

Environmental and Social Impact Assessment for the Gove-Chipindo-Cuvango-Jamba Transmission Line Project, Angola

Volume 1: ESIA Report

Report Prepared for

RNT & PAK YATIRIM



PAK YATIRIM

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Project Naming Clarification:

The Gove-Chipindo-Cuvango-Jamba Transmission Line Project was referred to as the Cassinga Electrical Power Supply Project during the ESIA process and stakeholder engagement.

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Executive Summary

Introduction and scope of report

SRK Consulting (South Africa) Pty Ltd (hereafter referred to as “SRK”), in collaboration with Angolan-registered environmental consultancy Geolab, Engenharia e Consultoria Lda. (hereafter referred to as “Geolab”) was commissioned by PAK Yatirim to undertake the Environmental and Social Impact Assessment (ESIA) for the construction and operation of the Gove-Chipindo-Cuvango-Jamba Transmission Line Project (*referred to as the Cassinga Electrical Power Supply Project during the ESIA and stakeholder engagement*) (hereafter referred to as the “Project”). The ESIA report is being submitted locally to the Ministério do Ambiente (MINAMB) by Geolab, a registered Environmental Consulting company with MINAMB, while SRK is leading the bankable ESIA. The Project entails the establishment of a 220 kV overhead transmission line (OHL), which spans 170 km through the provinces of Huíla and Huambo in Angola, along with the necessary substations and medium to low voltage network to enhance electrical distribution and connectivity. The ESIA aligns with the requirements of the Angolan Ministry of Environment’s Presidential Decree No. 278/22 and other pertinent national legislation, ensuring adherence to good international industry practice (GIIP) requirements. The ESIA was undertaken in alignment applicable international standards and guidelines set out by the International Finance Corporation (IFC), Equator Principles (EPs), International Labour Organisation (ILO), Organisation for Economic Co-operation and Development (OECD) and United Nations (UN). The project has been registered with the Ministério do Ambiente (MINAMB) (Protocol No. 5792017244) and is categorised as a Category B project.

The purpose of this report is to establish current environmental and social baseline conditions in the study area, define the legal requirements for the project and identify and assess the potential impacts arising from the development, indicating measures to mitigate negative impacts and optimise benefits. The findings of stakeholder engagements to date are also included.

Project location

The Project is centrally located in Angola and extends for about 170 km, crossing three municipalities (Municípios) which include Jamba, Cuvango and Chipindo. The main works will be carried out largely in Huíla province and continues into Huambo province. The source of electricity for the planned OHL network and associated infrastructure will be generated by the Gove Hydroelectric Power Plant.

This infrastructure initiative is designed to facilitate increased electrical capacity and reliability, supporting both existing residential communities and future developments.

Presentation of the promoter

The Project proponent is Rede Nacional de Transporte de Electricidade (RNT – the National Electricity Transmission Grid, Public Company). RNT, supervised by the Angolan Ministry of Energy and Water (Ministerio da Energia e Aguas - MINEA), is a public entity that manages the national electricity transmission network.

Pak Yatirim has been appointed as the engineering, procurement and construction (EPC) contractor for the Project. As EPC contractor, PAK Yatirim will hand over the Project to RNT once construction is completed. Founded in 2015, PAK Yatirim is a Turkish registered company with a portfolio that spans across construction, energy, and venture capital.

Presentation of the consulting firm

SRK Global, with a presence established since 1974, brings extensive experience in environmental and social impact assessments, operating globally to deliver high-quality consultancy services. Geolab, partnering in this endeavour, offers localised expertise and a deep understanding of Angola's environmental and engineering consultancy needs, having been a pivotal player in the region since 2008.

Project description

The Republic of Angola, through MINEA, is embarking on a significant enhancement of its electrical infrastructure with the Gove-Chipindo-Cuvango-Jamba Transmission Line Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project intends to leverage the development of the region by providing infrastructure which, in addition to boosting the agricultural, 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.

The Project is structured around the establishment of a new high voltage (HV) 220 kV OHL network, extending from Gove to Cuvango, and further branching out to Chipindo and Jamba. This network includes the construction of new substations in Chipindo, Cuvango, and Jamba, each equipped with a capacity of 220/30 kV - 20 MVA, to efficiently distribute the generated power to these villages. The Project further includes the laying down of medium voltage (MV) OHL for distribution, along with the necessary low voltage (LV) OHL network, public lighting and home connections within the communities of Chipindo, Cuvango, and Jamba. The overarching goal is to create a robust and reliable electric power supply system that not only caters to the current demands but is also scalable to accommodate future expansions, including the prospective 220 kV OHL interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Project, with an additional 10 MW anticipated for local community demands. This projection underscores the critical nature of the Project in addressing the power needs of the region, fostering economic growth, and improving the quality of life for its residents.

The following infrastructure will be constructed as part of the Project:

- Transmission lines and towers – These towers are approximately 47 m in height and a total footprint area of 10 m x 10 m is required for each tower;
- New substations – Commissioning and operation of three 220/30 kV substations in accordance with MINEA and International Electrotechnical Commission (IEC) standards;
- Overhead line infrastructure – OHL infrastructure refers to the network of towers, poles, conductors and equipment used to transmit and distribute electrical power through aerial cables. The OHL infrastructure for the Project will be constructed in two stages (stage 1: Gove – Chipindo – Cuvango and stage 2: Cuvango – Jamba);
- Electrification of community homes and public lighting – Network to supply grid electricity to approximately 1 000 homes in each community, including public lighting;
- Medium Voltage 30 kV OHL – The Project consists in the construction of a MV 30 kV OHL Network from the substations to be built at the 30 kV outlets, to the city of Jamba and Cuvango;
- Transformer stations – The intention is to construct transformer stations on the MV 30 kV OHL infrastructure; and
- System protection scheme – The Project will be fitted with earthing and lightning protection measures.

Project alternatives

The current proposed location of the Project was determined by it needing to connect Gove hydro power facility to the municipalities of Chipindo, Cuvango and Jamba. Two primary route options for the OHL were considered in the ESIA – the initial OHL route proposed by RNT during early planning

stages that avoided many key environmental and social features, and a refined route developed based on the outcomes of a detailed topographical survey conducted during the ESIA process. The refined route takes advantage of a more stable and accessible terrain, thus lowering construction costs and timelines while also minimising crossings of environmentally sensitive features such as wetlands and riverbeds. These adjustments not only improve constructability but also offer environmental benefits. Importantly, the overall environmental and social impacts associated with the revised alignment remain broadly consistent with those of the initial RNT-proposed route and can be effectively managed through applying recommended mitigation measures.

The substation locations were proposed by RNT during the early planning stages and were informed by high-level environmental and socio-economic screening through a desktop analysis and a field survey. The substation locations remain unchanged. However, two layout alternatives are being considered. While both alternatives have the same environmental footprint and impact, the decision will be driven by factors related to technical feasibility. Key aspects that influence the choice of layout will include ease of maintenance and access, future scalability, ease of construction and terrain suitability, soil stability, and proximity to existing infrastructure. The layout that allows for more efficient use of construction resources and minimises complexity will likely be favoured.

Any minor adjustments to the final route alignment informed by detailed engineering will be addressed through PAK Yatirim's Management of Change Procedure (PY-ANG-MOC-PRO-00001). This procedure will identify the environmental and social impact significance of any alterations, ensuring that potential impacts on ecosystems, biodiversity, local communities, and livelihoods are fully considered and appropriately mitigated. The Management of Change Procedure ensures that environmental and social considerations remain a priority throughout the Project's execution, in line with best practice for sustainable infrastructure development.

Currently, Huíla province has limited access to the national electricity grid particularly for the municipalities of Chipindo, Cuvango and Jamba. Blackouts are common in the region with little possibility for socio-economic development. The expansion of industry and mining in the region relies on reliable electricity supply. A no-go alternative would result in ongoing challenges relating to power supply and distribution and would fail to address the electricity transmission gap within Huíla Province and southern Angola as set out in the Power Development Master Plan for Angola (2018).

Legal and institutional frameworks

National laws, international standards and corporate policies and guidelines present requirements for environmental, socio-economic and health conditions, and hence were used to guide compilation of the ESIA. The following legislative documentation was considered during the study:

- Relevant legislation of the Republic of Angola, including the Presidential Decree № 117/20 of 22 April 2020 on the General Regulation of Environmental Impact Assessment and Environmental Licensing Procedures and other pertinent national legislation;
- Key international conventions and regional agreements; and
- Recognised good international industry practice (GIIP), comprising applicable standards and guidelines.

Description of baseline environment

The Project biophysical and socio-economic baseline conditions were ascertained through review of existing documentation and specialist investigations.

Biophysical environment

The Project area contains unique biophysical features (e.g. soils, land use and land capability, surface water, biodiversity, air quality and noise) and socio-economic characteristics (e.g. demographics,

heritage, education and local economy). A detailed account of the baseline environment is presented in the ESIA.

In summary, the Project footprint is primarily dominated by soils (e.g. Ferralsols, Acrisols, Plinthosols, Leptosols, and Anthrosols) that are moderately deep to very deep and well-drained, exhibiting red and yellow hues. These soils are generally arable, with moderate to high agricultural potential, supporting a wide range of cultivated crops. Agricultural land capability in the Project area is primarily restricted by climatic conditions, particularly water availability (moisture retention/rainfall) and temperature.

The Project area traverses a mosaic of Miombo woodland, secondary Miombo woodland, freshwater systems, agricultural fields and urban areas/villages. Habitat suitability for fauna species is varied and largely dependent on the habitat integrity and habitat connectivity. The Miombo woodlands and freshwater systems support the highest diversity of faunal species, with diversity levels decreasing notably in the more degraded habitats. Habitat connectivity along the freshwater systems is still functional, serving as important movement corridors for fauna.

In terms of air quality, there are several key emission sources within the Project area. These include agricultural emissions, domestic fuel burning, unpaved and paved road dust, industrial activities, and small-scale mining operations. The prevailing ambient noise levels in the vicinity of the Project area were created by subsistence farming activities, intermittent traffic along the main road (EN120) and roads in villages. Visually, the area is characterised by a 'sense of place' that is predominantly rural landscape interspersed with natural features and several significant towns and villages, including Gove, Bunjei, Chipindo, Catala, Cului, Cuvango and Jamba. These areas are connected by main roads such as EN 358, EN 270, EN 120, EN 280, and HLA 125. The region hosts the Gove Dam and a hydroelectric plant to the north, adding a distinct industrial element amidst the otherwise rural setting. The predominant activities in the Project area, include subsistence agriculture, artisanal and small-scale mining, except near Gove where gold prospecting is reported, and peri-urban and urban settlements.

Socio-economic environment

Angola is a vast country in Southern Africa, bordered by Namibia, Botswana, Zambia, and the Democratic Republic of the Congo. With a population of over 33 million (2022), the country's economy has historically relied on global oil demand to drive employment and development. Challenges persist, with the majority of jobs being informal, particularly in subsistence work and the primary sector. Urban and youth unemployment remain high, contributing to the country's ills. The Gove-Chipindo-Cuvango-Jamba Transmission Line Initiative is poised to significantly enhance the electric power distribution network in Huíla Province, catalysing economic development and improving the livelihoods of the Angolan people, meeting the growing energy demands of the region and ensuring the interconnection of Gove Hydroelectric Power Plant to the Gove-Chipindo-Cuvango-Jamba Transmission Line Project and the future OHL 220 kV interconnection to Cuchi/Menongue.

In the Project area, socio-economic characteristics are defined by specific demographic, social and economic characteristics. Demographically Huíla province is characterised by a population of 2.5 million (2014). The region is characterised by a number of ethnolinguistic groups, including Ovimbundu, Ocindonga, Owambo, Nyaneka-Humbe, Ovingangela, and Herero. In Huíla province, more than half of the population speaks Portuguese, with a higher prevalence in urban areas compared to rural areas. Umbundo is the second most prevalent language, with Nyaneka and Muhumbi also significant.

A little less than one-third of the Khoisan people of Angola occur in the Huíla Province, mostly in the municipalities of Lubango, Chibia, Jamba, Quipugo and Cacula. It was found that Khoisan people are located in the Jamba and Cuvango municipalities, approximately 70 km south of the project location

at the closest points. However, since initial site visits and stakeholder engagement, a small group of Khoisan was noted to be approximately 20 km south of the Project area. There are two San groups in Cuvango. The first group consists of four families making up 20 people in the town of Kassindi, where two people are in the boarding school of the Catholic Mission of Cuvango. The second group occurs in the town of Vilombelo and comprises 18 families, totalling 56 people and are supported by the Cuvango Municipal Administration.

The Project area displays a number of social characteristics. The educational infrastructure in Huíla varies, with 40.8% of villages reporting at least one primary school, which is above the national average. However, accessibility remains a challenge, with some needing to travel up to three hours to reach the nearest school. The population literacy levels are relatively low across the area. Health facilities and services are underdeveloped. There are 56 hospitals as well as clinics focusing on primary healthcare across the study area. Water supply and distribution is under-developed and focused on towns. Most people across the Project area rely on wells to serve their domestic water needs. There is limited electricity supply and distribution infrastructure across the area, with people relying mostly in power from generators. Sanitation infrastructure and services is poorly developed, with 86% of households using unsuitable facilities in rural areas. The area displays high levels of poverty characterised by significant income inequality and a substantial portion of the population living in conditions lacking dignity and citizenship.

The economic activities in the Project area are dominated by subsistence agriculture and livestock farming, which support local livelihoods. Formal employment levels in Huíla province are low compared to other areas of the country. Those people that are employed, mainly work in government sector. The town of Cuvango hosts one public hotel with 10 rooms, while in the town of Chipindo, there are no hotels. The town of Jamba is a potential tourist destination, with attractions like the Coluí and Kwandja rivers. In Chipindo, the geological formations and ruins of the Catholic Mission of Sanguave are notable tourist sites. Small businesses and markets are mainly located in urban settlements.

The Project area includes various known heritage sites such as Iron Age and Stone Age features, cemeteries and burial sites and places of worship, many dating back to the colonial era. There are several places of worship within the larger Project area, with almost every village having at least one. Notable cultural sites include the ruins of the Sanguave Catholic Mission in Chipindo, which illustrate the Catholic Church's historical influence. Religious and other intangible cultural heritage sites are difficult to define due to their lack of fixed locations, boundaries or physical entities. A map was created to illustrate potential heritage-sensitive areas within 2 km of proposed Project development areas.

The ESIA includes the Project's commitment to developing a comprehensive Resettlement Action Plan (RAP) and/or Livelihood Restoration Plan (LRP) to address any potential displacement or disruption to local communities. These plans will be integral in ensuring that affected populations, including those engaged in artisanal mining, are provided with appropriate support and alternatives to mitigate the impact on their livelihoods. Artisanal mining, a key source of income for many in the region, is recognised as a potentially impacted livelihood, and the RAP/LRP must specifically outline strategies to restore or enhance the economic opportunities of these individuals.

Public consultation and information

The stakeholder engagement process for the Project was undertaken by Geolab. This process aims to involve various stakeholders and communities affected by the Project to ensure transparency and collaboration throughout the Project's lifecycle. The objectives of stakeholder engagement were sharing project information, seeking opinions and comments from interested parties and adhering to national legislation and international standards. The ongoing engagement with identified stakeholders during the construction and operational phases of the Project will be guided by the Social Engagement Plan (SEP) developed as part of the ESIA.

The methodology for stakeholder engagement involves:

- Identifying project stakeholders and interested parties, and mapping their position in relation to the Project;
- Developing mechanisms for feedback and information sharing;
- Conducting consultations at local and national levels;
- Addressing stakeholder issues and concerns; and
- Establishing a grievances management mechanism.

Using these methods, the aim is to consult with representatives from various sectors of society (e.g. government, traditional leaders, businesses, civil society and communities), including marginalised groups such as women and young people.

The stakeholder engagement process was designed to include a number of rounds of consultations, which include:

- Initial round – the ESIA core team met with the main local stakeholders and interested parties within the Project area of influence during the reconnaissance visit;
- Round one – engagements were held with stakeholders and interested parties by the social team during the socio-economic survey focussing on communities that were located in close proximity to key Project infrastructure; and
- Round two – consultations with stakeholders and interested parties were undertaken after completion of the draft ESIA to present the preliminary results and to receive contributions. Stakeholders along the OHL route within the Huila province was prioritised.

In terms of the Presidential Decree No. 117/20, MINAMB can also engage with Project stakeholders in a public hearing/consultation forum that is organised by the regulatory authority.

Based on engagements held to date, the Project is viewed by the municipal authorities with enthusiasm given its potential to boost investment in the region and promote the start-up of projects. The traditional leaders and household representatives noted that their communities in the past have not benefitted from the construction of HV OHLs. They welcomed the electrification of villages in the Project area.

Project impact analysis

The environmental assessment team applied a standardised methodology to evaluate potential environmental and social impacts arising from Project activities. The impact assessment is divided into three parts (i.e. issue identification, impact description and impact evaluation) and applied an impact significance rating matrix to determine impact significance. Using the matrix, the significance of each described impact was established before and after applying management measures. Several impacts on the biophysical and socio-economic environment were identified.

Tables ES1 to ES3 provide summaries of the biophysical and socio-economic impacts for the Project during construction, operational and decommissioning phases. By applying management measures, it will be possible to mitigate Project-induced impacts and hence lower significance ratings identified negative impacts. In addition, positive impacts (benefits) can be enhanced by applying optimisation measures. More detail about the specific impact description, assessments and mitigation relating to identified biophysical and socio-economic impacts are provided in Section 6.4 and 6.5 of the ESIA report.

Based on a detailed review of the ESIA's alignment to applicable international standards, it will be possible for the Project to apply to the benchmark requirements of the IFC PSs assuming key actions are taken during the Project lifecycle and suitable systems, management plans and procedures are developed and implemented and regularly monitored.

Table ES1: Summary of impact assessment during the construction phase

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biophysical aspects		
Climate change		
CC1 - Increased runoff and erosion	Low	Low
CC2 – Increased possibility of landslides due to the geomorphic changes associated with land clearance	Medium	Low
Soils, land use and land capability		
SLU1 - Loss of agricultural land capability	Medium	Low
SLU2 - Soil erosion resulting from footprint clearing and excavation	Medium	Low
SLU3 - Soil compaction due to movement of construction vehicles	Medium	Low
SLU4 - Soil contamination because of spillage of hydrocarbons	High	Low
Hydrology		
SW1 - Siltation of river systems, local disturbance to riverbanks and channels	Medium	Medium
SW2 - Indirect siltation of river systems	Low	Low
SW3 - Hydrocarbon pollution	Medium	Low
SW4 - River pollution from effluent	Medium	Low
Hydrogeology		
GW1 - Impact on community wells and available groundwater resources	Low	Low
GW2 - Potential alteration or deterioration in groundwater quality	Low	Low
Biodiversity – Flora		
BFL1 - Loss of floral habitat and species diversity – Transformed habitat	Low	Low
BFL1 - Loss of floral habitat and species diversity – Freshwater habitat	Medium	Low
BFL1 - Loss of floral habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFL1 - Loss of floral habitat and species diversity – Miombo woodland habitat	High	Low
BFL2 - Loss of floral SCC – Transformed habitat	Low	Low
BFL2 - Loss of floral SCC – Freshwater habitat	Low	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
BFL2 - Loss of floral SCC – Secondary Miombo habitat	Low	Low
BFL2 - Loss of floral SCC – Miombo Woodland habitat	Medium	Low
BFL3 - Floral habitat fragmentation – Transformed habitat	Low	Low
BFL3 - Floral habitat fragmentation – Freshwater habitat	Medium	Low
BFL3 - Floral habitat fragmentation – Secondary Miombo habitat	Medium	Low
BFL3 - Floral habitat fragmentation – Miombo Woodland habitat	Medium	Low
Biodiversity – Fauna		
BFA1 - Loss of faunal habitat and species diversity – Miombo Woodland habitat	Medium	Low
BFA1 - Loss of faunal habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFA1 - Loss of faunal habitat and species diversity – Freshwater habitat	Medium	Low
BFA1 - Loss of faunal habitat and species diversity – Transformed habitat	Medium	Low
BFA2 - Loss of potential faunal SCC – All habitats	Medium	Low
BFA3 - Habitat fragmentation – All habitats	Medium	Low
BFA4 - Avifaunal collisions with overhead powerlines – Miombo Woodland and Freshwater habitats	High	Medium
BFA5 - Avifaunal collisions with overhead powerlines – Secondary Miombo Woodland and Transformed habitats	High	Medium
Biodiversity – Freshwater ecosystems		
FE1/2/3/4 - Changes in runoff, smothering and disturbance of aquatic biota and increased erosion	Medium	Low
FE5 - Potential temporary in-channel diversion of the freshwater crossing and loss of freshwater habitat	Medium	Medium
Air quality		
AQ1 - Addition of excess dust and gaseous emissions to ambient air quality	Low	Very Low
Noise		
N1 - Increase in the noise levels during land clearing	Medium	Low
N2 - Increase in the ground vibration and/or air pressure levels at the residential areas during potential blasting	Medium	Low
N3 - Increase in the noise levels during construction of OHL and associated infrastructure	Medium	Low
N4 - Increase in the noise levels during construction of internal roads and infrastructure	Medium	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Visual		
V1 - Visual impact associated with the construction of the OHL	Medium	Medium
V2 - Visual impact associated with the construction on the substations	Medium	Medium
Demining		
DM1 - Demining activities, including safety risks, habitat disturbance, and contamination	High	Medium
Social aspects		
Socio-economic		
SE1.1 - Reduced income-earning opportunities due to a loss of, or access to, farming or grazing land or access to such land	High	Medium
SE1.2 - Increased food insecurity due to loss of farming or grazing land or access to such land	High	Medium
SE1.3 - Reduced income-earning opportunities for artisanal miners due to the loss of available artisanal mining areas	Medium	Medium
SE1.4 - Disruption of access in and between communities and sites used by Khoi San people due to the presence of the transmission and distribution powerlines and substations	Medium	Low
SE1.5 - Altering the sense of place of community members and Khoi San people due to the presence of the transmission line	High	Medium
SE1.6 - Underpayment as part of economic displacement compensation conducted by state entities	High	Medium
SE1.7 - Undercompensating physically displaced PAH/ PAPs	High	Medium
SE1.8 - Increased gender marginalisation and vulnerability resulting from compensation payments to mostly male household heads	High	Medium
SE1.9 - Reduced community and Khoi San ecosystem services as a result of construction activities	High	Medium
SE2.1 - Social disruption due to disruption of access to gravesites	Medium	Low
SE2.2 - Discrimination or inadvertent exclusion of indigenous peoples (Khoi San) in consultation processes (for work opportunities or general project awareness)	High	Medium
SE3.1 - Improved household incomes and livelihoods as a result of temporary employment opportunities	Medium (+)	Medium (+)
SE3.2 - Increased gender marginalisation and vulnerability as a result of temporary employment opportunities	Medium	Medium
SE3.3 - Increase in social pathologies as a result of migrant worker influx and increased spending power	High	Medium
SE3.4 - Increase in the local economy as a result of increased income and spending by temporary workers/ contractors	Low (+)	Medium (+)

