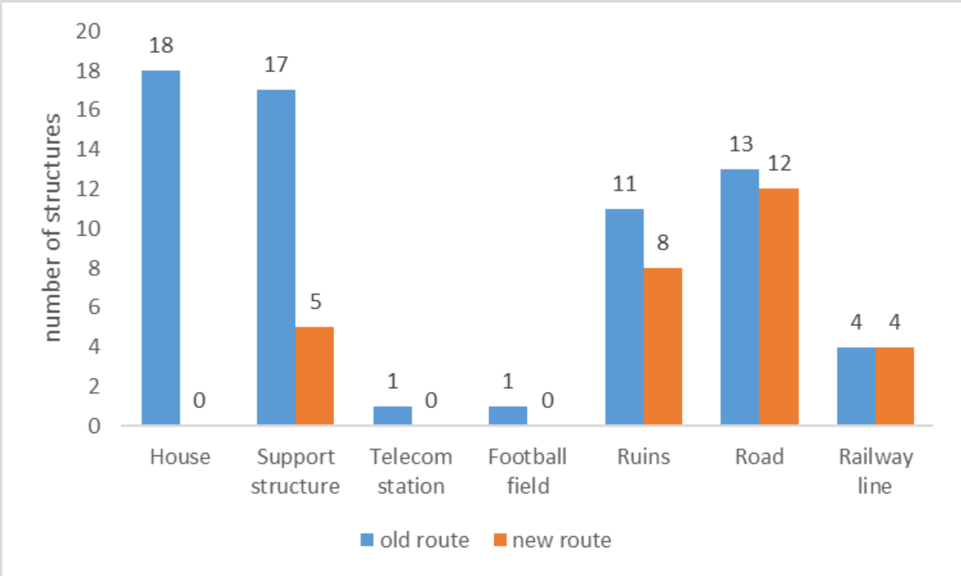


Source: NEMUS (2023)

Figure 8 – Transmission Line route adjustments to minimize resettlement (3).

The remaining analysis in this report will consider this new route of the transmission line. In this new version, only 29 structures were identified in the project's areas.

Figure 9 shows the structures identified in the old version of the transmission line route compared to the new version. It should be noted that the new route of the transmission line allowed the project to avoid the relocation of houses, as well as the telecommunication station and the football field.



Source: NEMUS (2023)

Figure 9 – Number of structures in old and new Transmission Line route

In the old route, there were 7 structures or infrastructures within the permanent tower site: 3 houses, 1 support structure and 3 roads. These cases were considered high priority in the delimiting of the new route. In the new route, only a support structure and a ruin were found within the permanent tower site.

Considering the improvements obtained in terms of structures affected by the project, **Alternative 2, corresponding to the final route for the transmission** (as detailed in section 2.2) was chosen.

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3. Area of influence of the Project

For the purposes of this impact assessment, the definition of Area of Influence given in IFC Performance Standard 1 is used. The area of influence encompasses:

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

3.1. Direct Area of Influence (DAI)

The Direct Area of Influence (DAI) is the area of direct impacts of the project on the natural environment (flora, pollution, physiographic changes, among others) and the socio-economic environment (land occupation, local and regional development, among others). Typically, DAI corresponds to the areas of physical deployment of infrastructure and construction work and a marginal area where the effects of the presence and operation of these actions are felt directly.

The DAI for the physical and biotic environment includes the following areas (as seen in Figure 10):

- 500 metres buffer around the ~150 km transmission line of 220 kV between Lomaum and Huambo and associated substations;

- Access roads to the supporting structures sites, if applicable (considering a buffer of 25 metres from the road axis);
- Social spaces, namely the camp of tents, changing rooms and spaces for water storage and energy support;
- Other spaces that are not yet foreseen, which may be directly intervened or through project activities.

In the context of this Project, the DAI is generally framed by natural vegetation with extensive agricultural use (rural context).

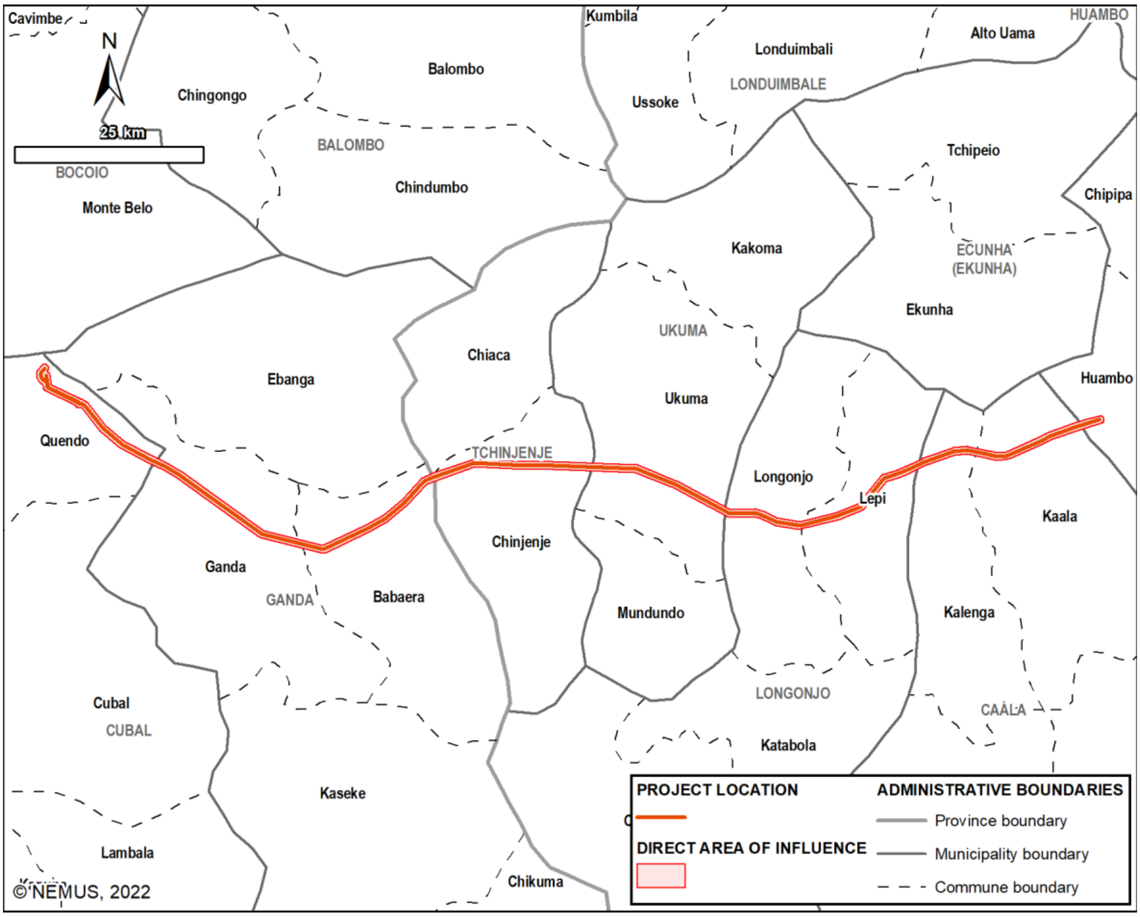

Figure 10 – Project's Direct Area of Influence.

3.2. Indirect Area of Influence (IAI)

The Indirect Area of Influence (IAI) is generally a more extensive area defined to analyse the influences of the proposed activities, not directly but through the possible side effects that may result from the project. Thus, the IAI includes a broader area, including the area of all communes crossed by the project, namely those presented in Table 14, as shown in Figure 11.

The level of analysis could be established on a larger scale, assessing the opportunities and effects on a Municipality scale or even on a Provincial or Superregional scale in the context of economic development in the Centre of Angola.

The various subjects to be addressed in the ESIA will start from the general areas of influence indicated above but may define specific areas of influence with interest to the topic under analysis.

Table 14 – Communes and Municipalities in the IAI.

Province	Municipality	Communes
Benguela	Cubal	Quendo
	Ganda	Babaera
		Ganda
Huambo	Caála	Kaala
		Kalenga
	Huambo	Huambo
	Longonjo	Lepi
		Longonjo
	Tchinjenje	Chinjenje
	Ukuma	Ukuma

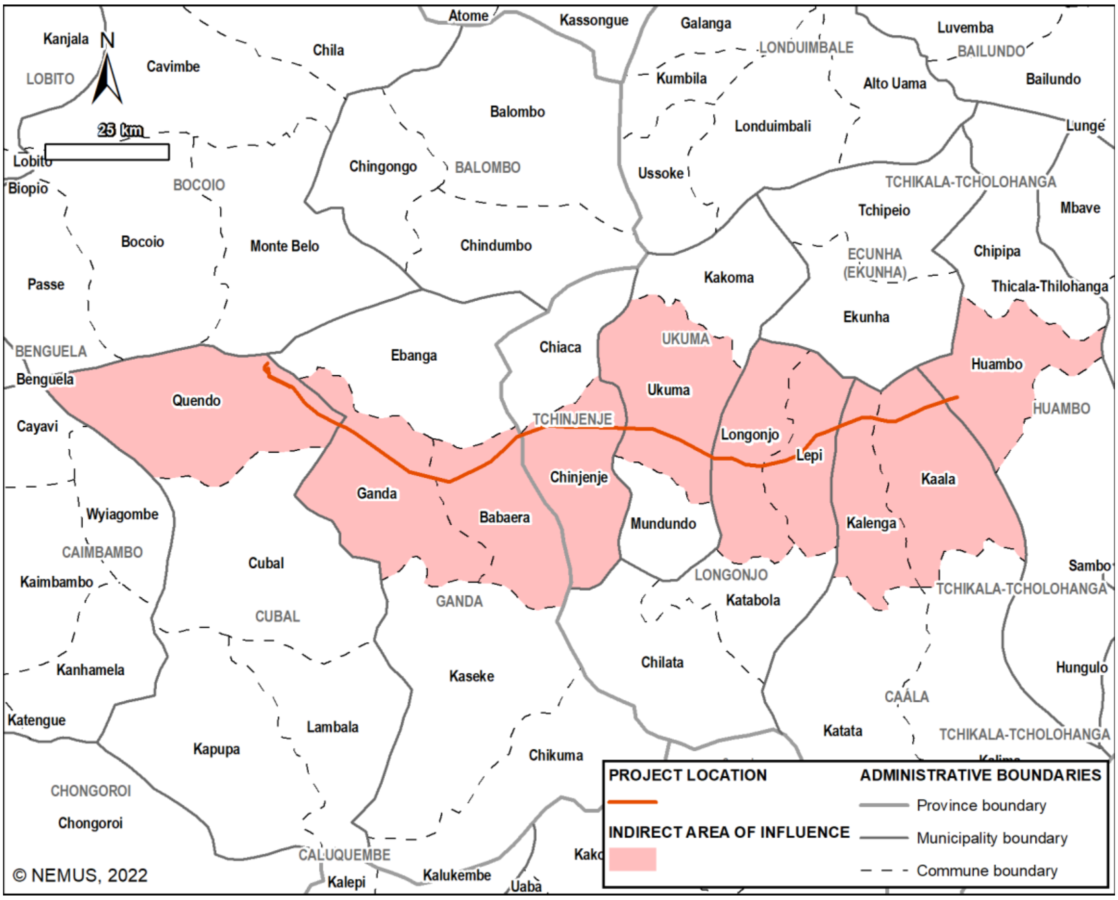

Figure 11 – Project's Indirect Area of Influence.

3.3. 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 basis 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.

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4. Legal and regulatory framework

4.1. Introduction

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

Where no local standards exist, applicable standards for international lending organizations are referred to, specifically those provided in the International Finance Corporation's (IFC) Performance Standards 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)].

4.2. Brief political and administrative framework

4.2.1. Brief political framework

In Angola, legislation is the primary 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, whereby the President of Angola is both head of state and head of government, and of a multi-party system. Executive power is exercised by the government and elections take place every five years. Legislative power is vested in the President, the government and 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, as well as the duty of defending and preserving it. Therefore, the State must adopt the necessary actions to protect the environment and the flora and fauna species throughout the entire national territory, to maintain the ecological equilibrium, to define the right localization of the economic activities and to guarantee the rational utilization and exploration of every natural resource, ensuring the sustainable development and respecting the future generations.

4.2.2. Administrative Division

Angola has a three-level administrative structure, as listed below:

- Province (província): 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 Stakeholder Engagement and Social Concertation Council) which aims at providing support at provincial level, in terms of discussion and decision-making of relevant socioeconomic policies for the province. This council includes, amongst others, local authorities, religious institutions, private sector, labour organizations, professional organizations, civil society representatives and a member of the Provincial Youth Council.

Each provincial level is headed by the Governor for the province, the Municipal administrator, and the Communal administrator. They are all appointed by and accountable to the Central government.

4.3. National regulatory framework

The following Table presents a synthesis of the main national pieces of law, with relevance to the Project.

Table 15 – National Legislation Relevant to the Project.

General
Judgement of the Constitutional Court n.° 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 117/20 (22 / 04 / 2020) on Environmental Impact Assessment and Environmental Licensing
Decree n.º 1/10 (13/01/2010) – Environmental Auditing
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 – Law of Forests and Wild Fauna
Environmental Pollution
Presidential Decree n.º 194/11 (07/07/2011) – Liability for Environmental Damage
Health and Safety
Decree n.º 31/94 (31/05/94) – Occupational Hygiene and Safety System
Labour
Law n.º 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) – Electricity General Law
Decree n.º 47/01 (20/07/2001) – Electric Energy Production Regulation
Decree n.º 41/04 (02/07/2004) – Regulation of Licensing of Production
Water
Law n.º 6/02 (21/06/2002) – Water Law
Presidential Decree n.º 82/14 (12/04/2014) – Regulation on General Rules of 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
Land Use and Resettlement
Law n.º 9/04 (09/11/2004) – Land Law
Law n.º 3/04 (25/07/2004) –Law on Territorial and Urban Planning
Decree n.º 58/07 of July 13, 2007 - General Regulation 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 for 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 the Licensing and Security of Electric Facilities
Decree n.º 46.847 dated 1966 - Regulation of the Protection of High Voltage Transmission Lines
Cultural Heritage
Law n.º 14/05 (07/10/2005) – Cultural Heritage Law

4.3.1. Relevant Policies and Plans

There are a number of relevant documents which are important for the development of energy projects in Angola and these include:

- The National Biodiversity Strategy and Action Plan (NBSAP) approved through the Resolution n. º 42/06 of July 26, 2006. This strategy incorporates measures for the conservation and sustainable use of biological diversity/resources in development policies and programs.
- The National Policy of the Forests, Wildlife and Protected Areas approved by the Resolution n. º 1/10 of January 14 focuses in four main axes, namely economic, social, institutional and environmental.
- The economic axis aims at promoting 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 the management and sharing of benefits resulting from the sustainable exploitation and use of forests, while the institutional axis is aimed at establishing institutional capacity building mechanisms to ensure

efficiency, transparency, professionalism and confidence in the fulfilment of the mandate related to the management of forest areas. The environmental axis aims at contributing to the conservation and protection of terrestrial biodiversity, with a view to national sustainable development.

- The Strategic Plan for New Environmental Technologies approved through the Presidential Decree N. º 88/13 of June 14, 2013. It focuses on its guiding and framework principles, in axles and programs, namely the transverse axle, including the promotion of the environmental technologies, and incentives to the investment in environmental technologies, and the sectorial axle, including the sectors of urbanism and construction, agriculture, and forests, and the environmental technologies, in the industry, energy and water, petroleum, and transportation sectors, and the implementation of the plan.

Other plans addressing issues specifically related to spatial planning will be discussed in the following Section.

4.3.2. Spatial planning

4.3.2.1. Historical context

After decolonisation (1975), Angolan cities grew significantly and were sometimes disorderly due to the dispersal of urban areas and the unbalanced growth of areas inhabited by refugees. There was a large population exodus at this stage, resulting in great pressure on existing infrastructure and equipment, a proliferation of neighbourhoods and informal settlements, traffic congestion, as well as urban and aesthetic disqualification of the country’s large urban centres.

In the territory under analysis, the conflicts of the last decades of the 20th century were a factor that caused the involuntary displacement of the populations towards the capital of the country and to other safer urban areas, causing, consequently, urban ruptures and chaos in the places of reception. Finally, after the end of the civil war in 2002 the accelerated urbanisation process caused more urban disorganisation and severe diverse social, environmental, and economic problems.

4.3.2.2. Strategic background

General strategic instruments such as the National Development Plan or the National Strategic Plan for the Administration of the Territory, although not being land management plans per se, provide key guidance for spatial planning instruments.

The National Development Plan 2018-2022 (Government of Angola, 2018) includes Axis 5: Harmonious Territory Development, with the underlying Territorial Development and Spatial Planning and Urbanism policies. In the context of the assessed project, the priorities of harmonious development and the creation of economically dynamic and competitive territories stand out as a result of strategic investments and coordination of sectoral actions in aspects such as energy for the development of the urban network.

The National Development Plan establishes a set of general strategic guidelines that are then specified at the provincial level.

In the Benguela province, the intended development for the industrial subdivision of Cubal (near the project area) is particularly relevant in the context of the strategic focus on accelerating the industrialization process underway in the province.

For the Huambo province, the various strategic focuses of the plan aim to reinforce the already established dynamics with regards to existing activities, contextualized by the existing constraint on the energy production capacity and fragility of the distribution network. The explicit priority for the “completion of the electricity transmission network from the Laúca hydroelectric plant to Huambo and Caála, with connection to Cuíto, and modernization and expansion of the medium and low voltage distribution network” is established.

The National Strategic Plan for the Administration of the Territory – PLANEAT 2015-2025 (Government of Angola, 2015) defines a strategic vision that reflects the guiding principles of the then Ministry for Territory Administration and establishes a set of programs to achieve its strategic objectives, focused on strengthening territorial administration services. The PLANEAT 2030 version is currently in force, in line with the updates to the country's strategic framework, namely the Angola 2025 Strategy and the 2013-2017 National Development Program in the context of the Sustainable Development Goals for 2030, the SADC’s Regional Indicative Strategic Development Plan and the African Union’s Agenda 2063 (in Portal de Angola, 2016).

The National Spatial Planning State Report is to be presented every two years by the relevant Ministry to the National Assembly, and summarizes the main spatial and urban planning options as well as analyses the causes and degrees of their implementation (*Jornal de Angola*, 2017). Currently, this is a responsibility of the Ministry of Public Works and Spatial Planning (Government of Angola, 2022).

These public instruments to order urban growth have proved inadequate and incapable of solving the problems, which have worsened over time, reaching unsustainable dimensions for affected populations. Hence, there are little to no general spatial planning instruments available.

The Decree no. 2/06, of 23 January, establishes the General Regulations for Territorial, Urbanization and Rural Management Plans (RGPTUR in Portuguese), which defines the legal basis for the land management system. This system has the general objectives of programming of the rational use of the effective and potential resources of the physical space, and of coordinating the policies of spatial planning with the economic, environment and nature conservation, education and culture, social welfare and of quality of life.

4.3.2.3. Spatial planning framework

The Law no. 3/04, of 25 June, for the Land Management and Urbanism ("*Lei do Ordenamento do Território e do Urbanismo*" – LOTU in Portuguese) establishes the national spatial planning system, bestowing upon the State the promotion and guidance of spatial planning policy and their compatibilization with development policy. This system is articulated through the instruments for urban and rural territorial land management and related policies. This law also regulates the coordination with other instruments such as the general regime of defence, occupation and use of land, and establishes that the land use must comply with municipal and special spatial plans that result from it.

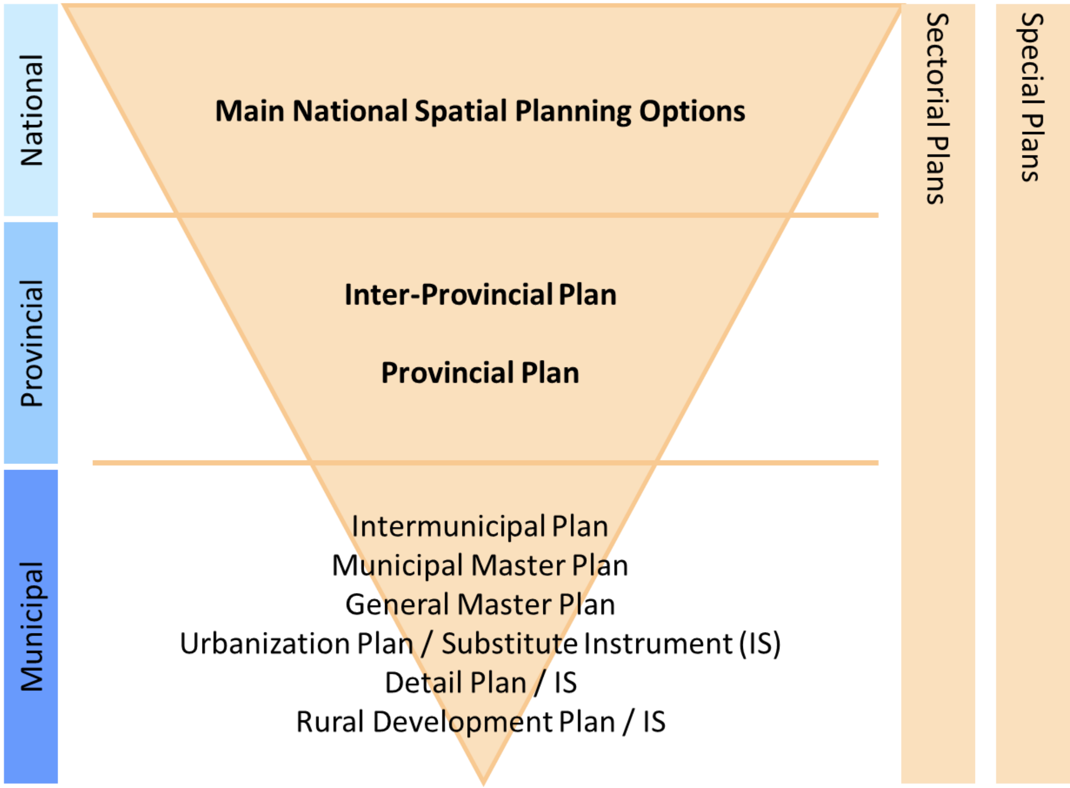
The land management instruments may be set forth by institutions at varying levels, namely:

- Political institutions such as the National Assembly or the Government - through the Ministry of Urbanism and Housing and the Inter-ministry Commission for Land Management and Urbanism;
- Participatory institutions such as national, provincial or municipal Consultive Commissions;
- Technical institutions at the central, provincial or local levels; and
- Local political and administrative bodies at the provincial (provincial government) or local (municipal administration) level.

Centrally, the implementation of public policy for the spatial planning process and territory management is articulated through the National Institute for Land Management and Urbanism.

Similarly to the land management institutions, the land management plans are articulated with each other according to their scope at the following levels:

- **National level**: establish national policies for land management through instruments such as the Major National Spatial Planning Options, the National Land Management and Urbanism Policy, or the National Development Plan 2018-2022;
- **Provincial or interprovincial level**: instruments such as the Provincial or Interprovincial Land Management Plans define strategic options for the territory of one or several provinces, integrate the national planning level with local planning instruments;
- **Municipal level**: plans that cover the municipal level, which can be extended to several municipalities, such as Municipal Master Plans, Intermunicipal Land Management Plans, Urbanization Plans, Rural Management Plans, Detailed Plans and General Master Plans for large cities.



Source: Martins (2016).

Figure 12 – Organization of the spatial planning system in Angola.

The land management plans specific to the study area are further described in Section 4.3.2.4 and include:

- Cubal Municipal Master Plan (PDM);
- Ganda PDM;
- Caála PDM;
- Huambo PDM.

4.3.2.4. Land management plans

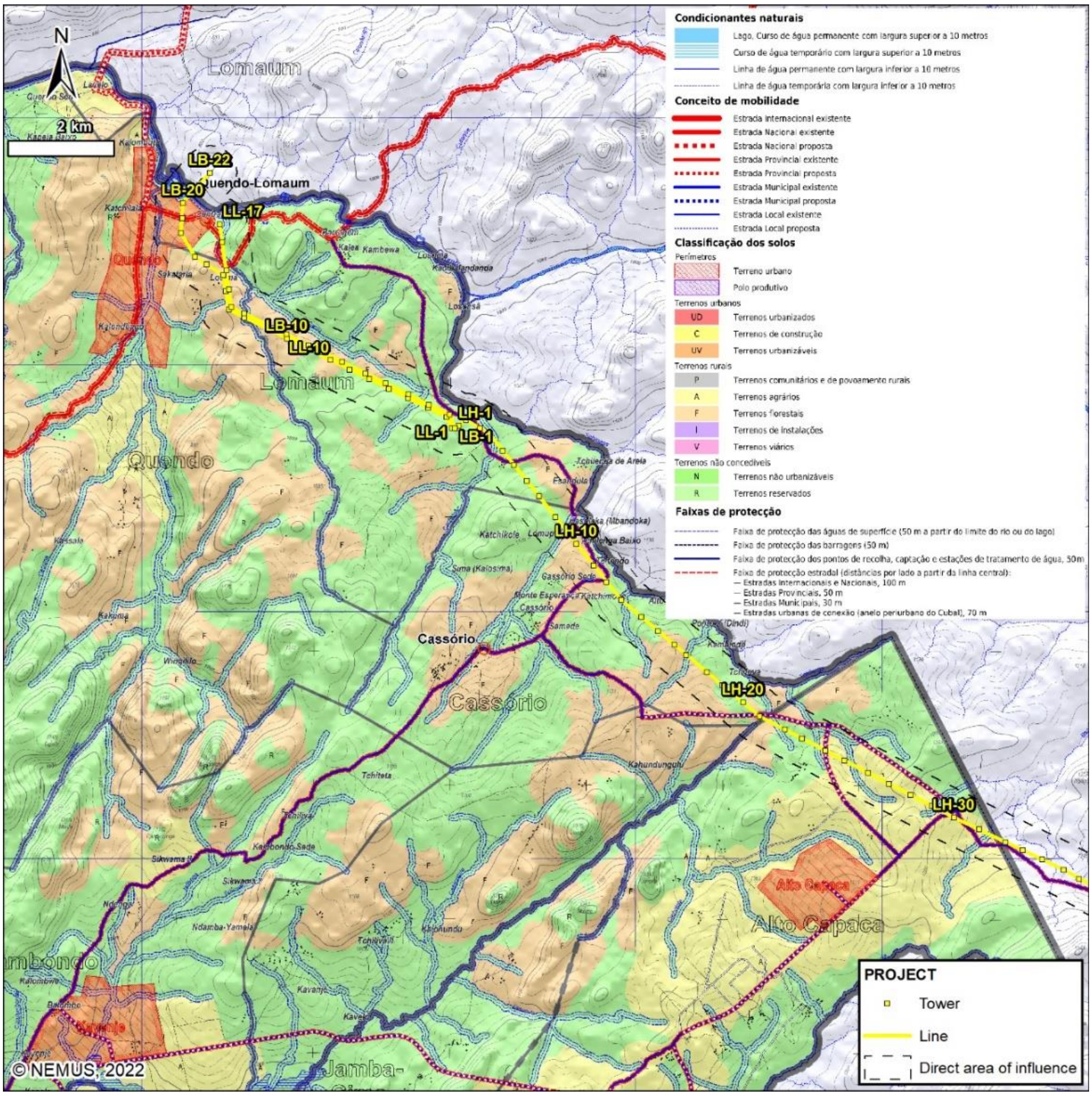
The planning status of the Angolan territory is still relatively incipient (Chissola, 2015; Martinho, 2021). It was only possible to identify the existence of the following instruments in the indirect area of influence of the assessed project:

- Ratified:

  - Benguela province:

  - Cubal PDM: ratified by Presidential Order No. 21/20 by the President of the Republic, on February 17. The project overlaps with several surface water protection zones, existing and proposed municipal roads and their protection zones, and the urban perimeter of Quendo (Samayongo, 2015, as represented Figure 13);
  - Ganda PDM: ratified by Presidential Order No. 200/19 by the President of the Republic, on November 12, without available detailed information.
- Presented, to be approved:
- Huambo province:
  - Caála PDM: presented in 2015, establishing the improvement of, among others, the electrical energy supply system (Portal de Angola, 2015), without available detailed information;
  - Huambo: presented in 2016 (UCCLA, 2016), without available detailed information.
- No information for:
- Huambo province:
  - Longonjo;
  - Tchinjenje;
  - Ukuma.

The spatial planning system also provides for the possibility of Rural Development Plans, although none were documented in the study area.



Source: Adapted from Samayongo, 2015

Figure 13 – Cubal PDM map of limitations near the project's direct area of influence.

4.4. 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 party, and which are relevant for the Project here analysed is presented in the following Table.

Table 16 – List of Multilateral Environmental Agreements Ratified by Angola.

International Convention	Applicability to the Project
General	
SADC Protocol on Trade	The Protocol intends to further liberalise intra-regional trade by creating mutually beneficial trade arrangements, thereby improving investment and productivity in the region. It advocates that Member States eliminate barriers to trade, ease customs procedures, harmonise trade policies based on international standards, and prohibit unfair business practices. The Protocol should be considered when developing Project activities.
Environment	
Convention on the Conservation of Migratory Species of Wild Animals	This ESIA has considered any potential impacts on migratory species.
United Nations Convention on Biological Diversity (CBD) (1992)	The objectives of the CBD have been considered in this ESIA.
Convention on Wetlands of International Importance especially Waterfowl Habitat (Ramsar Convention, 1971)	This EIA has taken into account any potential wetlands.
SADC Protocol on Wildlife Conservation and Law Enforcement (1999)	The principles and guidelines of the SADC Protocol should be considered when developing plans and programmes for the management of wildlife.
Hazardous 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/was considered when developing plans and programmes for the management of relevant hazardous chemicals and pesticides. Neither pesticides nor herbicides will be used during the project, since the site works do not entail the use of such chemicals.

International Convention	Applicability to the Project
Waste	
Basel Convention on Hazardous Waste (1989)	If applicable, obtain consent from the receiving country before the transboundary movement of hazardous waste.
Bamako Convention (1991)	Consider the content of the Bamako Convention (as well as the Basel Convention, above) if any hazardous wastes (broadly defined) are to be moved across national boundaries.
Heritage	
The World Heritage Convention (1972)	By applying international standards (such IFC Performance Standard 8) to any identification and management of cultural heritage aspects during project development, the developer will comply with the objectives of the convention.
Labour	
Abolition of Forced Labour Convention, 1957 (No.105)	Ensure that forced labour is prohibited and that human resource (HR) policies and procedures are developed and implemented to ensure this.
Minimum Age Convention, 1973 (No. 138)	Ensure that employment policies include prohibitions on the employment of children and that such polices are adhered to.
Worst Forms of Child Labour Convention, 1999 (No. 182)	Ensure that employment policies include prohibitions on the employment of children and that such polices are adhered to.
Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)	Ensure that the Project recognise workers freedom of association and protection of the right to organise.
Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	Discrimination in the field of employment and occupation should be expressly forbidden.
Human Rights	

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: 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 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
Climate Change	
Paris Agreement under the United Nations Framework Convention on Climate Change	Assessment of emissions associated with the Project's design, construction and operation phases and of climate transition risks associated with the Project. Propose measures to reduce GHG emissions and when needed readjust the Project to build resilience to climate change.

International Convention	Applicability to the Project
Vienna Convention for the Protection of the Ozone Layer (1985)	Implement appropriate measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which are likely to modify the Ozone Layer.
Energy	
SADC Protocol on Energy	The Protocol intends 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 Project activities.
Water	
SADC Revised Protocol on Shared Watercourses	The Protocol stresses the importance of taking a basin-wide approach to water management rather than emphasising the principle of territory sovereignty. It outlines specific objectives including improving cooperation to promote sustainable and coordinated management, protection, and utilisation of transboundary watercourses. The Protocol should be taken into account when developing Project activities.
Forestry	
SADC Protocol on Forestry	The Protocol promote the development, conservation, sustainable management and utilisation of all types of forest and trees; trade in forest products and achieve effective protection of the environment, and safeguard the interests of both the present and future generations. The Protocol should be taken into account when developing Project activities.

4.5. International standards and guidelines

4.5.1. IFC Performance standards

The ESIA report was done considering the IFC Performance Standards. These standards are directed towards providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate and, manage risks and impacts as a way of doing business in a sustainable way; including stakeholder engagement and disclosure obligations of the client in relation to project-level activities (IFC, 2012).

The IFC Performance Standards are:

- PS 1: Assessment and Management of Environmental and Social Risks and Impacts.
- PS 2: Labour and Working Conditions
- PS 3: Resources Efficiency and Pollution Prevention
- PS 4: Community, Health, Safety and Security
- PS 5: Land Acquisition and Involuntary Resettlement
- PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PS 7: Indigenous Peoples
- PS 8: Cultural Heritage

The IFC Performance Standards, and each of their applicability to the proposed Project and this ESIA, are outlined in Table 17.

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Table 17 – International Finance Corporation (IFC) Performance Standards

Performance Standards	Applicability to the Project
Assessment and Management of Environmental and Social Risks and Impacts Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project (any business activity that is subject to assessment and management).	• To identify and assess environmental and social risks and impacts of the Project. • To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. • To promote improved environmental and social performance of clients through the effective use of management systems. • To ensure that grievances from Affected Communities (both directly and indirectly affected) and external communications from other stakeholders are responded to and managed appropriately. • To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.
Labour and Working Conditions Performance Standard 2 recognises that the pursuit of economic growth through employment creation and	• To promote the fair treatment, non-discrimination and equal opportunity of workers. • To establish, maintain and improve the worker management relationship. • To promote compliance with national labour and employment laws.

Performance Standards	Applicability to the Project
income generation should be accompanied by the protection of the fundamental rights of workers.	• To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the clients supply chain. • To promote safe and healthy working conditions, and health of workers. • To avoid the use of forced labour.
Resource Efficiency and Pollution Prevention Performance Standard 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.	• To avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from Project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related greenhouse gas emissions.
Community Health, Safety and Security Performance Standard 4 recognises that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.	• To anticipate and avoid adverse impacts on health and safety of the Affected Community during the Project life from both routine and non-routine circumstances. • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.

Performance Standards	Applicability to the Project
Land Acquisition and Involuntary Resettlement Performance Standard 5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.	• To avoid, and when avoidance is not possible, minimise displacement by exploring alternative Project designs. • To avoid forced removal. • To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by: (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • To improve, or restore, the livelihoods and standards of living of displaced persons. • To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.
Biodiversity Conservation and Sustainable Management of Living Natural Resources Performance Standard 6 recognises that protecting and conserving biodiversity, maintaining ecosystems services, and sustainably managing living and natural resources are fundamental to sustainable development	• To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

Performance Standards	Applicability to the Project
Indigenous Peoples Performance Standard 7 recognizes that Indigenous Peoples are often among the most marginalized and vulnerable segments of the population and, consequently, be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.	• Not applicable as there are no indigenous people as per IFC definition in the Study Area.
Cultural Heritage Performance Standard 8 recognises the importance of cultural heritage for current and future generations	• Protect cultural heritage by ensuring that internationally recognised practices for the protection, field-based study, and documentation of cultural heritage are implemented. Where relevant this includes the retention of a competent professional to assist in the identification and protection of cultural heritage. • Develop provisions for managing chance finds, requiring any chance find to be undisturbed until an assessment by competent professional is complete and management actions are identified. • Consult with affected communities to identify cultural heritage of importance and to incorporate their views into the decision-making process. This should involve national and local regulatory agencies.

Performance Standards	Applicability to the Project
	• Allow continued access to cultural heritage sites for communities that have used the sites within living memory for long-standing cultural purposes. • Avoid or minimize impacts to, or restore in situ, the functionality of replicable cultural heritage. • Not remove any non-replicable cultural heritage unless the following criteria are met: there are no technically or financially feasible alternatives, the overall benefit of the Project outweigh the anticipated cultural heritage loss from removal and the removal of cultural heritage is conducted using the best available techniques. • Should not remove, significantly alter, or damage critical cultural heritage. In exceptional circumstances where impacts are unavoidable, the Project will use a process of Informed Consultation and Participation (ICP).

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4.5.2. Gap analysis between IFC PS and Angolan legal framework

This ESIA is being conducted in accordance with Angolan's environmental legislation. The financer and sponsor also subscribe to the requirements of the International Finance Corporation (IFC), therefore this ESIA process is designed and carried out to fulfil both.

IFC requirements are meant for situations where in-country standards and requirements are insufficient for the Lenders to make an informed decision about the full scope of environmental and social impact.

Table 18 below includes a generic description from the gaps and linkages between IFC PS's and Angolan Legislation. The table thus indicates how Performance Standards are to be complied with in this project.

4.5.3. Equator Principles

The ESIA report was done considering the Equator Principles (EP4, July 2020). These principles are intended to serve as a common baseline and framework for financial institutions to identify, assess and manage environmental and social risks when Equator Principles Financial Institutions finance Projects.

The Equator Principles considered are:

- Principle 1: Review and Categorisation
- Principle 2: Environmental and Social Assessment
- Principle 3: Applicable Environmental and Social Standards
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan
- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent Review
- Principle 8: Covenants
- Principle 9: Independent Monitoring and Reporting
- Principle 10: Reporting and Transparency

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Table 18 – IFC Performance Standards and Angolan Legislation Gap Analysis.

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
PS 1: SOCIAL AND ENVIRONMENTAL ASSESSMENT AND MANAGEMENT SYSTEMS			
An Environmental and Social Management System (ESMS) must be established that will describe mitigation and performance improvement measures and actions proportionate with the level of social and environmental risks and impacts.	An ESMP is required, but there is no mention of its translation into an Environmental and Social Management System.	The project will require the implementation of an ESMS.	Requirement to be included in the ESMP, specifically in the Chapter "Responsibilities for Reporting and Review"
The development of a Stakeholder Engagement Plan (SEP) is recognised as a tool in such a management system.	Not required by Angolan law.	Although the legislation does require adequate public participation (after submission of the ESIA report), it does not specifically refer to the development of a SEP. It should be incorporated in this project.	• SEP was developed. • ESIA describes relevant stakeholder engagement that has taken place to date. • Continued engagement was included in the ESMP.

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
The risks and impact identification process will be based on recent environmental and social baseline data at an appropriate level of detail.	Implied in terms of principles and on the generic Terms of Reference, but not regulated.	Applicable and the Angolan Regulations make adequate provision for this requirement.	• Included in the ToR document; • Environmental and socials baseline
An organisational structure that defines roles, responsibilities and authority to implement certain tasks need to be developed.	Not required by Angolan law. The overall responsibility lies with the project proponent.	Although this is not required by Angolan law it is applicable to this project.	Requirement included in the ESMP.
For projects posing potentially significant adverse impacts involve external experts to assist in the risks and impacts identification process	Not required by Angolan law.	Although the involvement of external experts are not specifically mentioned, MINAMB does state that the Team has to have sufficient knowledge.	Contracted specialists included (refer to Section 0 for details about team composition).
Ongoing reporting to the I&AP's needs to be implemented.	Law n. º 5/98 (19/06/1998) – Environmental Framework Law. Decree N. º 117/20 (22/04/2020) Executive Decree N. º 87/12 (24/02/2012)	Applicable and the Angolan Regulations make adequate provision for this requirement.	Throughout the project life cycle via public and authorities' meetings (stakeholder engagement);

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
	Executive Decree N. º 92/12 (01/03/2012)		
External grievance mechanisms need to be established to receive and facilitate resolution of I&AP's concerns about the project and its environmental and social performance.	Not required by Angolan law	Although this is not required by Angolan, law a grievance mechanism should be incorporated within this Project.	Requirement to be included in the ESMP (and RAP).
PS 2: LABOUR AND WORKING CONDITIONS			
Recognises that the pursuit of economic growth through employment creation and income generation should be balanced with the protection of basic rights for workers.	2010 Constitution and General Labour Law No. 7/15 of June 15th	Applicable and the Angola Regulations make adequate provision for this requirement.	Requirement included in the mitigation measures and ESMP.
Occupational health and safety requires the minimisation of the causes of hazards in a manner consistent with good international industry practice,	Decree N. º 31/94 (31/05/94) – Occupational Hygiene and Safety System This decree establishes the principles that aim to promote	Applicable, and the Angolan Regulations make adequate provision for this requirement. The Angolan Regulations do not, however, refer to the use of the WB	Analysis of the Project with regards to EMF in Table 10. Requirement to be included in the ESMP.

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
including the World Bank Group EHS Guidelines.	safety, hygiene and health at work. General Labour Law No. 7/15 of June 15th Stipulates that employers have a responsibility to ensure the quality of the work environment, including the adoption of "appropriate measures of safety and health at work".	EHS Guidelines and this shall be done additionally.	
PS 3: RESOURCE EFFICIENCY AND POLLUTION PREVENTION			
Recognises the importance of cultural heritage for current and future generations and is consistent with the convention concerning the protection of the world's cultural and natural heritage.	Law n. º 14/05 (07/10/2005) – Cultural Heritage Law Defines cultural heritage as the material and immaterial assets that, given its value, must be the object of protection of the right. Presents a set of activities that are considered violations against the cultural heritage.	Applicable and the Angolan Regulations make provision for most of this requirement.	Sections 6.12, 0 and 9 include baseline (based on primary and secondary data), impact assessment and mitigations Requirement included in the ESMP.

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
PS 4: COMMUNITY HEALTH, SAFETY AND POLLUTION PREVENTION			
Recognises that project activities, equipment and infrastructure bring benefits to communities including employment, services and opportunities for economic development. However, the project can also increase the potential for community exposure to risks from development.	Law n. º 5/98 (19/06/1998) – Environmental Framework Law. Executive Decree No. 117/20 of April 22nd – Environmental Impact Assessment Establishes a set of procedures that must be followed during the execution of Environmental Impact Studies with approval from the competent body of the State as well as the standards for the public consultation.	Applicable and the Angolan Regulations make adequate provision for this requirement.	Requirement included in mitigation measures from different environmental issues (e.g. surface water resources, soils, hydrogeology).
Where project activities pose risks of adverse impacts on the community health and safety, the developer is required to make available relevant information to affected parties and government authorities so	Executive Decree No. 117/20 of April 22nd – Environmental Impact Assessment Establishes a set of procedures that must be followed during the execution of Environmental Impact Studies with approval from the competent body	Applicable and the Angolan Regulations make adequate provision for this requirement.	The ESMP includes Occupational Health and Safety

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
that they can fully understand the nature and extent of the risks. This includes the details of an Emergency Preparedness and Response Action Plan	of the State as well as the standards for the public consultation; Environmental Licensing Executive Decree N. º 92/12 (01/03/2012) – Terms of Reference for the Development of Environmental Impact Studies		
PS 5: LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT1			
Consultation needs to take place with host and affected communities during involuntary resettlement.	Not required by Angolan law	Although this is not required by Angolan law this should be incorporated within this Project.	A SEP was developed and a Resettlement Action Plan is being developed
PS 6: BIODIVERSITY CONSERVATION AND SUSTAINABLE MANAGEMENT OF LIVING NATURAL RESOURCES			
Recognises that protecting and conserving biodiversity in all its forms is fundamental to sustainable development.	Resolution n. º 42/06 of July 26 - National Biodiversity Strategy and Action Plan (NBSAP) Decree N. º 117/20 (22/04/2020) – Environmental Licensing	Applicable and the Angolan Regulations make provision for most of this requirement.	Ecological issues (Sections 6.10, 8.9, 9)

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
	Executive Decree N. º 92/12 (01/03/2012) – Terms of Reference for the Development of Environmental Impact Studies Law n. º 6/17 – Law of Forests and Wild Fauna		
Where the project has potential impacts on legally protected or critical habitats, consultation with relevant authorities, specialists and communities must be undertaken.	Resolution n. º 42/06 of July 26 - National Biodiversity Strategy and Action Plan (NBSAP) Decree N. º 117/20 (22/04/2020) – Environmental Licensing Executive Decree N. º 92/12 (01/03/2012) – Terms of Reference for the Development of Environmental Impact Studies	Not applicable	Ecological issues (Sections 6.10, 8.9, 9)
PS 7: INDIGENOUS PEOPLES			

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
Recognises that indigenous groups in a project area can be at particular risks which may include loss of identity, culture, traditional lands and natural resource based livelihoods. Recognises the need for early engagement with indigenous groups, should they be affected, to build longer term processes of consultation, informed participation and good faith negotiation. Establish means for the full development of these people's own institutions and initiatives and in appropriate cases, provide the resources necessary for this purpose.	Not required by Angolan law	No indigenous people are located within the vicinity of the project are.	Not applicable to this project as there are no indigenous people as per IFC definition in the Study Area.

Performance Std	Angolan Regulation	Is this Applicable to the Project and What are the Gaps?	Where is this Addressed in the ESIA Process?
PS 8: CULTURAL HERITAGE			
Recognises the importance of cultural heritage for current and future generations and is consistent with the convention concerning the protection of the world's cultural and natural heritage.	Law n. º 14/05 (07/10/2005) – Cultural Heritage Law Defines cultural heritage as the material and immaterial assets that, given its value, must be the object of protection of the right. Presents a set of activities that are considered violations against the cultural heritage.	Applicable and the Angolan Regulations make provision for most of this requirement.	Sections 6.12, 0 and 9 include baseline (based on primary and secondary data), impact assessment and mitigations

Table 19 – Equator principles in the ESIA process

Equator Principles	How it is addressed in the ESIA Process
Principle 1: Review and Categorisation Categorise the Project based on the magnitude of potential environmental and social risks and impacts	• In an early stage of the ESIA process, the Project was categorised as Category A based on 1) the Angolan law and the list of activities included in Annex 1 of the Presidential Decree No. 117/20 of April 22; 2) the IFC environmental and social process (Project with potential significant adverse environmental and social risks or impacts that are diverse, irreversible, or unprecedented). In addition, this type of project is included in "Annex I: Illustrative List of Category A Projects" of the OECD Common Approaches: Construction of overhead electrical power transmission lines with a length of 15 km or above and a voltage of 110 kV or above.
Principle 2: Environmental and Social Assessment Conduct an appropriate Assessment process to address, to the Equator Principles Financial Institutions' satisfaction, the relevant environmental and social risks and scale of impacts of the proposed Project.	• Among other key issues, considering the potential impacts of the project and its location, the following key aspects were investigated in the ESIA through specialised studies: Climate change; Ecology; Socioeconomics and human rights. The former and the latter will focus on the Guidance Notes (2020) on Implementation of Climate Change Risk Assessment and Human Rights under the Equator Principles, respectively.
Principle 3: Applicable Environmental and Social Standards	• For the compliance with the Angolan law and with the IFC Standards please consult Section 4.5 and Table 17.

Equator Principles	How it is addressed in the ESIA Process
The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. In addition, for Projects located in Non-Designated Countries, there will be an evaluation on compliance with the applicable IFC Performance Standards on Environmental and Social Sustainability.	
Principle 4: Environmental and Social Management System and Equator Principles Action Plan For Category A Projects an Environmental and Social Management System (ESMS) should be developed and / or maintained. Further, an Environmental and Social Management Plan (ESMP) should be prepared to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards.	• An ESMS and an ESMP were developed and incorporated in the ESIA report.
Principle 5: Stakeholder Engagement For Category A Projects effective Stakeholder Engagement during the ESIA process is expected, as an ongoing process in a structured and culturally appropriate manner, with Affected Communities, Workers and, where relevant, Other Stakeholders.	• Stakeholder engagement was undertaken to ensure that all interested and affected stakeholders are involved in the ESIA process (including the HRIA process too) and that their views and concerns are incorporated into the process. This process was guided by a Stakeholder Engagement Plan. • The engagement throughout the process included preliminary interviews with stakeholders and meetings with local authorities. Interviews to key

Equator Principles	How it is addressed in the ESIA Process
	actors and focus groups with local community members were done in a following stage. • The formal round of public consultation required by Angolan Law (not yet done) will be developed during the ESIA phase in a next phase and will comprise one public consultation with one public session in each of the provinces in the project area (Huambo and Benguela province).
Principle 6: Grievance Mechanism For all Category A Projects, effective grievance mechanisms designed for use by Affected Communities and Workers, as appropriate, will be implemented.	• A resettlement action plan (RAP) is being developed and will include a grievance mechanism. In the present report a summary of the RAP was included, but the actual report will be finalised in a subsequent phase.
Principle 7: Independent Review For all Category A Projects an Independent Environmental and Social Consultant will carry out an Independent Review of the Assessment process including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation to assist the financer entity due diligence and determination of Equator Principles compliance.	• According to the Angolan Law, all Category A Projects should have their EIA reports reviewed by an independent environmental and social consultant.
Principle 8: Covenants An important strength of the Equator Principles is the incorporation of covenants linked to compliance.	• Not applicable to the ESIA process at this stage but this recommendation is stated in this report

Equator Principles	How it is addressed in the ESIA Process
Remedial actions to bring the Project back into compliance will be worked with the EIA team.	
Principle 9: Independent Monitoring and Reporting For all Category A Projects, in order to assess Project compliance with the Equator Principles after Financial Close and over the life of the loan, the financer will require independent monitoring and reporting. Monitoring and reporting should be provided by an Independent Environmental and Social Consultant	• Not applicable to the ESIA process at this stage but this recommendation is stated in this report
Principle 10: Reporting and Transparency The client will: 1) Ensure that, at a minimum, a summary of the ESIA is accessible and available online and that it includes a summary of Human Rights and climate change risks and impacts when relevant; 2) Report publicly, on an annual basis, GHG emission levels (combined Scope 1 and Scope 2 Emissions, and, if appropriate, the GHG efficiency ratio) during the operational phase for Projects emitting over 100,000 tonnes of CO2 equivalent annually;	• 1) A summary of the ESIA will be accessible during the public consultation foreseen in the Angolan law, and this summary will include of human rights and climate change impacts as reported in the ESIA report; • 2) Given that Project will not emit GHG above the indicated tonnes, this item does not apply;

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5. Impact assessment methodology

5.1. Introduction

The methodology used in the ESIA follows the legislation applicable to the preparation of Environmental Impact Studies, i.e., Decree n.º 117/20 of April 22nd, on Environmental Impact Assessment.

The Impact Assessment Steps integrate the following main components:

- Planning of activities;
- Cabinet work;
- Fieldwork and specialised studies;
- Preparation of the ESIA Report.

5.2. ESIA Phases

The **main goals** of the ESIA are:

- To comply with the Angolan legislative framework on ESIA;
- To identify and assess environmental and social impacts to be expected with the Project's construction, operation, and deactivation phases;
- To enhance positive impacts and mitigate negative impacts;
- To avoid unnecessary risks;
- To point out environmental and social impact balance and formulate recommendations for sustainable project implementation.

The ESIA's study area encompasses the area of impact of the Project in its various phases and a surrounding buffer area to set at the beginning of the work (kick-off). Thus, ESIA's scope comprises the study area and the Project's areas of influence and infrastructure and project actions necessary for its implementation.

Impacts were assessed within the following main environmental aspects: **Physical environment**, **Biotic Environment** and **Socio-economic environment**.

5.2.1. Baseline Studies

The baseline studies were be carried out using bibliographic review and fieldwork, which will allow the collection of complementary elements to make the characterisation of the reference situation as completely as possible.

The work focuses on the biophysical environment and the socio-economic environment of the project area, and the following subjects were examined according to the type of Project and the region in which it is included:

- Climate;
- Geology, geomorphology, and topography;
- Mineral resources;
- Hydrogeology;
- Natural disasters;
- Surface water resources;
- Soils;
- Land use;
- Quality of the environment (air quality and noise);
- Ecology (habitats, fauna, flora and ecosystem services);
- Socioeconomics;
- Cultural heritage.

5.2.2. Identification and assessment of potential impacts of the Project and its mitigation measures

This is one of the most critical stages of the ESIA, through which the main effects on the environment are identified and evaluated. The main goal is to identify the environmental and social impacts associated with the Project at and around the site, including direct and indirect, short, and long term and cumulative impacts, focusing on both positive and negative impacts on the biophysical, chemical, social, economic and cultural components of the environment associated with the construction and operation of the Project, including but not limited to:

- Potential displacement and related social impacts;
- Effects on wildlife, forests, and terrestrial biodiversity;

- Effects on existing or proposed protected areas or other sites of conservation or special management interest;
- Impact on soil erosion and siltation;
- Effects on physical and cultural resources, including sacred sites (if any) and cemeteries;
- Public health (including water- and vector-borne diseases) and worker and public safety during construction and operation.

The method to assess the significance of environmental and social impacts includes the following steps:

1. Defining the nature of the potential impact;
2. Rating of the potential impact;
3. Determination of the overall significance of the impact.

1) Defining the nature of the potential impact

Each potential impact was identified by its root cause (the project activity or action) that will result in an impact (change of the current conditions, be it positive or negative) on a receptor (the environmental aspect that will be affected). Terms for defining the nature of an impact are presented in the following table.

Table 20 – Terms for defining the nature of an impact.

Term	Definition
Positive Impact (Benefit)	An impact that is considered an improvement on the baseline or introduces a positive change.
Negative Impact	An impact that is considered an adverse change from the baseline or introduces a new undesirable factor.
Direct Impact	Impacts that result from a direct interaction between planned project activity and the receiving environment/receptors (e.g. between the occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect Impact	Impacts that result from other activities that are encouraged to happen due to the Project (e.g. in-migration for employment placing a demand on resources).

Term	Definition
Cumulative Impact	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the Project.

2) Rating of the potential impact

Each potential impact was rated based on a set of criteria, including its spatial and temporal scales, intensity, and probability (see tables below). A scale was used for each criterion ranging from no or negligible impact to major impacts. The magnitude of the impact is a function of these criteria.

Table 21 – Criteria for rating an impact.

Impact magnitude – the degree of change caused in the receptor	
Extent	• *On-site* – impacts that are limited to within the site boundaries; • *Local* – impacts that affect an area in a radius of 2 km around 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 have macro-economic consequences; • *Transboundary/International* – impacts that extend beyond country 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 for the duration of the construction period; • *Long-term* – impacts that will continue for the life of the Project but cease when the Project stops operating; • *Permanent* – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.
Intensity	Biophysical environment – intensity 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;

Impact magnitude – the degree of change caused in the receptor	
	• *Medium* – where the affected environment is altered but natural functions and processes continue, albeit in a modified way; • *High* – where natural functions or processes are altered to the extent that they will temporarily or permanently cease.
	Socio-economic environment – intensity can be considered in terms of the ability of Project affected people/communities to adapt to changes brought about by the Project • *Negligible* – there is no perceptible change to people's livelihood or health; • *Low* – People/communities are able to adapt with relative ease and maintain pre-impact livelihoods and health; • *Medium* – Able to adapt with some difficulty and maintain pre-impact livelihoods and health but only with a degree of support; • *High* – Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods and health.
Impact probability	
Unlikely	The impact is unlikely to occur.
Likely	The impact is likely to occur under most conditions.
Definite	The impact will occur.

3) Determination of the overall significance of the impact

Once a rating is determined for magnitude and likelihood, the table below is used to determine the significance of the impact. An impact may be negative or positive, and therefore the final significance rating is colour coded, as seen below.

Colour codes for the significance classification used in the impact assessment

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

Figure 14 – Colour codes for the significance classification used in the impact assessment.

Table 22 – Impact significance criteria.

Significance criteria	
Negligible significance	An impact of *negligible significance* is where the magnitude is negligible or low and the likelihood of the impact occurring is unlikely, or the magnitude is negligible and the impact probability is likely or definite.
Low significance	An impact of *low significance* is where the magnitude of the impact is low but the likelihood is probable or definite, or where the magnitude is moderate but the probability of occurrence is unlikely.
Moderate significance	An impact of *moderate significance* is where the magnitude is medium, and the probability of the impact occurring is likely or definite, or the magnitude is high but the probability is unlikely.
High significance	An impact of *high significance* is where the magnitude of the impact is high, and the probability of the impact occurring is likely or definite.

A **final matrix** (synthesis table) will be drawn up with a global evaluation of the overall impacts of the different alternatives and the Project's phases.

Impact	Project Phase	Status	Extent	Duration	Likelihood	Intensity	Significance (without mitigation)	Significance (post-mitigation/ enhancement
LAND USE AND SPATIAL PLANNING								
Changes in land use mosaic	Operation	Negative	Local	Permanent	Definite	Low	High	Low to Moderate
Pursuance of territorial, socioeconomic and sector policies and strategies goals	Operation	Positive	Local/ Regional	Long-term	Low	Low	Low	Low
SOCIOECONOMICS AND PUBLIC HEALTH								
Creation of employment and new opportunities to local business	Construction	Positive	Local/ Regional	Short-term	Definite	Moderate	Moderate	Moderate to High
Influence of external workforce in local communities	Construction	Negative	Local	Short-term	Likely	Low	Low	Low
Increase of sexually transmitted diseases	Construction	Negative	Local/ Regional	Short-term/ Long-term	Likely	Low	Moderate	Low
Spread of communicable diseases	Construction	Negative	Local	Short-term	Likely	Low	Low to Moderate	Low
Traffic disruption	Construction	Negative	Local	Short-term	Likely	Low	Low	Negligible
Increased risk of accidents	Construction	Negative	Local	Short-term	Likely	Low	Low	Negligible

Figure 15 – Example of Matrix of environmental and social net impacts.

5.2.2.1. Mitigation measures

The ESIA team proposed feasible and cost-effective measures and procedures to prevent, minimise, restore damaged areas, and offset any significant environmental and/or social impacts to achieve the above-defined goals. A cost estimate is also provided, where applicable (cf. Section 9).

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6. Biophysical and socio-economic description

6.1. Introduction

This chapter presents a biophysical and socio-economic description of the reference environmental situation in the project area in the following subjects:

- Climate;
- Geology, geomorphology, and topography;
- Mineral resources;
- Hydrogeology;
- Natural disasters;
- Surface water resources;
- Soils;
- Land use;
- Spatial planning;
- Quality of the environment;
- Ecology;
- Socioeconomics;
- Cultural heritage.

6.2. Climate

6.2.1. Introduction

This section presents the summary of the Climate Change Specialised Study (CCSS) carried out for this project. The complete study, including graphic representations of all results, can be consulted as an annex to the ESIA Report. The specialized study develops characterization of the project influence area relative to climate change, based on the analysis of statistical and bibliographic information, accounting also information collected in the field technical visit of June-July 2022, referring to present climate, climate change projections, greenhouse gases (GHG) emissions, climate change risks and adaptation and mitigation policies.

Supporting Principle 2 of the Equator Principles (Equator Principles Association, 2020a), concerning Environmental and Social Assessment, the characterization in this specialised study includes the identification of climate change risks, referring 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.

6.2.2. Present climate

The main influences on Angola's climate are geography, namely proximity to the South Atlantic Ocean, altitude, including the influence of the central plateau, and proximity to the ocean, especially influenced the cold current of Benguela, together with the movement of the Intertropical Convergence Zone (ITCZ), an area where the northern and southern air masses converge (Carvalho, Santos, & Pulquério, 2016).

The project's area of influence spans over the middle west part of Angola, with a Köppen-Geiger **climatic classification** of tropical savannah (Aw) in the western lower altitude part and temperate dry winter warm summer (Cwa) in the eastern higher altitude part. A dry season (Cacimbo) occurs between May and September and the rainy season, controlled by the movement of the ITCZ, between October and April.

The average annual **air temperature** in Angola decreases with increasing latitude and altitude and decreases with increasing distance to the sea. Larger air temperature is generally associated with the wet season, but with an annual range of temperature variation very small, verifying in the project's area of influence between 20 and 28ºC in Benguela and 16 and 21ºC in Huambo. The mean annual **precipitation** is above 1200mm in the project's area of influence.

Meteorological data collection in Angola has been very limited since 1974, with severe lack of observations over long periods of time (Carvalho, Santos, & Pulquério, 2016). To assess a **climatology** for the project's influence area, it is considered the analysis of observed data by the Climatic Research Unit (CRU) of University of East Anglia (World Bank, 2021).

It can be observed that despite mean air temperature tends to be higher in Benguela, maximum air temperatures are slightly larger in Huambo, between 24ºC (March/December) and 28ºC (September), facing values between 23ºC (July) and 27ºC (March) in Benguela. Minimum temperature is higher in Benguela, between 12ºC (July) and 18ºC (March), than in Huambo, between 8ºC (July) and 15ºC (March).

Monthly precipitation is null or very low in the period from June to August in both provinces, but in the wet season it is more evenly distributed in the Huambo Province, where two relative maximum monthly mean values of nearly 240mm are found in March and December, as opposed to a single maximum in March in Benguela Province. The time series of evolution of observed average annual precipitation in both provinces evidences important interannual variability, and the occurrence of relative maximum/minimum average annual precipitation years approximately every 6-10 years.

6.2.3. Climate change

The analysis of observed data for the Benguela and Huambo provinces by CRU (World Bank, 2021) suggests an increasing trend in air temperature since 1951, while no trend is apparent for precipitation. While it is assumed that these results may be partially affected by the lack of regular meteorological monitoring in the recent decades in the provinces, these findings may signal the on-setting of a climate change trend in the project influence area.

Provided the uncertainty related to climate assessment globally and regionally and following international guidelines (TCFD, 2021) (EBRD, 2018), the assessment of the probable climate change effects in the project's influence area is made considering a **scenario analysis**, considering two Shared Socioeconomic Pathways (SSP, related to previous Representative Concentration Pathways – RCP), composed of radiative forcing levels and socio-economic storylines (IPCC, 2021), used in the global climate model (GCM) compilation of the Sixth Phase of the Coupled Model Inter-comparison Project (CMIP6), aligned with the most recent IPCC Assessment Report (IPCC, 2021):

- Current GHG pathway: a worst-case scenario represented by SSP5-8.5, with GHG emissions roughly doubling the current levels by 2050;
- Desired GHG pathway: a reasonably possible best-case scenario represented by SSP2-4.5, with GHG emissions remaining around current levels until the middle of the century, approaching the goal to limit warming to below 1.5ºC by 2100 established by the Paris Agreement (with a probability ≥50%).

To account for uncertainty climate change projections, climate change is assessed for the project's influence area using the multi-model ensemble of CMIP6 derived from simulations of 11 GCM with 100km x 100km resolution. Although projections with higher resolution for the project's influence area would be desirable, as far as known there are no regional experiments available for downscaling the CMIP6 GCM projections and lack of climate data poses constraints for downscaled results interpretation.

Considering the characteristics of the project and its influence area climate projections are presented for the following climate variables: maximum temperature, minimum temperature, maximum of daily maximum temperature, precipitation and largest 1 day precipitation. The projections are assessed for two time periods, namely 2040-2059, corresponding to medium stage of project's lifetime, and 2060-2079, corresponding to end of project's lifetime.

The results showed that the projected maximum temperature anomaly relative to the reference period of 1995-2014, in Benguela and Huambo provinces is generally positive (increased temperature) and, while the median of models is above 1ºC throughout the year in both scenarios, it tends to be larger in autumn and spring when the median of model results project a maximum value 1,5-2ºC in Benguela and 2-2.2ºC in Huambo

(October) in 2040-2059 and 2-3.3ºC in Benguela and 2.5-3.8ºC in Huambo (October-November) in 2060-2079. The two emissions scenarios cause an anomaly difference up to 1-1.5ºC in 2040-2059 and 1.5-2.5ºC in 2060-2079, more accentuated in Huambo. The spread of model results is also large relative to the median, especially in Huambo, revealing a large uncertainty: in some GCMs anomaly can be as high as 4-4.5ºC in 2040-2059 and 5-6.5ºC in 2060-2079 in the SSP5-8.5 scenario.

As for the projections for minimum air temperature anomaly (relative to 1995-2014) in Benguela and Huambo, for periods 2040-2059 and 2060-2079, the median of the multi-model ensemble's anomaly is between 1ºC and 2ºC for 2040-2059, nearly 0.5ºC larger in SSP5-8.5 relative to SSP2-4.5, and between 1.5ºC and 3.5ºC for 2060-2079, nearly 1.5ºC larger in SSP5-8.5 relative to SSP2-4.5. This suggests a general increase of minimum temperature relative to current values, more distributed throughout the year than maximum air temperature. However, it should be noted that some GCMs project for Huambo a decrease of minimum temperature (relative to the in the winter months (June to August) in the SSP2-4.5 scenario which can be as much as 2ºC in the 2040-2059 period and less evident in 2060-2079.

Together with maximum air temperature, these results suggest the occurrence of a consistent increase of air temperature during the project's lifetime, more accentuated in autumn and spring.

Regarding maximum of daily maximum air temperature for Benguela and Huambo provinces, informing on extreme temperatures for the 2040-2059 period, the multi-model ensemble median is within the 1-2ºC and 1.5-2.5ºC ranges (for the two SSPs considered) of the reference period values, respectively for Benguela and Huambo, with the anomaly remaining approximately constant throughout the year. Some GCMs present anomalies up to 3-3.5ºC in Benguela and 4-4.5ºC in Huambo (for the SSPs considered), signalling important uncertainty relative to extreme temperature.

Regarding the 2060-2079 period, the multi-model ensemble median is within 2-3ºC range (for the two SSPs considered) of the reference period values. Some GCMs present anomalies up to 3.5-5ºC in Benguela and 5-6.5ºC in Huambo (for the two SSPs considered), evidencing important uncertainty regarding extreme temperature values. Almost all GCMs results indicate increase of the maximum daily maximum temperature, indicating good confidence in this projection.

Concerning precipitation, the projection results for precipitation change in for periods 2040-2059 and 2060-2079 indicate a reduction of precipitation (up to 25%) in the winter and spring months (June to October), more evident in Huambo, together with a slight increase (smaller than 15% in 2040-2059 and 25% in 2060-2079) of precipitation in summer, concentrated in December and January. However, the uncertainty concerning these projections is very large.

As for extreme precipitation, results concerning the largest 1-day precipitation return period change for 100-year return period events in the historical period show that extreme precipitation events of 100-year return period are expected to become more frequent, specially towards the end of the century and in the SSP5-8.5 scenario.

6.2.4. GHG emissions

GHG emissions inventory is available only at national level for Angola. A first inventory was presented for years 2000 and 2005 at Angola's Initial National Communication to the United Nations Framework Convention on Climate Change (Government of 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 methodology from IPCC (IPCC, 2006), considering the contributions of the main sectors:

- Energy: production and consumption of fuels and energy from biomass;
- Industrial processes and product uses: existing industries;
- Agriculture and livestock: agricultural activity;
- Waste: production and treatment of waste and the sewerage system;
- Land use, land use change and forests (LULUCF): deforestation and coal production.

Total GHG emissions for Angola for the period 2005-2018 show that GHG emissions amounted to 100.5 million tonnes of CO_2 eq. in 2018 and verified a 79% increase since 2005. Most of the emissions concern CO_2 (83% in 2018), followed by CH_4 (15% in 2018). Emissions concerning the LULUCF are dominant in the total value (70% of total emissions in 2018).

The results also show that, apart from the LULUCF sector, emissions result mainly from the energy sector which amounted to 19% in 2018 (increase of 118% since 2005), followed by the agriculture and livestock (7% increase since 2005) and waste (124% increase since 2005) sectors, representing 6% and 4% in 2018, respectively. Industrial processes and product uses is the smallest contributor to national GHG emissions but has verified the most expressive growth in the period, 369%.

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

- CO_2: energy (road and air transport), LULUCF, industrial processes and product uses (cement production);
- CH_4: waste (solid waste treatment category) and agriculture and livestock (enteric fermentation, associated with livestock raising);
- N_2O: agriculture and livestock (managed soil direct emissions, associated with fertilization).

The sectors that contributed the most to the growth of GHG emissions in 2005-2018 in absolute terms were road transport, air transport, cement production, managed soil direct emissions and domestic wastewater treatment (Government of Angola, 2021b). Concerning the evolution of GHG emissions from sectors in 2005-2018 it is also worth mentioning the contribution of the energy, industry and LULUCF sectors (Government of Angola, 2021b).