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
SE4.1 - Increased safety hazards and accidents to community members, Khoi San, and livestock due to unfenced project infrastructure, unsafe access routes or speeding heavy vehicles	Medium	Medium
SE4.3 - Nuisance impacts due to air, water and noise pollution	Medium	Medium
SE4.4 - Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members	High	Medium
SE4.5 - Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	High	Medium
SE4.6 - Improved community safety after removal of UXOs from project construction footprint (Pre-construction)	Medium	High (+)
SE4.7 - Safety risk to community and personnel during removal of UXOs in project footprint (Pre-construction)	High	Medium
Cultural heritage		
CH1 - Damage to or destruction of recorded cemeteries/ burial sites	Medium	Low
CH2 - Damage to or destruction of places of worship/ sacred sites and monuments	Medium	Low
CH3 - Damage to or destruction of heritage resources	Medium	Low

Table ES2: Summary of impact assessment during the operational phase

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biophysical aspects		
Climate change		
CC3 - Temperatures exceed the designed operational limits of the equipment causing equipment malfunction	Medium	Low
CC4 - Increased staff heat stress, demand for cooling and associated increase in GHG emissions	Medium	Low
CC5 - Uncontrolled release of hazardous materials or waste to surrounding environment due to flooding events	Medium	Low
CC6 - Failure of wastewater treatment facilities resulting in discharge of contaminated water to the environment	Medium	Low
CC7 - Operational disruptions or damage to Project infrastructure due to flooding	Low	Low
CC8 - Operational disruptions or damage to project infrastructure due to lightning	Medium	Low
CC9 - Operational disruptions or damage to project infrastructure due to high windspeeds	Low	Low
CC10 - Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods	Medium	Low
CC11 - Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility	Medium	Low
CC12 - Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months	Low	Low
CC13 - Disruption of transportation routes due to offsite/ remote flooding related infrastructure damage.	Medium	Low
CC14 - Health and safety risks to staff associated with flooding	Medium	Low
CC15 - GHG impacts through use of SF ₆ as quencher for the substations given its high global warming potential	High	Medium
CC16 - Increasing the availability of electricity resulting in a reduction in the use of non-renewable fuels	High	High
Soils, land use and land capability		
SLU5 - Loss of high potential agricultural resources and land use resulting from placement of infrastructure on arable and cultivated fields	Medium	Low
SLU6 - Soil erosion resulting from vegetation clearing/ maintenance	Medium	Low
SLU7 - Soil compaction due to movement of vehicles	Medium	Low
SLU8 - Soil contamination because of spillage of hydrocarbons	Medium	Low
Hydrology		
SW5 - Hydrocarbon pollution from leaking substations/ transformers	Medium	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
SW6 - Hydrocarbon pollution from vehicle traffic, overnight laydown and in-field servicing	Medium	Low
SW7 - Siltation of river systems from access roads use and possible river crossings	Medium	Low
SW8 - Siltation of river systems from pylon foundation scouring	Low	Low
SW9 - Increase in flood level due to climate change related factors	Low	Low
Hydrogeology		
No impacts are anticipated during operation	n/a	n/a
Biodiversity – Flora		
BFL3 - Loss of floral habitat and species diversity – Transformed habitat	Low	Low
BFL3 - Loss of floral habitat and species diversity – Freshwater habitat	Medium	Low
BFL3 - Loss of floral habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFL3 - Loss of floral habitat and species diversity – Miombo Woodland habitat	Medium	Low
BFL4 - Loss of floral SCC – Transformed habitat	Low	Low
BFL4 - Loss of floral SCC – Freshwater habitat	Low	Low
BFL4 - Loss of floral SCC – Secondary Miombo habitat	Medium	Low
BFL4 - Loss of floral SCC – Miombo Woodland habitat	Medium	Low
BFL5 - Floral habitat fragmentation – Transformed habitat	Low	Low
BFL5 - Floral habitat fragmentation – Freshwater habitat	Medium	Low
BFL5 - Floral habitat fragmentation – Secondary Miombo habitat	Medium	Low
BFL5 - Floral habitat fragmentation – Miombo Woodland habitat	Medium	Low
Biodiversity – Fauna		
BFA6 - Loss of faunal habitat and species diversity – Miombo Woodland habitat	Medium	Low
BFA6 - Loss of faunal habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFA6 - Loss of faunal habitat and species diversity – Freshwater habitat	Medium	Low
BFA6 - Loss of faunal habitat and species diversity – Transformed habitat	Medium	Low
BFA7 - Loss of potential faunal SCC – All habitats	Medium	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
BFA8 - Habitat fragmentation – All habitats	Medium	Low
BFA9 – Avifaunal and bat collisions with overhead powerlines – Miombo Woodland and Freshwater habitats	High	Medium
BFA10 – Avifaunal and bat collisions with overhead powerlines – Secondary Miombo Woodland and Transformed habitats	High	Medium
Biodiversity – Freshwater ecosystems		
FE6 - Changes in flow, pattern and timing due to increased impermeable surfaces	Low	Low
FE7 - Increased impermeable surfaces due to the presence of surface infrastructure (substations)	Low	Low
FE8 - Altered timing and pattern of flows within the catchment; and potential desiccation of downstream reaches	Medium	Low
Air quality		
AQ2 - Addition of excess dust emissions to ambient air quality	Low	Very Low
AQ3 - Potential emission of SF ₆ from transformers and substation switchgears	Low	Very Low
Noise		
N5 - Increase in the noise levels from transformer noise, colling fans and other noise sources	Medium	Low
N6 - Increase in the noise levels from transformers at the pylons which can be intrusive	Medium	Low
N7 - Increase in the noise levels during maintenance activities	Medium	Low
Visual		
V3 - Visual impact associated with the operation and maintenance of the OHL	High	High
V4 - Visual impact associated with the operation and maintenance of the substations	High	High
Social aspects		
Socio-economic		
SE1.1 - Reduced income-earning opportunities due to a loss of, or access to, farming or grazing land or access to such land	High	Medium
SE1.2 - Increased food insecurity due to loss of farming or grazing land or access to such land	High	Medium
SE1.3 - Reduced income-earning opportunities for artisanal miners due to the loss of available artisanal mining areas	Medium	Medium
SE1.4 - Disruption of access in and between communities and sites used by Khoi San people due to the presence of the transmission and distribution powerlines and substations	Medium	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
SE1.5 - Altering the sense of place of community members and Khoi San people due to the presence of the transmission line	High	Medium
SE1.6 - Underpayment as part of economic displacement compensation conducted by state entities	High	Medium
SE1.7 - Undercompensating physically displaced PAH/ PAPs	High	Medium
SE1.8 - Increased gender marginalization and vulnerability resulting from compensation payments to mostly male household heads	High	Medium
SE1.9 - Reduced community and Khoi San ecosystem services as a result of project activities	High	Medium
SE2.1 - Social disturbance due to disruption of access to gravesites	Medium	Low
SE2.2 - Discrimination or inadvertent exclusion of indigenous peoples (Khoi San) in consultation processes (for work opportunities or general project awareness)	High	Medium
SE4.2 - Safety hazards and accidents to people and livestock	High	Medium
SE4.5 - Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	High	Medium
SE5.1 - Improved access to electricity due to presence of transmission and distribution lines	High (+)	High (+)
SE5.2 - Downstream economic development	High (+)	High (+)
Cultural heritage		
CH4 - Damage to and destruction of recorded cemeteries/ burial sites	Medium	Low
CH5 - Damage and destruction of places of worship/ sacred sites and monuments	Medium	Low
CH6 - Damage to and destruction of heritage resources	Medium	Low

Table ES3: Summary of impact assessment during the decommissioning phase

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biophysical aspects		
Climate change		
CC17 - GHG impacts resulting from SF ₆ emissions from substations	High	Medium
Soils, land use and land capability		
No significant impacts are anticipated during decommissioning	n/a	n/a
Hydrology		
No significant impacts are anticipated during decommissioning	n/a	n/a
Hydrogeology		
No significant impacts are anticipated during decommissioning	n/a	n/a
Biodiversity – Flora		
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Low	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Low	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Medium	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Medium	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Low	Low
Biodiversity – Fauna		
No significant impacts are anticipated during decommissioning	n/a	n/a
Biodiversity – Freshwater ecosystems		
FE9 - Soil erosion and sedimentation of freshwater and disturbance to aquatic biota.	Low	Low
Air quality		
AQ4 - Potential emission of SF ₆ from transformers and substation switchgears	Low	Very Low
Noise		
N8 - Increase in the noise levels during the removal of all structures through demolition	Medium	Low
N9 - Increase in the noise levels during the rehabilitation of disturbed areas	Medium	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
N10 - Increase in the noise levels during revegetation activities	Medium	Low
Visual		
V5 - Visual impact associated with the decommissioning of the OHL	Low	Low
V6 - Visual impact associated with the decommissioning of the substations	Low	Low
Social aspects		
Socio-economic		
No significant impacts are anticipated during decommissioning	n/a	n/a
Cultural heritage		
No significant impacts are anticipated during decommissioning	n/a	n/a

Impacts due to demining of landmines

The demining of landmines is a critical activity within the Project footprint that must be completed before construction can safely commence. It involves non-technical and technical surveys, landmine clearance, and subsequent site rehabilitation. This process is necessary to ensure the safety of both Project personnel and local communities while minimising environmental impacts. Key risks associated with demining include safety hazards to workers and communities, environmental disturbances such as vegetation clearing and soil disruption, and potential social and economic disruptions due to restricted access to demining zones.

The environmental impacts of demining activities may include habitat loss, soil erosion, and contamination of soil and water from explosive residues. Social impacts include safety risks to demining personnel, disruptions to local communities due to access restrictions, and psychological stress related to the presence of unexploded ordnance (UXOs). To mitigate these impacts, several management measures are recommended, including the use of certified demining contractors, community awareness and safety training, the establishment of safety zones, and post-demining rehabilitation efforts. The significance of impacts is expected to be reduced from high to medium with these management strategies in place.

Impacts of upstream and downstream services

The project will source building materials and equipment from both local and international suppliers, balancing cost efficiency, quality, and timely delivery, while adhering to environmental and social impact guidelines. Key materials like transformers, cables, and steel structures will be imported, and hazardous materials such as SF₆ gas and transformer oils will be managed according to international safety standards. Upstream impacts include environmental issues from resource extraction, transport, and hazardous materials, as well as social concerns such as unfair labour practices and missed local economic opportunities. To mitigate these, measures such as enhancing local supply chains and ensuring supplier compliance with environmental and social standards will be implemented.

Downstream impacts involve waste management challenges due to limited local facilities, necessitating temporary storage and long-distance transport to certified sites. Improper disposal could lead to soil and water contamination, while the lack of local waste infrastructure limits economic benefits. The project aims to mitigate these impacts by implementing secure waste management protocols, promoting recycling, enhancing community safety, and supporting the development of local waste management capacities.

Cumulative impacts and risk considerations

Cumulative impacts on valued environmental components (VECs) are largely driven by the construction phase of the Project, the future presence of the OHL and associated infrastructure, and environmental stressors such as climate change related effects. A number of cumulative impacts on biophysical features (e.g. freshwater ecosystems and watercourses, Miombo woodland habitats and water resources) are identified and discussed in the ESIA.

Socio-economic cumulative impacts include land-based livelihoods, socio-economic development, road infrastructure and cultural heritage.

It is necessary to take account of environmental and social risks that may present challenges to the Project, in alignment with guidance provided by applicable standards. Key risk considerations relating to climate change, human rights, and major hazards (including electrical accidents, fire risks, transportation of hazardous materials, and natural disasters) are discussed in the ESIA.

Environmental and social management plan (ESMP)

PAK Yatirim's Integrated Management Systems (IMS) Manual will form the foundation for developing the Project-specific Environmental and Social Management System (ESMS), with the Environmental and Social Management Plan (ESMP) as a key component of the ESMS. The purpose of the ESMP is to ensure that environmental and social impacts and risks identified and assessed during the ESIA process are effectively managed during all phases of the Project. The ESMP specifies the mitigation and management measures to which identified responsible persons are committed and shows how the Project should mobilise organisational capacity and resources to implement these measures. The ESMP also shows how mitigation and management measures will be monitored to ensure ongoing compliance and continual improvement.

The following environmental and social management plans and procedures are applicable to the Project:

- Stakeholder Engagement Plan (SEP);
- Grievance Management Procedure;
- Environmental, Health and Safety (EHS) Training and Awareness Plan;
- Biodiversity Management Plan (BMP) including an Avifauna Monitoring Programme;
- Emergency Preparedness and Response Plan (EPRP) which includes an Oil Spill Response Plan;
- Waste Management Plan (WMP);
- Labour Management Plan;
- Contractors Management Plan;
- Traffic and Transportation Management Plan;
- Community Health, Safety and Security (CHSS) Management Plan;
- Occupational Health and Safety (OHS) Management Plan;
- Cultural Heritage Management Plan (CHMP) which includes a Chance Find Procedure;
- Security Management Plan; and
- Gender-Based Violence and Harassment (GBVH) Prevention and Response Plan.

Recommendations have been made for additional Project-specific execution management plans and procedures that are essential for implementing the ESMP and should be developed before the commencement of construction activities. A comprehensive environmental and social monitoring programme, which includes the responsible party and frequency of proposed monitoring activities, is also presented in the ESMP. The ESMP should be viewed as a living document hence requiring periodically review and update (when the need arises).

Final considerations

The Gove-Chipindo-Cuvango-Jamba Transmission Line Initiative represents a significant leap forward in Angola's energy infrastructure development. The proposed Project will significantly enhance the electric power distribution network in Huíla Province, catalysing economic development, improving the livelihoods and meeting the growing energy demands of the region. It will ensure the interconnection of Gove Hydroelectric Power Plant to the Project and the future OHL 220 kV interconnection to Cuchi/Menongue

Based on the evaluation of environmental and social impacts related to the Project, it is the opinion of the SRK and Geolab team that the identified biophysical and socio-economic impacts can be suitably mitigated and managed, while optimising potential benefits.

The implementation of the management and monitoring plans will ensure that mitigation measures are effectively applied to reduce the effect of identified impacts during all Project activities. This will include the execution of the Project's dedicated waste management plan. Consistent and ongoing

management and monitoring will ensure that the environmental regulatory requirements of the Republic of Angola are upheld in order to mitigate any lasting effects on the environmental quality of the population residing in the surrounding areas.

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Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by PAK Yatirim. The opinions in this Report are provided in response to a specific request from PAK Yatirim to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

List of Abbreviations

°C	Degree Celsius
μT	micro Tesla
AC	Alternating Current
ACADIR	Associação de Conservação do Ambiente e Desenvolvimento Integrado Rural
ADECOS	Agentes Comunitários e de Desenvolvimento da Saúde (Community and Health Development Agents)
AIP	Alien Invasive Plant
AKZ	Angolan Kwanza
AMSL	Above Mean Sea Level
AoI	Area of Influence
AR6	Sixth Assessment Report
ASM	Artisanal and Small-scale Mining
BAP	Biodiversity Action Plan
BFD	Bird Flight Diverters
BI	Biodiversity Importance
BID	Background Information Document
BMP	Biodiversity Management Plan
CASI	Centros Integrados de Ação Social (Integrated Social Action Centres)
CCKP	Climate Change Knowledge Portal
CDW	Construction and Demolition Waste
CHA	Critical Habitat Assessment
CHSS	Community Health, Safety and Security
CHWs	Community Health Workers
CI	Conservation Importance
CIA	Cumulative Impact Assessment
CLO	Community Liaison Officer
cm	Centimetre
CMIP6	Coupled Model Intercomparison Project Phase 6
CO	Carbon Monoxide
CRR	Comments and Responses Register
CSO	Civil Society Organization
DAA	Directly Affected Area
DC	Direct Current
DEM	Digital Elevation Model
DFO	Diesel Fuel Organics
DIA	Direct Influence Area
DPM	Diesel Particulate Matter
DNTA	National Directorate of Environmental Technologies
DWAF	Department of Water and Forestry

EAP	Environmental Assessment Practitioners
EAS	Estudo Ambiental Simplificado (Simplified Environmental Study)
EAS	Estudo Ambiental Simplificado (Simplified Environmental Study)
ECO	Environmental Compliance Officer
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMF	Electromagnetic Field
ENDE	Empresa Nacional de Distribuição de Eletricidade (National Electricity Distribution Corporation Company)
EPC	engineering, procurement and construction
EPC + F	Engineering, Procurement, Construction and Finance
EPDA	Estudo de Pré-Viabilidade Ambiental e Definição do Âmbito (Environmental Pre-Feasibility Study and Scope Definition)
EPFIs	Equator Principles Financial Institutions
EPRP	Emergency Preparedness and Response Plan
EPs	Equator Principles
ESA	Early Stone Age
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
FABDEM	Forest And Buildings removed Copernicus Digital Elevation Model
FI	Functional Integrity
FNLA	Front for the Liberation of Angola
FPIC	Free, Prior, and Informed Consent
GAC	Grievance Appeal Committee
Geolab	Geolab, Engenharia e Consultoria Lda
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GPS	Global Positioning System
GRC	Grievance Resolution Committee
ha	Hectares
HGM	Hydrogeomorphic
HIV	Human Immunodeficiency Virus
HRIA	Human Rights Impact Assessment
HV	High Voltage
Hz	Hertz
ICAO	International Civil Aviation Organisation
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IDA	Instituto de Desenvolvimento Agrário (Agrarian Development Institute)
IEC	International Electrotechnical Commission

IFC	International Finance Corporation
IIA	Indirect Influence Area
ILO	International Labour Organisation
IMAS	International Mine Action Standards
INE	Instituto Nacional de Estatística (National Statistics Institute)
IPCC	Intergovernmental Panel on Climate Change
IT	Interim targets
IUCN	International Union for Conservation of Nature
JW	Jehovah's Witnesses
kA	kilo Amperes (A thousand Amperes)
km	kilo metre (A thousand metres)
kV	kilo Volt (A thousand Volts)
kVA	kilo Volt Amperes (A thousand Volt Ampoeres)
LARF	Land Acquisition and Resettlement Framework
LC	Least Concern
LIA	Late Iron Age
LIDAR	Laser Imaging Detection and Ranging
LMP	Labour Management Plan
LPG	Liquified Petroleum Gas
LRP	Livelihood Restoration Plan
LSA	LaterStone Age
LV	Low Voltage
m	Metre
m/s	Metres per second
MAT	Ministério da Administração Territorial e Reforma do Estado (Ministry of Territorial Administration and State Reform)
MBAKITA	Missão de Beneficência Agro-pecuária do Kubango, Inclusão, Tecnologia e Ambiente
MERRA	Modern-Era Retrospective Analysis for Research and Applications
MIA	Middle Iron Age
MINAGRIF	Ministry of Agriculture and Forests
MINAMB	Ministério do Meio Ambiente (Ministry of the Environment)
MINEA	Ministerio da Energia e Aguas
MINIPOT	Ministério das Obras Públicas e Ordenamento do Território (Ministry of Public Works and Spatial Planning)
MINOPUH	Ministério das Obras Públicas, Urbanismo e Habitação (Ministry of Public Works, Urban Planning and Housing)
MOSAP 3	Angola Agricultural Transformation Project
MRE	Mine Risk Education
MSA	Middle Stone Age
MSDS	Material Safety Data Sheets
MV	Medium Voltage

MVA	Mega Volt Amperes (A million Volt Amperes)
MW	Mega Watt (A million Watts)
NBSAP	National Biodiversity Strategy and Action Plan
NDP	National Development Plan
Nox	Nitrogen Oxides
NTD	Neglected Tropical Diseases
NTS	Non-Technical Summary
OCADEC	Organizacao Crista de Apoio ao Desenvolvimento Comunitario
OECD	Organisation for Economic Co-operation and Development
OHL	Overhead Transmission Line
OHS	Occupational Health and Safety
OHSP	Occupational Health and Safety Plan
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
OPGW	Optical Ground Wire
PAC	Project Affected Community
PAH	Project Affected Household
PAP	Project Affected Party
PES	Present Ecological State
PET	Potential Evapotranspiration
PIDLCP	Plano Integrado de Desenvolvimento Local e Combate à Pobreza (Integrated Plan for Local Development and Combating Poverty)
PM	Particulate Matter
PNGA	Programa Nacional de Gestão Ambiental (National Environmental Management Programme)
PNQA	National Environmental Quality Programme
POC	Probability of Occurrence
PPE	Personal Protective Equipment
PRODEL	Companhia Nacional de Produção de Energia Elétrica (National Electricity Production Company)
PT	Power Transformation
PTSE	Programa de Transformação do Setor Elétrico (Electricity Sector Transformation Programme)
RAP	Resettlement Action Plan
rms	root mean square
RNT	Rede Nacional de Transporte de Electricidade
RR	Receptor Resilience
SADC	Southern African Development Community
SCADA	Supervisory Control and Data Acquisition
SCC	Species of Conservation Concern
SDGs	Sustainable Development Goals
SE	Stakeholder Engagement

SEI	Site Ecological Importance
SEI	Site Ecological Importance
SEIA	Socio-Economic Impact Assessment
SEM	Stakeholder Engagement Manager
SEP	Stakeholder Engagement Plan
SF ₆	Sulphur Hexafluoride
SHE	Safety, Health and Environmental
SHEQ	Safety, Health and Environmental Quality
SIA	Sistema Integrado do Ambiente (Integrated Environment System)
SIMOP's	Simultaneous Operations
SMMEs	Small, Medium and Micro Enterprises
SO ₂	Sulphur Dioxide
SQA	Schist-Quartzite-Amphibolite
SRK	SRK Consulting (South Africa) Pty Ltd
SRTM	Shuttle Radar Topography Mission
SSPs	Shared Socioeconomic Pathways
TB	Tuberculosis
TCFD	Task Force on Climate-related Financial Disclosures
TMU	Terrain Morphological Unit
TS	Technical Survey
TSP	Total Suspended Particulates
UDHR	Universal Declaration of Human Right
UN	United Nations
UN SDGs	United Nations Sustainable Development Goals
UNDP	United Nations Development Programme
UNGP	United Nations Guiding Principles
UNITA	Union for the Total Independence of Angola
USA	United States of America
USEPA	United States Environmental Protection Agency
UXOs	Unexploded Ordnances
V/m	Volts per metre
VAC	Visual Adsorption Capacity
VECs	Valued environmental and Social components
VHV	Very High Voltage
VOCs	Volatile Organic Compounds
VPSHR	Voluntary Principles on Security and Human Rights
VU	Vulnerable
WMP	Waste Management Plan
WSAF	West Southern Africa
ZnO	Zinc Oxide

1 Introduction and background

1.1 Introduction to the assessment

SRK Consulting (South Africa) Pty Ltd (hereafter referred to as “SRK”), in collaboration with Angolan-registered environmental consultancy Geolab, Engenharia e Consultoria Lda. (hereafter referred to as “Geolab”) has been commissioned by PAK Yatirim to undertake the Environmental and Social Impact Assessment (ESIA) for the construction and operation of the Gove-Chipindo-Cuvango-Jamba Transmission Line Project (*referred to as the Cassinga Electrical Power Supply Project during the ESIA and stakeholder engagement*) (hereafter referred to as the “Project”). The ESIA report is being submitted locally to the Ministério do Ambiente (MINAMB) by Geolab, a registered Environmental Consulting company with MINAMB, while SRK is leading the bankable ESIA. The Project entails the establishment of a 220 kV overhead transmission line (OHL), which spans 170 km through the provinces of Huíla and Huambo in Angola, along with the necessary substations and medium to low voltage network to enhance electrical distribution and connectivity (see Figure 1-1).

The ESIA aligns with the requirements of the Angolan Ministry of Environment’s Presidential Decree No. 278/22 and other pertinent national legislation, ensuring adherence to good international industry practice (GIIP) requirements. The ESIA report was done considering not only the relevant Angola legislation, but also GIIP requirements in terms of the International Finance Corporation (IFC), Equator Principles Version 4 (EPs), International Labour Organisation (ILO), Organisation for Economic Co-operation and Development (OECD) and United Nations (UN) (hereafter collectively referred to as “applicable standards”). The Project has been registered with the MINAMB (Protocol No.5792017244) as a Category B Project (refer to Volume 3, Appendix A) as per the national legislative requirements.

1.2 Presentation of promoter

The Project proponent is Rede Nacional de Transporte de Electricidade (RNT – the National Electricity Transmission Grid, Public Company). RNT, supervised by the Angolan Ministry of Energy and Water (Ministerio da Energia e Aguas – MINEA), is a public entity that manages the national electricity transmission network.

Pak Yatirim has been appointed as the engineering, procurement, construction and finance (EPC-F) contractor for the Project. As EPC contractor, PAK Yatirim will hand over the Project to RNT once construction is completed. Founded in 2015, PAK Yatirim is a Turkish registered company with a portfolio that spans across construction, energy, and venture capital.

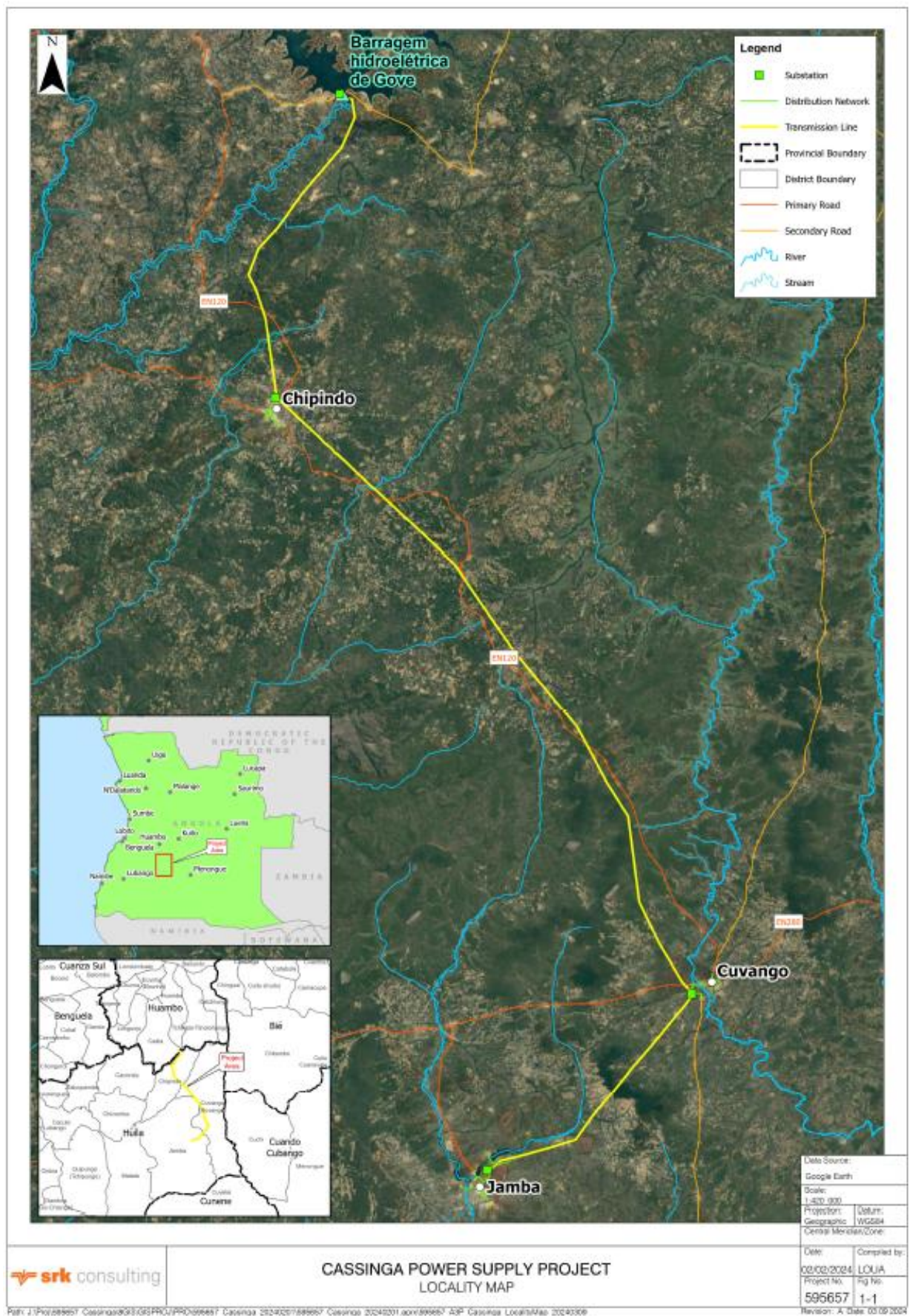


Figure 1-1: Location of the proposed 220 kV OHL and the towns it will supply with electricity

1.3 Presentation of the consulting firm

SRK, in collaboration with Geolab, is responsible for preparing the ESIA. Further details on the consulting firms are provided below. The ESIA report is being submitted locally to the Ministério do Ambiente (MINAMB) by Geolab, a registered Environmental Consulting company with MINAMB, while SRK is leading the bankable ESIA.

1.3.1 SRK

SRK Global is the overarching company of the SRK Group companies and is the global investment vehicle for employee shareholders. SRK Group Consulting Practices now employ approximately 1800 professionals operating from more than 40 established offices on 6 continents.

SRK employs leading specialists in the fields in which it offers services. It's seamless integration of services and global base has raised its reputation in technical advice, feasibility studies, due diligence and confidential internal reviews.

Among SRK's 1500 clients are many of the world's major and medium sized mining companies, exploration companies, banks, construction companies and government bodies.

Established in 1974, SRK has over the years grown into a large consulting practice with a broad client base worldwide. Whilst the Group operated initially as specialist consultants in the geotechnical engineering field, the growth of the Group has led to diversification into the related engineering fields of mining, civil, electrical, environmental and mineral processing engineering, as well as into the scientific fields of hydrology, geohydrology and the environmental and social sciences.

SRK (South Africa) has extensive expertise spanning over 40 years in conducting ESIA's for development Projects across the African continent. The Practice has also conducted multiple Projects in Angola, including specialist studies and ESIA's. The company has a certified Quality Management System aligned to ISO 9001:2015 as well as a NOSA 5-star rating. This accreditation affirms SRK's commitment to professional excellence, quality assurance and employee safety.

When leading ESIA projects across the African region, SRK endeavours to partner with established national consultancies who are registered in their host country.

1.3.2 Geolab (Engenharia e Consultoria, Lda)

Geolab is an Angolan firm established in 2008, with its headquarters in Luanda. Initially founded with a focus on Geomatics technologies, the company broadened its horizons in 2010 to encompass engineering and environmental consulting services, responding to the increasing demand for expertise in critical sectors vital for Angola's progress. Recognised for its exceptional technical and scientific knowledge, its mission is to assist local authorities and both national and international companies in finding the best technological and economic solutions, offering consultancy and training services that span the areas of engineering and environment. Geolab operates with a commitment to legal compliance, integrity, ethics, transparency, and honesty, principles that each of its employees upholds, thereby reinforcing the company's core values and moving closer to its vision of becoming the reference entity in Engineering and Environmental Consulting Services. Geolab is deeply committed to social responsibility, promoting local employment and material usage to foster community development, while emphasising environmental respect through the adoption of best practices and technologies. Legally accredited by IRCOOP with a class 6 license, registered with MINAMB as an Environmental Consulting company.

1.4 Presentation of the licensor

The Ministry of Environment (Ministerio Do Ambiente - MINAMB), as the primary authority responsible for the implementation of the Environment Framework Law, No. 5/98, the Presidential Decree No.

117/20 approving General Regulation on Environmental Impact Assessment, Environmental Licensing Procedures and all associated Regulations, is responsible for the review and regulation of the ESIA. Additional information on MINAMB is contained in Section 3.1.1.

1.5 Methodological approach

SRK and Geolab have undertaken the ESIA in a phased manner to deliver the detailed environmental and social impact assessment report. The methodological approach comprises several phases in accordance with Angolan legislation for ESIA studies and is presented in Figure 1-2. The phased approach was informed by applicable GIIP requirements which include those of the IFC, Equator Principles (EPs), ILO, OECD and UN.

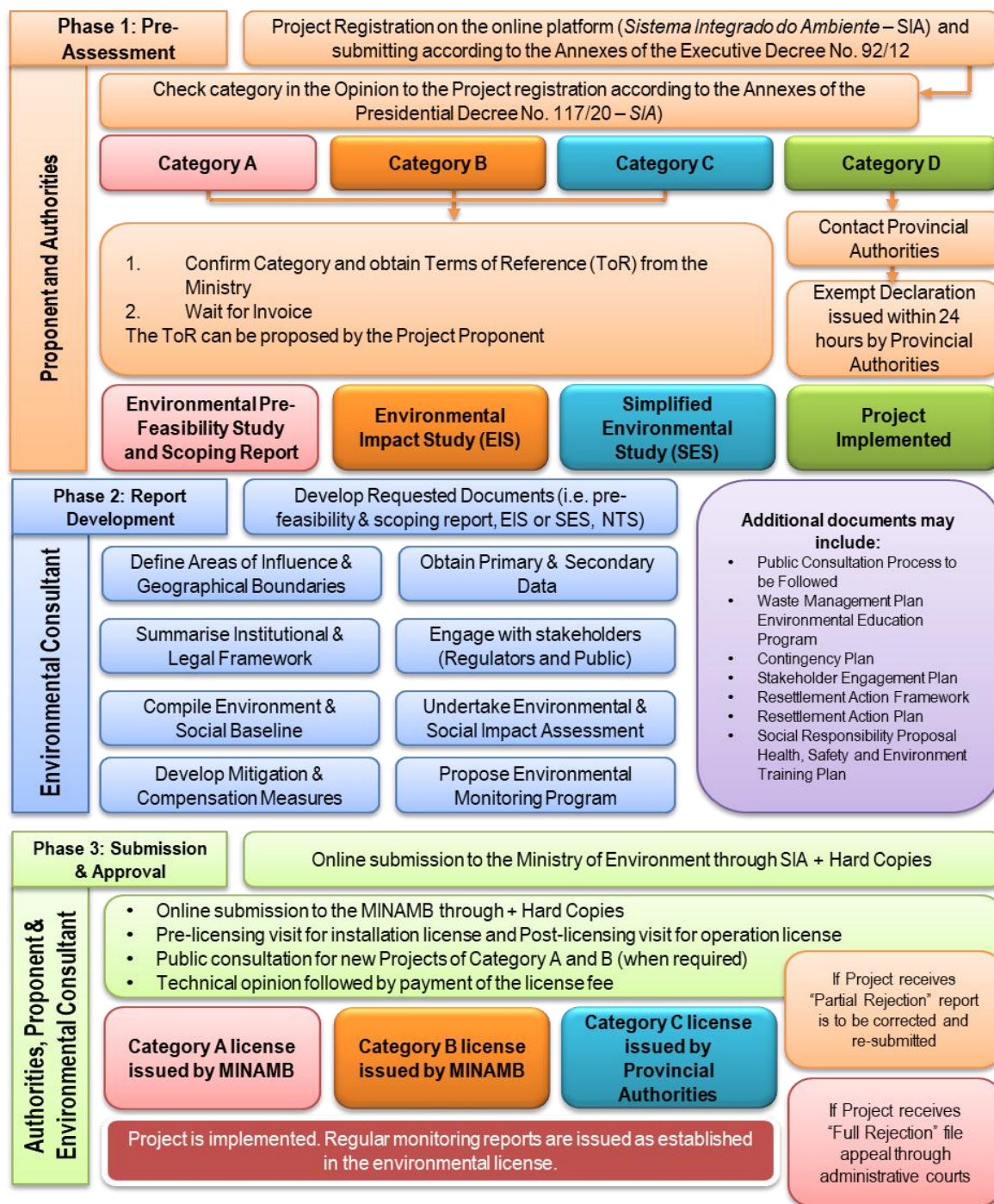


Figure 1-2: Schematic detailing the ESIA phases in Angola which includes applicable GIIP requirements

1.6 Assumptions, limitations and exclusions

The following presents assumptions, limitation and exclusions applied to this ESIA.

1.6.1 General

The following general assumptions, limitations and exclusions are applicable:

- The requirements set out in the Angola national legislation were used to guide the scope of specialist studies. In instances where Angolan laws did not set out requirements for baseline conditions, suitable GIIP requirements and applicable standards were applied;
- All the technical and spatial data, Project description and information provided by PAK Yatirim to the Environmental Assessment Practitioner (EAP) and specialists, reflects the proposed activities of the Project and is assumed to be correct at the time of assessment;
- The EAP has identified all potential impacts based on available information, research and site investigations and these have been assessed and rated accordingly using a standardised impact assessment methodology;
- Due to the increased risk of land mines along the proposed study area, on foot investigations were restricted and often confined to cleared areas deemed safe to access by the de-mining team present. Such restrictions limited extensive on foot investigations of the study area. Furthermore, there were extensive sections of the route that were located off any main roads or viable access routes, limiting access to sample sites. Where sites could not be accessed, alternative sites observed as a proxy were selected and sampled;
- The stakeholder engagement process to date and specialist investigations have been sufficiently effective in identifying the issues that needed to be addressed for the Project; and
- Although data sources consulted provide useful and often verifiable, high-quality data such as the sensitivity of areas, they do not always provide an entirely accurate indication of the focus areas site characteristics at the scale required to inform the ESIA process. Where relevant, field assessments were conducted in order verify data sources and provide more accurate information about on-site conditions (e.g., for biodiversity and freshwater ecosystems).

1.6.2 Air quality and climate change

The following assumptions, limitations and exclusions are applicable to the air quality and climate change specialist studies:

- There was no ambient monitoring data available for assessment in the air quality study;
- The air quality study is a qualitative assessment on the potential air quality impacts arising from the Project and therefore quantifications of emissions and dispersion modelling was excluded from this assessment. A qualitative assessment is deemed adequate for a project of this nature due to the following reasons:
 - During operations, there are no anticipated adverse impacts to regional or local air quality, as there will be no significant sources of air emissions;
 - During construction, air quality impacts are minimal and majority of the impacts will be due to construction fleet. Air quality impacts from the construction fleet are anticipated to be minimal considering the small scale of the fleet, phased out and short construction durations which will result in localised impacts that will cease on completion of construction works. Adherence to mitigation measures contained in the ESMP will result in negligible impacts to air quality during construction;
 - The Project is set within an area that has relatively good air quality, with only periodic localised impacts from emissions caused by smoke from cooking fires in villages and from fires set to clear small patches of vegetation for gardens. It is expected that the baseline will remain largely unchanged due to the nature of the Project; and
- Monitored data was not used for the generation of the climate baseline due to: (1) Missing data records for rainfall and temperature captured by the Gove SASSCAL station, (2) Missing data records for all MET parameters from the Matala SASSCAL station; and (3) The general and altitudinal distances between both INAMET stations (Dongo and Cuvelai) and the proposed site.

1.6.3 Hydrology

The following assumptions, limitations and exclusions are applicable to the hydrology specialist study:

- Aerial photography and field observations provided a good indication of hydraulic characteristics;
- The study incorporates hydrological and hydraulic calculations for 104 river crossings. A detailed LIDAR survey was available for a 100 m corridor along the power line route, while data outside this corridor were obtained from the publicly available FABDEM DEM, which has a 30 m resolution;
- Accurate hydraulic flow depths are unnecessary for impact prediction, making the FABDEM suitable;
- The FABDEM is suitable for catchment delineation but not accurate for hydraulic calculations, LIDAR is needed for precise hydraulic flow depths;
- Flow depths are not suitable for infrastructure sizing and placement; detailed topographical surveys and site inspections will be needed for infrastructure sizing and placement;
- Floodlines for all 104 crossings are not within the study's scope. However, accurate cross-sections were obtained at each crossing, and normal flow depths were calculated based on assumed roughness and channel slope measurements; and
- The assessment results are based on single-visit data with no medium or long-term hydrological measurements.

1.6.4 Soil, land use and land capability

The following assumptions, limitations and exclusions are applicable to the soil, land use and land capability specialist study:

- Whilst data sources used provide useful and often verifiable, high-quality data, they do not always provide an entirely accurate indication of the actual site characteristics associated with the investigation area at the scale required to inform an environmental process. However, this is useful background information to the study and, if desktop results are considered with the outcome of the soil and land capability assessment, sufficient decision-making can take place;
- The soil survey conducted as part of the land capability assessment was confined to the study area. However, consideration of the immediately adjacent areas was given; and
- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another. For this reason, the classifications presented in this report are based on the "best fit" to the World Reference Base Classification System (2014).

1.6.5 Biodiversity

The following assumptions, limitations and exclusions are applicable to the biodiversity specialist study:

- The dry season biodiversity surveys will be conducted at a later stage and results will be included in the updated ESIA;
- Best practice methodologies for faunal and floral assessments based on site access and time constraints were utilised. Where necessary, reference sites were selected and assessed along accessible routes in order to provide suitable data to allow for inference of site conditions;
- The ecological assessment was confined to the study area. The exact location of associated infrastructure, such as new roads (and associated borrow pits) and the proposed operations and maintenance building were not known at the time of the assessment, and therefore site-specific surveys could not be undertaken for these; and
- Not all the areas within the larger study area were accessible at the time of assessment and as such conditions and habitat for these areas has been inferred from satellite imagery and data collected whilst on site.

1.6.6 Freshwater ecosystems

The following assumptions, limitations and exclusions are applicable to the freshwater ecosystem's specialist study:

- The delineation and mapping of freshwater features as presented are regarded as a best estimate of the outer boundaries based on the site conditions present at the time of the survey;
- Given the extensive agricultural activities as well as other anthropogenic disturbances within the study footprint, the zonation of the freshwater ecosystems has been altered and, in some areas, augmented over time. To mitigate this limitation, satellite imagery over time was used to verify boundaries using time-series imagery. Despite this, the delineations as presented are regarded as a best estimate of the boundaries based on the site conditions present, as observed during the site assessment and are deemed appropriately accurate to guide the authorisation process;
- Wetland, riparian and terrestrial ecosystem zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundary may occur. In the absence of protocols developed specifically for Angolan wetland systems, “best practice” methods developed for the African continent (such as the various wetland assessment tools developed in South Africa), were utilised and adapted where necessary in order to ensure the most appropriate and accurate characterisation of the resources. For the purpose of this assessment, the Department of Water Affairs and Forestry (DWAF) (2008) method followed is considered sufficient to provide similar results; and
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the freshwater ecosystems will need to be surveyed and pegged according to surveying principles and with land survey equipment.

1.6.7 Noise

The following assumptions are applicable to the noise specialist study:

- The noise calculations assumed that the following components are relevant during the operational phase:
 - 1 OHP (220/30kV electricity) in the public domain;
 - 3 villages (Jamba, Cuvango, and Chipindo);
 - 36 transformation stations in Jamba, Cuvango, and Chipindo; and
 - 3 substations in Jamba, Cuvango, and Chipindo.

1.6.8 Visual

The following assumptions, limitations and exclusions are applicable to the visual specialist study:

- The viewshed illustrates the areas from which the infrastructure relating to the Project is likely to be visible. It does not take local undulations, existing vegetation and man-made structures into account;
- Locations and footprint of the construction camp sites (planned every 80 km along the route) and temporary laydown areas was unknown at the time of modelling and hence could not be included in the viewshed models and the visual impact not analysed. Visual impacts are assumed to be localised and of short duration for these areas;
- Viewpoints (representing potentially visually sensitive areas) were selected based on a digital inspection of the site and surrounds;
- A visual assessment, by nature, is not a purely objective or a quantitative process, but is dependent on the subjectivity of the judgments made. Where required, appropriate criteria and motivations have been clearly stated;
- Decommissioning and rehabilitation plans were not available at the time of the assessment. It has been assumed that the process of decommissioning will be of minor impact to sensitive viewers and can be accomplished in a relatively short period, generally less than 5 years;
- The models were calculated with available digital data, and the results have not been verified with field/site data;
- Elevation data for the greater impacted area surrounding the Project site was not provided, as such SRK used NASA SRTM data for surface modelling; and
- Exact substation footprint areas were not provided hence an evaluation of the approximate locations provided was done (based on a 3ha area). Modelling parameters used were based on digital research on similar existing substations and SRKs experience with similar infrastructure.