Under a business-as-usual scenario Angola's GHG emissions are projected to increase gradually from 2015 to 2050, with energy sector remaining an important source of GHG emissions and with the largest emissions increases expected to occur in sectors agriculture and livestock, industry and waste (Government of Angola, 2021a).

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 influence area GHG emissions result from the following sources (cf. Socioeconomics and human rights specialised study, Ecology specialised study and Surface water resources baseline assessment):

- Use of coal, firewood, gas and diesel generators as energy sources for domestic use in settlements

- Road transportation using fuel combustion;
- Production of coal;
- Clearance fires;
- Wildfires;
- Fertilized agriculture.

It should be noted also the generalized occurrence of deforestation (cf. Ecology specialised study), especially for coal production, which contributes to GHG emissions through the removal of carbon sinks.

6.2.5. Exposure to climate change physical risks

Given climate change projections for the Benguela and Huambo provinces and the project influence area characteristics (cf. baseline assessment of Geology, geomorphology and topography, Soil and land use, Surface water resources and Ecology and Socioeconomics specialised studies), **climate physical risks** foreseen for the project include (Government of Angola, 2021a):

- Increased soil instability and landslide;
- Increased susceptibility to desertification and soil erosion;
- Erosion of riverbeds;
- Increased frequency and intensity of extreme precipitation and flood events;
- Increased frequency and intensity of periods of drought and water scarcity;
- Degradation of assimilation and purification of water courses;
- Increased frequency and intensity of heat waves, increased frequency and intensity of rural fires;
- Change/loss of biodiversity;
- Health risks and disease transmission.

Angola's National Strategy for Mitigation and Adaptation to Climate Change 2020-2035 (Government of Angola, 2017) comprises strategic **adaptation** initiatives for different strategic areas acting on these risks including:

- Agriculture and fishing:
- Forests, ecosystems and biodiversity:
- Water resources:
- Human health:
- Infra-structures:

1.1.1 Exposure to climate change transition risks

Angola ratified the **United Nations Climate Change Convention** (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 has submitted its Intended Nationally Determined Contribution and in 2020 ratified the Paris Agreement.

In the **Nationally Determined Contribution** of Angola (Government of Angola, 2021a), required under Paris Agreement, is set the target to achieve (unconditionally) a 14% reduction of GHG emissions by 2025, as compared to the base year of 2015.

Angola's National Strategy for Mitigation and Adaptation to Climate Change 2020-2035 (Government of Angola, 2017) comprises strategic **mitigation** initiatives directed for the diverse GHG emitting sectors: energy, agriculture, forestry and other land uses, industry and waste

From these initiatives and given the characteristics of the project under assessment and its influence area, it is worth highlighting some mitigation measures under 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, as shown in the CCSS.

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

Due to the lack of electricity supply in communes, low income and poor fertility of soils (cf. Soil and land use baseline assessment) the required transition to a less carbon intensive livelihood, as required to meet the Paris Agreement, is currently difficult. Moreover, the application of the strategic mitigation measures proposed by National Strategy for Mitigation and Adaptation to Climate Change 2020-2035 in the project influence area is expected slow due to the rural setting and lack of funding.

Overall, the population in the project influence area is considered very vulnerable to the following **climate transition risks**:

- Costs and technological difficulties of adopting alternative climate sustainable energy sources for livelihood;
- Costs of food production;
- Costs of building materials and farming supplies (fertilizers, livestock feeding).

6.3. Geology, geomorphology, and topography

6.3.1. Introduction

The characterisation of the main geological, geomorphological and topographic features of the project and the region where it is located was carried out according to data from available technical and scientific bibliography and cartography, as well as geological studies carried out specifically in the area of the project's implantation and/ or in its surroundings.

It is important to highlight the data resulting from the following sources of data:

- **Geological Map of Angola**, elaborated, by the British Geological Survey (BGS, 2019), for the Africa Groundwater Atlas;
- The book **Biodiversity of Angola. Science & Conservation: A Modern Synthesis** (2019), which is supported by peer-reviewed journals, books and, in some cases, unpublished official reports;
- The **Shuttle Radar Topography Mission (SRTM) data**, a high-resolution digital topographic database of the Earth obtained by NASA;
- **Nemus' field inspection**, conducted in June 2022 to observe the main geological features of the project's area.

6.3.2. Geology

Angola has a significant range of rocks, from Archean age to Recent. Considering the main outcrops distribution, the country can be subdivided into five main regional geological units (Figure 16):

- **Quaternary to Tertiary sedimentary cover deposits**, extending over nearly half of Angola, especially the eastern part. In this units there are alluvium filling the river valleys, occupying the floodplains, and near-coast deltas of large rivers like the Cuanza, Zaire and Cunene. From the Tertiary-Quaternary period are also loosely consolidated sandstones and unconsolidated sands and silts from the Kalahari Group. The Kalahari Group are covering much of the eastern part of the country to a maximum depth of 600 m.

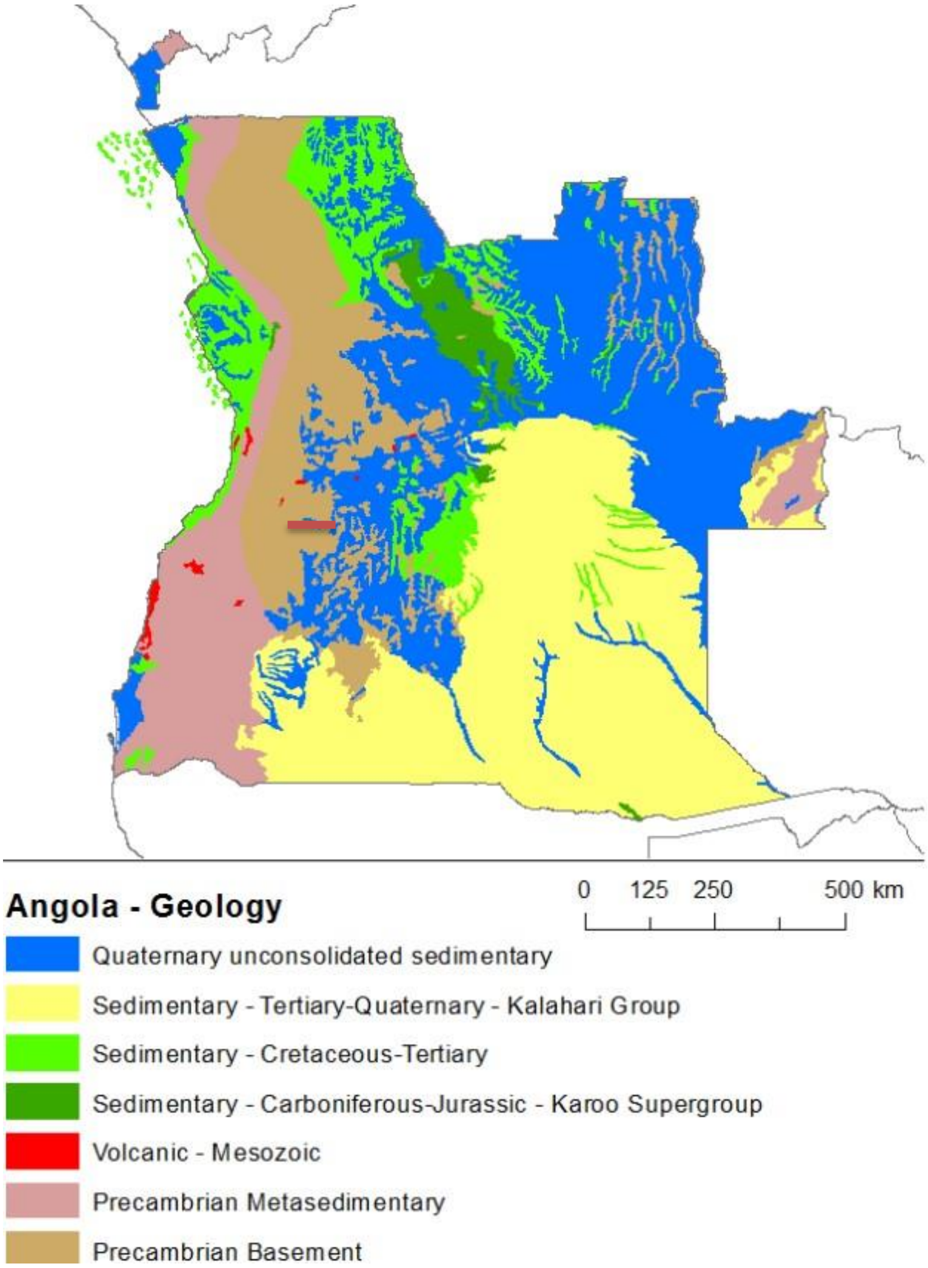
- **Pleistocene to Cretaceous marine sediments.** Rocks from this extensive geological period mainly occur in a series of coastal basins on the western margin of Angola and over the Palaeozoic sediments. The Cretaceous is represented by sedimentary rocks from the Aptian-Maastrichtian age, mainly argillaceous sandstones with marine and evaporitic deposits. The cretaceous rocks have up to 150 m thickness and are overlain by up to 1,200 m thickness of Paleocene to Pliocene age sedimentary rocks.

- **Mesozoic to Palaeozoic sediments.** In the north of Angola, within the Cassanje Graben, there are outcrops of consolidated sediments, up to 500 m thick, and volcanic rocks (dolerites) of the Karoo Supergroup.

- **Precambrian Metasedimentary.** The west of the country is characterized by a set of metasedimentary rocks of the Proterozoic age. This unit from late Precambrian–Lower Cambrian belongs to the Bembé System and is represented by schist-limestones overlain by metasandstones, metaconglomerates and quartzites.

- **Lower Proterozoic to Archaean rocks.** A significant part of the country is occupied by ancient crystalline rocks from the Precambrian Basement (the most representative are granites) that are exposed to the surface. Most of this unit is overlaid by the unfossiliferous carbonate and sedimentary rocks laid down during the Mesozoic and Cenozoic eras.

Sub-volcanic and **volcanic rocks,** resulting from magmatic activity during the Karoo period, also outcrop, especially near the coastline. These include kimberlites and carbonatites along a major south-west to north-east trend line across the country (Lucapa´s corridor), as well as basalt, dolerites, syenites, trachytes and phonolites.



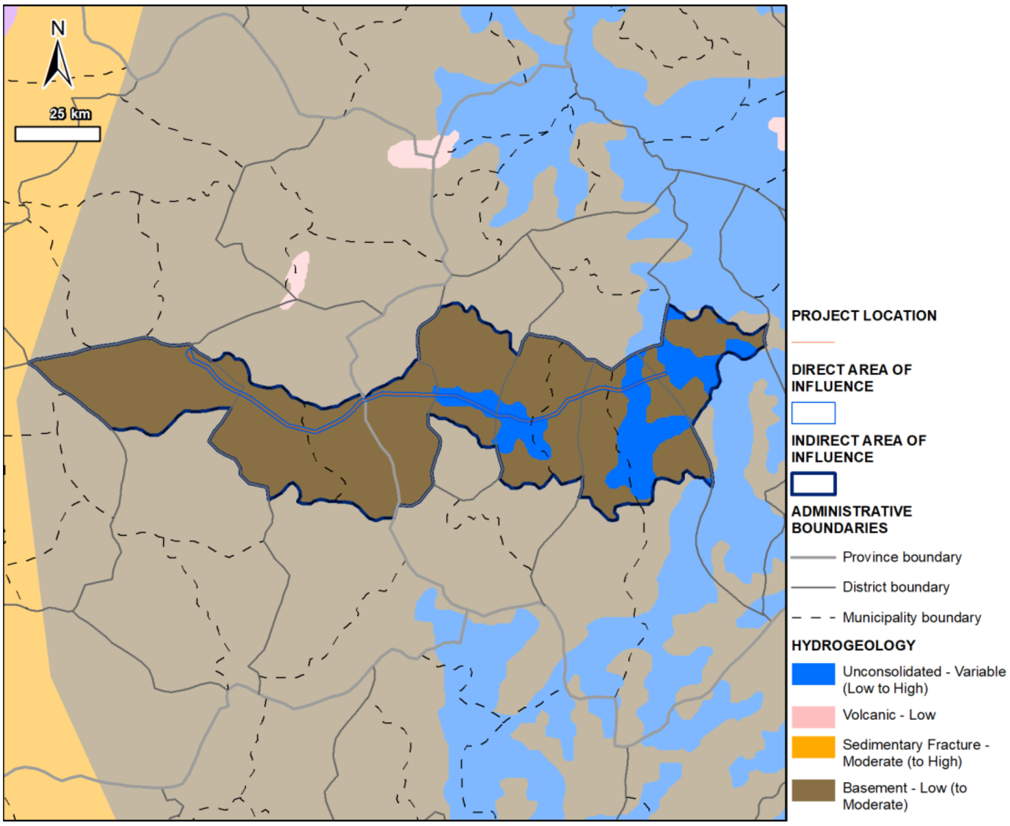
Source: (BGS, 2019) Based on map described by Persits et al. 2002 / Furon and Lombard 1964
Geology of Angola at 1:5 million scale.
Red line indicates approximate project area

Figure 16 – Angola's geological units.

The project's area encompasses some of the most ancient rocks in the country (Figure 17), contrasting with the ones located in the occidental part of the territory, near the coastal plain.

The majority of the outcrops throughout the transmission lines route belong to the **Precambrian basement** of the country (Figure 18). Locally, mainly on the river's dependence, some **unconsolidated Quaternary** sediments occur.

The Precambrian basement includes **metamorphic and volcanic crystalline rocks**, like granites, gneisses, schists, quartzites, migmatites and amphibolites, whereas the sedimentary Quaternary deposits are mainly composed of **sand, quartzitic sandstone, gravel and clay.**



Source: (BGS, 2019)

Figure 17 – Project's geological units.

Source: Nemus (2022)

Figure 18 – General appearance of the crystalline rocks' outcrops of the basement in the project area.

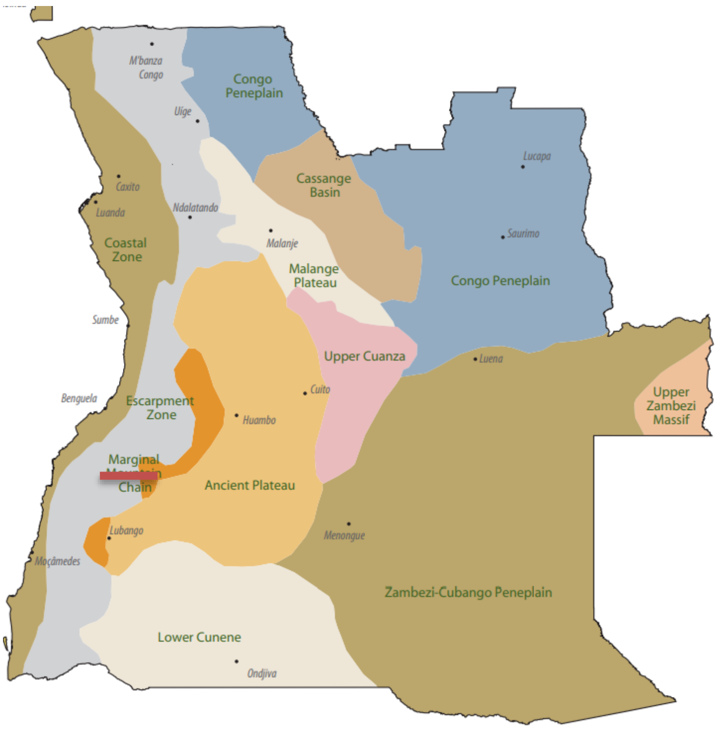
6.3.3. Geomorphology

Angola's territory is characterised by three important natural regions:

- a **coastal lowland**, in the western part that contacts to the Atlantic Ocean. This flat littoral zone has low plains and terraces. Varies in width from about 25 km, near Benguela, to more than 150 km in the Cuanza River Valley, just south of Angola's capital. The far south is marked by sand dunes, which give way to dry scrub along the middle coast.
- a **series of hills and mountains** more or less parallel with the coast, in the median zone. These hills rise inland from the coast into a great escarpment at distances ranging from 20 km to 100 km inland.
- a **high plateau** that extends eastward and south-eastwards from the escarpment that limits the hills and mountains, dominating Angola's territory. Towards the east, the plateau is depressed and forms the Kalahari Basin. Incision of valleys started during the Cretaceous and further deepening took place following the Miocene tectonic upheaval.

The project encompasses **3 of the 11 geomorphological units** in which Angola is commonly subdivided. From West to East the following major units are crossed by the transmission lines (Huntley, Russo, Lages, & Almeida, 2019):

- **Escarpment zone –** the Western part of the project encompasses this geomorphological unit. Corresponds to a transition area between the coastal plains and the interior plateaus and is comprised of the crystalline rocks of the Precambrian.
- **Marginal Mountain Chain** – corresponding to mountainous terrains supported by metamorphic and volcanic Precambrian rocks. One of the main features is the mountainous belts in the north and some major inselbergs in the south.
- **Ancient Plateau –** the project encompasses this unit in its Eastern part. It is an extensive plateau that drops eastwards from below the Marginal Mountain Chain and encompasses the headwaters of the Cunene, Cubango, Queve and Cutato rivers, comprising rolling landscapes with wetlands and low ridges with scattered granitic inselbergs.



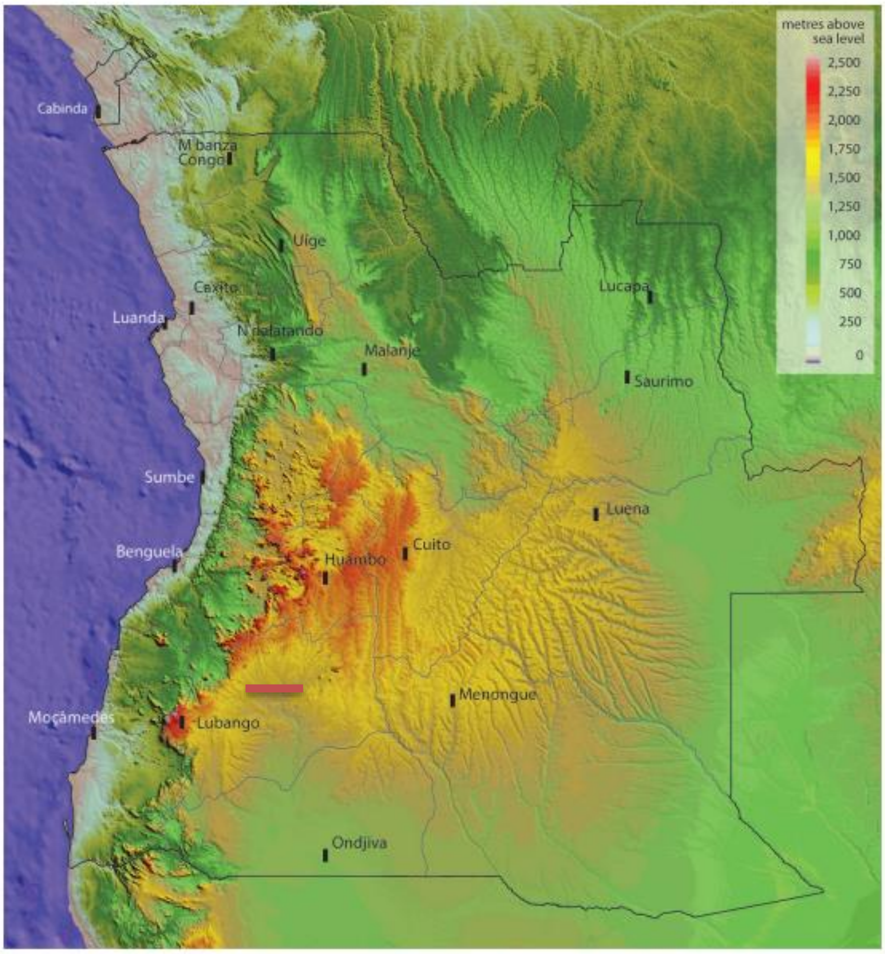
Source: (Huntley, Russo, Lages, & Almeida, 2019)
Red line indicates approximate project area

Figure 19 – Angola's geomorphological units.

6.3.4. Topography

As previously mentioned, Angola has three natural regions with distinctive characteristics in the country's topography:

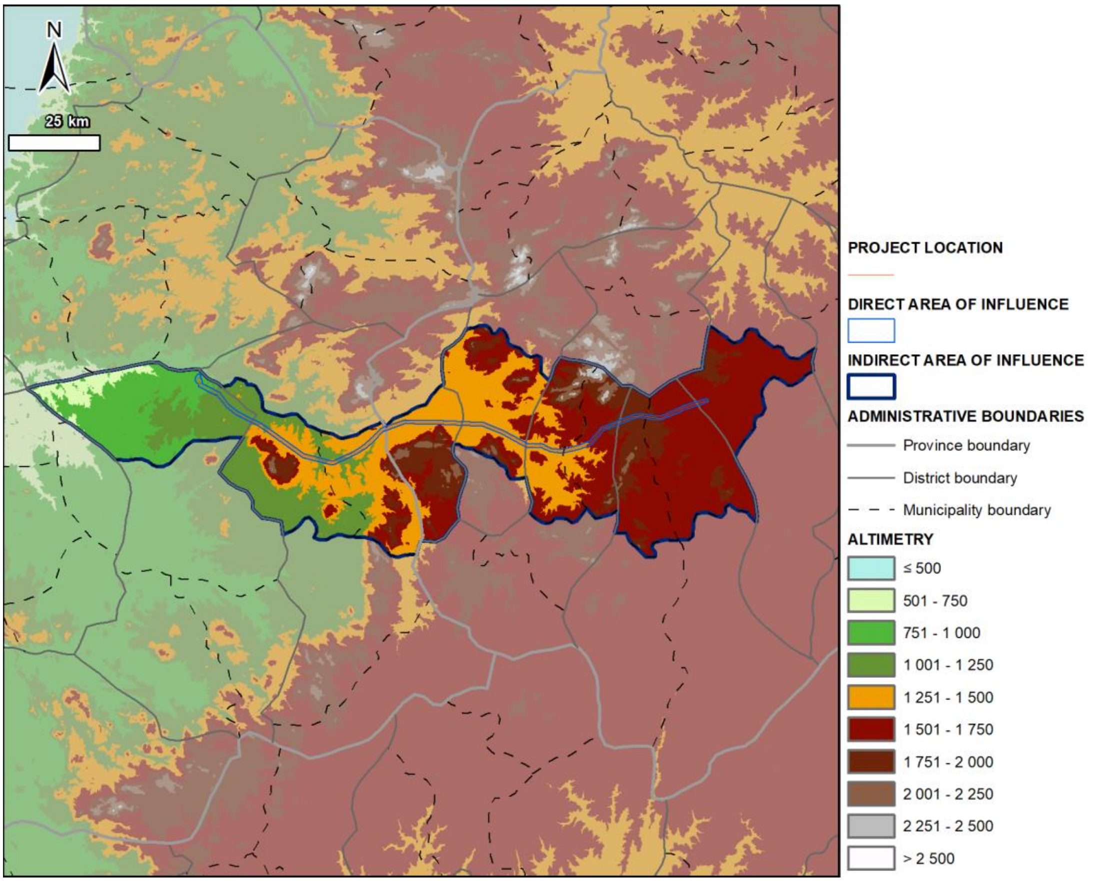
- **coastal lowland**, characterised by low plains and terraces (<500 m);
- **hills and mountains**, rising inland from the coast into a great escarpment with 1,800 to 2,200 m altitude range. The highest peaks rise to 2,420 m on Mount Namba, 2,582 m on Serra Mepo and 2,620 m at Mount Moco. The escarpment, also known, as the Western Angolan Scarp, also includes very mountainous areas, like the Serra da Neve, which rises to almost 2,500 m. In the south, between Moçâmedes and Lubango, the escarpment of the Serra da Chela is very sharp, rising 1,000 m at Tundavala and Bimbe. The Cuanza River divides the region into two parts:
    - the northern part rises gradually from the coastal zone to an average elevation of 500 m, with crests as high as 1,000 to 1,800 m
    - the south part, the hills rise sharply from the coastal lowlands and form a high escarpment, extending from a point East of Luanda and running South through Namibia
- **high plateau**, which extends eastward from the escarpment. It drops from 1,800 m, in the west, to 1,400 m, in central Angola. In this area of high plains, typically flat or rolling, is the highest point in Angola (Morro de Moco, located in Huambo, at 2,620 m above sea level).



Source: (Huntley, Russo, Lages, & Almeida, 2019)
Red line indicates approximate project area
Figure 20 – Angola's relief.

In the project area, from West to East, it is **very clear an increase in altimetry** the further one progresses into the Eastern limit and different geomorphological units are crossed.

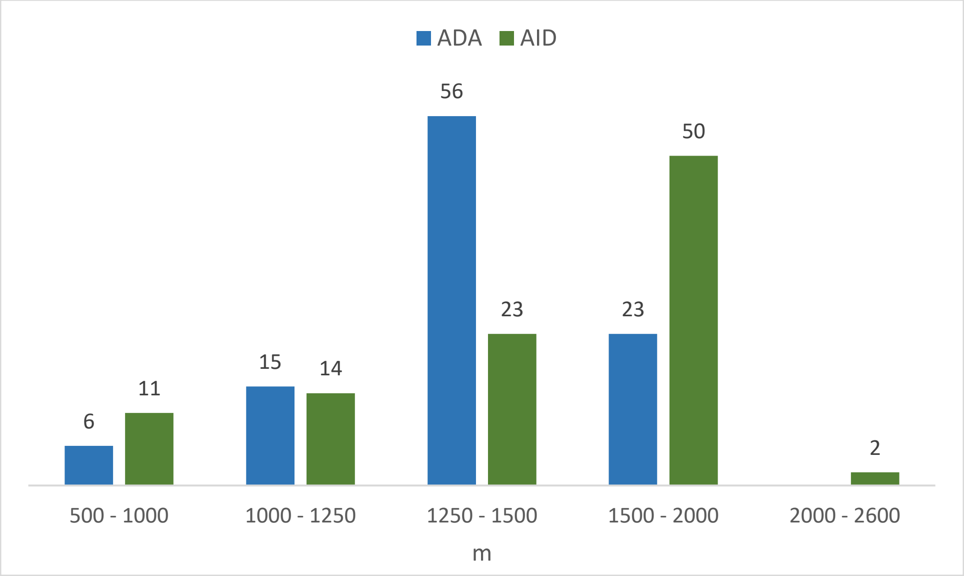
In the Benguela province, the ground surface ranges from 500 to 1,250 m. Gradually, as progress to Huambo, increasing altitudes are quite noticed until reaching almost a maximum of 2,000 m high.



Source: Nemus (2022) with data from Shuttle Radar Topography Mission (SRTM)

Figure 21 – Project's area altimetry.

Overall, around 63% of the direct area of influence ranges from 1,200 to 1,500 m, whereas 15% is below 1,000 m and 23% between 1,500 to 2,000 m.



Source: Nemus (2022) with data from Shuttle Radar Topography Mission (SRTM)

Figure 22 – ADA and AID altimetry percentage distribution.

Source: Nemus (2022)

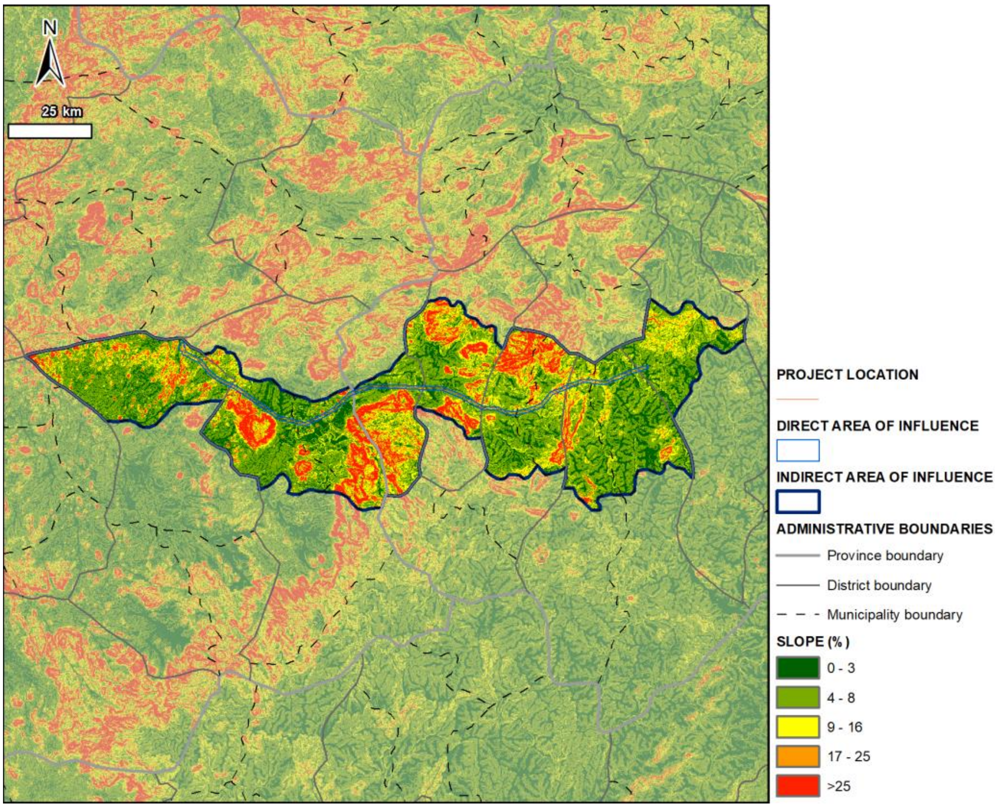
Figure 23 – Project's influence area view.

One important feature that highlights from the projects influence area are inselbergs, isolated hills that stand above the plain area.

Source: Nemus (2022)

Figure 24 – Inselberg (South of Canjumba/North of EN110).

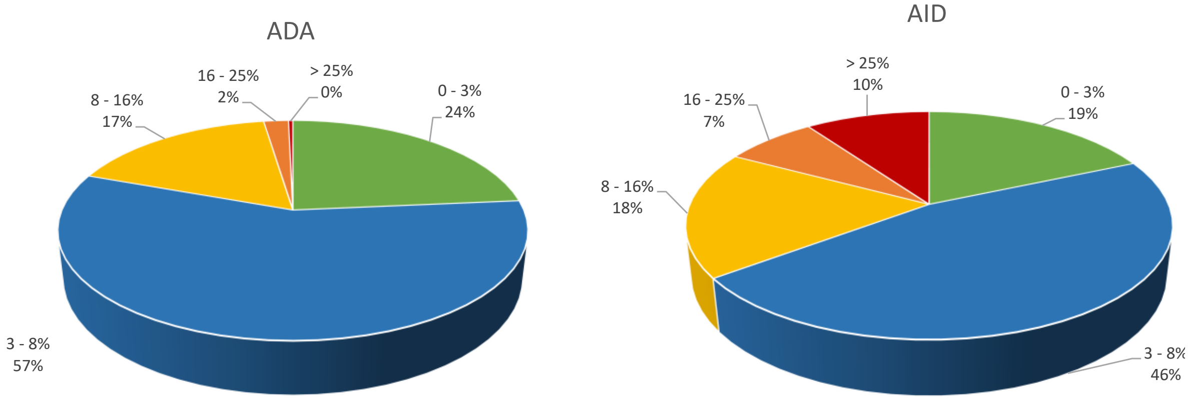
Regarding slope gradient, the nearby area around the transmission lines mainly presents **gentle slopes** (4 - 8 % gradient).



Source: Nemus (2022) with data from Shuttle Radar Topography Mission (SRTM)

Figure 25 – Project's slope gradient.

However, the project's indirect area of influence shows some areas with moderate (9 - 16% gradient) to steep and extremely slopes (more than 25% gradient).



Source: Nemus (2022) with data from Shuttle Radar Topography Mission (SRTM)

Figure 26 – ADA and AID slope gradient distribution.

6.4. Mineral resources

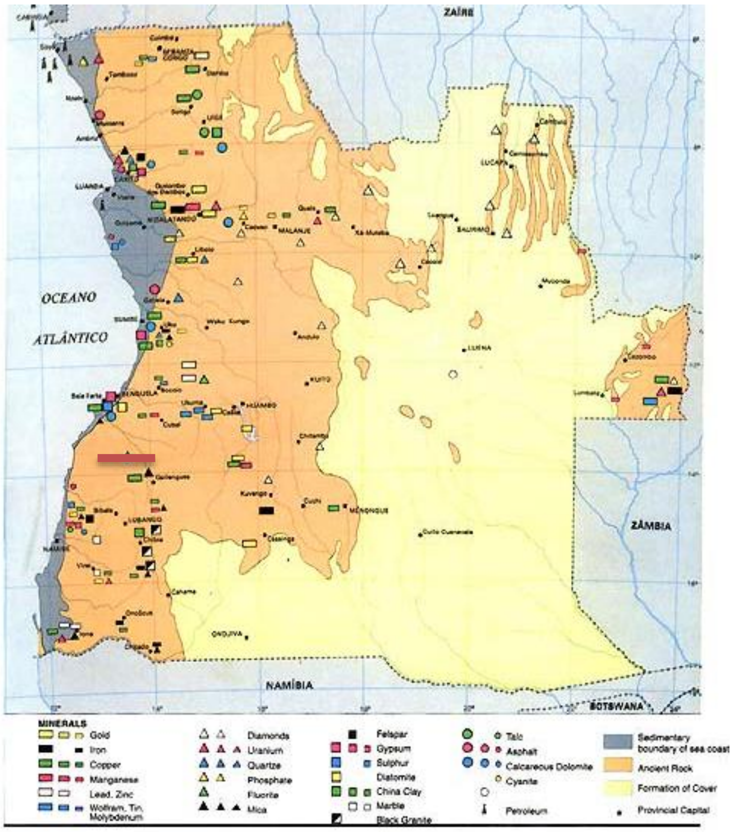
Angola presents a significant mineral potential, most of it related to the Precambrian basement.

Diamonds and crude petroleum are the most important mineral commodities. According to the (USGS, 2021), in 2017 and 2018, the country accounted for nearly 6% of the world's total rough diamond output.

Besides oil, gas and diamonds, the most important mineral resources, a significant number of other substances should also be highlighted: gold; platinum group minerals, iron, manganese, copper, lead, zinc, vanadium, cobalt, nickel, chrome, mineral associated with carbonatite complexes (niobium, tantalum, rare earths, fluorite and barite), tungsten, uranium, coal, lignite; quartz, phosphate, kaolin, mineral sands, mica, salt; gypsum and sulphur (Pinheiro, 2010).

The most active and promising regions for mining potential are Lunda North and South, Uíge, Cuanza Norte and Malange. With new investments in rare earths, industrial and construction minerals, new regions are taking the lead, namely Huambo, Bengo, Namibe, Cuando Cubango, Cuanza South, Zaire Benguela and Cunene (Fialho & Viana, 2021).

A map showing the main mineral reserves in Angola is presented on the website of the Embassy of Angola in India. According to this source, in the region where the project is located there are mineral reserves of **wolfram, tin, molybdenum and gold**.



Source: http://www.angolaembassyindia.com/about/map3.html
Red line indicates approximate project area
Figure 27 – Main mineral reserves in Angola.

During the field visit to the project area no current exploitation area was identified as being encompassed by the transmission lines. However, three exploitation areas were identified on the project indirect influence area.

There are no available data regarding mining concessions or quarries foreseen on the project area.

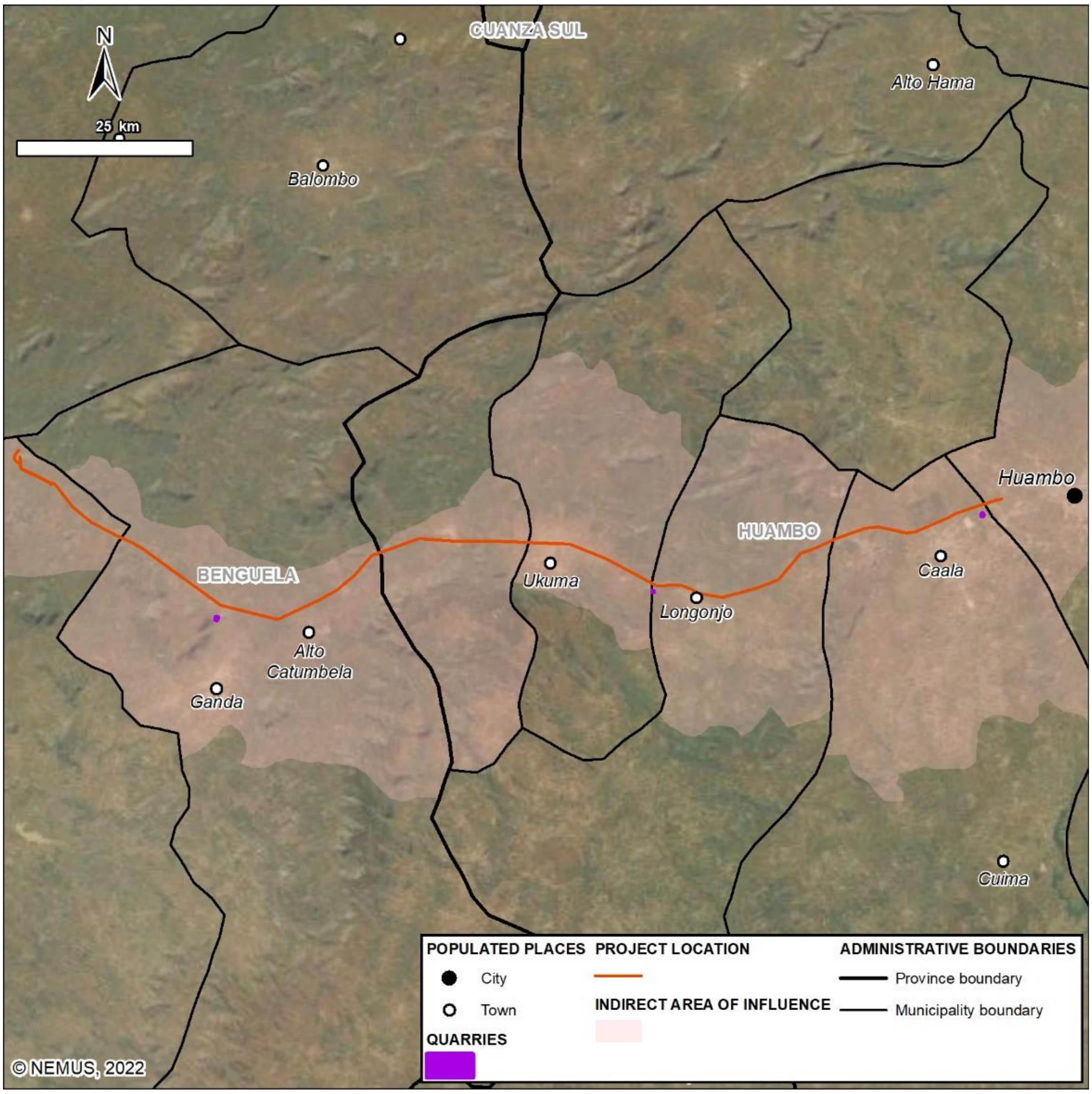


Figure 28 – Quarries identified during the field visit.

Figure 29 – Small active quarry NE of Chimboa.

Source: Nemus (2022)

Figure 30 – Active quarry SW of Calenga.

6.5. Hydrogeology

6.5.1. Introduction

Planning instruments and specific technical-scientific studies undertaken in the country were consulted to support the hydrogeological characterisation presented in this chapter.

It is important to highlight the importance of the Hydrogeological Map included in the Africa Groundwater Atlas, concluded in 2019, once Angola's groundwater knowledge is, in general, restricted to regions with significant aquifers, which is not the case of the project area.

Data available on the Hydrogeological Map allowed an evaluation of the aquifer potential of the geological outcrops in the area of the project, as well to support an assessment of the natural vulnerability to pollution of the underground water environment.

6.5.2. Angola's groundwater overview

Although most population's water needs in Angola are provided by surface resources, groundwater always had a major role. The population dependence on groundwater is mostly noticed in the south and coastal zone where the country is more arid and water availability is lower compared to the central and northern territories.

It is also important to highlight that, rural areas largely rely on groundwater, through boreholes, hand-dug wells and springs. In areas where existing water supply systems are no longer working or have not been developed, surface water is more widely used (Miguel, 2018).

According to (Angola, 2013), Angola's territory may be subdivided into four large areas with different hydrogeological features:

- **Northwest quadrant** (corresponding to the provinces of Zaire, Uíge, Malanje, Kwanza-Norte and Bengo), where fissured and/or karstified rocks with medium to high permeability support aquifers with good flow rates (5 to 10 l/s) and water quality.

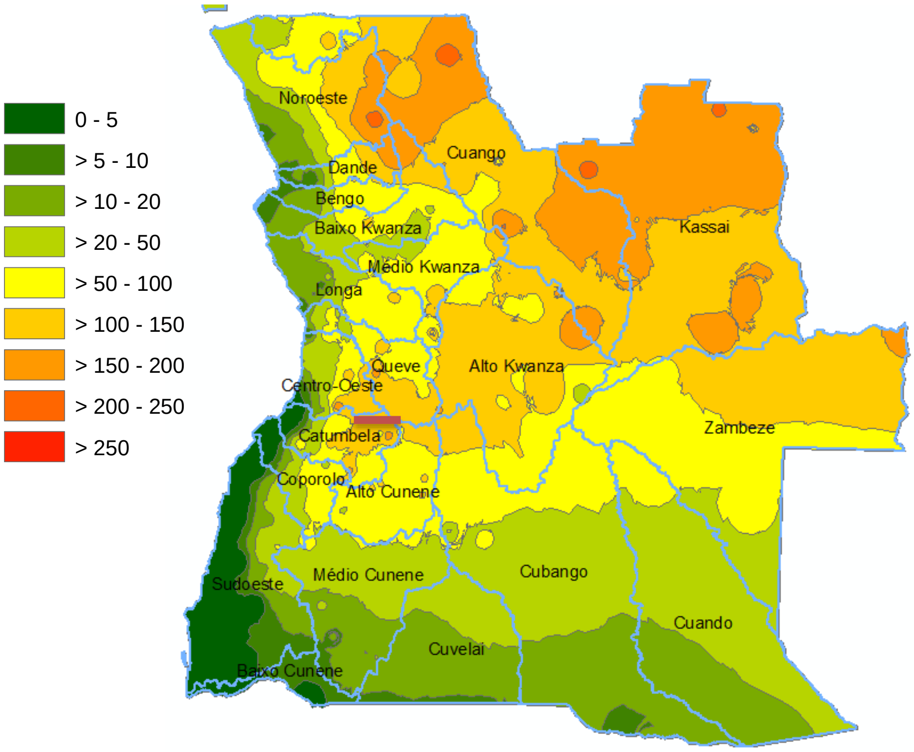
- **Northeast quadrant** (Lundas e Moxico Provinces), where aquifers are predominantly intergranular, with very high permeability and flow rate around 5 l/s. The quality of the water is good, but sometimes it has a high iron content, especially in-depth.

- **Southwest quadrant** (Benguela, Huambo, Huíla and Namibe provinces), where the project is located, there are compact fissured rocks of medium to low permeability with flow rates ranging from 3 to 5 l/s. Local aquifers occur, with flow rates ranging from 3 to 5 l/s. Groundwater quality, in general, is good, but some areas present quality issues.

- **Southeast quadrant** (Provinces of Cuando-Cubango), where extensive granular aquifers are formed. These aquifers have high permeability, with variable flow in-depth. Some of them present higher salinity conditioning the groundwater quality.

According to the Angola's National Water Plan, the territory has a groundwater recharge rate of 7.2% of the annual average rainfall. The project encompasses two river basins: Cunene and Catumbela, where the National Water Strategic Program 2013-2017 estimate average annual recharge ranging from 77.5 mm/y (Catumbela) and 81.6 mm/y (Cunene).

The annual renewable groundwater resources in Angola have been estimated at around 58 km^3 / year. Although wells are to be found all over the country, groundwater reserves are generally not significantly developed due to the easy availability of surface water. The most important aquifers are to be found in sedimentary deposits. The depth to groundwater varies from between 10 to 30 m in the Central Plateau around Huambo, between 5 to 30 m in the coastal zone and over 200 m in the semi–arid areas of the south in the Kunene basin where well yields are low (FAO 2005a, in (AHT GROUP AG, 2017)).



Source: (INRH, 2018)
Red line indicates approximate project area
Figure 31 – Angola's groundwater recharge (mm/year).

Only limited research has been conducted concerning groundwater and no national resource estimates have been completed. However, based on the presently identified potential and the limited level of existing development, it is safe to assume that only a very small portion of national groundwater resources are being used (Groundwater Consultants Bee Pee (Pty) Ltd, SRK Consulting (Pty) Ltd, 2002).

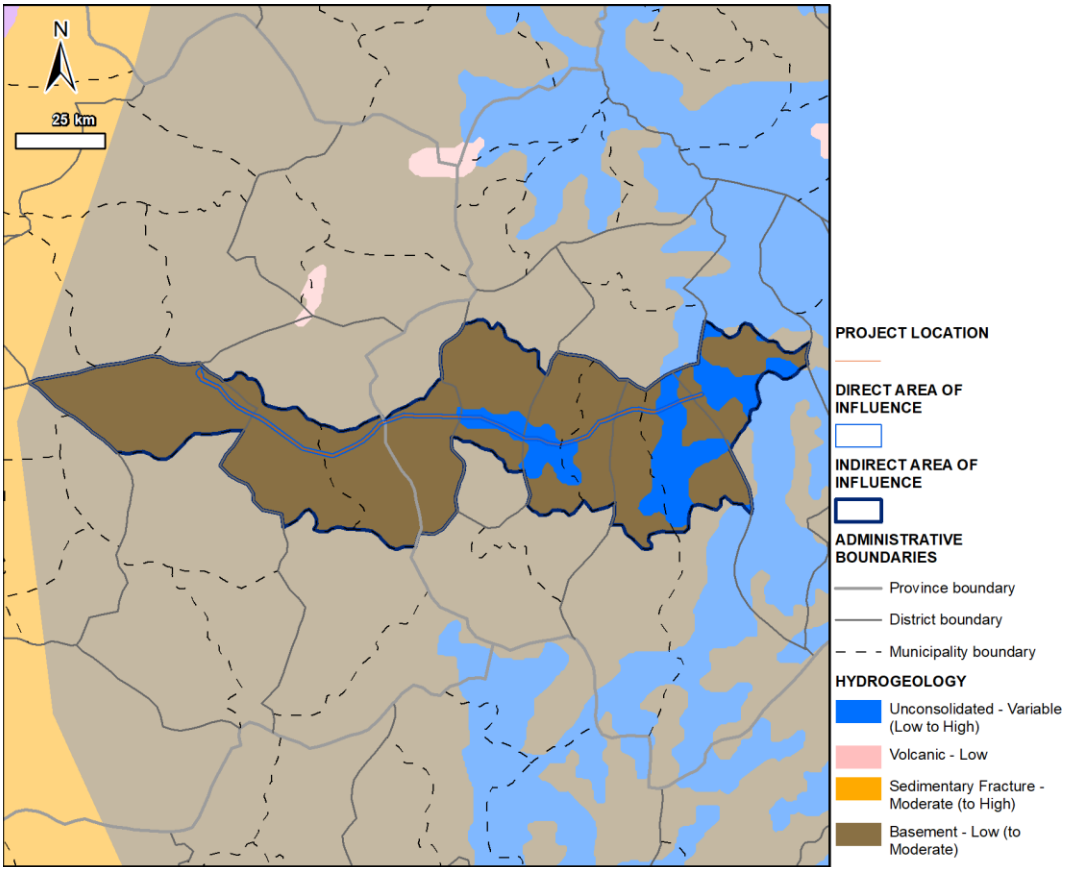
There is no available data regarding groundwater quality, but there are records of alluvial aquifers with high iron and sulphate concentrations, probably linked to the low precipitation and high potential evapotranspiration.

6.5.3. Main aquifers encompassed by the project

Even though the hydrogeological knowledge of the country is somehow limited, it is quite obvious that the groundwater availability is closely related to the geological framework.

The recent Africa Groundwater Atlas (BGS, 2019) makes a correlation between geology and the potential aquifer productivity of the main rock types. In the case of the project area, it is possible to identify two different types of hydrogeological units:

- **Fractured aquifers**, related to the basement crystalline rocks, which generally has hard rocks. These aquifers have low to moderate productivity depending on the fractured and/or weathered grade of the metamorphic and volcanic rocks.
- **Porous aquifers**, related to unconsolidated Quaternary sediments/alluvial. These aquifers' productivity depends on the outcrops' thickness and the more or less presence of clay sediments that may restrict water circulation. It is important to notice that in the project case, these aquifers have small importance, being only present in the area where the transmission lines cross a river.



Source: (BGS, 2019)

Figure 32 – Main aquifers encompassed by the project.

In general, the most common yields of boreholes in granites and gneisses are less than 1 l/s, especially where boreholes are less than approximately 50 m deep (DNA, 2005, in (BGS, 2019)).

The basic rocks in Angola such as gabbro are probably the best aquifers, and in the hydrogeological map of Angola their productivities are often indicated as being 3-5 l / s with a drill success rate of 70-80% (DNA, 2005). Basic intrusive rocks are found both in the north and south of the country.

One study showed that borehole yield was directly related to the direction of tectonic structures (fracture orientation). For example, where fractures are in a NE-SW direction, yields are less than 3 m^3/hour; and where fractures are in a N-S direction, yields are more than 8.5 m^3/hour (United Nations, 1989).

The best groundwater potential may be in zones of quartz veins and basic rocks; contact zones between crystalline rocks of different texture and composition; zones of fractured granitogneiss; and contact zones between metavolcanic and quartz-schist rocks.

In the case of Quaternary aquifers, yields could range from 15 to 50 l/s, depending of the alluvial plains' extent (DNA, 2005).

Source: Nemus (2022)

Figure 33 – Local well on crystalline rocks.

Source: Nemus (2022)

Figure 34 – Groundwater borehole.

As in other areas of the country, in the project's influence area, there are cases of groundwater uses (human supply, domestic, among others) relying on dug wells, most of them without proper sanitary conditions.

Source: Nemus (2022)

Figure 35 – Local use of dug well to water supply.

Moreover, it is also possible to make a close correlation between aquifers' lithology and their potential vulnerability to pollution as a result of a pollutant located on the ground surface. Therefore, considering the geology encompassed by the project, it is possible to consider that the main aquifers have **low to variable vulnerability to pollution**.

Both fractured and porous sedimentary aquifers have their vulnerability to pollution dependent on porosity and permeability.

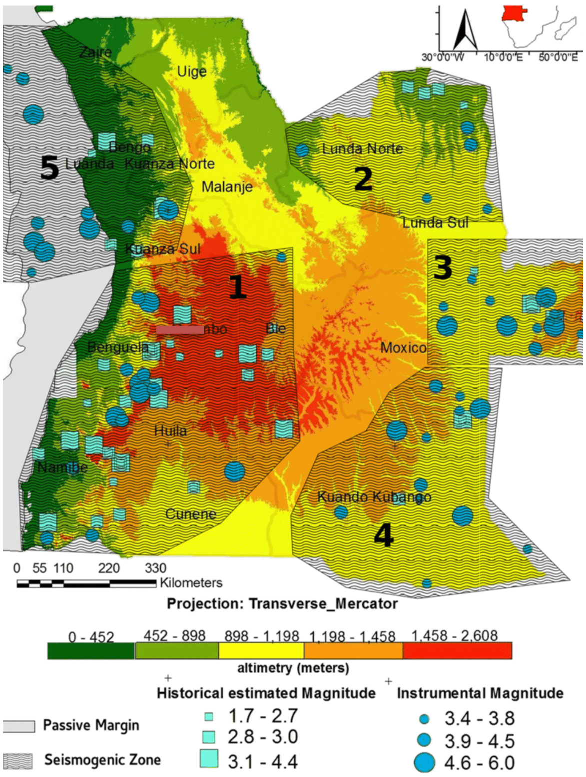
The more extensive the fracturing and weathering on the crystalline rocks, the higher is infiltration surface over runoff, and, therefore, the higher the likelihood of a groundwater body being polluted. In the case of the porous aquifers, hydraulic connection to surface water is a factor of vulnerability to pollution. However, in-depth pollutants mobilisation capability depends on the thickness of the sedimentary deposits and clay percentage.

6.6. Natural disasters

6.6.1. Seismicity

Angola is located in the Southwestern African Plate, in a **region with little seismicity activity**. The known earthquake with higher magnitude had 6.0 Ms, while events with magnitudes of 4.5 have a return period of about 10 years. Events with magnitude 5 and above occur with a return period of about 20 years (Neto F. , França, Condori, Sant'Anna Marotta, & Chimpliganond, 2018).

(Neto F. A., França, Condori, & Marotta, 2018), identified five main seismic zones in Angola. The project encompasses zone 1, corresponding to the Angola craton, which along with other cratons tends to have more earthquakes compared to other regions such as sedimentary basins.



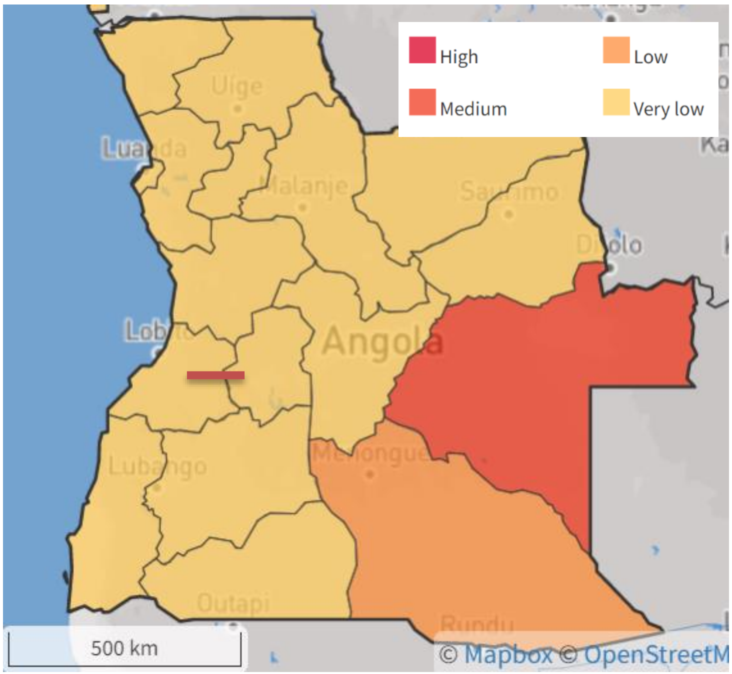
Source: (Neto F. , França, Condori, Sant'Anna Marotta, & Chimpliganond, 2018)
Red line indicates approximate project area

Figure 36 – Seismicity map of Angola.

These authors present the Angolan earthquake catalogue with the seismicity distribution for the 1914/2014 period. It is quite noticeable that in 100 years, the majority of the earthquakes had a magnitude under 6.

Considering the last 10 years, the USGS identifies one single earthquake in Angola with significant magnitude. This earthquake occurred in 2014, at 15 km depth, had epicentre 73 km NW of Longonjo and a magnitude of 4.1.

According to the ThinkHazard!, developed by the Global Facility for Disaster Reduction and Recovery (GFDRR), which provides information regarding the potential impacts of disasters on new development projects, Angola can be generally classified as having a medium earthquake hazard. This means that there is a 10% chance of potentially-damaging earthquake shaking in the country in the next 50 years.



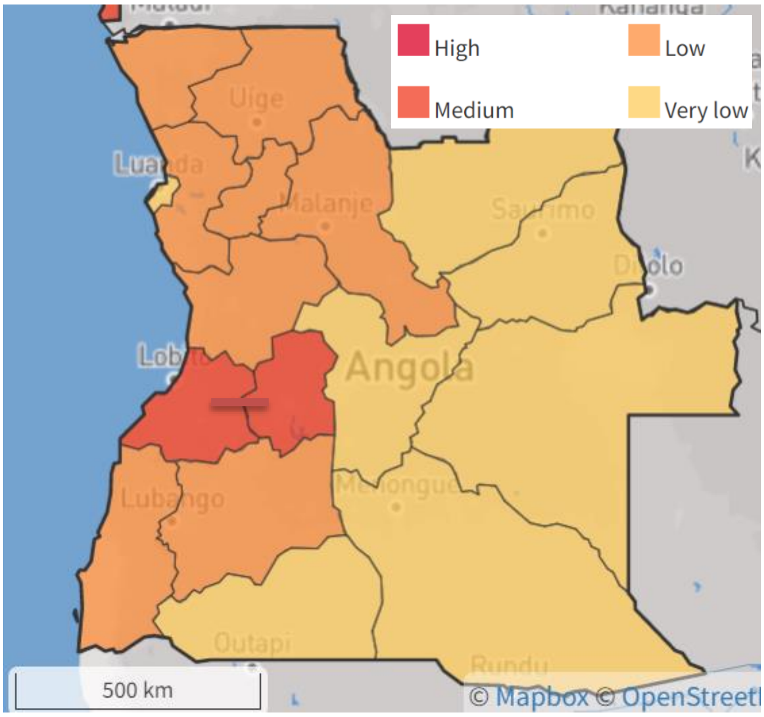
Source: https://thinkhazard.org/en/report/8-angola/EQ (2022)
Red line indicates approximate project area
Figure 37 – Earthquake hazard of Angola.

Looking closer to the provinces that are encompassed by the project, the earthquake hazard is even lower, being classified as very low. In these cases, there is less than a 2% chance of a potentially damaging earthquake shaking in the next 50 years.

6.6.2. Slope instability

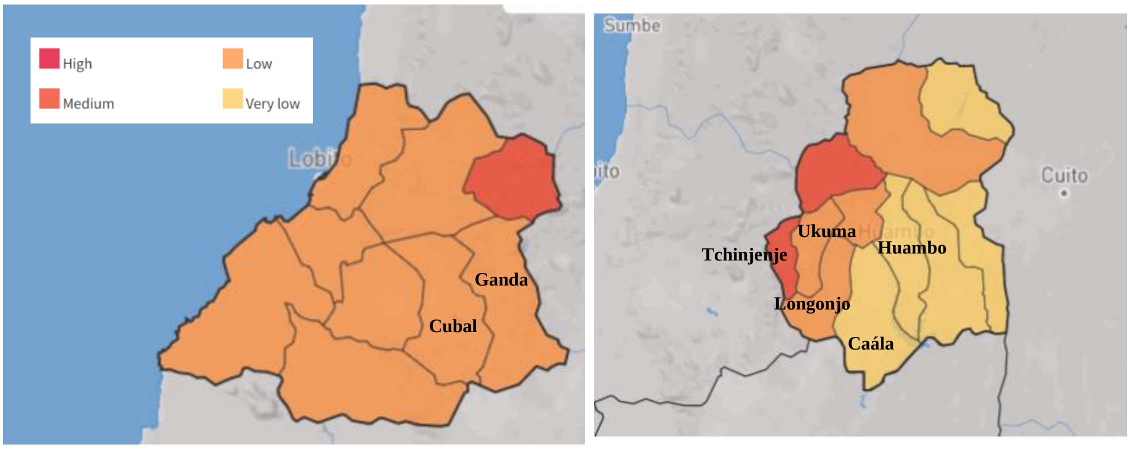
Different landslide susceptibility in the country depends on the geological and soil features of the slopes, rainfall patterns, slope gradient, land cover and seismic activity.

In the case of both provinces encompassed by the project, the landslide susceptibility is, overall, medium.



Source: https://thinkhazard.org/en/report/8-angola/LS (2022)
Red line indicates approximate project area
Figure 38 – Landslide hazard level of Angola.

Nevertheless, it is important to notice that landslide susceptibility experience some changes throughout the municipalities encompassed by the project. In Cubal and Ganda, the landslide susceptibility is low, increasing to medium in Tchinjenje, as a result of higher slopes, to low between Ukuma and Longonjo, and very low in Caála and Huambo.



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

Figure 39 – Landslide hazard level of municipalities encompassed by the project.

Looking closer to the project area influence, is observed a higher landslide susceptibility in the indirect area of influence than the direct area of influence. This higher susceptibility is especially noticed in areas where slopes are above the 16% gradient, namely along the following sections of the transmission line:

- LH37 to LH42 and substation V07 (around 1,800 m);
- LH125 to LH128 and substation V13 (around 1,200 m);
- LH167 to LH169 and substation V18 (around 1,000 m).

6.7. Surface water resources

6.7.1. Introduction

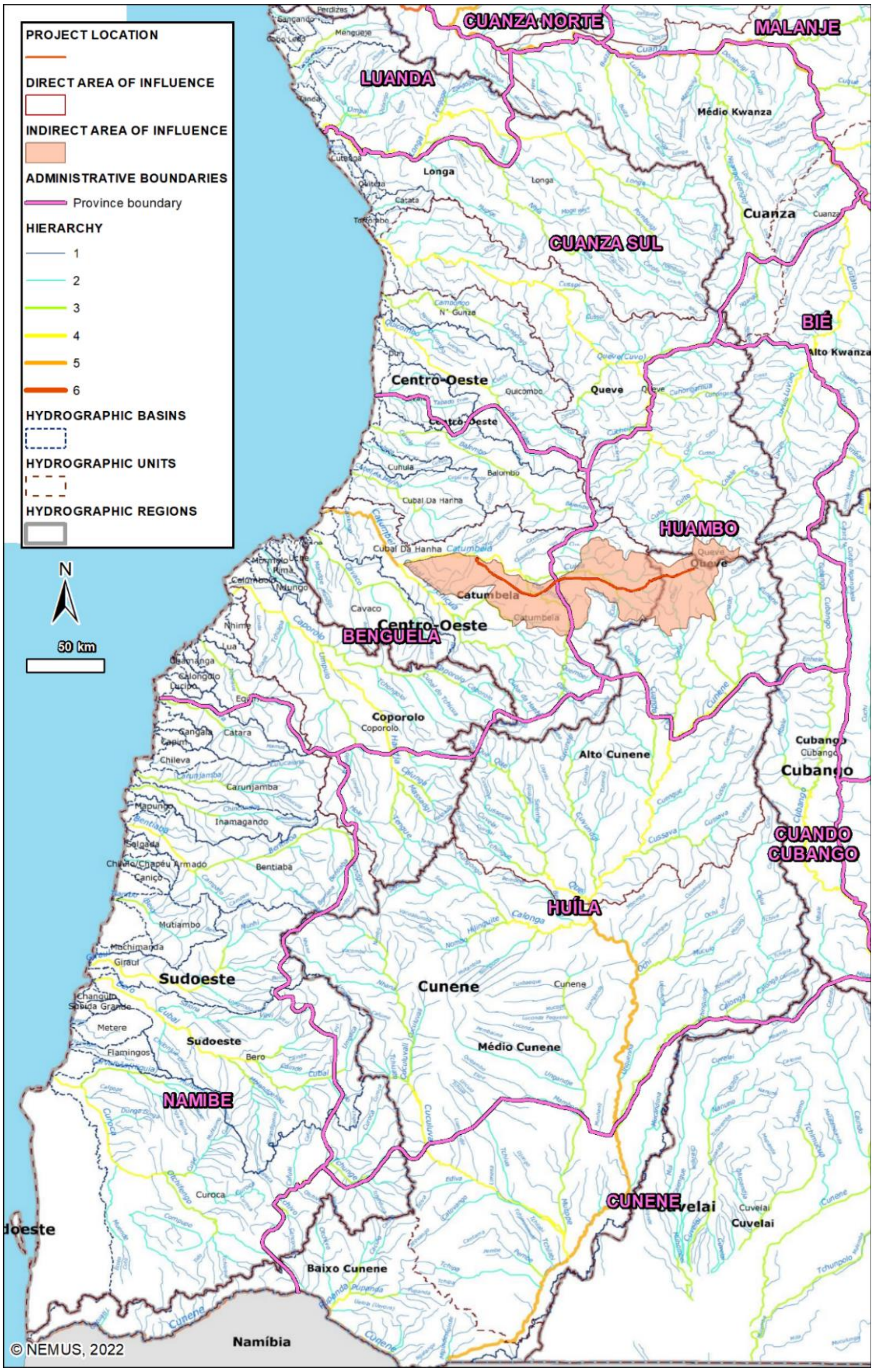
This Chapter presents the characterisation of the surface water resources in the project's area of influence, including the following issues:

- Hydrology;
- Floods and droughts;
- Water uses;
- Water quality.

This characterisation is based on information from Angola's National Water Resources Institute (INRH) and relevant bibliography. This information is complemented with additional information gathered in a field survey held in June-July 2022.

6.7.2. Hydrology

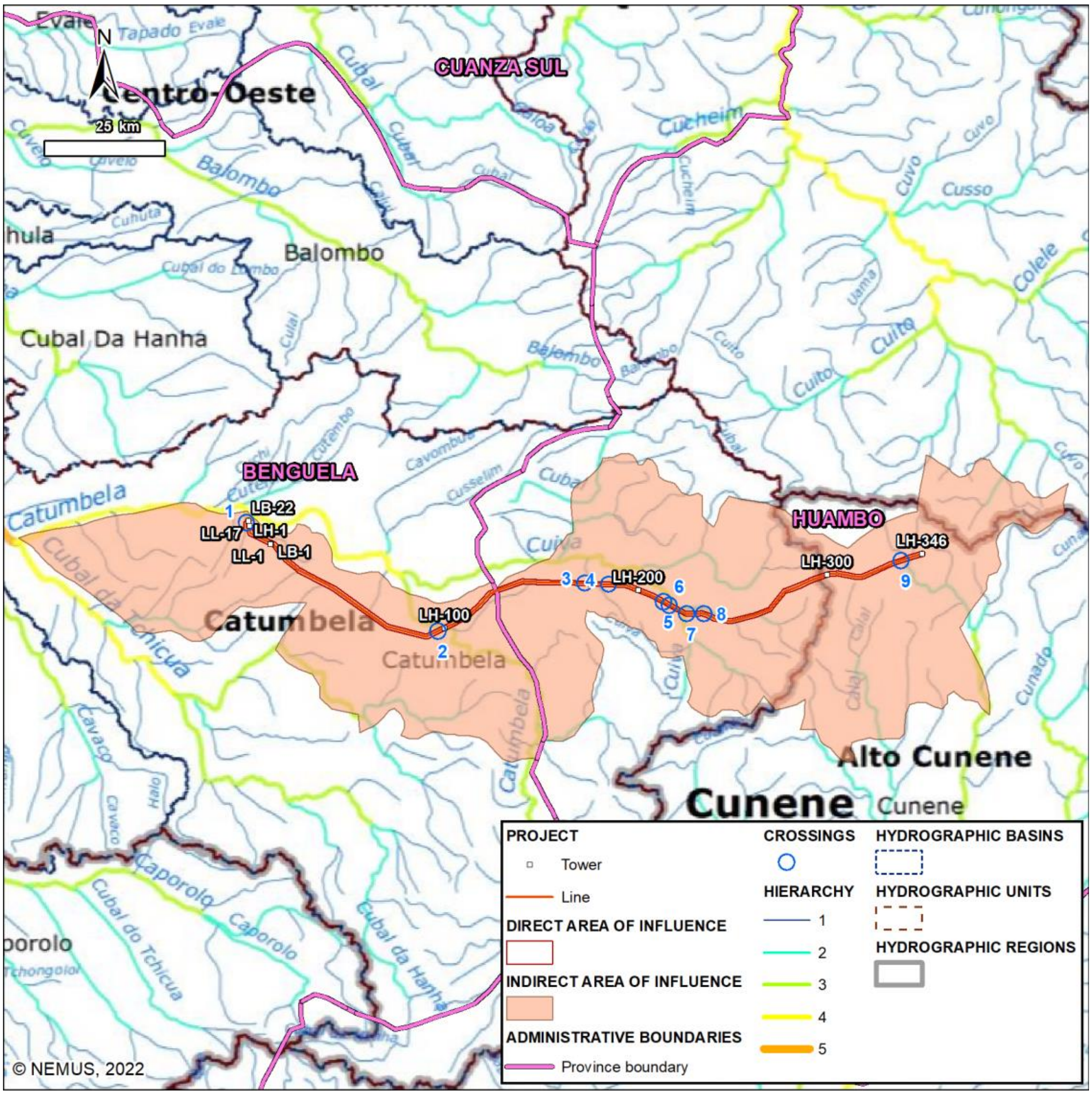
The project's area of influence is inserted partially in the **Cunene River Basin**, in the Huambo Province, and partially in the **Catumbela River Basin**, in the Huambo and Benguela provinces (Figure 40). Both rivers are included in the Angola's Atlantic slope watershed area (Government of Angola, 2013), the Cunene River in the Cunene Hydrographic Region and the Catumbela River in the Centre-West Hydrographic Region (INRH, 2020). A small part of the project's indirect area of influence is located in the **Queve River Basin**, in Queve Hydrographic Unit and in Centre-West Hydrographic Region (INRH, 2020).