1.6.9 Socio-economic

The following assumptions, limitations exclusions apply to the socio-economic impact assessment (SEIA):

- Data was obtained from the National Institute of Statistics (*Instituto Nacional de Estatísticas*, INE) in Angola, is from the national census of 2014;
- Where no specific data for the villages affected by the Project was available, the data for the commune, municipality, Province or national data was used (in that order); and
- Surveys of a sample of households in each of the selected villages was undertaken using pre-developed in-depth paper questionnaires. The aim was to survey at least four households per village, based on the remoteness/location of the communities and the parameters of available time. Interviews were supplemented by other consultations with municipal and communal administration and traditional leaders (*sobas* or *regedores*), which allowed the collection of socio-economic information on village demographics, the number of households, livelihood activities, available services and infrastructure and other important information such as qualitative inputs into perceptions of the Project.

1.6.10 Heritage

The following assumptions, limitations and exclusions are applicable to the heritage specialist study:

- It is incumbent upon the developer to inform the relevant heritage authority should further cultural remains be unearthed or laid open during the process of development, as this study does not claim to have recorded every site on the landscape;
- As the final pylon positions were not yet available, the line was not systematically surveyed by an archaeologist and previously unidentified cultural heritage sites can occur along the corridor. This limitation is successfully mitigated with the implementation of a chance find procedure and implementation of a pre-construction survey;
- Limited published information is available on intangible heritage and sacred sites for the study area. Information on such sites is sometimes considered confidential and is difficult to obtain. The social study was able to enquire about heritage resources from respondents; and
- Due to access restrictions, and safety concerns (including active landmines) the entire corridor was not systematically surveyed by an archaeologist and previously unidentified cultural heritage sites can occur along the corridor. It is assumed that this limitation can be successfully mitigated with the implementation of a chance find procedure and pre-construction survey.

1.7 ESIA team

The team that conducted the ESIA comprised a core group of professionals that possess extensive experience in environmental assessment. The EAP were supported by registered technical specialists, which collectively worked to compile the ESIA report.

1.7.1 Core team

The core team included a Project partner, a technical advisor, Project manager and dedicated Project co-ordinator. The core team was responsible for the day-to-day management and co-ordination of the study, client liaison and technical and quality assurance. The team worked closely with the Angolan in-country partner, Geolab, who ensured that the Angolan regulatory requirements were fully met. The members of the core team are presented in Table 1-1.

Table 1-1: Core team members, their roles and responsibilities

Name and position	Project role	Responsibilities
Darryll Kilian Partner & Principal Environmental Consultant, SRK	Project partner	• Internal review and quality assurance • Project risk management

Name and position	Project role	Responsibilities
Kavandren Moodley Senior Environment Scientist, SRK	Project manager	- Client liaison - Progress reporting - Internal review - Management of sub-consultant - Technical review
Joanna Goeller, Principal Environmental Scientist, SRK	Technical advisor	- Strategic input into technical process issues - Overall technical review
Sara Pizarro Environmental Advisor, Geolab	In-country lead consultant	- Liaison with in-country specialists and relevant government departments - External reviewer and contributor
Ana Ramos Social and stakeholder engagement Advisor, Geolab	Social and stakeholder engagement advisor	- Liaison with in-country specialists and relevant government departments - Socio-economic baseline and stakeholder consultations
Lynnette Herbst Senior Social Scientist, SRK	Advisor on international social aspects	- Oversight of social inputs - Stakeholder engagement - Social Impact Assessment - Community health and safety
Tania Oosthuizen Principal Environmental Scientist, SRK	Technical support	- Preparation of management plans - ESIA reporting inputs
Jesse Spratt Environmental Scientist, SRK	Project coordinator and reporting	- General Project coordination - Reporting and ESIA compilation
Richard Damant Environmental Scientist, SRK	Reporting	- Research and reporting - ESIA compilation

1.7.2 Specialist team

Experienced environmental and social specialists supported the core team. Table 1-2 presents the specialists' name or companies and area of expertise.

Table 1-2: Project specialist team

Name and affiliation	Specialist area
Christopher Hooten (SAS Environmental)	Fauna, flora, soils and wetlands impact study
Bruce Randell (HCV Africa)	Hydrology impact study
Barend van der Merwe (HCV Africa)	Noise impact study
Philippa Burmeister (SRK)	Climate change risk study
Christine Brown (SRK)	Visual impact study
Hasheel Tularam (SRK)	Air quality impact study
Jaco van der Walt (Beyond Heritage)	Heritage impact study
Kenneth Mahuma (SRK)	Occupational health and safety (OHS) review
Tim Hart (Sustainable Futures)	Land acquisition and resettlement framework (LARF) review

1.8 Purpose and structure of the report

This report has been prepared to fulfil the requirements set out in Executive Decree 92/12, Terms of Reference for the Preparation of Environmental Impact Studies, Presidential Decree 117/20 and GIIP requirements in terms of the IFC, EPs, ILO, OECD and UN, as detailed in Section 3. The purpose of

this report is to establish current environmental and social baseline conditions in the Project area. Furthermore, the report sets out to define legal requirements which need to be considered for the Project. The potential negative and positive environmental and social impacts resulting from the Project are assessed, without and then with proposed management measures in place. The mitigation and management recommendations contained within the report will be carried through into the various phases of the Project in order to ensure that potential impacts are reduced, managed and mitigated for the life of the Project. These measures will be presented in a detailed environmental and social management plan (ESMP), which will include a monitoring programme. This report will be submitted to government (i.e., MINAMB) as a permit application requirement. The findings of the ESIA will also be communicated to stakeholders as part of the stakeholder engagement process. The report consists of 5 volumes and 8 sections, as follows:

- **Volume 1:**
 - **Section 1: Introduction and background** (this section) - Provides an overview of the report's purpose and outlines the context of the study;
 - **Section 2: Project description** - Describes the Project in detail, including its scope, objectives, alternatives and key features;
 - **Section 3: Legal and institutional frameworks** - Discusses the legal and regulatory frameworks governing the Project, as well as the relevant institutions involved;
 - **Section 4: Description of the social and environmental baseline** - Presents an analysis of the existing social and environmental conditions in the Project area;
 - **Section 5: Stakeholder engagement and information** - Explains the strategies and methods employed for engaging with stakeholders and disseminating information about the Project;
 - **Section 6: Environmental and social impact assessment** - Evaluates the potential environmental and social impacts of the Project and assesses their significance;
- **Volume 2:**
 - **Section 7: Environmental and social management plan (ESMP), inclusive of a monitoring programme** - Outlines the measures and strategies to mitigate and manage the identified impacts, ensuring sustainable Project development;
 - **Section 8: Land acquisition and resettlement framework** - Presents an overview of the objectives, principles, policies, procedures, and organisational arrangements for dealing with land access and resettlement;
 - **Section 9: Conclusions and recommendations** - Summarises the findings of the report and provides recommendations for decision-makers;
- **Volume 3:**
 - **Appendices (Supporting data and analysis);**
- **Volume 4:**
 - **Specialist assessments;**
- **Volume 5:**
 - **Socio-economic questionnaires; and**
- **Volume 6:**
 - **Addendum.**

This structured approach ensures comprehensive coverage of all relevant aspects of the Project, from its inception to its potential environmental and social implications, ultimately facilitating informed decision-making and responsible Project management.

2 Project description

The Project description section of the ESIA presents information pertaining to the Project need, background, location, alternatives and further details of the planned development.

2.1 Project need and background

The Republic of Angola, through MINEA, is embarking on a significant enhancement of its electrical infrastructure with the Gove-Chipindo-Cuvango-Jamba Transmission Line Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project intends to leverage the development of the region by providing infrastructure which, in addition to boosting the agricultural, 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.

The Project is structured around the establishment of a new 220 kV OHL network, extending from Gove to Cuvango, and further branching out to Chipindo and Jamba. This network includes the construction of new substations in Chipindo, Cuvango, and Jamba, each equipped with a capacity of 220/30 kV - 20 MVA, to efficiently distribute the generated power to these villages. The Project further includes the laying down of medium voltage (MV) OHL for distribution, along with the necessary low voltage (LV) OHL network, public lighting and home connections within the communities of Chipindo, Cuvango, and Jamba. The overarching goal is to create a robust and reliable electric power supply system that not only caters to the current demands but is also scalable to accommodate future expansions, including the prospective 220 kV OHL interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Project, with an additional 10 MW anticipated for local community demands. This Projection underscores the critical nature of the Project in addressing the power needs of the region, fostering economic growth, and improving the quality of life for its residents.

In terms of regulatory compliance, the Project aligns with the ET-E-008-Ed. This is a Technical Specification for Metallic Structures for Lines and Substations that adheres to international standards such as EN 50341-1, EUROCODE 3, and various others pertaining to steel quality, galvanizing and construction norms. This ensures the required levels of safety, reliability and efficiency in the Project's execution and operation.

The Gove-Chipindo-Cuvango-Jamba Transmission Line Initiative represents a significant leap forward in Angola's energy infrastructure development. The Project is fully aligned with Angola's National Development Plan (Plano de Desenvolvimento Nacional - PDN 2023-2027), which prioritises infrastructure development as a catalyst for sustainable socio-economic growth. The Project directly supports the government's goal of improving access to reliable electricity in rural areas, fostering industrial development, and enhancing living standards. By modernising energy infrastructure, the Project aligns with the PDN's strategic objectives, which focus on regional development, poverty reduction, and employment generation. Furthermore, the Project contributes to the broader Angola 2050 Vision by facilitating balanced development and reducing regional disparities. The upgraded power infrastructure will stimulate local economic activity, attract investment, and support key sectors such as agriculture, ultimately promoting inclusive and sustainable growth in southern Angola.

2.2 Project location

The Project is just south of the centre of Angola (Figure 2-1) and extends for about 170 km, crossing three municipalities (Municípios) which include Jamba, Cuvango and Chipindo.

The main works will be carried out largely in Huíla province. The source of electricity for the OHL will be generated by the Gove Hydroelectric Power Plant and extend for 135 km with an OHL 220 kV to

Cuvango, where a new 220/30 kV substation will be built. A new 220/30 kV substation will also be built for distribution in Chipindo along with the construction of an OHL 220 kV from Cuvango to Jamba, with an approximate length of 35 km. A new 220/30 kV – 20 MVA substation will be constructed in Jamba. In addition, the infrastructure for village electrification (Chipindo, Cuvango, and Jamba), along with construction sites and access roads for transporting equipment, materials, and personnel will be constructed (Figure 2-1).

The Gove Hydroelectric Power Plant is a renewable energy Project designed to enhance the power supply of Huambo province and beyond. A brief overview of this plant is presented in Table 2-1.

Table 2-1: Overview of the Gove Hydroelectric Power Plant (CDM – Executive Board, 2014)

Category	Details
Location and Capacity	• River: Cunene River • Proximity: 120 km from Huambo Municipality, 600 km from Luanda • Installed Capacity: 61.86 MW (three units of 20.62 MW each)
Infrastructure and Operation	• Existing Infrastructure: Utilises a dam built in 1975 for flood control • Hydroelectric Technology: Francis turbines • Electricity Distribution: Directly dispatched to Huambo's isolated power system
Environmental and Economic Impact	• Emission Reduction: Aims to reduce greenhouse gas emissions compared to fossil fuel plants • Sustainable Development: Supports economic growth by providing reliable electricity • Use of Natural Resources: Uses the hydro potential of the Cunene River for renewable energy
Technical Details	• Generation Units: 3 Francis turbines • Average Annual Generation: Approx. 150,000 MWh • Operational Lifetime: Expected 40 years, with a plant load factor of 27.68%
Financial and Regulatory Aspects	• Investment: EPC contract worth approx. \$150 million • Energy Tariff: Set by the Angolan government, considering long-term sustainability and affordability

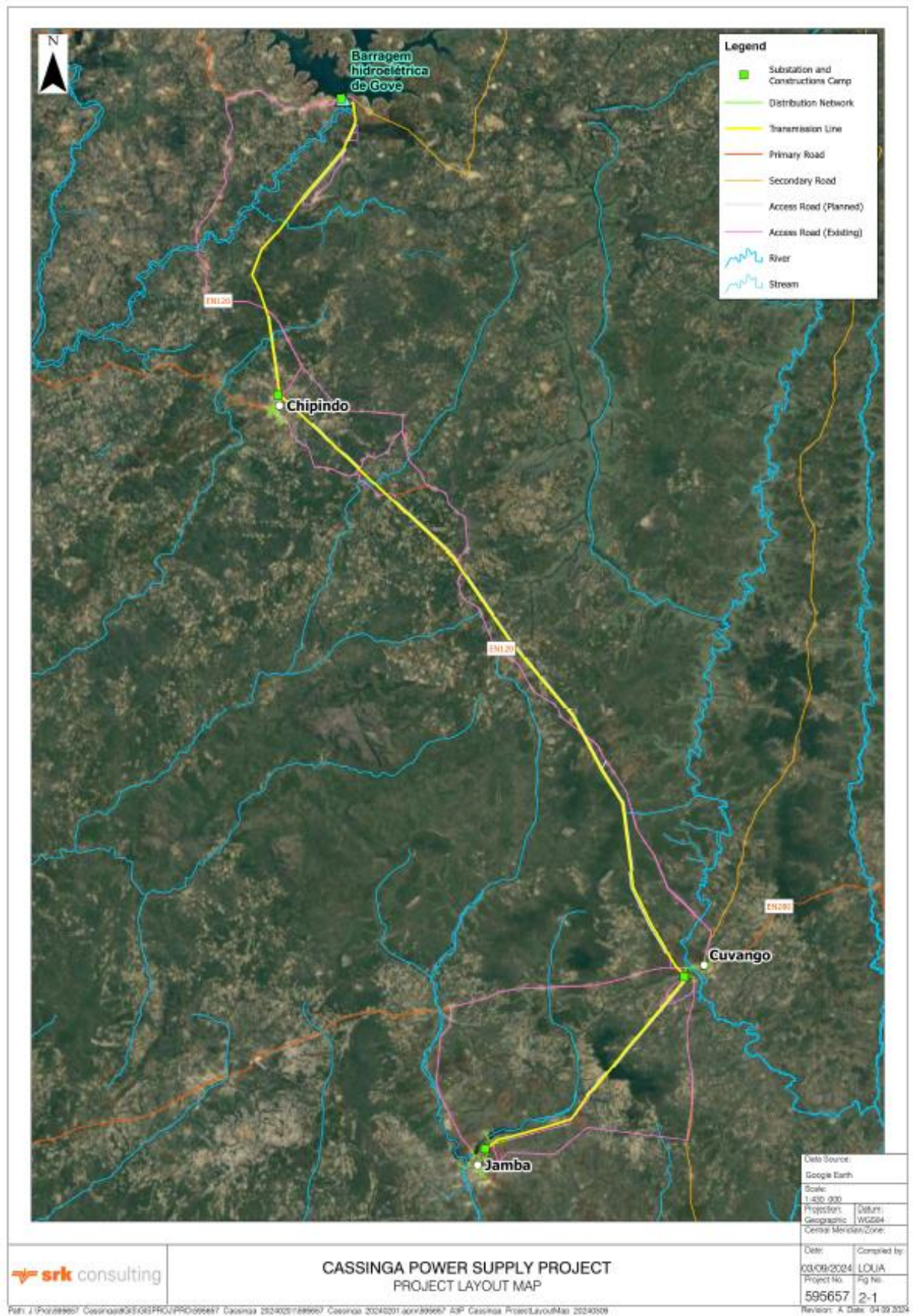


Figure 2-1: Proposed 220 kV OHL and supporting infrastructure Project

2.3 Proposed Infrastructure

The Project involves the construction of three new substations and the establishment of a new 220 kV OHL network extending from Gove to Chipindo, Cuvango, and Jamba. For electrification of the villages (i.e., Chipindo, Cuvango and Jamba), the Project will include a 30 kV MV OHL network to the new substations and a LV OHL network to supply electricity to 1 000 homes in each of the three villages. Supporting infrastructure such as construction sites and access roads will be constructed. Further details are provided in the subsections that follow. It should be noted that all described infrastructure fall within the scope of the funded Project, unless indicated otherwise.

2.3.1 Transmission lines and towers

The locations of the transmission line towers, including in-line suspension towers and bend (strain) towers, have been determined using detailed topographical surveys and engineering assessments, thereby ensuring optimal placement for structural stability and operational efficiency. Environmental and social factors have been thoroughly considered to minimise impacts on local ecosystems and communities. A total of 509 metallic Y-type towers will be constructed (Figure 2-2), positioned approximately 350 m apart along the 220 kV OHL route. These towers, which are suitable for the line's angle and designed to withstand various load conditions, stand at approximately forty-seven meters in height, with each requiring a footprint of 10 m by 10 m for safe and stable installation.

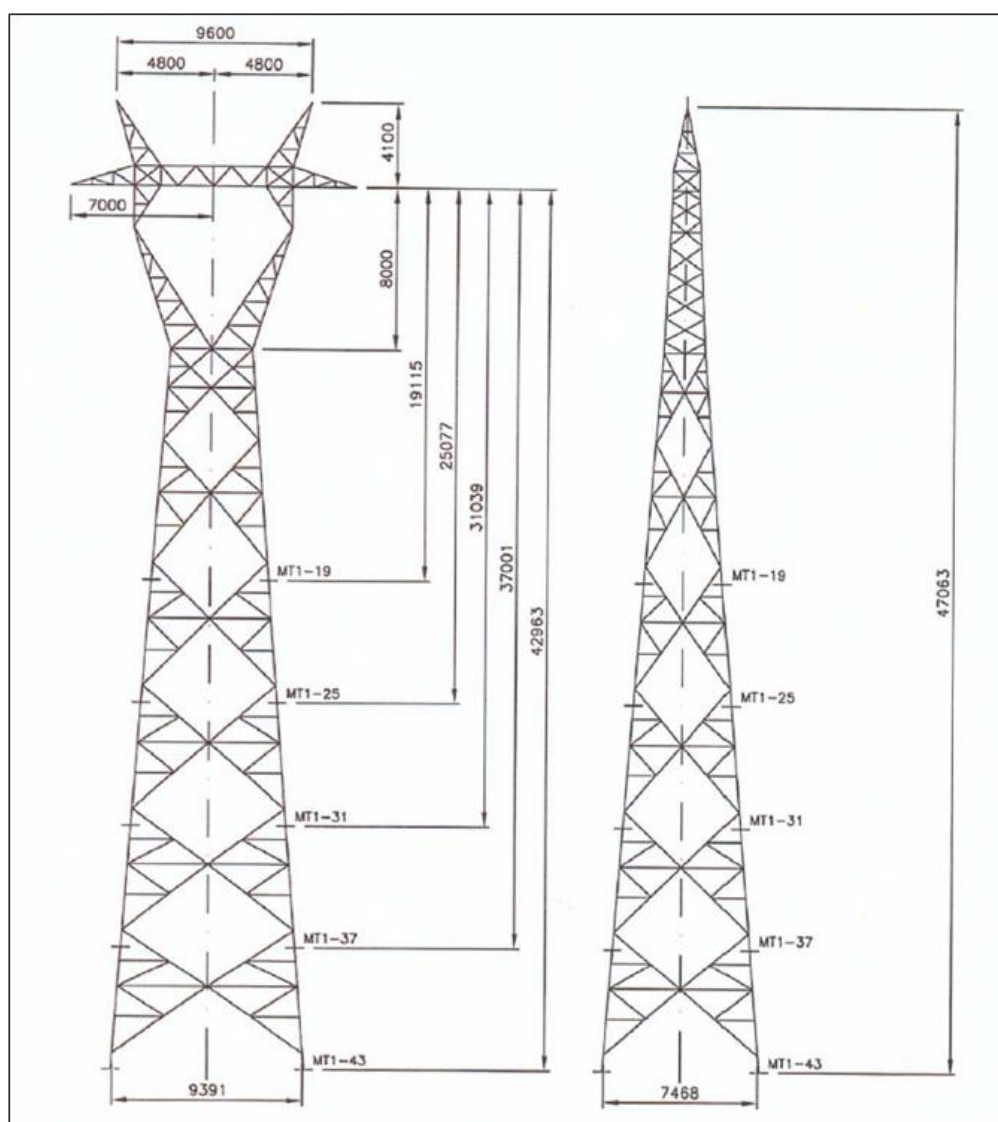


Figure 2-2: Example of a MT Tower (MT1)

2.3.2 New substations

A substation is a key part of the electrical generation, transmission and distribution system, where voltage is transformed from high to low or the reverse using transformers. The Project will comprise the supply, installation, testing, commissioning and operation of three 220/30 kV substations in accordance with MINEA and International Electrotechnical Commission (IEC) standards. The construction of the new substations will be in accordance with the plan and the single line schemes that will be presented at a later stage, based on relevant guideline schemes. The design of the Chipindo, Cuvango and Jamba 220/30 kV substations is based on MINEA Technical Specifications and IEC standards. At the 220 kV level, the single busbar configuration was implemented, and the width of each 220 kV Bay Line is 15 m. Table 2-2 presents the requirements needed to implement the new substations at the proposed locations of Chipindo, Cuvango and Jamba.

Figure 2-3 presents the draft cross-section layout for the 220/30 kV – 20 MVA substation.

Table 2-2: Technical specifications for the substations

Component	Specifications	Quantity (Each Location)
Design & Engineering	Comprehensive design including civil works	1 set
Line Protection Bay	220 kV	3
Transformer Protection Bay	220/30 kV	3
Busbar	220 kV	3
Power Transformer	220/30 kV- 20 MVA ONAN/ONAF	3
Auxiliary Power Transformer	160 kVA	3
Diesel Generator	150 kVA	3
Earthing Transformer	Standard specifications	3
MV Board SF6	30 kV - 1 Input Cell and 3 Exit Cells	3
Command and Protection System	Including SCADA	1 set
Tests and Commissioning	Comprehensive testing of all components	1 set

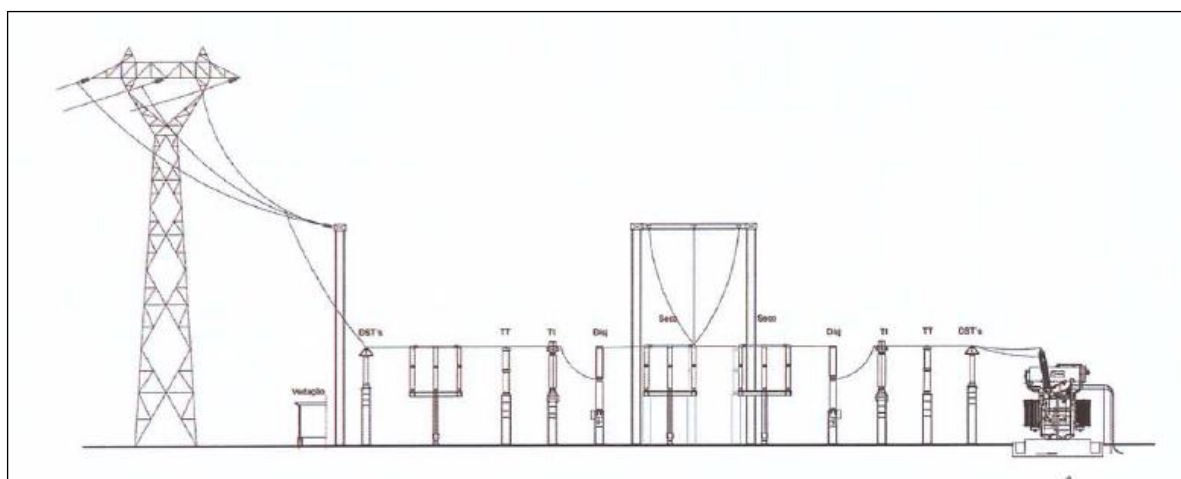


Figure 2-3: Draft layout for the 220/30 kV – 20 MVA substation

2.3.3 Overhead line infrastructure

OHL infrastructure refers to the network of towers, poles, conductors and equipment used to transmit and distribute electrical power through aerial cables. The OHL infrastructure for the Project will be constructed in two stages (stage 1: Gove – Chipindo – Cuvango and stage 2: Cuvango – Jamba), with the requirements of these OHL presented in Table 2-3.

Table 2-3: OHL design requirements

Component	Description	Quantity (for Gove - Chipindo - Cuvango)	Quantity (for Cuvango - Jamba)
Route Study & Survey	Topographic and geotechnical assessment	1 set	1 set
Project Design	Mechanical & Electrical Calculations+ Drawings	1 set	1 set
Suspension Metallic Towers	Type Y, with signalisation plates	238	78
Tension Metallic Towers	For anchoring and dead-end	107	43
Concrete Foundations	For towers	As per requirement	As per requirement
Bush Clearing & Access Roads	To facilitate construction and maintenance	135 km	35 km
Conductor Cable	"YEW" Cable 479mm ²	135 km	35 km
OPGW Cable	With 24 Optical Fibres	135 km	35 km
Commissioning & Final Tests	Ensuring operational reliability	1 set	1 set

Stage 1: Gove – Chipindo – Cuvango

The Gove – Chipindo – Cuvango section of the OHL (Figure 2-1) will comprise the following components:

- High Voltage (HV) OHL, between Gove Hydro and New Cuvango 220/30 kV Substation, energized 220 kV single circuit, for a distance of appx 135 km;
- Metallic Towers type Y, adequate to the angle of the OHL;
- Three-Phase OHL 220 kV, bundled conductor "YEW" Cable 479 mm² (2 by phase); and
- Two Guard Wires will be installed, one conventional "Guinea" and another type "OPGW" with 24 Optical Fibres.

Stage 2: Cuvango – Jamba

The Cuvango – Jamba section of the OHL (Figure 2-1) will comprise the following components:

- HV OHL, between New Substation at Cuvango and New Jamba 220/30kV Substation, energized 220 kV single circuit, for distance of appx 35 km;
- Metallic Towers type Y, adequate to the angle of the OHL;
- Three-Phase OHL 220 kV, bundled conductor "YEW" Cable 479 mm² (2 by phase); and
- Two Guard Wires will be installed, one conventional "Guinea" and another type "OPGW" with 24 Optical Fibres.

2.3.4 Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba requires several infrastructure components, which are detailed in Table 2-4. The installation of these components within each community will establish a MV and LV OHL network to supply grid electricity to approximately 1 000 homes in each community, including public lighting.

Table 2-4: Electrification component details

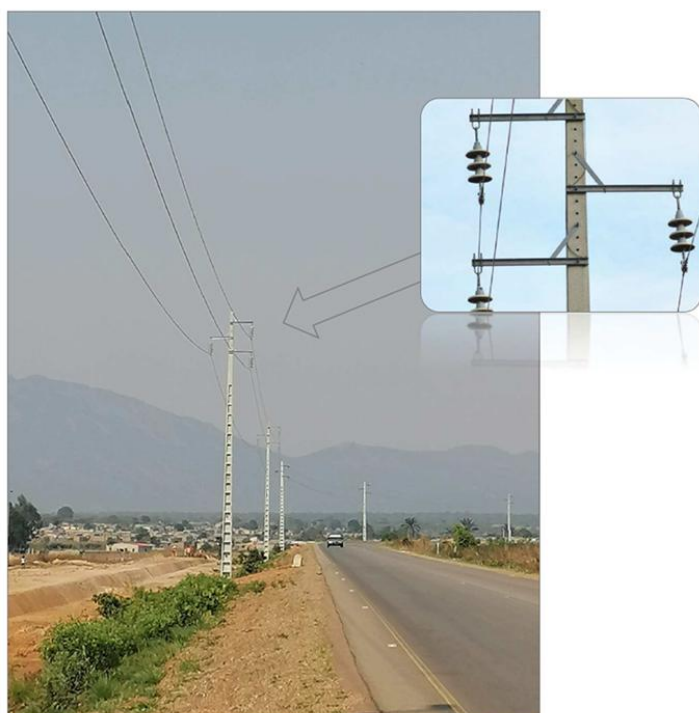
Component	Description	Specifications	Quantity (For Each Community)
MV Network 30 kV	To interconnect power transformation stations	Conductor ACSR 110 mm ² , various concrete poles	Approx. 10-17.5 km
Transformation Station	250 kVA / 30 kV and 160 kVA / 30 kV	Complete equipment for transformer station	4-7 (Based on capacity)
LV Network and Lighting	For home connections and public lighting	Cables LXS 4 x 70 + 16 mm ² , Luminaires 150 W - VS	As per design
Home Connections	To supply electricity to homes	Connection accessories	Approx. 1 000 homes

2.3.5 Medium voltage 30 kV OHL

The Project consists in the construction of a MV 30 kV OHL Network from the substations to be built at the 30 kV outlets, to the city of Jamba and Cuvango. This infrastructure will be established along the existing access roads and be based on concrete poles and comprise a cable ACSR 110 mm² conductor, single circuit and pennant conductors (Table 2-5). Figure 2-4 presents a picture of a 30kV OHL.

Table 2-5: General characteristics of the OHL

Component	Specifications
Number of Circuits	1
Number of Conductors per phase	1
Conductors	ACSR 110 mm ²
Supports	Concrete Poles 16 Mt
Insulators	Chain 4 x Disco U70 Glass
Conductor arrangement	Simple pennant suit

**Figure 2-4: Photograph of medium voltage 30 kV OHL**

2.3.6 Transformer stations

The intention is to construct transformer stations on the MV 30 kV OHL infrastructure. The characteristics of these facilities are presented in Table 2-6 and a representative diagram is shown in Figure 2-5.

Table 2-6: Transformer station specifications

Construction type	Aerial
Transformation Ratio	30/0,4 kV
Power	250 or 160 kVA at 30 kV
Cut Out Circuit Breakers	XS 30 kV
Electric Board	Tripolar LV
Accessories	Regulatory

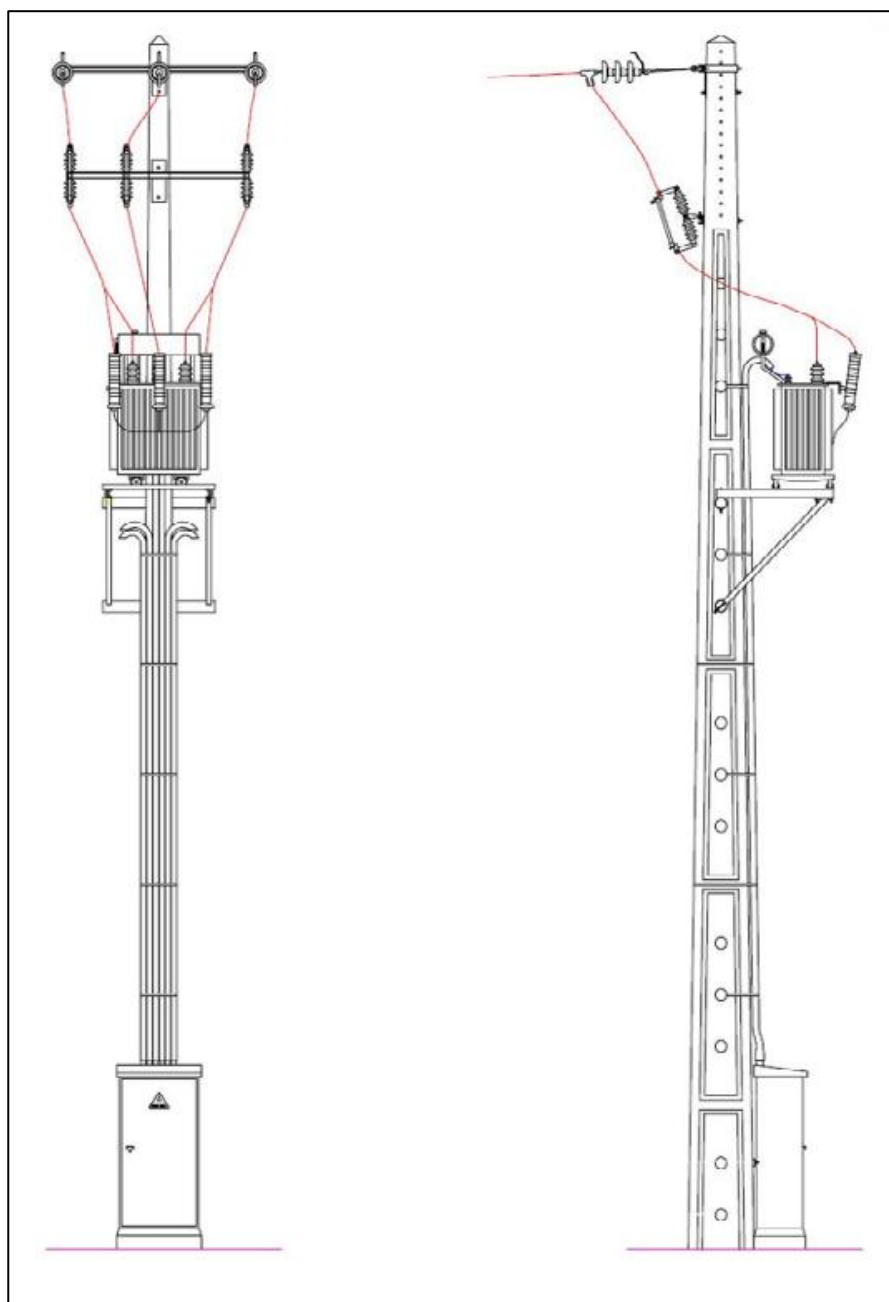


Figure 2-5: Transformer station

Electrification of Chipindo

In order to electrify the town of Chipindo from the new 220/30 kV substation (Figure 2-6), the following scope will be considered:

- MV 30 kV OHL Network, with approximately 10 km to connect the new 220/30 kV substation to interconnect all power transformation (PT) stations to home connections and public lighting to be installed; and
- Construction of LV Network to supply grid electricity to around 1 000 Homes, including public lighting.

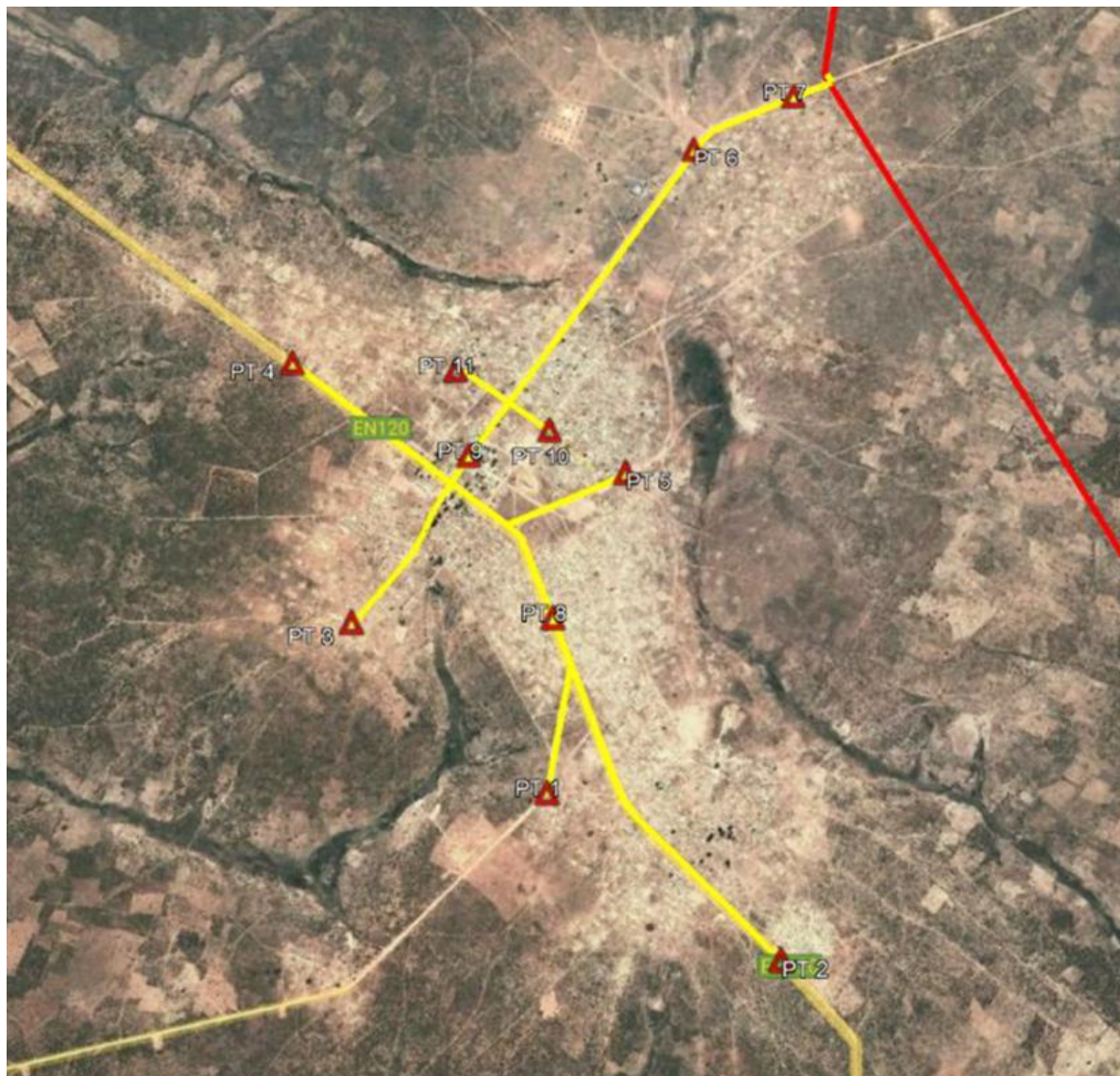


Figure 2-6: MV network and transformation station sites for Chipindo

Electrification of Cuvango

In order to electrify the town of Cuvango from new 220/30 kV substation (Figure 2-7), the following scope will be considered:

- MV 30 kV OHL Network, with approximately 13 km to connect the new 220/30 kV substation to interconnect all PT stations to home connections and public lighting to be installed; and
- Construction of LV Network to supply grid electricity to around 1 000 Homes, including public lighting.

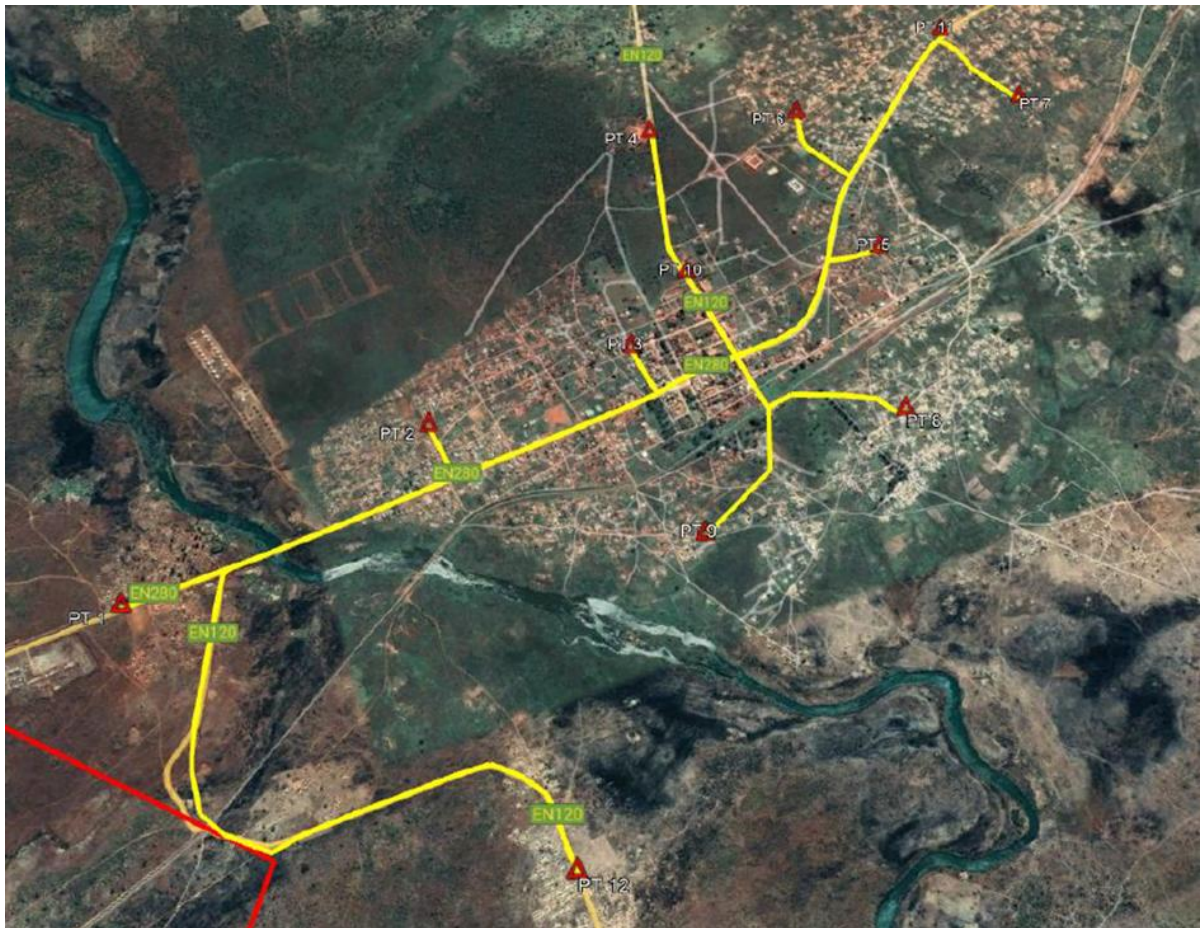


Figure 2-7: MV network and transformation station sites for Cuvango

Electrification of Jamba

In order to electrify the town of Jamba from the new substation 220/30 kV (Figure 2-8), the following scope will be considered:

- MV 30 kV OHL Network, with approximately 17,5 km to connect the new 220/30 kV substation to interconnect all PT stations to home connections and public lighting to be installed; and
- Construction of LV OHL Network to supply grid electricity to around 1 000 Homes, including public lighting.



Figure 2-8: MV network and transformation station sites for Jamba

2.3.7 Supporting infrastructure

Access roads

The Project will include the development and maintenance of access roads to facilitate transportation of equipment, materials, and personnel (Figure 2-1). Where possible, existing roads outside the OHL 100 m corridor will be upgraded or maintained to meet the Project's access requirements. These access roads will have a width of 4 m, with an additional 2 m buffer on either side, forming a disturbance zone to accommodate construction and maintenance related activities. In cases where new access roads are needed, these will be constructed entirely within the designated OHL 100 m corridor to minimise and contain the environmental impact and avoid unnecessary disturbance to the adjacent areas.

Where possible, new access paths will be established using techniques that minimise disturbance to avoid permanent removal of vegetation. These would include trimming vegetation rather than removing vegetation to gain access to construction areas. Maintenance of some paths may be required for ongoing maintenance during the Project operations and will be undertaken in accordance with the ESMP specifications. Other paths not required for ongoing maintenance will be rehabilitated concurrently.

Construction sites/camps

Four construction sites/camps will be established at Gove, Chipindo, Cuvango and Jamba, each with a footprint of 5 000 m² or 0.5 ha. These construction sites will be located in close proximity with the

planned substation footprints and within the assessed OHL corridor to minimise land disturbance. A maximum total area of 2 ha for both the construction camps and substation footprint. The exact siting of the construction sites will take cognisance of any no-go and sensitive areas identified by the ESIA. Once construction activities have been concluded, the construction sites will be dismantled and the area rehabilitated.

Temporary laydown and assembly areas

An area of approximately 2 000 m² on each tower site will be demarcated as a temporary laydown and assembly area to allow each tower to be installed. The entire OHL route will have multiple temporary laydown areas due to the length of the line. These temporary laydown areas will be located at 350 m intervals and need to be cleared of vegetation. Where possible, vegetation will be trimmed down rather than removed. The exact siting of the temporary laydown and assembly areas will take cognisance of any no-go and sensitive areas identified by the ESIA. All temporary laydown and assembly areas will be rehabilitated concurrently after use.

Borrow pits

The specific locations of borrow pits for the construction of the OHL and supporting infrastructure (e.g., access roads) are currently unknown. The identification of these sites during detailed engineering will be informed through PAK Yatirim's Management of Change Procedure (PY-ANG-MOC-PRO-00001). This procedure will evaluate any alterations related to the selection of borrow pit sites, ensuring that the environmental and social impact significance is carefully assessed. It will specifically focus on potential effects on ecosystems, biodiversity, local communities, and livelihoods. The procedure ensures that all identified impacts are fully assessed and appropriate management measures identified before any borrow pit activities commence.