Source: Adapted from (INRH, 2020)

Figure 40 – Hydrographic regions, hydrographic units and provinces of Angola in project's area of influence.

The Cunene River is an international perennial river 1,050 km long with spring at the Serra Encoco Mountains and spanning through provinces of Huambo, Huila, Namibe and Cunene; meets the Atlantic Ocean in the divide with Namibia, south of Angola (INRH, 2022) (AHT Group AG & Hatfield, 2017). Total basin area is 113,835 km^2, 94,822 km^2 in Angola (INRH, 2022). The project's DAI intersects the Cunene River near the town of Caála, in the **Upper Cunene Hydrographic Unit** (Figure 41), whose main characteristics are presented in the following table.



Source: adapted from (INRH, 2020)

Figure 41 – Cunene and Catumbela hydrographic units and main surface water resources in project's area of influence (crossings): Catumbela River (1, 2), stream 1 (3), Tonga River (4), stream 2 (5), Cuiva River (6), Chicanda River (7, 8), Cunene River (9).

The Catumbela River spans East to West from Huambo Province to Benguela Province where it meets the Atlantic Ocean at Catumbela Town. Total basin area is 20.860 km^2 (Government of Angola, 2013). The project's DAI intersects Cuiva River, an affluent of Catumbela, and two of its affluents (Tonga River and a stream) in Ukuma Municipality (Huambo Province), one affluent of Cuiva River (Chicanda River) in Longonjo Municipality and intersects Catumbela River in Babaera and Quendo municipalities (Benguela Province; Figure 41). The main characteristics of **Catumbela Hydrographic**

Unit are presented in the following table. Considering the division of the Catumbela River basin by (Matos, 2017) the project area locates in the sub-basins of Upper Cuiva, Lower Cuiva and Upper Catumbela.

a)

b)
Source: Nemus, 2022
Figure 42 – Main rivers in project's area of influence: a) Cunene; b) Catumbela.

The Queve River extends from Huambo Province to Cuanza Sul Province, meeting the Atlantic Ocean north of Sumbe Town. Total basin area is 22.813 km^2 (Government of Angola, 2013). The project's IAI intersects an affluent of the Cuito River in Huambo municipality (Huambo Province, Figure 42). The main characteristics of the **Queve Hydrographic Unit** are presented in the following table.

Table 23 – Main characteristics of hydrographic units in project's area of influence.

Hydrographic Unit	Area (km^2)	Mean annual precipitation (mm)	Flow (mm)		
			Mean year	Dry year	Very dry year
Catumbela	20,860	1079	187	126	94
Upper Cunene	27,983	1154	224	144	103
Queve	22,813	1199	255	177	136

Source: (Government of Angola, 2013).

Crossings of water courses by the project lines are summarised in the following table.

Table 24 – Water courses' crossings by the project.

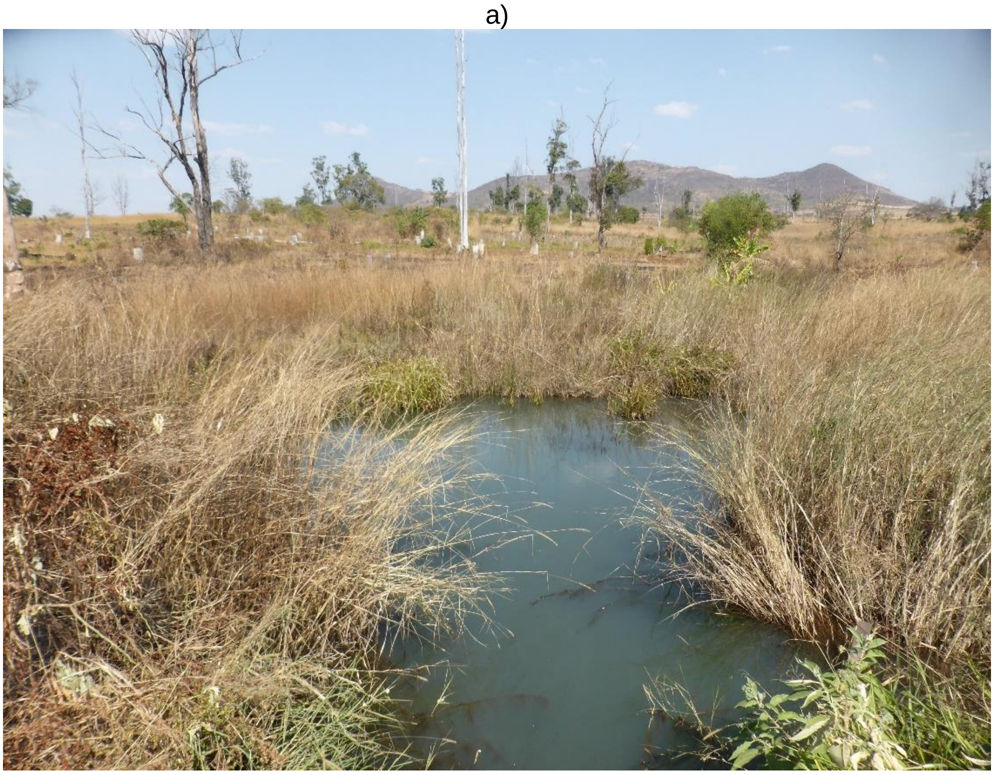
Water courses	Line - Tower	Municipality	Commune
Catumbela River	LB-20 – LB-21	Cubal	Quendo
Catumbela River	LH-96 – LH-97	Ganda	Babaera
Stream	LH-174 – LH-175	Tchinjenje	Chinjenje
Tonga River	LH-185 – LH-186	Ukuma	Ukuma
Stream	LH-213 – LH-214	Ukuma	Ukuma
Cuiva River	LH-216 – LH-217	Ukuma	Ukuma
Chicanda River	LH-226 – LH-227	Longonjo	Longonjo
Chicanda River	LH-234 – LH-235	Longonjo	Longonjo
Cunene River	LH-335 – LH-336	Caála	Kaala

Flow in Catumbela and Upper Cunene hydrographic units evidences an important variability between mean and dry years as well as between the wet and the dry season (Government of Angola, 2013).

As occurs generally in Angola, river flow is small or null in the dry season of June to September, reflecting the monthly distribution of precipitation. This situation does not occur in the perennial rivers as Catumbela and Cunene (Canivete, 2014) (Honrado, Martins, Calejo, Dos Santos, & David, 2011).

Groundwater provides an important contribution for river flow in the months without precipitation in Catumbela and Cunene hydrographic basins (Government of Angola, 2017) (Canivete, 2014). The base flow index, the ratio between base flow (contribution of groundwater) and total river, being assessed in the National Water Plan (Government of Angola, 2017), from available hydrometric stations data, as generally exceeding 0.6.

a)



Source: Nemus, 2022

Figure 43 – Main rivers in the project's area of influence: a) Cuíva (affluent of Catumbela River); b) Chicanda (affluent of Cuíva River).

Table 25 – Base flow index (ratio of base river flow and total river flow) in the Catumbela and Cunene hydrographic basins.

Hydrographic Basin	Number of hydrometric stations	Mean	Median	Minimum	Maximum
Catumbela	8	0.62	0.67	0.46	0.71
Cunene	15	0.76	0.77	0.61	0.80

Source: Government of Angola, 2017.

6.7.3. Floods and droughts

Benguela and Huambo provinces are noted for occurrence of important **flood** events (Government of Angola, 2017). Floods occur frequently in the downstream area of the Cunene River Basin, particularly in February and March with peak flows in the range of 350-450 m^3/s in Ruacana (Low Cunene Hydrographic Unit), while in Upper Cunene floods are local and with limited extent (AHT Group AG & Hatfield, 2017).

Drought events occur in the South of Angola, namely in Benguela Province (Government of Angola, 2017). Communities and local authorities of Ganda (Benguela Province) and Ukuma (Huambo Province) municipalities refer to occurrence of drought conditions in the provinces under study.

6.7.4. Water use

Concerning surface water resources use, both Cunene and Catumbela rivers are used for hydroelectric production at Gove and Ruacana plants (Cunene River, downstream DAI) and Lomaum and Biópio plants (Catumbela River, DAI and downstream DAI, respectively; INRH, 2016).

The Cunene River is used as water source for irrigation perimeters in Huila province (downstream project's area of influence) and for irrigation (project's area of influence; Figure 44) and the public supply system at Cunene Province (Government of Angola, 2017); irrigated areas also exist in the Catumbela Hydrographic Unit and Catumbela River is used as source for irrigation (Canivete, 2014; field survey of June-July 2022).

The hydrographic units of Medium Cunene and Catumbela concentrate 18.5% and 7.2% of the irrigated areas of Angola, respectively (Government of Angola, 2017).

Public supply comprises urban and rural water uses (Government of Angola, 2017):

- Urban use: domestic, businesses and services, small industry in urban areas, public and institutional services, municipal community use;
- Rural use: domestic.

As Angola's cattle production concentrates in Huíla, Cunene, Namibe and Benguela provinces, surface water resources in the Cunene (Middle and Lower Cunene) and Catumbela river basins constitute important water sources for cattle use.

Subsistence fishing occurs in the Catumbela hydrographic unit, in locations not infested by crocodiles in the Cuiva and Catumbela Rivers (field survey of June-July 2022). Despite Cunene River's perennial flow is a potential location for fishing activities (Government of Angola, 2013) (Government of Angola, 2017), fishing does not occur in the Caála Municipality (field survey of June-July 2022).

Due to relatively small coverage of the urban and rural public water supply systems (23.7-38.9% in Benguela and 28.4-30.2% in Huambo), focusing mostly the central areas of main towns (Government of Angola, 2013), surface water resources of the Upper Cunene and Catumbela hydrographic units are also used for general domestic uses such as ingestion and food preparation, bathing, dish and clothes washing, car and motorcycles washing, complemented by groundwater (Canivete, 2014) (Government of Angola, 2017).

Information collected in the field survey and in interviews with local authorities (June-July, 2022) confirms that at least part of the population in locations of Lomaum (Cubal Municipality), Alto Catumbela (Ganda Municipality) and Longonjo (municipality with the same name) uses rivers as water source for human consumption, supplementing groundwater when this source is scarce. It was also found that the Tchinjenje Municipality is abstracting Cuiva River's water for public supply through a gravity system, but without treatment, as a temporary solution after the usual groundwater use is not possible due to generator malfunction. A larger use of surface water for human consumption is prevented by safety threat represented by crocodiles and the perceived low water quality.

a)

Source: Nemus, 2022

Figure 44 – Surface water uses in project's area of influence: a) irrigation (Cunene River); b) clothes washing (Catumbela River).

Water needs for the main consumptive uses are summarised per hydrographic unit in the following table. It can be observed that in almost all the focused hydrographic units irrigation amounts for the larger volume, being the sole exception the Upper Cunene unit, where human supply is the dominant use. Cattle raising is generally less important, except in the Medium Cunene unit where it is next to irrigation use. Apart from these uses it is noted that industrial use amounts to small volumes in Benguela and Huambo, 2.0 hm^3/year and 0.5 hm^3/year in 2015, respectively (Government of Angola, 2017).

Table 26 – 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		
Catumbela	21.39	15.28	6.10	38.2	1.5
Upper Cunene	19.43	9.70	9.74	12.5	0.9
Medium Cunene	21.61	8.74	12.77	172.8	24.6
Lower Cunene	0.83	0.31	0.52	8.6	1.4
Queve	20.66	11.21	9.45	111.4	11.2

Source: (Government of Angola, 2017).

Relative to the environmental uses, the assessment of the National Water Plan (Government of Angola, 2017) concluded that the general water uses are compatible with environmental uses, being verified almost natural ecological conditions, with little modification of aquatic habitat and riparian vegetation.

The current water balance of the Catumbela and Upper Cunene hydrographic units under study is assessed in the National Water Plan (Government of Angola, 2017) as Excellent in mean, dry and very dry years, with none or little management actions being required (following table). Nonetheless, Medium and Lower Cunene hydrographic units are assessed less favourably in Comfortable condition in dry and very dry years, meaning that situations requiring specific management actions at basin level may occur.

Table 27 – 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
Catumbela	1.0	1.6	3.2
Upper Cunene	0.6	0.8	1.2
Medium Cunene	4.3	6.2	8.8
Lower Cunene	4.4	6.2	9.0
Queve	1.6	2.2	2.9

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 investiments; WEI > 40%, Very Critical.
Source: (Government of Angola, 2017).

6.7.5. 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.

Water quality is not monitored on a regular basis in Catumbela and Cunene rivers. The assessment within Angola's Water National Strategic Program (Government of Angola, 2013) with scarce data concludes with good quality water in the rural areas, despite interference from human activities is evident in wet season in the downstream area of the Catumbela River basin, including metals probably derived to mining activities upstream the sampling site and soil erosion (Sassoma, Sousa, Aguiar Netto, & Carvalho, 2015) (following table; cf. Geology, geomorphology and topography and Soils and land use baselines). Communities and local authorities assessed for the ESIA consider that surface water has a degraded quality for human consumption and refer turbidity as the main water quality problem, while sewage pollution may also occur.

Table 28 – Water quality sampling in Catumbela River downstream the project's area of influence (Catumbela Municipality).

Parameter	March/April 2012 (Wet season)	June/July 2012 (Dry season)	Presidential Decree n.º 261/11	
			Drinking water standard	Minimum quality standard
Dissolved oxygen (% saturation O_2)	124.7	116.5	70*	50*
pH	7.4	7.8	6.5-8.5	5.0-9.0
Phosphate (mg/L)	0.36	**1.2**	0.4	-
Nitrate (mg/L)	20.4	0	25	-
Sulphate (mg/L)	20	0	150	250
Chromium (µg/L)	**73**	0	50	50
Copper (µg/L)	**294**	**24**	20	100
Iron (µg/L)	**381**	**1404**	100	-
Zinc (mg/L)	0.16	-	0.5	0.5

Notes: * minimum value; in **bold** results exceeding water quality standards; sampling site 10 km from Catumbela River outlet in the Atlantic Ocean.
Source: (Sassoma I. T., 2013).

As available public sanitation systems in Angola occur only in a small number of towns (Luanda, Huambo, Namibe, Lobito and Benguela), with a reduced service area and generalised lack of wastewater treatment (only Luanda, Lobito and Benguela had wastewater treatment in 2013), surface water resources' quality is pressed mainly by domestic wastewater pollution. Septic tanks and dry latrines are used by most urban population, but part of the population has no sanitation facilities (Government of Angola, 2013). Irregular waste disposal is also an important source of surface waters' pollution (Government of Angola, 2017).

Comparatively, industry and agriculture are less important pollution sources in most of Angolan territory (Government of Angola, 2017). Nonetheless, the incidence of irrigation in Catumbela and Upper and Medium Cunene hydrographic units and the common use of fertilization (field survey June-July 2022) makes agriculture activities a potential source of nutrients and other agro-chemical pollution to surface water sources (AHT Group AG & Hatfield, 2017).

As soil erosion hazard ranges from high to very high in the project influence area (cf. Soil and land use baseline), soil erosion, triggered by overgrazing and deforestation, is a relevant source of pollution to surface water resources, affecting turbidity and concentration of total suspended solids and some metals present in soils, such as iron.

Roads can also be a pollution source to surface water resources in the project influence area, especially at bridges sites, due to runoff of pollutants (hydrocarbons, metals, organic substances) from oils and fuels spilled on land to watercourses after intense precipitation events.

6.7.6. Expected evolution

The future water balance estimated in the scope of the National Water Plan (Government of Angola, 2017), considering a scenario of balanced socio-economic growth with increasing water consumption for irrigation and cattle raising till 2025 and for industry and energy production from 2025 to 2035 foresees the degradation of water availability in the Catumbela, Cunene and Queve hydrographic units, reaching Critical or Very Critical water balances in 2040, specially in dry and very dry years (following table).

Table 29 – Water exploitation index (WEI) for scenario C4 in 2040.

Hydrographic unit	Water availability (hm^3)	Water needs (hm^3)	WEI (%)		
			Mean year	Dry year	Very dry year
Catumbela	5,960	763	12.8	21.0	41.9
Upper Cunene	7,263	1,505	20.7	28.2	48.6
Medium Cunene	10,114	2,692	26.6	37.4	57.1
Lower Cunene	10,162	2,744	27.0	37.9	57.6
Queve	8,195	1,113	13.6	18.4	24.5

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 investiments; WEI > 40%, Very Critical.
Source: (Government of Angola, 2017).

The National Water Plan (Government of Angola, 2017) includes for the period till 2040 investments concerning water uses in the Catumbela, Cunene and Queve hydrographic units. Those investments include flow regularization dams, water diversions between hydrographic units, improving water supply and sanitation networks, rehabilitation of and new irrigation areas, hydroelectric plants.

Flow regularization dams to attend multiple water uses, including energy production, irrigation, cattle supply and human supply are planned for Catumbela, Upper Cunene, Medium Cunene, Lower Cunene and Queve hydrographic units:

- Catumbela Hydrographic Unit: Cacombo (Benguela and Huambo provinces, 2025) and Capitongo (Benguela Province, 2040) dams;
- Upper Cunene Hydrographic Unit: Jamba-ia-Mina, Jamba-ia-Oma dams (Huíla Province, 2025);
- Medium Cunene Hydrographic Unit: rehabilitation of Calueque dam (Cunene Province, 2025);
- Lower Cunene Hydrographic Unit: Baynes dam (Namibe Province, 2025);
- Queve Hydrographic Unit: Cafula dam (Kwanza-Sul Province, 2025).

Water diversion infrastructures are planned for water abstraction from the Catumbela and Lower Cunene hydrographic units:

- Catumbela Hydrographic Unit: rehabilitation of the diversion pipeline from Cubal da Hanha River to Halo River;
- Lower Cunene Hydrographic Unit: implementation of water diversion schemes from Lower Cunene to Southwest and Cuvelai hydrographic units.

Planned measures concerning water supply and sanitation include enlarging and reinforcing the water supply to provincial capitals, water supply to municipalities, urban water supply and sanitation systems, rural water supply and sanitation systems, restoration and construction of urban and peri-urban drainage systems and construction of small-scale communitarian water supply and sanitation systems for sub-urban and rural areas.

The rehabilitation / implementation of irrigation areas is foreseen in Catumbela (177,515 ha), Upper Cunene (213,960 ha), Medium Cunene (81,214 ha), Lower Cunene (3,562 ha) and Queve (191,350 ha) hydrographic units.

The implementation of new hydroelectric plants is planned in the hydrographic units of Catumbela, Upper Cunene, Medium Cunene, Lower Cunene and Queve in the 2025-2040 period (Government of Angola, 2017):

- Catumbela Hydrographic Unit: Cacombo and Lomaum II hydroelectric plants (Benguela and Huambo provinces, 2025); Calengue, Calindo, Capitongo, Calitianga, Cubal, Súpua and Tala hydroelectric plants (Benguela Province, 2040);
- Upper Cunene Hydrographic Unit: Jamba-ia-Mina and Jamba-ia-Oma hydroelectric plants (Huíla Province, 2025);
- Medium Cunene Hydrographic Unit: Calueque hydroelectric plant (Cunene Province, 2040);
- Lower Cunene Hydrographic Unit: Luandege hydroelectric plant (Cunene Province, 2040), Mariem hydroelectric plant (Namibe Province, 2040);
- Queve Hydrographic Unit: Genga and Quilengue (Balalunga) hydroelectric plants (Kwanza-Sul Province, 2025); Benga, Cafula, Balalunga, Sanga hydroelectric plants (Kwanza-Sul Province, 2040).

Although the full implementation of these developments could be delayed by lack of funding, and while they can promote the increase of water use in the project area, these are expected to bring some relief to water scarcity and water pollution problems in the project incidence area, increasing resilience to possible climate change effects on reduced surface water availability.

6.8. Soils and Land Use

The present section describes and characterises the existing soil types and land use in the study area, considering the Direct Area of Influence (DAI) and Indirect Area of influence (IAI), defined in Chapter 3.

The map of soil types is shown in Figure 45, according to the Soil Atlas of Africa (Jones et al., 2013). The predominant soil types in the DAI and AIA are Xanthic Ferralsols (FRxa) and Haplic Ferrasols (FRha), distributed as shown in Figure 25. Haplic Acrisols (ACha) are also present in the DAI, in the western part of the area (Cubal). Other soil types locally present in small areas are found in the DAI and AIA.

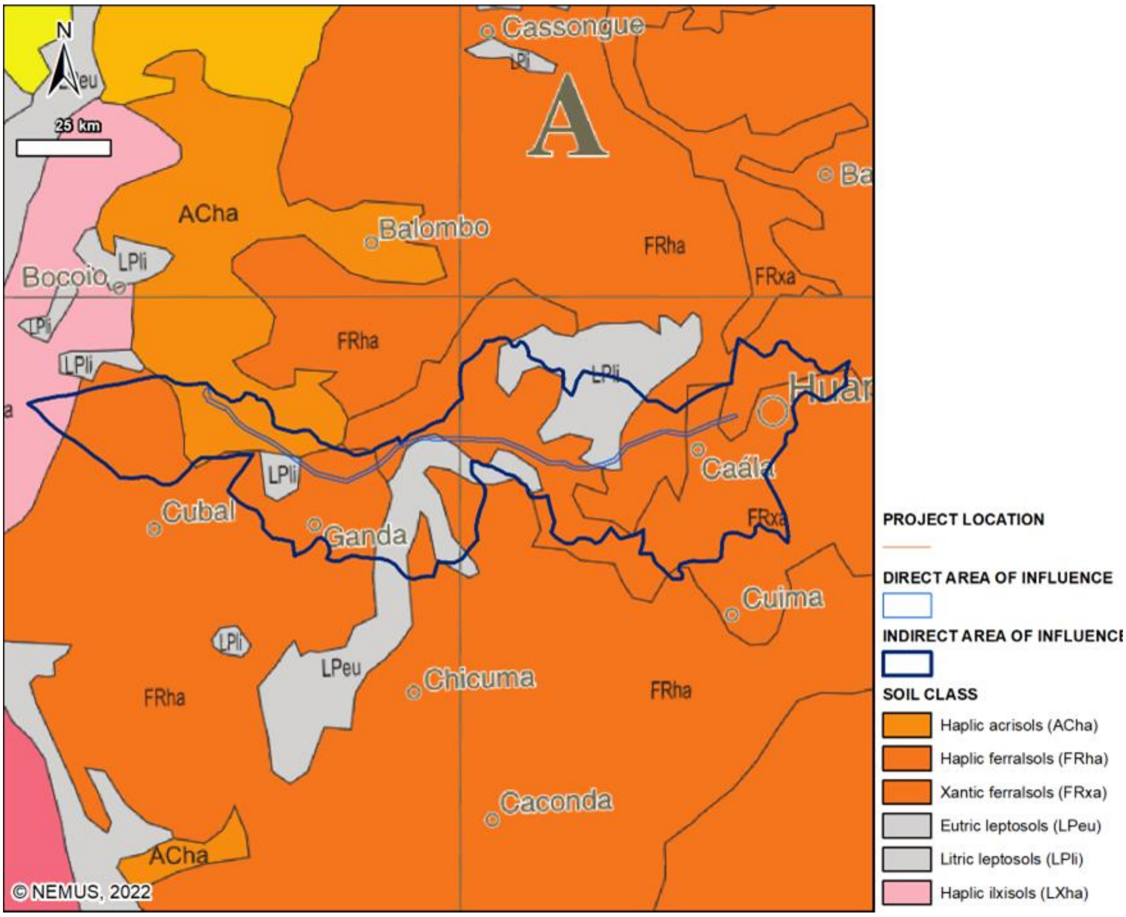


Figure 45 – Soil classes in the study area (Source: Soil Atlas of Africa, Jones et al., 2013).

Table 30 – Soil type distribution along the Transmission Line Route (DAI and AIA).

Soil classes	Area	
Soil Atlas of Africa (Jones et al., 2013)	**Km^2**	**%**
DAI		
Haplic Acrisols (ACha)	31,0	19,7
Haplic Ferralsols (FRha)	45,8	29,1
Xanthic Ferralsols (FRxa)	63,1	40,1
Eutric Leptosols (LPeu)	6,6	4,2
Litric Leptosols (LPli)	10,7	6,8
Total	157,2	100
AIA		
Haplic Acrisols (ACha)	472,2	7,2
Haplic Ferralsols (FRha)	2565,9	39,4
Xanthic Ferralsols (FRxa)	2265,1	34,8
Eutric Leptosols (LPeu)	547,6	8,4
Litric Leptosols (LPli)	593,1	9,1
Haplic Lixisols (LXha)	72,3	1,1
Total	6516,2	100

The geology, topography and climate play a role in determining the soil types present in the area. As referred above, Ferralsols are the most abundant soil type in the DAI. Ferralsols are generally red and/or yellow weathered soils due to metal oxides, including iron and aluminium. They are generally low in organic matter and nutrients (low fertility), and are usually found in humid tropical climates, with a rainforest growing in the natural state. Ferralsols are defined by a fine-textured subsurface layer of low silt-to-clay ratio, high contents of kaolinitic clay and iron and aluminium oxides, and low amounts of available calcium or magnesium ions (Jones et al., 2013; Britannica, 2022).

Acrisols are usually found in undulating topography and humid tropical climates. They are associated with woodlands and tree savannas. The age, mineralogy and extensive leaching of these soils have led to low levels of nutrients, excess aluminium, and high erodibility. Acrisols acidic and have a subsurface layer of accumulated kaolinitic clays (Jones et al., 2013; Britannica, 2022).

Leptosols are very shallow in depth and often contain large amounts of gravel, hence have a weak soil structure. Depending on climate and topography, they are susceptible to erosion, desiccation, or waterlogging. They have limited rooting depth, low water-holding capacity and low nutrient availability, therefore being unsuitable for growing crops (Jones et al., 2013; Britannica, 2022).

Lixisols are found under climates with pronounced dry seasons. They have high base status with low-activity clay, are slightly acid and show a distinct increase in clay content with depth. The clay is predominantly kaolinite with limited nutrient holding capacity. They occur mainly in the dry savannah region having low biomass production and organic matter content, consequently lacking a well-developed soil structure (Jones et al., 2013; Britannica, 2022).

These soil types influence the agricultural potential of these areas and therefore land use. The summary of soil types in the study area, including their main characteristics and potential for agriculture is presented in Table 31.

Table 31 – Summary and main characteristics of the soil types in the study area (Jones et al., 2013; Britannica, 2022).

Soil type	Charact.	Strengths	Weakness.	Opport.	Threats
Acrisols	Strongly acid soils with low nutrient-holding capacity; Humid subtropical and warm temperate areas	Usually under natural vegetation; Can support agriculture if managed	Very hard when dry (land preparation)	Can be productive if fertilized; Best for acid tolerant crops, low-demanding crops	Erosion and capping if bare; Best left under natural vegetation (low productivity)
Ferralsols	Extensively weathered with low nutrient and water-holding capacity; Humid tropics	Sustain natural vegetation (tropical rain forest); Limited cultivation if managed	Specific soil management (low to very low nutrient retention, low water-retention capacity); iron content results in the fixation	Can be easily corrected by liming	Surface soil erosion; Maintain soil fertility

Soil type	Charact.	Strengths	Weakness.	Opport.	Threats
			phosphorus from fertilisers		
Leptosols	Shallow soil over hard-rock or gravelly material; Eroded uplands	Provide solid foundation	Unsuitable for growing crops (limited root depth, low water-holding capacity)	Cattle grazing	Erosion
Lixisols	Slightly acidic with low-nutrient-holding capacity; Driest humid tropics	Can be fairly productive if managed	Low biomass production/low organic matter content leading to soil structure destruction by rainfall	Mulch prevents crust development	Prone to erosion, crust development with overland flow eroding the topsoil (most fertile part); Wind erosion

Note: Charact. = characterisation; Weakness. = Weaknesses; Opport. = Opportunities

Land use in the study area is shown in Figure 46, considering the DAI and IAI. In both areas, the predominant land uses are grassland, cropland, tree cover areas and shrubs cover areas.

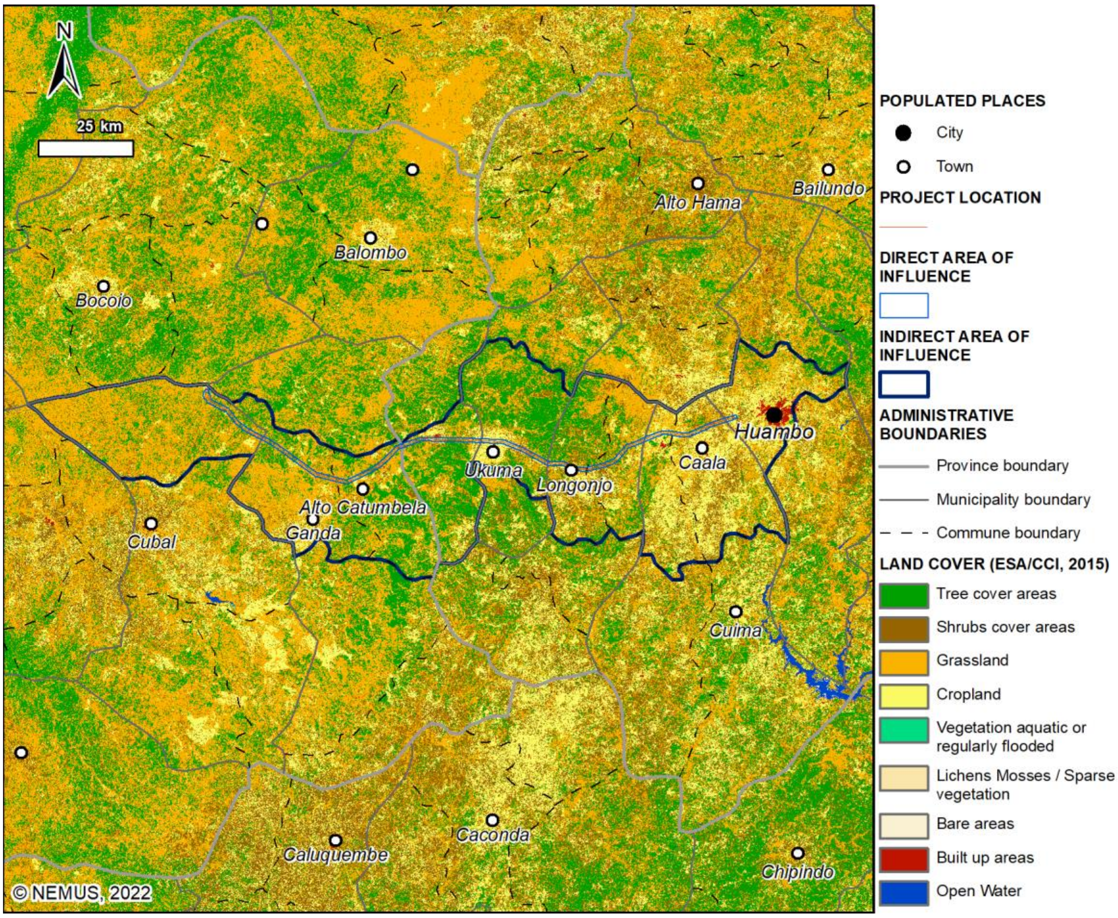


Figure 46 – Land Use in the study area (Source: ESA/CCI, 2015).

The project area is mainly located in a rural and forestry context in the central region of Angola, with proximity of the transmission line to current semi-urban and rural environments. Specifically, the most common land use along the transmission line (DAI) are grasslands (43,8% of the area), cropland (23,85% of the area) and tree and shrubs cover areas (covering 16,5 and 16,1% of the area, respectively), according to Table 32.

The tree cover areas are mainly located in the central region of the study area, namely Ganda, Tchinjenje, Ukuma and (partially) Longonjo municipalities. Grasslands are predominant in the western part of the area (Ganda and Cubai), while in the eastern region (Longonjo, Caála and Huambo), the grasslands and croplands are the main land uses.

The Project does not cross protected areas and most part of the transmission line crosses areas of very low population density.

Table 32 – Land use distribution in the AID and AII.

Land Use	Area	
ESA/CCI, 2015	**Km^2**	**%**
DAI		
Built up areas	0,2	0,2
Cropland	36,9	23,5
Grassland	68,9	43,8
Shrubs cover areas	25,2	16,1
Tree cover areas	25,9	16,5
Total	157,2	100
AIA		
Bare areas	2,6	0,04
Built up areas	60,9	0,9
Cropland	1149,5	17,6
Grassland	2772,4	42,5
Open Water	1,9	0,03
Shrubs cover areas	953,7	14,6
Tree cover areas	1574,5	24,2
Vegetation aquatic or regularly flooded	0,6	0,01
Total	6516,2	100

Considering the overlap between the DAI and the Erosion Hazard Map (ESDAC, 2022), four erosion hazard sections were identified, ranging from High to Very High, with or without subfactors. A summary of factors affecting soil erosion along the proposed transmission line route sections is presented in Table 33 from East to West. These factors include the land use, the topographic slope and the typical soil type in the DAI.

Table 33 – Summary of erosion hazard classification and factors affecting soil erosion along the transmission line route (DAI).

Transmission Line Section	Erosion hazard (subfactor)	Land Use	Slope	Soil type
LH-346 – LH-307 	High (Rainfall erosivity and Cover)	Grassland (35%), Cropland (30%), Shrubs cover areas (29%), Tree cover areas (5%)	Little or no slope gradient to gentle slopes (73% of the area), moderate slopes (25% of the area), steep slopes to extremely steep (1% of the area)	Ferralsols (Surface soil erosion)

Vegetation cover by grassland; most cropland areas are well managed (mulch, contour cultivation)

LH-307 – LH-115 	Very high (Slope and Rainfall erosivity)	Grassland (35%), Cropland (32%), Shrubs cover areas (19%), Tree cover areas (14%)	Little or no slope to gentle slopes (79%), moderate slopes (18%), steep slopes to extremely steep (2%)	Ferralsols (Surface soil erosion)

Vegetation cover by grassland and trees; some areas with sparce vegetation; some cropland areas are well managed (mulch, contour cultivation)

LH115 – LH1 	High	Grassland (60%), Tree cover areas (23%), Cropland (9%), Shrubs cover areas (8%)	Little or no slope to gentle slopes (89%), moderate slopes (10%), steep slopes to extremely steep (1%)	Acrisols (Erosion and capping if bare) Ferralsols (Surface soil erosion)

Vegetation cover by grassland and trees

LH1 – LB22 	Very high	Grassland (56%), Tree cover areas (27%), Shrubs cover areas (9%), Cropland (8%)	Little or no slope to gentle slopes (60%), moderate slopes (32%), steep slopes to extremely steep (8%)	Acrisols (Erosion and capping if bare)

Extensive vegetation cover by grassland and trees; steeper slopes

The erosion hazard in the study area varies from high to very high, with the amount of rainfall, vegetation cover and slope gradient as the main factors contributing to the erosion hazard. The DAI along the transmission line span from flat areas to gentle slopes (< 8% gradient). Grassland and cropland occupy approximately similar areas and dominate land use in the eastern sections. Westwards there is a decreasing trend in areas occupied by croplands and shrubs compensated by the increase of tree cover.

The soil types in the study area are classified as having high erosion potential, with hills and ridges even more prone to erosion (Figure 47). Considering the land use cover and the slope gradient in the different sections, the erosion hazard will mainly depend on land use practices contributing to soil erosion, including inappropriate land management, overgrazing, and deforestation (Jones et al., 2013). The predominant soil types in these sections are Ferralsols, prone to surface soil erosion and Acrisols, highly erodible and prone to capping if left bare, therefore both should be carefully managed to prevent erosion.

Figure 47 – Detail of soil erosion in Ferrasols along an access road (eastern region).

6.9. Quality of the environment

6.9.1. Air quality

6.9.1.1. Introduction

Air pollution is the main environmental risk to threaten human health (WHO, 2016). The present chapter aims to characterise the air quality of the areas affected by the project, on a local and regional scope. This analysis includes a description of the **main atmospheric pollutants**, their respective **sources** and **effects**, the identification of the **sensitive receptors** and a characterisation on the **pollutant levels**.

Since there is no local, regional or national air quality monitoring program, information collected by the **WHO** and **The World Bank** was used as proxy for the characterisation of the air quality in the project area.

Angola does not have specific technical and legal framework for evaluation and analysis of air quality and atmospheric pollution. Therefore, the characterisation of the air quality in this work is done using the Air Quality Guidelines developed by the **World Health Organization** (WHO). These guidelines include recommended limit values for the most common atmospheric pollutants, namely particulate matter (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 the planning of incremental milestones toward cleaner air, particularly for cities, regions and countries that are struggling with high air pollution levels).

Table 34 – WHO Air quality guidelines and interim targets.

Pollutant	Averaging time	IT 1	IT 2	IT 3	IT 4	Guideline
SO_2 (µg/m^3)	24-hour	125	50	-	-	40
	10-minute	-	-	-	-	500
NO_2 (µg/m^3)	Annual	40	30	20	-	10
	24-hour	120	50	-	-	25
PM_{10} (µg/m^3)	Annual	70	50	30	20	15
	24-hour	150	100	75	50	40
$PM_{2.5}$ (µg/m^3)	Annual	35	25	15	10	5
	24-hour	75	50	37,5	25	15
O_3 (µg/m^3)	Peak season	100	70	-	-	60
	8-hour	160	120	-	-	100

Pollutant	Averaging time	IT 1	IT 2	IT 3	IT 4	Guideline
CO (mg/m^3)	24-hour	7	-	-	-	4

Source: (WHO, 2021)

6.9.1.2. Atmospheric pollutants and respective sources

The global assessment of ambient air pollution and its effects, for the year 2014, carried out by the WHO in 2016, reports that the median concentration of $PM_{2.5}$ in rural Angola is circa 27 $\mu g/m^3$, with the concentrations ranging from 8 to 95 $\mu g/m^3$. On urban areas, the $PM_{2.5}$ concentrations can range from 9 to 182 $\mu g/m^3$, with a median value of 42 $\mu g/m^3$ (WHO, 2016). Table 35 summarises these results.

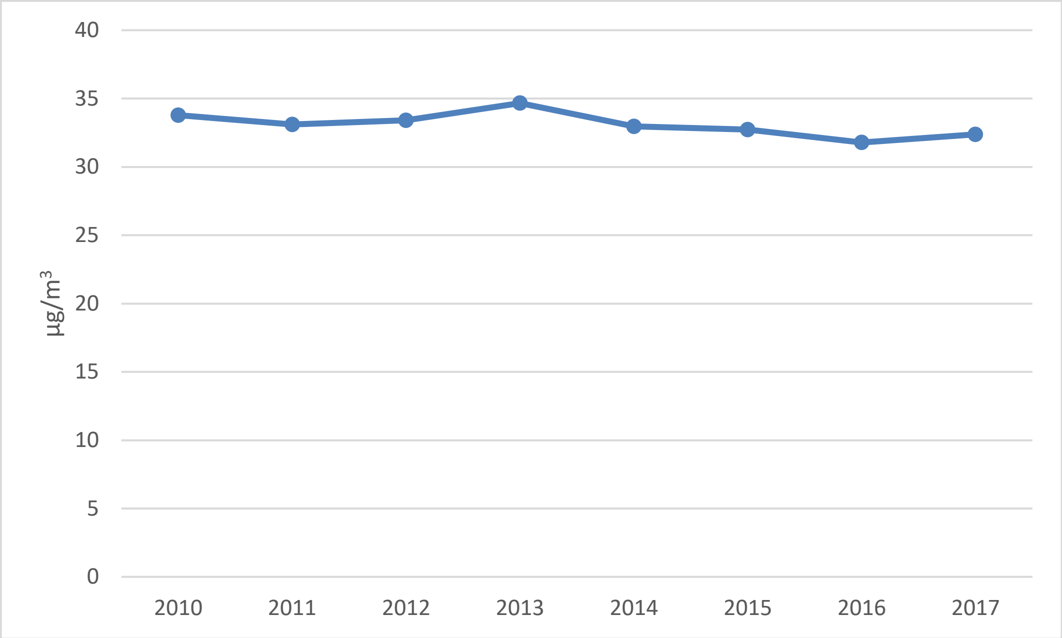
Table 35 – PM2.5 concentrations in rural and urban areas of Angola.

Country	$PM_{2.5}$ ($\mu g/m^3$) rural and urban areas			$PM_{2.5}$ ($\mu g/m^3$) urban areas		
	Median	Minimum	Maximum	Median	Minimum	Maximum
Angola	27	8	95	42	9	182

Source: (WHO, 2016)

The registered concentrations do not comply with the standards set by the WHO Air Quality Guidelines for annual concentration of $PM_{2.5}$ (5 µg/m3). However, the results obtained considering rural and urban areas complies with the first interim target (35 µg/m3).

The most recent data from the World Bank Group, gathered between 2010 and 2017, shows an annual mean concentration of $PM_{2.5}$ in Angola relatively constant, ranging from 31.8 $\mu g/m^3$ (in 2016) to 34.7 $\mu g/m^3$ (in 2013), and averaging 33.1 $\mu g/m^3$, shown in Figure 48. It is important to notice that this is 6.6 times higher than the threshold recommended by the WHO (5 $\mu g/m^3$).



Source: (The World Bank, 2022)

Figure 48 – Annual mean concentration of PM2.5 in Angola.

The WHO indicates that on average, about 8 million people die annually from causes associated with poor air quality (WHO, 2022). Particularly in Angola, 50 out of each 100 000 people die from causes associated to poor ambient (outdoor) air quality. This ranks Angola as the Portuguese-speaking country with the highest mortality rate associated with air pollution (Lusa, 2016).

In the study area the main sources of atmospheric pollution are the burning of fossil fuels, by the engines of vehicles (cars, motorcycles, buses, etc.), the suspension of dust and particles by the circulation of vehicles in non-paved roads and industrial activities. Furthermore, in rural areas with limited access to electricity, biomass burning is a common source of energy and heating. This practice is also a relevant source of atmospheric pollution in the area.

These activities are mainly responsible for the emission of pollutants such as **particulate matter** (PM_{10} and $PM_{2.5}$), **sulphur dioxide** (SO_2), nitrogen oxides (NO_X) and carbon monoxide (CO and dioxide (CO_2) **volatile organic compounds** (VOC). These pollutants, besides from having negative effects on human health and the environment, can also react with other components in the atmosphere, forming secondary pollutants such as **tropospheric O_3**, which can be as harmful (or, in some cases, even more) than the primary pollutants.

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

Table 36 – Characterisation of atmospheric pollutants.

Pollutant	Description, sources and effects
Carbon monoxide (CO)	- 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 ability of the blood to exchange oxygen with vital tissues and can cause death.
Ozone (O_3)	- A bluish gas, which is characterised by its high oxidizing 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 on the environment **Sources:** it appears in the troposphere as a secondary pollutant originating in reactions, enhanced by sunlight, between various precursors of anthropogenic and biogenic origin, 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 themselves as irritation of the eyes, nose and throat, headaches, respiratory problems, chest pain or coughing; on vegetation, ozone can be responsible for loss or damage to individual tree species, as well as to 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)	- Nitrogen oxides include nitrogen dioxide (NO2) and nitrogen monoxide (NO). NO_2 is a toxic gas, easily detectable by odour, 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 into the atmosphere or microbial transformations **Effects**: NO_2 can cause damage to bronchi and lung alveoli and increase reactivity to naturally occurring allergens; NOx can also cause harmful effects on vegetation when present in high concentrations, such as leaf tissue damage and reduced growth; damage to materials due to high concentrations of NOx in the atmosphere (natural and synthetic polymers are most affected)
Sulphur dioxide (SO_2)	- Colourless gas, with an intense sulphur smell when in high concentrations. It is an acidifying gas, very soluble in water, and can give rise to sulfuric acid, H_2SO_4 **Sources:** industrial sector, especially refineries and boilers which burn fuels with high sulphur contents **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); appearance of 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 (VOC)	- Volatile Organic Compounds (VOC), depending on their chemical composition, can be classified into non-aromatic hydrocarbons, oxygenated organic compounds and aromatic organic compounds **Sources:** in the troposphere there is an enormous diversity of VOCs, of natural or 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 gasoline evaporation are mentioned as the main sources of aromatic compounds **Effects:** they are very reactive compounds, being considered ozone precursors and substances known to be carcinogenic, such as benzene

Pollutant	Description, sources and effects
Suspended particles	- Particulate matter is one of the main pollutants with respect to effects on human health. **Sources:** the main sources are related to automobile traffic, burning of fossil fuels and industrial activities, such as the cement industry, steel mills and quarries, chemical reactions in the atmosphere and natural sources **Effects:** the particles, especially the smaller ones, since they are inhalable, penetrate the respiratory system, where they can cause damage; there are also negative consequences for vegetation (inhibition of gas exchange) and on the built heritage (deterioration of materials); at the climate level, this pollutant can intervene in the formation of clouds, fog, precipitation or change the absorption of solar radiation; it can also enhance the effects caused by other pollutants. Smaller particles with an aerodynamic diameter of less than 10 µm (PM_{10}) are usually more harmful because they are deposited at the level of the functional units of the respiratory tract. 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 primary source emissions associated with the project are the exhaust emissions of the construction vehicles (NO_2 and PM), the resuspension of particles and dust by the circulation of vehicles on unpaved roads, the emission of dust and particles from construction activities such as excavation works and land stripping.

The project area covers mainly rural areas, where emission sources are scarce and less likely to cause local air quality degradation. However, urban settlements can be found along the transmission line. Around these areas, air quality may be affected by increased sources of pollution, such as road traffic on unpaved roads or roads with degraded pavement, biomass burning in domestic activities, and open fires, as shown in the figures below.

Figure 49 – Unpaved road in the project corridor.

Figure 50 – Open fire near an urban settlement.

6.9.1.3. Sensitive receptors

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

Considering the linear nature of the project under evaluation, which aims to transport electrical energy from the hydraulic power plant in Lauca to the province of Benguela, the identified sensitive receptors are the residents, workers and users of public spaces in general distributed along the DIA of the project (500 m around the area of intervention).

6.9.2. Noise

6.9.2.1. Introduction

This chapter develops the characterisation of the quality of environmental noise in the study area, which includes the Project intervention area, as well as the sensitive receptors and noise sources in its surroundings, coinciding with the direct area of influence.

Noise pollution is one of the main factors of comfort and well-being of the populations, especially in urban areas. This degradation translates into decreased acoustic comfort and health effects, such as the potential onset of hearing problems (from fatigue to trauma), psychological (stress and irritability), physiological (sleep disturbance) or negative effects on work (impaired ability to concentrate).

The reference sound level of a given site can be defined as the ambient noise existing there before the introduction of a new acoustic disturbance, which may be temporary or permanent. In this case, this disturbance will result from the implementation of a project (through its various phases), to which are associated various uses and activities that may change both temporarily and permanently the noise environment of the site.

To our knowledge, Angola has no norms or legal framework that regulates noise in the national territory. For this purpose, international reference standards are usually used, such as the standards of the World Health Organization (WHO), which include reference values for the daytime period (7:00 a.m. – 10:00 p.m) and night-time period (10:00 p.m. – 07:00 a.m.) for residential and educational areas and also commercial/industrial receptors (WHO, 1999). These WHO standards, also referenced by the IFC in the Environment, Health and Safety Standards (IFC, 2007), are presented below in Table 37.

Table 37 – Reference values for ambient noise.

Receptor	Day-time (7h00 – 22h00)	Night-time (22h00 – 7h00)
Residential, institutional, educational	55	45
Comercial, industrial	70	70

Source: (IFC, 2007)

Noise levels must not exceed the values shown in the table above or result in impacts on nearby receptors that cause a differential of 3 dB(A) or greater from background noise levels.

6.9.2.2. Noise sources

The majority of the planned route for the electricity distribution lines follow a pathway in relatively close proximity with 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 that connect the villages can be seen in Map Geo1, Volume II.

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

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

6.9.2.3. Noise monitoring

Noise monitoring points were selected along the corridor set for the transmission lines, where the access was possible at the time. The selected points cover several land uses in order to assess different noise backgrounds, such as a substation, open areas and near sensitive receptors such as houses and an elementary school. The results of the monitoring are shown in Figure 47.

Figure 47 shows the location of the monitoring stations along the corridor, while Figures Figure 52 to Figure 57 show the exact location of each monitoring point.

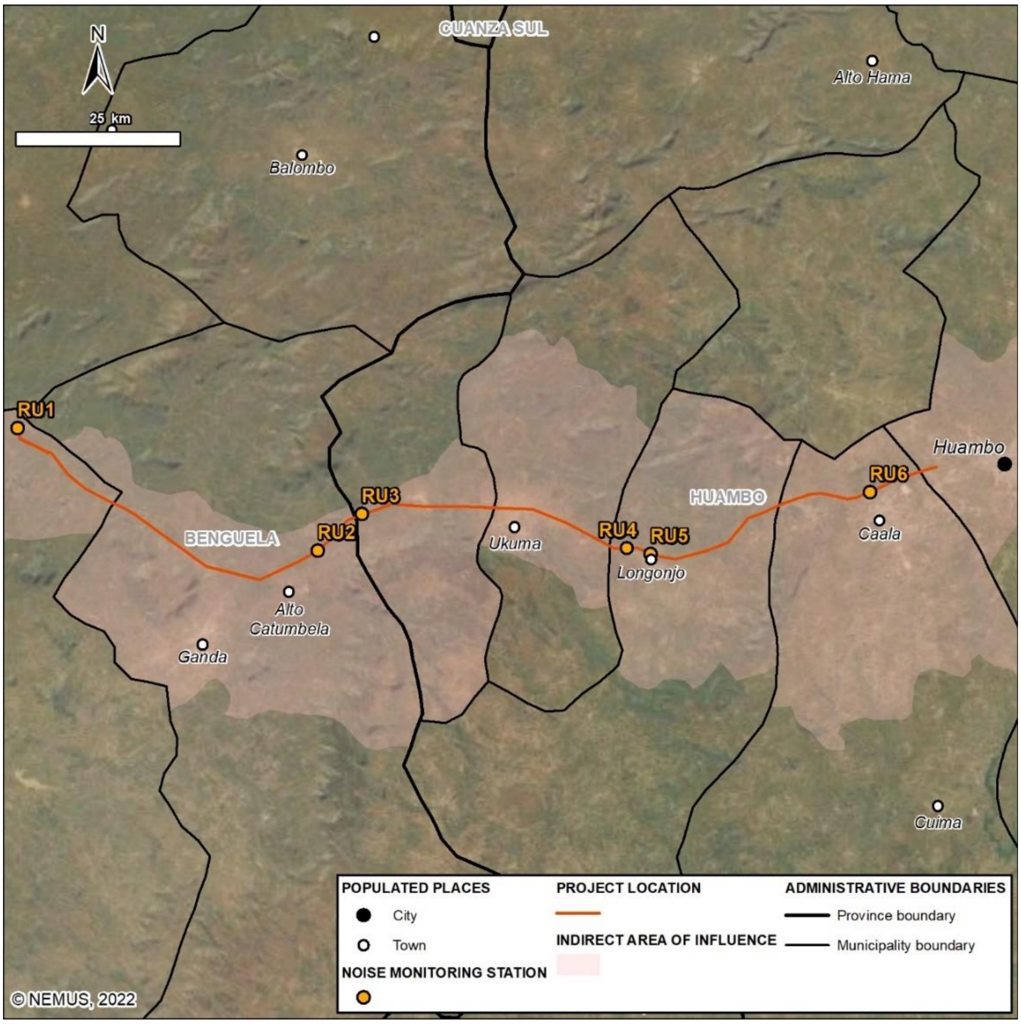


Figure 51 – Noise monitoring stations.

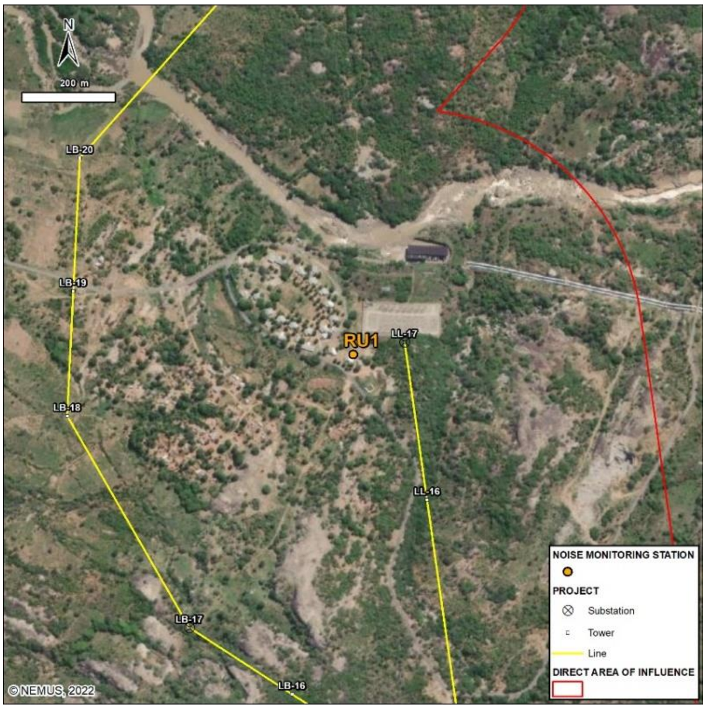


Figure 52 – Noise monitoring station 1.

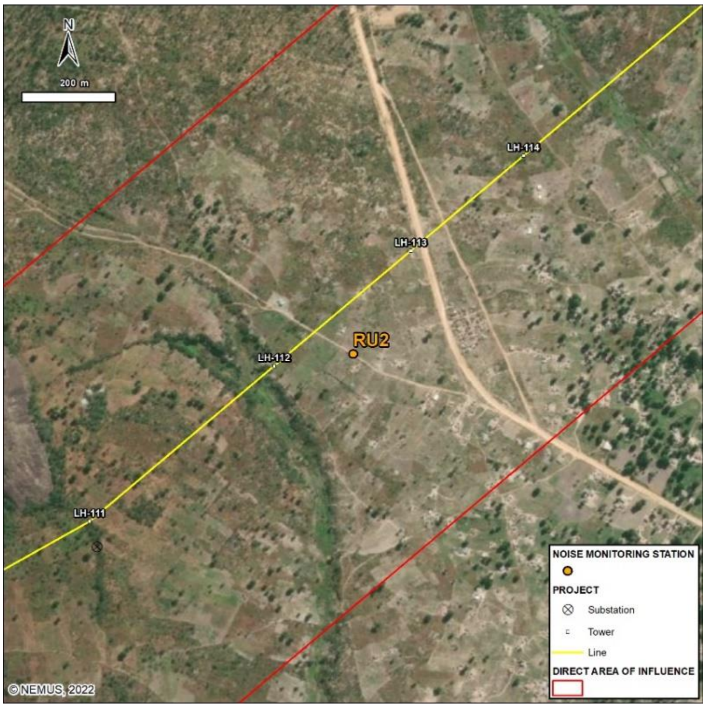


Figure 53 – Noise monitoring station 2.

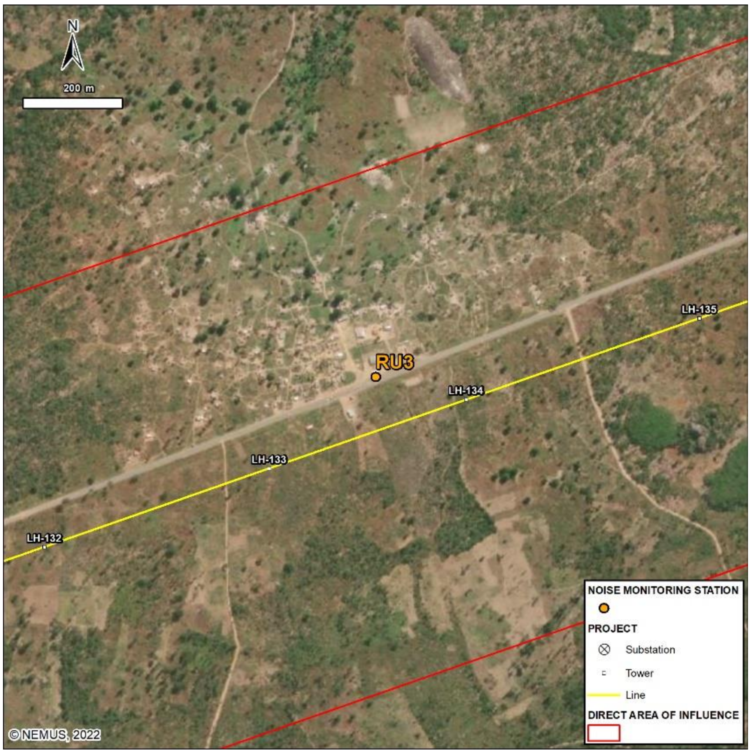


Figure 54 – Noise monitoring station 3.

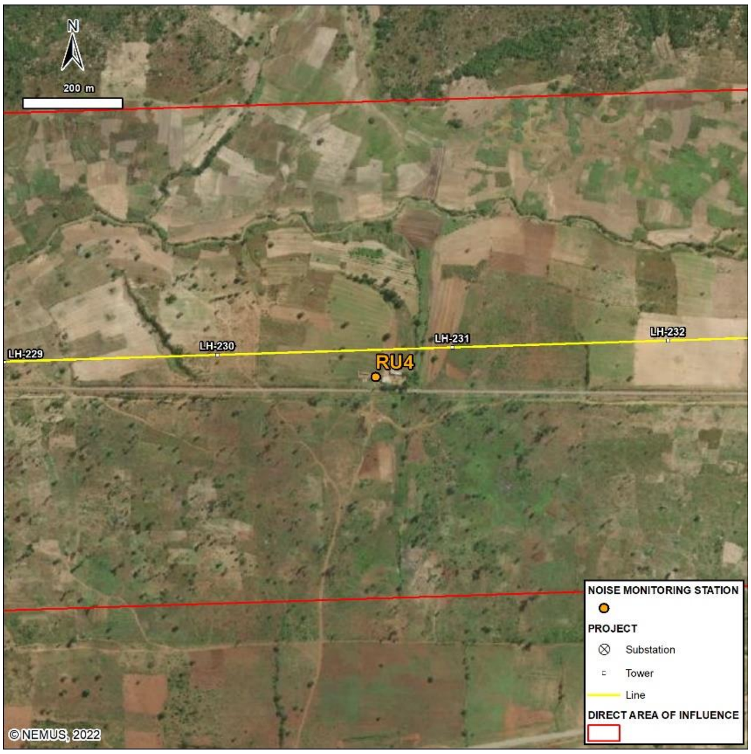


Figure 55 – Noise monitoring station 4.

Figure 56 – Noise monitoring station 5.

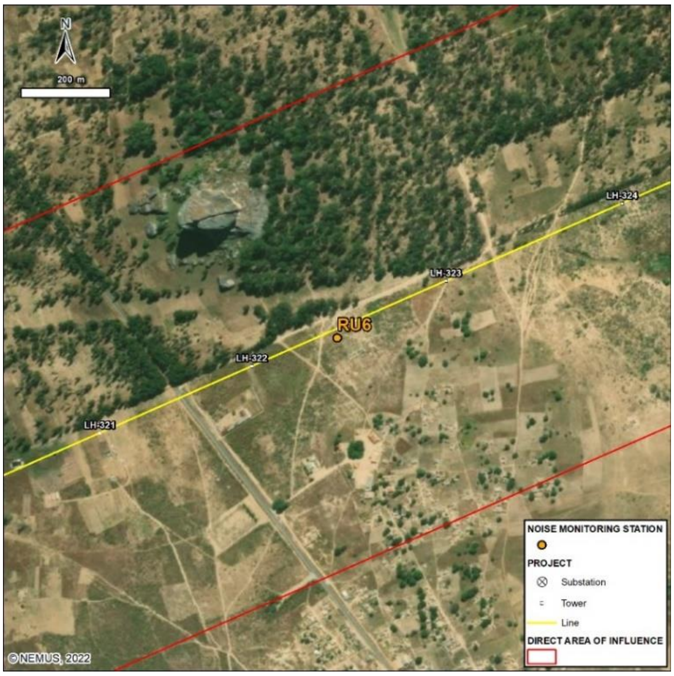


Figure 57 – Noise monitoring station 6.

The monitoring was carried out through a Convergence Instruments NSRT MK3 sonometer, set to measure dB(A) with a bandwith of 24 kHz and a log interval of 1 minute. Each measurement had a duration of 30 minutes. The equipment was placed approximately 1.5 m above ground and at least 3.5 m away from reflecting surfaces, as illustrated in Figure 58.

Figure 58 – Noise monitoring station 1, near the Lomaum SS.

Table 38 – Noise monitoring results.

Point	Location	Date	Time	Noise levels dB(A)			Noise sources
				L_{eq}	L_{max}	L_{min}	
RU1	Quendo, near the Lomaum SS	23/06/2022	13:35	42.3	53.5	38.3	Background noise of a waterfall; people talking; motorcycle passing on the road
RU2	Babaera, close to a house	25/06/2022	14:17	46.1	**62.5**	33.4	Background noise of foliage; people talking; motorcycles passing on the road
RU3	Tchijenje, close to an elementary school	25/06/2022	15:16	**61.7**	**78.7**	37.7	Cars; motorcycles; children playing; roosters; trucks
RU4	Longonjo, near a farm	26/06/2022	12:46	50.2	**74.3**	34.4	Children playing; people talking; a train passes by 3 times a week (did not pass, during the monitoring)
RU5	Longonjo, next to a house	26/06/2022	13:35	**56.0**	**77.9**	34.9	Motorcycles; people talking; music playing
RU6	Caala, near roadside	26/06/2022	16:15	**65.6**	**84.1**	39.9	Wind on foliage; people talking; music playing; animals, motorcycle

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

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The noise environment in the monitoring stations is influenced by the day-to-day activities that occur in the settlements nearby. The most common noise sources were cars and motorcycles passing by, people talking, domestic animals and background noise from natural sources (waterfall, wind on foliage).

Averaged measured day-time L_{eq} ranged from 42.3 dB(A) on RU1 to 65.6 dB(A), on RU6. Three of the selected locations are noisy locations, with the average L_{eq} surpassing the IFC guidelines for residential areas during day-time (55 dB(A)). However, it is interesting to note that in the measurement station near a substation (RU1) the noise levels were considerably below the recommended limit.

Noise monitoring was carried out exclusively during day-time since no significant noise emissions associated to the project are expected during the night.

6.9.2.4. Sensitive receptors

Similarly to air pollution, the sensitive receptors to noise are defined as certain land occupations that can be affected by noise originating from activities in the area under analysis. Again, the main concern, is the presence of sensitive human occupation, that is, places where people live or stay, taking into special account 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, sensitive receptors identified are the residents, workers and users of public spaces, in general distributed throughout the area of direct influence of the project.

These receptors are concentrated in the main urban centres where the project will focus, such as Huambo, Babaera, Tchinjenje, Ukuma and Longonjo. In addition to these larger nuclei, all localities and settlements along the study area in more rural areas, also likely to be affected by the project activities, are identified.

6.10. Ecology

6.10.1. Introduction

This Chapter presents a detailed characterisation of the ecological component of the ESIA, particularly focusing on the habitats and the communities of flora and fauna that compose the study area. These biodiversity values were evaluated for their ecological functions, their conservation status and their ecological value.

The sum of this characterisation process will allow to identify critical aspects, such as biodiversity values that are sensible or susceptible to the impacts generated by the development of the project in its different stages.

The **study area** defined for the analysis of the ecological component, corresponds to the Direct Area of Influence (DAI), the 161 km transmission line of 220 kV between Lomaum and Huambo and its substations, associated to a 500 metres buffer. This area will receive the direct impacts of the project.

Considering the biological and ecological traits of the study area, the following components will be characterised for being potentially susceptible to the impacts generated by the development of the project: **Habitats; Vegetation and flora; Fauna (Birds, Mammals, Amphibians, Reptiles and Invertebrates)**.

Overall, the methodology applied for the ecological characterisation of the study area was based on: (i) two fieldwork visits, conducted in June 2022 (dry season) and April 2023 (wet season); (ii) analysis with Geographic Information Systems (GIS); and (iii) consultation of specialized bibliography.

The biodiversity fieldwork consisted in the visit and sampling of a total of 22 points, as presented in the Map of Habitats (ECO 1) in ESIA Vol. II, 20 points in each season. A combination of direct observations, walkovers, and aerial photography and videos (through drone surveys) was applied to obtain fine-scale data, thus complementing the information collected during the desktop study, following best-practices for biodiversity surveys, as specified in the Equator Principles and IFC PS-6.

The selection and application of each of these methodologies was conditioned by the presence of landmines within the study area. Hence, whenever clear and safe tracks to each sampling point were identified, a direct in-person observation of the floral and faunal communities present was performed.

These observations were combined with drone flights to obtain an overview of the habitat and vegetation structure (including tree height and occupation of tree, shrub and herbaceous layers, as well as dominant tree species and potential presence of endangered species), thus complementing the GIS habitat mapping during the desktop study.

If no clear accesses to the ecology points were identified (which was the case for 7 of the 22 points visited in two seasons), the field sampling consisted exclusively of drone surveys, with posterior characterization and identification of the floral communities.

Overall, the observed fauna was low, and its observation was further limited by access limitations to the habitats as previously mentioned. This gap was addressed by performing walkovers in the tracks leading to each sampling point, whenever these were present and its access was deemed safe, in order to maximize the likelihood of observing faunal communities.

During the literature review and considering the typology of the projects, birds were identified has the faunal group potentially most susceptible to be impacted by the project. This was also the most observed faunal group in fieldwork visits, particularly abundant in wetland systems, in both wet and dry seasons. Bird *taxa* identification (up to the species level) was possible through the use of binoculars and resorting to guides of local fauna prepared during the desktop study.

6.10.2. Legally Protected and Internationally Recognized Areas

Angola has 12,98% of its terrestrial national territory classified with protected areas, nonetheless, the study area crosses none of these classified areas. The closest, Buffalo Partial Reserve in the province of Benguela, occurs more than 60 km to the west of the study area.

6.10.3. Ecoregions and habitats

6.10.3.1. Introduction

The provinces of Benguela and Huambo, where the project is located, include escarpments, highlands and plateaus, and span three (3) ecoregions according to Burgess *et al.* (2004)'s classification: 81, Angolan Scarp Savanna and Woodland; 82, Angolan Montane Forest-Grassland Mosaic; and 49, Angolan Miombo Woodland.

These ecoregions, defined on a global scale, directly reflect on the habitats that are found along the study area and that, on its hand, reflect a more local scale.

The following section presents the characterisation of the natural and modified habitats present in the study area, that may be impacted by the implementation of the project.