Gove substation upgrades

The Gove substation will not require any civil works to accommodate the Project. However, a new control and protection panel will be installed to integrate the OHL into the existing supply infrastructure. The space for this installation is available within the Gove substation, and hence the upgrades fall outside the scope of the funded Project. Upgrade activities will be undertaken by the relevant responsible parties using established procedures.

2.3.8 System protection scheme

Environmental conditions

The design criteria for the Project electrical reticulation network are based on the following environmental conditions:

- Maximum Temperature: 50°C;
- Minimum Temperature: 0°C;
- Average Daily Temperature: < 40°C;
- Maximum Wind Speed: 33m/s;
- Pollution Level: Strong; and
- Altitude: 1 000 < m.

The electrical equipment has been designed to ensure that the equipment will withstand the environmental conditions for the entire life of the Project.

Earthing and lightning protection

The Project will be fitted with earthing and lightning protection measures. This is crucial in electrical network to ensure that the infrastructure and people coming in close proximity of the electrical

infrastructure are as far as possible protected against lightning strikes and electrical shocks. Earthing will prevent electrical shock by providing a path for a fault current to flow to earth.

Two Guard Wires will be installed, one conventional Guinea and another type of Optical Ground Wire (OPGW), for earthing and lightning protection of the OHL. In addition, the OPGW will be equipped with 24 core fibre, which will be used for communications and monitoring of the OHL via the Supervisory, Control and Data Acquisition (SCADA) system. Allowance has also been made for earthing of the structures. Surge arrestors and lightning arrestors have been included in the design to cater for any over voltages that can be as a result of lightning strikes and for lightning protection respectively.

Fault level or short circuit protection

Project infrastructure will be designed with fault level/short circuit protection to deal with power surges. The instantaneous surge of current that flows when a fault occurs on an electrical network, which is significantly greater than the normal load current, can cause total failure of equipment. This fault is normally caused by a short circuit occurring in the network. In some instances, this can result in explosion of equipment such as switchgear, causing damage to equipment and harm to personnel that might be in close proximity at the time. A fault level rating is hence critical when designing busbars and protective equipment such as circuit breakers and fuses.

For the HV 220 kV OHL network, the root mean square (rms) fault level is given as 40 kA for three seconds (40 kA/3s) while the peak value fault level has been given as 100 kA. Substations infrastructure such as busbars, supporting structures, flexible connections, current transformers and terminations will be designed so as to be capable of withstanding the mechanical forces associated with the passage of the fault current.

Fault levels will be finalised in the detailed design phase for the MV 30 kV and LV electrical infrastructure. A load flow and short circuit analysis will be carried out during detailed design phase to ensure that fault levels are correctly determined.

Effects of magnetic fields

The proponent will give consideration to the potential effects of the electromagnetic field (EMF) of Project infrastructure. EMF is typically between 50 and 60 Hz, which is considered to be extremely low frequency (National Institute of Environmental Health Sciences, 2002).

Detailed designs will be based on the European Union Council recommendation on the limitation of exposure of the general public to electromagnetic fields (0Hz-300 GHz) and other national and international standards. Although there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from OHLs and substations, the exposure limits for the general public developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (Table 2-7) will be used as guideline when siting Project infrastructure.

Should EMF levels be expected to be above the recommended exposure limits, engineering techniques will be considered to reduce the potential effects of EMF.

Table 2-7: ICNIRP exposure limits for general public exposure to electric and magnetic fields

Frequency	Electric field (V/m)	Magnetic field (μT)
50 Hz	5000	100
60 Hz	4150	83
Source: IFC Environmental, Health and Safety Guidelines, Electric Power Transmission and Distribution		

Induced voltages

Due to the EMF present around energised HV OHLs, voltages may be induced onto adjacent de-energised or non-commissioned powerlines and may be large enough to deliver potentially lethal electric shocks.

Although in there is no indication that Project OHLs will run in parallel or adjacent to any existing powerlines, there are some locations where powerlines may cross over each other or be sited nearby to each other, as in the case of the HV 220 kV OHLs and the MV 30 kV OHLs around the north-eastern side of the Jamba substation. This area will be thoroughly assessed during the detailed design phase to ensure that the risks associated with induced voltages are reduced, if not totally eliminated. The management of induced voltages will be addressed in the detailed design phase by applying relevant national and international standards.

System insulation coordination

The classification of places according to the level of pollution is decisive in the choice of insulators and will inform the detailed design of the Project. The choice of insulators for the OHL has been based on a high pollution level, whereby the minimum nominal specific creepage distance has been identified as 31 mm/kV, which according to IEC, falls under pollution level IV, described as very heavy pollution. Glass insulators (Type U70) have been identified for use on the medium voltage reticulation (30 kV) while composite insulators have been adopted on the high voltage (220 kV) reticulation network.

The maximum service voltage has been defined as 245 kV, as per IEC 60071-1 requirements. The basic insulation level is defined as the maximum voltage level that electrical equipment insulation can withstand without failing. Electrical equipment such as transformers, circuit breakers and cables will be designed to operate at specific voltage levels. Line bays will be protected against surges by means of surge arresters mounted on the heads of the line panels. These surge arresters will be of the metallic oxide type in accordance with technical specification ET-E-105 – Equipment Characteristics.

The insulation coordination requirements to be adopted for the Project are as follows:

- Standard insulation requirements for measurement transformers;
- Standard insulation requirements for cutting and manoeuvring apparatus; and
- External insulation of equipment considering the altitude correction factor.

Nominal insulation levels for power transformers with neutral rigidly grounded are given in Table 2-8. Minimum isolation distances are given in Table 2-9.

Table 2-8: Nominal insulation levels: power transformers (neutral rigidly grounded)

Maximum service voltage one kV (effective value)		Power transformers					
		Phase-earth			Phase-earth		
		50 Hz 1 minute (kVef)	Atmospheric shock (kV)	Switching shock (kV)	50 Hz 1 minute (kVef)	Atmospheric shock (kV)	Switching shock (kV)
245	Isolation "line side"	360	850	750	----	----	----
	Isolation "neutral side"	185	450	----	----	----	----
72	Isolation "line side"	140	325	----	----	----	----
	Isolation "neutral side"	140	325	----	----	----	----

Table 2-9: Minimum isolation distances

Maximum service voltage one kV (effective value)	Insulation distance (cm)		Ground clearance (cm)	Working distance (cm)	
	Phase-earth	Phase-phase		Horizontal	Vertical
245	210	240	455	440	440
72	66	76	300	300	300

Acoustic noise

Noise in the form of buzzing or humming can often be heard around transformers or high voltage power lines producing corona. The acoustic noise produced by transmission lines is greater with HV OHLs (400-800 kV) and even greater with ultra-high voltage lines (1000 kV and above). According to the IFC Environmental, Health and Safety Guidelines, Electric Power Transmission and Distribution (2007), the level of noise impact likely from electricity transmission lines increases with the increase of the voltage strength of the line. It is also notes that “Corona Noise” only becomes a significant issue from 400 kV and above, suggesting that significant “Corona Noise” impacts may not be likely for 220 kV OHLs.

The Project’s HV 220 kV OHL routing and substation positioning take account of the IFC’s Environmental, Health and Safety Guidelines, by ensuring that this infrastructure is located as far away from residences as possible.

Aviation obstruction

The Project will coordinate with the Aviation Authorities to obtain approval for the final heights and locations of the towers for the new Gove-Cuvango route near the Gove airport. This is to ensure that the towers are sized in such a manner as not to obstruct aircraft traffic and avoid damage to both the electrical infrastructure and aircraft. Where necessary, the beacon balls and marking/light beacons will be included in the design of the towers to ensure that there is adequate indication of the existence of powerlines in the area, as required by International Civil Aviation Organization (ICAO) Annex 4 requirements.

Corridors and minimum clearances required

The corridor for the HV 220 kV OHL will be sized to ensure safe operation of the OHL. This will necessitate that trees or shrubs over 1.5 m in height and within a 22.5 m range on both sides of the centre of the OHL (i.e. total of 45 m for 220 kV) will be cleared. Hence, in the unlikely event of a collapse of a type MT tower (MT1), which is 47 m high, adequate clearance will be made available in fulfilment of the minimum vertical clearances set out in the MINEA standards (ET-E-102-Ed.A), as set out in Section 2.4.1.

2.3.9 General occupational health and safety aspects for electrical infrastructure

Fire detection and suppression

During the detailed design phase, a risk assessment will be carried out to determine the risk of fires that can be caused by electrical faults such as arcing occurring in substation equipment. Generally, electric fires mostly occur in substations, and therefore they will be designed to prevent the start and spread of fires by adopting the necessary fire detection and suppression systems.

Access

All enclosed substation buildings will be equipped with minimum of two entries/exits, lockable on the outside and complete with panic bars on the inside to allow occupants to quickly leave the building by depressing the panic bar in the event of emergencies. This two entries/exits access will allow

personnel to leave the substation at any closest point in the event of emergencies. Outdoor substations or switchyards will be fenced off and be equipped with lockable gate/s to restrict unauthorised personnel from entering these areas. Transformer bays will also be equipped with lockable gates, where practically possible.

All equipment requiring servicing or maintenance such as switchgear and transformers will have unobstructed access and enough clearances around it for ease of maintenance.

Lighting

The Project makes allowance for public lighting. The lighting requirements in and around Project infrastructure such as substation buildings and switchyards will be carefully considered during the detailed phase. Lux level calculations will be guided by the minimum workplace illumination intensity requirements set out by national and international standards (IFC, 2007). This will provide workers with enough visibility to avoid safety incidents. Emergency lighting will also be allowed for to ensure that there is some lighting in the event of normal power failure to ensure safe evacuation of personnel in areas such as substation buildings. A 150 kVA generator will be located at each substation (Chipindo, Cuvango and Jamba).

Signage and labelling

The construction phase will allow for signage around areas such as HV OHL towers, substations and switchyards to ensure that people are aware of the dangers associated with such areas. Labelling of transformers, transformer bays, exit/emergency exits, switchgear and cabling will also be used during construction to ensure safety and ease of fault finding. Signage will be provided and maintained through the life of the Project.

All energised electrical devices and powerlines will be marked with warning signs during construction, commissioning, operation, and decommissioning stages of the Project. All buried cables will be identified, marked and made safe during construction to avoid damage and any safety hazards (electrical shocks) during excavation work.

2.4 Project design guidelines

The layout of the Project is based on both national Angolan regulations and international standards and good practice guidelines.

2.4.1 National requirements

The 2004 Land Law specifies in Article 27 that there is a designated right of way, consisting of a 30-meter strip on both sides of the HV OHL, creating a total corridor width of 60 meters. The recommendation from MINEA for Projects of this nature is to keep houses and structures out of this 60-meter corridor where possible. For the purposes of the Project, a right of way of a 50-meter strip on both sides of the HV transmission line was adopted following a conservative approach which considered the tower height (i.e., 47 m). For the MV and LV transmission line, a designated right of way consisting of a 12-meter strip on both sides of the MV/LV line is recommended. As the pole height is 18 m, a larger clearance will be considered for the MV/LV transmission lines. MINEA also sets minimum vertical clearance requirements between the conductors and any obstacles, which are detailed in the standard ET-E-102-Ed.A and summarised in Table 2-10.

Table 2-10: National minimum clearance requirements

Description	Distance (m)
Soil	12
Trees	5

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

2.4.2 International requirements

The IFC's EHS guidelines serve as technical reference materials that offer both general and industry-specific examples of recognised good international industry practice. These guidelines outline acceptable performance levels and measures for the IFC and World Bank, emphasising solutions that are feasible with current technology at reasonable costs.

The guidelines are designed to guide efforts in preventing, reducing and managing EHS impacts throughout the construction, operational, and decommissioning stages of a Project or facility. In instances where the regulations of the host country, in this instance Angola, deviate from the standards set in the general and sector-specific EHS Guidelines (IFC, 2007), Projects will aim to comply with the more stringent requirements based on the unique Project conditions.

The IFC recommends that Right-of Ways widths for transmission lines range from 15 to 100 m depending on voltage and proximity to other rights-of-way (typical range is between 15 and 30 m). For OHLs up to 35 kV, 12 to 24 m corridors (6 to 12 m on each side) are recommended.

2.5 Project phases

The phases of the Project at a high-level include construction, operations and decommissioning.

2.5.1 Planning and construction

The ESIA will inform Project planning and guide where and how construction activities will take place to avoid and/or mitigate potential environmental and social impacts such as resettlement and compensation. The construction phase of the Project will include several activities to lay the foundation for the electrical infrastructure. This phase will include preparatory activities such as clearing of trees and shrubs for servitudes and substation platforms, access paths construction and the establishment of temporary construction camps and laydown areas for materials and equipment. Pesticides and herbicides will not be used during the construction phase. Vegetation clearance and site preparation will be conducted exclusively through mechanical methods.

Following these preliminary activities, the main construction works will commence. These will include the erection of the three new substations at Chipindo, Cuvango, and Jamba and the installation of the towers and HV 220 kV OHL network stretching approximately 170 km.

Construction activities may involve earthmoving for substation platforms, setting up of structural components like towers and poles for the OHL, installing conductors and guard wires and setting up the necessary electrical and mechanical systems within the substations. Environmental management measures will be implemented throughout the construction phase to mitigate potential impacts on the local ecosystem and communities.

Towers

Once the centre line has been cleared, the Contractor's surveyor will peg every tower position and mark the crossing point with existing fences for new gate installation. Where required, once the tower

positions have been marked, the vegetation clearing team will return to every tower position and clear vegetation, in accordance with the specifications outlined in the ESMP presented in Section 7.

Foundations

The choice of foundation is influenced by the type of terrain encountered, as well as the underlying geotechnical conditions. The actual size and type of foundation to be installed will depend on the soil bearing capacity (actual sub-soil conditions). Strain structures require more extensive foundations for support than in-line suspension structures, which contributes to the cost of the construction of the line. The footprint area required for the construction of the foundation for the powerline is 1,5 m x 1,5 m. The minimum working area required around a structure position is 20 m x 20 m for self-supporting towers and 40 x 40 m for compact cross-rope suspension towers.

Foundations may be mechanically excavated where access to the tower position is readily available. The same usually applies to the pouring of concrete required for the setting of the foundations. Prior to erecting the towers and filling of the foundations, the excavated foundations are protected in order to safeguard animals and people from injury. All foundations will be backfilled, stabilised through compaction, and capped with concrete at ground level.

Stringing of conductors

A pilot cable will be used to string the conductors between towers. This can be undertaken mechanically or by hand. The line will be strung in sections (from bend to bend). Cable drums will be placed at 5 km intervals (depending on the length of the conductor) during this stringing process. In order to minimise any potential negative impacts on the surrounding area, these cable drums will be placed within the OHL servitude.

Substations

The construction of the three new substations at Chipindo, Cuvango, and Jamba is a critical component of the Project. Activities will involve earthworks to prepare the substation platforms, followed by the assembly and installation of electrical and mechanical components. Foundations for transformers, switchgear and other substation equipment will be constructed using precise civil works to ensure structural stability. Once the platforms are prepared, the electrical systems, including transformers, circuit breakers and control panels, will be installed. The substations will be connected to the transmission lines and distribution network, enabling voltage regulation and electricity distribution to the intended areas.

Electrification of villages

The electrification of Chipindo, Cuvango, and Jamba will be implemented concurrently during the construction of the OHL and substations. This process involves connecting local households and businesses to the new substations via low- and medium-voltage distribution networks. Activities will include the installation of distribution poles, transformers and power lines within the villages to ensure reliable electricity access. Furthermore, specialised teams will handle the integration of household connections, ensuring that power is distributed safely and efficiently.

Timing

In most cases, the construction will begin at one end and progress towards the other. Construction of the Project will be undertaken over a period of approximately 36 months, provided construction proceeds as scheduled. It is proposed that the Contractor will commence with construction in the first quarter of 2025. Table 2-11 details the Project's construction timeline.

Table 2-11: Project construction timeline

Phases	Cassinga Power Supply Project - 36 Month Project Execution Timeline																																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	Jan-26	Feb-26	Mar-26	Apr-26	May-26	Jun-26	Jul-26	Aug-26	Sep-26	Oct-26	Nov-26	Dec-26	Jan-27	Feb-27	Mar-27	Apr-27	May-27	Jun-27	Jul-27	Total	
NEW OHL 220 KV GOVE - CHIPINDO - CUVANGO																																						
Design & Engineering	20%	16%	16%	16%	16%	16%																														100%		
Civil Works (Towering)						15%	25%	30%	20%	10%																										100%		
Towering									10%	15%	25%	25%	15%	10%																						100%		
Stringing											10%	10%	15%	15%	25%	15%	10%																			100%		
Tests & Commissioning																																		50%	50%	100%		
NEW SUBSTATION 220 / 30 KV MVA - CHIPINDO																																						
Design & Engineering	20%	16%	16%	16%	16%	16%																														100%		
Civil Works										15%	25%	30%	20%	10%																						100%		
Galvanized Steel Structures												15%	25%	30%	20%	10%																				100%		
Electrical 220 / 30 KV Equipments														15%	25%	30%	20%	10%																		100%		
Command & Protection Systems																	15%	25%	30%	20%	10%															100%		
Tests & Commissioning																																			50%	50%	100%	
NEW SUBSTATION 220 / 30 KV - 20 MVA - CUVANGO																																						
Design & Engineering	20%	16%	16%	16%	16%	16%																														100%		
Civil Works															15%	25%	30%	20%	10%																	100%		
Galvanized Steel Structures																	15%	25%	30%	20%	10%															100%		
Electrical 220 / 30 KV Equipments																			15%	25%	30%	20%	10%													100%		
Command & Protection Systems																							15%	25%	30%	20%	10%										100%	
Tests & Commissioning																																			50%	50%	100%	
NEW OHL 220 KV CUVANGO - JAMBA																																						
Design & Engineering	20%	16%	16%	16%	16%	16%																															100%	
Civil Works (Towering)																	15%	25%	25%	20%	15%															100%		
Towering																					30%	25%	25%	20%												100%		
Stringing																							30%	25%	25%	20%										100%		
Tests & Commissioning																																			50%	50%	100%	
NEW SUBSTATION 220 / 30 KV - 20 MVA - JAMBA																																						
Design & Engineering	20%	16%	16%	16%	16%	16%																															100%	
Civil Works																					15%	25%	30%	20%	10%											100%		
Galvanized Steel Structures																							15%	25%	30%	20%	10%										100%	
Electrical 220 / 30 KV Equipments																								15%	25%	30%	20%	10%									100%	
Command & Protection Systems																									15%	25%	30%	20%	10%									100%
Tests & Commissioning																																				50%	50%	100%
ELECTRIFICATION OF CHIPINDO, CUVANGO & JAMBA																																						
Design & Engineering	20%	16%	16%	16%	16%	16%																															100%	
Civil Works (MV Network)																									10%	15%	25%	25%	15%	10%							100%	
OHL 30 KV MV Network																											10%	15%	25%	25%	15%	10%					100%	
LV Network + Home Connections + Public Lighting																													15%	20%	30%	20%	15%				100%	
Tests & Commissioning																																				50%	50%	100%
MISCELLANEOUS PRICES ASSOCIATED TO PROJECT																																						
Demining		10%	10%	15%	15%	15%	15%	10%	10%																												100%	
Environmental and Social Impact Study	10%	10%	15%	15%	15%	15%	10%	10%																													100%	
Training																																50%				50%	100%	

2.5.2 Operation and ongoing maintenance

Once the construction phase is completed, the Project will transition into the operation phase. This phase involves the energisation of the substations and OHL network, enabling the distribution of electricity across the targeted regions. Operational activities will include routine maintenance of the infrastructure, monitoring system performance and ensuring the reliability and efficiency of power supply.

During the lifespan of the OHL, ongoing maintenance will be performed with line inspections undertaken on an average of 1 – 2 times per year, depending on the area. During this maintenance period, the line will be accessed via the access paths established during the construction phase. Maintenance of the access paths is required to be undertaken in accordance with the specifications of the ESMP.

As part of vegetation control and management during ongoing operations, no pesticides and herbicides will be applied. RNT has further confirmed that Polychlorinated Biphenyls (PCBs) will not be used in the operation of the Project substations. While some legacy infrastructure in Angola still contains PCBs, RNT has adopted a policy of excluding their use in all new substations. As a member of the Southern African Power Pool (SAPP), RNT supports regional efforts to align with international environmental standards. Although Angola is not yet participating in the World Bank-funded SAPP programme focused on eliminating PCBs, RNT's practices reflect its broader commitment to responsible environmental management and regional energy integration.

The operating conditions will focus on ensuring reliable power transmission while minimising environmental and social impacts. The OHL will operate at high voltage levels in compliance with national and international standards, ensuring efficient and continuous power supply to the target regions. Regular maintenance and monitoring will be carried out to ensure the safety, reliability and longevity of the infrastructure. The substations will be designed to manage peak loads while maintaining operational stability across the network. Adequate safety measures, including protective relays and grounding systems, will be implemented to mitigate risks associated with power transmission. Operational protocols will be implemented to minimise the environmental footprint, focusing on continuous monitoring of vegetation management under the powerline, ensuring minimal disruption to local ecosystems and communities. Engagement with local communities will continue to address any concerns and ensure that the Project delivers tangible benefits to the region's socio-economic development.

2.5.3 Closure and rehabilitation

After the completion of construction activities, concurrent rehabilitation will be conducted e.g., when a campsite is removed, this area will be cleared and cleaned of any debris, topsoil re-established and revegetated.

The closure and/or rehabilitation will also be initiated upon the decommissioning of Project facilities at the end of their operational life or if there is a need for significant upgrades or replacements. This Phase will involve dismantling and removing electrical equipment, structures and any other installations, followed by the rehabilitation of Project sites to ensure that they are returned to their natural state or repurposed in a manner that benefits the local communities and environment.

Rehabilitation efforts will focus on soil stabilisation, replanting vegetation and ensuring that any residual impacts from the construction and operation phases are adequately addressed. A detailed closure and rehabilitation plan will be developed and implemented, taking into account the findings of the ESIA.

2.6 Project alternatives

As part of the ESIA process, project alternatives are evaluated to ensure that the proposed development minimises negative environmental and social impacts while achieving its intended development objectives. The consideration of alternatives allows comparison of different scenarios and selection of the most viable option that strikes a balance between technical feasibility, economic efficiency and sustainability.