6.10.3.2. Habitats present in the study area

Overall, the habitats present in study area are characterised by high degrees of anthropogenic perturbation, which reflects on is conservation status, ecological values and on their ability to support faunal communities. The natural habitats observed are marked by anthropogenic pressures, particularly in those where human populations can easily access.

The following habitats were inventoried in the study area:

- Miombo woodland
- Wetlands
- Wooded grasslands and agricultural areas
- Areas of *Eucalyptus* sp.
- Artificial areas

A detailed map of habitats of the study area is presented in Eco1, ESIA Volume II.

Miombo woodland

The habitat of miombo woodland is the main natural habitat found across the study area. In the study area it occupies 4,833 hectares, corresponding to 30.8%.

This habitat is characterised by a dominant stratum of large trees, dominated by *Brachystegia* spp. and *Julbernardia paniculata*, and a grass layer up to 2 meters tall (Figure 59).

Figure 59 – Habitat of miombo woodland present in the study area.

In terms of conservation status, the Angolan Miombo Woodland is considered to be relatively intact for the country (Burgess et al., 2004), nevertheless, in the study area this habitat is severely fragmented as a result of anthropogenic disturbance, many times being reduced to small patches of vegetation.

This fragmentation is particularly visible closer to the major municipalities of Huambo, where the habitat was replaced by seminatural or artificial land uses. But the degradation of this habitat is also marked in rural communities where these woodlands, are replaced by agricultural areas or are used for charcoal manufacture.

Regarding flora, miombo woodlands are known for its high flora richness, despite a low diversity of canopy tree species. Considering the current status of miombo woodlands in the study area, faunal communities that are dependent on this type of habitat may be constricted in terms of space. Faunal richness is classified has moderate, with a low number of large mammals, but a high number of birds, reptiles and amphibians.

Wetlands

In the study area wetlands occupy 847 hectares (5.4%) of the study area. Except for large rivers with high ecological flows (Cuíva, Catumbela, Chicanda and Cunene), most wetlands lose most of their water during the dry season (Figure 60).

Wetlands composed of wet grasslands are considered to be a particularly sensitive type of habitat for its biological characteristics, resources and ecosystem services (EPA, 2022). These are considered hotspots of biodiversity, particularly for migratory bird species that seek refuge, locations for breeding, nesting and feeding. Therefore, wetlands normally reunite a considerable biodiversity, particularly avifauna.

Agriculture in wetlands and the constant human presence at the study area has conducted to some degradation, introduction of exotic species such as *Arundo donax*, and plantations with bananas and other crops (e.g., Massango, *Pennisetum glaucum*).

Figure 60 – Wetlands present along the study area.

Wooded grasslands and agricultural areas

Wooded grasslands and agricultural areas occupy 7,334 hectares (46.8%) of the study area. The wooded grasslands present in the study area are mostly modified habitats, which have suffered continuous anthropogenic pressures over the last decades. As a natural habitat, grasslands are currently reduced to small and fragmented patches (Figure 61).

Where grasslands are still found, or where they are able to regenerate, the habitat is mostly composed by a natural grass layer that can reach 2 meters, and is constituted by *Monocymbium ceresiiforme* and species of genera *Loudetia*, *Hyparrhenia*, *Tristachya*. Some dispersed individuals of miombo species can also be found in this habitat.

Overall, the agricultural areas present in the study area are modified habitats, which present low ecological value.

Figure 61 - Wooded grasslands modified by anthropogenic pressures.

Areas of *Eucalyptus* spp.

The area of implementation of the project presents areas of *Eucalyptus* spp., which occur in 2,229 hectares (14.2%) of the study area. These areas occur in sympatry with miombo woodlands, agricultural areas or modified grasslands (Figure 62).

The miombo woodlands present in these areas have a low tree cover presenting signs of being underdeveloped. This can be caused by more intense human perturbations (e.g., deforestation, trampling, fires, etc.) and / or by ecological constrains derived from the presence of the eucalyptus.

Figure 62 – Forests of *Eucalyptus* spp. present in the study area.

<u>Artificial areas</u>

The artificial areas inventoried across the study area, during fieldwork, occupy 449 hectares, corresponding to 2.9% of the DAI. Besides the active substations, urban settlements and roads are the main artificial areas found, although industrial clusters are also present (Figure 59).

Figure 63 – Artificial areas found at the study area.

As an anthropogenic habitat, ornamental plants and fruit trees are the dominant vegetation, but some native species typical of the miombo are also found. Regarding fauna, the species that occur in urban settlements and other artificial areas are the ones that thrive in this type of habitats or can tolerate human presence, such as the pied crow (*Corvus allbus*). Two endemic reptiles, *Trachylepis bocagii* (Bocage's Skink) and *Agama (planiceps) schacki* (Schack's Rock Agama) were confirmed in the area.

6.10.4. Vegetation and flora

This section presents the phytogeographic framework of Angola and of the study area, and the characterisation of the reference situation of aspects related to the vegetation and flora of this area.

The study area is completely inserted in the Zambezian Regional Centre, which occupies 80% of Angola. While the vegetation is most typically miombo woodland (47% of Angola), its structure varies from tall dry forests to open, treeless edaphic grasslands (Huntley & Matos, 1994).

Most of the study area is composed of typical miombo woodland dominated by *Julbernardia paniculata*, *Brachystegia spiciformis*, *B. boehmii*, *Isoberlina angolensis* and *Albizia antenusiana*.

Angola has a high floristic richness, counting with around 6850 native species and 230 naturalized species. Among the most diverse are Legumes (934 spp.), grasses (526 spp.), Compositae (463 spp.) and Rubiaceae (444 spp.).

A total of 49 species of flora and plus 3 taxa only identified to the genera are listed for the study area (Annex I, below). This includes species confirmed in the study area, the dominant species of each habitat, threatened or vulnerable species (included in the National Red List and in the IUCN database), endemic species, commercial species.

A total of 26 species were confirmed on field, including three vulnerable species - *Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (Mupanda), *Pterocarpus angolensis* (tacula) and 3 alien species *Arundo donax*, *Tithonia diversifolia* and *Eucalyptus* spp.

Some of the commercial species identified in the study area were: *Julbernardia paniculate* (olumue), *Brachystegia boehmii* (ussamba) and *Isoberlina angolensis* (mone).

6.10.5. Fauna

During fieldwork low numbers of fauna were observed. The list of fauna species that occur in the study area is presented below in Annex II. This list focuses on species that: i) were confirmed during fieldwork, ii) are characteristic of the habitats found in the study area, iii) are endemic, and iv) are threatened with extinction.

6.10.5.1. Birds

Bird diversity is significantly higher in Angola compared with the remaining countries of Austral Africa. Overall, at least 940 species have been identified, of which 29 are endemic, and several others are rare or poorly known (Dean et al., 2019).

Six species were confirmed in the study area during field reconnaissance, the pied crow (*Corvus albus*), the Angola swallow (*Hirundo angolensis*), the white-rumped swift (*Apus caffer*), *Nectarinia bocagii* (Bocage's Sunbird), *Falco disckinsoni* (Dickinson's Kestrel), and *Vidua chalybeate* (Village Indigobird) (Figure 64).

It was observed that most species of birds are associated with wetlands of big dimension, which retain some water during the dry season. More species were observed in this type of habitat than in all remaining ecosystems.

According to the Angola Red List and the IUCN database (Ministério do Ambiente, 2018; IUCN, 2022), 26 species, that occur in the provinces and habitats affected by the project, are of particular concern for being classified with a poor conservation status (Specialised study, ESIA Volume II).

Corvus albus (pied crow)

Hirundo angolensis (Angola swallow)

Figure 64 – Bird species identified at the study area during fieldwork.

6.10.5.2. Mammals

Angola presents high values of mammal richness, with 275 registered species. However, around 49 of these species have a concerning conservation status in the country. Angola has 73 species of bats, but none is considered to be threatened with extinction (Huntley, 2019). According to IUCN (2022), the provinces of Benguela and Huambo are the habitat for several endemic micro-mammals.

No mammals were observed in the study area during fieldwork. The list of species potentially occurring in the study area was restricted to the ones classified in poor conservation status and endemic species. A total of 8 species identified for the study area are classified in poor conservation status (Specialised study, ESIA Volume II).

6.10.5.3. Amphibians

The study area presents several types of habitats which can be used by amphibians to reproduce (wetlands), to feed or to take refuge (wetlands, grasslands, woodlands or even close to human populations).

According to both the Angolan Red List of Species and the IUCN database, there are no amphibians currently evaluated as being threatened with extinction in Angola. Nevertheless, at least 23 species are classified as Data Deficient (DD), due to the lack of information on their populations, distribution and conservation status (IUCN, 2022). Also, from the 21 endemic species accounted for in IUCN database, only 3 are evaluated.

Considering the available bibliography, 17 species may occur in the study area or in adjacent areas. From these, none presents a poor conservation status, but 3 are endemic of Angola (Specialised study, ESIA Volume II).

6.10.5.4. Reptiles

In the study area, reptiles are likely to be occupy all types of habitats, especially in more naturalized habitats such as the miombo woodlands and wetlands, but some rupicolous species are also common near human populations.

In total, 46 species of reptiles are described for the study area or adjacent regions within the provinces of Benguela and Huambo (Marques et al., 2018). From these, 2 are endemic (Specialized study, ESIA Volume II). From the reptiles described for the study region, four species are particularly relevant to highlight as they have a poor conservation status: two are included in the Angolan Red List of Species and one in the IUCN database.

During fieldwork four different species were confirmed in the study area (Figure 65), three by direct observation - *Psammophis mossambicus* (Olive Grass Snake), *Agama schacki* (Schack's Rock Agama) and *Trachylepsis sulcata* (Western Rock Skink) – and one by local communities - *Crocodylus niloticus* (Nile Crocodile).

Agama schacki (Schack's Rock Agama) *Trachylepsis sulcata* (Western Rock Skink)

Figure 65 – Reptile species observed in the study area.

6.10.5.5. Invertebrates

The Angolan Red List classifies two endemic species of dragonflies and damselflies - *Umma femina* (Angola Sparklewing) and *Platycypha crocea* (Angola Jewel) – as Vulnerable. The IUCN also gives a global classification of Vulnerable (VU) to *U. femina*.

Besides dragonflies, a special remark should be made about the group of termites, which occur along all the study area. Extensive areas of *Macrotermes* spp. mounds were observed during fieldwork (Figure 66). One species, *Macrotermes subhyalinus*, is included in the Angolan Red List of Species as Vulnerable.

There is also another species with the conservation status of Vulnerable that occurs in the study area, more particularly in the area of Huambo, the endemic *Phymeurus chianga* (Huambo Agile Grasshopper).

Overall, there are other 9 species of terrestrial invertebrates endemic of Angola that occur in the study area (Specialized study, ESIA Volume II) (IUCN, 2022).

Figure 66 – Mounds of *Macrotermes* spp. observed in the study area.

6.10.6. 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.

The identification of ecosystem services within the Project's area started with a preliminary literature review (Table 1), which was then validated with:

- Ecological surveys conducted in both dry and wet seasons (June 2022 and April 2023, respectively), focusing on the exiting tree communities, their abundance and their services to the nearby populations;

- Community surveys and interviews conducted in June and July 2022, during the dry season field site visit.

For the natural habitats occurring within the Project's area, a total of five provisioning ecosystem services and one regulating service were identified:

- 5 ecosystem services in the miombo woodlands – charcoal production, provision of craft materials, non-wood forest products, carbon sequestration and habitat for biodiversity;
- 3 ecosystem services in wetlands – carbon sequestration, water source, and habitat for biodiversity).

Table 39 – Main ecosystem services identified for the study area which are prone to be impacted by the project's activities.

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.

Contacts with local administrations and community surveys were conducted in the municipalities of the Project's Direct Area of Influence between 24th June and 7th 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.

ES identified	ES Category	Habitats	References
Charcoal production	Provisioning	Miombo	(Miapia et al. 2021; Chiteculo et al. 2018a; Chiteculo et al. 2018b)
Provision of building and craft materials (e.g., timber)	Provisioning	Miombo	(Campbell, 2007; Ryan, et al., 2016; Dewees, 2011)
Access to non-wood forest products (NWFP, e.g., fruit trees and medicinal plants)	Provisioning	Miombo	(Ryan, et al., 2016; Chirwa, Syampungani, & Geldenhuys, 2008; Dewees, 2011; Campbell, 2007)
Carbon sequestration	Regulating	Wetlands and miombo	(Jew, Dougill, Sallu, O'Connel, & Benton, 2016; Sileshi, et al., 2007; Jogo & Hassan, 2010; Gardner & Finlayson, 2018)
Water supply for irrigation and clothes' washing (section 6.7.4)	Provisioning	Wetlands	(Gardner & Finlayson, 2018; Schuyt, 2005; Jogo & Hassan, 2010)
Habitat for biodiversity	Provisioning	Wetlands and miombo	(Gardner & Finlayson, 2018; Jew, Dougill, Sallu, O'Connel, & Benton, 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 220kv Lomaum-Huambo Transmission Line and associated Substations project.

Table 40 – Summary of the contacts made with communities and administrations of the municipalities within the Project's area of influence.

Town	Comune	Municipality	Project	Date of contact	Type(s) of contact
All of Comunes	Longonjo	Longonjo	Stage 2	24.06.2022	Administration **Discussion group in the community**
Caála	Kalenga	Caála	Stage 2	24.06.2022	Administration
Huambo	Huambo	Huambo	Stage 2	24.06.2022	Administration
Alto Catumbela	Babaera	Ganda	Stage 2	25.06.2022	Administration **Discussion group in the community**
Chinjenje sede	Chinjenje	Tchijenje	Stage 2	27.06.2022	Administration
Ukuma	Ukuma	Ukuma	Stage 2	27.06.2022	**Discussion group in the community**
Bairro da sede	Babaera	Ganda	Stage 2	28.06.2022	Administration **Discussion group in the community**
Luanda	Luanda	Luanda	Stage 2	29.06.2022	Administration
Bairro Jango	Kalenga	Caála	Stage 2	29.06.2022	**Discussion group in the community**

Alto de Catumbela

Ukuma

Babaera (*Bairro Sede*)

Kalenga (*Bairro Jango*)

Figure 67 – Focus group discussions.

The Project area is dominated by agricultural areas, which represented modified habitats, as presented in the map of habitats in ECO1, in ESIA Vol. II. In the community surveys conducted in June and July 2022, a common concern expressed, regarding resources in natural habitats, was the availability of trees (including *Brachystegia* sp. and *Albizia* sp.) for charcoal production.

Charcoal production was previously identified as an important economic activity for the Huambo region (Table 1), only surpassed by agriculture and livestock. The observed fragmentation and lack of trees for charcoal production was pointed out in each of the five community surveys held in the municipalities.

It should also be noted that the exploration of native tree species for charcoal production is also one of the identified causes for deforestation in the miombo woodlands. Mitigation measures, including an inventory of native trees species inside the 20 metres OHTL footprint corridor (estimated at around 8 ha) are also presented in the ESIA.

6.10.7. Critical Habitat Assessment

Based mainly on literature review and available information on Angolan ecosystems and present species (or of likely occurrence), complemented by the gathered field data (habitat identification and validation, main floral communities and vegetation structure, and observed avifauna) on both dry and rainy seasons (in June 2022 and April 2023, respectively), a Critical Habitat Assessment (CHA) was conducted, based on the previously mentioned criteria, supported by the IFC Performance Standard 6 (IFC, 2012), particularly the Guidance Notes GN53 to GN83.

The CHA was aimed mainly at natural habitats, as these are the ones presenting higher conservation value, in relation to modified habitats.

Table 41 – Natural and modified habitats in the study area (IFC-PS6 criteria).

Habitat units	IFC-PS6 habitat	Natural habitat
Miombo woodland	Natural	This is a natural habitat impacted by anthropogenic pressures (e.g. logging for wood and agriculture).
Wetlands	Natural	Wetlands are natural habitats that can be impacted by human activities (e.g. agriculture), especially in wet grasslands or other low flow streams that lose almost all water in the dry season.
Areas of *Eucalyptus* spp.	Modified	These are classified as modified habitats because they are not native from the study area, having replaced or occupied areas of native vegetation.
Agricultural areas	Modified	Agricultural areas are modified habitats composed by crops, that replaced the natural native vegetation of grasslands or miombo woodlands.
Artificial areas	Modified	These constitute urban settlements, roads and other artificial infrastructures that result from human expansion. No natural vegetation is found in this habitat.

According to IFC-PS6, the identification of critical habitats is performed considering the following five criteria:

- Criterion 1 – Presence of Critically Endangered or Endangered Species;

- Criterion 2 – Presence of Restricted Range Species;
- Criterion 3 – Presence of Migratory or Congregatory Species;
- Criterion 4 – Presence of Highly Threatened or Unique Ecosystems;
- Criterion 5 – Key Evolutionary Processes.

The Critical Habitat Assessment conducted is detailed in ESIA Volume II. A summary of this analysis, including the critical habitats identified (wetlands) and the criteria triggering this classification, are presented in the table below.

Table 42 – Summary of the CHA conducted in the identified habitats within EAAA.

Habitat units	IFC-PS6 habitat	Area (in hectares)	Critical Habitat	CHA Criteria
Miombo woodland	Natural	4,833 (30.8%)	No	-
Wetlands	Natural	847 (5.4%)	Yes	1 and 5
Areas of *Eucalyptus* spp.	Modified	2,229 (14.2%)	No	-
Agricultural areas	Modified	7,334 (46.8%)	No	-
Artificial areas	Modified	449 (2.9%)	No	-

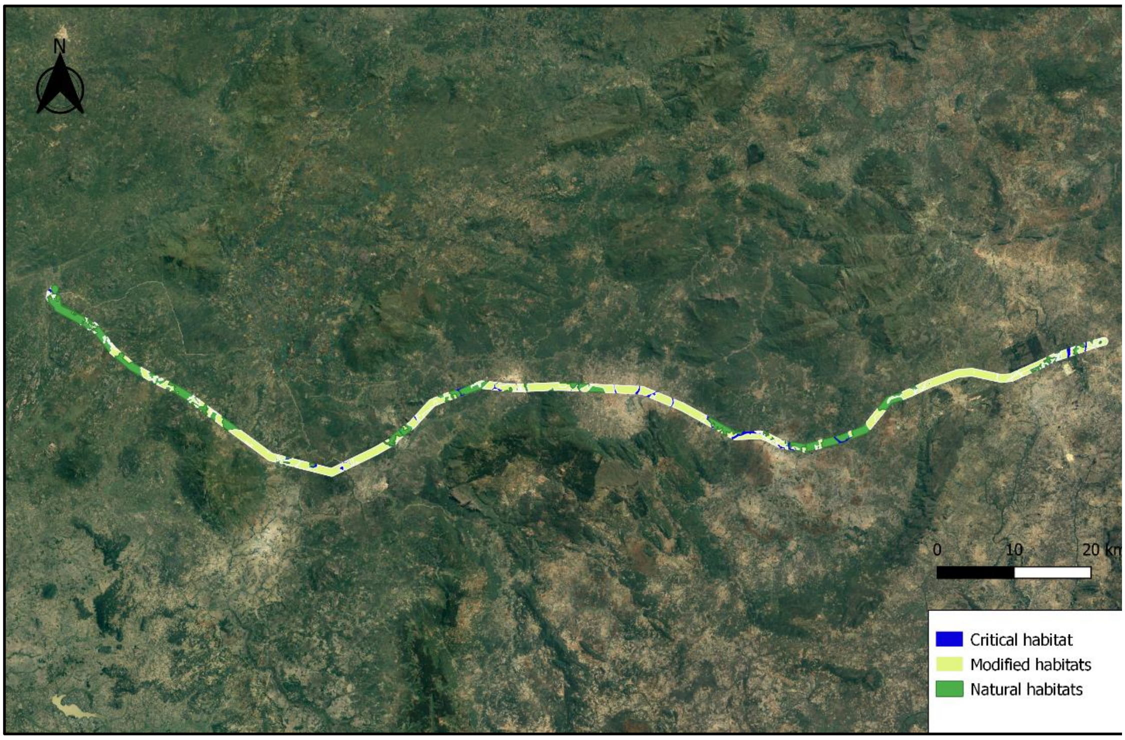


Figure 68 – Map representation of natural, modified and critical habitats, following the Critical Habitat Assessment in IFC-PS6 guidelines (IFC, 2012).

6.11. Socioeconomics and human rights

6.11.1. Introduction

This section presents the socioeconomic characterisation of the intervention area, based on the analysis of statistical, bibliographic information, and also of primary data collected. The Direct Area of Influence (see Section 3.1) is located in the municipalities of Cubal and Ganda (Province of Benguela) and Caála, Huambo, Longonjo, Tchinjenje and Ukuma (Province of Huambo).

The socio-economic characterization here presented is a summarized version of the one presented in the specialised study (volume II of the ESIA), where the analysis is disaggregated by vulnerable groups.

6.11.2. Methodology

6.11.2.1. Methodology – overall

The study of socioeconomics was accomplished through the following steps:

- **Review of relevant data sources**, such as population and housing census and employment and health surveys, project reports, Government annual reports and databases, and aerial images, among others;
- **Site visit** to determine an approach for baseline assessment, including mapping of social infrastructure, contacts with relevant stakeholders (including local institutions and local authorities) and collection of data
- **Baseline study**, comprising the characterisation of these subjects for the project site and surrounding area; this was supported by a set of key indicators to be calculated through diverse information sources (documentary, statistic and qualitative);
- **Impact assessment** evaluates how the Project's activities will affect socioeconomics and local community health and safety in all phases.
- If significant negative impacts are identified, propose possible **mitigation measures and monitoring actions.**

6.11.2.2. Specific methodology & content of human rights assessment

According to Principle 2 of the Equator Principles (Environmental and Social Assessment), it is expected that an ESIA includes an assessment of potential adverse human rights impacts, referring to the *United Nations Guiding Principles on Business and Human Rights*. Therefore, the ESIA incorporates a Human Rights Impact Assessment (HRIA).

Human rights impact assessment (HRIA) analyses 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 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, specifically:

1. Planning and scoping – to define the parameters for the HRIA through gathering preliminary information on the area of impact of the business project or activities.

2. Data collection and baseline development – includes field research on human rights enjoyment of workers, community members and other relevant rights-holders. The data collection phase emphasises fieldwork, interviews, and different types of stakeholder engagement – see section 0;

3. Analysing impacts – analysing the collected data 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, stakeholder engagement findings, etc.;

4. Impact mitigation and management – the ESIA team, with stakeholders' contribution, will create a plan for preventing and addressing human rights impacts. All human rights impacts will be addressed, with the most severe impacts taking priority;

5. Reporting and evaluation – this detailed ESIA report is to be available and accessible to all stakeholders to foster dialogue and accountability by documenting the impacts (including human rights impacts) identified 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.

6.11.3. Administrative structure

The Lomaum-Huambo transmission line route passes through the municipalities of Cubal (commune of Quendo) and Ganda (communes of Babaera and Ganda) in the Province of Benguela; and through the municipalities of Tchinjenje (commune of Chinjenje), Ukuma (commune of Ukuma), Longonjo (communes of Longonjo and Lepi), Caála (communes of Kalenga and Kaala), and Huambo (commune of Huambo), in the Province of Huambo (see Table 14 and Figure 11 in Chapter 0).

There are 332 settlements in the DAI as detected by CIESIN (2021). Of these only ten comprised more than 100 inhabitants inside/ adjacent to the DAI (two in Cubal; two in Ganda; one in Caála and other in Huambo; two in Longonjo and two in Tchinjenje). Of these ten settlements with more than 100 inhabitants inside/ adjacent to the DAI, only one is a built-up area[3] (in the commune of Longonjo, municipality of Longonjo). The remaining nine settlements are defined as small settlement areas[4]. Furthermore, all of these medium-sized settlements in the project's DAI are not located in the Project's Right of Way (RoW). See Map SE1 for a detailed representation of the population residing in the vicinity of the Project.

[3] A built-up area is generally, an area of urbanization with moderately-to-densely-spaced buildings and a visible grid of streets and blocks. Built up areas are characterized as polygons containing 13 or more buildings across an area greater than or equal to 400,000 square meters (CIESIN, 2021).

[4] A small settlement is a settled area of permanently inhabited structures and compounds of roughly a few hundred to a few thousand inhabitants. The housing pattern in small settlement areas is an assemblage of family compounds adjoining other similar habitations. Small settlement areas are characterized as polygons containing 50 or more buildings across an area less than 400,000 square meters (CIESIN, 2021).

6.11.4. Demographics

Based on data from the National Institute of Statistics for the first General Census of Population and Housing carried out after National Independence (INE, 2016a; INE, 2016b), the population counts for 2014 and 2022 (projection) for all the municipalities within the project's scope are presented in Table 43.

Table 43 – Population in the project's municipalities and total per Province.

Province/ Municipality	Population 2014 (10^3)	Population 2022* (10^3)
Benguela (total)	2,239	2,749
Cubal	307	377
Ganda	236	290
Total (2 Mun.)	543	667
Huambo (total)	2,028	2,645
Caála	281	366
Huambo	716	934
Longonjo	92	121
Tchinjenje	31	40
Ukuma	55	72
Total (5 Mun.)	1,175	1,533
Total (all 7 Mun.)	1,718	2,200

Note: * - INE projection.
Sources: (INE, 2016a; INE, 2016b).

Huambo is the municipality with the largest population in the project's area of influence in 2022 (around 934 thousand), followed by Cubal (377 thousand) and Caála (366 thousand).

Comparing demographic indicators between both provinces (Benguela and Huambo), it is possible to highlight some differences and similarities: regarding life expectancy at birth, in both provinces women have a higher indicator (more three to four years); child mortality is still significant in both provinces, particularly in the case of men; the mortality rate is similar in both provinces, around 8%; the birth rate is higher in Huambo (41% vs. 34%); and the aging index is similar and very low.

Regarding the distribution between rural and urban population, Table 44 presents the estimates for 2022, according to INE. Contrary to Huambo province, Benguela has a majority of urban population (almost two thirds) in 2022. According to INE's own estimates, it is not expected that urban population surpasses rural population in Huambo in the next three decades.

Table 44 – Urban and rural population in the project's municipalities and total per Province (2022*).

Province	Urban		Rural	
	Number (10^3)	Proportion (%)	Number (10^3)	Proportion (%)
Benguela	1,784	64.9%	965	35.1%
Huambo	1,283	48.5%	1,362	51.5%

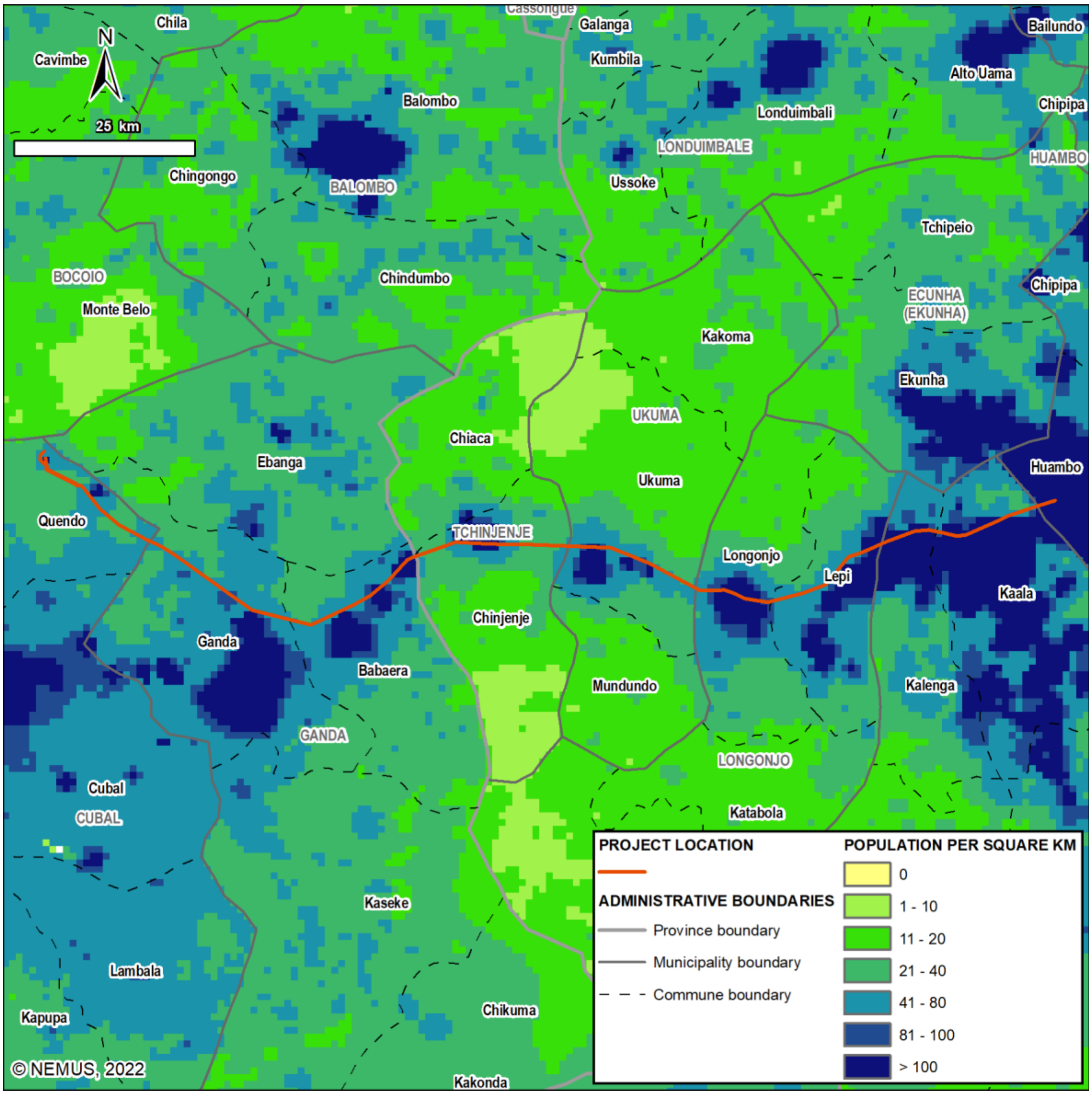
Note: * - INE projection for 2022.
Sources: (INE, 2016a; INE, 2016b).

Figure 69 presents the **population density** adjacent to the project's extension. As can be seen, in the municipalities of Huambo and Caála (both in Huambo Province), a higher population density occurs in the vicinity of the project under analysis. It is estimated that <u>around five thousand people lived in the project's Direct Area of Influence in 2020</u> (CIESIN, 2021). Their distribution per municipality can be seen in Table 45.

Of the total five thousand people living inside the DAI, around two thousand people (37%) lived in Benguela Province in 2020, and the remaining three thousand lived (63%) in the Huambo Province, in 2020. Ganda and Longonjo are the municipalities with more people living within the project's DAI, 21% and 30%, respectively.

Of the estimated five thousand people living in the project's Direct Area of Influence, only 2.6% are estimated to live contiguously or in the 60 metres Project's right of way (around 130 people). Cubal, Tchinjenje and Longonjo are the municipalities with more people estimated to be living within the project's RoW, 31%, 22% and 21%, respectively (around four and three tens of people per each municipality, respectively).

See Map SE1 for a detailed representation of the population residing in the vicinity of the Project.



Source: (Bondarenko, Kerr, Sorichetta, & Tatem, 2020).

Figure 69 – Population density in the project's surroundings (estimate for 2020 according to UNDP methodology).

Table 45 – Population distribution in the project's direct area of influence and right of way (2020).

Province/ Municipality	Population in the DAI (% of total)	Population in the 60m RoW (% of total)
Benguela		
Cubal	15%	**31%**
Ganda	**22%**	16%
Total (2 Mun.)	37%	47%
Huambo		
Caála	8%	7%
Huambo	8%	3%
Longonjo	**30%**	**21%**
Tchinjenje	13%	**22%**
Ukuma	3%	1%
Total (5 Mun.)	63%	53%
Total (all 7 Mun.)	100% (4.9 thousand)	100% (0.1 thousand)

Source: Own calculations based on the Center for International Earth Science Information Network (2021) data.

6.11.5. Land use and ownership

6.11.5.1. Land ownership

Although the State is the formal owner of all land, in practice there is an active informal land market, and increasing conflicts affecting communities, small holders and families. While the existing land law recognizes customary land use, customary traditions are practiced in the various regions and cultures of the country, ownership and inheritance are weakly protected (Cain, 2019). The results of the focus group discussions carried out in the communities under study point to the same conclusion.

In rural areas, because of the low population density, all households are entitled to one parcel of land for individual agricultural use and one parcel for residential use. Inheritance is the primary source of access to rural land, but, as said above, land can also be accessed in the informal land market. The soba also allocates land to individuals and households, and he will take into consideration the size of the household and land availability when defining the size of the parcel (Foley, 2007).

In general, in urban/peri-urban areas, land access is less dependent on inheritance and allocation by the *soba* and more dependent on the land market. Therefore, is in urban and peri-urban areas where land is most valuable and pressure on space is greatest (Foley, 2007). This is mainly because the value of urban land has risen in the past decades as a result of the large influx of people into urban areas.

The majority of rural families have their own plot of land, but that is not the case in urban areas in Angola. Moreover, although in Benguela and Huambo a greater part of families received their land through inheritance, the purchase or occupation of a land plot is still very common (especially in Benguela).

6.11.5.2. Land use

The IAI comprises several land uses. The predominant ones are grasslands, tree cover areas, croplands, and shrubs cover areas. The tree cover areas are mainly located in the middle region of the study area, namely in the Ganda, Tchinjenje, Ukuma and, partially, Longonjo municipalities. The grasslands are predominant in the western part of the area (Ganda and Cubal), while in the eastern section (Longonjo, Caála and Huambo municipalities) the grasslands and croplands are the main land covers.

Specifically in the DAI (see Table 46), the most common land cover is grassland, which cover 68,7 km^2 (43,9% of the DAI), followed by cropland (36,6 km^2, 23,4%) and tree and shrubs cover areas, which extend for 25,7 km^2 and 25,1 km^2, respectively, covering 16,4% and 16,1% of the DAI, respectively. Built up areas cover only 0.2 km^2 of DAI area, 0.1% of the total.

Table 46 – Land cover distribution in the DAI (2015).

Land use	Area (km^2)	%
Tree cover areas	25.7	16.4%
Shrubs cover areas	25.1	16.1%
Grassland	68.7	43.9%
Cropland	36.6	23.4%
Built up areas	0.2	0.1%
Total	**156.5**	**100%**

Source: (ESA/ CCI, 2015).

In the DAI, there is a clear distinction between land cover in Benguela and Huambo provinces. In Benguela (in Cubal or in Ganda municipalities), grassland is the most common land cover (more than half of the total area in each commune). On the contrary, in Huambo province, cropland is more common in almost all communes (Kalenga, Huambo, Longonjo, Chinjenje, Ukuma) except for Kaala (in Caála) and Lepi (in Longonjo municipality), where grassland is the most usual land cover in the project's DAI.

In the Project's right of way (60 metres corridor), the most common land cover is also grassland, which cover 4.2 km^2 (43.9% of the RoW), followed by cropland (2.2 km^2, 23.1%) and tree and shrubs cover areas, which extend for 1.6 km^2, respectively, covering 16,7% and 16,2% of the RoW. Built up areas cover less than a 0.01 km^2 of the RoW area, 0.1% of the total (see Table 47).

In the RoW area, there is also a clear distinction between land cover in Benguela and Huambo provinces. In Benguela (in Cubal or in Ganda municipalities), grassland is the most common land cover (more than half of the total area in each commune). On the contrary, in Huambo province, cropland is also common. There are only built up areas in the communes of Quendo (municipality of Cubal) and Babaera (municipality of Ganda), both in the Benguela province.

Table 47 – Land cover distribution in the RoW (2015).

Land use	Area (km^2)	%
Tree cover areas	1.6	16.7%
Shrubs cover areas	1.6	16.2%
Grassland	4.2	43.9%
Cropland	2.2	23.1%
Built up areas	0.0	0.1%
Total	**9.7**	**100%**

Source: (ESA/ CCI, 2015).

6.11.6. Economy and employment

6.11.6.1. Economic activities

Angola's economy is mainly driven by its oil sector. Oil production and its supporting activities contribute about half of GDP, more than 70% of government revenue, and more than 90% of the country's exports. Diamonds contribute an additional 5% to exports. Although agriculture accounts for only about 9% of Angola's GDP, subsistence agriculture provides the main livelihood for most of the people (including in the provinces under scrutiny), but half of the country's food is still imported (CIA, 2022).

Overall, because the import basket is very diverse and composed mostly of complex products (e.g., machines, transport products, chemicals), and given the overwhelming importance of oil exports, the economy of Angola is very exposed to the international commodity markets and is marked by its volatility. The economic complexity index rank of 116th (of 127) expresses the modest development of the industry of Angola.

Nominal GDP per capita was around US$ 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 Kwanzas, and slower than expected growth in non-oil GDP (World Bank, 2022; CIA, 2022). As shown in Table 48, poverty is still very much a preeminent issue in Angola, with around half of the country with less than $1.90 a day.

Table 48 – Angola economic indicators.

Indicator	Year	Value
GDP per capita (current US$)	2021	2,137
GDP per capita, PPP (current international $)	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%
Economic Complexity Index (ECI)	2020	Rank 116 of 127
Top export	2020	Oil products (92.2%)
Top import	2020	Boilers, machinery, and mechanical appliances (16.4%)
Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)	2018	49.9%

Sources: (World Bank, 2022; CIA, 2022; OEC, 2022).

Benguela province concentrates about 10% of all manufacturing companies of Angola, and Huambo province about 5%. Of all companies in Angola, Benguela province concentrates about 7.5% of the total (Huambo about 4%). This demonstrates the relatively importance of the manufacturing sector in Benguela (but concentrated in the coastal areas, not in the study area).

Although with somehow comparable populations, Benguela has almost double the number of active companies as Huambo. A large part of the companies in Benguela and Huambo are of the trade and vehicles repair section (48% and 54%, respectively).

Other significant sections in terms of number of companies in both provinces are section A (agriculture, animal production, hunting, forestry and fishing) with 8% and 3% of companies in Benguela and Huambo, respectively; and section I (accommodation, restaurants) with 6% and 8% of companies in Benguela and Huambo, respectively.

6.11.6.2. Employment

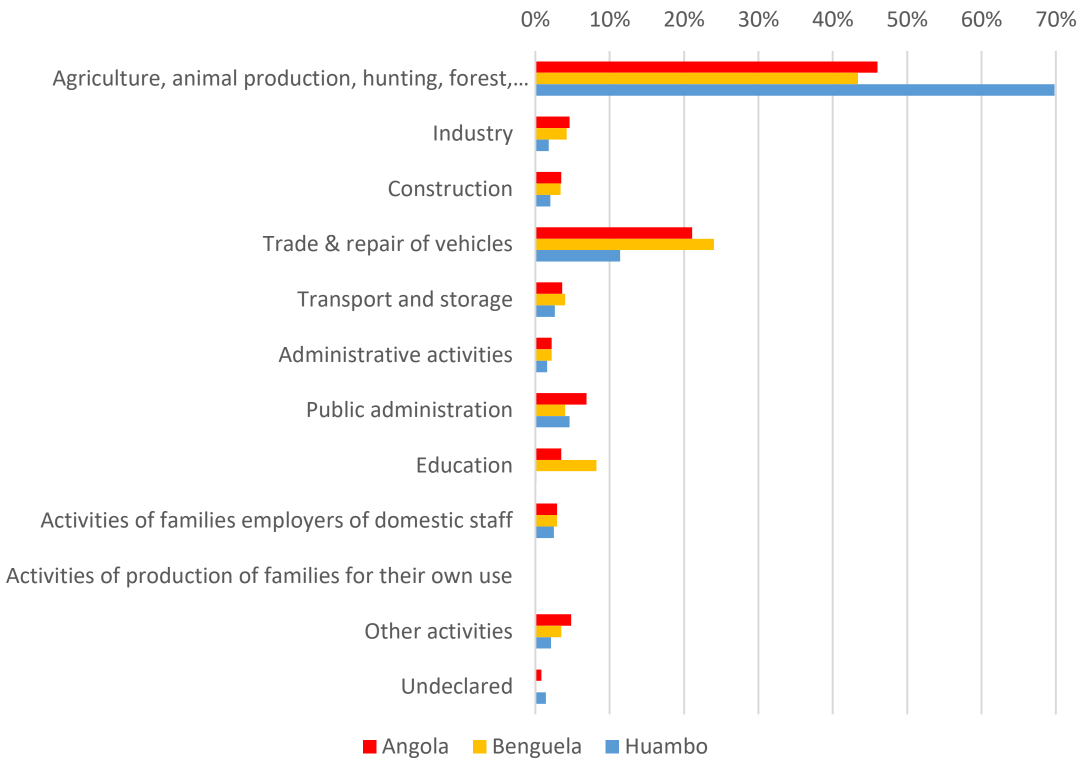
The activity rate of population aged 15 or over in Angola is significant, 87% in total and over 90% in rural areas. There are important differences between urban and rural areas (with rural areas having a higher activity rate) and between men and women (with men having a slightly higher activity rate). Regarding Benguela and Huambo provinces, there are no significant differences between activity rates (between 88% and 92% in total, for men and for women). However, unemployment rates show a contrasting difference between Benguela and Huambo provinces, with a significantly higher unemployment rate in the former (more six percentage points in total; more nine percentage points in the case of men). This perhaps demonstrates the mostly rural reality of Huambo relatively to Benguela (urban areas present a higher unemployment rate).

Although about 62% of the population in Angola resided in urban areas (in 2014) and there is a growing trend towards increased urbanisation, the agriculture, animal production, hunting, forest, and fishing sector (from now on referred to as the agriculture sector) is the largest employer in Angola. The trade and repair of vehicles sector also employs a significant proportion of the total in Angola, 21%. All other sectors of the economy of Angola employ less than 10% of the employed population. As expected, in rural areas, the agriculture sector is dominant, representing a total of 84% of employment in 2018-2019. In the urban areas of Angola, trade & repair of vehicles encompasses 34% of total employment, and the public sector is the third most important employer, with 11%.

In the two provinces under study, the agricultural sector is also the most important, with 45% and 70% of the population employed in Benguela and Huambo, respectively (Figure 70). But again, this indicator shows the more rural reality of Huambo compared to Benguela.

Other sectors somehow crucial for the local economies of Benguela and Huambo are the trade sector (24% and 11% of employment, respectively) and the public administration (4% and 5% of employment, respectively).

It is found that women work more significantly in the agriculture and trade sectors, while men are more represented in the administrative activities, public administration, transport, construction, and industry sectors.



Source: (INE, 2020).

Figure 70 – Population employed by sector of economic activity in Angola, Benguela and Huambo (2018-2019).

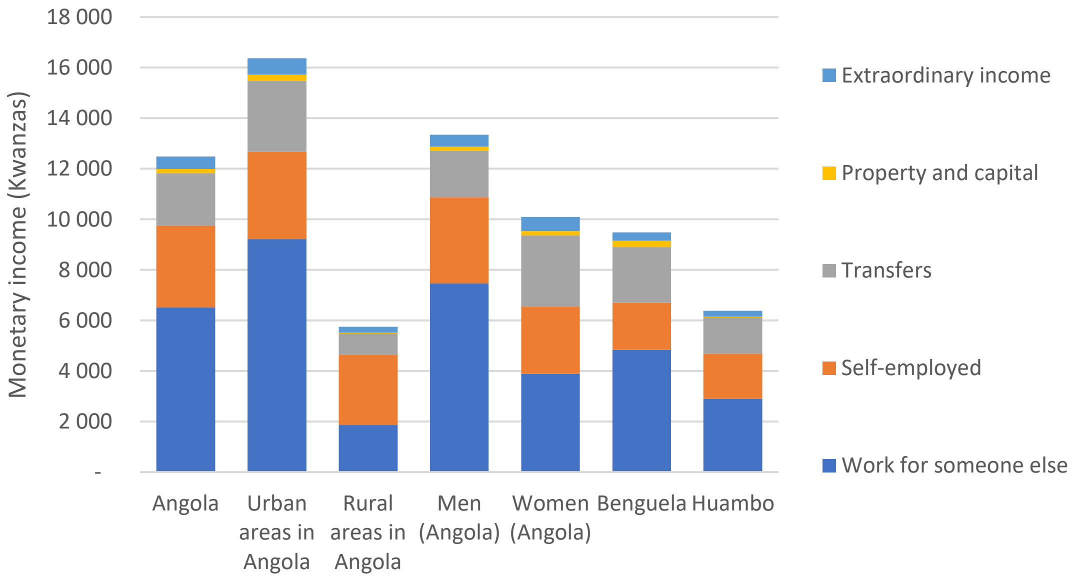
6.11.7. Income and livelihoods

6.11.7.1. 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 observed before, Huambo is a significant rural province of Angola, so it is not unexpected to observe that more than two thirds of families obtain income through self-employment. The reality in Benguela is different, with an equilibrium between income sources (self-employment vs employment). Moreover, as stated before, households headed by a woman obtained income from self-employment much more significantly than households headed by men.

Figure 71 compares average monthly monetary income (and its sources) in Angola (for rural, urban, men and women headed households), Benguela and Huambo, for 2018-2019. As is clear, average income in urban areas was much higher than that observed in rural areas as a result of a higher labour income (16 thousand Kwanzas vs six thousand Kwanzas, respectively). Regarding the study area, Benguela province had a significantly higher average income per person than Huambo (9.5 thousand Kwanzas vs 6.4 thousand Kwanzas, respectively). Substantially is also the difference between average income in households headed by a man and those headed by a woman (13.3 thousand Kwanzas vs ten thousand Kwanzas, respectively). Again, the major difference concerns income from labour.

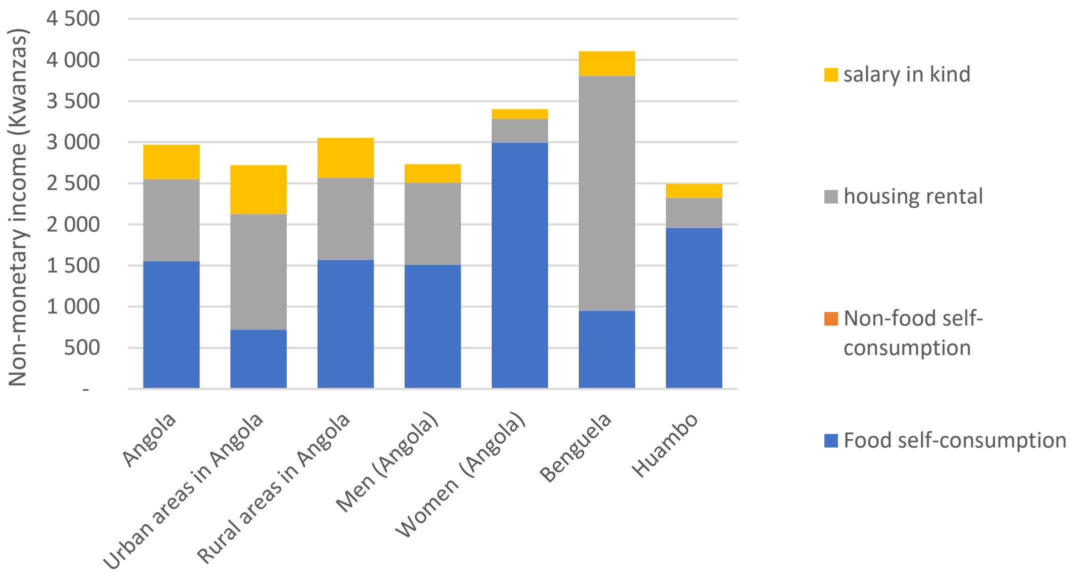
Regarding non-monetary income (as seen in Figure 72), the observed differences between the different areas and types of households are less pronounced. In this case (non-monetary income), Benguela registers the higher value (more than four thousand Kwanzas), mostly because of housing income (not paid rental values). On the contrary, self-consumption income is higher in rural areas (as expected) and in female-head households (compared to male-headed ones). Huambo also registers average higher self-consumption income than Benguela (as expected given the rurality of the province, in comparison).



Source: (INE, 2019).

Figure 71 – Average monetary monthly income per person according to household

income sources (Kwanzas) in Angola, Benguela and Huambo (2018-2019).

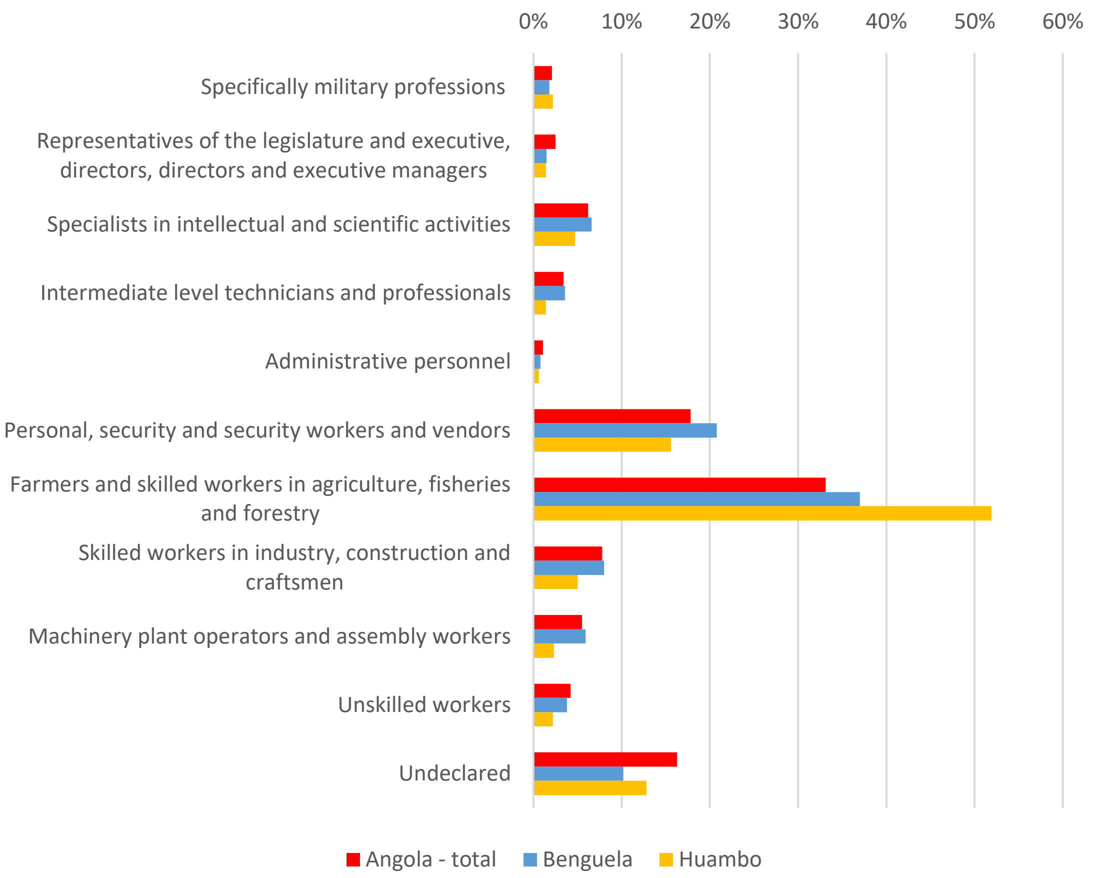


Source: (INE, 2019).

Figure 72 – Average non-monetary monthly income per person according to household income sources (Kwanzas) in Angola, Benguela and Huambo (2018-2019).

Farmers and skilled workers in agriculture, fisheries and forestry are the most common household heads in the country, in rural areas, but also in male and female headed households. In urban areas *personal and security workers and vendors* are the most common (25%). Again, gender differences occur, with more women vendors (households heads) and with men having more diverse occupations.

In Benguela and Huambo (see Figure 73), farming is also the most common occupation of the households' head, with more than half in the case of Huambo (37% in Benguela). Vendors and security worked represented 21% of household heads' occupation in Benguela (and 16% in Huambo). Furthermore, skilled construction and industry workers were the third most common occupation of household heads in Benguela (8%).



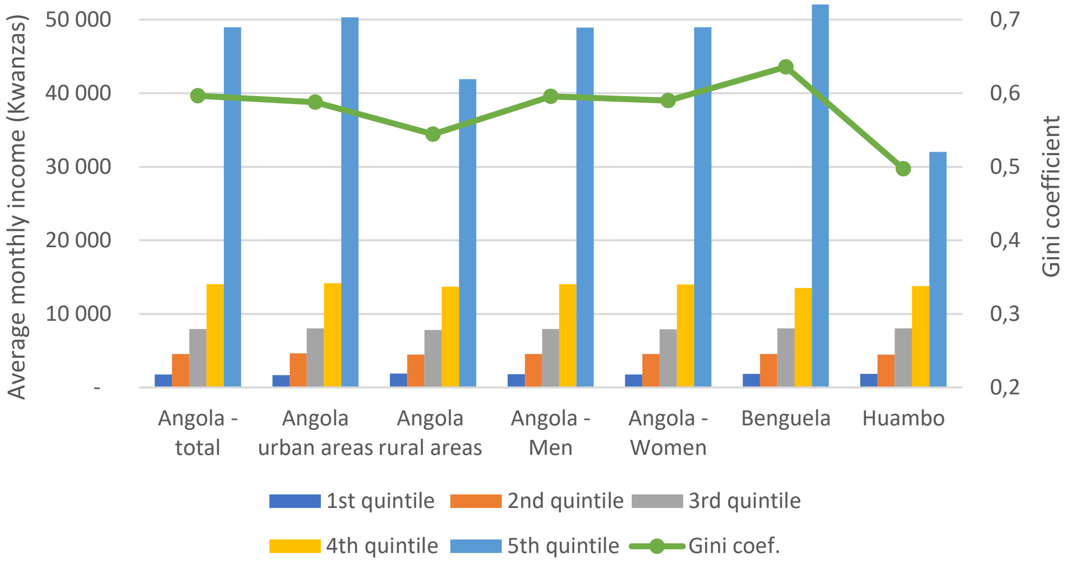
Source: (INE, 2020).

Figure 73 – Main occupation of the head of the household in Angola, Benguela and Huambo (2018-2019).

6.11.7.2. Poverty and inequality

Inequality levels are relatively high in Angola, as can be seen in Figure 74 (Gini coefficient of 0.60). Income quintiles observed in Angola also show the major disparity between fourth and fifth quintiles (more than three times higher). Regarding the provinces under scrutiny, it is possible to observe a high income gap in Benguela (Gini coefficient of 0.64) and a relatively low income gap in Huambo (Gini coefficient of 0.50). This reality results from the fact that incomes are generally lower in Huambo and from less diverse sources (given the more rurality nature of the province).

Income levels in the first quintile are very low in all considered subsets in Angola (rural or urban; male or female head households; in Benguela and in Huambo), around 1,700 to 1,850 Kwanzas per month in average.

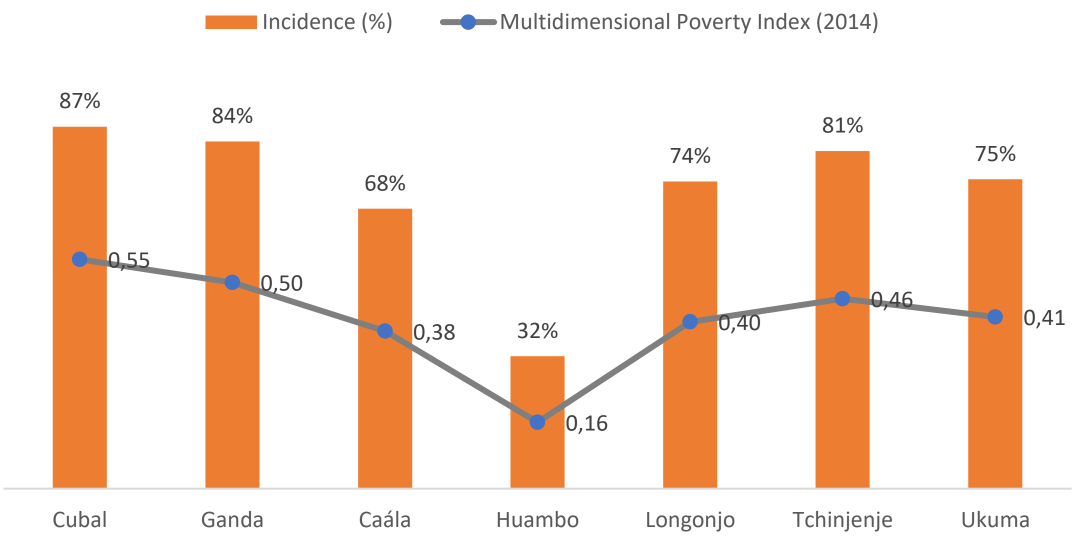


Source: (INE, 2019).

Figure 74 – Inequality (average monthly income per person according to income quintiles and Gini coefficient) in Angola, Benguela and Huambo (2018-2019).

Low income levels (particularly in urban areas) are also correlated with food insecurity and food shortages. Female headed households are also particularly at risk, as can be seen. Huambo is the province of Angola with the lowest number of households with food insufficiency (recorded in the last 12 months, in 2018-19), at 27.5%. This reflects not only the rurality of the province but also the availability of land for agriculture and relatively high productivity levels.

In the municipalities under study, as can be seen in Figure 74, Cubal and Ganda presented the highest levels of multidimensional poverty (that considers health, education, housing, and employment dimensions) in 2014 (data from the Census). Both municipalities of Benguela registered high levels of multidimensional poverty in the following indicators: access to sanitation, water, and electricity. Huambo's municipalities had lower levels of multidimensional poverty, although in Longonjo, Tchinjenje and Ukuma, multidimensional poverty incidence was very high (74% or more).



Source: (INE, 2019).

Figure 75 – Multidimensional Poverty Index – Municipalities (2014).

6.11.7.3. Agriculture

As presented before, agriculture (including livestock creation) is the most important activity in the areas under scrutiny, not only for self-consumption, but also for income generation. In Benguela and Huambo, more than 90% of families with a land plot cultivated agricultural products in 2018-2019. About 8% of families with available land, though, did not used it for agricultural, pasture or other economic uses. Livestock creation was also common in both provinces, with 44% and 57% of families with land in Benguela and Huambo using it for raising livestock.

Huambo is the province in Angola with the higher area sowed with grains, the majority with maize (almost 700 thousand hectares in 2019/20). Other important agricultural products in Huambo (in terms of area of cultivation) are beans (almost 180 thousand hectares in 2019/20), soy (almost 29 thousand hectares in 2019/20) and peanuts (almost 22 thousand hectares in 2019/20). In Benguela, maize also has the higher sowed area (almost 340 thousand hectares in 2019/20), followed by cassava (46 thousand hectares in 2019/20), beans (almost 44 thousand hectares in 2019/20) and banana (37 thousand hectares in 2019/20). Total agricultural area sowed in Huambo was more than one million hectares, with 550 thousand estimated hectares of agricultural area sowed in Benguela in 2019/20.

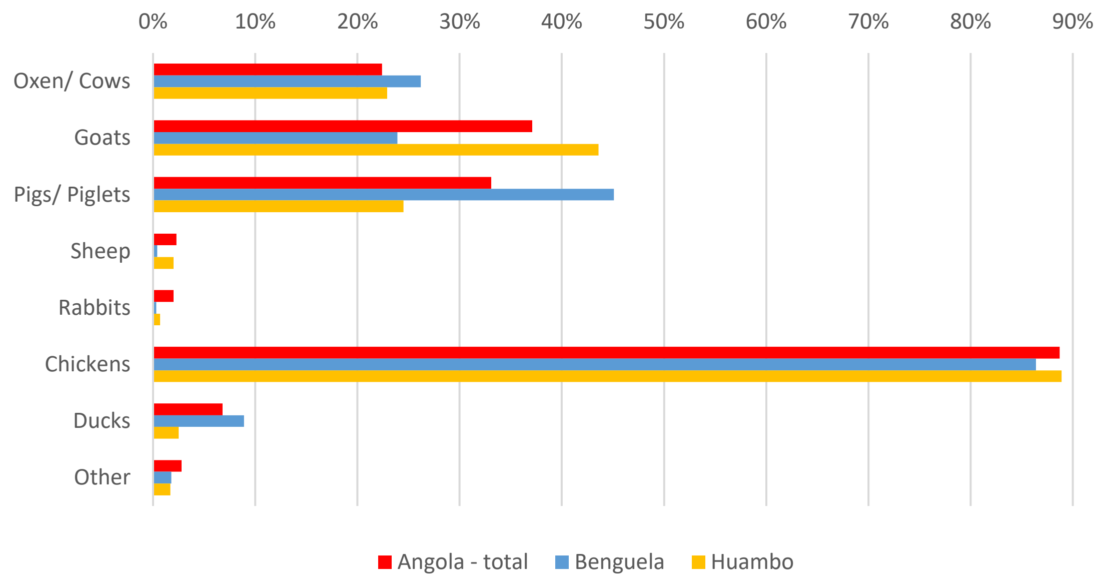
Production of agricultural products in Benguela totalled almost 2.5 million tons, with the following being the highest-producing agricultural products: bananas (more than one million tons), maize (334 thousand tons) and cassava (289 thousand tons). In Huambo, total agricultural production totalled almost 2.1 million tons in 2019/20, with the following being the highest-producing agricultural products: maize (844 thousand tons) and other vegetables (156 thousand tons), onions (133 thousand tons), tomatoes (131 thousand tons). In the municipalities in the study area, the main agricultural crops were also maize, cassava, and vegetables, among others (see Table 49).

Table 49 – Main agricultural crops in the project's municipalities and total per Province.

Province/ Municipality	Agricultural crops
Benguela	
Cubal	Maize, cassava, beans, sorghum, millet, peanuts, sweet potatoes, and potatoes
Ganda	Maize, cassava, beans, sorghum, peanuts, sweet potatoes, and potatoes
Huambo	
Caála	Maize, potatoes, beans, vegetables, fruits
Huambo	Maize, potatoes, beans, vegetables, fruits, lupine
Longonjo	Maize, potatoes, beans, vegetables, fruits
Tchinjenje	Maize, vegetables
Ukuma	Maize, beans, vegetables, garlic

Sources: (CESO, 2015; CESO).

Regarding livestock production, in the province of Benguela and Huambo the most common animals are the following: chickens (in almost 90% of all families with livestock), pigs (in 45% of all families with livestock production in Benguela) and goats (in 44% of all families with livestock production in Huambo).



Source: (INE, 2020).

Figura 76 – Possession of animals or birds in Angola, Benguela and Huambo (only households who practice livestock activities) (2018-2019).

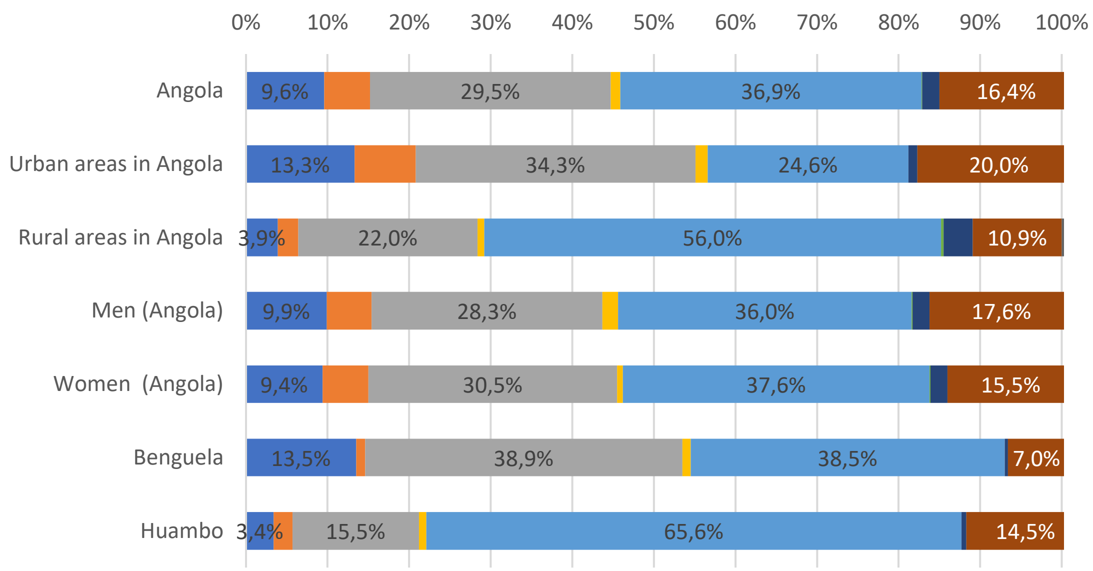
6.11.8. Health

Public health services are critical for Angolans, notably those living outside Luanda and other large cities, and in rural areas. Almost 85% of people in Angola use public health services, and this proportion is higher in rural areas (89%), and also in the provinces under study (Benguela, 93%; Huambo 92%) (INE, 2020). But access to health services remains a challenge, particularly in isolated rural areas, with 71% of families not using public health services stating that these units are just non-existent (40.7%) or are too far away (30.1%). In contrast, in urban areas the non-preference for public health services has very different reasons (lack of medicines, or too much demand). In Huambo, almost 60% of families not using public health services stated that these units are too far away from their residence.

Nevertheless, the number of people that had an accident or had been sick and then got medical support is almost 80% in Huambo (in 2018/19), a proportion higher than in Benguela (72%) or even in urban areas in Angola. And in Huambo, almost two thirds of the people that had an accident or had been sick and then got medical support used public health centres/ posts (Figure 77). But also in Huambo, 15% of sick or accidented people went to a private hospital or clinic (higher proportion than in Benguela, 7%).

On the contrary, in Benguela, a large part of the people that had an accident or had been sick seek out medical attention in a municipal hospital (38.9%), with health centres/ posts also commonplace (38.5%). Additionally, central, or provincial hospitals received 15% of people seeking medical help after an accident or sickness in Benguela (this proportion was only six per cent in Huambo).

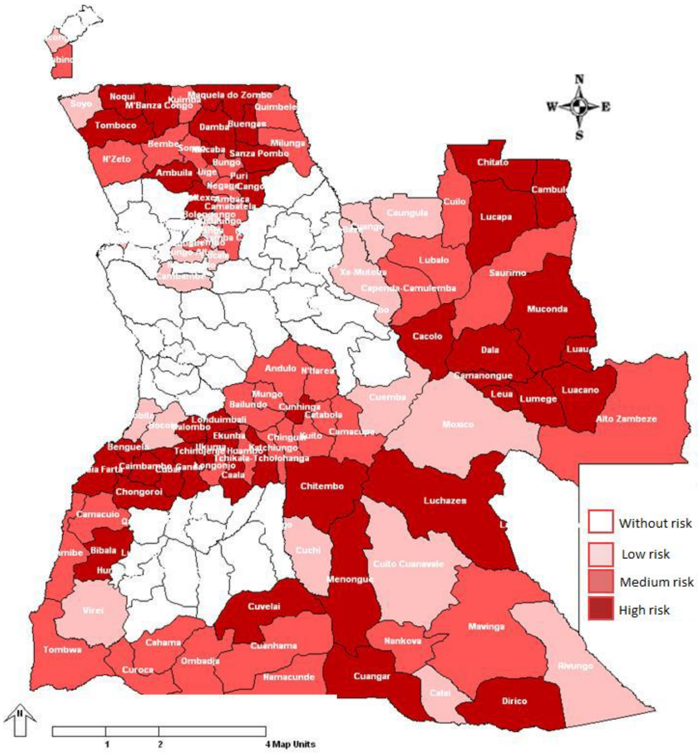
These statistics indicate not only the rurality of Huambo (in comparison with Benguela), but also the lower density of public sanitary units (in particular, hospitals). For example, 4.6% of people in Benguela had a hospitalization in the 12 months prior to 2018-2019, in comparison to only 2.4% in Huambo (INE, 2020).



Source: (INE, 2020).

Figure 77 – Percentage distribution of the population who were sick and had consultations in the last 30 days, according to the place of consultation, in Angola, Benguela and Huambo (2018-2019).

Regarding morbidity risk stratification of respiratory diseases, Benguela and Huambo provinces have a high risk. In the study area, high morbidity risk of respiratory diseases is presented in Cubal, Ganda, Caála, Tchinjenje and Ukuma (Huambo and Longonjo have a medium risk), according to Manuel, Freitas, & Lamezón (2020). The most common transmissible diseases in Angola in 2019 were the following: malaria (66.5%), severe acute respiratory syndrome (10.4%), flu syndrome (8.2%), typhoid fever (4.1%), diarrhoea with dehydration (3%) and dysentery (2.2%) (INE, 2022).



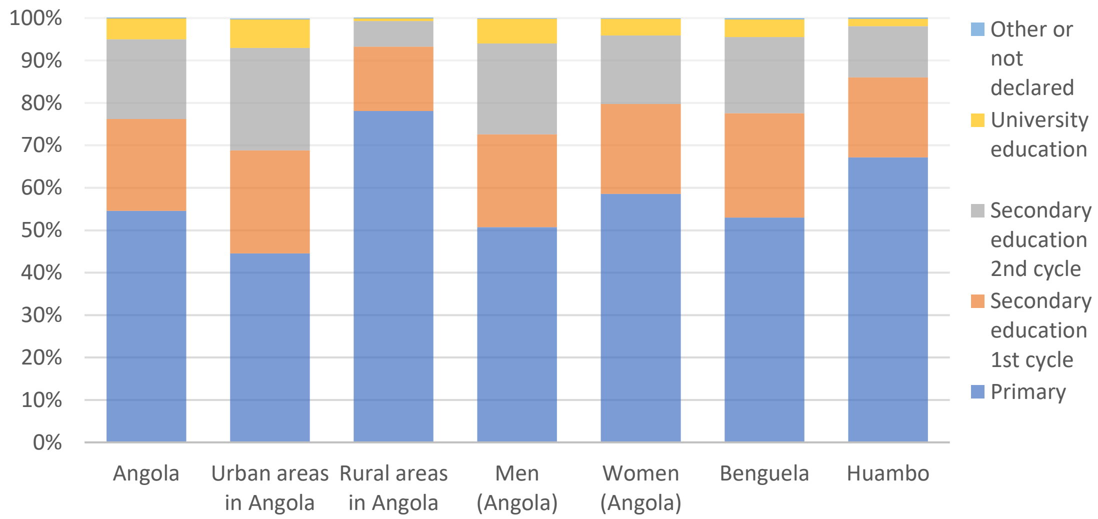
Source: (Manuel, Freitas, & Lamezón, 2020).

Figure 78 – Morbidity risk stratification of respiratory diseases by municipality in Angola (2019).

6.11.9. Education

Regarding literacy rates in Angola, there are significant differences between each area and between genders (with men globally with higher literacy rates, particularly in rural areas). In Benguela, the overall literacy rate for population aged 15 and over was 74% in 2018-2019 (86% for men, 65% for women); and in Huambo the literacy rates were slightly lower, 61% in total (77% for men; 48% for women).

Regarding level of education attained (Figure 79), as expected urban areas have more people with secondary education (24% with secondary education 1st cycle, 24% with secondary education 2nd cycle). In rural areas of Angola, only about 22% of the population (aged five and over) have at least secondary education. Benguela presents higher education levels than Huambo, with 47% of population aged 5 years with at least secondary education (in 2018-2019). The same indicator for Huambo is only 23%.



Source: (INE, 2020).

Figure 79 – Percentage distribution of the population aged 5 years and over according to the level of education attained, in Angola, Benguela and Huambo (2018-2019).

School attendance still shows the gender differences seen previously (in literacy levels, for example), but on a much smaller scale (men attendance is only 2.5 percentage points above women in Angola). Huambo also shows lower levels of children enrolled and attending school than Benguela, continuing the asymmetric levels of education between both provinces, as can be seen in Table 50.

Table 50 – Percentage distribution of the population aged 6-17 years old, according to school attendance in the 2018 academic year.

Indicator	Proportion of population in Angola						
	Total	Urban	Rural	Men	Women	Benguela	Huambo
Enrolled	73.6%	82.5%	59.7%	74.9%	72.3%	83.4%	74.9%
Attends school	71.7%	80.8%	57.7%	73.0%	70.5%	82.9%	74.0%

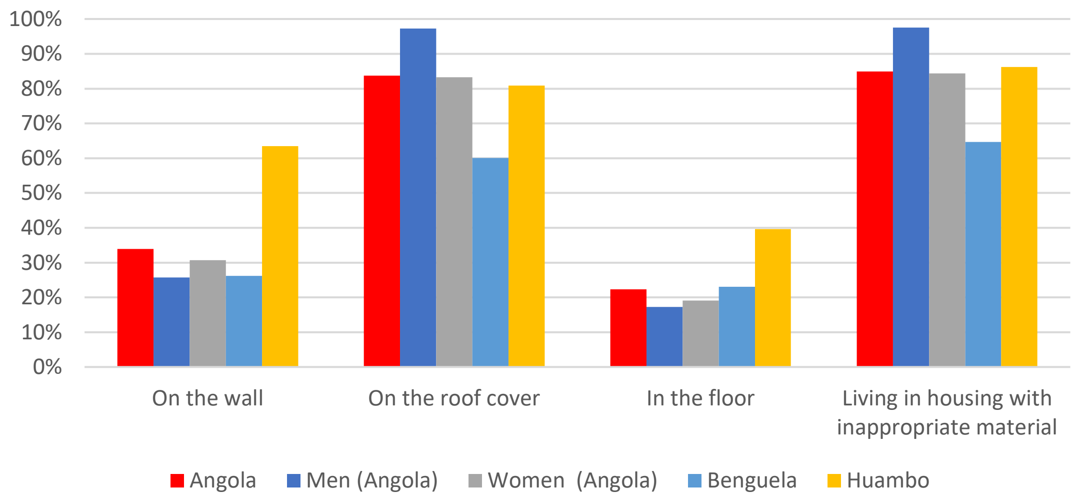
Fonte: (INE, 2020).

Various factors can explain this discrepancy between both provinces, e.g., the rurality of Huambo (children tend to abandon school earlier in rural areas compared to urban ones, in average); but another factor which can explain this difference (in enrolled children in schools) can also be the higher time spent commuting from home to school.

6.11.10. Infrastructure and services

6.11.10.1. Housing

Overall, houses with inappropriate materials (e.g., floor with beaten earth) was the overwhelming majority in Angola in 2018-2019, particularly in rural areas (for example in Huambo), as can be seen in Figure 80.



Source: (INE, 2020).

Figure 80 – Percentage distribution of households residing in the urban area according to inappropriate housing material, in Angola, Benguela and Huambo (2018-2019).

6.11.10.2. Energy

Energy infrastructure is still uncommon in most of Angola's provinces, particularly in rural areas and isolated urban settlements. Gas is only used for cooking by 46% of households, and 72% of those in urban areas (in 2018-2019). In rural areas, firewood was still the most common fuel used for cooking. The same reality can be seen in Huambo (59% of households used firewood for cooking) in contrary to what is seen in Benguela, where gas was widely used (56%).

Regarding lighting sources, access to the public electricity network was fairly common in urban areas (59%) but not in rural areas, where flashlights were still used to provide light. Again, in Huambo flashlight was the most common source of light for households (67%). In Benguela, only slightly more than one third of households had access to the public electricity network (35%) and 37% also used flashlights for lighting.

6.11.10.3. Water access

Regarding access to fresh water sources, Angola was a very diverse country. In urban areas, as expected, the public water network provided water for 44% of households (home or neighbour house connected to the water network). However, other sources were still widely used in urban areas, such as wells (protected) and tanker trucks. In rural areas, almost no house was connected to a water distribution grid, with rivers, lakes, lagoons and streams the source of fresh water for a majority of households (50%).

In Benguela, a diverse set of water sources were used by households, being the most common the following: neighbour’s house (34%); indoors (23%) and river/ lake/ lagoon/ stream/ irrigation channel (21%). In Huambo, the most common sources of fresh water were the following: protected well (31%); river/ lake/ lagoon/ stream/ irrigation channel (23%); and not protected well (13%).

A significant number of families in Angola took more than 30 minutes to collect drinking water in Angola (34% of households without connection to the water network, or 30% in general). In Benguela, this indicator was also fairly high (27% of households without connection to the water network, or 21% in general).

6.11.11. Vulnerable groups

Vulnerability is related to the ability of individuals and groups to adapt to socioeconomic or bio-physical change. 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 are put at risk by a discrete and identifiable event in nature or in society. Social vulnerability refers to the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recovery from the impact of a natural hazard (Wisner, Gaillard, & Kelman).

Vulnerable individuals and groups are therefore more susceptible to negative impacts and/or have a limited ability to take advantage of positive impacts. Vulnerability is a pre-existing status that is independent of the project and may be reflected by the existing low level of access to key socio-economic or environmental resources or a 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, households characteristics, such as single parents, among others.

In the Study Area, vulnerability has been identified and linked to the following factors:

- Households with particularly low incomes and high land dependency for subsistence and income generation – as presented before, in Benguela and Huambo the majority of households depend on self-employment and a larger part of these families rely on agricultural products to live (self-consumption but also for income). Moreover, income levels are very low in the first four quintiles (80% lived with less than 14 thousand Kwanzas per month in 2019 – about US$ 30);

- Female and / or child headed households – these families are particularly vulnerable in the study area – not only female and child headed households have lower incomes than male headed households, but also rely more on self-employment and with higher land dependency for subsistence and income generation. Furthermore, female and child headed households have more challenges regarding land tenure rights, access to education, among other dimensions;
- Elderly – elderly headed households have a lower income (in average 10% lower than average) and also rely more on self-consumption (77% more than average), which puts this group at risk of land tenure conflicts. Furthermore, these families have more difficulties adapting to new contexts, and displacement impacts could be particularly challenging;

- Disable persons – Those who lack physical mobility or who have mental health issues may be vulnerable to changes and have more difficulties adapting to new contexts. Displacement impacts related to restriction on land access or need to replace housing could be exceptionally demanding.

The analysis of socio-economic baseline disaggregated by vulnerable groups is the Volume II of the ESIA. Due to data limitations, it was not possible to analyse the socio-economic indicators for disabled people, so the analysis focused on women, the elderly and people in the first income quintile.

The findings highlight several key issues faced by vulnerable groups in the study area, particularly those in the first income quintile, the elderly and women. These issues include barriers to accessing health care, lower literacy rates and inadequate housing. In addition, reliance on traditional biomass fuels such as firewood for cooking and lack of access to reliable and affordable lighting pose significant challenges to these communities, affecting their health, environmental sustainability and socio-economic well-being.

The incidence of multidimensional poverty in the municipalities covered by the project was significantly high in 2014, according to census data (Figure 75). A large proportion of the families in the project area are considered vulnerable because they are poor, a vulnerability criterion associated with a population that is largely dependent on land for subsistence and has significantly low incomes.

6.11.12. Human rights

The Human Rights Impact Assessment (HRIA) assesses the potential impacts of the construction of the transmission line between Lomaum and Huambo on the human rights of people living and working in the areas affected by the project. The HRIA process aims to ensure that the construction of the transmission line is carried out in a manner that respects and protects the human rights of people who may be affected by the project.

<u>The complete HRIA is in Volume II of the ESIA and this chapter provides only a summary on the main findings.</u>

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.

6.12. Cultural heritage

The analysis of the cultural heritage aims to get to know the existing heritage realities in the study area, in order to understand the components of the historic landscape based on 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 legal framework in force, not only the material heritage, where architectural and archaeological heritage are included, but also the intangible heritage, which covers areas as vast as art, tradition, beliefs, etc. (Presidential Decree No. 15/11 of 11 January).

In this study are considered architectural and archaeological heritage (material heritage) and traditional cemeteries, graves, sacred forests and trees (immaterial heritage). The information presented is based on specialised bibliography and field work carried out by the Nemus experts, including the focus groups conducted with the populations affected by the project.

6.12.1. Background: a brief overview of the past and the present

6.12.1.1. Huambo Province

As Africa is the birthplace of humanity, the current territory of Angola was explored by Man from early times. Despite the presence of Olduvense and Acheulense archaeological materials produced initially by *Australopithecus* (1,600,000 years old), and later produced by *Homo Erectus*, traces of human presence in the region of the study area are mainly from the Iron Age, being represented both in fortified settlements and rock art stations (Barham & Mitchell, 2008).

The Angolan people have their origins in various Bantu ethnic groups, which were mixed with local groups, with specific local characteristics. The ethnic group present in the region of Huambo is the Ovimbundo. Although there is no secure record, it is traditionally pointed to the 17th century as the date of their arrival. The population was grouped in "quimbos" and around one family, all descending from the same soba.

The region was the centre for conflicts between Ovimbundo clans leading to the displacement of settlements to high points and to the construction of fortifications, such as the Hondio mountain range, the fortified citadels of Quitavava (Pedreira) or Pumbala (Pedra do Elefante) where the vestiges of ancient fortifications appear at almost inaccessible points. The origin of the conflicts may lie in the attempt to control the commercial route used by the caravans that circulated goods from the interior of Bié to Benguela and Catumbela, known and exploited since the beginning of the 17th century, initially with the slave trade, and then wax and ivory, and finally rubber.

Legend:1) Kingdom of Kongo (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 the South-West (XVI-XVII century); 8) region of communities without kingdom clusters.

Source : (Universidade Aberta, 2022)

Figure 81 – Historic kingdoms on Angolan territory.

Until the 18th century, the monarchies of Bailundo, Bié, Huambo and other independent kingdoms resisted against the Portuguese presence, and names such as Ekuikui II, Mutu Ya Kevela or Mandume have remained recorded in history. The occupation of the plateau was only possible from the 20s of the 20th century, when the population began to consider it advantageous to do business or work on the construction of the Benguela Railway and plant eucalyptus to feed the locomotives.

The region went under a colonial administration with an economy based on agriculture and on the export of raw materials. In the second quarter of the 20th century, nationalist movements were formed 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. It has a World Heritage Site (classified by UNESCO in 2017): Mbanza Kongo (capital of Zaire province).

The province of Huambo is one of the richest in Angola in terms of historical and cultural monuments and sites, with 131 historical places and monuments listed in the provisional inventory of cultural assets drawn up by the Provincial Directorate of Culture with the aim of being classified as national heritage (Table 51).

Table 51 – Heritage listed by the Provincial Directorate of Culture (Gayeta, 2013).

Material/building heritage	Intangible heritage
• 12 monuments of civil architecture • 26 religious' architecture; • 9 of military architecture; • 6 archaeological sites; • 18 historical sites; • 11 historic zones	• 22 areas of landscape interest; • 8 symbols of traditional power; • 10 cemeteries; • 9 statues.

Of this group of buildings/constructions, those already classified as historical and cultural heritage stand out:

- Fort of Quissala - symbol of the resistance of the native people against the colonial occupation in 1902;
- The Feti archaeological station, in the commune of Calima - dating from the Iron Age, it is of great interest for the prehistory of the Ovimbundu because, according to tradition, it is the oldest place in the central and southern region of Africa;
- The Kaninguili rock paintings, in the Mungo municipality - dated from 7,000 to 10,000 years old, they show geometric figures, hunting scenes, animals and human figures;
- The Candumbo Fort, in the municipality of Chicala Cholohanga - here took place the battle that culminated with the colonial occupation of the territory of Huambo, in 1902, after the resistance of the population, under the command of the sovereign Ndala Candumbo ;
- The buildings around Agostinho Neto Square, in the city of Huambo - government palace, the provincial directorates building and the provincial government building.

Many of these places that constitute the collective memory of the people of the central plateau region are in an advanced state of degradation, besides being invaded by the population that is unaware of the importance of the place, putting its existence at risk.

6.12.1.2. Project Area

6.12.1.2.1. Intangible 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).

Intangible 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 knowledge transmission 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.

Intangible cultural heritage is not only valued as a cultural good on a comparative basis for its exclusivity or exceptional value. Heritage has to be developed on the basis of communities, depending on those who have 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.

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.

The present analysis focuses specifically on two types of intangible heritage because they are those which, in fact, may be affected by the project under evaluation.

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, which are managed by individual families or clans or by the local community.

Some of the basic rules of use of sacred forests are: no burning, no entering the sacred forest without permission, no cutting of fruit trees, restriction of exploitation of resources and prohibition on the sale of forest resources.

Three traditional cemeteries were identified in the study area: between towers LH76 and LH77 (C1), on the alignment of tower LH190 (C2) and on the alignment of tower LH322 (C3).

Figure 82 – Traditional cemetery (C1) in sacred forest in the study area

The C3 cemetery has the particularity of being located at the base of the N'Ganda-La-Kawhe Inselberg (Figure 83). It is in this cemetery where the tombs of Soba Wuambo Kalunga are found, a figure of great importance in the history of the foundation of Huambo, and of the sobas Muanguja (1964) and Zeferino Lucamba (at the beginning of the 21st century).

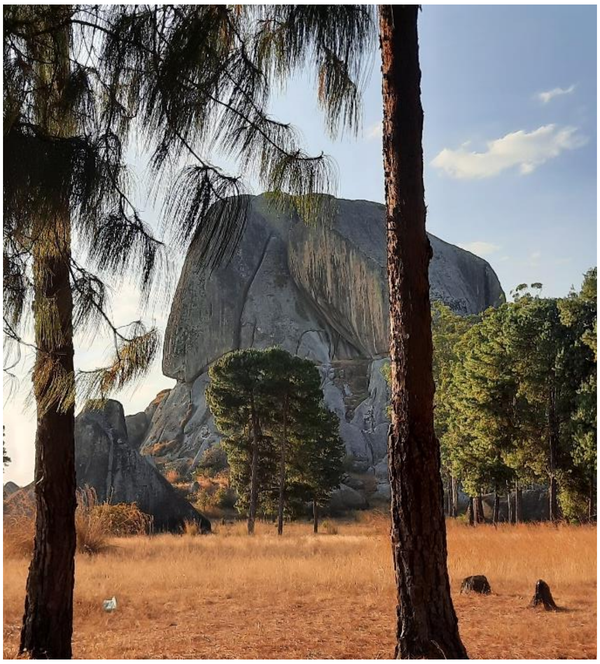


Figure 83 – Traditional cemetery (C3) where the tomb of Soba Wuambo Kalunga is

located (La Kawé stone)

Also considered intangible heritage is the relationship of the population with one of the trees of greater symbolic value, the baobab. The baobab is popularly known as the sacred tree or tree of life. It is laden with mystery, spirituality and tradition throughout Africa, and provides food, water, medicine and shelter for those living in 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 project area some baobabs have been identified, such as the one in Figure 84, which is still a young specimen, as it can reach 1,000 to 2,000 years old.

Figure 84 – Baobab, a tree of cultural importance, which can be a place of rituals.

The 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.

6.12.1.2.2. Archaeological Heritage

In the Huambo region, several sites of heritage value are known, particularly of archaeological value, however there are no recent studies[5]. The sites known in the study corridor and surrounding area include (see drawing CH1):

- Abrigo 1 da Ganda;
- Hondio mountain fortified settlement;
- Nganda fortified settlement;
- Lumpi;
- Pumbala fortified settlement; and
- Quitavava fortified settlement.

Figure 85 shows the alignment of the known fortified settlements between Ganda and Babaera.

[5] The information refers to research carried out between the 1960s and the 1980s, in particular studies carried out by the archaeologists Desmond Clark, Carlos Ervedosa and Victor Oliveira Jorge.

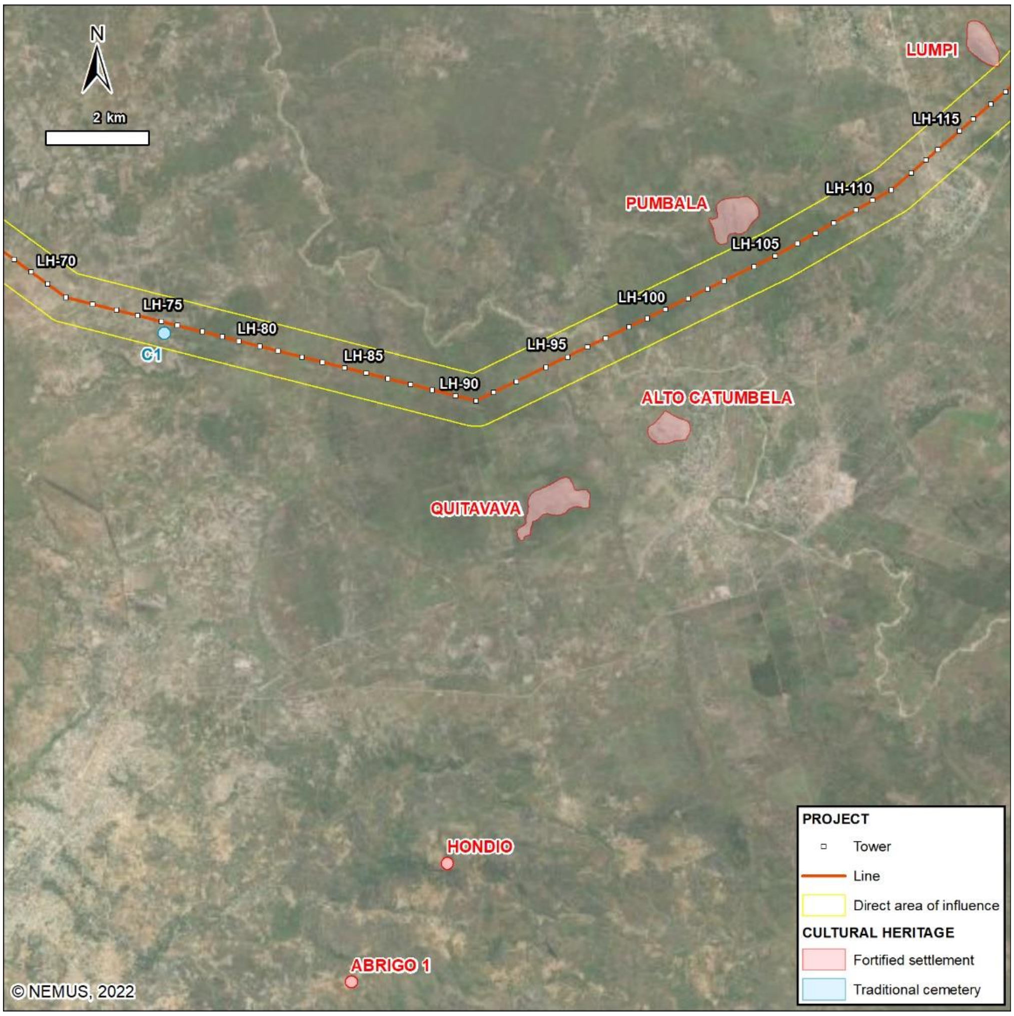
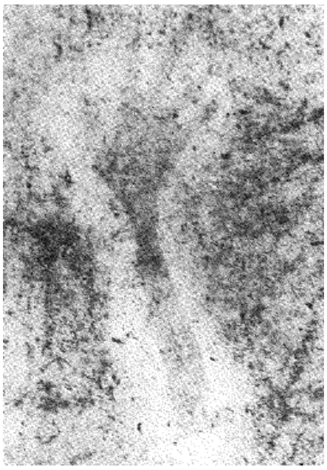


Figure 85 – Alignment of fortified settlements in the study area.

Abrigo 1 da Ganda (Figure 86) is located at one of the highest points of the Hondio mountain range and may be associated with a nearby fortified settlement (Ervedosa, 1980). This natural shelter is a recess in a granite socket, about 12 meters wide and 3 meters high. This site was subjected to three archaeological campaigns, and a forge and several paintings (geometric, anthropomorphic figure, an arm (Figure 87) and three hands painted in negative) have been identified.

Source: (CPires, 2022)

Figure 86 – Abrigo 1 da Ganda. April 1973 excavations

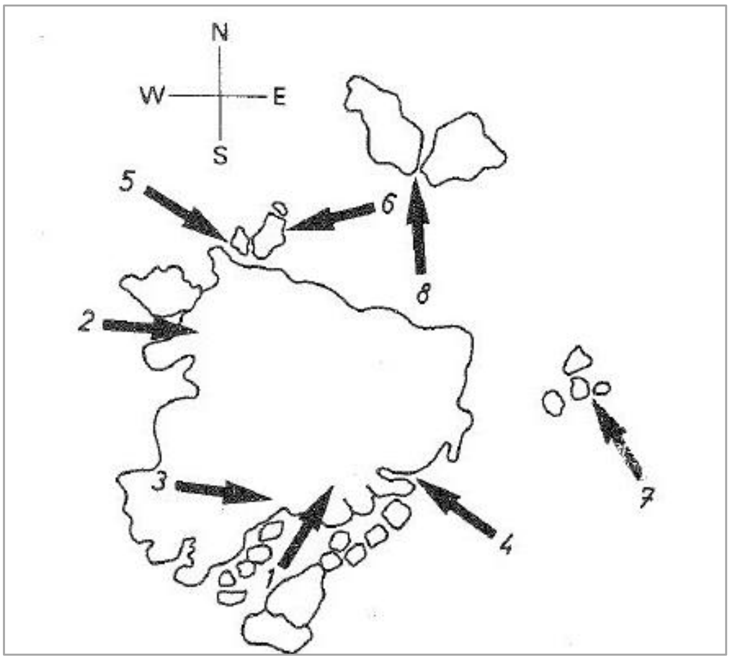


Source: (Ervedosa, 1980)

Figure 87 – Right arm represented in negative

Nganda fortified settlement is part of the Ovimbundo kingdoms and is said to have been one of the most important in the region (Ervedosa, 1980).The Nganda inselberg, north of Caála, marks the oldest site of the kingdom of Huambo, where Mbola, the ancient capital of the kingdom, was located. No archaeological work has ever been carried out on this site (Jorge, 1974), so only oral information exists.

Around the Nganda inselberg there are stories and archaeological remains which are represented in Figure 88.



Legend: 1) Cave entrance; 2) Cave exit; 3) Stone of the Herald; 4) Palace Cave (elombe); 5) Stabbing Cave (where Wuambo Kalumba died); 6) Stone of the Paintings; 7) Bell Stone; 8) Shelter on rock
Source: (Ervedosa, 1980)

Figure 88 – Nganda inselberg plan view.

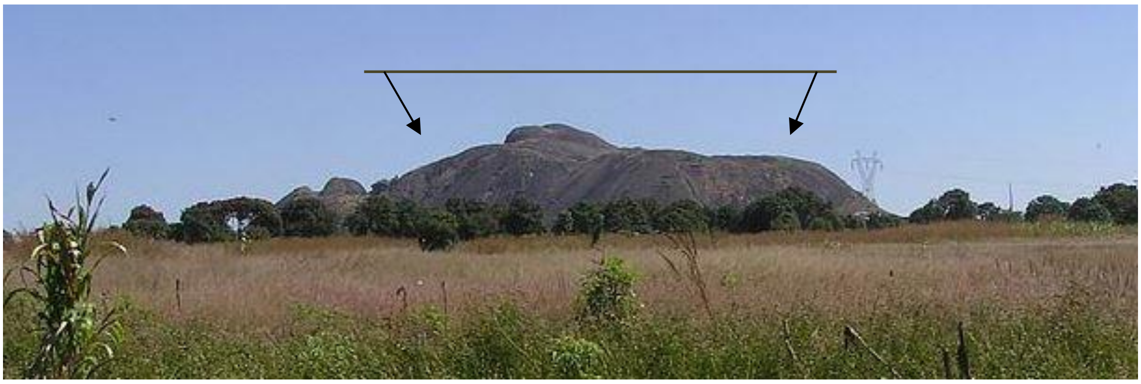
The **Lumpi** settlement is situated on top of an inselberg (Figure 89), north of Babaera. This site has never been subject to archaeological work, having been identified during prospecting in the 1970s.

Figure 89 – Lumpi settlement.

The settlements of **Pumbala** and **Quitavava** are located on top of the inselbergs Pedra do Elefante (Figure 93) and Pedreira (Figure 90), respectively, on opposite banks of the Catumbela River. About 150 m from the valley floor, the fortified settlement of Quitavava constitutes a defensive complex, where subsistence terraced agriculture could be practised within its interior, along the western boundary of the wall. In periods of less danger, the population would use the soils of the foothills, where there would also be huts.

Around 500 hut traces were identified (Figure 91), which would allow a base occupation of 1000 individuals, which reveals the importance of this site. The identified artefacts reach the order of 1000 pieces, most of them from inside the huts, or nearby. The lithic materials are mainly blades, scrapers or atypical chips. In terms of ceramics most pieces were without decoration, although there are exceptions with geometric motifs by incision (Figure 92). A fragment of "algaraviz" [6] was identified in the site which reveals the mastery of the iron metallurgy technique.

Despite the data collected it is not possible to give a precise chronology of its occupation.



Source: (CPires, 2022)

Figure 90 – Fortified settlement of Quitavava, in the Pedreira inselberg.

[6] Blacksmith bellows tube in refractory clay.

Source: (GED, 2008)

Figure 91 – Hut base in Quitavava

Source: (CPires, 2022)

Figure 92 – Example of materials collected in Quitavava

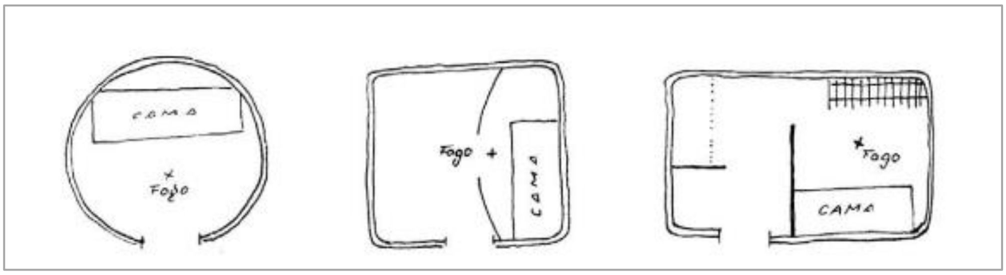
The fortified settlement of Pumbala (Figure 93) follows the lines of the Quitavava settlement, and a great variety of lithic and ceramic materials have also been identified here. It is worth mentioning that a blacksmith's workshop has been identified and studied at the site (Jorge, 1974)

Figure 93 – Fortified settlement of Pumbala.

6.12.1.2.3. Architectural Heritage

The architectural heritage is important for the understanding, permanence and construction of national identity and for the democratisation of culture. They are assets which constitute testimonies with a value of civilization or culture. The architectural heritage integrated in the environment results from the interaction between people and places over time, functioning as a factor of differentiation and valorisation of the territory, which should be preserved and bequeathed to future generations. Its conservation, enhancement and dissemination have a potential for local, regional, national and, in specific cases, global projection, with the ability to appeal to different publics 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, as these are dwellings with ancestral roots (Figure 94).



Source: (Daniel, 2019)

Figure 94 – Cubata plant evolution.

It is characterised 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 the construction of walls, adobe bricks or clay bricks reinforced by a structure of stiff sticks tied together (pau-a-pique) are frequently used. In the study area solid materials such as adobe and rammed earth are mainly used for walls.

Currently, there is a trend towards rectangular plan houses, with an area of 20 - 30 m^2, divided into 2 to 3 compartments.

In Figure 95 it is possible to observe an aggregate of cubatas where the 2 central cubatas stand out, whose dimensions suggest they have 3 compartments - kitchen and bedroom flanking the central room. These 2 cubatas face the courtyard where domestic activities are carried out, such as cooking outdoors, threshing and drying grains, which are common moments in the life of an agricultural community in rural Angola. The remaining cubatas are smaller, square, most likely one-compartment.

Figure 95 – Small rural settlement near Babaera

6.12.1.3. Summary

Cultural heritage has a general legal framework, although there are some gaps in the specialities, namely as regards to archaeological heritage, making its protection difficult. In the 1960s and 1970s scientific research was conducted with the specific aim of understanding the origin and evolution of the Angolan people, with several prospecting and excavation campaigns having been carried out in various old fortified settlements and shelters in the region.

In the province of Huambo there is great cultural diversity, both at the level of intangible heritage and archaeological and architectural heritage. Currently, the knowledge and systematization of cultural heritage is still in an embryonic phase, although there is a public cultural policy theorization for its protection, especially in academic circles, and there is awareness of its importance in the social and economic sphere.

The non-systematisation of the heritage reality makes its defence difficult, and mechanisms must be created to protect assets that have not yet been properly evaluated and studied, for example by creating a specialised legal framework, with the definition of criteria and methodologies. It is fundamental to understand that heritage is a fragile and non-renewable asset that must be protected as the identity heritage of a group or community.

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7. Stakeholder Engagement Approach

7.1. Introduction

This section presents a summary of the stakeholder engagement approach for the ESIA of the Transmission Line of 220 kV Lomaum-Huambo and associated substations (hereafter referred to as the "Project"). This section includes:

- The overall methodology used to develop this SEP (section 7.2);
- The identification and characterisation of stakeholders to determine appropriate ways of engagement (section 7.3);
- The stakeholder engagement program with the approach and timetable (section 7.4).

The full SEP can be found in Volume III of the ESIA.

7.2. Methodology

7.2.1. Introduction

Stakeholder participation aims to involve, inform, and consult different stakeholders in the 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 the IFC (2007), eight concepts and principles are key:

- Stakeholder identification and analysis – identify and prioritise stakeholders and assess their interests and concerns.
- Information disclosure – communicate information to stakeholders early in the decision-making process, in ways that are meaningful and accessible, and continue this communication throughout the project life.

- Stakeholder consultation – plan out each consult inclusively, document the process and communicate follow-up.
- Negotiation and partnerships – for controversial and complex issues, enter into good faith negotiations that satisfy the interests of all parties.
- Grievance management – establish accessible and responsive means for stakeholders to raise concerns and grievances.
- Stakeholder involvement in project monitoring involves affected stakeholders in monitoring project impacts, mitigation, and benefits, and external monitors where they can enhance credibility.
- Reporting to stakeholders – report back to stakeholders, both those consulted and those with more general interests in the project.
- Management functions – build and maintain sufficient capacity within the company to manage the stakeholder engagement.

Based on the principles listed above, this ESIA's stakeholder engagement followed a four-step approach, according to Figure 96.

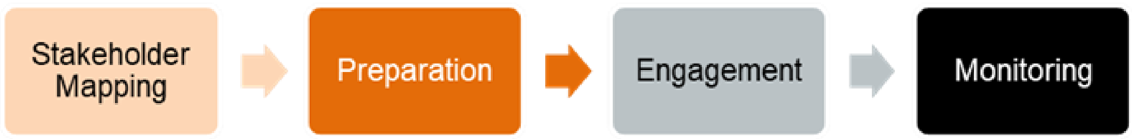

Figure 96 – Stakeholder engagement plan approach.

7.2.2. Stakeholder mapping

Stakeholder mapping is the first step in the stakeholder's engagement plan. It involves the identification of the relevant groups, organisations, and people concerning the project; understanding how the stakeholders may affect (or be affected by) the project; examining their relations and objectives; and prioritising stakeholders according to their relevance (BSR, 2012) (see Figure 97).

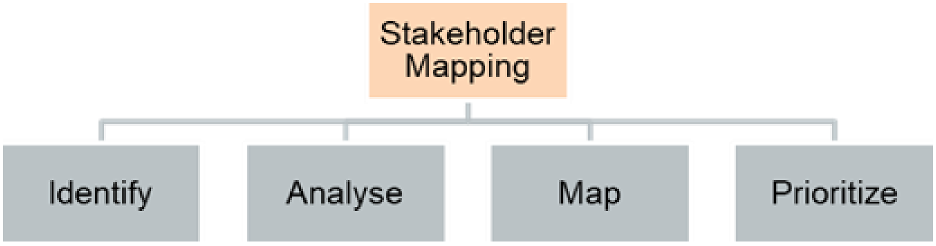

Figure 97 – Stakeholder mapping methodology.

An institutional analysis provides the main stakeholder's identification. At this point, there is a need to exhaustively identify institutions and groups such as national, regional, and local government structures, community associations, NGOs; local-based organisations, and research institutions. Afterwards, it is important to do further analysis to understand better their relevance and the perspective they offer, to understand their relationship to the project. Five criteria can be used in this task (BSR, 2012):

- Contribution: Does the stakeholder have information that could be helpful?
- Legitimacy: How legitimate is the stakeholder's claim for engagement?
- Willingness to engage: How willing is the stakeholder to engage?
- Influence: How much influence does the stakeholder have?
- The necessity of involvement.

After that, mapping is helpful to visualise the complex interplay of issues and relationships to see where stakeholders stand when evaluated by the same key criteria and compared to each other. And in the last step of the stakeholder mapping, it is important to select the more important stakeholders. It is not practical to engage with all stakeholder groups with the same level of intensity all the time. Therefore, it is imperative to strategize and be clear about who to engage with and why.

7.2.3. Preparation

The next phase of the stakeholder engagement is the preparation phase which includes the groundwork for the information disclosure and the construction of the consultation plan. Information disclosure should be done early in the process, with objective and meaningful data and ensuring accessibility to all. Communicating such information in a manner understandable to the stakeholders is crucial.

Perhaps one of the most important steps in the preparation phase is creating a stakeholder consultation plan. This task shall state which stakeholders need to be included in any subsequent activities and how. Furthermore, the consultation plan must be developed according to the following (IFC, 2007):

- Purpose: the consultations must be planned for key stakeholders, considering the analysis realised in the early phase.
- Requirements: must meet legal and regulatory requirements.
- Stakeholders: according to their issues and interests.
- Priority issues: key issues must be addressed with special attention (ex: Monitoring & Evaluation systems).
- Techniques must be adapted to the issues and each stakeholder involved.
- Responsibilities: must be defined clearly (who is responsible for what).
- Documentation: how will the consultations be recorded (video, audio; paper records).

Other important matter is the differentiation of techniques, methods, approaches, and timetables according to the local situation and the type of stakeholder being consulted. The geographical and regional context of the area and the accessibility of the chosen locations should also be considered. Moreover, there are several options for conveying the information, each one with a different level of engagement:

- Public hearings: an open gathering of officials and citizens, in which citizens are permitted to offer comments.
- Briefings: meetings where officials give information or data.
- Round tables: a few stakeholders and officials gather for a conference and discussion.
- Workshops: seminar or series of meetings with interaction and exchange of information among a small number of stakeholders and officials.
- Focus groups: a gathering of deliberately selected stakeholders who participate in a planned discussion about an issue/ theme.
- Web-based sessions: communications between officials and stakeholders/ citizens using social networks.
- Surveys: a standard form with questions to gather information about stakeholders' opinions.

7.2.4. Engagement and monitoring

7.2.4.1. Engagement

The next phase of stakeholder engagement is the engagement phase. It includes executing all the activities prepared in the previous phase, namely the consultations. In this phase, it is important to cooperate with the affected parties in good faith, conducting them with an open mind and a willingness to engage in the process. That means transparent consultations, considering the available time of the negotiating parties. Regarding the consultations, it is decisive to document the process and its results and report back to let the stakeholders know what has happened and what the next steps will be.

7.2.4.2. Monitoring

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

7.3. Project stakeholders

7.3.1. Stakeholder identification

Stakeholder identification is the first step of the stakeholder mapping. It involves identifying the relevant groups, organisations, and people in relation to the project and understanding how the stakeholders may affect (or be affected by) the project.

7.3.2. Stakeholder mapping

As stated in section 7.2.2, in the stakeholder mapping phase, it is important to do further analysis to understand better the relevance of the relationship to the project of identified stakeholders. Five criteria can be used in this task (BSR, 2012): contribution, legitimacy, willingness to engage, or interest; influence and necessity of involvement. After that, mapping is helpful to visualise the complex interplay of issues and relationships to see where stakeholders stand when evaluated by the same key criteria and compared to each other. And in the last step of the stakeholder mapping, selecting the more important stakeholders is important.

Given the proposed methodology to prioritise stakeholders' involvement, Figure 98 presents the stakeholder mapping with two axes: influence and willingness to engage or interest. The mapping results underline the importance of directly involving the following stakeholders:

- Key ministries;
- Provincial authorities;
- CBOs;
- NGOs, more specifically, those present in the IAI;
- Traditional authorities (soba);
- Municipal and commune authorities;
- And Government agencies.

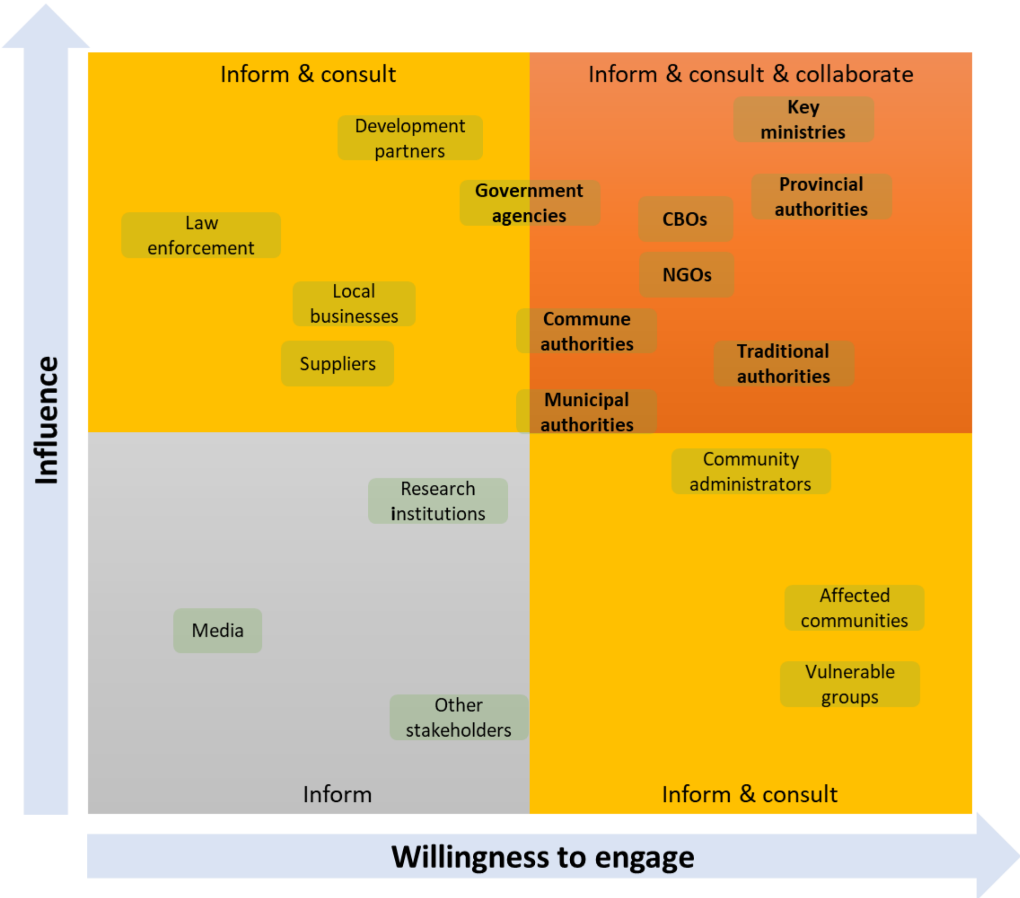

Figure 98 – Stakeholder mapping.

7.4. Stakeholder engagement programme

7.4.1. Introduction

This stakeholder engagement programme covers only the ESIA phase, i.e., the planning and design phase before construction. During the ESIA phase, stakeholder engagement activities and objectives are presented in section 7.4.2. Engagement tools to record and present data regarding the stakeholder engagement activities are described in section 7.4.3.

7.4.2. ESIA Phases and stakeholder engagement

The ESIA was developed in three phases: phase 1 – work plan; phase 2 – initialisation and scoping phase; phase 3 – detailed assessment of the environmental and social impacts and risks. Each of these phases have stakeholder engagement activities, as seen in Table 52 and further specified in the next sections.

Table 52 – Stakeholder engagement during the ESIA.

Phase	Stakeholder activities	Stakeholders to engage
Phase 1 – work plan	Kick-off meeting with the project sponsors	Proponents (Elecnor) Funder (UKEF)
	Kick-off meeting with local government	Municipal, commune and lower-level authorities
Phase 2 – initialisation and scoping phase	Key informant consultations	• Provincial authorities • Municipal and commune authorities • And government agencies
	Focus group discussions	At least five (one per municipality), with: • CBOs • Local NGOs • Traditional authorities (soba) • Other community representants (including vulnerable groups)
Phase 3 – detailed assessment of the	Public consultations	At least two (two events), with listed stakeholders

Phase	Stakeholder activities	Stakeholders to engage
environmental and social impacts and risks		

7.4.2.1. Phase 1 – work plan

During the first phase of the ESIA (June 2022), kick-off meetings with the project's proponents and sponsors were held, as were held also meetings with municipal and lower-level authorities. These kick-off meetings had the following objectives:

- To make the first contact with local government entities to facilitate the next moments of engagement;
- Present the project and anticipated significant environmental and social impacts;
- Inform about the next phases and activities, including expected stakeholder engagement activities;
- To obtain feedback on key issues regarding the project's impacts.

7.4.2.2. Phase 2 – initialisation and scoping phase

The following stakeholder engagement activities were completed for ESIA's phase 2:

- Key informant consultations;
- Focus group discussions.

7.4.2.2.1. Key informant consultations

Consultations with key informants were held to collect data for the project's human rights impact assessment. The following key informants were interviewed (see also Figure 99).

- Caála municipal administration – including deputy of the technical sector; communal administrator of Caála; Kalenga commune *regedor* and municipal director of energy and water;
- Alto Catumbela *regedora*;

- Ukuma municipal administration – including municipal administrator, legal office director and director for infrastructure;
- Tchinjenje municipal administration – including municipal director of infrastructure and water, municipal director of registrations, IT technician and social affairs technician;
- Babaera commune administration – including the administrator of the commune and the head of secretariat;
- Longonjo municipal administration – including deputy director, secretary and director of energy services;
- Elecnor – including logistics technician and Health and Safety technician.

Caála municipal administration

Ukuma municipal administration

Babaera commune administration

Alto Catumbela *regedora*

Figure 99 – Key informant consultations.

The locations of all key informant consultations and focus group discussions can be consulted in Figure 100.

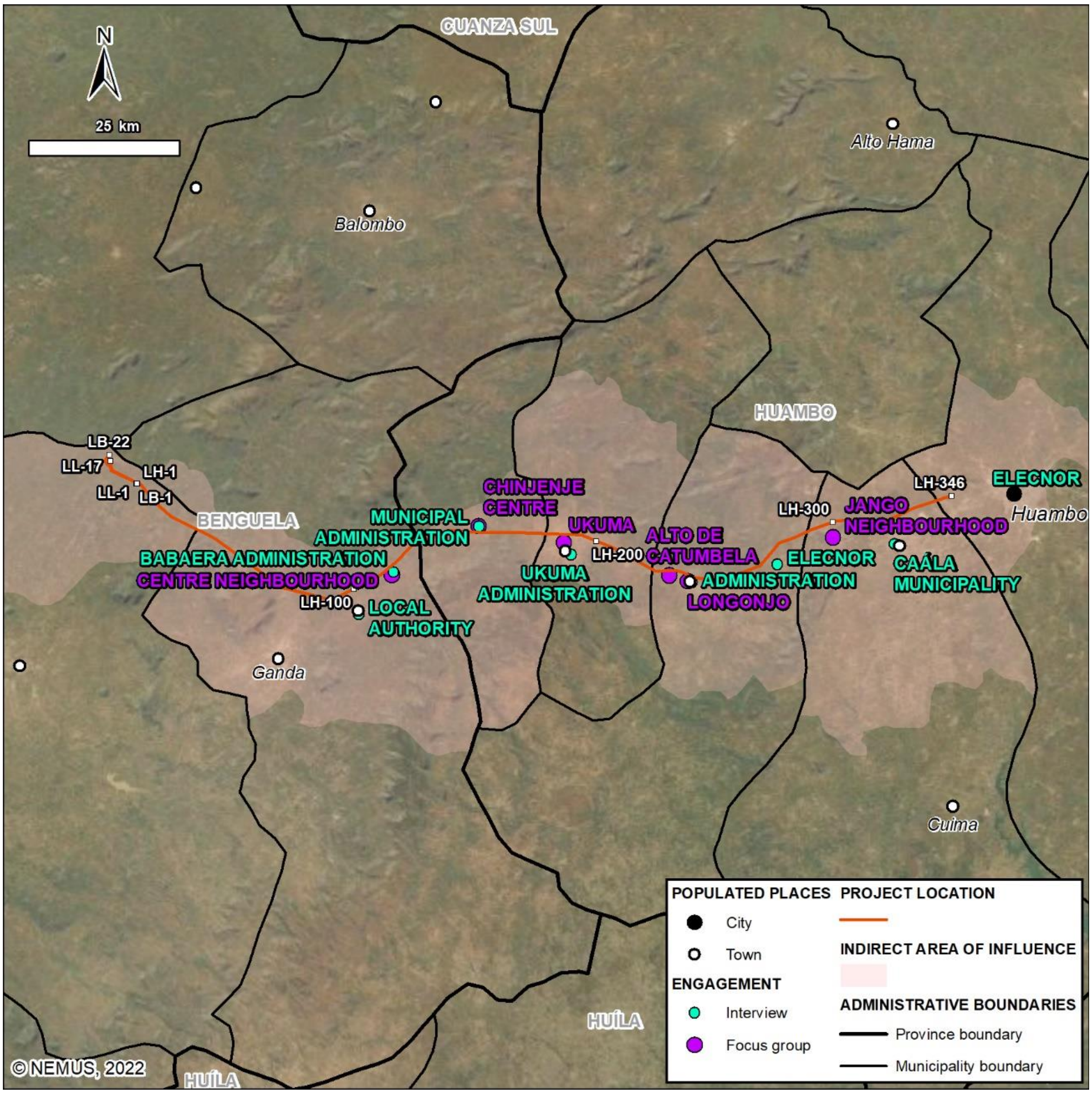

Figure 100 – Key informant consultations and focus groups discussions' locations.

7.4.2.2.2. Focus group discussions

The purpose of conducting focus group discussions is to collect qualitative information from a small group (for instance, 6 to 12 participants) in a systematic and structured format; participants interact with a facilitator who presents the participants with questions designed to yield insight into current or desired results about a specific topic or issue (Watkins et al., 2012).

Concerning the ESIA, the focus group discussions facilitated the assessment of the project's impacts on the affected communities and their socioeconomic environment.

At least five focus group discussions were held in the following localities (see also Figure 101):

- Longonjo (including leaders from all communes);
- Alto de Catumbela (Babaera commune, Ganda municipality);
- Ukuma;
- Chinjenje (Tchinjenje municipality);
- *Bairro da Sede* (Babaera commune, Ganda municipality);
- *Bairro Jango* (Kalenga commune, Caála).

Alto de Catumbela

Ukuma

Babaera (*Bairro Sede*)

Kalenga (*Bairro Jango*)

Figure 101 – Focus group discussions.

It should be noted that the selection participants for the focus group discussions are particularly important. In this way, key elements of the communities were chosen, including CBOs' leaders, Local NGOs' representants, traditional authorities (soba), and other community representants (including vulnerable groups).

7.4.2.3. Phase 3 – detailed assessment of the environmental and social impacts and risks

Disclosure of the ESIA involved engaging with national, provincial, and local stakeholders in public consultations. The ESIA disclosure process required consultation with affected communities and interested stakeholders to ensure their views and concerns are considered in developing the final ESIA document. It is also required to ensure they are promptly informed of the project activities and timeline.

The ESIA team disclosed the ESIA in a way that was culturally and technically adapted to each group of stakeholders. It was particularly presented the project activities and their associated impacts in non-technical language to local communities to ensure they are fully understood. Stakeholder comments were feed into the ESIA.

Public consultation consisted of five public sessions held in five municipalities of the Project's Direct Area of Influence (see Table 53). Furthermore, a second meeting was held in Longonjo with municipal administrators to present the Project and the detailed assessment of the environmental and social impacts and risks.

Table 53 – Public consultations conducted.

Municipality	Date
Tchinjenje	October 4th
Ukuma	October 5th
Longonjo*	October 10th and 11th
Caála	October 11th
Huambo (Belém do Dango)	October 13th

Note: * - two meeting were held in Longonjo, one with municipal administrators, and a public consultation with local community leaders.
Source: NEMUS (2022).

The information gathered can be seen in Volume II (Public Consultations) along with the list of participants per meeting. Figure 102 shows the geographical location of the public consultations carried (between October 4th and October 13th).

Figure 102 – Location of the public consultations held.

7.4.3. Engagement tools

7.4.3.1. Introduction

To achieve a consistent and effective stakeholder engagement programme implementation, the tools outlined below will be key in all project phases.

7.4.3.2. Engagement tools for kick-off meetings

For the kick-off meetings held during the work plan phase (phase 1), the following tools were used: event record sheet (to record the main occurrences and participations); presentation of key issues for debate.

7.4.3.3. Community and stakeholder consultations guide

A data collection tool was developed to collect data from the key informant consultations and focus group discussions (see section 7.4.2.2). A digital data collection tool is ideal given that this eliminates potential data entry errors, facilitates the data analysis process, and provides a tool for reporting the stakeholder engagement activities.

Therefore, two digital templates for data collection were created for the focus group discussions and the key informant consultations, using CAPI software for the data entry (see Figure 103).

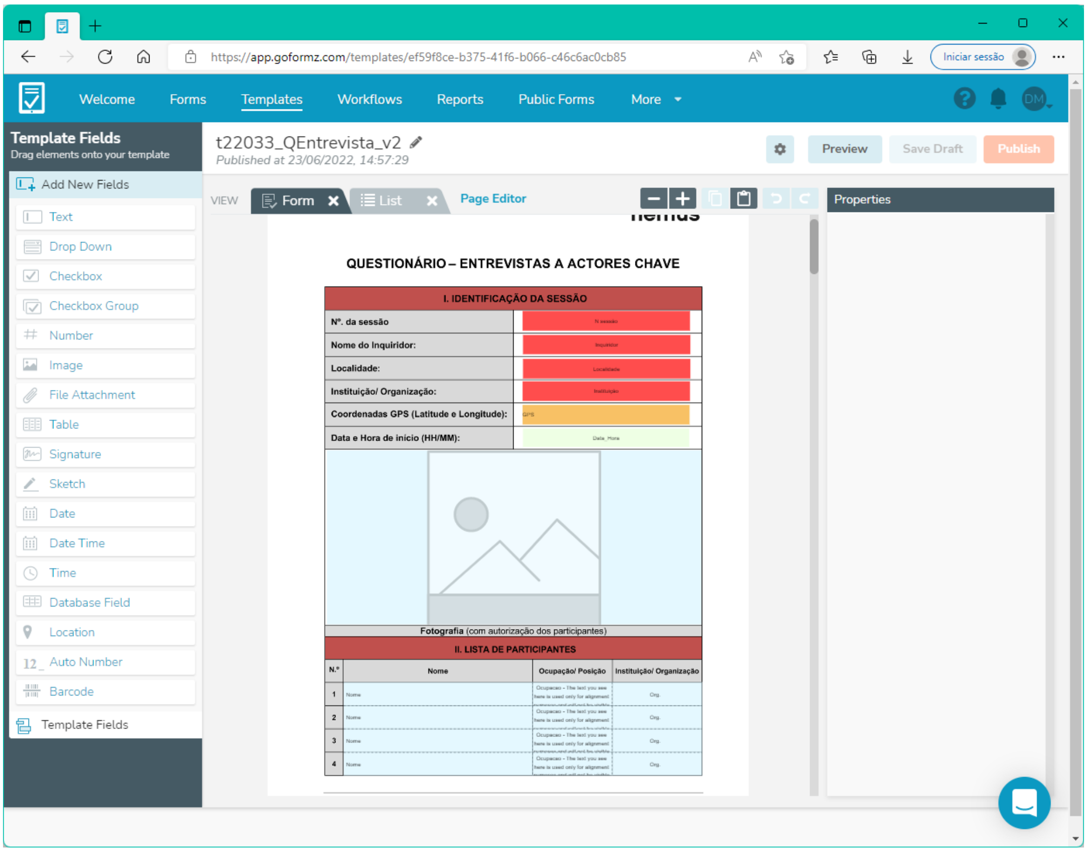

Figure 103 – Key informant consultations questionnaire in the GoFormz application.

7.4.3.4. Engagement tools for public consultations

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

The ESIA team will disclose the ESIA previously (via municipal and provincial authorities), and the presentation will describe the ESIA's main findings in a way that is culturally and technically adapted to each group of stakeholders.

7.5. Public consultations

Public consultation consisted of five public sessions held in five municipalities of the Project's Direct Area of Influence (see Table 54 and Figure 102 to Figure 107). Furthermore, a second meeting was held in Longonjo with municipal administrators to present the Project and a detailed assessment of the environmental and social impacts and risks.

Table 54 – Public consultations conducted.

Municipality	Date
Tchinjenje	October 4th
Ukuma	October 5th
Longonjo*	October 10th and 11th
Caála	October 11th
Huambo (Belém do Dango)	October 13th

Note: * - two meeting were held in Longonjo, one with municipal administrators, and a public consultation with local community leaders.
Source: NEMUS (2022).

These sessions had the following objectives:

- Present the Project and its impacts, including the resettlement needs;
- Present the resettlement implementation team and timetable;
- Collect feedback on communities' views and concerns about the Project's environmental and social impacts and risks, including on mitigation and enhancement measures.

The following sections present the Public Consultations' main results and conclusions (for each session).

Figure 104 – Location of the ESIA's public consultations.

Figure 105 – Public consultation in Tchinjenje (October 4th).

Figure 106 – Public consultation in Caála (October 10th).

Figure 107 – Public consultation in Belém do Dango, Huambo (October 13th).

7.5.1. Tchinjenje, October 4th

As stated before, a public consultation was held in Tchinjenje on October 4th. Details about this session (event coordinator, facilitator, location, date and hour and photo) can be seen in Figure 108.

Event Coordinator	Diogo Maia
Facilitator (if any)	Abel
Province	Huambo
Municipality	Tchinjenje
Commune	Chinjenje
GPS Coordinates	-12.8253964, 14.9354998
Date and Hour	2022-10-04 9:35 a.m.

Figure 108 – Details of the Public consultation in Tchinjenje (October 4th).

Regarding the ESIA, the following feedback was received in this public session:

- Several community members asked about the future availability of electricity in the municipality. It was answered that the distribution of electricity in the center of the municipality might be established afterwards but that its development is not part of the current Project under evaluation;
- Two community members asked about the Project's employment and if members of the community will be employed. It was answered that the ESIA anticipated the hiring of workers from communes in the IAI wherever possible for the project construction activities;
- A community member asked about the worker recruitment process. It was answered that this process will involve local municipalities' administrations and eventually also the *Sobas*;
- A community member asked about the resettlement process. It was answered that this process will be ongoing in the following months and that no physical resettlement is anticipated at this moment.

The list of participants of the Public Consultation in Tchinjenje can be seen in the following pages.

REPÚBLICA DE ANGOLA
Governo da Província do Huambo
ADMINISTRAÇÃO DO MUNICÍPIO DO CHINJENJE

SECRETARIA - GERAL

LISTA DE PRESENÇA DE ABERTURA DA JORNADA DA MULHER RURAL DO MUNICÍPIO DO CHINJENJE/2022

Nº	NOME	Nº DE TELEFONE
01	Evaristo Pedro Paris	958736581
02	[illegible] Salomão Kamuato	935706283
03	[illegible] Elisa	923558158[illegible]
04	Felix Adriano	936927005
05	Francisco Sawando	924205626
06	Paulo Kalikili	93669[illegible]90
07	Francisco Tchambasuku	932965443
08	Kamuelo Domingos	947491504
09	[illegible]	93296[illegible]55
10	José [illegible] Venâncio	92[illegible]93096
11	Paulino [illegible] Gonçalves	921686870

12	Valdemir Umela Tombo Alrtio	924359011
13	Mário Quintas	944664259
14	Grace Velelchiaido	927659567
15	Joaquim Cacilhas Fernandez	930208443
16	Leonardo Chimuco Jorge	926460396
17	Nuno Cabila Salongo	939044457
18	Simão T. Hasel	933724241
19	Horacio gaspar	935621098
20	Cesar Chadiina	943716619
21	Paulo Kapucca geraldo	949872142
22	Idaliso Gabriel Jecayamale	941267374
23	Celestino Ferramenta	92
24	Mariano Diogo	921667151
25	Manuel Kamulambo	923599166
26		

27	Xavier Evaristo	934925354
28	Filipe Tchimbolo	926364636
29	Gosatio Tchipula	926733688
30	Daniel José Kamalé	927781403
31	Fernando Kalivala	927263658
32	Daniel Kapingala	934336217
33	Maria Isabel Muluta	928124987
34	Isaías Neto	L.R.C.V.V. - 923805565
35	João Epalanga	D.M.S. - 923863609
36	Maria Domingos	925464203
37	Mauricio Tchonata	
38	Ana Salsimina	923358907
39	Manuel Kamuquenje	
40	António Kambanga	920224869

41	Bernarda Martins	
42	Marciana Noquinda	
43	Dominga Kassunda	
44	Benvinda Jololi José	
45	Teresa Nassapalo	
46	Hilária Balombo	
47	Félix Moreno	
48	Kandida Kapunga	
49	Paula Domingos	
50	Maria Domingas	
51	Regina Kaulio	
52	Filomena Nacombe	
53	Bento Kapitango	933227181
54	Mateus Queiroz Tchamolena	944268157

55	Amélia Costa Barreira	939450095
56	Isaac Tiongombe	931061245
57	Teresa Tchissombongo	935955965
58	Kandida Mulica	
59	Emília Senge	
60	Angelina Sola	942846600
61	Adelina Kandeia	
62	Victorina Mukongo	935924734
63	Teresa Nalote	
64	Maria de Fátima	938814125
65	Isabel Katevo	927510910
66	Natalia Imbo	
67	Angelina da Conceição	928653306
68	Maria Nassessa	

69	Victoria Tchitombe	
70	Constantina Vatulila	
71	Domingas Lirronga	
72	Delfina Nassi	
73	Emiliana Sofia	
74	Antonio Tchilepa	
75	Felicia Vayekela	92~~7~~657877
76	Teresa Noleti Tiago	
77	Margarida Maria Vayola Pereira	924330326
78	Maria Jacinta Natualila	944252571
79	Das Jorlfa	
80	Francisco Armando	933638451
81	Bernarda F Teresa Tchinhama	
82	Numã Diana	93 1314 633

83	Evangelista Tchiano Vinganbi - Igreja Católica	929199787
84	Madalena Salala	
85	Domingas Tchaimba	
86	Ilisa Bâmbi	
87	Rosalia Wessi	
88	Verónica Benga	
89	Luisa Nequinda	
90	Bento Sassatuala	936672099
91	Victoria Vela	942370580
92	Florentina Cipriano	
93	Simão Catombela	946391681
94	Catarina Júlia	
95	Domingas Sombo	
96	Madalena Nassapalo	932049394

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97	Albina Vayombela	
98	Rosalia Nguere	
89	Zelita olimpio	
100	Luisa Chilombo	926961514
101	Sofia Nguere	
102	Inês Nguere	
103	Albertina Ebanjo	
104	Ermelinda Rosa	
105	Felicia Ndumbo Mondaca	
106	Flora Mbueta	
107	Felicia Madruga	
108	Justino Tomas [illegible]	940227719
109	Damião Sicrito Miguel	Estudante
110	Jovita Tuta	

111	José Sumano	
112	Paulo Justino Chico	
113	Frederico Jamba Mukanjo	945416828
114	Teresa Wandi	
115	Teresa Chinossole	
116	Maria Soma Vilinga	
117	Joaquina Nacalinga	
118	Domingos Vandende	
119	Inocência K. Catchipis	924166238
120	Amandio José	943707274
121	Abel Mohlan Dong Dc.	922-22-59-13
122	Luciana Nanguli K. Vilinga	
123	Teresa Bola Manuel	935253326
124	Perfelina Miranda	

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125	Anealete Anastância Tchicamba	
126	Antónia Eládia Tchinguelo Severino	
127	Mariana Kalanguê	
128	Eduardo Vitekenho	
129	Adelaide Tch. Kapaca	
130	Elizabeth N/a Quimola	
131	Luzia Sósa	
132	Inácia Balombo	
133	Adélia Tchapeka	
134	Helena Chilula Ana Gonzalves	
135	Delfiana Sinangeli	
136	Amélia Cacinda	
137	Luciana Wimbo	
138	Juliana Vapeyela	

139	Verónica Cassova	
140	Cipriana Nacessa	
141	Helena Tchilimbo	
142	Augusta Tchambela	
143	Rosária Tito	
144	Josefina Sussi	
145	Angelina Fonseca	
146	Maria Tchindjumbile	
147	Victorina Maria	
148	Maria Nguewe	
149	Florinda Tchilulo	
150	Cristina Loopessa	
151	Lucia Silva Kalifuita	

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139	Verónica Cassova	
140	Cipriana Nacessa	
141	Helena Tchilimbo	
142	Augusta Tchambela	
143	Rosária Tito	
144	Josefina Sussi	
145	Angelina Fonseca	
146	Maria Tchindjumbile	
147	Victorina Maria	
148	Maria Nguere	
149	Florinda Tchilula	
150	Cristina Locessa	
151	Luis Silva Felizmita	

166	Paulo Francisco Sapalalo	946971284
167	Mateus Joaquim da Cruz	935616310
168	Feliciana Domingas Severino	924180335
169	Helena Teresa Abel	
170	Josefina Maiele Cupatele	936321722
171	José Xavier Dias Guilherme	923965557
172	Ana Cachongo Chimonda	
173	Abel Feliciano	925053848
174	José Pedro Ngahango	924145260
175	Rosa Tchina Lambela	922911404
176	Mário Chinhama Lipita	931393555
177	Florença E. S. Soares	923797258
178	Ilda Clara C. Manuel	930120914
179	Matias Paulo Felizmitar	927467604

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CHINJENJE, 04 DE OUTUBRO DE 2022.

O SECRETÁRIO GERAL

Obadias Vata Bernardo

OBADIAS VATA BERNARDO

Figure 109 – List of participants – public consultation in Tchinjenje (October 4th).

Tchinjenje, October 4th

As stated before, a public consultation was held in Tchinjenje on October 4th. Details about this session (event coordinator, facilitator, location, date and hour and photo) can be seen in Figure 108.

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Facilitator (if any)	Abel
Province	Huambo
Municipality	Tchinjenje
Commune	Chinjenje
GPS Coordinates	-12.8253964, 14.9354998
Date and Hour	2022-10-04 9:35 a.m.

Figure 110 – Details of the Public consultation in Tchinjenje (October 4th).