Project alternatives typically include variations in the location, design, technology and operational methods, with the goal of identifying options that reduce potential risks to the environment and local communities. This includes the “no-go” alternative, where the proposed project is not implemented, in order to understand the implications of foregoing the development altogether. By thoroughly analysing these alternatives, stakeholders are better positioned to make informed decisions that align with regulatory requirements, community needs, and environmental preservation.

The subsequent sections outline the key alternatives considered for the Project and explains why the preferred option was selected. For further information on the alternatives analysis, refer to the Addendum to the ESIA (Volume 6).

2.6.1 Location alternatives

The current preferred proposed location of the Project is in Huíla Province where it connects the Gove hydro power facility to Chipindo, Cuvango and Jamba (Figure 2-1), and serves to address the electricity transmission gap within Huíla Province and southern Angola as set out in the Power Development Master Plan (Section 3.3.8) for Angola (Republic of Angola, Ministry of Energy and Water Affairs, 2018).

The substation locations were informed by high-level environmental and socio-economic screening through a desktop analysis and a field survey. The broad principles for site selection included:

- Avoiding overlap with areas of special attention, such as:
 - Environmentally sensitive areas (e.g., wetlands);
 - Housing areas;
 - Historical monuments;
 - Cultural heritage features;
 - Cemeteries;
 - Areas allocated for future dams;
 - Existing electrical lines and their exclusion zones;
 - Telecommunication lines and their exclusion zones;
- Prioritising selection of sites previously disturbed (e.g., for the substation at Jamba and use of existing access roads outside of the OHL corridor during construction); and
- Prioritising selection of sites for current and future infrastructure needs. Specifically, substations were strategically placed in locations that not only optimise their integration into RNT's future projects but also maximise their capacity to connect nearby villages and underserved communities to the grid. This forward-looking placement ensures that the OHL will contribute to long-term regional development and energy access, while also meeting immediate operational needs.

The initial OHL route was proposed by RNT and also avoided many of these key environmental and social features. This alignment was subsequently refined based on the outcomes of a detailed topographical survey undertaken during the ESIA process, and necessitated minor adjustments to the initial RNT-proposed route (Figure 2-1). The refined route takes advantage of a more stable and accessible terrain, thus lowering construction costs and timelines while also minimising crossings of environmentally sensitive features such as wetlands and riverbeds. These adjustments not only improve constructability but also offer environmental benefits. Importantly, the overall environmental and social impacts associated with the revised alignment remain broadly consistent with those of the

initial RNT-proposed route and can be effectively managed through applying recommended mitigation measures.

The substation locations remain unchanged. RNT holds the land rights for the Jamba substation footprint and is in the process of obtaining the land rights for the Cuvango and Chipindo substation footprints. Based on the topographical survey, ESIA and associated specialist studies, it is anticipated that the Project infrastructure (i.e., OHL, substations, access roads and community electrification networks) will remain mostly unchanged.

Any minor adjustments to the final route alignment informed by detailed engineering will be addressed through PAK Yatirim's Management of Change Procedure (PY-ANG-MOC-PRO-00001). This procedure will identify the environmental and social impact significance of any alterations, ensuring that potential impacts on ecosystems, biodiversity, local communities and livelihoods are fully considered and appropriately mitigated. The Management of Change Procedure ensures that environmental and social considerations remain a priority throughout the Project's execution, in line with best practice for sustainable infrastructure development.

2.6.2 Layout alternatives

For the substations, two layout alternatives of approximately 15 000 m² are being considered (Figure 2-9 and Figure 2-10). While both alternatives have the same environmental footprint and impact, the decision will be driven by factors related to technical feasibility. Key aspects that influence the choice of layout will include ease of construction, where terrain suitability, soil stability, and proximity to existing infrastructure will be crucial in determining which layout is more practical to construct. The layout that allows for more efficient use of construction resources and minimises complexity will likely be favoured. Additionally, operational efficiency is a major consideration. The layout that provides a more streamlined design for power distribution and better integration with the existing grid infrastructure will be prioritised.

Maintenance and access are also important. The layout that provides easier access for routine inspections, repairs, and any future upgrades will offer greater long-term benefits. Considering the importance of maintaining safety and minimising downtime, the layout that facilitates safer and more efficient access will be selected.

Finally, future scalability is critical for ensuring that the substations can accommodate technological advancements or capacity expansions. The layout that allows for easier adaptation to increased demand or new technologies will support the long-term sustainability of the Project.

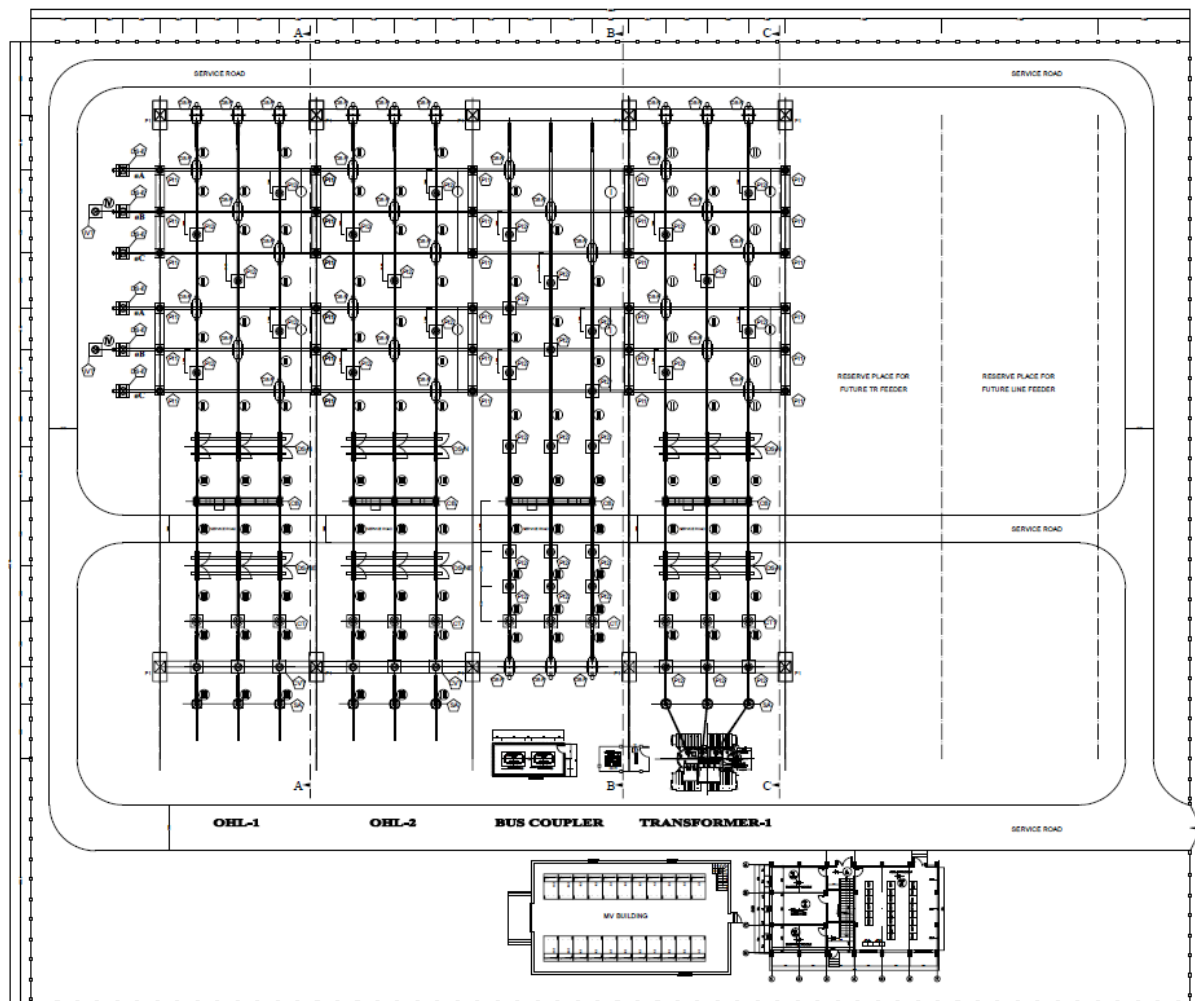


Figure 2-9: Substation layout alternative 1

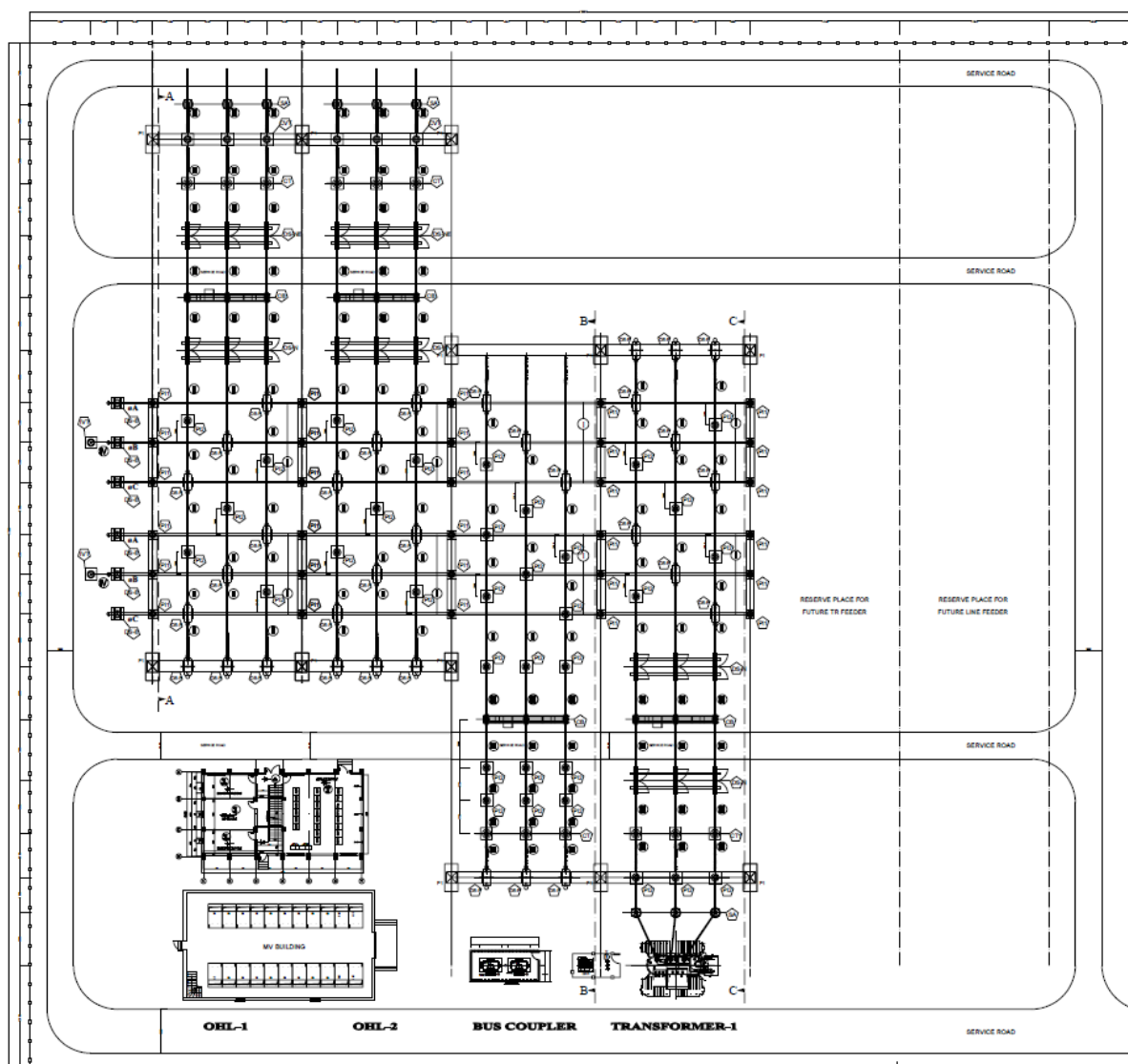


Figure 2-10: Substation layout alternative 2

2.6.3 Design alternatives

Based on the initial technical screening for the Project and established national practices and codes, RNT and PAK Yatirim selected the chosen design as described in this section.

2.6.4 No-go alternative

Currently, Huíla province has little access to the national electricity grid particularly for the municipalities of Chipindo, Cuvango and Jamba. Blackouts are common in the region with little possibility for socio-economic development. The expansion of industry and mining in the region relies on reliable electricity supply. A no-go alternative would result in ongoing challenges relating to power supply and distribution.

The Project is aligned with the Power Development Master Plan for Angola (Republic of Angola, Ministry of Energy and Water Affairs, 2018) and provides a crucial high voltage link between existing powerline routes and power generation facilities to areas that are constrained and confined. The Project therefore forms an important part of a greater national scale power generation and transmission development plan. A no-go alternative would fail to address the electricity transmission gap within Huíla Province and southern Angola as set out in the plan.

2.7 Project resource needs

The Project will require a variety of different resources, which includes human resources, construction resources and the provision of utilities such as water and electricity. The quantity of resource requirements will vary between Project phases. For additional information on the resource efficiency measures integrated into the Project, refer to the Addendum to the ESIA (Volume 6).

2.7.1 Work force number of workers for construction and operation

During the construction phase of the Project, a large and diverse workforce will be required to manage and execute various construction, technical, and support activities. The Project will involve both local and international labour, with specific roles assigned to different stages of the Project. The labour force for the Project will be sourced locally where possible, providing employment opportunities for the community while also incorporating international expertise for more specialised roles.

Work force composition during construction

A significant portion of the work force will be recruited locally. This includes foremen, electricians, machinists, bricklayers, and general labourers. Local workers will be engaged through contracts for the duration of the construction stage, contributing to both skilled and unskilled labour requirements.

Specialised roles, such as some high voltage (HV) and medium voltage (MV) technicians, will require international expertise. These workers will possess skills for highly technical aspects of the Project that may not be readily available in the local labour market.

Employment and labour management during construction

The work force will consist of full-time and temporary employees, depending on the specific nature of the task. Full-time staff, including managers and key technical personnel, will oversee ongoing activities, while temporary workers will be contracted as needed for construction phases. All workers will be provided with adequate medical insurance and safety provisions as part of their employment contract. The Project will follow a structured shift pattern, with working hours regulated to ensure efficient progress and worker safety. This will include both day and night shifts for critical operations.

Subcontractors

The Project may involve the use of specialised subcontractors for certain technical functions, particularly for electrical and mechanical works. These subcontractors will bring expertise in specific areas of construction and will be engaged based on the Project's requirements, including environmental, health and safety management considerations.

Construction work force breakdown

The construction work force required for this Project is categorised into different sections, each fulfilling a specific function related to construction, technical operations and management. The estimated number of workers for each category is outlined in Table 2-12.

Table 2-12: Construction work force breakdown

Category	Position	Quantity	Origin
Project Management	Project Manager	1	International
	Technical Office Manager	1	International
	Progress Engineer	1	International
	Business Planning Chief	1	International
	Procurement	1	International

Category	Position	Quantity	Origin
	Logistics	1	Local
Engineering	Project / Engineering Manager	1	International
	Project Engineer (Primary Jobs)	1	International
	Project Engineer (Secondary Jobs)	1	International
	Overhead Line Engineer (OHL)	1	International
	Civil Engineer	1	International
Finance	Finance Manager	1	International
	Chief Financial Officer	1	International
	Budget Planning Manager	1	International
	Chief Accountant	1	International
Construction	Construction Manager	1	International
	Construction Site Managers	3	International
Quality Control & Assurance	QA / QC Manager	1	International
	QA Engineer	1	International
	QC Engineer	1	Local
	Quality Control Technician	1	Local
Environment & Safety	EHS Manager	1	International
	Environmental Specialist	1	International
	Ecological Expert	1	International
	CLOs (Public Relations)	1	Local
	Environmental Chief (per site)	1	International
	Archaeologist	1	Local
Administrative & Social Affairs	Administrative Manager	1	International
	Human Resources Chief	1	International
	Security Chief	1	Local
Substation	Electrical Engineer	1	International
	Civil Engineer	1	International
	Survey Engineer	1	International
OHL	Electrical Engineer	1	International
	Civil Engineer	1	International
	Survey Engineer	1	Local
Construction support	Surveyor	1	Local
	Surveyor's Assistant	1	Local
	Driver / Conductor	3	Local
	Driver's Assistant	3	Local
	Driver Machines	3	Local
	Machinist Helper	3	Local
Construction work	Foreman	1	Local
	Team Leader	3	Local
	Bricklayer Officer	6	Local
	Mason's Servant	6	Local

Category	Position	Quantity	Origin
	Undifferentiated Laborers	12	Local
HV Works	HV Foreman	1	International
	HV Electrical Officer	16	4 International, 12 Local
	Electromechanical Workers	16	4 International, 12 Local
	HV Electricians	18	12 Local, 6 International
	HV Electrician Assistants	18	9 Local, 9 International
	Undifferentiated Laborers	18	Local
MV Works	MV Foreman	1	Local
	MV Electrical Officer	12	2 International, 10 Local
	MV Electricians	12	4 Local, 2 International
	MV Electrician Assistants	12	Local
	Undifferentiated Laborers	12	Local
LV Works	LV Foreman	1	Local
	LV Electrical Officer	9	8 Local, 1 International
	LV Electricians	9	Local
	LV Electrician Assistants	18	Local
	Undifferentiated Laborers	9	Local

Operations work force

During the operational phase of the Project, it is anticipated that the existing RNT maintenance and operational structures will be expanded to accommodate the new Project infrastructure. The current RNT work force will manage routine operations and maintenance activities. If additional personnel are required to support the operation of the Project, these recruits will be sourced locally and employed on a full-time basis. This approach will ensure alignment with local employment policies while maintaining operational efficiency.

2.7.2 Water consumption

Construction water requirements

During the construction phase, water will be required for the following:

- **Potable Water for Construction Workers:** Water will be required for potable use for the construction workers, ensuring their hydration and sanitary needs. This water will be sourced through contracted water trucks and provided as bottled drinking water to the workers; and
- **Water for Construction Activities:** Water will also be necessary for various construction activities, including the mixing of concrete and for general camp domestic purposes (e.g., cleaning, dust suppression, vegetation management and other sanitary needs). The source of this water will be surface water bodies, such as streams and rivers in the Project area, including rivers located in Chipindo, Cuvango, and Jamba. The water for construction will be supplemented by water sourced from local supply points.

The water consumption estimates for this Project have been calculated based on the needs for both human consumption and construction purposes. Table 2-13 shows that most of the water consumption will be dedicated to potable use for the construction workers, with approximately 9 971 m³ required throughout the Project duration.

Table 2-13: Estimated water consumption during the construction phase

Category	Water quantity (m ³)
Potable Water for Workers	8 977
Water for Construction:	
OHL 220 KV (Transmission Line)	583
220/30 KV Substation (Civil Works)	38
30 KV (Medium Voltage Network)	378
Total Project Water Consumption	9 971

Operations water requirements

The water requirements during the operational phase of the Project are currently unknown but are expected to be minimal. It is anticipated that water may be required for the following purposes:

- Maintenance Cleaning: Periodic cleaning of equipment and facilities;
- Cooling Systems: Water for cooling equipment, if applicable; and
- Vegetation Management: Irrigation of plants used for restoration activities and other environmental management efforts around the Project infrastructure.

Potential sources for operational water requirements may include:

- Local Surface Water Bodies: Similar to construction, local streams and rivers in the Chipindo, Cuvango, and Jamba areas can provide water for operational needs;
- Groundwater Wells: Depending on availability, groundwater from local supply points could be used as a supplementary source; and
- Recycled Water Systems: Depending on the Project design, recycled water from cooling or maintenance activities could also be reused to minimise the overall water footprint.

These water requirements will be managed in line with environmental sustainability practices.

2.7.3 Energy consumption

Construction energy requirements

During the construction phase of the Project, energy will be required primarily for powering construction equipment, machinery, and camp operations. The construction sites will require electrical power for running equipment, tools, lighting, and other essential construction activities. The main source of energy during construction will be diesel-powered generator sets. These generators will supply power to the main construction site as well as smaller secondary construction sites.

The estimated energy consumption is based on the use of diesel generator sets for the main and secondary construction sites, is summarised in Table 2-14. The table shows the energy requirements for running the main construction site and three smaller secondary construction sites during the Project. The total annual energy consumption for the construction phase is estimated to be approximately 173 010 kW/h.

Table 2-14: Estimated energy consumption during the construction phase

Category	Average consumption / day (kW/h)	Annual consumption (kW/h)	Period (Days)	Total partial consumption (kW/h)
Main Construction Site (Gove)	162	59 130	540	87 480
Secondary Construction Site 1 (Chipindo)	104	37 960	270	28 080
Secondary Construction Site 2 (Cuvango)	104	37 960	270	28 080
Secondary Construction Site 3 (Jamba)	104	37 960	270	28 080
Totals		173 010		171 720

Operations energy requirements

The energy requirements during the operational phase of the Project are currently unknown but are expected to be minimal. It is anticipated that energy may be required for:

- Powering Maintenance Equipment: Periodic maintenance of electrical infrastructure may require small amounts of energy;
- Cooling Systems: Energy may be needed for cooling equipment, if applicable, particularly in transformer stations; and
- Monitoring and Control Systems: Continuous operation of SCADA systems and other monitoring technologies for the Project infrastructure.

Potential sources for operational energy requirements may include:

- Grid Connection: Once operational, the Project may source energy from the grid for its maintenance and monitoring systems; and
- Renewable Energy Sources: Depending on feasibility, renewable energy options such as solar power could be considered for powering smaller operational systems to ensure sustainability.

These energy requirements will be managed efficiently to ensure that the operational phase of the Project has minimal environmental impact.

2.7.4 Concrete, steel and fuel requirements

The Project construction will require significant quantities of concrete, steel, and fuel. These materials will be required to construct the 509 towers, substations and the necessary infrastructure to support the Project. Careful planning and proactive determination of resource specifications are essential to ensure timely procurement and minimise environmental impacts.

Concrete will mainly be used for tower foundations and substation platforms and walls, while steel will be needed for tower structures, substations, and various support systems. Fuel will be used to operate heavy machinery during construction and transport materials from international and local suppliers to the Project sites.

To align with IFC Performance Standards, resource efficiency and sustainability are integral aspects of this Project. This involves optimising material usage, using local materials where possible, and reducing transportation distances to limit fuel consumption and associated emissions. Additionally, careful management of material deliveries and fuel usage will help reduce the overall environmental footprint and costs of the Project.