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08	Kamleto Domingos	947491504
09	Francisco Joyeta	932964955
10	José Sambalundi Venâncio	929993056
11	Paulino Bongonja Gonçalves	921686870

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12	Valdemir Ornela Santos Abílio	924359011
13	Mário Quintas	944664259
14	[illegible]	927659567
15	Joaquim [illegible]	930208493
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17	Nuno [illegible] Lourenço	9390 [illegible] 457
18	Simão T. Abel	933724241
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21	Paulo Kapuca Geraldo	949872142
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23	Celestino Ferramenta	92
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25	Manuel Kamulambo	923599166
26		

27	Xavier Evaristo	934925354
28	Filipe Tchimbole	926364636
29	[illegible] Tchipula	926733683
30	Daniel José Kamalê	927781403
31	Fernando Kalivala	927263658
32	Daniel Kapingala	934336217
33	Maria [illegible] Muluta	928124987
34	[illegible] Neto	L.R.C.V.V. – 9[illegible]
35	João Epalanga	D.M.S. – 923863609
36	Maria Domingas	925464203
37	Maurício Tchonata	
38	Ana [illegible]	992358904
39	Manuel Kamuquenje	
40	António Kanhanga	930224869

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41	Bernardo Martins	
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43	Dominga Kassinda	
44	Binvinda Jololi José	
45	Teresa Nassopalo	
46	Hilária Balombo	
47	Félix [illegible]	
48	Kandida Kapunga	
49	Paula Domingos	
50	Maria Domingas	
51	Regina Kanuco	
52	Filomena Nocombe	
53	Bento Kapitango	933227181
54	Mateus Queiroz Tchamolena	944268157

55	Acidia Costa Barreia	939450095
56	Isaac Kumgambe	931061245
57	Teresa Tchocombinge	935955965
58	Kandida Mulica	
59	Emília Senje	
60	Angelina Sola	942846600
61	Adelina Kondeia	
62	Victorina Mahongo	935924734
63	Teresa Nalate	
64	Maria de Fátima	938814125
65	Isabel Kativa	927510910
66	Natalia Imbo	
67	Angelina da Conceição	9386533 06
68	Maria Nassessa	

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69	Victoria Tchitombe	
70	Constantina Vatulila	
71	Domingas Tiwonga	
72	Delfina Nassi	
73	Emiliana Sofia	
74	Antonio Tchilopa	
75	Felicia Vayekela	927657877
76	Teresa Noloti Tiago	
77	Margarida Maria Vayola Pereira	924330326
78	Maria Jacinta Natuali	94 4252571
79	Das Forla	
80	Francisco Armando	933638451
81	Bernarda F Teresa Tchinhama	
82	Irmã Diana	93 1314 633

83	Evangelista Tchiaano Vinsanbi - Igreja Católica	929199787
84	Madalena Salala	
85	Domingas Tchoimbo	
86	Ilisa Bimbi	
87	Rosalia Wessi	
88	Verónica Benga	
89	Luiza Nguinda	
90	Bento Sakatuela	936672099
91	Victoria Vela	942370580
92	Florentina Cipriano	
93	Simão Catombela	946391681
94	Catarina Júlia	
95	Domingas Sombo	
96	Madalena Nassayele	932049394

97	Albina Vayombela	
98	Rosalia Nguenve	
89	Zelita olimpio	
100	Luisa Chilombe	926961514
101	Sofia Nguenve	
102	Inês Nguevé	
103	Albertina Ekanjo	
104	Ermelinda Rosa	
105	Felicio Ndombo Mondo	
106	Flora Mbueta	
107	Felicio Madrugo	
108	Justino Tomas Quiála	940227719
109	Damião Sacuto Miguel	Estudante
110	Jovita Tuta	

111	José Sumone	
112	Paulo Julino Chico	
113	Frederico Jamba Mukanjo	945416828
114	Teresa Wandi	
115	Teresa Chinossole	
116	Maria Soma Vilinga	
117	Joaquina Nacalinga	
118	Domingos Vandende	
119	Inocêncio K. Catchipis	924166238
120	Armandio José	943707274
121	Abel Mohlongongo	922-22-59-13
122	Luciana Nongali K. Vilinga	
123	Teresa Bola Manuel	935253326
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126	António Elóidio Tchinguali Severino	
127	Mariana Kalavãgui	
128	Eduardo Vitekeno	
129	Adelaide Tch. Kapeca	
130	Elizabeth N/a Guinala	
131	Luzia Sosa	
132	Inácia Balombo	
133	Adélia Tchapeka	
134	Helena Chilula Angolana	
135	Delfina Simangui	
136	Amélia Cacinda	
137	Luciana Wunso	
138	Juliana Vafeyela	

139	Verónica Cassova	
140	Cipriana Nacessa	
141	Helena Tchilimbo	
142	Augusta Tchambela	
143	Rosária Tito	
144	Josefina Sussi	
145	Angelina Fonseca	
146	Maria Tchindumbile	
147	Victorina Maria	
148	Maria Nguere	
149	Florinda Tchilulo	
150	Cristina Lopessa	
151	Lucia Silva Kalifunita	

139	Verónica Cassova	
140	Cipriana Nacessa	
141	Helena Tchulimso	
142	Augusta Tchamsela	
143	Rosária Tito	
144	Josefina Sussi	
145	Angelina Fonseca	
146	Maria Tchindjum Sile	
147	Victorina Maria	
148	Maria Nguere	
149	Florinda Tchilula	
150	Cristina Loopessa	
151	Luís Silva Folifuita	

166	Paulo Francisco Sapalalo	946971284
167	Mateus Joaquim da Cruz	935616310
168	Feliciana Domingas Severino	924180335
169	Helena Tereza Abel	
170	Josefina Maiele Cupatele	936321722
171	José Xavier Dias Guilherme	923965557
172	Ana Cachango Chimonda	
173	Abel Feliciano	925053848
174	José Pedro Mahango	924145260
175	Constância Lambela	922911404
176	Mário Chinhama Lipota	931393555
177	Florença E. S. Sonaneo	923797258
178	Ilda Clara C. Manuel	930120914
179	Matias Paulo Folifuitaz	927467604

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CHINJENJE, 04 DE OUTUBRO DE 2022.

O SECRETÁRIO GERAL

Obadias Vata Bernardo

OBADIAS VATA BERNARDO

Figure 111 – List of participants – public consultation in Tchinjenje (October 4th).

Ukuma, October 5th

A public consultation was held in Ukuma on October 5th. Details about this session (event coordinator, facilitator, location, date and hour and photo) can be seen in Figure 112.

Event Coordinator	Diogo Maia
Facilitator (if any)	
Province	Huambo
Municipality	Ukuma
Commune	Ukuma
GPS Coordinates	-12.8675406, 15.0716086
Date and Hour	2022-10-05 2:30 p.m.

Figure 112 – Details of the Public consultation in Ukuma (October 5th).

Regarding the ESIA, the following feedback was received:

- The *Soba* stated that the community is conscientious about the Project's importance and overall impacts and that he did not anticipate any negative impacts in the community;
- The police officer stated that security measures should be taken during the construction phase. It was answered that this was anticipated and detailed in the ESIA, and that coordination will occur between Elecnor and the police station in Ukuma;
- Two community members asked about the future availability of electricity in Ukuma. It was answered that the distribution of electricity in Ukuma might be established afterwards but that its development is not part of the current Project under evaluation;
- A question about the demining process was asked (details and timeframe). It was answered that demining will occur previously to any other Project's activities and that this process will be communicated in due time to local authorities.

The list of participants of the Public Consultation in Ukuma can be seen in the following page.

Lista de presença

1-
2-
3-
4-
5- Alberto Manuel Carlenos Deleg. Ministr. Ukuma 923459733
6- Paula Cristina Adolfo - Acção Social - 941480[illegible]
7- Anabela Santiago — C.M.F. — 94379953
8- Osvaldo Anacleto Pedro - Gab. Jurid. - 941-899[illegible]
9- Mário Armindo Sapalo - chef. sec. Registo - 935694[illegible]
10- Vitorino António Mena — Sec GEPE - 923154635
11- Desejado Nanga Sungo — Diretor Infraestr. 925551977
12- [illegible] — C. Adm. — 923357785
13- Jeremias Eduardo Kakelenguelo — D.M. Energia e Água - 9256412[illegible]
14- José Sertão Gusinefi → D.M.F. 923960501
15- António Muetalo Nito — D.M.R. - 936645646
16- Gerald Kafitango Mariano DRH - 926396855
17- Alexandre Bouieres Ramalho - Assessor - 932825100
18- Cláudio Florentino Carlos - Soba - 926464795
19- Filipe Quintino — Sociedade Civil
20- Jusinalda Valentina Cassoma - 926737358
21- Bernardo Canguji → directora GMPDEI - 922880612 - Assessor

Figure 113 – List of participants – public consultation in Ukuma.

Longonjo, October 10^{th} and 11^{th}

Two meeting occur in Longonjo in early October. A meeting with the municipalities' administrators, and a public consultation the day after. Details about these sessions (event coordinator, facilitator, location, date and hour and photo) can be seen in Figure 114 and Figure 115.

Event Coordinator	Diogo Maia
Facilitator (if any)	
Province	Huambo
Municipality	Longonjo
Commune	Longonjo
GPS Coordinates	-12.9076816, 15.246175
Date and Hour	2022-10-10 11:07 a.m.

Figure 114 – Details of the Public consultation in Longonjo (October 10^{th}).

Event Coordinator	Diogo Maia
Facilitator (if any)	
Province	Huambo
Municipality	Longonjo
Commune	Longonjo
GPS Coordinates	-12.9081911, 15.2464056
Date and Hour	2022-10-11 9:36 a.m.

Figure 115 – Details of the Public consultation in Longonjo (October 11th).

Regarding the ESIA, the following feedback was received in Longonjo:

- The municipality's administrators asked about the future availability of electricity in the municipality. It was answered that the distribution of electricity in the center of the municipality might be established afterwards but that its development is not part of the current Project under evaluation;

- The municipality's administrators and several community members inquired about the Project's employment and if members of the community will be contracted. It was answered that the ESIA anticipated the hiring of workers from communes in the IAI wherever possible for the project construction activities, and that the hiring process will involve local municipalities' administrations and eventually also the *Sobas*;
- The municipality's administrators inquired about the resettlement process and compensation rates. It was answered that a Resettlement Action Plan is being prepared, that this process will be ongoing in the following months and that no physical resettlement is anticipated at this moment;
- Finally, a community member also asked about the resettlement process, affected households and agricultural actives. It was answered that this process will be ongoing in the following months and that no physical resettlement is anticipated at this moment.

The list of participants of the Public Consultation in Longonjo can be seen in the following pages.

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Estudo de Impacto Ambiental e Social (EIAS) da Linha de Transmissão de 220 Kv Lomaum-Huambo e Subestações Associadas

Consultas públicas

REGISTO DE PARTICIPANTES

Data: ________________

Local: Longonjo

Nome	Instituição (por favor não utilize acrónimos)	Função	Endereço	Tel. / Cel.	E-mail
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Figure 116 – List of participants – public consultation in Longonjo (1).

CONSULTA PÚBLICA - LONGONJO 11/10/2022

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Nome	Instituição (por favor não utilize acrónimos)	Função	Endereço	Tel. / Cel.	E-mail
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Nunda Queirino	Soba	Chilali		947979634	
Alberto Sapato		Tawein		927758055.	
Verónica	Bunolo	Capango			
Marcelina Nululo					
Joaquim Paulo					

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Nome	Instituição (por favor não utilize acrónimos)	Função	Endereço	Tel. / Cel.	E-mail
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José Inocêncio	Soba	A.SPAT.		946273583	

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Figure 117 – List of participants – public consultation in Longonjo (2).

Caála, October 11th

A public consultation was held in Caála on October 11th. Details about this session (event coordinator, facilitator, location, date and hour and photo) can be seen in Figure 118.

Event Coordinator	Diogo Maia
Facilitator (if any)	
Province	Huambo
Municipality	Caála
Commune	Kaala
GPS Coordinates	-12.8517761, 15.5540053
Date and Hour	2022-10-10 2:11 p.m.

Figure 118 – Details of the Public consultation in Caála (October 11th).

Regarding the ESIA, the following feedback was received:

- The *Soba* stated that he did not anticipate any negative impacts in the community. Furthermore, he stated the need for electricity to be distributed in the local communities where the transmission line will pass by. It was answered that the distribution of electricity in Ukuma might be established afterwards but that its development is not part of the current Project under evaluation;
- Several community members inquired about the Project's employment and if members of the local communities will be contracted. It was answered that the ESIA anticipated the hiring of workers from communes in the IAI wherever possible for the project construction activities, and that the hiring process will involve local municipalities' administrations and eventually also the *Sobas*.

The list of participants of the Public Consultation in Caála can be seen in the following figures.

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Estudo de Impacto Ambiental e Social (EIAS) da Linha de Transmissão de 220 Kv Lomaum-Huambo e Subestações Associadas

Consultas públicas

REGISTO DE PARTICIPANTES

Data: ____________

Local: Caála

Nome	Instituição (por favor não utilize acrónimos)	Função	Endereço	Tel. / Cel.	E-mail
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António Capitango	Mwangunja	Morador	Mwangundja	94726 5907	
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Nome	Instituição (por favor não utilize acrónimos)	Função	Endereço	Tel. / Cel.	E-mail
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Venâncio Tchavonga	Mwangundja	Morador	Mwangundja		
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Figure 119 – List of participants – public consultation in Caála.

Belém do Dango (Huambo), October 13th

A public consultation was held in Belém do Dango (Huambo) on October 13th. Details about this session (event coordinator, facilitator, location, date and hour and photo) can be seen in Figure 120.

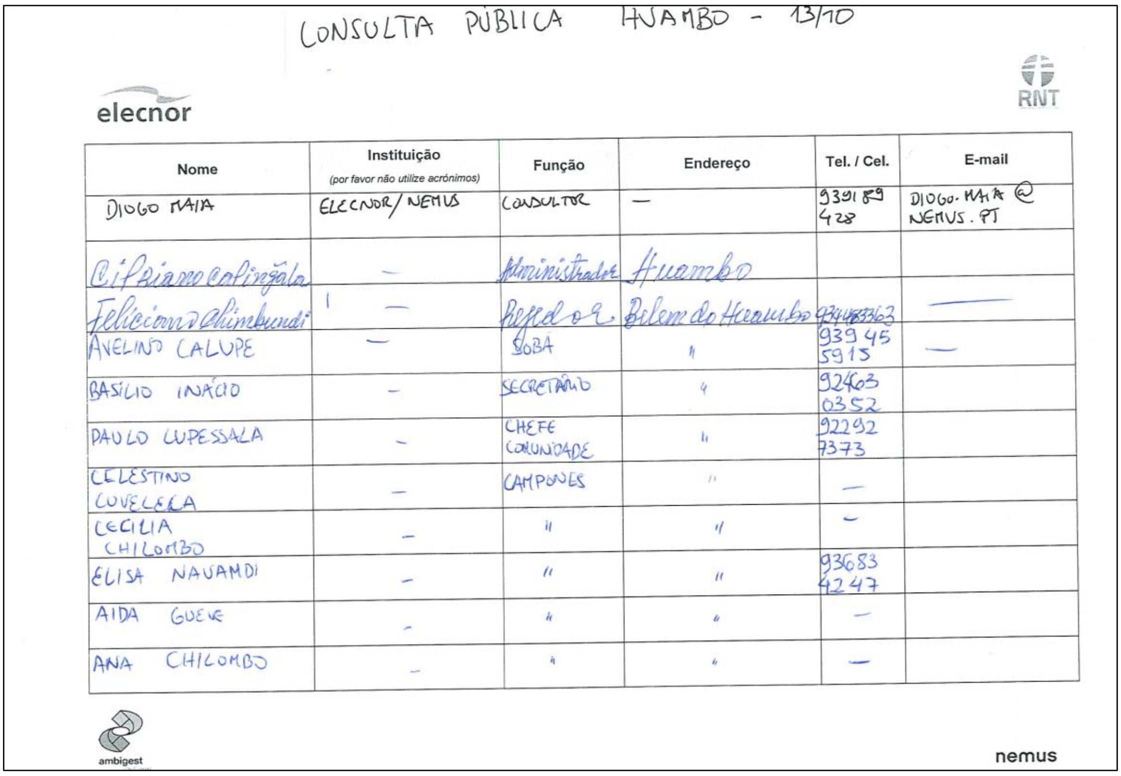
Event Coordinator	Diogo Maia
Facilitator (if any)	José Mundo
Province	Huambo
Municipality	Huambo
Commune	Huambo
GPS Coordinates	-12.8003467, 15.6382899
Date and Hour	2022-10-13 9:36 a.m.

Figure 120 – Details of the Public consultation in Huambo (October 13th).

Regarding the ESIA, the following feedback was received:

- The *Soba* stated that he did not anticipate any negative impacts in the community.
- Several community members inquired about the resettlement process, affected households and agricultural land and compensation rates. It was answered that a Resettlement Action Plan is being prepared, that this process will be ongoing in the following months and that no physical resettlement is anticipated at this moment.

The list of participants of the Public Consultation in Huambo can be seen in the following figures.



CONSULTA PÚBLICA HUAMBO - 13/10

elecnor

RNT

Nome	Instituição (por favor não utilize acrónimos)	Função	Endereço	Tel. / Cel.	E-mail
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Feliciano Chimbundi	—	Regedor	Belem do Huambo	934483363	—
AVELINO CALUPE	—	SOBA	"	93945 5915	—
BASÍLIO INÁCIO	—	SECRETÁRIO	"	92463 0352	
PAULO LUPESSALA	—	CHEFE COMUNIDADE	"	92292 7373	
CELESTINO CUVELELA	—	CAMPONES	"	—	
CECILIA CHILOMBO	—	"	"	—	
ELISA NAUAMDI	—	"	"	93683 4247	
AIDA GUEVE	—	"	"	—	
ANA CHILOMBO	—	"	"	—	

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JOSÉ MUNDO	ADM. SECTOR XAVIER SAMALAU	FISCAL AD ECON.	SÃO JOÃO	94333 7969	

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Figure 121 – List of participants – public consultation in Huambo.

8. Identification and Evaluation of Environmental and Social Impacts

8.1. Climate

8.1.1. Introduction

Supporting the objectives of the 2015 Paris Agreement, according to Principle 2 of the Equator Principles (Equator Principles Association, 2020a), concerning Environmental and Social Assessment, and given the project characteristics, it is expected in the ESIA a Climate Change Risk Assessment (CCRA) is to identify and analyse the relevant potential or actual climate-related physical risks and, if applicable, transition risks related impacts of the Project and propose measures to avoid the same impacts and risks where possible or otherwise to minimise and mitigate them during the project development lifecycle. Where residual impacts remain, measures to compensate/ offset/ remedy for 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, comprised of this section, the Climate Change specialised study and associated mitigation measures, follows, as far as possible, the guidelines and methods provided by the Equator Principles Association (Equator Principles Association, 2020b), Task Force on Climate-related Financial Disclosures (TCFD, 2021), European Bank for Reconstruction and Development (European Bank for Reconstruction and Development, 2018) and International Finance Corporation (IFC, 2012a) (IFC, 2012b), together with GHG Protocol and with applicable national legislation (including Environment 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). Also, the OECD Common Approaches for Officially Supported Export Credits and Environmental, and Social Due Diligence (OECD, 2022b) is observed.

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.

All 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.

8.1.2. Construction phase

The project construction activities likely to impact climate are the following:

- Land clearance for transmission tower foundation areas, new SS area, access roads: removal of vegetation;
- General operation of construction equipment and vehicles at transmission tower foundation areas, SS (new and existing) areas, access roads,

temporary tower laydown and assembly areas and construction camps: use of fuels;

- Operation of construction camps and construction staff displacement on construction areas: use of fuels for electricity generation, camp activities and transportation;
- General building / assembling operations of transmission towers and SS (new and existing): use of materials.

Given the project characteristics and the previous baseline assessment on climate, the project is expected to cause the following negative impacts in the construction phase:

- Emissions of GHG: from fuels consumption in equipment, vehicles and construction camps related to construction phase - Scope 1 and electricity Scope 2 emissions; from production of materials used in construction phase – Scope 3 emissions (climate transition risk);
- Reduction of carbon sinks: clearance of vegetation (climate transition risk).

Considering the **emission of GHG**, the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) are followed for the calculation of emissions from activity data. The information available for emission sources in the construction phase is the following:

- Direct emissions (Scope 1): total fuel consumption by construction vehicles and mobile equipment: 506,876 l diesel, 4,461 l gasoline;
- Indirect emissions from consumption of purchased electricity (Scope 2): average monthly consumption of 2,500 kWh;
- Indirect emissions from materials used (Scope 3): total 7,000-8,000 m^3 of concrete, total 400-500 ton of steel for tower foundations and 3,800 ton of steel for tower structure.

The base information for the calculation of the direct CO_2 emissions from diesel and gasoline consumption (reference method) is presented in the following table. Direct CO_2 emissions are estimated in 1,351 t.

Table 55 – Base information for calculation of direct GHG emissions

Fuel	Density (kg/l)	Net calorific value (TJ/Gg)	CO_2 emission factor (kg/TJ)
Diesel	0.83	43.0	74,100
Gasoline	0.75	44.3	69,300

Source: (IPCC, 2006)

As for indirect emissions from consumption of purchased electricity, it is considered 1.111 kg CO_2 eq. /kWh as the emission factor of electricity supplied in the Benguela Province (Elecnor, 2022), which results in 100 t CO_2 eq.

Finally, 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. Considering 8,000 m^3 as the concrete volume used, indirect emissions from concrete used are estimated in 106 t CO_2. Accounting for 4,300 t of steel used (500 t for foundations and 3,800 t for tower structure), indirect emissions from steel are estimated in 6,278 t CO_2.

Table 56 – Base information for calculation of indirect GHG emissions from concrete production

Material	Type	Cement content (kg/m^3)	Clinker incorporation in cement (%)	CO_2 emission factor (t/t clinker)
Concrete	C25/30	340	75%	0.52

Source: (IPCC, 2006); (SECIL, 2014)

Table 57 – 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 these results the total GHG emissions estimated for construction phase are 7,835 t CO_2 eq., 17% resulting from direct emissions and 81% of indirect emissions related with construction materials' used, mainly steel. This represents 0.03% of the current (2018) National GHG emissions.

The impact is negative as it goes against the national commitments regarding the Paris Agreement, in particular the Nationally Determined Contribution of Angola (Government of Angola, 2021a), and the mitigation efforts proposed under the National Climate Change Strategy 2018-2030 (Government of Angola, 2017). However, due to the amount of estimated GHG emissions the impact is considered with low intensity and significance.

Table 58 – Impact assessment on “Climate” (construction phase): “Emissions of GHG”

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct/Indirect
Extent	National/International
Duration	Permanent
Likelihood	Definite
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

Relative to **reduction of carbon sinks**, the construction phase will involve the clearance of a total area of 15,109.08 ha, comprising 2,229.20 ha of forest plantation (*Eucalyptus spp.*), a relevant carbon sink. The base information for the calculation of the carbon content of the forest cleared area related with yearly biomass growth is provided in the following table.

Table 59 – Base information for calculation of removal of carbon sinks (forest) emissions

Ecological zone	Plantation	Yearly above-ground biomass growth (t d.m. / (ha.year)	Carbon fraction (t C / t d.m.)
Tropical shrubland	*Eucalyptus sp.* (older than 20 years)	8	0.47

Source: (IPCC, 2006)

For this information results that clearance avoids a yearly increase of carbon stock of 8,382 t C, accounting only above-ground biomass and excluding carbon in soil and dead organic matter, which is equivalent to 30,733 t CO_2. This value is 4 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. Climate Change specialised study), being considered that the impact intensity is Medium and the significance is Moderate.

Table 60 – Impact assessment on "Climate" (construction phase): "Reduction of carbon sinks"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	National/International
Duration	Permanent
Likelihood	Definite
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

8.1.3. Operation phase

The foreseen project operation activities likely to impact climate are the following:

- Operation of transmission line and SS: transmission of electricity from hydroelectric source to Benguela Province and occurrence of corona discharges;
- Routine maintenance of transmission line and SS: use of fuels.

The project is expected to cause the following positive impact on climate in the operation phase:

- Reduction of GHG emissions from electricity consumption in Benguela Province: replacement of electricity generated from fossil fuels (diesel) by electricity generated from hydroelectric plants which have lower GHG emissions (climate transition risk).

Concerning **GHG emissions**, in the project operation phase it expected that the main contribution would be the replacement in Benguela province of electricity currently supplied by power plants fuelled by fossil fuels or by domestic diesel-driven generators by electricity generated by the Lauca hydroelectric plant, reducing the carbon intensity of electricity.

In fact, it is estimated that GHG emissions from current public supply electricity sources in Benguela, which use 6,800 – 7,000 l of oil per hour, amount to 1,111 g CO_2 eq. / kWh (Elecnor, 2022). With the project implementation by 2025 74% of the installed power will be renewable, resulting in a CO_2 emissions reduction of 91% to 98 g CO_2/ kWh, and avoiding 565,437 t CO_2 eq. This positive impact is aligned with the national commitments under the Paris Agreement and the mitigation efforts, particular under initiative M1 – Low carbon electricity generation of the National Climate Change Strategy 2018-2030 (Government of 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 in transmission lines and SS maintenance and the maintenance of cleared forest areas in project DAI yearly.

Table 61 – Impact assessment on "Climate" (operation phase): "Reduction of GHG emissions from electricity consumption in Benguela Province"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Indirect
Extent	National/International
Duration	Long-term
Likelihood	Definite
Intensity (or magnitude)	High
Significance (without mitigation)	High
Significance (expected post-mitigation)	High

There is not available detailed information concerning project maintenance activities during the operation phase. However, it is expected that GHG emissions from vehicles should be considerably lower than yearly GHG emissions verified in the construction phase, amounting to 450 t CO_2. The maintenance of the cleared forest area would imply an avoidance of carbon sinks limited by the amount calculated for the construction phase, 30,733 t CO_2.

It should be also noted the occurrence of other GHG emission sources related to fugitive emissions from the possible use of SF_6, a potent GHG gas, in isolation and current interruption operations and to the occurrence of corona discharges. Fugitive emissions due to SF_6 has been estimated for Africa in 2.45 kg CO_2 eq. / MWh (US EPA, 2006), which would amount to 1,247 t CO_2 eq. in the Benguela Province (508.98 GWh use of electricity per year) (Elecnor, 2022). Corona discharge refers to the emission of N_2O in transmission lines, with an irregular occurrence, which are estimated to represent 1-3 kg of CO_2 eq. / MWh (AURECON, 2020), which can represent in Benguela Province 1,526 t CO_2 eq.

Hence, major GHG emissions related to project operation phase would represent an amount smaller than 31,183 t CO_2, which would represent 6% of the GHG emission reduction caused by the project positive impact, resulting in a positive cumulative impact.

Direct and indirect GHG emissions related to fuels use, electricity, and materials, in the project operation phase are thus expected to be lower than the threshold of 25,000 t CO_2 eq. per year.

Given the project characteristics it is expected that the concretization of climate change should interfere with the project in operation phase mostly due to the following effects:

- Increased air temperature;
- Reduced water availability;
- Increased frequency of extreme weather (heat waves, floods).

Due to these effects climate change can potentially involve the following negative impacts on the project operation:

- Increased risk of reduction of transmission efficiency of lines during heat waves (climate physical risk);
- Increased risk of damage to transmission towers and SS in extreme weather events (floods, wildfires) (climate physical risk).

Considering the foreseen increased frequency of extreme temperature and precipitation events, with associated increased frequency of floods, soil erosion and wildfires in a rural setting, there is an increased risk that project infra-structure, including transmission towers and SS to be affected by these events, constituting generally acute climate physical risks.

The occurrence of extreme temperatures including in heat waves can result in a more frequent exceedance of maximum operation temperature for transmission lines, resulting in a **reduction of the transmission efficiency of lines** during these events, in possible association with higher demands for electricity for cooling. However, while the likelihood occurrence of this essentially temporary impact is difficult to assess due to climate change projections' uncertainty, it is considered not likely due to the low demand currently in force. Due to the temporary and eventual occurrence and the possible management of electricity demand in the events, the impact is considered with low intensity and negligible significance.

Table 62 – Impact assessment on "Climate" (operation phase): "Increased risk of reduction of 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 SS in floods and wildfire events**, the impact on the project operation is considered unlikely due to the location of project infrastructures relatively away from main watercourses (cf. Surface water resources baseline assessment) and the protective vegetation clearance areas considered by the project. Due to the eventual occurrence of these events, the impact is considered with low intensity and negligible significance.

Table 63 – Impact assessment on "Climate" (operation phase): "Increased risk of damage to transmission towers and SS in extreme weather events (floods, wildfires)"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	On-site
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

1.1.1 Decommission phase

In the project decommission phase the activities likely to impact climate are similar to those occurring in the construction phase:

- General operation of construction equipment and vehicles at transmission tower foundation areas, SS (new and existing) areas, access roads, temporary tower disassembly areas and work camps: use of fuels;
- Operation of work camps and staff displacement on decommission areas: use of fuels for electricity generation, camp activities and transportation.

The project is expected to cause the following negative impact in the decommission phase:

- Emissions of GHG: from energy consumption in equipment, vehicles and construction camps related to decommission phase - Scope 1 and 2 emissions (climate transition risk).

All impacts are expected to be similar to those foreseen in the construction phase albeit with smaller intensity and significance.

8.1.4. Cumulative impacts

The following impacts of the project on climate are found cumulative with other activities external to the project:

- Emissions of GHG (construction and decommission phases): cumulative with impact resulting from other activities in the project's area of influence, namely use of coal and diesel as energy source in settlements and road transport;
- Reduction of carbon sinks (construction phase): cumulative with impact resulting from deforestation in the project's area of influence.

8.1.5. Summary

The project implementation is expected to result in negative impacts on climate, concentrated on the construction phase and related to fuel use in construction equipment, vehicle and construction camps and material use, together with permanent clearance of vegetation, which cause cumulative to other activities in the project's area of influence, GHG emissions, with low significance, and reduction of carbon sinks, mitigable to low significance.

In operation phase the project is expected to cause as a positive impact with high significance the reduction of GHG emissions associated with electricity generation, through the supply of hydroelectric electricity, achieving a 91% decrease in GHG emissions due to electricity use in Benguela Province, strongly aligning with national commitment under the Paris Agreement and National Climate Change Strategy 2018-2030's mitigation initiatives.

Climate physical risks impacting the project are expected to relate to reduction of the transmission efficiency of lines in heat waves and damage to transmission towers and SS in floods and wildfire events, both classified with negligible significance.

8.2. Geology, Geomorphology, and Topography

8.2.1. Construction phase

The transmission lines execution will need to clear the vegetation and excavate the surrounding land for the construction of foundations. In the case of the associated substations, excavations will be done in a much higher area to implant the substructure. Besides the excavations, there is also a need for embankment areas to level the ground.

It is not yet known what the excavation and earthwork volumes are in total, especially if there is an equilibrium between both.

Considering the area's features encompassed by the project, the impacts will be negative due to **changes in local morphology**, direct and permanent, but limited to the points of implantation of each of the pillars and the substations' areas and, therefore, probably of medium intensity and moderate significance.

These impacts may be mitigated if the excavated soils are used for the project's embankments demands or on other engineering works that are being carried out in the surroundings. Also important to mitigate the excess of soils that cannot be used on local embankments is their use on quarries requalification located around the project influence area.

Table 64 – Impact assessment on "Geology, geomorphology and topography" (construction phase): "changes in local morphology"

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Permanent
Likelihood	Definitive
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

For the transmission towers it is known that the project will have 14 000 m^3 of excavated soil and 7 000 m^3 of filling, remaining 7 000 m^3 of **surplus soil**. Having more excavation soil than for filling is a negative impact, however, mitigated if the surplus soil is used on the embankments of the project or even to level some areas around it that need to be restored.

Table 65 – Impact assessment on "Geology, geomorphology and topography" (construction phase): "Surplus soil"

Criteria	Assessment
Status	Negative
Extent	Local
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Negligible

Moreover, the soil sealing will increase surface drainage and consequently enhance **local erosion**. This impact is negative and indirect, but of negligible intensity and significance if proper mitigation measures, like vegetation planting, are implemented to reduce the surface run-off.

Table 66 – Impact assessment on "Geology, geomorphology and topography" (construction phase): "Local erosion"

Criteria	Assessment
Status	Negative
Extent	Local
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Negligible

It is important to notice that **no geological formation** of particular interest or vulnerability is classified or identified in the intervention area, so none of the activities in this phase will affect geological and geomorphological heritage.

8.1.1. Operation phase

During the exploration phase, **no impacts on the geological, geomorphological and topographical features are expected** due to the project's maintenance.

8.3. Mineral Resources

8.1.2. Construction phase

The project does not encompass any concession or in which there is foreseen research for geological resources. Therefore, **the project will not directly interfere with the current or future geological resources' use**.

To ensure the construction works, the project should need to use geological resources (aggregates). Those resources should be from licensed exploitation areas, so this exploitation does not become an impact of the project.

8.1.3. Operation phase

During the exploration phase, **no impacts on the mineral resources are expected** due to the project's maintenance.

8.4. Hydrogeology

8.4.1. Construction phase

In this stage, the project is not expected to affect the groundwater quality as long as environmental requirements and measures usually applied to these projects are adopted.

Possible negative impacts may result from on-site accidents during the works, especially with the spillage and leakages of oil tanks, vehicles or machinery used.

The negative impacts of an **accident polluting soils and locally contaminating groundwater quality** will be temporary, of low intensity and significance.

Table 67 – Impact assessment on "Hydrogeology" (construction phase): "Groundwater contamination"

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

The project has foreseen the possibility of building a well to supply the workers and human activities during the construction stage. The groundwater use is a temporary negative impact on the **natural availability** but is of low intensity and significance, once it won't affect the groundwater reserves or other wells near the project due to the water table downgrading.

Table 68 – Impact assessment on "Hydrogeology" (construction phase): "Groundwater use"

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Temporary

Criteria	Assessment
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

8.4.2. Operation phase

The new and to be expanded substations and installation of transmission lines locations will waterproof the surface, increasing run-off and preventing rainfall infiltration and contributing to the aquifer's recharge

It is important to notice that the **recharge area reduction** is very small considering the large extent of the basement aquifer that will be affected by the project. Therefore, the negative impacts are very located and with negligible significance.

Table 69 – Impact assessment on "Hyidrogeology" (operation phase): "recharge area reduction"

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Permanent
Likelihood	Definitive
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

During the operation phase, there is a risk of groundwater pollution due to a **spillage of oils and other products used in the maintenance of the substation**. Following an accident, groundwater contamination is likely to occur. The impact of this kind of event should be insignificant and of reduced intensity, especially if removing the soils and other necessary mitigation measures are taken immediately.

Table 70 – Impact assessment on “Hydrogeology” (operation phase): “risk of groundwater contamination due to oil spill”

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Temporary
Likelihood	Definitive
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

8.5. Natural Disasters

8.5.1. Construction phase

Even though the large extent of the project encompasses gentle slopes (4 - 8% gradient), occasionally steep slopes are close to the project's direct area of influence.

There are three sections along the transmission lines near slopes with gradients over 16%, and the construction may indirectly interfere with their stability:

- LH37 to LH42 and substation V07 (around 1,800 m);
- LH125 to LH128 and substation V13 (around 1,200 m);
- LH167 to LH169 and substation V18 (around 1,000 m).

In these three sections, the project should ensure that **excavation does not compromise the slope stability, as well as punctual landslides or rockfall** from weathered rock masses are not potentiated by the machines' movement.

Slope instability corresponds to a negative impact, although very local and with negligible significance if safety measures to mitigate the risk of instability are adopted during the works.

Table 71 – Impact assessment on "Natural disasters" (construction phase): "Slope instability"

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Temporary
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

Regarding seismicity, none of the project components may trigger an earthquake, once **no activity causes a significant stress load that induces local seismicity.**

8.5.2. Operation phase

Angola is a country with low seismic activity, with the earthquake catalogue of the 1914/2014 period registering most of the earthquakes below magnitude 6. According to the ThinkHazard!, developed by the Global Facility for Disaster Reduction and Recovery (GFDRR), the Province of Huambo has a very low earthquake hazard.

Therefore, considering the reduced seismic activity the negative impacts of a **seismic event** are negligible.

Table 72 – Impact assessment on "Natural disasters" (operation phase): "seismic event"

Criteria	Assessment
Status	Negative
Extent	On-site
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

As referred to in the construction phase, three sections near the transmission lines have steep slopes. However, no project activity may trigger a mass movement. On the other hand, any instability event that results from the natural dynamics of the slopes should not interfere with the project safety after the construction stage has dealt with the main factors of instability.

8.6. Surface Water Resources

8.6.1. Construction phase

The project construction activities likely to impact surface water resources are the following:

- Land clearance for transmission tower foundation areas, new SS area, access roads, temporary tower laydown and assembly areas and construction camps: potential erosion of unprotected soil and runoff to watercourses;
- Excavations for transmission tower foundation: potential runoff of spoiled excavated soil to watercourses;
- Operation of construction camps and construction staff displacement on construction areas: generation of solid waste and sanitary effluents;
- General operation of construction equipment and vehicles at transmission tower foundation areas, SS (new and existing) areas, access roads, temporary tower laydown and assembly areas and construction camps: potential oils, fuels and other hazardous substances accidental spills to land or water courses.

Given the project characteristics and the previous baseline assessment on surface water resources, the project is expected to cause the following negative impacts in the construction phase:

- Increased turbidity and total suspended solids in rivers and streams;
- Increased concentrations of faecal bacteria and organic matter and reduced concentration of dissolved oxygen in rivers and streams;
- Risk of hydrocarbons and other hazardous substances pollution of rivers and streams.

Increased turbidity and total suspended solids in rivers and streams, degrading water quality for the several uses like human consumption, cattle consumption, fishing and aquatic ecosystems' support in downstream areas, a negative impact, might occur related with land clearance and excavation activities in high slope areas near intersections of water courses after intense precipitation events (temporary). Given the project location and considering information on slope gradient (cf. Geology, geomorphology and topography), this may occur near two streams and Cuiva River intersections, with nearby slopes reaching up to 25%:

- Between LH-174 and LH-175 (stream): transmission tower 300 m uphill;
- Between LH-213 and LH-214 (stream): transmission tower 350 m uphill;
- Between LH-216 and LH-217 (Cuiva River): transmission tower 80 m uphill.

Given the distance of the transmission towers to the water courses' intersections and the foreseen relatively low volume of soils to be mobilised, the impact is considered unlikely, and with low intensity and negligible significance.

Table 73 – Impact assessment on "Surface water resources" (construction phase): "Increased turbidity and total suspended solids in river and streams"

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

Increased concentrations of faecal bacteria and organic matter and reduced concentration of dissolved oxygen in rivers and streams, might result from activities in construction camps and the construction staff displacement on construction areas, if sanitary effluents and solid wastes are disposed on nearby water courses (direct) or are left in the land and run-off to water courses in intense precipitation events (indirect), without adequate waste and sanitary effluents management and disposal.

This is a negative impact which could affect downstream water uses, particularly human consumption. This impact is expected to be likely, with medium intensity in the construction camps located in or near the Lomaum SS, due the proximity to the

Catumbela River (nearly 100 m) and the concentration of construction staff, and low intensity elsewhere near water courses, resulting in a Moderate significance at the Lomaum SS site and Low significance elsewhere. It should be noted that construction staff is expected to amount to 550, with 120 from outside the project municipalities, which is relevant facing the population of the area (667 in Cubal and Ganda municipalities, cf. Socioeconomics specialised study).

With adequate management and disposal of solid waste and sanitary effluents the impact is expected to have negligible significance.

Table 74 – Impact assessment on "Surface water resources" (construction phase): "Increased concentrations of faecal bacteria and organic matter and reduced concentration of dissolved oxygen in rivers and streams"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct/Indirect
Extent	Local
Duration	Short-term
Likelihood	Likely
Intensity (or magnitude)	Low to Medium (at Lomaum SS construction camp)
Significance (without mitigation)	Low to Moderate (at Lomaum SS construction camp)
Significance (expected post-mitigation)	Negligible

The **hydrocarbons and other hazardous substances pollution of rivers and streams** could result in accidental spill events to land or water courses of oils, fuels and other hazardous substances used by equipment and vehicles. This potentially increase concentrations of hydrocarbons, PAH, metals, and other substances hazardous for human and ecosystems' health and reduce dissolved oxygen concentrations in the affected watercourses, resulting in a negative impact to surface water resources' quality. Since resulting from accident situations, the impact is considered unlikely.

The impact's intensity ultimately depends on the type and quantity of the spilled substance, but can be high, with moderate significance, in the locations of the watercourse intersections and road bridges due to the possible hazard to human health, if the water is used for human consumption. Provided the implementation of risk management measures reducing likelihood, the significance is expected to be generally low. As the risk cannot be eliminated totally, possible alternative locations for construction camps, transmission lines and access roads more distant from watercourses should be preferred to mitigate impacts on surface water resources.

Table 75 – Impact assessment on "Surface water resources" (construction phase): "Risk of hydrocarbons and other hazardous substances pollution of rivers and streams"

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

8.6.2. Operation phase

The project operation activities likely to impact surface water resources are the following:

- General operation of SS (new and existing) transformers and maintenance vehicles at transmission tower areas, SS (new and existing) areas, access roads: potential oils, fuels and other hazardous substances accidental spills to land or water courses.

Given the project characteristics and the previous baseline assessment on surface water resources, the project is expected to cause the following negative impact in the operation phase:

- Risk of hydrocarbons and other hazardous substances pollution of rivers and streams.

The **hydrocarbons and other hazardous substances pollution of rivers and streams** could result in accidental spill events to land or watercourses of oils, fuels and other hazardous substances used by SS transformers and vehicles. This potentially increase concentrations of hydrocarbons, PAH, metals, and other substances hazardous for human and ecosystems' health and reduce dissolved oxygen concentrations in the affected watercourses, resulting in a negative impact to surface water resources' quality.

Regarding the SS transformers, in common operation and maintenance it is considered that only small spills of transformer oil can occur. A significant spill is expected to result only from severe malfunction of transformers, which is considered unlikely. As for maintenance vehicles it is expected that spill arise only from accident situations. Overall, the impact is considered unlikely.

The impact's intensity ultimately depends on the type and quantity of the spilled substance and the spill contain procedures/systems in force at the location. Considering that the project includes spill contain systems for SS transformer's locations, with a water and oil separator and safe storage in an oil tank, it is considered that intensity is generally low, with negligible significance, at SS transformers locations if contain systems are adequately managed.

However, it is considered that intensity of impact resulting from maintenance vehicles but can be high, with moderate significance, in the locations of the watercourse intersections and road bridges due to the possible hazard to human health, if the water is used for human consumption. Provided the implementation of risk management measures reducing likelihood, the significance is expected to be generally low.

Table 76 – Impact assessment on "Surface water resources" (operation phase): "Risk of hydrocarbons and other hazardous substances pollution of rivers and streams".

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)

8.6.3. Decommission phase

In the project decommission phase the activities likely to impact surface water resources are similar to those occurring in the construction phase:

- Excavations for removal of transmission tower foundations: potential runoff of spoiled excavated soil to watercourses;
- Operation of work camps and staff displacement on areas: generation of solid waste and sanitary effluents;
- General operation of decommission equipment and vehicles at transmission tower foundation areas, SS (new and existing) areas, access roads, temporary tower laydown and assembly areas and construction camps: potential oils and fuels and other hazardous substances accidental spills to land or water courses.

The project is expected to cause the following negative impacts in the decommission phase:

- Increased turbidity and total suspended solids in rivers and streams;
- Increased concentrations of faecal bacteria and organic matter and reduced concentration of dissolved oxygen in rivers and streams;
- Risk of hydrocarbons and other hazardous substances pollution of rivers and streams.

All impacts are expected to be similar to those foreseen in the construction phase albeit with smaller intensity and significance.

8.6.4. Cumulative impacts

All the identified impacts on surface water resources are cumulative with effects of pollution sources present in the baseline situation and its evolution, namely, settlements with sanitation deficiencies and soil erosion and roads' runoff after precipitation events.

8.6.5. Summary

The project implementation is expected to result in negative impacts on surface water resources, especially concentrated on the construction phase and related to land clearance, excavation, operation of construction camps and presence of construction staff and operation of equipment and vehicles.

The main impacts, cumulative with pollution sources affecting surface water resources in the baseline situation, refer to short-term increased concentrations of faecal bacteria and organic matter and reduced concentration of dissolved oxygen in rivers and streams and, in temporary accident events in construction and operation phases, of risk of polluting rivers and streams with hydrocarbons and other hazardous substances. Both impacts may reach Moderate significance but are mitigable to negligible or low significance with the implementation of adequate measures.

8.7. Soils and Land Use

8.7.1. Construction phase

The identified impacts over soil and land use during the construction phase are:

- Loss of soil resources due to erosion
- Reduction of soil quality
- Changes in land use

Loss of soil resources due to erosion

Possible direct physical impacts to soil due to project activities include soil erosion resulting from construction activities. Excavations and landfills for the construction of the substation platform, access paths, tower foundations, installation of project infrastructures and support areas can be highlighted as the most significant, as well as vegetation clearing along the transmission line route and intervention areas. A rough estimate for the excavation of foundations for electricity pylons indicates a volume of soil excavated of 11,600 m^3.

Stripping of land and soil excavation will disrupt soil cohesion and surface exposure (reduced soil erosion resistance) and create a soil surplus. If not properly restored or managed, the soil will be at risk of erosion caused by runoff and wind. Erosion may likewise be in the form of landslides in steeper slopes and intense weathering rocks. The sensitivity to soil erosion along the proposed transmission line depends on the factors detailed in Table 33 - Section 6.8.

The direct negative impact of excavations on soil cohesion (approximately 11,600 m^3) and vegetation clearing (approximately 325 ha, considering the 20 m footprint corridor) increases the risk of erosion along the DAI of the project. The impact is likely to occur but the extent is local and likely to be limited to the DAI. The impacts of construction activities on soil erosion are anticipated to last for the duration of the construction phase (i.e. short term), but may extend further in the future if not handled. The magnitude and significance of the impact, without mitigation, is expected to be medium and moderate respectively, considering the combination the factors affecting soil erosion (see Table 33 - Section 6.8). The existing soil types in the DAI are prone to erosion, therefore should be carefully managed to prevent erosion, namely in the areas with higher slope gradient and less vegetation cover. With proper revegetation and restoration and management of the soil (post-mitigation), the magnitude and significance of the impact are expected to be low. Proposed mitigation measures to reduce soil erosion are in Chapter 9.

Table 77 – Impact assessment on Soil (construction phase): Soil Erosion.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short term (long term in case of mismanagement)
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

Reduction of soil quality

Soil pollution due to accidental spills of hazardous materials (fuels and oils) may occur during construction activities, fueling and maintenance of machinery and vehicles outside the impervious areas, namely during excavations, vegetation clearance and removal of houses and structures. These spills have the potential to affect terrestrial environments, leading to soil deterioration.

Incidental spills are infrequent and would be localised (on-site) if occurring during construction and maintenance activities. The duration of the impact can be short term or long term, depending on the volume spilt. The magnitude and significance of the impact, without mitigation, is expected to be medium and low respectively, considering the areas along the transmission line where land clearance activities will take place are natural areas. With proper and timely soil removal or remediation (post-mitigation), the magnitude and significance of the impact are expected to be low.

Table 78 – Impact assessment on Soil (construction phase): Soil Pollution.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	On-site
Duration	Long term
Likelihood	Unlikely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

<u>Changes in land use</u>

Changes in land use during the construction phase will occur along the transmission line route, substations and temporary working areas and include: Temporary loss of access to land; and Permanent removal of vegetation in the transmission line corridor, including crops.

The temporary land take during construction activities may lead to a temporary loss of land or limited access to crops (approximately 71 ha, considering the 20 m footprint corridor) and forest products (approximately 107 ha, considering the remaining right of way area), 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 dependance on agriculture in cropland areas. With adequate compensation for the loss of crops and/or alternative access to land of equal productivity (post-mitigation), the magnitude and significance of the impact are expected to be low.

Table 79 – Impact assessment on Land Use (construction phase): Temporary land take and loss of access to land.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Temporary (for most cases) and Permanent (for specific cases)
Likelihood	Definite
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

Permanent removal of vegetation in the transmission line corridor during construction activities will lead to loss of crops (approximately 11 ha, considering the 4 m maintenance road) and trees/forest products (approximately 53 ha, considering the 20 m footprint corridor) as subsistence activities. The magnitude and significance of the impact, without mitigation, are expected to be medium and moderate respectively. Considering the amount of vegetation clearance will be minimized, and with adequate compensation for the loss of forest products and/or alternative access to land of equal productivity (post-mitigation), the magnitude and significance of the impact are expected to be low.

Table 80 – Impact assessment on Land Use (construction phase): Permanent removal of vegetation, including crops.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Long term
Likelihood	Definite
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

8.7.2. Operation phase

The identified impacts over soil and land use during the construction phase are:

- Reduction of soil quality
- Changes in land use

Reduction of soil quality

Overall, the impacts of soil pollution due to accidental spills of hazardous materials (fuels and oils) during maintenance activities of the transmission lines and substations are similar to those expected during the construction phase. These may occur during maintenance activities outside the impervious areas, such as maintenance operations to keep permanent tower site laydown areas free of vegetation.

Changes in land use

Changes in land use will occur along the transmission line route and substations, with permanent land restrictions due to permanent land take of tower site laydown areas, maintenance corridor and substations. No new houses or structures will be allowed in the right of way area (1 ha of built-up areas), no trees will be allowed in the 20 m footprint corridor (55 ha, including tree cover lost to the substations), no crops will be allowed in the maintenance corridor (11 ha). In the 20 m footprint corridor, vegetation and/or crops of up to 6-7 m will be allowed.

The amount of permanent land take and restrictions to trees are relatively small in the overall context of the land around the transmission line route (DIA) (80 ha *vs.* 15,700 ha), however property size and value must be considered. Provided agreement of landowners 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 land value such as heritage value. With adequate compensation for the loss of land and forest products and/or alternative access to land of equal productivity (post-mitigation), the magnitude and significance of the impact are expected to be low.

Table 81 – Impact assessment on Land Use (operation phase): Permanent land restrictions

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Definite
Intensity (or magnitude)	Medium/Low
Significance (without mitigation)	Moderate/Low
Significance (expected post-mitigation)	Low

8.7.3. Decommission phase

Overall, the project´s impacts in the deactivation phase are similar to those expected during the construction phase.

General operation of decommission equipment and vehicles at transmission tower foundation areas, substation areas, access roads, temporary tower laydown and assembly areas and construction camps:

- Excavations and vegetation clearance for operation of work camps and removal of transmission tower foundations: soil erosion;
- Potential oils and fuels accidental spills outside impervious areas: reduction of soil quality.

All impacts are expected to be similar to those foreseen in the construction phase albeit with smaller intensity and significance.

8.7.4. Cumulative impacts

The impacts of the project on soil erosion are found to be cumulative with the deforestation rate in Huambo province. Miombo lands, native and plantation forest and scattered trees provide many ecosystem services, namely the reduction of soil erosion. Deforestation associated with charcoal demand is having a particularly adverse impact on the natural Miombo woodlands of Huambo Province, and over the last 19 years the highest levels of deforestation have occurred in the municipalities including Caála and Longonjo. The loss of trees, which anchor the soil with their roots, can cause widespread soil erosion.

8.7.5. Summary

Particular concern is expressed about the potential for soil erosion following the excavation activities and creation of access paths. Once soil is disturbed in some areas, it is very difficult to stabilise it again, particularly in steep, heavily wooded areas.

In areas growing very little grass and areas protected by a combination of shrubs and trees, the soil moves easily down slope into gullies during rain, following mechanical disturbance. Even in gentler slopes, heavy machinery can cause erosion that is difficult to repair. Construction practices must prevent any serious damage so that, after the construction phase is complete, rehabilitation of disturbed areas will ensure that the impact does notn't continue (see Section 9 – Mitigation and Compensation Measures).

8.8. Quality of the Environment

8.8.1. Air Quality

8.8.1.1. Construction phase

During the construction phase expected impacts on air quality are, the emission of pollutants (particularly NO_2) from vehicles – especially heavy-duty vehicles (HDV) – and temporary power generators and the emission of particulate matter and dust resulting from the construction activities.

NO_2 exhaust emissions

The project corridor covers mainly rural areas, and does not cross urban city centres, thus, it is not expected that the NO_2 levels in these areas reach the international guidelines.

The impact of the NO_2 exhaust emissions will be *negative*, with a *regional* extent, since it will be present along the routes that lead to the project corridor. It is a *direct* consequence of project activities and is a *short-term* impact, lasting only during construction phase. It is *certain* to happen, but the rise in traffic is unlikely to make the NO_2 levels surpass what is recommender by the WHO guidelines, thus its intensity is *low*. Considering the mitigation measures, the significance of this impact will be *negligible*.

Table 82 – Impact assessment on "Air quality" (construction phase): "NO_2 exhaust emissions"

Criteria	Assessment
Nature	Negative
Extent	Regional
Type	Direct
Duration	Short-term
Likelihood	Definite
Intensity (or magnitude)	Low to Negligible
Significance (without mitigation)	Low to Negligible
Significance (expected post-mitigation)	Negligible

PM and Dust emissions

In urban and peri-urban areas unpaved roads are common, and so dust and particle emissions, particularly coarse particles (PM_{10}) are more likely to be relevant.

The Project activities that are likely to contribute to particles and dust emissions are earthworks to install the foundations of the posts and substations, the traffic on unpaved roads, including trackout (dirt and dust created from vehicles moving from unpaved roads to paved roads) and other construction activities.

The impacts of dust and particles emissions will be *negative* and result *directly* from the project activities. Traffic on unpaved roads can have a *local* extent, while the other activities are limited to the project boundaries (*on-site*), thus, the extent of PM and dust emissions is considered *local*. These impacts are *definite* but *temporary*, happening occasionally during the construction phase.

The intensity of the impacts depends on the receptor. The most sensitive receptors are the elderly people and the younger babies, as well as people with respiratory problems. Thus, the intensity of dust and PM emissions' impacts will be *low to negligible* in unoccupied and agricultural areas, where people are present during short periods of time, and *medium* near residential areas, which are generally permanently occupied.

The significance of the impacts is a combination of the impact intensity and the likeliness of it occurring. The significance will be *moderate* in residential areas and *low* in the unoccupied and agricultural areas. The mitigation measures will reduce the significance to *low*.

Table 83 – Impact assessment on "Air quality" (construction phase): "PM and Dust emissions"

Criteria	Assessment
Nature	Negative
Extent	Local
Type	Direct
Duration	Temporary
Likelihood	Definite
Intensity (or magnitude)	Low to Medium

Criteria	Assessment
Significance (without mitigation)	Low to Moderate
Significance (expected post-mitigation)	Low

8.8.1.2. Operation phase

The technology to be implemented in the new Lomaum substation includes the use sulphur hexafluoride (SF6). This gas will only be used in circuit breaker cut-off chambers. In case of accidental destruction of a circuit breaker, this gas can leak to the atmosphere, but in small quantities. Furthermore, any emptying operation is projected to be carried out in a controlled manner into a tank for subsequent treatment of the gas. Taking this into account the risk of SF6 leak is negligible. Thus, once the construction works are finished and the Project is operational there are no expected relevant impacts on air quality.

8.8.1.3. Decommission phase

The decommission phase refers to the reversal of the project activities, and thus, it will also involve the same activities that generate impacts on air quality during the construction phase.

The impacts in the decommission phase will be similar to the ones identified in the construction phase.

8.8.1.4. Cumulative impacts

The impacts of the Project are cumulative with other sources of atmospheric pollutants, in particular NO_2, PM and dust emissions, such as local traffic, biomass burning, open fires and other construction works that may happen in the DIA, during the construction and/or decommission phases.

8.8.1.5. Summary

In the **construction phase** the expected impacts of the Project in the air quality are the **exhaust emissions of NO_2** from the vehicles and electricity generators used in the construction works and the **emission of particulate matter and dust** from the traffic on unpaved roads (including trackout), earthworks and other construction activities.

Considering the application of mitigation measures, the significance of the impact associated with exhaust emissions of NO_2 are considered *negligible*, while the impact of the PM and dust emissions is *Low*.

In the **operation phase** no significant impacts on air quality are expected.

In the **decommission phase** the expected impacts result from activities similar to those that happen in the construction phase, hence the expected impacts are the same.

The impacts thar will arise during the construction and decommission phases are cumulative with other activities in the DIA that emit air pollutants, especially NO_2, PM and dust, such as biomass burning, traffic (on unpaved roads) and construction works that may occur in those time periods.

8.8.2. Noise

8.8.2.1. Construction phase

During construction phase the expected impacts on noise are the emissions from vehicles (particularly heavy-duty vehicles - HDV), temporary power generators, earthworks and construction activities.

The noise baseline monitoring carried out during the field work revealed that some areas within the project can be noisy (up to L_{eq} of 65.6 dB(A)) due to road traffic, animals and other human activities happening in the settlements along the project corridor.

The construction activities can produce sound levels superior than what is recommended by the IFC Guidelines. The noisiest predicted activities are the installation of the transmission towers, particularly their foundations, since this activity includes the need for drilling and excavation and the expansion of the existing substation un Lomaum. The towers will be mounted on the ground and installed using a mobile crane, and the expected installation time is short (less than one month for each tower). The installation and operation of the construction camps are also a relevant source of noise emissions, through traffic of heavy and light duty vehicles, machinery and equipment such as power generators.

The construction works and traffic have *definite negative* and *direct* impact on the acoustic environment of the DIA, however, this is only significant where sensitive receptors are present, i.e., human settlements. As such, the extent of the impact is considered *on-site*, in Lomaum, where the existing substation will be expanded, on the construction camps and where the towers are installed close to towns and/or villages. The location of the new substation to be constructed in Belém do Dango is not occupied and there are no settlements nearby, so the noise impact there is not considered.

In terms of duration, the impact on the substation expansion site and on the construction camps is considered *short-term*, since they last only during the construction phase. As for the towers, their installation time is short (~1 week), thus the duration of the impacts on each site is *temporary*.

The intensity of the impact depends on the proximity to the noise source. Near (less than 30 meters away) the substation to be expanded, the intensity is considered *moderate*. Further away from the noise sources the impact is *low to negligible*. The Environmental Management introduced in Chapter 10 (and more in detail in ESIA Volume III) includes measures to mitigate noise.

The significance of the impact is assessed combining the intensity of the impact with its duration. On the Lomaum substation and its vicinity, the significance (without mitigation) of the construction activities' noise impact is *moderate*. On the tower locations, close to settlements, the significance (without mitigation) of the noise impact is *low to moderate*. Considering mitigation measures, the noise impact from the project activities can be considered *low*.

Table 84 – Impact assessment on "Noise" (construction phase): "Noise emission"

Criteria	Assessment
Nature	Negative
Extent	On-site
Type	Direct
Duration	Temporary/Short-term
Likelihood	Definite
Intensity (or magnitude)	Low to Medium
Significance (without mitigation)	Low to Moderate
Significance (expected post-mitigation)	Low

8.8.2.2. Operation phase

Substation operation

During the operation phase, substations comprise several sources of noise emissions, the most significant being the continuous radiation of audible discrete tones. The noise of this type is primarily generated by power transformers, reactors, emergency generators, etc. Despite this, near the new projected substation there are no sensitive receptors, so this is *negligible*. In the substation that will be expanded these noise sources are already present, so the impact is also *negligible*.

Table 85 – Impact assessment on "Noise" (operation phase): "Operation of the substations".

Criteria	Assessment
Nature	Negative
Extent	On-site
Type	Direct
Duration	Long-term
Likelihood	Definite
Intensity (or magnitude)	Negligible
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

Wind on cables and Corona effect

Overhead power transmission powerlines can be sources of noise, due to the wind effect on the conductor cables and the corona effect (noise from electrical discharges). However, powerlines go through mostly inhabited lands and roads, and most of the sensitive receptors are at a safe distance from the source. Furthermore, these noise sources are weather related and during dry weather the lines are usually quieter. During periods of wind and rain, ambient noise levels also tend to increase, so the noise generated in the power lines is also considered *negligible*.

Table 86 – Impact assessment on "Noise" (operation phase): "Wind effect on cables and Corona Effect".

Criteria	Assessment
Nature	Negative
Extent	On-site
Type	Direct
Duration	Long-term
Likelihood	Definite
Intensity (or magnitude)	Negligible
Significance (without mitigation)	Negligible
Significance (expected post-mitigation)	Negligible

8.8.2.3. Decommission phase

The decommission phase refers to the reversal of the project activities, and thus, it will also involve the same activities that generate noise during the construction phase.

The impacts in the decommission phase will be similar to the ones identified in the construction phase.

8.8.2.4. Cumulative impacts

The impacts of the Project are cumulative with other sources of noise, such as local traffic, construction works that may happen in the DIA and human activities that occur in the settlements.

8.8.2.5. Summary

In the **construction phase** the expected impacts of the Project in the noise environment are the **noise emissions** from the vehicles and equipment used in the construction works, earthworks and other construction activities. Considering the application of mitigation measures, the significance of the impact is considered *low*.

Considering the application of mitigation measures, the significance of the impact is considered *low*.

In the **operation phase** the expected impacts of the project are related to the noise emitted by the substations operation as well as the noise emitted from the cables (corona effect and wind effect).

The impacts of the substations' operation on noise are considered *low*, taking into account the mitigation measures. As for the noise emitted by the cables, its impact, post-mitigation, is considered *low*.

In the **decommission phase** the expected impacts result from activities similar to those that happen in the construction phase, hence the expected impacts are the same.

The impacts thar will arise during the construction and decommission phases are cumulative with other activities in the DIA that emit air pollutants, especially NO_2, PM and dust, such as biomass burning, traffic (on unpaved roads) and construction works that may occur in those time periods.

8.9. Ecology

8.9.1. Construction phase

During the construction phase, the major activities from the implantation of the transmission lines, that will result in impacts over ecosystems and biodiversity will be:

- Operation and movement of machinery and vehicles;
- Construction and/ or assemblages of the towers;
- Soil movements;
- Removal of vegetation to:

i) Implement a temporary construction site (40 x 50 meters), where no planting or harvest is allowed during construction.

ii) Create a permanent tower site laydown area (10 x 10 meters) within the construction site, where no trees or crops are allowed.

iii) Create a 4 meters wide corridor (2 m each side) for the implantation of the towers and lines and its maintenance, where all trees and crops will be removed;

iv) Create a 20 meters (10 m each side) footprint corridor (wire zone), where all trees will be removed;

v) Create a 20 meters border zone each side of the footprint corridor, where vegetation will be cleared (pruning of trees), to ensure safe operations.

vi) Create 4 meters wide access roads to the area of construction, perpendicular to the transmission line;

These activities will result in several impacts over the biodiversity values of the study area, either in terms of affected habitats, flora, fauna, threatened and endemic species or over the ecosystems as a whole. The specific impacts resulting from this project are:

- Loss of vegetation and flora;
- Loss and fragmentation of habitats for faunal communities;
- Disturbance of faunal communities;

- Habitat contamination with hazardous materials (e.g. insulating oils/gases and fuels in addition to herbicides for right of way vegetation maintenance);
- Degradation of ecosystem services.

The **loss of vegetation and flora** will be extremely relevant when concerning the natural vegetation of the miombo woodlands, particularly where they have a high ecological value, and threatened species such as *Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (mupanda) and *Pterocarpus angolensis* (tacula), which were confirmed in the study area. Such species can reach heights superior to 4.5 meters and, therefore, due to safety reasons their coexistence with the transmission line is not possible.

Through SIG analysis it was possible to calculate that in the footprint corridor and new substation, where all vegetation will have to be cleared, there will be a total loss of at least 114 hectares of miombo woodland (Table 87). An additional 229 hectares of miombo may be subject to actions of pruning or even tree removal.

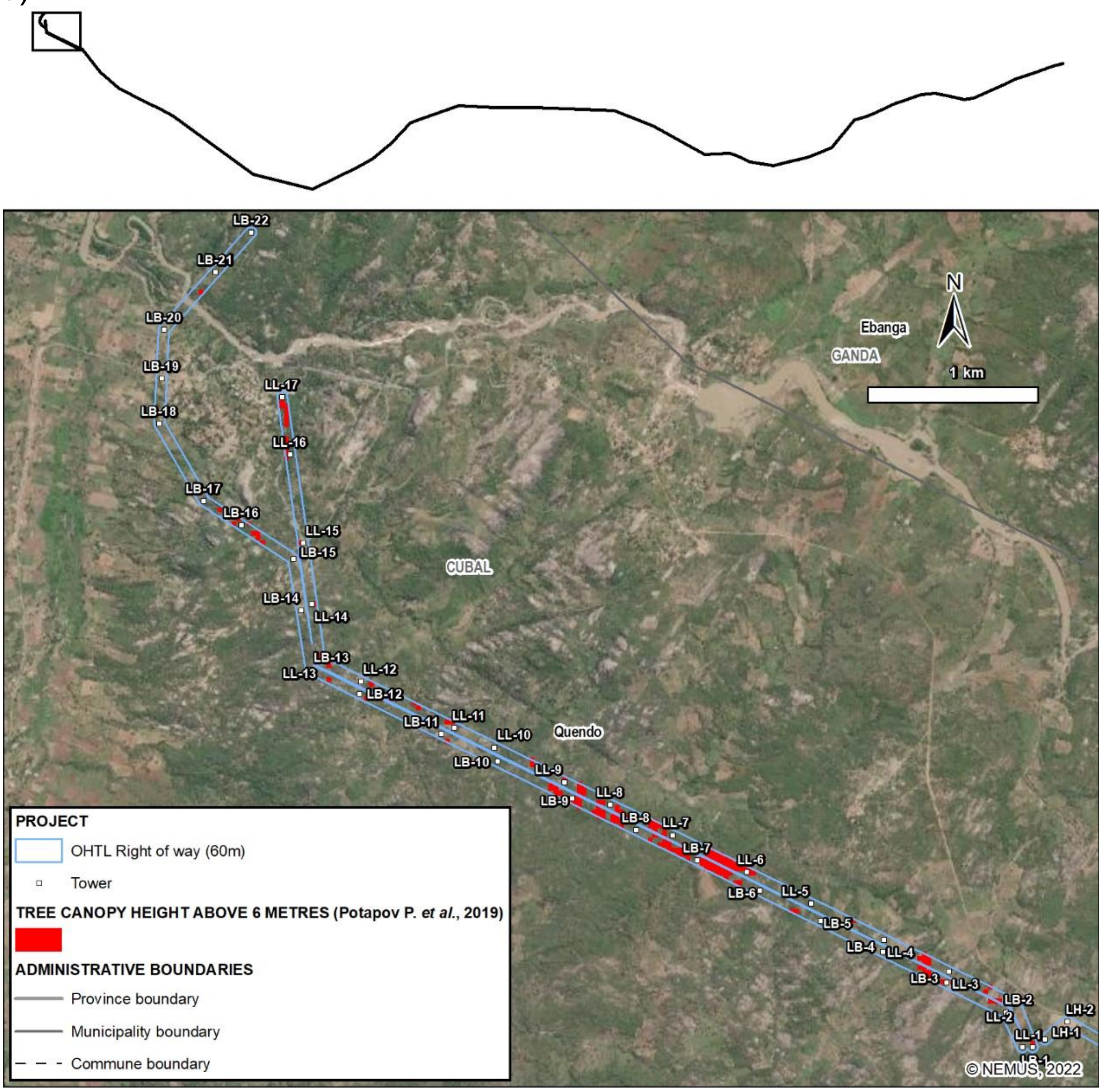
For instance, in the case of wetlands, 39.5 hectares of vegetation may be degraded by the construction activities. This area can be reduced with the application of the mitigation measures recommended.

Table 87 – Area of habitats at risk of being removal in the OHTL Right of Way.

Habitat	OHTL Right of Way (60 m)	Footprint corridor (20m)
Miombo woodland	342.9 ha	114.2 ha
Wetlands	39.5 ha	13.1 ha
Wooded grasslands and agricultural areas	437.4 ha	145.9 ha
Areas of *Eucalyptus* sp.	132.9 ha	43.8 ha
Artificial areas	13.8 ha	5.1 ha

Using data from (Potapov et al., 2021), it was also possible to calculate which locations of the study area present higher densities of vegetation with heights superior to 6-7 meters. The results show that some of the miombo areas with higher cover of big trees affected will be between, amongst others, towers LB(LL)-16 and LB(LL)-05, LH-9 and LH-12, LH-54 and LH-58, LH138 – LH146; LH-262 and LH-265 (Figure 122).

a)



b)

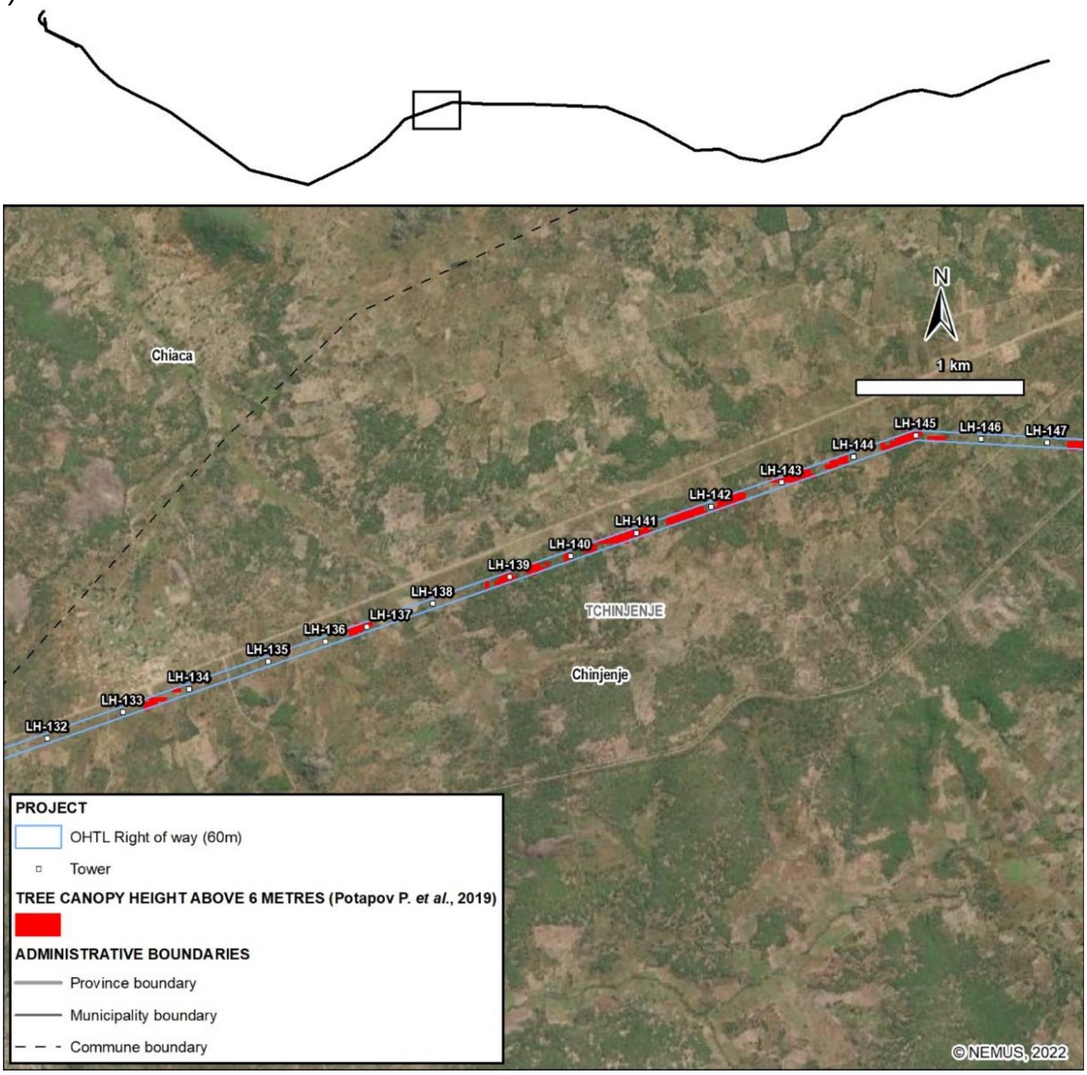


Figure 122 – Example of two zones of the study area where miombo woodland tree canopy above 6 meters will be affected by the project.

The loss of miombo, natural grassland, wetland vegetation, and associated threatened species, is considered to be an impact of high magnitude and high significance. The application of mitigation measures will allow to minimize these parameters to reach an impact of medium magnitude and moderate significance.

Both parameters (magnitude and significance) will differ in the remaining types of vegetation, which constitute modified habitats (*Eucalyptus* spp., or other alien species, and plants of agricultural areas or artificial areas). From an ecological perspective, the removal of this vegetation will have low magnitude and significance.

Table 88 – Impact assessment on "Ecology" (construction phase): "Loss of vegetation and flora".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	On site
Duration	Long-term
Likelihood	Definite
Intensity (or magnitude)	Low to medium
Significance (without mitigation)	Low (modified and alien vegetation) to high (native vegetation)
Significance (expected post-mitigation)	Low to moderate

The **loss and fragmentation of habitats for faunal communities** will affect the natural ecosystems as a whole, and the threatened and endemic species (identified in Annex II, Volume II), which are confined to particular types of habitats.

This impact will be more detrimental in great continuous areas of habitat (namely pristine miombo woodlands), which will be divided. For fauna, this will constrain and expose the movements of fauna with big core areas, such as mammals, but it will also fragment the habitat of small fauna (invertebrates, reptiles and amphibians), which has less mobility making dispersal between habitat patches more difficult. Some of the continuous areas of miombo affected by the project are those between towers:

- LB-22 and LB-04;
- LH-5 and LH-12;
- LH-16 and LH-24;
- LH-35 and LH-41;
- LH-136 and LH-146;
- LH-251 and LH-266.

At the same time, the study area presents several areas of miombo, which are already severely fragmented, occurring in patches (e.g., LH-50, LH-85, LH-133, LH-286, 287, 288, LH-305-306, LH-329). These may be the last refuges for small fauna, such as micro-mammals, reptiles, invertebrates, and amphibians, and their fragmentation and degradation may conduct to population extinctions.

The loss and fragmentation of miombo woodland will, therefore, be a negative impact of high magnitude and significance. Nevertheless, the adoption of mitigation measures will reduce the impact, which will have a medium magnitude and moderate significance. Because this habitat has a dominant arboreal layer, the maintenance activities to be carried during the operation phase will turn this vegetation loss into a long-term impact, contrarily to herbaceous habitats, which will not endure vegetation control.

Concerning the remaining natural habitats, some towers are foreseen in areas of wet grasslands that can become flooded during the wet season (LH-49; LH-94; LH-121; LH138; LH-149; LH-193; LH-197; LH-198; LH-204; LH-226; LH-227; LH-228; LH-335). Because these habitats are mostly formed by an herbaceous layer, it is expected that most vegetation removal will occur on the base of each tower and when opening road accesses, without the need for opening a transmission line corridor. Also, in cases where arboreal vegetation is present along the transmission line (riparian galleries and vegetation of river edges), the creation of a maintenance road is not possible due to the riverbed and, therefore, the removal of trees will not be necessary. Considering this and the application of mitigation measures, the loss and fragmentation of wetlands is considered an impact of low magnitude and low significance.

For modified habitats with lower biodiversity and ecological value, such as areas of *Eucalyptus* spp. and agricultural areas, the loss and fragmentation of habitat is considered a low magnitude and significance impact.

Table 89 – Impact assessment on “Ecology” (construction phase): “Loss and fragmentation of habitats for faunal communities”.

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect

Criteria	Assessment
Extent	On site
Duration	Short-term (herbaceous habitats) to Long-term (arboreal habitats)
Likelihood	Definite
Intensity (or magnitude)	Low to medium
Significance (without mitigation)	Low (modified habitats) to moderate (wetlands) to high (miombo woodlands)
Significance (expected post-mitigation)	Negligible (modified habitats) to low (wetlands) to moderate (miombo woodlands)

The **disturbance of faunal communities**, through the increase in noise, vibration and human circulation, is one of the main impacts that will occur during the construction phase. When disturbed, fauna will be chased away, seek refuge in other locations, and change their feeding and reproduction behaviours. In fragmented habitats, mobility may be constricted, and animal moving can result in encounters with human populations, putting fauna and humans at risk. The circulation of machinery and vehicles will also conduct to runovers and mortality of wildlife, especially of herpetofauna and micro-mammals.

Disturbance will affect all groups of fauna, but will be particularly detrimental for threatened species that is already more sensible to anthropogenic pressures. Natural habitats of high ecological value will be the most impacted due to their important role for biological communities, nevertheless, fauna from all habitats will be disturbed and chased away. Even though the study area has already some human disturbance, the most common activities (circulation of people and vehicles) produce less noise and vibrations than the ones expected during construction activities.

Because wet grasslands (e.g. LH-226-228; LH-255-256; LH-335) are hotspots of biodiversity and reunite migratory avifauna including a lot of endangered, rare, endemic fauna, these are considered to be sensitive habitats, and will be the most disturbed during the construction phase.

Considering these factors, the disturbance of faunal communities will only be of low magnitude and significance close to urban settlements and roads (artificial areas), of medium magnitude and moderate significance for miombo woodlands and of high magnitude and significance for wetlands. Considering mitigation measures, disturbance significance will be reduced as observed in Table 90.

Table 90 – Impact assessment on "Ecology" (construction phase): "Disturbance of faunal communities".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	Local
Duration	Short-term
Likelihood	Definite
Intensity (or magnitude)	Low to medium
Significance (without mitigation)	Low (artificial areas) to moderate (miombo woodlands) to high (wetlands)
Significance (expected post-mitigation)	Negligible (artificial areas) to low (miombo woodlands) to moderate (wetlands)

The set of construction activities in general and the circulation of machinery must presuppose the use of oils and lubricants, fuels, paint strippers, among others, which may cause chemical **contamination of the habitats** present in the study area, through spillage, accidental dispersion and application of herbicides for vegetation maintenance.

For actions directly related to the work and movement of machinery, it appears that the implementation of adequate safety measures at the work site will reduce the probability of occurrence of these eventualities.

The application of herbicides may conduct to contamination of the soils and vegetation, and bioaccumulation, putting soil fauna such as termites and micro-mammals at risk, but also of herbivores which feed on grasses and other types of vegetation.

Taking the scale and probability of such impact, this is classified as an impact of low magnitude and significance.

Table 91 – Impact assessment on "Ecology" (construction phase): "Habitat contamination with hazardous materials".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	On-site
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

The **degradation of ecosystem services** during the construction phase will mostly translate into a reduction of provisioning services in the miombo woodlands, 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 (for irrigation and clothes' washing, as described in section 6.7.4) 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 (detailed in Chapter 9) 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 the miombo woodlands than in wetlands, resulting in a lower capacity of the first to capture CO_2; nonetheless, the implementation of the mitigation measures proposed in Chapter 9, namely regarding the avoidance of native trees within the OHTL footprint corridor, can reduce its impact in the identified ecosystem services, particularly in the miombo woodlands.

Table 92 – Impact assessment on "Ecology" (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 (miombo woodlands)
Significance (expected post-mitigation)	Low (wetlands and miombo woodlands)

8.9.2. Operation phase

During the operation phase of the transmission line, the main expectable impacts are related to the:

- Presence of the electrified transmission lines;
- Operation of the substations, with risk of oil spill;
- Maintenance activities of the transmission lines, of the towers and of the Over Head Transmission Line (OHTL) Right of Way:

  i. Permanent tower site laydown areas: maintenance to keep permanent tower site laydown areas free of vegetation, as no trees or crops are allowed in the 10 x 10 m area.

  ii. Maintenance Road (4 m wide): mechanical actions to keep it free of vegetation, as no trees or crops are allowed.

  iii. Footprint corridor: maintenance to keep permanent tower site laydown areas free of vegetation and pruning of remaining areas. No new trees are allowed, only vegetation/crops of up to 6-7 meters high.

iv. Border zone: crops and trees allowed if clearance (5 m to conductors) is respected.

Considering these main activities and actions, the following impacts generated over the local biodiversity and habitats are highlighted:

- Degradation of the habitats' conservation status;
- Disturbance and mortality of avifauna and bats.

The **degradation of the habitats' conservation status** is mainly related to maintenance works that will i) increase human population to the study area and ii) continuously clear vegetation.

As an alien species of low ecological value, the removal and clearance of *Eucalyptus* spp. will not be detrimental for ecosystems. In fact, even though it will not be significant in the overall study area, its removal can become beneficial for native vegetation.

On the contrary, the maintenance of a corridor (maintenance road) in miombo woodlands without any arboreal vegetation and the increase of human circulation will cause ecosystem degradation, as described in the construction phase for impacts "Loss and fragmentation of habitats for faunal communities" and "Disturbance of faunal communities". This negative impact is classified with medium magnitude for natural habitats and moderate significance. Notwithstanding, by applying the measures recommended in the following chapter, this impact may be mitigated and it can become of low significance.

In the case of wetlands, it is assumed that a maintenance road will not be possible to open and, as so, this impact will be negligible for these types of habitats.

For agricultural and artificial areas this impact is also classified has negligible as these habitats are already modified and have a low conservation status.

Oil spills from the operation of the substations can also occur and degrade the ecosystems, nevertheless this risk is unlikely and it is accounted for with measures, in the project's descriptive memory.

Table 93 – Impact assessment on "Ecology" (operation phase): "degradation of the habitats' conservation status".

Criteria	Assessment
Nature	Positive (alien flora) to Negative (natural habitats)
Type (Direct/Indirect)	Direct
Extent	On-site
Duration	Long-term
Likelihood	Definite
Intensity (or magnitude)	Low (alien flora) to medium (natural habitats)
Significance (without mitigation)	Low (alien flora) to moderate (natural habitats)
Significance (expected post-mitigation)	Low

The **disturbance and mortality of avifauna and bats** is the most common impact generated by electric transmission lines and the probability of occurring in the study area is high. This is mostly due to direct interaction between the animals and the lines, namely (ICNF, 2019):

- Collisions: of birds and bats in flight with the electric cables, a risk that is amplified when the cable section is smaller (less visible) or when the cables are installed in different levels, increasing the number of collision levels.
- Electrocutions: happens when the animals come in contact with two conductive elements at two different powers. The risk is amplified when the cables are located at shorter distances.

These two phenomena are increased when birds are able to use the tower infrastructures as breeding and nesting spots. Besides being a danger to avifauna and bats, this interaction can also cause damages to the transmission system and interrupt its normal operation.

In addition to direct interactions, the alteration of the habitat by the appearance of linear aerial structures entails a series of alterations in the behaviour of the birds that, in turn, result in broader changes to the local faunal communities. For instance, due to the greater availability of landing sites for predatory birds. These effects are more evident in open habitats such as open miombo woodlands, wetlands and agricultural areas.

The susceptibility of birds to the direct interactions described depends on several factors, among them, the characteristics of the animals - morphology, behaviour, habits -, the characteristics of the landscape, the meteorological conditions and the characteristics of the infrastructures - distance between parts in tension, places of perch, cable thickness and layout, among others.

Different species have different risks of collision and/or electrocution. Steppe birds, aquatic birds, gliding migratory birds (such as eagles, vultures, storks) and birds of prey are the most sensitive groups, the first three predominantly due to collisions, and for birds of prey due to electrocution. Storks are noteworthy, for using the tower platforms as breeding and nesting sites.

It is considered that the adoption of the mitigation measures significantly reduces the risks of collision and electrocution (ICNF, 2019), with the impacts associated with electrocution having a low significance and those of collision, moderate or low depending on the area crossed.

Table 94 – Impact assessment on "Ecology" (operation phase): "disturbance and mortality of avifauna and bats".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	On-site
Duration	Long-term
Likelihood	Likely
Intensity (or magnitude)	High
Significance (without mitigation)	Moderate (modified areas) to High (natural areas)
Significance (expected post-mitigation)	Low (modified areas) to Moderate (natural areas)

8.9.3. Decommission phase

The activities of the decommission phase will be similar to the ones of the construction phase, namely the increase of human circulation, circulation of machinery and vehicles, the activities of dismantling and the actions developed in order to rehabilitate the areas affected by the project.

The impacts generated by these actions will also be similar to the ones observed during the construction phase, namely the **disturbance of faunal communities** and **habitat contamination**. These impacts will be of low significance if all mitigation measures proposed are adopted.

Table 95 – Impact assessment on "Ecology" (decommission phase): "disturbance of faunal communities".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Indirect
Extent	On-site
Duration	Short-term
Likelihood	Likely
Intensity (or magnitude)	Low
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

Table 96 – Impact assessment on "Ecology" (decommission phase): "habitat contamination".

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	On-site
Duration	Temporary
Likelihood	Unlikely
Intensity (or magnitude)	Low
Significance (without mitigation)	Low
Significance (expected post-mitigation)	Low

After the dismantling of the transmission line is completed, special cautions and surveillance actions must be made to ensure that:

1) Natural vegetation regeneration is possible and progressing within the ecological succession, without processes such as the invasion by alien or ruderal species, which reduce the intrinsic and conservation value of the natural habitats. To reduce the possibility of such events, all alien and invasive species must be removed from the OHTL Right of Way. Also, if the habitat is not able to naturally generate, afforestation with native flora characteristic of each habitat must be proceeded.

2) Deforested areas are not occupied by human populations in search of areas for agriculture, as this will prevent vegetation from regenerating and will introduce crops and plants distinct from the native flora.

If all these scenarios are pondered and all measures to prevent negative processes are adopted, the removal of the infrastructures will result in the **restoration of the habitats'** natural condition and with that, the restoration of their intrinsic ecological value. Afforestation will allow habitat parcels to reconnect, stopping habitat fragmentation. For fauna, this will mean more habitat available, higher dispersal area and less disturbance (for terrestrial and flying fauna) and encounters with human populations.

This is a <u>positive impact of low magnitude and significance for modified habitats</u>, such as artificial and agricultural areas, but will have a <u>medium magnitude and moderate significance for miombo woodlands</u> that were severely deforested during the construction and operation phases.

Table 97 – Impact assessment on "Ecology" (decommission phase): "Restoration of the habitats".

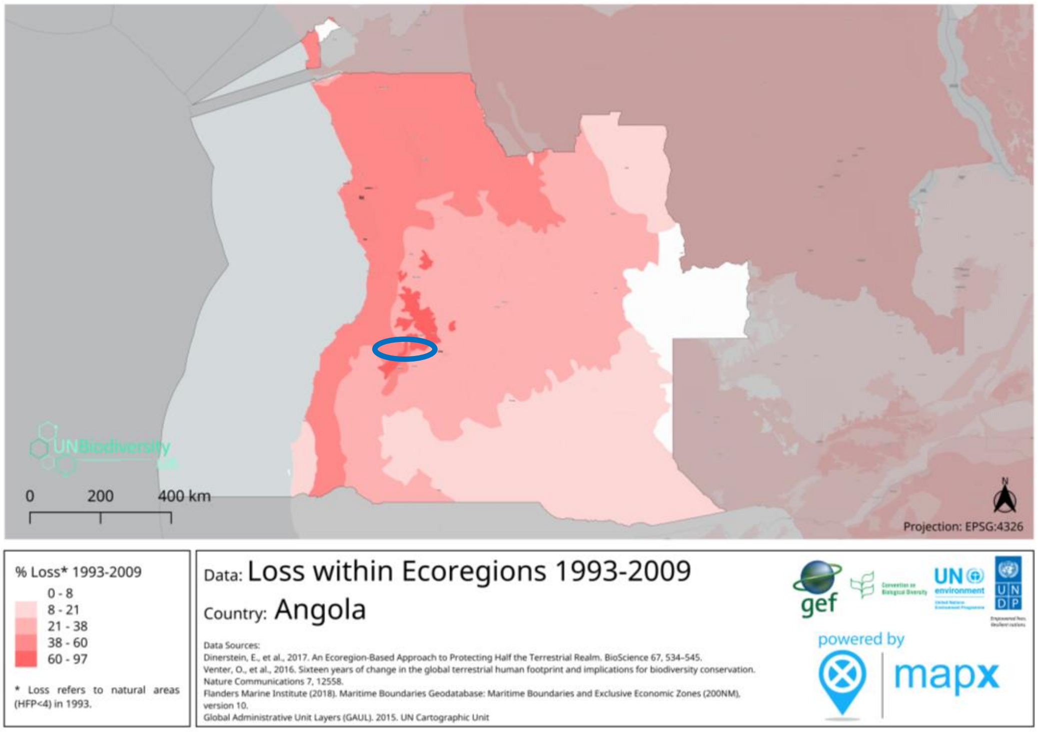
Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Indirect
Extent	On-site
Duration	Permanent
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Low (modified areas) to Moderate (miombo woodlands)

Criteria	Assessment
Significance (expected post-mitigation)	Low (modified areas) to Moderate (miombo woodlands)

8.9.4. Cumulative impacts

The study area is located in a region known for the high rates of deforestation and loss of natural areas (Figure 123), a process that is also noticed by local populations. It is considered that the removal of vegetation and loss of habitats, resulting from the implantation of the project, will be a cumulative impact to this problem that occurs nationally, but particularly at a regional scale.

According to the features of the project, at least 375 hectares of land will be completely depleted of arboreal stratum. This area contains 114 hectares of miombo woodland which will be affected, an area correspondent to 2% of the miombo woodland present in the study area (DAI). Considering this value, the cumulative impact is considered negative, of low magnitude and low significance.



Source: UNDP (2022)

Figure 123 – Loss of natural areas in Angola. The study area location is identified in blue.

8.9.5. Summary

During the construction phase, the removal of vegetation is the main activity resulting in impacts over the ecological systems and biodiversity of the study area. The main negative impacts, and with higher levels of significance, will be over natural habitats (miombo woodlands and wetlands), and are related to **loss of vegetation and flora** and **loss and fragmentation of habitats** for faunal communities.

During the operation phase, the main activities that will conduct to negative and significant impacts are the maintenance of the transmission line, which will remove vegetation and **prevent regeneration**, and the presence of the transmission lines, which will present a **risk of collision and electrocution for birds and bats**.

Nevertheless, most impacts are attenuated by the application of the mitigation measures presented in c.f. Chapter 9 - Mitigation and Compensation Measures. For moderate impacts occurring the critical habitats (identified in the Critical Habitat Assessment in ESIA Volume II), Biodiversity Management Plans are proposed in Chapter 10.

8.10. Socioeconomics and human rights

8.10.1. 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;
- Increase disease transmission;
- Loss of livelihoods, mostly temporary;
- Potential resettlement during construction;
- Impacts on workers' health and safety.

8.10.1.1. Creation of temporary employment opportunities

Firstly, regarding socioeconomic impacts, it is expected the creation of temporary employment opportunities (primarily low skilled and semi-skilled workforce). According to Elecnor, during the 36-month construction phase, around 550 are expected to be created in the construction phase (direct and indirect workforce necessary to construct the transmission line and associated substations).

Regarding local employment, the project is expected to create direct and indirect employment to approximately 430 local workers, again mainly semi-skilled and low skilled jobs, over a period of two years. However, this is key for this impact to be considered of medium magnitude for the regional economies of the municipalities of Cubal, Ganda (Benguela province), Caála, Huambo, Longonjo, Tchinjenje and Ukuma (Huambo province).

Given that in the majority of these municipalities (except for Huambo), employment outside the agricultural and trade sector is uncommon, and monetary income is very low, the creation of more than four hundred jobs (even temporary) is an impact of significance, if these jobs are created locally, and not fulfilled by migrant workers from urban areas (Huambo city centre, for example).

An enhancement measure is thus necessary in order to assure that impacts are to be felt in the communities that are impacted by the construction of the transmission line and associated substations, specifically: guarantee the hiring of at least 75% of workers from the rural communes in the IAI (Quendo, Babaera, Ganda, Kaala, Kalenga, Lepi, Longonjo, Chinjenje, Ukuma), through local leaders, i.e., traditional authorities (soba). This measure will ensure that jobs are created locally, prevent the migration of workers (and its associated impacts), contributing to the reduction of local unemployment and boost the local economies, improving living conditions in the process.

With the previously stated enhancement measure, the impact “creation of temporary employment opportunities” is anticipated to be of moderate significance (i.e., expected post- enhancement measure) (see Table 98).

Table 98 – 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	Definite
Intensity (or magnitude)	Low
Significance (without enhancement)	Low
Significance (expected post-enhancement)	Moderate

8.10.1.2. Boost of the regional economy and improvement of living conditions

Economic impacts during the construction of the transmission line and associated substations will stem from procurement of goods and services by the project, local indirect employment, and induced economic effects of spending by construction workers. The overall investment is estimated to be around US$ 90 million with a part to be directly invested in the regional economy through the acquisition of services and the hiring of workers.

The Project can create a few long-term benefits for local contractors and suppliers and their employees from capacity enhancement and the acquisition of specific skillsets through on-the-job and formal training (spillover effects). Considering the importance of urban development and related construction, transport, and storage sectors in Angola in general, these skill sets may be transferable to other construction-related projects in the area after the completion of construction.

Furthermore, the economic impact of project workforce spending in the local economy is expected to be modest, since the construction camps will, most likely, provide food and other services for the workers. Project construction workers will be present at construction camps for a period of up to 36 months. As the camps are expected to be open allowing relatively free movement of workers, visits to local settlements in the study area and near-by urban centres during the workers' free time is quite likely. These visits can be expected to generate income for local shops, bars, restaurants and coffee shops, and other existing formal and informal businesses in the service sector.

Finally, the project will require the contracting the provision of services such as water supply, solid waste management, catering to provide food to the construction workers. As such, the use of local suppliers may contribute to the creation of local economic development and diversification opportunities for the construction period.

Again, an enhancement measure is thus necessary in order to assure that impacts are to be felt in the regional economy, so that services are not contracted in Luanda or Benguela and shipped to the study area. As such, the following enhancement measure is suggested: maximise local procurement, contracting local suppliers (in the municipalities of the project) for all possible services (provisioning of water, waste management, catering, cleaning services, among others).

With the previously stated enhancement measure, the impact "boost of the local economy and improvement of living conditions" is anticipated to be of moderate significance (i.e., expected post- enhancement measure) (see Table 99).

Table 99 – 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	Definite
Intensity (or magnitude)	Low
Significance (without enhancement)	Low
Significance (expected post-enhancement)	Moderate

8.10.1.3. Safety of local communities

Given the construction activities to be expected during the 36-month period (24 months for the construction of the transmission lines; 20 months for the associated substations), an impact on the local communities safety is expected. As was presented before, there are an estimated five thousand people living in the project's Direct Area of Influence.

During construction there will be an increase in traffic movements of heavy machinery and light vehicles in the road along the transmission line route and in access roads leading to the 408 transmission towers working areas during a period of 24 months. This will include water trucks, cement trucks, transport of construction material, excavation machinery, among others, which is expected to increase the risk of road 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. Furthermore, 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. The impact is temporary and limited to the settlements in the DAI and the surrounding road network. Considering the potential risk posed to communities, the magnitude is considered medium and the significance moderate (given the likelihood of the impact is likely).

The development, execution and monitoring of a Community Health and Safety Management Plan is expected to mitigate the impact on the safety of local communities, transforming it in an impact of low significance (i.e., expected post-mitigation measure) (see Table 100). The Community Health and Safety Management Plan should include the following, regarding the mitigation efforts for the impact on the safety of local communities:

- 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.

Table 100 – 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

8.10.1.4. 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 the movement of vehicles, among others, can be sources of dust emission, vibrations, and responsible for increasing noise levels and generation of waste, among others, in the locations of the project near settlements. As a result, air quality is likely to decrease, noise emissions to increase, causing disturbances in local communities and impacting their health.

The impacts on environmental health during construction are temporary in nature for the duration of the construction phase. Construction activities and associated traffic will take place in 408 transmission towers working areas and dirt access roads along the transmission line and close to local settlements. Considering the temporary nature of the works and the sequential approach, the magnitude is considered medium and the significance moderate (given the likelihood of the impact is likely).

The development, execution and monitoring of a Community Health and Safety Management Plan is expected to mitigate the impact on the health of local communities, transforming it in an impact of low significance (i.e., expected post-mitigation measure) (see Table 101). The Community Health and Safety Management Plan should include the following, regarding the mitigation of the impact on the health of local communities:

- Provide access to health care for those injured by the Project's activities, including local communities dealing with respiratory diseases and others;
- Create and execute a stakeholder engagement plan and consultation to educate local communities of the health concerns around working sites;
- Create a plan to deal with emergencies;
- Establish appropriate safety distances and perimeters for communities;
- Implement a Community Grievance Mechanism.

Table 101 – Impact assessment on "socioeconomics and human rights" (construction phase): "impact on the health of local communities"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct

Criteria	Assessment
Extent	Local
Duration	Short-term
Likelihood	Likely
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

8.10.1.5. Increase disease transmission

The concentration of workers in working and accommodation sites, the free movement of workers and possible interaction with local communities, could potentially lead to an increased transmission of transmissible diseases and sexually transmitted diseases within these communities. This is a particular risk given the current situation of the Covid-19 situation and the fact that in the study area, high morbidity risk of respiratory diseases is presented in Cubal, Ganda, Caála, Tchinjenje and Ukuma (Huambo and Longonjo have a medium risk) (Manuel, Freitas, & Lamezón, 2020).

The profile of these diseases will be influenced by the existing diseases profile of communities along the route and the diseases profile of the areas workers are sourced from. In addition, if opportunistic workers arrive in the area hoping to benefit from employment spin offs this could also impact the transmission of communicable diseases. Communicable diseases of concern are likely to include diarrhoea, respiratory infections, and typhoid fever, malaria. Children and the elderly will be at particular risk.

In addition, considering that HIV/AIDS prevalence in Angola is relatively high, transmission of HIV may also occur. Prostitution and pregnancies in young girls may also occur.

Based on the above, interaction between the project’s workforce and local communities in the DAI is considered likely during the construction phase. Considering that the Project workforce of 550 workers represents 11% of the estimated population of the settlements in the DAI, distributed into two accommodation sites, the impact magnitude is considered medium. This results in impact with moderate significance (pre-mitigation).

Table 102 – 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)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

With mitigation measures, the impact can be less significant (of low significance). For that the Community Health and Safety Management Plan should include the following, regarding the mitigation efforts for the increase disease transmission impact:

- 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).

8.10.1.6. Loss of livelihoods, mostly temporary

The following restrictions to agricultural activities will be enforced during the construction phase of the project:

- Maintenance road (4 metre corridor): land clearance and removal of all trees and crops;
- OHTL footprint corridor (20 metre corridor): crops of up to 6-7 metres high are allowed but removal of all trees;

- Temporary tower site working areas (40x50 metres per tower): removal of trees and crops (maybe it will be possible to maintain trees in this area, outside of tower footprint and 20 m OHTL footprint corridor);
- Construction camp for new Lomaum SS: removal of trees and crops.

As a result of these restrictions, there will be a temporary loss of access to 78 ha of seasonal crops, corresponding to an estimated 2,700 agricultural plots. Even though the estimated number of agricultural plots affected is relatively high, the total agricultural land area affected is considered minimal (less than 3% of the Project's Direct Area of Influence).

In addition, it is estimated that 8.9 ha of fruit trees will be affected during the construction phase of the project.

It is important to note that where possible, households will be given the opportunity to harvest their crops before the land is cleared for construction. In addition, although the construction period is 24 months, not all areas will be inaccessible at the same time.

It is recognised however that the land productivity may take time to fully re-establish, and seasonal crops may take three to six months to reach maturity depending on the crop. This means that once the land is reinstated after the construction phase, land users may not experience an immediate return to their initial levels of productivity and income generation.

Furthermore, communities will lose access to forest areas and their resources, such as firewood, charcoal, and others. The estimated deforestation caused by the construction of the project is approximately 45.9 ha.

Due to the heavy reliance on land-based activities and the small plot sizes, the level of impact from the temporary 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 the land, access to alternative land and livelihood activities and their current income levels.

Vulnerable groups rely more on subsistence agriculture, which makes them more land dependent, and have lower average monthly incomes. This means that their livelihoods are closely linked to their land resources, and any disruption to their access or use of land can have a serious impact on their ability to sustain their livelihoods.

Low-income households also have less formal land tenure and may face greater difficulties in accessing compensation for land-related losses, making them more vulnerable to loss of livelihoods and face a greater level of impact than those with access to alternative resources.

In addition, 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 potential impacts from temporary loss of land given they do not have clear customary rights.

It is therefore essential to prioritise the needs of vulnerable groups in the compensation for the loss of livelihoods.

The impact is a direct result of the project's activities. The impact is temporary in most of the area, but permanent in some areas, corresponding to the maintenance road and the permanent tower sites. Considering the importance of land-based activities for the local communities, and given the high proportion of vulnerable households, the magnitude is considered medium and the significance moderate (given the likelihood of the impact is definite).

Table 103 – Impact assessment on "socioeconomics and human rights" (construction phase): "loss of livelihoods, mostly temporary"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Short-term & permanent
Likelihood	Definite
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

With mitigation measures, the impact can be less significant (of low significance). For that a Livelihood Restoration Plan should be create and executed and include the following:

- 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.).

8.10.1.7. Potential resettlement during construction

Following feedback from Nemus, Elecnor adjusted the route of the transmission line to minimise resettlement, allowing the project to avoid the physical displacement of families' houses. However, according to the analysis made in the Preliminary Resettlement Action Plan, 5 support structures are expected to be resettled.

Similar to the impact related to loss of livelihoods, vulnerable groups are more vulnerable to potential resettlement and it is therefore important to prioritise their needs. Resettlement should not result in the further marginalisation or impoverishment of vulnerable groups, but should aim to improve their socio-economic well-being and protect their rights to land and livelihoods. In addition, all those affected by the project, especially vulnerable groups, should be involved in decision-making processes that affect their land and livelihoods.

As resettlement of houses is not expected, only of support structures, and mitigation measures are recommended to ensure fair compensation for resettled structures (i.e., Livelihood Restoration Plan), the impact may be less significant (of low importance).

Table 104 – Impact assessment on "socioeconomics and human rights" (construction phase): "potential resettlement during construction"

Criteria	Assessment
Nature	Negative
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Unlikely
Intensity (or magnitude)	High
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

8.10.1.8. Impacts on workers' health and safety

Typical activities for the construction of the transmission lines include clearance of the RoW 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 also 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.

Therefore, during construction, the direct interaction between the project and the workforce if not managed properly, will result in negative impacts on the workers' working conditions and potentially permanent impacts on their health and safety. The impact is considered short-term and continuous over the 36 months construction phase across all hundreds of construction sites resulting in a medium impact magnitude.

Since companies are expected to operate according to international standards (the workforce is expected to be trained and the employer is expected to enforce the use of personal protective equipment and health and safety measures) and considering the level of prior training of the workforce, the magnitude is considered medium. Therefore, the impact is of moderate significance. With the enforcement of mitigation measures (creation and execution of a Workers' Health and Safety Management System), the impact significance is expected to decrease to low.

Table 105 – 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

8.10.2. 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.

8.10.2.1. 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 infrastructure and the OHTL footprint corridor (20m wide) and monitoring activities for 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. RNT is a state company therefore hiring may be limited as RNT 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 of the 20 m OHTL footprint corridor will require low skilled workforce.

Considering the above, the magnitude of the “local employment opportunities” impact is considered low and the significance low (likelihood of the impact is definite).

Table 106 – 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	Low

8.10.2.2. Provision of electrical capacity and related benefits

In addition to employment generation, another positive impact during the project’s operation phase will be the increased electrical capacity in Benguela, which will receive the Lauca Hydro Plant generated electricity through the national grid. 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 Benguela.

Specifically, the improved and more stable supply may result in an increase in productivity and growth of service industries and in the development and increased competitiveness of small enterprises over 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 from the reduction in noise and air emissions from generators.

Furthermore, the project will interconnect the West and Southern transmission networks in Angola to guarantee a continuous, stable, and balanced power supply and transporting energy service. Finally, the project will facilitate the construction of a new distribution network in the future (Benguela Province Electrification Project) including more than 50,000 new housings connections in Alto Catumbela, Ganda, Cubal (urban areas in the IAI), Caiambambo and other cities.

Vulnerable groups, particularly those in the first income quintile, rely more heavily on traditional biomass fuels such as firewood for cooking and lack access to reliable and affordable lighting. Increased electricity capacity can therefore directly benefit vulnerable groups by providing them with reliable and affordable sources of lighting, cooking and other household activities, which can improve their **socio-economic wellbeing** by enabling them to engage in income-generating activities such as small businesses that require electricity to operate.

The project's stimulus to local economic development can also stimulate local economic development by attracting investment and encouraging the growth of small industries that can provide employment opportunities for vulnerable groups.

In addition, access to electricity can also have significant **health and safety benefits** for vulnerable groups. For example, it can reduce indoor air pollution caused by burning firewood or other biomass fuels indoors, which can lead to respiratory diseases. It can also reduce the risk of accidental fires associated with the use of torches for lighting, which is particularly common among vulnerable groups.

Therefore, the construction of an electricity transmission line has the potential to bring multiple benefits to vulnerable groups in Angola. However, it is important to ensure that these benefits are realised in practice by addressing potential challenges related to affordability, infrastructure, and social inequalities, and by involving vulnerable groups as active stakeholders in the planning, implementation and management of the project.

Considering the above, the magnitude of the "provision of electrical capacity and related benefits" impact is considered high (taking into account the potentially affected population) and the significance high (likelihood of the impact is definite).

Table 107 – 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	Definite
Intensity (or magnitude)	High
Significance	High

8.10.2.3. Permanent loss of livelihoods

The following restrictions on agricultural activities will be enforced during the operation phase of the project:

- Maintenance road (4 metre corridor): no trees or crops allowed;
- OHTL footprint corridor (20 metre corridor): no planting of new trees allowed, only vegetation/crops of up to 6-7 metres;
- Permanent tower sire (10x10 metres per tower): no trees or crops allowed;
- New Lomaum SS: removal of trees and crops: no trees or crops allowed.

As a result of these restrictions, there will be a permanent loss of access to 39 ha of seasonal crops, corresponding to an estimated 2,300 agricultural plots. Even though the estimated number of agricultural plots affected is relatively high, the total agricultural land area affected is considered minimal, representing only 1.1% of the DAI. In addition, a permanent loss of 8 ha of fruit trees has been estimated.

Furthermore, communities will lose forest areas (estimated 40.6 ha of forest) and their resources, such as firewood, charcoal, and others.

Due to the heavy reliance on land-based activities and the small plot sizes, the level of impact from 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 the land, access to alternative land and livelihood activities and their current income levels.

Vulnerable groups rely more on subsistence agriculture, which makes them more land dependent, and have lower average monthly incomes. This means that their livelihoods are closely linked to their land resources, and any disruption to their access or use of land can have a serious impact on their ability to sustain their livelihoods.

Low-income households also have less formal land tenure and may face greater difficulties in accessing compensation for land-related losses, making them more vulnerable to loss of livelihoods and face a greater level of impact than those with access to alternative resources.

In addition, 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 potential impacts from temporary loss of land given they do not have clear customary rights.

It is therefore essential to prioritise the needs of vulnerable groups in the compensation for the loss of livelihoods.

The impact is a direct result of the project's activities. The impact is permanent in about 20 ha (less than 1% of the agricultural land available in the DAI). Considering the importance of land-based activities for the local communities, and given the high proportion of vulnerable households, the magnitude is considered medium and the significance moderate (given the likelihood of the impact is definite). With mitigation measures (Livelihood Restoration Plan), the impact can be less significant (of low significance).

Table 108 – 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	Definite
Intensity (or magnitude)	Medium
Significance (without mitigation)	Moderate
Significance (expected post-mitigation)	Low

8.10.2.4. Increased community safety after demining

Once the construction phase is completed, mine clearance will have been undertaken in all areas inside the 60 m OHTL RoW that had not been previously cleared and that did not have an associated demining certificate. This clearance will result in increased safety for households and land users moving about in the area and will also release additional areas of land for cultivation. The impact is therefore positive.

Considering the above, the magnitude of the "increased community safety after demining" impact is considered medium (taking into account the potentially affected population) and the significance moderate (likelihood of the impact is definite).

Table 109 – Impact assessment on "socioeconomics and human rights" (operation phase): "increased community safety after demining"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct

Criteria	Assessment
Extent	Local
Duration	Permanent
Likelihood	Definite
Intensity (or magnitude)	Medium
Significance	Moderate

8.10.2.5. Benefits to local settlements from road infrastructure improvements

Improvements to roads have the potential to positively impact on community access to education, employment, services, and road safety. Communities in rural and remote areas are currently lacking in quality roads and infrastructure have the potential to be most positively impacted by infrastructure improvement. Communities benefiting from the upgrade and construction of new roads may also experience positive impacts such as enhanced access to markets for their local agricultural produce, and access to transportation and services (education, health, transport, etc.).

As the Project is expected to use mainly existing roads, these will require upgrading during the construction phase and maintenance during operations which result in a long-term positive impact for local communities.

Considering the above, the magnitude of the "benefits to local settlements from road infrastructure improvements" impact is considered low and the significance low (likelihood of the impact is definite).

Table 110 – Impact assessment on "socioeconomics and human rights" (operation phase): "benefits to local settlements from road infrastructure improvements"

Criteria	Assessment
Nature	Positive
Type (Direct/Indirect)	Direct
Extent	Local
Duration	Permanent
Likelihood	Definite

Criteria	Assessment
Intensity (or magnitude)	Low
Significance	Low

8.10.3. Decommission phase

Overall, the project´s impacts in the deactivation 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; potential resettlement during construction; 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.

8.10.4. Cumulative impacts

The impacts regarding loss of livelihoods (construction and operation phase of the project) are found to be cumulative with the deforestation rate in Huambo province. Miombo lands, native and plantation forest and scattered trees provide important resources for local communities. Deforestation associated with charcoal demand is having a particularly adverse impact on the availability of resources such as firewood and wood necessary for charcoal production, construction, and other socioeconomic activities.

8.10.5. Summary

Regarding socioeconomic and human rights, the following impacts are to be expected:

- During the construction phase:
  - Creation of temporary employment opportunities – positive and with moderate significance expected post-enhancement measures;

  - Boost of the regional economy and improvement of living conditions – positive and with moderate significance expected post-enhancement measures;
  - Impact on the safety of local communities – negative and with low significance expected post-mitigation measures;
  - Impact on the health of local communities – negative and with low significance expected post-mitigation measures;
  - Increase disease transmission – negative and with low significance expected post-mitigation measures;
  - Loss of livelihoods, mostly temporary – negative and with low significance expected post-mitigation measures;
  - Potential resettlement during construction – negative and with null significance expected post-mitigation measures;
  - Impacts on workers' health and safety – negative and with low significance expected post-mitigation measures;
- During the operation phase:
  - Local employment opportunities – positive and with low significance;
  - Provision of electrical capacity and related benefits – positive and with high significance;
  - Permanent loss of livelihoods – negative and with low significance expected post-mitigation measures;
  - Increased community safety after demining benefits – positive and with moderate significance;
  - Benefits to local settlements from road infrastructure improvements benefits – positive and with low significance.

8.11. Cultural Heritage

This chapter assesses the potential impacts on cultural heritage as a result of the development of the project in its construction phase, when the project components will be introduced, in its operation phase, when maintenance actions may be required, and in its decommissioning phase, when the removal of structures is planned.

The evaluation of the impact is based on the modification of the environment, which can occur in both the physical and the perceptual environment. The physical environment is understood as the presence of material remains, which may be the result of previous human presence (archaeological sites) or physical spaces of high value for the communities (traditional burial grounds). The perceptual affect results from the modification of a landscape, such as sacred forests, which are fundamental as spaces of worship and subsistence for local communities.

8.11.1. Construction phase

In a comprehensive analysis of all the elements gathered, it is considered that the construction phase includes a number of interventions to be carried out in the project's direct area of influence that could potentially generate negative impacts on cultural heritage, such as archaeological sites, traditional cemeteries and sacred forests.

Generally speaking, the main risks hanging over the heritage are during the construction phase and can be grouped according to the nature of the action:

Table 111 – Levels of allocations caused by actions carried out on worksites

Impact category	Actions carried out on construction sites
Actions with a higher earmarking effect	- Excavations and earthmoving activities - Preparatory works for setting up a construction site and infrastructures
Actions with a lower earmarking effect	- Land clearing - Heavy machinery circulation

Table 112 shows the heritage features identified in the project's corridor and the significance of the impact according to the magnitude of the expected impact.:

Table 112 – Heritage affected by the project.

Type	Name	Coordinates	Impact magnitude	Expected impact
Traditional cemeteries	C1	12º55'21.10''S 14º39'32.75''E	High	High
	C2	12º50'28.21''S 15º04'11.50''E	Medium	Moderate
	C3	12º48'43.30''S 15º32'44.80''E	High	High
Archaeological sites	Lumpi	12º52'29.85''S 14º48'27.35''E	Low	Low
	Nganda	12º14'43.30''S 15º32'44.80''E	High	High

The traditional cemeteries will be the most affected, with a total (C1 and C3) and partial (C2) magnitude of impact, since they are located close to the power line, on low lying land that is easily accessible. Although these are sacred sites, and as such are generally respected by the local population, their proximity to the worksite corridor, easy access and the possibility of providing shade for the workers put the area at risk. Thus, the impact is assessed as negative, direct, temporary, local and site protection measures must be taken.

The inselberg where the Lumpi settlement is located is located at the outer limit of the project's corridor of influence; however, the impact will take place at the foot of the inselberg, a location where these communities used to occupy in peacetime with temporary dwellings to support agricultural activity. In this context, the impact is assessed as likely, although of low intensity, negative, direct and will be permanent, since the loss of archaeological heritage is never recoverable, and measures must be taken to preserve the site.

The settlement of Nganda is almost entirely covered by the corridor of influence of the project. Figure 124 only shows the area occupied by the inselberg, where legends and rock art exist. Here, as the information is not very objective regarding the settlement's occupation space, it is not possible to represent it in the figure. However, despite the subjectivity, it is possible to evaluate the impact as probable negative, direct, permanent, and high significance.

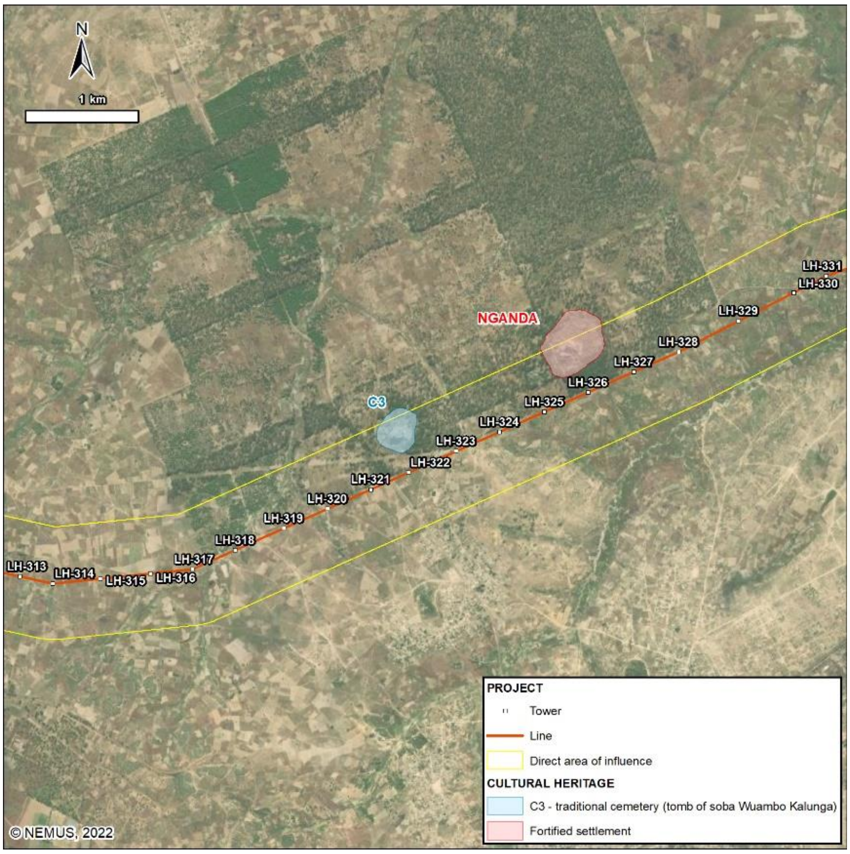


Figure 124 – Nganda settlement location.

The impact assessed for the construction phase is mitigable, becoming insignificant/ null, with the application of the measures proposed in Chapter 9.

8.11.2. Operation phase

No impacts are expected in the operational phase, however, in the event that removal or soil movement actions are required, it is considered that the impacts are the same as those assessed in the construction phase.

8.11.3. Decommission phase

No impacts are expected in the decommissioning phase, however, if removal or soil movement actions are necessary, the impacts are considered the same as those assessed in the construction phase.

9. Mitigation and Compensation Measures

The following tables synthesise mitigation and enhancement measures indicated above separately for the different issues, now separated according to the different phases of the project.

Table 113 – Mitigation and enhancement measures for the detail design phase

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Climate	
Emissions of GHG (construction and operation phase)	• Development of a plan to manage the GHG emissions associated with all the project's phases (construction, operation and decommission), including: o Policy statement with the compromises of the project's infrastructure owner relative to GHG emissions and implementation of required mitigation measures; o Annual assessments of emissions, through an adequate system for the collection and management of data (materials used, energy consumption and energy sources, among others); o Regular collection and assessment of information regarding climate change projections for the project influence area (IPCC reports and regional downscaling applications); o identification of relevant construction and operation processes to control and reduce GHG emissions during the project lifetime; o Establishment of GHG emissions' reduction targets for the project for the short, medium and long terms aligned with national mitigation objectives, allowing monitorization of the project's performance relative to GHG emissions

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Increased risk of reduction of transmission efficiency of lines during heat waves	• Account for increasing air temperatures in operation phase in the specification of the transmission lines' materials, studying the use of transformers cooling and heat dissipation equipment for conductors
Increased risk of damage to transmission towers and SS in extreme weather events (floods and wildfires)	• Consider protection of the project infrastructures against floods and soil erosion, especially in transmission towers located in steep areas
Geology, geomorphology and topography	
Changes in local morphology	• Rock and sand materials necessary for the work construction must come from licensed exploitations • Whenever possible, excavated materials that have good geomechanical characteristics should be reused for local embankments construction, mitigating the use of deposits from outside the project area of influence and the volume of surplus soils to be transported to a landfill • Excavation materials that cannot be used due to lack of adequate geomechanical characteristics or have superior volumes than the foreseen needs in the project should preferably be used to restore the morphology of degraded sites in the project area or its vicinity.
Local erosion	• Develop drainage solutions around the waterproofed areas to mitigate erosion due to surface runoff
Mineral resources	
Use of aggregates for embankments	• The use of mineral resources must be from an area assigned to this purpose by the Angolan authorities
Natural disasters	
Landslides and/or fall of blocks from weathered rock masses	• Geological survey of the three sections of the transmission lines layout (LH37 to LH42, LH125 to LH128/LH167 to LH169) and substations (V07/V13/V18) with the higher slopes to identify critical situations of instability that may justify an intervention before beginning the construction works

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Seismic event	• Complying with international standards regarding anti-seismic design and the ability to withstand seismic stresses
Surface Water Resources	
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	• In case alternative locations for construction camps, transmission lines and access roads are studied, the locations more distant from watercourses should be, if possible, preferred to mitigate impacts on surface water resources
Soils	
Soil erosion	• Ensure the safe construction activities of the working areas without causing unnecessary clearance of vegetation; • Programme construction work during the dry season, wherever possible.
Soil pollution	• All staff are to receive environmental training are to receive environmental training prior to working on site.
Air quality	
PM and Dust emission	• Plan the activities with higher emission potential to happen as far as possible from the receptors.
Noise	
Noise emission	• Plan the activities with higher noise emission potential to happen as far as possible from the receptors.

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Ecology	
Loss of vegetation, flora and loss and fragmentation of habitats	• Without prejudice to the provisions the legislation makes regarding the development of transmission lines, whenever possible, it is recommended that the line layout deviates from areas with dominant arboreal layers (of native vegetation), to avoid their removal. This should be studied case-by-case. • The OHTL Right of Way should avoid crossing areas where individuals of threatened tree species are present (*Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (mupanda), *Pterocarpus angolensis* (tacula)). Because *P. angolensis* has a slow growth rate, this species should not be removed even during the construction phase. During the operation phase must only be preceded if the security of the transmission line is at risk of being compromised. If tree removal is not possible to avoid, post-construction monitoring should be planned in order to evaluated the condition of the populations of these species (particularly *P. angolensis*) along the DAI. • The implementation of the construction site and support infrastructures should be design in areas already free of vegetation. • The access roads that will be opened should be pre-delineated, in order to avoid crossing natural habitats (miombo woodlands and wetlands). Whenever possible dirt roads that already exist should be used. When this is not possible, roads should be opened in modified habitats such agricultural areas, even if it requires a longer path. The access roads must not be planned/opened in locations where individuals of *Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (mupanda) and *Pterocarpus angolensis* (tacula) occur.

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Degradation of ecosystem services	• The mitigation measures addressing vegetation loss and habitat fragmentation, particularly the delineation of access roads that avoid crossing of natural habitats, are expected to contribute to the mitigation of ecosystem service degradation in the miombo woodlands. In addition, the implementation of the measures included in the Environmental and Social Management Plans (Chapter 10), such as the removal of exotic species in wetlands, is expected to increase the resilience of these habitats to degradation and minimize the degradation of the ecosystem services they provide, namely access to water sources.
Disturbance of birds and bats	<u>Minimizing risk of collisions:</u> • The line must have the minimum height possible, which guarantees the safety of the human populations; • It is recommended that Bird Flight Diverters (BFD) are installed along the conductors, at a maximum distance of 20 m, and placed alternately from one conductor to the other. These flags can be double-signaling spirals and of bright and visible colors; Other alternative BFD are rotating or ribbon fireflies <u>Minimizing risk of electrocution:</u> • The tension cables of up to 120 cm on each side of the support posts and sub-stations must be covered; they can be flexible cables, or self-vulcanizing tapes, for example. • Anti-landing and anti-nesting devices must be installed on top of the posts. The adoption of the recommended measures must be prioritised based on the sensitivity of the area covered, particularly in the natural habitats, miombo woodlands and wetlands, but also in grasslands and agricultural areas.

Table 114 – Mitigation and enhancement measures for the construction phase

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Climate	
Emissions of GHG	• Use construction equipment and vehicles with low fuel consumption • Use as much as possible materials of local origin to avoid transport over long distances • Adequate planning and efficient use of materials to avoid waste • Careful handling of materials to avoid damage in transportation, storage and assembly • Use materials partially of recycled origin if possible
Reduction of carbon sinks	• Minimize deforestation in the construction phase • Rehabilitation of soil and vegetation temporarily disturbed in the construction phase • Promote forestation in the project's AII with the same area of forest vegetation clearance due to project, considering vegetation adapted to local climate and efficient as carbon sink
Hydrogeology	
Groundwater contamination	• Constructive activities should be limited to the strictly necessary areas, in order to minimise the waterproofing of the soil, as well as accidents that could interfere with the groundwater quality • Contaminant products should be stored in properly waterproofed places and carefully handled to minimise the dangers of groundwater contamination • In case of an accidental spillage, the site must be cleaned up, removing the affected soil layer and transporting it to an appropriate final destination • Any interference with wells or springs in the influence area of the project should be followed by the replacement of their conditions before the accident • If groundwater is used to ensure the water needs of the project, adequate control and management of the abstracted water must be ensured

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Surface Water Resources	
Increased concentrations of faecal bacteria and organic matter and reduced concentration of dissolved oxygen in rivers and streams	• Installation of adequate sanitation facilities with collection of effluents in the construction camps, new SS area and temporary tower laydown and assembly areas; sanitary effluents should be regularly transported to adequate licenced sewage treatment and disposal facilities • Installation of adequate solid waste collection systems in the construction camps, SS areas and temporary tower laydown and assembly areas and adequate disposal of wastes in appropriate licenced facilities • Awareness sessions for construction staff to prevent surface water resources in construction activities
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	• Perform maintenance and washing of construction vehicles/equipment in the construction camps and in controlled areas (impermeable and with spillage drainage and contain systems), to prevent spills to soil and water resources and with adequate disposal of spilled substances • Storage of oils, fuels and other hazardous substances in a special area in construction camps with impermeable floor and specific drainage system to contain spillages • Training of construction staff for the correct maintenance and operation of vehicles/equipment to prevent spillages • Perform preventive maintenance of construction vehicles/equipment to avoid spilling while in use
Soils	
Soil erosion	• Vegetation clearing and topsoil disturbance minimised and should not extend beyond the corridor or substation site; • Spread mulch generated from indigenous cleared vegetation across exposed soils; • Excavated or cut and fill areas allowed to revegetate or indigenous species used for replanting; • Seeding, mulching and other soil conservation measures implemented effectively during or immediately after each land-disturbing activity;

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Soil erosion	• Topsoil stockpiled separate from subsoil. Stockpiles located away from drainage lines, and protected from rain and wind erosion, and contamination; • Soil backfilled into excavations replaced in the order of removal in order to preserve the soil profile; • Topsoil evenly spread across the cleared areas when reinstated; • Sloped areas impacted through construction activity must be stabilized to ensure erosion control (plant slope protection or engineering slope protection depending on slope gradient); • Rehabilitate any areas damaged by construction activities by cleaning and loosening soil compaction; • Prevent sheet erosion of soil (diversion berms, etc.); • Prevent accelerated erosion from storm events (managing storm water runoff with velocity control measures).
Soil pollution	• Ensure regular maintenance of all vehicles; • Immediately contain and clear up all spills outside • impervious areas; • Drip trays must be used when refuelling and servicing vehicles or equipment, when not on an impermeable standing surface; • Contaminated areas will be remediated and post remediation verification will be carried out; • Waste Management Plan (storage, handling and disposal of hazardous waste) • Oil Spill Response Plan
Land Use	
Temporary land take and loss of access to land	• Disturbed areas with temporary land restrictions landscaped and rehabilitated; • Sloped areas impacted through construction activity must be stabilised to ensure proper rehabilitation; • Indigenous species used for replanting; • Provide compensation for loss of assets from seasonal and permanent crops and forest products; • Stockpiled topsoil used for rehabilitation; • Improve or restore the livelihoods, including the provision of alternative land for cultivation with equal or better soil productivity

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Air Quality	
PM and Dust emission	• Carry out monitoring, through visual inspection, on relevant sites such as the SS locations and the electrical posts' locations; • Forewarn local communities of the potential disturbance on air quality and register all complaints related to dust and air quality. These complaints will be recorded and promptly investigated and dealt with; • Watering of particularly busy unpaved roads or intersections near sensitive receptors; water used should be recycled/reused water (from sedimentation lagoons for example); • Where trackout happens, use wet road cleaning methods to avoid suspension; • Avoid excavation, handling and transport of eroding materials during high wind conditions. • Enforce speed limits in order to reduce dust emissions; • Access roads must be properly compacted, levelled and maintained periodically; • Fine-grained material may not be transported in overloaded vehicles and, when necessary, loads of this material should be covered with tarpaulins to prevent the dispersion of dust; • All vehicles and machinery should be maintained and served according to the manufacturer's specifications; • Ensure that all new equipment delivered to site has been inspected to ensure good working conditions and compliance with the applicable requirements; • Minimise downtime by requiring vehicles and equipment to equipment to switch off when not in use and/or reducing maximum downtime to five minutes for all reduce maximum downtime to five minutes for all equipment; • The indiscriminate burning of materials resulting from the removal of trees, bushes, combustible materials and waste is forbidden.

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Noise	

Noise emission	• If construction work has to take place after working hours, all affected communities must be notified in advance;
	• Stationary noisy equipment should be placed as far from the sensitive receptors as possible, and facing away from them;
	• When possible, place stationary noisy equipment (e.g. electrical generators) in acoustic enclosures;
	• Provide adequate individual protection equipment (IPE), including sound mufflers to the workers;
	• Forewarn local communities of the potential disturbance quality and register all complaints related to noise. These complaints will be recorded and promptly investigated and dealt with;
	• Avoid simultaneous use of noisy equipment in locations near sensitive receivers;
	• Ensure the adoption of good driving practices, such as:
	  ○ Minimise equipment reversing manoeuvres to prevent nuisance associated with reversing alarms;
	  ○ Reduce unnecessary acceleration and braking when arriving at and leaving the sites;
	  ○ Ensure compliance with speed limits for all construction vehicles; and
	  ○ Limit the use of noisy signals, including, horns, whistles, alarms and bells to safety warnings only.

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Ecology	
Loss of vegetation and flora	• In the course of deforestation actions, whenever possible, the killing or affecting of individuals of the following species, considered a priority in terms of biodiversity conservation because they are Vulnerable (Ministério do Ambiente, 2018) should be avoided: *Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (Mupanda), *Pterocarpus angolensis* (tacula). • Special caution should be taken when removing vegetation in areas of *Eucalyptus* spp., which occur in mosaic with native vegetation, to ensure non-discriminated tree removal occurs. • It is also recommended to implement a training and environmental awareness program for workers during the construction phase of the project. The program in question should address issues such as the ecological framework of the natural values present in the area of intervention, as well as the definition of behaviours to be avoided and to be promoted, such as the exploitation or removal of certain tree species. • In the closing phase of the works, the areas affected must be adequately cleaned and rehabilitated (i.e., deforested or altered in another way), in order to prevent the spread of invasive species.
Loss and fragmentation of habitats for faunal communities	• This impact will be mitigated with the measures referred for the detail design phase (Loss of vegetation, flora and loss and fragmentation of habitats) and for the construction phase (Loss of vegetation and flora).
Disturbance of faunal communities	• For wetland habitats (which occupy 4.1% of the OHTL Right of Way), it is recommended that, as far as possible, the scheduling of the most impacting construction works (excavations for the installation of poles, cutting and/or removal of vegetation) are carried out avoiding the most critical periods for sensible and threatened avifauna (migration and reproduction), occurring between October and March. When construction during this period in not possible to avoid, other measures should be implemented such as:

Environmental or Social Impacts	Mitigation/ Enhancement Measure
	• Undertaking monitoring of bird species, with special focus on endangered and migratory species, particularly in the flooded areas (section 10.1). • Breeding sites and birds must remain intact and disturbance should be avoided. Special care shall be taken where nestlings or fledglings are present. • All poaching activities (egg/birds collection/capture) are forbidden for endangered and migratory species. • The client should prepare and implement a code of conduct to prevent impactful actions over bird populations, during construction and maintenance actions. • Still regarding the timing, the construction works must be carried out continuously (once started, they must be completed without significant breaks in between) in order to avoid the recolonization of the area by fauna and a re-displacement.
Habitat contamination with hazardous materials (e.g. insulating oils/gases and fuels in addition to herbicides for right of way vegetation maintenance).	• The appliance of herbicides should be avoided in order to prevent contamination of the soils and bioaccumulation, which will put soil fauna at risk (e.g. micro-mammals, invertebrates, etc.) and other fauna that feeds on this vegetation. Manual techniques should be used instead. This will also allow to better select which flora will be removed, ensuring threatened flora will not be affected.
Socioeconomics and human rights	
Potential resettlement during construction	• Fine adjustment of the project and the route of the transmission line
Cultural Heritage	

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Heritage potentially affected: Traditional cemeteries and Archaeological sites	• Preparation of an *Awareness-raising Action* of workers as regards cultural heritage. This should explain the different types of heritage that may be found in the work area, 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 (in the specific case of archaeological sites).). • Development of cultural awareness panels covering key issues including the location and importance of cultural sites; • Sobas of the local communities should be consulted for panel content creation;

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Heritage potentially affected: Traditional cemeteries and Archaeological sites	• The panels should be placed at easily visible locations on the construction sites for workers to see. • Preparation of a Guide of Procedures to be applied whenever a grave is identified in the project area. • Seal off access to traditional cemeteries and sacred forests, and those that may be identified in the course of the work. • Access to traditional cemeteries and sacred forests shall be the exclusive privilege of the local community; • Prohibition of machinery and people from outside the community from circulating in the fenced space; • Prohibition on using the space as a building site; • Prohibition of grave removal without prior consent of the local community as well as the required legal requirement. • Provide a perimeter protection with fencing in Lumpi and Nganda villages: • Prohibition of movement of machinery and people from outside the community in the fenced space; • Prohibition of using the space as a construction site. • Systematic prospection of the Lumpi and Nganda settlements affected area and also the surrounding area to update the characterisation of the archaeological sites; • The prospection works must be carried out by a credentialed archaeologist; • The survey must be exhaustive, including a descriptive record of materials and structures observed, drawing and photography. • Survey with the local community of the stories, myths and traditions surrounding the inselberg of Nganda and the death of the soba Wuambo Kalunga. • Archaeological monitoring of ground clearing, removal and soil movement works in the vicinity of the Nganda (between LH321 and LH329) and Lumpi (between LH117 and LH120) settlements. • Archaeological monitoring must be carried out by accredited archaeologist.

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Socioeconomics and human rights	
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	• Livelihood Restoration Plan
Impacts on workers' health and safety	• Workers' Health and Safety Management System

Table 115 – Mitigation and enhancement measures for the operation phase

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Climate	
Reduction of GHG emissions from electricity consumption in Benguela Province	• Adequate planning and efficient use of materials to avoid waste • Careful handling of materials to avoid damage in transportation, storage and assembly • Use maintenance equipment and vehicles with low fuel consumption • Use alternative fuels with lower carbon intensity: consider the use of biodiesel for transport of materials and workers
Increased risk of reduction of transmission efficiency of lines during heat waves	• Manage electricity demand in heat waves events to avoid the effects of reduction of transmission efficiency of lines
Increased risk of damage to transmission towers and SS in extreme weather events (floods and wildfires)	• Creation and maintenance of prompt emergency teams to attend to project infrastructure damages due to extreme weather events and limit the impact on project operation
Hydrogeology	
Groundwater contamination	• In case of an accidental spillage of oils and other products from substation operation, the site must be cleaned up, removing the affected soil layer and transporting it to an appropriate final destination

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Surface Water Resources	
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	• Perform maintenance and washing of construction vehicles/equipment in the construction camps and in controlled areas (impermeable and with spillage drainage and contain systems), to prevent spills to soil and water resources and with adequate disposal of spilled substances • Storage of oils, fuels and other hazardous substances in a special area in construction camps with impermeable floor and specific drainage system to contain spillages • Training of construction staff for the correct maintenance and operation of vehicles/equipment to prevent spillages • Perform preventive maintenance of construction vehicles/equipment to avoid spilling while in use
Soils	
Soil pollution	• Immediately contain and clear up all spills; • Contaminated areas will be remediated and post remediation verification will be carried out; • Waste Management Plan (storage, handling and disposal of hazardous waste) • Oil Spill Response Plan
Land Use	
Permanent land restrictions	• Provide compensation for loss of assets from seasonal and permanent crops and forest products; • Improve or restore the livelihoods, including the provision of alternative land for cultivation with equal or better soil productivity; • Monitoring and providing the necessary follow-up to support to restore livelihoods throughout the operation phase; • In the case of changes in land values post-construction, provide cash compensation at replacement values for the reduced opportunities to use the land most productively

Environmental or Social Impacts	Mitigation/ Enhancement Measure
Ecology	
Degradation of the habitats' conservation status	• In the whole area of the OHTL Right of Way, all vegetation that does not compromise the lines and populations' safety must be allowed to develop, especially grasses and trees under 6-7 metres. If possible, big trees should only be pruned. When threatened species of trees are observed growing on the footprint area, these should be transplanted while young, to prevent their removal in a more advanced stage. • Similarly to the construction phase, the appliance of herbicides should also be avoided during the operation phase. Manual techniques for vegetation maintenance will ensure that only the trees that put the transmission line at risk are cut or pruned.
Disturbance and mortality of avifauna and bats	• While the opening of a maintenance road in a river is not possible, this zone should not be opened in a wetland that dries in the dry season, as this will cause a significant disturbance of the faunal populations. In these types of habitats, maintenance of towers should be done through accesses that will not cross a wet area. • Regular monitoring actions are recommended, in order to rescue fauna that may have collided with the lines and be trapped. As hotspots of birds, wetlands are the main habitat for monitoring, nonetheless, miombo woodlands and agricultural areas are the habitats for birds of prey and vultures, which are highly susceptible to collisions. Therefore, monitoring in these habitats is also important.
Socioeconomics and human rights	
Loss of livelihoods, permanent (operation)	• Livelihood Restoration Plan

10.Biodiversity Management Plan

Measures towards the protection of biodiversity should be directed towards the most vulnerable biological groups and habitats identified for the Project. Based on the Critical Habitat Assessment (CHA) that was conducted (summary in section 6.10.7, presented in detail in ESIA Vol. II), the implementation of both a Biodiversity Management Plan (BMP) and Biodiversity Action Plans (BAPs) is required according to IFC-PS6.

According to the CHA and community surveys conducted during the first fieldwork visit (June 2022), priority should be given to the two natural habitats identified: wetlands and miombo woodlands, due to their importance for migratory birds, provision of ecosystem services, including the supply of charcoal, wood and fruit trees, and access to water sources.

Following 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.

The BMP will focus on bird communities (due to the risk of collision with the transmission line) and plant communities (due to the presence of the invasive *Arundo donax*), in line with the proposed mitigation measures (summary in Table 117):

- **Avoid** crossing miombo areas with native tree species, including *Brachystegia spiciformes*, *Adansonia digitata* and *Pterocarpus angolensis* (following the methodology presented in section 8.9.1, based on tree height);
- **Minimize** impacts on bird communities, by installing Bird Flight Diverters (BFDs) and monitoring bird collision through a Fauna Monitoring Program (**BAP-I**);
- **Rehabilitate/restore** wetlands by removing invasive giant reed (*Arundo donax*), through an Invasive Species Management Plan (**BAP-II**).

It is recommended that Bird Flight Diverters (BFD) are installed along the conductors, at a maximum distance of 20 m, and placed alternately from one conductor to the other. These flags can be double-signaling spirals and of bright and visible colors; Other alternative BFD are rotating or ribbon fireflies. Proposed sites for the implementation of

BAP-I and BAP-II are proposed in the table below, which include wetlands and mosaics of wetlands with miombo and agricultural areas, are presented in the table below.

Table 116 – Biodiversity Action Plans (BAPs) for the prioritised biodiversity values in wetlands, timeframe of implementation, site coordinates and responsible parties.

<table>
<tr><th>BAP ID</th><th>Target group</th><th>Timeframe</th><th>Responsible parties</th><th>Towers</th></tr>
<tr><td>BAP-I</td><td>Birds</td><td>First 3 years after the construction phase</td><td>Elecnor (BFD installation) and RNT (monitoring)</td><td rowspan="2">LB21–LB20
LH-4–LH-5
LH-84–LH-85
LH-173–LH174
LH-226–LH-235</td></tr>
<tr><td>BAP-II</td><td>Plants (invasive)</td><td>Before the construction phase and at least one year after the first removal campaign</td><td>Elecnor</td></tr>
</table>

A summary of the mitigation measures proposed for Ecology, in Chapter 9, are presented below. The two BAPs proposed under the scope of this BMP are in line with these measures and aim to complement the mitigation scheme for this project, as detailed in sections 10.1 and 10.2. In section 10.3, a summary and overview of these plans is presented, including the timeframe for its implementation, performance indicators and responsible parties.

Table 117 – Mitigation and enhancement measures for Ecology

Environmental Impact	Mitigation/ Enhancement Measure
Detail design phase	
Loss of vegetation, flora and loss and fragmentation of habitats	• The implementation of the construction site and support infrastructures should be design in areas already free of vegetation. • The transmission line, OHTL Right of Way and access roads should avoid crossing areas where individuals of native threatened tree species are present (*Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (mupanda), *Pterocarpus angolensis* (tacula)). • The access roads that will be opened should be pre-delineated, in order to avoid crossing natural habitats (miombo woodlands and wetlands). Whenever possible, dirt roads that already exist should be used. When this is not possible, roads should be opened in modified habitats such agricultural areas, even if it requires a longer path.
Degradation of ecosystem services	• The mitigation measures addressing vegetation loss and habitat fragmentation, particularly the delineation of access roads that avoid crossing of natural habitats, are expected to contribute to the mitigation of ecosystem service degradation in the miombo woodlands. In addition, the implementation of the measures included in the Environmental and Social Management Plans (Chapter 10), such as the removal of exotic species in wetlands, is expected to increase the resilience of these habitats to degradation and minimize the degradation of the ecosystem services they provide, namely access to water sources.

<table>
<tr><th>Environmental Impact</th><th>Mitigation/ Enhancement Measure</th></tr>
<tr><td>Disturbance of birds and bats</td><td><u>Minimizing risk of collisions:</u>
The line must have the minimum height possible, which guarantees the safety of the human populations;
It is recommended that Bird Flight Diverters (BFD) are installed along the conductors, at a maximum distance of 20 m, and placed alternately from one conductor to the other. These flags can be double-signaling spirals and of bright and visible colors; Other alternative BFD are rotating or ribbon fireflies
<u>Minimizing risk of electrocution:</u>
The tension cables of up to 120 cm on each side of the support posts and sub-stations must be covered; they can be flexible cables, or self-vulcanizing tapes, for example.
Anti-landing and anti-nesting devices must be installed on top of the posts.
The adoption of the recommended measures must be prioritised based on the sensitivity of the area covered, particularly in the natural habitats, miombo woodlands and wetlands.</td></tr>
</table>

Environmental Impact	Mitigation/ Enhancement Measure
Construction phase	
Loss of vegetation and flora	• In the course of deforestation actions, whenever possible, the killing or affecting of individuals of the following species, considered a priority in terms of biodiversity conservation because they are Vulnerable (Ministério do Ambiente, 2018) should be avoided: *Adansonia digitata* (embondeiro), *Brachystegia spiciformis* (mupanda), *Pterocarpus angolensis* (tacula). • Special caution should be taken when removing vegetation in areas of *Eucalyptus* spp., which occur in mosaic with native vegetation, to ensure non-discriminated tree removal occurs. • It is also recommended to implement a training and environmental awareness program for workers during the construction phase of the project. The program in question should address issues such as the ecological framework of the natural values present in the area of intervention, as well as the definition of behaviours to be avoided and to be promoted, such as the exploitation or removal of certain tree species. • In the closing phase of the works, the areas affected must be adequately cleaned and rehabilitated (i.e., deforested), in order to prevent the spread of invasive species.
Loss and fragmentation of habitats for faunal communities	• This impact will be mitigated with the measures referred for the detail design phase (Loss of vegetation, flora and loss and fragmentation of habitats) and for the construction phase (Loss of vegetation and flora).

Disturbance of faunal communities	• For wetland habitats (which occupy 5.4% of the OHTL Right of Way), it is recommended that, as far as possible, the scheduling of the most impacting construction works (excavations for the installation of poles, cutting and/or removal of vegetation) are carried out avoiding the most critical periods for sensible and threatened avifauna (migration and reproduction), occurring between October and March. When construction during this period in not possible to avoid, other measures should be implemented such as
	    • Undertaking monitoring of bird species, with special focus on endangered and migratory species, particularly in the flooded areas (section 10.1).
	    • Breeding sites and birds must remain intact and disturbance should be avoided. Special care shall be taken where nestlings or fledglings are present.

Environmental Impact	Mitigation/ Enhancement Measure
	• All poaching activities (egg/birds collection/capture) are forbidden for endangered and migratory species. • The client should prepare and implement a code of conduct to prevent impactful actions over bird populations, during construction and maintenance actions. • Still regarding the timing, the construction works must be carried out continuously (once started, they must be completed without significant breaks in between) in order to avoid the recolonization of the area by fauna and a re-displacement.
Habitat contamination with hazardous materials (e.g. insulating oils/gases and fuels in addition to herbicides for OHTL vegetation maintenance).	• The appliance of herbicides should be avoided in order to prevent contamination of the soils and bioaccumulation, which will put soil fauna at risk (e.g. micro-mammals, invertebrates, etc.) and other fauna that feeds on this vegetation. Manual techniques should be used instead. This will also allow to better select which flora will be removed, ensuring threatened flora will not be affected.
Operation phase	
Degradation of the habitats' conservation status	• In the whole area of the OHTL Right of Way, all vegetation that does not compromise the lines and populations' safety must be allowed to develop, especially grasses and trees under 6-7 metres. If possible, big trees should only be pruned. When threatened species of trees are observed growing on the footprint area, these should be transplanted while young, to prevent their removal in a more advanced stage. • Similarly to the construction phase, the appliance of herbicides should also be avoided during the operation phase. Manual techniques for vegetation maintenance will ensure that only the trees that put the transmission line at risk are cut or pruned.

Environmental Impact	Mitigation/ Enhancement Measure
Disturbance and mortality of avifauna and bats	• While the opening of a maintenance road in a river is not possible, this zone should not be opened in a wetland that dries in the dry season, as this will cause a significant disturbance of the faunal populations. In these types of habitats, maintenance of towers should be done through accesses that will not cross a wet area. • Regular monitoring actions are recommended, in order to rescue fauna that may have collided with the lines and be trapped. As hotspots of birds, wetlands are the main habitat for monitoring, nonetheless, miombo woodlands and agricultural areas are the habitats for birds of prey and vultures, which are highly susceptible to collisions. Therefore, monitoring in these habitats is also important.

10.1. BAP-I: Fauna Monitoring Plan

10.1.1. Introduction

The assessment of the impacts of the project on ecological systems resulted in the identification of one (1) potentially significant negative impact, the disturbance and deterioration of fauna populations in the operation phase.

This impact can be direct, through animal interactions with the electrified line, or indirect, through increased human presence, regionally, which will result in reduced available habitats and increased wildlife/human community interactions.

The potential that the implementation of the project has to intensify the fragmentation of these areas and affect the conservation of fauna populations requires that mitigation measures be adopted, on the one hand, and that the impact be duly assessed and described, on the other.

It is recommended that this plan be commissioned by the line management entity (RNT) from national research or education institutes. This plan should be preceded by the implementation of Bird Flight Diverters (BFD), as detailed in Chapters 9 and 10.

10.1.2. Objectives

The specific objectives of this fauna monitoring programme are

- Estimate the number of bird fatalities resulting from collisions or electrocutions caused by the presence of the power line, in order to assess the effectiveness of the measures adopted, and modify or define new measures if necessary;
- Detect new impacts or direct interactions with the line (such as nesting by threatened birds) to define new mitigation measures, if necessary.

10.1.3. Parameters

As a minimum, the following parameters should be obtained (ICNF, 2019; STRIX, 2016)

- Number of fatalities;

- Observed Mortality Rate;
- Estimated Mortality Rate;
- Number of nests built in the supports and respective species.

10.1.4. Data collection methods

Seeking to meet the objectives listed, a dead body count should be carried out along the line corridor by prospecting it on foot in predefined sections.

Prospecting should be carried out in a 5 m strip to either side of the central axis of the line, based on a zigzag transect (allowing a more exhaustive search than in linear prospecting), according to the methodology used in STRIX (2016).

For each cadaver detected, the following information should be recorded:

- Date;
- Observer;
- Identification of the species (with the aid of field guides), age and sex of the individual;
- Distance to the nearest support;
- Distance and positioning (south/north, east/west) to the centre line;
- Location (GPS coordinates);
- Habitat or type of land use;
- Carcass condition;
- Cause of death (collision or electrocution), whenever possible, based on the injuries observed (burns, cuts or fractures), and the position of the corpse in relation to the elements of the line;
- Approximate date of death.

Corpses found outside the prospecting area should be recorded, although they do not enter into the estimation of the mortality rate. It is recommended to remove from the site all corpses and/or remains found, in order to avoid duplication of records on subsequent visits. All contacts should be properly photographed.

Guide to describing the condition of the corpse and estimating the date of death (according to STRIX, 2016 and ICNF, 2019). Carcass condition at the time of detection: • Intact - the carcass was intact, neither decomposing nor having served as food for scavengers or predators; • Partially removed - the carcass showed obvious signs of having served as food for predators or scavengers, or only a portion of the carcass was found; • Signs - various feathers or bones found at a site indicating the previous presence of a carcass; • With injuries - the animal was alive, but with injuries that made it impossible for it to fly. Approximate date of death / estimated stay in the field, based on state of decomposition: • 1-2 days - the bird shows no signs of decomposition; • 1 week - developing insect larvae are visible; • 1 month - considerable portion of bone tissue exposed; • Over 1 month - virtually all bone tissue and no insect larval activity.

Determination of estimated true mortality is not feasible. It is necessary to correct for factors associated with scavenger predation and corpse detectability. This is typically done with field testing. If possible, these tests should be done in the first year of sampling (for each season and for each bird size class), and the results used in the remaining years. If it is not at all possible to perform these tests, standard values available in the bibliography may be used.

10.1.5. Geographical scope and sampling design

Monitoring should be targeted at the forest sections south of Uíge and a smaller number of control areas in the savannah, wooded savannah and cropland habitats in order to cover the environmental variability of the corridor. Sections of 1 km along the line should be defined in order to obtain a representative sample of the habitats crossed by the project, and the types of support and tension of the cables.

10.1.6. Frequency and sampling periods

In studies of the impact of power lines on avifauna it is typically recommended to sample during the different phenological periods of this group, i.e., wintering, breeding, post-reproduction dispersal and migration, which is done monthly. Considering that most of the potentially occurring species (including the target species) are resident, it is admissible to reduce the effort to two annual campaigns, in June/July (dry season), and between November and February.

In each of these seasons, four (4) visits should be made to each section, with a seven (7) day interval between each visit. The number of visits should be the same in all seasons (ICNF, 2019).

10.1.7. Data processing and analysis

The estimated fatality rate is expressed in number of corpses per kilometre per unit time, and should be obtained by the following formula (STRIX, 2016)

$$TM_e = TM_o / D \times R$$

In which:

- TM_o = observed mortality rate, or number of carcasses found per km;
- D = proportion of carcasses found by the observer during the experiment to determine detectability;
- R = proportion of carcasses not removed in the experiment to determine the carcass removal rate (the rate is determined for each season and for each size class of birds).

The cast of species detected should also be analysed (conservation status, most represented families, etc.), the temporal and spatial pattern of distribution of mortality rate, the pattern of mortality rate differentiated by collision and electrocution, and mortality should be compared between years and between habitats or sections, with statistical evaluation of significance.

In the case of endangered species - and especially for the orange-breasted shrike - the percentage (%) of the local/regional/national population that is affected by the infrastructure should be estimated to interpret the significance of the impact.

10.1.8. Report and discussion of results

Monitoring must be carried out for an initial minimum period of 3 years, after which its continuity must be defined in the light of the results obtained. Annual monitoring reports should be submitted with the results of the two campaigns. An annual evaluation of the results should also be made and the monitoring programme adapted as necessary.

If there is a high mortality rate on stretches without signposting, the need to install these devices should be assessed. If nests are detected, the need for protective devices against electrocution should be assessed.

10.2. BAP-II: Invasive Species Action Plan

Given the ecological relevance of wetlands as carbon sinkers, as well hotspots for biodiversity (particularly for native bird species), actions towards its conservation should take place. This need is reinforced by the classification of this natural ecosystem as a critical habitat, following the Critical Habitat Assessment.

One of the main identified causes of wetland degradation is the introduction of exotic plant species, namely of the giant reed *Arundo donax*. This species has long been described as being highly invasive in riverine systems, but also in wetlands in general. Its dispersion occurs mainly vegetative propagation, through fibrous underground rhizomes that form knotty, spreading mats which penetrate deep into the soil.

Controlling an invasive species requires a well-planned management, through:

- Identification of the invaded area and a prioritization of the sites targeted for control;
- Identifying the causes of invasion and assessing impacts;
- Defining intervention priorities and implement adequate control methodologies;
- Monitoring the efficiency of the selected methodology and the recovery of the intervened area; if necessary, a follow-up control should be

Dispersal is usually associated with temperature increases in late spring and early summer. This species is also known to be well adapted to floods and relatively resistant to drought. The replacement of native plant communities by *A. donax* is generally associated with a loss of ecosystem quality and functioning (Matono, et al., 2019). This invasive species competes with native tree species for water and nutrient uptake. The combination of these factors makes *A. donax* a species with a high invasive potential and threat to native plant communities and freshwater and wetland ecosystems.

General guidelines for the management and eradication of this exotic species mention its mechanical removal (Matono, et al., 2019), in opposition to chemical removal (risk of contamination and targeting native species) and biological control (some arthropods have been tested as biological controls, but its success rate is very variable and unknown in these particular type of wetland systems). Hence, mechanical removal is considered to be the most adequate procedure for the removal of *A. donax*.

The removal of *A. donax* should consist in the extraction the entire plant through hand pulling, particularly for young plants which generally have small rhizomes, up to 2 metres high. or, in case it is not possible (as individuals can generally grow up to 6 metres, making mechanical removal of the entire plant extremely difficult), the aerial part of the reed should be removed, followed by the extraction of the rhizomes.

Following mechanical removal, it should be guaranteed that there are no rhizomes and/or large rhizome fragments are left in the ground, as they can regenerate very vigorously, thus reducing the efficacy of removal. It is recommended to remove the rhizomes from the extraction location and burn them afterwards. The stems should be also destroyed.

Eradication campaigns of *A. donax* should be before the construction phase and before the wet season, to avoid a faster dispersal of this species. The efficacy of the removal campaign should be assessed in the following year.

Elecnor should engage with a third-party with biodiversity monitoring experience (e.g., universities or environmental NGOs) and civil society, to promote citizen participation and environmental awareness under the scope of the Project and also on the conservation of wetlands.

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10.3. Summary of the Biodiversity Action Plans

Table 118 – Biodiversity Action Plans elaborated for birds (BAP-I) and invasive flora species (BAP-II).

BAP ID	GOAL	ACTION DESCRIPTION	PERFORMANCE INDICATORS	TIMEFRAME	RESPONSIBLE PARTIES
BAP-I	Minimize risk of bird collision	• Installation of Bird Flight Diverters (BFD) along the conductors, at a maximum distance of 20 m, and placed alternately from one conductor to the other. • These flags can be double-signaling spirals and of bright and visible colors; Other alternative BFD are rotating or ribbon fireflies • The tension cables of up to 120 cm on each side of the support posts and sub-stations must be covered; they can be flexible cables, or self-vulcanizing tapes, for example. • Anti-landing and anti-nesting devices must be installed on top of the posts.	I-a: Number of fatalities I-b: Observed Mortality Rate I-c: Estimated Mortality Rate I-d: Number of nests built in the supports and respective species	An annual survey should be conducted for a period of 3 years after the construction of the transmission line. Based on the results provided by the completion indicators, the need for further measures should be re-assessed.	**Device implementation:** Elecnor, RNT **Monitoring:** RNT, in collaboration with a third-party with biodiversity monitoring experience (e.g., universities or environmental NGOs)
BAP-II	Wetland rehabilitation through invasive plant removal	• Removal of the invasive giant reed *Arundo donax*	II-a: Number of *Arundo donax* individuals removed II-b: Total area targeted for the removal of *Arundo donax*	Removal campaign before the construction phase and preferably before the wet season. The efficacy of the removal campaign should be assessed in the following year.	Elecnor, in collaboration with a third-party with biodiversity monitoring experience (e.g., universities or environmental NGOs) and civil society

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11.Environmental and Social Management Plan

11.1. Introduction

The ESIA report Environmental and Social Management Plan (ESMP) consists of a set of mitigation, enhancement, monitoring, and institutional measures to be taken during the implementation and operation of the Project to eliminate adverse environmental and social impacts, offset them or reduce them to acceptable levels, and also to enhance environmental benefits. The ESMP will include the following Management Plans (MPs), which are summarized in the sections below:

- Environmental Management MP, including the Greenhouse Gases MP;
- Waste MP and certificate of validation (PGR);
- Emergency preparedness response MP, with an Oil Spill Response Plan;
- Community Health & Safety MP;
- Occupational Health & Safety MP;
- Labour MP;
- Contractors MP;
- Training MP;
- Traffic & Transportation MP;
- Influx MP;
- Local Procurement MP;
- Cultural Heritage MP;
- Stakeholder Engagement Plan (SEP), including the Grievance Mechanism;
- Quality MP.

Overall, the ESMP identifies the information needed to guide management decisions. The contractor must follow it during the project construction and operation to effectively implement mitigation and compensatory measures. This chapter also includes a section on the Attribution of Responsibilities for Reporting and Review. Hence, the ESMP identifies the goals, activities, schedules, and budget allocation to ensure a good balance between environmental and social costs and benefits associated with the Project.

The detailed Management Plans were included in ESIA Volume III, together with Elecnor's Human Rights' Policies.

11.2. 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.

Among these impacts, the management of noise and disturbance of faunal communities were incorporated in Elecnor's full Environmental Management Plan, which is included in Volume III of the ESIA.

Specifically, regarding noise, counteract measures include:

- Ensuring that both machinery and equipment follow national legislation on noise, including maximum levels allowed; permits for working during nighttime will be asked to the national regulator; nevertheless, activities where higher noise levels are expected should be conducted in schedules that minimize human and animal disturbance;
- Avoid having several activities running at the same time that may generate higher noise levels;
- Informing the population of the schedules of the working activities and potential noise discomfort that may arise;
- Using machinery with acoustic isolation.

Technical inspections of both machinery and vehicles should be incorporated every three months, to ensure the acoustic control in the construction site and surrounding areas. All inspections, as well as licenses and data on the effect of the countermeasures on noise mitigation, should be recorded by Elecnor.

11.2.1. 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 119 - 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 characterized 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 120 - 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

11.2.2. 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.

Elecnor's full Environmental Management Plan, which includes the GHG Management Plan (in section 14.2) is included in Volume III of the ESIA.

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.

11.3. Waste Management Plan

11.3.1. 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. 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 (24^{th} August). Elecnor's full Waste Management Plan is included in Volume III of the ESIA

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 (RNT) 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 municipalities of the Huambo and Huíla 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.

11.3.2. 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 Benguela and Huambo, namely:

- **3Z Sucatas de Angola**, based in Benguela, and responsible for collection, sorting, baling and consequent sale of scrap metal. It also cleans yards, private yards and yards of public or private entities, as well as urban areas, public roads and any other locations, whenever requested;
- **Street Limpa**, operating in Benguela and providing door-to-door collection of waste, environmental consulting and eco-centres;
- Other private entities that may be required to contract.

Details on the waste infrastructure, as well as safe storage and transport by certified companies, are provided in the Waste Management Plan provided by Elecnor, which was included in ESIA Volume III.

11.3.3. 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.

Table 121 – Waste Management measures

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		

Mitigation / Enhancement Measure	Environmental Impacts	Institution / Persons responsible for implementation
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		

11.4. 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. Elecnor's full Emergency Preparedness and Response Management Plan is included in Volume III of the ESIA. 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.

11.4.1. Oil Spill Response Plan

The Oil Spill Response Plan will align with Elecnor's Emergency Preparedness and Response Plan and Environmental Management Plan, both included in Volume III of the ESIA. The response plan includes three sets of procedures:

- Procedures and training of workers on how to prevent oil spills and correctly handle oils and hazardous substances;
- Procedures to contain and respond to oil spills
- Procedures to respond to oil spills in the transmission line.

Regarding the prevention and training of workers, the following guidelines are presented:

- Inform and train workers on how to proceed in the event of an oil spill;
- Perform regular and rigorous maintenance of all equipment and machinery;
- Conduct visual inspections of machines and generators before the start of the activities;
- Whenever possible, oils should be handled in a retention basin or impermeable floor;
- Oil recipients must be properly labeled;
- Safely store all hazardous residuals produced, using tight containers, properly identified; these containers should be covered and distant from the sewage network and areas of rain drainage.
- An anti-spillover kit should be available in each site where oil handling will take place; this kit should contain absorbent material (sand or sepiolite) and tools to collect the oil spill and safely storage produced residuals.

The following procedures should be adopted to deal with oil spills:

1) Immediately inform the Emergency Responsible or the Construction Responsible;
2) Identify the substance spilled and, if available, consult the corresponding security sheet;
3) Place the individual protection equipment (gloves and glasses);

4) Apply a natural absorbent (sand) in case a spillover occurred outside a natural soil (e.g., concrete, tiles) and collect the material with the aid of a broom and shovel;
5) Store the material in a properly closed plastic bag and place it in the adequate container;
6) Treat the residuals that resulted from the spillover of hazardous material;
7) Fill in report on environmental accidents in the case of spillovers bigger than 5L e report it to Elecnor's Water Quality Tecnhician in charge at Elecnor's branch in Angola.

In the event that an oil spill is detected in the transmission line, the following procedures should be adopted:

1) Identify the source of the spillover and, if possible, interrupt it;
2) Assess if nearby drains and channels should be blocked, to avoid water contamination;
3) Spread absorbing material around the source of the oil spillover, to control and contain it (if applicable);
4) Notify the environmental technician (if applicable) and health and safety coordinator);
5) Place absorbing material (e.g., sand or sepiolite) to collect the oil spilled;
6) Remove the generated residuals and transfer them into a clean site.

11.5. 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:

- 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;
- Develop and implement a stakeholder engagement and consultation plan to inform local communities of safety concerns around work sites;
- 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.

Elecnor's full Community Health and Safety plan is in Volume III of the ESIA, and includes prevention measures in the following areas:

- Insulation distance outside residential and other buildings;

- Access by unauthorised personnel;
- Excavation and concreting;
- Erection and pouring;
- Traffic and pedestrian safety.

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.

11.6. Occupational Health and Safety Management Plan

Elecnor's full Health and Safety Plan for this project is included in Volume III of the ESIA, All workers and contractors will be covered by an insurance of occupational accidents.

This Plan includes:

- Organisation and management of the health and safety plan, including a detailed description of responsibilities, and who will be responsible for the specific role;
- Hazard identification, risk assessment and control;
- Temporary support facilities at the construction site;
- Health and safety requirements for workers and contractors;
- Selection of subcontractors, suppliers of materials and work equipment;
- Means of ensuring cooperation between the various parts evolved in construction;
- Training of workers.

Elecnor's Health and Safety principles are also included in the Integrated Policy for Environmental Management, which is found in Volume III of the ESIA, and is governed by the following principles:

- Provide appropriate equipment that contributes to health and safety at work;
- Training workers for prevention techniques;
- Ongoing inspections and audits of the works and implementation of the appropriate corrective actions to eliminate the cause of the deficiencies.

The plan also commits the company to consult and involve workers in the continuous improvement of health and safety measures. To this end, employees are expected to cooperate fully in the following areas.

- Carry out their work in accordance with the rules, instructions and procedures established by the Group;
- Correct use of the individual or collective protective equipment provided;
- Correct use of equipment, tools, vehicles and any other means used to carry out the work;

- Not carry out work where there is an imminent serious risk to workers and inform their immediate supervisor so that he/she can take the necessary measures;
- Any action taken to prevent a possible accident or incident will always be protected by this policy.

Construction activities such as those involved in this project, often present occupational health and safety hazards to workers. Exposure to those risks may lead to physical injuries 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 burden of diseases but also a detrimental aspect on the overall welfare of workers. Thus, in order to minimise such risks and protect the health of workers, the present section focuses on the measures that should be taken for every risk situation identified.

Construction activities in general carry the risk of falling from heights or into pits and trenches, as well as the risk of being hit with fragments of rocks or falling objects. These can cause severe injuries or even be fatal. Besides adequately managing these activities, the contractor should provide safety training for workers (at least one session before construction starts), communicating the safety practices that must be followed by employees (*e.g.*, wearing protective clothing and materials, compliance with the indications for a safe circulation in the construction areas) as well as the general measures implemented by the contractor (*e.g.*, training sessions, working schedules) and the rights and obligations of workers. Besides, the contractor should put in place adequate signage and protective barriers in areas where the risks are higher. Worker supervision should complement these measures, so as to ensure workers are following them effectively.

The close proximity to heavy machinery such as cranes and excavators, and the circulation of construction vehicles can also pose a threat to the safety of workers, potentially leading to injuries, trauma or even death. In order to prevent such accidents, workers should be provided with training regarding the operation of heavy machinery and comply with safety circulation measures on the work sites.

Electrical wires may constitute a danger for construction workers when left exposed and inappropriately located, resulting in electrical shocks. Wires should hence be adequately labelled and isolated and should be kept away from busy areas. Working in high voltage installations also carries a high risk of electrocution, from unprotected contact with the transmission lines and towers.

Furthermore, workers will be exposed to dust, noise and air pollution, requiring adequate personal protective equipment such as gloves, safety glasses and masks, and sound-blocking earmuffs.

Exhaustion and dehydration can also arise during construction activities when employees are working under extreme conditions (*e.g.*, heat, extensive working days). This poses not only a detrimental effect on the well-being of individual workers, but may also lead to lack of focus which, in turn, can result in accidents. Ensuring access to water and maintaining a balanced work schedule should mitigate these negative effects. Furthermore, supervision of workers will also be important in detecting such cases of exhaustion.

The project area covers areas not entirely demined, as such, a demining campaign will be carried out before the construction works. Despite this, the risk of interaction from workers, contractors or local communities with land mines is still significant. This hazard can lead to permanent and/or fatal injuries. Ensuring a comprehensive demining campaign and clearly identify the demined areas is will be important in minimizing the risk.

Ensuring the safety of construction personnel thus requires the implementation of a range of safety procedures that will help mitigate occupational health and safety hazards. These hazards are presented in Table 122, along with the proposed measures to be implemented by the contractor following national and international standards (IFC: PS 2). To ensure those measures are followed effectively by all persons involved, a manual outlining them should be distributed in an appropriate format and be accessible at the workplace. Moreover, the contractor should appoint a person/team who 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 meant as a substitute to those required by Angolan legislation, namely, the General Labour Law (Law n.º 7/15 of June 15th) and the Occupational Health and Safety System (Decree n.º 31/94 (31/05/94). Further measures and rules should hence be consulted in the referred documents. An extensive Health and Safety Plan will be developed in the Execution Project phase, where the specific risk inherent to the works and respective safety measures will be further detailed.

Table 122 – Occupational Health and Safety hazards and respective measures

Hazard	Measures
Falling from heights or into pits and trenches	• Provide safety training for workers • Implementation of adequate signage and protective barriers • Provision and use of personal protective equipment such as safety harnesses, hard hats and safety shoes, along with worker supervision • Provide and maintain First Aid supplies • Regular inspection of equipment (including ladders and scaffolds) • Fall victims will be treated with first aid in the location of their fall until possible injuries are identified, and she/he can be safely moved to the closest medical facility for further treatment
Injuries from the projection of fragments of rocks or falling objects	• Provide safety training for workers • Provision and use of personal protective equipment such as hard hats, protection glasses and reflective vests, along with worker supervision • Provide and maintain First Aid supplies
Slips, trips and falls (especially while carrying heavy loads)	• Provide training to workers on how to safely lift and move heavy loads • Define spaces for storing hand tools and other equipment, so as to keep an organised working area • Provide and maintain First Aid supplies

Hazard	Measures
Musculoskeletal injuries (especially of the back), resulting from lifting and moving heavy loads	• Provide training to workers on how to safely lift and move heavy loads • Use mechanical aids to assist in lifting
Injuries caused by the circulation of vehicles	• Define and delineate road access routes • Provision and use of personal protective equipment such as reflective vests, along with worker supervision • Provide and maintain First Aid supplies • In the event of a road accident involving Elecnor’s employees or contractors: - The Health, Safety and Environment (HSE) 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 victims of the crash, 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 crash are not to be moved until the Police arrive - Victims will be moved to a hospital or medical centre if required - If members of the public are involved in an accident which has occurred as a result of a Elecnor employee or contractor, the injured persons will either be given first aid and/or taken to the nearest hospital for treatment, depending on their injuries - Details of the accident including how it was caused, number of persons involved, police reports, etc. will be recorded by the HSE Manager
Hearing impairment/loss	• Provision and use of personal protective equipment such as sound-blocking earmuffs by operators of loud equipment, along with worker supervision

Hazard	Measures
	• Implement regular equipment check-ups • Arrange for initial and periodic medical examinations for workers who are exposed to the risk of noise-induced hearing impairment
Exposure to dust and air pollution	• Provision and use of personal protective equipment such as safety glasses and masks • Adopting shorter excavation sections, when possible • Irrigate construction work sites frequently • Arrange for initial and periodic medical examinations • Carry out periodic indoor air quality monitoring campaigns in work areas inside the substations
Chemical hazards from exposure to various chemicals	• Provision and use of personal protective equipment such as safety glasses and masks, and protective gloves • Provide and maintain First Aid supplies
Injuries from the operation of heavy machinery	• Provide safety training for workers, especially for heavy machinery operators • Closely monitoring heavy machinery operations • Restrict work areas to safety trained workers • Implement regular equipment check-ups • Provide and maintain First Aid supplies
Minor accidents (scrapes, cuts, abrasions, etc.)	• Minor accidents will be treated through first aid • If an employee / worker realises that she/he has been injured, no matter how insignificant they may perceive it to be, she/he should stop the job being carried out to seek first aid treatment • First aid boxes will be provided in all operational areas
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 • Further health or safety risks like entering a dangerous or unstable area will be prevented • Should an employee require emergency off-site medical transportation, the closest Government Hospital or medical centre will be contacted for transfer of the victim,

Hazard	Measures
	who will be accompanied by a staff member to give pertinent information about the incident • In the event of death, only a professional medical practitioner can confirm the death. Immediate notification of management is required after the death of any employee from a work-related incident
Electrocution	• Establish a safety perimeter around the installation sites for the transmission towers • Label and isolate exposed electrical wires, keeping them far from busy areas • No attempt to install or service electrical systems will be made by anyone who is not a qualified, trained technician familiar with electrical infrastructure and installations • All workers shall wear suitable insulating personal protective equipment (PPE) when handling or working with electrical equipment • At least two persons will always be present when work is being carried out on electrical equipment. No attempt will be made to service or adjust unless another person capable of rendering first aid and CPR is also present • Provide and maintain First Aid supplies • Any accidents will be immediately reported to the HSE Manager • In the event of an electrocution emergency: - Assess the situation and ensure safety of yourself, the casualty and others - Turn off the power - If the power cannot be turned off, stand on a dry insulated surface (rubber mat, etc.) and use a non-metal object to move the casualty away from danger, and - Once the casualty has been moved out of harm's way, immediate medical response will be administered
Exhaustion and/or dehydration	• Provide an adequate supply of drinking water • Establish an adequate work schedule • Worker supervision

Hazard	Measures
	• Keep an open communication channel for feedback with the view of continuingly improving occupational health and safety guidelines
Exposition to land mines	• A comprehensive demining campaign will be carried out before the construction starts • Areas where demining was not carried out should be dully identified • Provide and maintain First Aid supplies • In case of a land mine activation, the victim should be transported to the nearest hospital • In the event of death, only a professional medical practitioner can confirm the death. Immediate notification of management is required after the death of any employee from a work-related incident

Finally, concerning the operation phase of the project, the occupational health and safety guidelines currently implemented at the existing substation in Lomaum should be reviewed and updated (and duly communicated to all workers) in accordance with the upgrade envisioned for the plant. The updated guidelines should follow an initial review of current safety practices and the identification and assessment of safety hazards arising from the new work setting (*e.g.*, new operating systems and machines), also taking into account the measures contemplated in the Waste management plan.

Workers will also be exposed to health and safety hazards during maintenance works to the transmission lines; therefore, specific measures to minimize those hazards are also necessary. For these activities, significant hazards include falling from heights and electrocution and exhaustion and/or dehydration. The measures outlined in Table 122 in regard to those hazards as well as those defined by Angolan legislation and international standards are expected to reduce these risks and increase the safety and welfare of workers.

11.7. Labour Management Plan

Elecnor's Labour Management Plan establishes the terms and conditions of employment for the Project, referring to the requirements, procedures and code of conduct that workers must follow during the construction and operation phases. Elecnor's full Labour Management Plan is in Volume III of the ESIA.

Workers will be directly hired by Elecnor, and will necessarily include: a project manager, engineers, security personnel, environmental and social technicians, topographers, mechanisms, electricians, plummers, stonemasons, among others.

Recruitment will mainly occur in Lomaum and Huambo, thus contributing for the social and economic development of the regions affected by the Project. In the case hiring occurs through an intermediate company, this process will following Angolan legislation and will be established through contracts that ensure human and workers' rights are respected (i.e., no forced nor child labour).

Elecnor's Labour MP also includes a training schedule for 2023, related to several areas relevant to environmental, social, health and safety aspects of the Project, including:

- First aid response;
- Response to spillovers with the aid of an environmental emergency kit;
- Endemic diseases (e.g., malaria and dengue);
- Safety equipment and health and work safety;
- Environmental management;
- Project management.

11.8. 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. Elecnor's full Training Plan is in Volume III of the ESIA.

The project manager and/or site supervisor should assess the training needs of the project team under their direct control and, if necessary, provide or arrange training to meet the specific requirements of the project. Training is provided to workers at the start of construction and throughout the construction period.

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.

11.9. Contractors Management Plan

Elecnor's full Contractors Management Plan, included in Volume III of the ESIA, includes a detailed description of the responsibilities for implementing the plan and prevention measures.

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, etc.), personal documents (identity card, occupational health certificate, driving licence, etc.) and vehicle/equipment documents (vehicle identification, compulsory insurance, etc.).

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.

11.10. Traffic & Transportation Management Plan

A Traffic & Transportation Management Plan should be prepared prior to construction to minimise traffic disruption and environmental impacts, and to avoid the potential harm to people during construction.

Elecnor's Traffic & Transportation Management Plan, included in Volume III of the ESIA, outlines the responsibilities for implementing the following prevention measures:

- 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.

In addition, the following measures are recommended to complete Elecnor's full Traffic & Transportation Management Plan:

- Develop a road maintenance and repair plan to ensure that construction vehicles and equipment do not cause damage to local roads during transportation activities. This should include regular inspections of road conditions, timely repair of any damage, and ongoing maintenance to keep roads in good condition;
- Implementing 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.

11.11. Influx Management Plan

With the goal of reducing constrains on the communities near the construction sites, Elecnor elaborated an Influx Management Plan that comprises communication platforms with the local population.

Elecnor will write letters informing municipal, communal and traditional authorities about each activity to be developed before its start, including the arrival of working personnel to the community.

Elecnor will also organize awareness meetings with local authorities and communities with the goal of presenting the work to be developed before during the construction and operation phases, choosing the appropriate means of communication (illustrative panflets, Power Point presentations, radio emission, journal postings, and others) in each case. Topics covered in these meetings will include:

- Works to be implemented together with local communities;
- Community rights and grievance mechanisms;
- Workshops regarding the Project.

Contacts between Elecnor and communities will be ensured by: a social specialist; a field technician; an environmental expert; a health and safety technician; an administrative manager, and a project manager.

Elecnor will ensure that adequate training is provided to its workers, promoting a righteous conduct which respects human rights, the environmental and the ethical standards of local communities.

Local hiring will be considered a priority, as a means to positively impact local communities and allow it to engage with the ongoing project. These workers will also receive training.

All works will follow Elecnor’s Code of Conduct, which safeguards good principles of corporate governance, ethics, transparence, and respect for human rights.

11.12. 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.

11.13. Cultural Heritage Management Plan

Project construction activities have the potential to result in negative impacts on both tangible and intangible cultural heritage, which can be held as highly valuable within local communities and often also at a regional level. Some cultural heritages sites may also be tourist attractions that help support local economies.

Through this Cultural Heritage Management Plan (CHMP), the project seeks to proactively manage, avoid or limit any negative impacts on cultural heritage. To this effect the CHMP included specific obligations regarding cultural heritage in the tender documents issued to potential Contractors.

CHMP must be developed for the Project to manage and minimise potential impacts to cultural heritage resources. The CHMP must be developed and agreed prior to construction, to allow mitigation measures to be applied before impacts occur. Items to be covered in the CHMP include the main following elements:

- Chance Finds Procedure;
- Grave Relocation Plan;
- Memorandum of Understanding;
- Cultural Heritage input into the Grievance Mechanism;
- Detailed site-specific mitigation plan;
- Built Heritage recording sheets.

The full Cultural Heritage MP is provided in ESIA Vol. III. This plan, elaborated by Nemus, will also align with Elecnor's policies and procedures 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 receive training to deal with cultural or archaeological findings.

11.14. Stakeholder Engagement Plan

11.14.1. Introduction

The Stakeholder Engagement Plan (SEP) 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.

The full SEP can be found in Volume III of the ESIA.

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 125).

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 is suggested:

- 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;
- Announced 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 125 – Stakeholder engagement phases, objectives and activities.

11.14.2. 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.

11.14.2.1. 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.

11.14.2.2. 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).

11.14.3. 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.

Figure 126 shows the grievance mechanism developed to effectively address workers and individuals'/communities' complaints during the construction phase of the project.

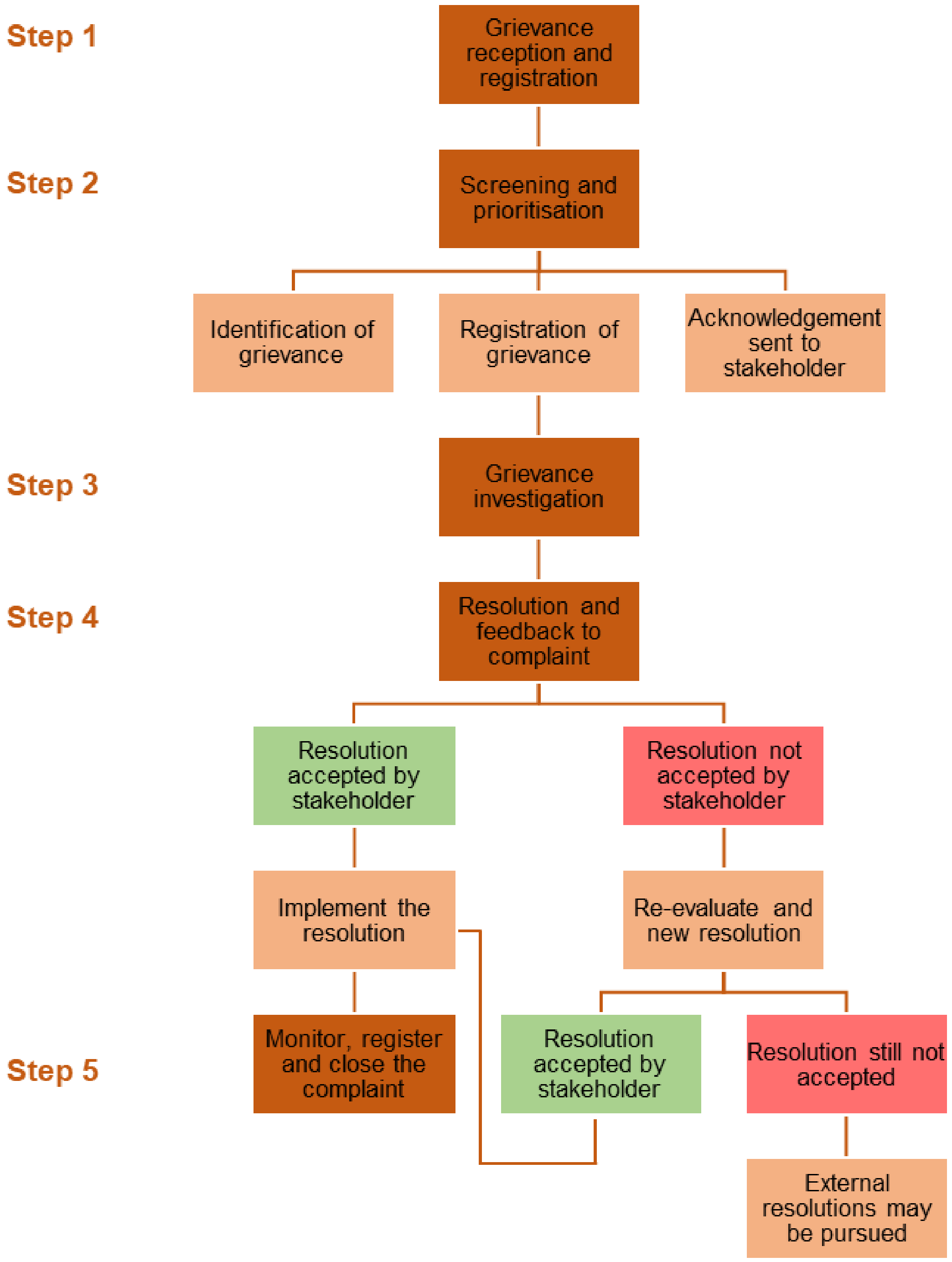

Figure 126 – Grievance Mechanism for workers and affected individuals/communities during construction phase

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.

11.15. Quality Management Plan

The Quality Management Plan includes the procedures and standards established by Elecnor to ensure quality control during the implementation of the transmission line 220 kV Lomaum-Huambo and associated substations.

Specifically, the implementation of Elecnor's Quality Management Plan aims to ensure that the Quality Management System is known and plan the resources in terms of equipment and staff necessary to conduct the different activities of the Project.

Elecnor's full Quality Management Plan, which is certified by AENOR (norm ISO 9001:2015), is included in ESIA Volume III.

11.16. 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 123 – 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
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 7.2.4.2) Depending on each monitoring programme (monthly, quarterly or annually)

Phase	Reports	Reporting responsibilities	Actions / Frequency
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

11.16.1. 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 124.

Table 124 – 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; • 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;

Position	Role and Responsibility
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; • To control and verify the correct maintenance of the project vehicles; • Propose improvement actions; • Identify social training needs; • Preparation and implementation of social training;

Position	Role and Responsibility
	• 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;

12. Summary of the Resettlement and Livelihood Restoration Framework

11.1. Introduction

A Resettlement and Livelihood Restoration Framework was elaborated because, during the initial phases of the ESIA, the involuntary acquisition of land and consequent displacement was considered unavoidable.

This framework specifies procedures and necessary actions to avoid, minimise and compensate affected people and communities for their losses or other negative social impacts arising from involuntary resettlement, establishing the basis for the agreement with the Project Affected Persons. The ultimate goal of a RAP is to restore or minimise livelihood disruption and enable those displaced by a project to improve their standard of living.

At this stage of the ESIA and RAP process, the Resettlement and Livelihood Restoration Framework sets the basis for the Resettlement Action Plan currently under development.

11.2. Legal and regulatory framework

The legal and regulatory framework being considered in the Resettlement and Livelihood Restoration Framework include laws, regulations, protocols, and standards pertaining to the project, in Angola as well as at international and regional level. A gap analysis between national and international frameworks will be made to ensure that standards and legal requirements are met.

These instruments establish that Resettlement Action Plans and Frameworks must adhere to strict consultation and disclosure requirements to offer affected communities opportunities to participate in planning, implementing, and monitoring resettlement. Additionally, vulnerable groups should be identified and provided with specially tailored assistance. A grievance mechanism shall be established to receive and facilitate the resolution of the affected communities' concerns and grievances, and procedures to monitor and measure RAP's implementation shall be created.

Importantly, IFC Performance Standard 5 distinguishes between physical and economic displacements. Physical displacement refers to relocation or loss of shelter and requires a Resettlement Action Plan, while economic resettlement stands for loss of income sources or means of livelihoods and demands a **Livelihood Restoration Plan**. A Livelihood Restoration Plan aims to mitigate the negative impacts of displacement, identify development opportunities, and establish the entitlements of all categories of affected persons, with particular attention paid to the needs of the poor and the vulnerable.

11.3. Results

The adjustment of the transmission line allowed the project to avoid the physical displacement of families' houses.

Only three support structures are expected to be affected by the project, a delimited built-up area in Belém do Dango, Huambo, and two farm ponds. Although the delimited built-up area contains a house, it is not anticipated that the house will need to be removed or displaced (only the walls of the delimited area).

Regarding economic resettlement, i.e., loss of income sources or means of livelihoods, the following resettlement needs are anticipated:

- Temporary loss of seasonal crops within the 4-metres maintenance road and the temporary tower working area, corresponding to around 78 ha.
- Permanent loss of seasonal crops within the 4-metres maintenance road and the permanent tower footprint, corresponding to around 39 ha.
- Permanent loss of crop trees inside the 20 metres OHTL footprint corridor estimated at around 8 ha.
- Total deforestation caused by the construction of the project is approximately 45.9 ha, including the deforestation within the 20 m OHTL footprint corridor and the deforestation within the temporary working areas of the tower sites. This represents in a deforestation of around 1.8% of the areas covered by trees in the DAI. This will result in loss of access to community resources for settlements in the direct project impact area.

11.4. Next steps

Following the elaboration of a Resettlement and Livelihood Restoration Framework, a Resettlement Action Plan is being prepared and will be presented in the following months, after demining takes place. The elaboration of the Resettlement Action Plan will be developed in four essential phases:

- Phase 1 – Preparation: identification of data needs, stakeholders and potential affected communities, and adjustment of final project;
- Phase 2 – Secondary data collection and analysis: desk-based baseline data collection and analysis;
- Phase 3 – Primary data collection and analysis – through field visits, comprising qualitative data (consultations), quantitative data (surveys), and field observations (direct observation).
- Phase 4 – Finalization of the RAP, with resettlement footprint and impacts, compensation and eligibility, project displacement planning and management, consultation and disclosure, monitoring, and evaluation plan proposal; conclusions and recommendations.

12. Overall assessment

12.1. Introduction

Following the impact identification and assessment presented in the previous sections, as well as the mitigation and enhancement measures proposed along Section 9, this section shows a summary and overall assessment of the projects' expected social and environmental impacts.

The detailed impact description, justification and assessment for the environmental and social issues considered is shown in Section 8. Therefore, the following synthesis matrix should be read in conjunction with the support text in the referred sections. The main interest of this format resides in the simultaneous presentation of information on all the issues involved, allowing for an easy read and cross-referencing.

The impact matrix presents the studied environmental factors on the horizontal axis and the impact assessment obtained according to some pre-defined criteria on the vertical axis.

It is noted that the results presented in the impact matrix, in terms of net significance, include a preview of the mitigation/enhancement possibilities, thus roughly corresponding to the significance of residual environmental impacts. However, there is always some uncertainty in the prediction of residual impacts, since it is difficult to determine the effectiveness of some measures, and they often depend on multiple factors which can also be of great variability. Even the response of the environmental factors for which possible changes were predicted is not a linear process, consequently introducing an additional complexity factor. Given these limitations, synthesis matrices should be primarily regarded as an overview of the approximate project balance in terms of the residual impacts' significance.

A colour scheme was added to allow for a more immediate perception of the general significance of the impact after mitigation, using green hues for positive impacts and red for negative, increasing the colour's intensity according to the severity of its significance degree (Table 125).

Table 125 – Colour codes for the significance classification used in the impact assessment.

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

12.2. Impact matrix

The impact matrix is presented in Table 126.

Table 126 – Summary of environmental and social impact assessment.

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
CLIMATE							
Emissions of GHG	Construction	Negative	Definite	Low	Low	►	Low
Reduction of carbon sinks	Construction	Negative	Definite	Medium	Moderate	►	Low
Reduction of GHG emissions from electricity consumption in Benguela Province	Operation	Positive	Likely	High	High	►	High
Increased risk of reduction of transmission efficiency of lines during heat waves	Operation	Negative	Undetermined	Low	Negligible	►	Negligible
Increased risk of damage to transmission towers and SS in extreme weather events (floods, windstorms, wildfires)	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
GEOLOGY, GEOMORPHOLOGY AND TOPOGRAPHY							
Changes in local morphology	Construction	Negative	Definite	Medium	Moderate	►	Low
Surplus soil	Construction	Negative	Likely	Low	Low	►	Negligible

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Local erosion	Construction	Negative	Likely	Low	Low	►	Negligible
HYDROGEOLOGY							
Groundwater contamination	Construction	Negative	Unlikely	Low	Negligible	►	Negligible
Groundwater use	Construction	Negative	Likely	Low	Negligible	►	Negligible
Reduction of recharge	Operation	Negative	Definite	Low	Negligible	►	Negligible
Risk of groundwater contamination	Operation	Negative	Definite	Low	Negligible	►	Negligible
NATURAL DISASTERS							
Slope instability	Construction	Negative	Likely	Low	Negligible	►	Negligible
Seismic event	Operation	Negative	Unlikely	Low	Negligible	►	Negligible
SURFACE WATER RESOURCES							
Increased turbidity and total suspended solids in river and streams	Construction	Negative	Unlikely	Low	Negligible	►	Negligible
Faecal bacteria and organic matter contamination in rivers and streams	Construction	Negative	Likely	Low to Medium (Lomaum SS)	Low to Moderate (Lomaum SS)	►	Negligible
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	Construction	Negative	Unlikely	High (watercourses' intersections)	Moderate	►	Low

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Risk of hydrocarbons and other hazardous substances pollution of rivers and streams	Operation	Negative	Unlikely	Low (SS) to High (watercourses' intersections)	Negligible to Moderate	►	Negligible to Low (watercourses' intersections)
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	Definite	Medium	Moderate	►	Low
Permanent removal of vegetation, including crops	Construction	Negative	Definite	Medium	Moderate	►	Low
Permanent land restrictions	Operation	Negative	Definite	Medium/Low	Moderate/Low	►	Low
AIR QUALITY							
NO2 exhaust emissions	Construction	Negative	Definite	Low/Negligible	Low/Negligible	►	Negligible
PM and Dust emissions	Construction	Negative	Definite	Medium/Low	Moderate/Low	►	Low
NOISE							
Noise emission	Construction	Negative	Definite	Medium/Low	Moderate/Low	►	Low
Operation of the substations	Operation	Negative	Definite	Negligible	Negligible	►	Negligible
Wind effect on cables and Corona Effect	Operation	Negative	Definite	Negligible	Negligible	►	Negligible
ECOLOGY							
Loss of vegetation and flora	Construction	Negative	Definite	Medium/Low	Low to High	►	Low to Moderate (native vegetation)

Impact	Project Phase	Status	Likelihood	Intensity	Significance (without mitigation)	►	Significance (post-mitigation/ enhancement
Loss and fragmentation of habitats for faunal communities	Construction	Negative	Definite	Medium/Low	Low, moderate, high	►	Negligible, low (wetlands) to moderate (miombo woodlands)
Disturbance of faunal communities	Construction	Negative	Definite	Medium/Low	Low, moderate, high	►	Negligible, low (miombo woodlands) to moderate (wetlands)
Habitat contamination with hazardous materials	Construction	Negative	Unlikely	Low	Low	►	Low
Degradation of ecosystem services	Operation	Negative	Likely	Medium	Low (wetlands) to moderate (miombo woodlands)	►	Low (wetlands and miombo woodlands)
Degradation of the habitats' conservation status (Alien Flora)	Operation	Positive	Definite	Low	Low	►	Low
Degradation of the habitats' conservation status (Natural habitats)	Operation	Negative	Definite	Medium	Moderate	►	Low
Disturbance and mortality of avifauna and bats	Operation	Negative	Likely	High	High / Moderate	►	Moderate (natural areas) / Low (modified areas)

SOCIOECONOMICS AND HUMAN RIGHTS							
Creation of temporary employment opportunities	Construction	Positive	Definite	Low	Low	►	Moderate
Boost of the regional economy and improvement of living conditions	Construction	Positive	Definite	Low	Low	►	Moderate
Impact on the safety of local communities	Construction	Negative	Likely	Medium	Moderate	►	Low
Impact on the health of local communities	Construction	Negative	Likely	Medium	Moderate	►	Low
Increase disease transmission	Construction	Negative	Likely	Medium	Moderate	►	Low
Loss of livelihoods, mostly temporary	Construction	Negative	Definite	Medium	Moderate	►	Low
Potential resettlement during construction	Construction	Negative	Unlikely	High	Moderate	►	Low
Impacts on workers' health and safety	Construction	Negative	Likely	Medium	Moderate	►	Low
Local employment opportunities	Operation	Positive	Likely	Low	Low		-
Provision of electrical capacity and related benefits	Operation	Positive	Definite	High	High		-
Permanent loss of livelihoods	Operation	Negative	Definite	Medium	Moderate	►	Low
Increased community safety after demining	Operation	Positive	Definite	Medium	Moderate		-
Benefits to local settlements from road infrastructure improvements	Operation	Positive	Definite	Low	Low		-

CULTURAL HERITAGE							
Interference with traditional cemeteries	Construction	Negative	Likely	Medium / High	Moderate / High	►	Low
Interference with Lumpi settlement	Construction	Negative	Likely	Low	Low	►	Null
Interference with Nganda settlement	Construction	Negative	Likely	High	High	►	Low

12.3. Construction phase overall impact and risk assessment

Most of the identified impacts in the construction phase are negative impacts (32 *vs.* 2, negative and positive impacts, respectively) (Table 126). This is due to the necessary construction activities, namely: land clearance, changes and restrictions in land use, excavations, operation of heavy machinery, truck traffic, among others. These are likely to cause mainly temporary to short-term negative impacts such as:

- Different impacts over local communities (loss of livelihoods, safety, health, disease transmission);
- Temporary land take and loss of access to land;
- Loss of vegetation and flora;
- Loss and fragmentation of habitats for faunal communities;
- Disturbance of faunal communities;
- Restriction in accessing provisioning ecosystem services;
- Interference with cultural heritage important areas;
- Pollution (noise, dust, and possible spillages);
- Soil erosion.

Mitigation is usually possible for all these impacts, meaning that most of them should be of low or negligible significance after adequate action and management.

The impacts raising more concerns during the construction phase refer to loss of livelihoods, interference with ecological values and with cultural heritage sites. With regards to the loss of livelihoods, a preliminary Resettlement Action Plan is being prepared and it will identify resettlement footprint and impacts, compensation and eligibility, project displacement planning and management, consultation, and disclosure.

The importance of the three negative impacts on ecology referred above will vary according to type of habitat affected. Miombo woodlands and wetlands stand out as the most vulnerable habitats, however if the mitigation measures defined for these impacts are followed, the significance over the most important habitats can be reduced to moderate significance.

On the positive side, construction will create temporary employment and new opportunities for local business, which will lead to positive impacts on local income, increased trading activities, empowerment of local contractors and suppliers, among other indirect benefits. Construction will employ approximately 430 local workers (semi-skilled and low skilled jobs) over a period of two years, which is key for the regional economies of the municipalities of Cubal, Ganda (Benguela province), Caála, Huambo, Longonjo, Tchinjenje and Ukuma (Huambo province).

The Project has the capacity to create a few long-term benefits for local contractors and suppliers and their employees from capacity enhancement and the acquisition of specific skillsets through on-the-job and formal training (spillover effects). Considering the importance of urban development and related construction, transport, and storage sectors in Angola in general, these skill sets may be transferable to other construction-related projects in the area after the completion of construction.

12.4. Operation phase overall impact and risk assessment

The operation phase will clearly bring the major expected positive impacts, with the most relevant ones spanning from climate change mitigation to socioeconomics:

- Reduction of GHG emissions from electricity consumption in Benguela Province;
- Local employment opportunities;
- Provision of electrical capacity and related benefits;
- Increased community safety after demining;
- Benefits to local settlements from road infrastructures improvements.

The replacement of electricity generated from fossil fuels (diesel) by electricity generated from hydroelectric plants which have lower GHG emissions is a positive impact in line with the objectives established in the Nationally Determined Contribution of Angola (2021), required under Paris Agreement, which sets the target to achieve (unconditionally) a 14% reduction of GHG emissions by 2025, as compared to the base year of 2015.

The remaining positive impacts are directly associated to the Project and are not constraint to specific conditions, and so they are very likely to occur. These impacts are particularly important to the area under study, an area where agriculture (including livestock creation) is the most important activity, not only for self-consumption, but also for income generation; where most of the area is not connected to the public electricity network nor to a water distribution grid.

Despite of the above, twelve negative impacts were identified in the operation phase. However, only four of these were classified with moderate or higher significance (without mitigation):

- Permanent restrictions on land use;
- Degradation of the habitats' conservation status;
- Disturbance and mortality of avifauna and bats;
- Permanent loss of livelihoods.

From the above negative impacts, only the disturbance and mortality of avifauna and bats has moderate significance after mitigation, while the remaining decrease to low significance. It is therefore very important that measures defined to mitigate disturbance and mortality of avifauna and bats are implemented, such as defining the minimum height possible for the line (guaranteed conditions of security for human populations), the implantation of bird flight diverters flags, of anti-landing and anti-nesting devices, and others.

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13. Knowledge gaps

13.1. Climate and climate change

The following information on climate and climate change is missing or the ESIA team did not have access to while developing the study:

- Meteorological and climate data for project incidence area
- Regionalised climate change projections for latest SSP scenarios
- GHG emission factors for activities in Angola
- GHG emission inventory at province level

13.2. Geology, geomorphology, topography

The following information on geology, geomorphology, topography is missing or the ESIA team did not have access to while developing the study:

- Recent topographic survey of the transmission lines area
- Absence of a geological and geotechnical study
- Data regarding mining concessions or quarries in the municipalities encompassed by the project
- Lack of wells inventory and data regarding groundwater quality

13.3. Cultural Heritage

The collection of information to assess the impact of the project on cultural heritage was very limited due to the difficulty in collecting oral information from local communities who did not disclose the locations of traditional cemeteries and sacred forests. The sites recorded and presented in this study were identified during fieldwork by Nemus experts.

It should also be noted that there is a strong gap in knowledge of the archaeological heritage due to the lack of recent work in this area. The lack of knowledge of these sites in this study does not mean that they do not exist, and there is the possibility that the project will affect other sites in addition to those recorded.

13.4. Design Management Process

A demining exercise along the proposed alignment corridor is needed in order to allow full access to undertake further ground-based studies and enable alignment finalisation. Should significant change to specific sections of the alignment be needed, this could result in alteration of the Direct Area of Influence in specific parts and thereby require additional focused baseline data and update to the impact assessment beyond what is presented here. Information gaps and how they will be addressed due to the need to first conduct a demining exercise will be captured in a Design Management Process.

14. Conclusions and recommendations

Elecnor has been awarded a contract by the Ministry of Energy and Water of Angola (Ministerio da Energia e Aguas - MINEA) to develop the Project Transmission Line of 220 kV Lomaum-Huambo and associated substations. Under the Angolan environmental regulations high voltage transmission lines are an undertaking for which an Environmental Impact Assessment (EIA) is mandatory. Elecnor commissioned Ambigest and Nemus to carry out the ESIA for this Project to meet Angolan environment regulations in addition to complying with the International Finance Corporation (IFC) Performance Standards (PS).

The Final ESIA conclusions point out to no significant negative environmental and social impacts from the implementation of the Transmission Line of 220 kV Lomaum-Huambo and associated substations. Some negative impacts of moderate significance have been identified in the construction and operation phases, but these can be adequately mitigated by the suggested measures, alongside a rigorous implementation of the Environmental and Social Management Plan. These are mainly related to social and economic issues (Permanent restrictions on land use and Permanent loss of livelihoods) and ecological issues (Degradation of the habitats' conservation status and Disturbance and mortality of avifauna and bats).

Positive impacts are expected in the social context, mainly in terms of local employment opportunities (construction) and economic development (operation), improvement of the local road networks (operation). The replacement of electricity generated from fossil fuels (diesel) by electricity generated from hydroelectric plants which have lower GHG emissions is also an important positive impact. This consequence is in line with the objectives established in the Nationally Determined Contribution of Angola (2021), required under Paris Agreement, which sets the target to achieve (unconditionally) a 14% reduction of GHG emissions by 2025, as compared to the base year of 2015.

These benefits overcome the major negative aspects of the project implementation, with an overall and clear positive balance, especially if the following recommendations are strictly enforced:

- Detail Design of the Transmission Line of 220 kV Lomaum-Huambo and associated substations should respect the optimizations proposed in this report to minimise negative impacts;
- Construction activities should be temporally planned in order to mitigate ecological, soil and surface water resources impacts;
- The Environmental and Social Management Plan (ESMP) shall be integrated as part of the Terms of Reference (ToR) for the construction's process.
- Implementation of environmental and social impact mitigation measures should be monitored and audited by an independent third party, in order to ensure that the project is fully meeting international standards;
- Strong commitment and leadership from the MINEA and the other relevant governmental stakeholders are critical for a successful implementation and to ensure adequate provision for mitigation and compensation activities;

A Resettlement Action Plan (RAP) is being developed as a parallel process to the ESIA. It will identify resettlement footprint and impacts, compensation and eligibility, project displacement planning and management, consultation, and disclosure, to mitigate adverse effects, compensate losses, and provide development benefits to persons and communities affected by the Project.

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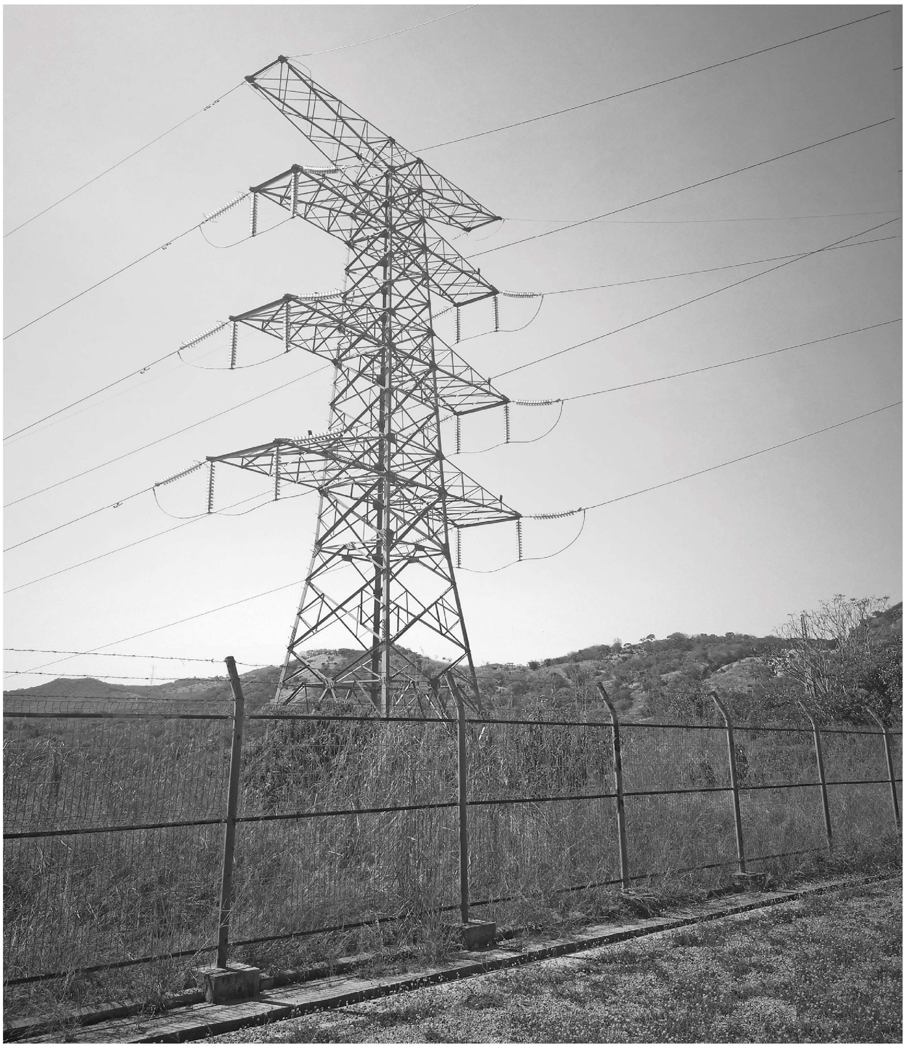

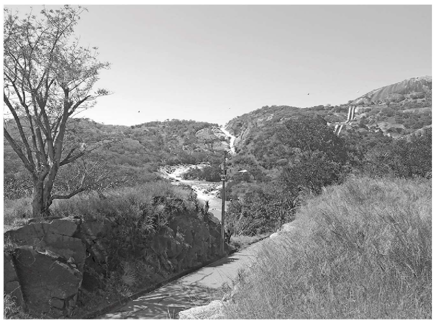

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