Table 2-15 provides a summary of the estimated quantities of concrete, steel, and fuel needed for the Project's construction phase.

Table 2-15: Summary of concrete, steel and fuel requirements

Resource	Quantity Required	Description
Concrete	11 680 m ³	For 509 tower foundations and three substations (Chipindo, Cuvango, and Jamba)
Steel	7 112.5 tons	For tower structures and substation frameworks
Fuel	Approximately 7.6 million litres	For machinery operation and transportation of materials during the construction phase

2.8 Supply chain

The Project requires a sophisticated supply chain strategy to meet the extensive demands for building materials and equipment crucial for its successful execution. This strategy encompasses the procurement, sourcing, and transportation of a diverse range of resources essential for constructing substations, OHL infrastructure and community electrification. These supply chain details are discussed below. The Contractor will implement effective due diligence procedures in selecting suppliers to ensure that environmental and social sustainability requirements are upheld.

2.8.1 Building materials and equipment needs

The Project will require various building materials and equipment. These will be sourced from both local and international suppliers, depending on availability, specifications and logistical considerations. The Project's supply chain strategy aims to balance cost efficiency, quality, and timely delivery while adhering to environmental and social impact guidelines.

Key materials and equipment include power transformers, switchgear, cables, steel structures and concrete for foundations. Most high-voltage electrical components, including transformers, circuit breakers, and protection systems, will be imported from reputable suppliers in Europe and the United States of America (USA). Locally, materials such as concrete poles, earthing structures, and general construction materials will be sourced from accredited Angolan suppliers. Table 2-16 provides a list of building materials and equipment that will be sourced.

Table 2-16: Materials and equipment requirements

Material/Equipment	Origin	Supplier	Country of Origin
Power Transformer	Import	Hitachi	Sweden
SVC (Static Var Compensator)	Import	Hitachi	Sweden
245 kV Circuit Breaker	Import	Hitachi	Sweden
Concrete (Foundations)	Local	Norafica/Jembas/Tecnovia	Angola
Medium Voltage Cables	Import	Volvetia	Poland
Steel Structures	Import	Stalfa/Valmont/Staler	Poland/Europe
OPGW Cable (ACST Type) with 24 Optical Fibres	Import	Resul	Portugal/Spain/Poland
Conductor "YEW" Cable 479 mm ²	Import	Resul/NPA SKAWINA	Portugal/Spain/Poland
Concrete Poles	Local	Various	Angola
Suspension and Tension Clamps	Local	Various	Angola
Home Connections	Local	Various	Angola

2.8.2 Hazardous materials

Hazardous materials will be sourced and handled during the Project phases, posing risks that need to be proactively managed (Table 2-17).

The sourcing strategy will be as follows:

- **Local Sourcing:** Fuel, lubricants, and some basic cleaning chemicals will be sourced locally to support the Angolan economy and reduce transportation-related emissions. Local suppliers will be required to meet environmental and safety standards as per Project requirements;
- **International Sourcing:** Specialised hazardous materials, such as SF₆ gas, transformer oils, and lead-acid or lithium-ion batteries, will be imported from reliable suppliers in Europe and the USA. Suppliers will be selected based on their compliance with international safety and environmental regulations, such as REACH (Registration, Evaluation, Authorisation, and Restriction of Chemicals) and the Basel Convention for hazardous materials; Prohibited Chemicals: Chemicals and chemical formulations listed in Annexes A and B of the Stockholm Convention and Annex III of the Rotterdam Convention will not be utilised at any stage of the project and will be avoided;
- **Refrigerants:** Hazardous refrigerants or coolant materials listed in Annexes A and B of the Montreal Protocol will be avoided; and
- **Non-Hazardous Substitutes:** Opportunities to utilise non-hazardous materials in place of hazardous ones should be explored at every project phase.

Recommendations for the management of hazardous materials are included in the ESMP. In general, all hazardous materials, whether locally sourced or imported, will be stored in secured, labelled containers with spill containment systems. These storage facilities will comply with international standards. When required, hazardous materials will be disposed of by licensed waste management companies to ensure proper handling and disposal in accordance with international best practice, reducing risks to both human health and the environment.

Table 2-17: Hazardous materials supply chain

Hazardous Material	Description	Usage/Source	Country/Region of Origin	Potential Risks
Construction				
Diesel Fuel	Fuel for powering construction vehicles and machinery	Vehicles, generators, and heavy machinery	Local fuel suppliers in Angola	Fire risk, spills leading to soil and water contamination
Lubricating Oils and Greases	Used for machinery maintenance to reduce friction and prevent wear	Heavy equipment and vehicles	Import from global oil companies or local suppliers	Soil contamination, water pollution if spilled
Hydraulic Fluids	Used in construction machinery to transfer power in hydraulic systems	Cranes, bulldozers, excavators	Import from global manufacturers	Soil and water contamination, potential fire hazards
Batteries (Lead-acid, Lithium-ion)	Used in vehicles, machinery, and portable equipment for power storage	Construction vehicles, portable tools, and backup systems	Import from Europe or local suppliers	Leaking acids/metals can contaminate soil and water
Solvents	Used in cleaning equipment or as part of coating and painting processes	Cleaning of machinery, parts, or construction equipment	Import from Europe/USA	Inhalation hazards, flammability, and water contamination
Paints and Coatings	Used for protective coatings on structures and machinery	Painting and coating of metal structures (e.g., towers)	Import from Europe/USA	Toxic fumes, VOCs (volatile organic compounds), fire risk

Hazardous Material	Description	Usage/Source	Country/Region of Origin	Potential Risks
Cement and Concrete Additives	Certain additives, such as accelerators and retarders, may contain chemicals that are hazardous	Concrete mixing for foundations	Local suppliers in Angola	Water contamination from runoff, respiratory hazards
Adhesives and Sealants	Chemical adhesives used in construction for bonding materials	Installing insulation, bonding construction materials	Import from Europe/USA	Emission of VOCs, flammability, potential health risks
Welding Gases (e.g., Acetylene, Argon)	Gases used for welding and cutting metal components	Welding operations on towers, substations, and equipment	Local suppliers or imports	Fire hazard, explosion risk, toxic inhalation
Compressed Gases	Gases stored under pressure used in various construction processes	Cutting, welding, and gas-powered tools	Local suppliers or imports	Explosion risk, toxic gas exposure
Operation				
Sulphur Hexafluoride (SF ₆)	A gas used in electrical switchgear and circuit breakers for insulation and arc suppression	Substations and switchgear	Imported from Europe (e.g., Sweden)	High global warming potential if leaked, respiratory hazard
Transformer Oils (Mineral Oil)	Used as an insulator and coolant in transformers	Power transformers in substations	Imported from Europe (e.g., Sweden)	Oil leaks can contaminate soil and water, fire hazard
Diesel Fuel	Used for backup generators in substations	Backup power generators	Local fuel suppliers in Angola	Fire risk, spills leading to soil and water contamination
Battery Systems (Lead-acid, Lithium-ion)	Used in energy storage systems and backup systems	Substations and auxiliary equipment	Imported from Europe/USA	Battery acid leakage, fire hazard, soil contamination
Cleaning Chemicals	Used during maintenance for cleaning electrical and mechanical equipment	Substation maintenance activities	Local suppliers or imports	Toxic inhalation, water contamination if improperly disposed of
Coolants	Used in cooling systems for electrical equipment, such as transformers	Cooling systems in substations	Imported from Europe	Risk of leaks leading to water contamination
Welding Gases and Equipment	Used in occasional maintenance tasks requiring welding or metalwork	Maintenance of towers, substations, or other equipment	Local suppliers or imports	Fire hazard, toxic fumes, explosion risk

2.8.3 Transportation and logistics

The transportation and logistics strategy for the Project will be designed to ensure that all activities emphasise efficiency, safety, environmental sustainability, and the support of local economies. The strategy considers the complexity of transporting both international and local materials, as well as the movement of personnel to and from Project sites. The objectives of the strategy are to minimise the environmental impact of transportation activities, ensure safe working conditions, and promote the development of local businesses. Table 2-18 provides a high-level overview of the transportation and logistical considerations for the Project.

Table 2-18: Transportation and logistical considerations

Component	Description
Material Transportation	International components (e.g., transmission towers, conductor cables, iron fittings) will be shipped to the Port of Luanda and subsequently transported by truck to Project sites. Locally sourced materials such as cement and aggregates will be transported directly from local suppliers to the Project sites, supporting the local economy and reducing long-haul transport emissions. Efforts will be made to optimise vehicle loads and routes to minimise the number of trips and associated emissions.
Personnel Movement	Organised and scheduled transportation for personnel from local accommodation centres to Project sites will be provided using buses or other suitable vehicles. This ensures both safety and efficiency, while also minimising the environmental impact of individual commuting. Where possible, local drivers and transportation services will be utilised to support local services.
Logistics Management	A dedicated logistics management team will be established to coordinate procurement, shipment tracking, and delivery. The team will use advanced tracking systems to monitor the real-time status of materials in transit and identify any potential logistical bottlenecks. Communication with local authorities and communities will also be maintained to ensure smooth operations and mitigate any disruptions to local traffic or services. This system will ensure that logistics activities are carried out in a way that minimises risks to the environment and local communities.

2.9 Project emissions

The section below presents a variety of potential waste/emission streams that may be applicable to the proposed Project during the construction and operational phases. For additional information on measures to address impacts from emissions, refer to the Addendum to the ESIA (Volume 6).

2.9.1 Waste generation and disposal

Anticipated waste streams

The Project will generate various types of waste during its construction, operation and decommissioning phases. A general overview of the types of waste that are anticipated during the Project phases are outlined in Table 2-19. Recommendations for the management of waste are included in the Waste Management Plan (WMP) (refer to Volume 2).

Table 2-19: Anticipated waste streams

Phase	Type of Waste	Waste Description
Construction	Construction and Demolition Waste	Includes concrete rubble, metal scraps, timber, packaging materials, and excess construction materials.
	Hazardous Waste	Includes used oils, lubricants, and paints from machinery and equipment, as well as batteries and electronic waste.
	Domestic Waste	Generated from temporary construction camps, including food waste, packaging, and other general refuse.

Phase	Type of Waste	Waste Description
Operation	Maintenance Waste	Includes used oils, filters, and worn-out parts from machinery and vehicles.
	Domestic Waste	Arising from operational staff and possibly from the maintenance of permanent facilities.
Decommissioning	Construction and Demolition Waste	Similar waste types as in the construction phase, due to the dismantling of infrastructure.

Anticipated waste quantities

The following waste quantities and characteristics are anticipated:

- Construction and demolition waste: Significant amounts of concrete rubble, metal scraps, and excess materials will be generated during the construction and decommissioning phases. The Project could generate several tons of concrete and steel waste, requiring appropriate disposal or recycling strategies;
- Hazardous waste: The use of machinery and vehicles during construction and maintenance activities will generate hazardous waste such as used oils, paints, lubricants, and solvents. Hazardous waste quantities are expected to be 1-5 litres per vehicle service for oil, while larger quantities may arise from machinery maintenance;
- Domestic waste: Construction camps and operational facilities will generate food waste, packaging materials, and other general refuse. Based on industry standards, construction sites may generate 2-4 kg of domestic waste per person per day. Waste from operational staff at substations will be minimal but must be appropriately managed; and
- Maintenance waste: Operational maintenance activities will generate used filters, worn-out parts, and electronic waste. These will require proper disposal to avoid environmental contamination.

Due to the general lack of local waste management facilities, designated areas will be established at the campsites where waste will be properly stored until a certified waste management company, approved by the Ministry, is identified in the provinces of Huambo, Huíla, or eventually Luanda. An agreement will be signed with the selected contractor(s), and waste collection and disposal (both non-hazardous and hazardous) will be initiated once sufficient volumes are accumulated. The certified company will be required to issue a certificate confirming the type of waste, the quantities handled, and the treatment method used, ensuring compliance with regulatory standards. While the exact waste disposal sites are still being determined, the following options are under consideration during construction:

- Licensed landfills: The Contractor is investigating the availability of licensed landfills in the nearby municipalities and provincial capitals, such as Lubango in Huíla Province. These landfills could be used for the disposal of general construction waste, domestic waste from construction camps, and other non-hazardous materials;
- Recycling facilities: Wherever possible, the Contractor will prioritise the recycling of materials such as metal scraps, concrete, and electronic waste. Recycling centres in Lubango or other nearby cities may be used to reduce the overall volume of waste sent to landfills; and
- Hazardous waste treatment facilities: For hazardous waste, certified facilities in larger urban centres or specialised disposal sites will be utilised. If no local facilities are available, the Contractor will arrange for the safe transport of hazardous materials to licensed treatment facilities outside the region.

Application of waste standards

To ensure compliance with good international industry practice, the following waste management standards will be adhered to:

- Hazardous waste management: International guidelines, including those from the IFC and Basel Convention, require that hazardous waste such as oils and chemicals be stored in leak-proof containers and disposed of by certified waste handlers to prevent soil and water contamination;

- Construction and demolition waste: Recycling and reuse of construction materials, as promoted by European Union Waste Framework Directive, can significantly reduce the environmental impact of construction and decommissioning waste; and
- Domestic waste: World Health Organisation (WHO) standards for solid waste management recommend that domestic waste be properly segregated, collected, and disposed of to avoid health hazards and environmental impacts.

Mitigation measures

The following mitigation measures will be implemented to minimise waste generation and ensure that all waste streams are handled in a manner that complies with good international industry practice and national laws and regulations:

- Waste segregation and recycling: All waste generated during construction, operation, and decommissioning will be segregated at the source. Recyclable materials, such as metals and timber, will be collected separately and processed for reuse or recycling;
- Hazardous waste handling: Dedicated storage areas with spill containment systems will be used for hazardous materials like oils and solvents. Licensed contractors will collect and dispose of hazardous waste according to local regulations and international standards;
- Domestic waste management: Waste from construction camps and operational facilities will be regularly collected, segregated, and transported to authorised waste disposal sites. Organic waste may be composted where possible to reduce landfill use; and
- Decommissioning waste: During decommissioning, construction and demolition waste will be managed in a similar manner to the construction phase, with an emphasis on recycling materials and proper disposal of non-recyclable waste.

2.9.2 Wastewater generation

Anticipated sources

The generation of wastewater can vary during the construction and operational phases. The types of wastewaters that could be expected during these phases are presented in Table 2-20. Recommendations for the management of wastewater are included in the ESMP.

Table 2-20: Anticipated wastewater sources

Phase	Source of wastewater	Anticipated wastewater Type
Construction	Construction camps	Domestic wastewater from kitchens, sanitation, and laundry
	Equipment and vehicle maintenance	Wastewater with grease, oil, and other contaminants
	Concrete mixing and construction processes	Wastewater with suspended solids and materials
Operation	Substation maintenance	General cleaning and maintenance wastewater
	Cooling systems for electrical equipment	Cooling water discharge

Anticipated wastewater volumes

The following wastewater volumes and characteristics can be expected during construction:

- Construction camps: Wastewater generated at construction camps will include domestic sewage, with typical flows estimated at 80-120 litres per person per day. This wastewater will contain organic material and nutrients that must be treated before discharge;
- Equipment and vehicle maintenance: Wastewater generated from maintenance activities is expected to contain oils, greases, and hydrocarbons, which could pose risks to water quality if not properly managed. Quantities will depend on the scale of maintenance activities, but typical oil-contaminated water could be 1-5 litres per vehicle service;

- Concrete mixing and construction processes: Wastewater from concrete mixing will likely contain high levels of suspended solids such as sand, cement, and gravel. These materials can increase turbidity in water bodies if discharged without treatment. Wastewater volumes depend on construction intensity, but for major projects, 20-30 litres per cubic metre of concrete can be generated; and
- Substation maintenance and cooling systems: During operations, cooling systems used in electrical equipment may generate small volumes of cooling water discharge. These discharges are typically low in volume but may require treatment to reduce temperature and remove any contaminants.

Application of wastewater standards

To ensure compliance with good international industry practice, the following wastewater standards must be adhered to:

- WHO and IFC guidelines suggest that wastewater discharges should be treated to ensure that biological oxygen demand (BOD) and chemical oxygen demand (COD) levels are kept below established thresholds that protect water quality and aquatic life;
- Oil and grease concentrations in wastewater should not exceed 10 mg/L to prevent harmful impacts on watercourses, as recommended by EPA and IFC standards; and
- Total suspended solids (TSS) in wastewater from construction processes should be reduced to below 50 mg/L before discharge to ensure minimal impact on nearby watercourses and waterbodies.

Mitigation measures

The following mitigation measures will be implemented to ensure that wastewater generation and discharge during construction and operation phases adhere to good international industry practice and protect local watercourses and waterbodies from contamination:

- Wastewater treatment systems: Domestic wastewater from construction camps will be treated using septic tanks or portable treatment plants before being discharged or reused. These systems will reduce organic content and nutrients to meet discharge standards;
- Oil-water separators: Maintenance facilities will be equipped with oil-water separators to capture and treat oil-contaminated water before discharge, ensuring compliance with requisite discharge standards;
- Sedimentation ponds: For construction activities such as concrete mixing, sedimentation ponds will be used to settle out solids from wastewater before discharge, ensuring that TSS levels are within acceptable limits; and
- Cooling water management: During the operational phase, cooling water from substations will be monitored and treated to reduce temperature and ensure it meets environmental discharge standards.

2.9.3 Noise

Anticipated sources

Noise emissions can vary during the construction and operational phases. Potential noise sources during construction and operational phases are shown in Table 2-21. Mitigation measures to reduce noise levels are presented in the ESMP (refer to Volume 2).

Table 2-21: Anticipated noise sources

Phase	Source of noise	Noise description
Construction	Heavy machinery and equipment operation	Activities like earthmoving, excavation, and compaction involve the use of heavy machinery generating significant noise.
	Construction vehicles	Frequent movement of construction vehicles, including trucks transporting materials and machinery, contributes to overall noise levels.

Phase	Source of noise	Noise description
	Construction activities	Specific tasks like pile driving, welding, and the erection of towers and substations are inherently noisy.
	Temporary construction camps	Day-to-day operations within construction camps contribute to the overall noise environment and can pose a nuisance to nearby social receptors.
Operation	Substation operations	Hum or buzz from transformers and other substation equipment can be audible, especially in quieter, rural areas.
	Maintenance activities	Occasional noise from maintenance operations, including the use of vehicles and machinery for repairs and inspections.
	Cooling systems	If cooling systems are used in substations, they can generate continuous noise during operation.

Anticipated noise levels

The following noise levels are anticipated:

- Construction Phase: During construction, noise levels from heavy machinery and equipment can range between 85-100 dB(A) near the source. Vehicles transporting materials, especially trucks, typically generate noise levels of 70-90 dB(A). Pile driving and similar activities can produce peak noise levels of over 100 dB(A), which may be disruptive to local communities and wildlife; and
- Operational Phase: In the operational phase, noise emissions from substation transformers and other electrical equipment can range between 40-60 dB(A), depending on the equipment and ambient noise conditions. This is particularly noticeable in quiet, rural areas where the background noise level is lower. Maintenance activities may generate periodic noise similar to the construction phase but at a much lower level.

Application of noise standards

To ensure compliance with good international industry practice, the following noise standards must be adhered to:

- WHO guidelines recommend that community noise should not exceed 55 dB(A) during the day and 40 dB(A) at night to avoid significant disturbance; and
- Occupational Safety and Health Administration (OSHA) recommends that workplace noise levels be kept below 90 dB(A) for an 8-hour workday to prevent hearing damage.

Mitigation measures

The following measures will be implemented to minimise noise impacts, ensuring that disruptions to local communities and wildlife are kept to a minimum throughout construction and operational phases:

- Scheduling and limiting noisy activities: High-noise activities, such as pile driving and welding, must be scheduled during daytime hours to reduce impacts on nearby communities and sensitive wildlife;
- Noise barriers and buffers: Where appropriate, temporary noise barriers or berms can be installed around construction sites and camps, particularly near residential areas;
- Equipment maintenance: Regular maintenance of construction vehicles and machinery will ensure they operate efficiently and generate lower noise levels. Low-noise machinery will be preferred where available;
- Community engagement: Local communities will be informed in advance of any particularly noisy construction activities, allowing them to prepare and raise concerns; and
- Monitoring: Noise levels will be continuously monitored to ensure compliance with international standards, especially in sensitive areas.

2.9.4 Vibration

Anticipated sources

Vibration emissions during the construction and operational phases can vary significantly based on the equipment and activities involved. Table 2-22 outlines the potential sources of vibration during these phases. Vibration management is detailed in the ESMP (refer to Volume 2).

Table 2-22: Anticipated Vibration Sources

Phase	Source of vibration	Vibration description
Construction	Heavy machinery and equipment	Activities like earthmoving, pile driving, and compaction involve the use of heavy machinery, generating significant vibrations
	Construction vehicles	Movement of large trucks and machinery can generate vibrations, especially on unpaved or rough terrain
	Tower and foundation work	Excavation and foundation construction, as well as tower erection, create localised ground vibrations
	Blasting (if required)	In some cases, controlled blasting may be used for excavation in difficult terrain, generating short bursts of intense vibrations
Operation	Substation operations	Transformers and other large electrical equipment can cause low-frequency vibrations, although these are generally minimal
	Maintenance activities	Occasional maintenance, involving heavy vehicles or machinery for repairs, may generate localised vibrations

Anticipated vibration levels during construction

During the construction phase, vibration levels are expected to vary depending on the activity, notably:

- Pile driving and compaction activities can generate peak particle velocities (PPVs) between 10-30 mm/s at distances of 10-15 m from the source;
- Excavation and earthmoving activities typically generate lower levels, with PPVs between 2-10 mm/s at similar distances; and
- Construction vehicles such as heavy trucks on unpaved roads can produce vibration levels of 2-5 mm/s at close distances (5-10 m).

These estimates are based on similar infrastructure projects and the specific machinery used for construction. Vibrations are expected to decrease rapidly with distance from the source, meaning that areas further than 50 m from construction activities will experience minimal vibration impacts.

Application of vibration standards

International standards, such as ISO 4866 and the British Standard BS 5228-2, provide guidance on acceptable vibration levels. These standards recommend:

- PPVs below 5 mm/s at buildings and sensitive structures to avoid cosmetic damage; and
- For human comfort, vibration levels should generally remain below 0.3-1 mm/s to avoid disturbance in residential areas.

Construction activities taking place in sensitive areas (e.g. near to communities or habitats) will be monitored to ensure that recommended vibration levels are not exceeded.

Mitigation measures

Mitigation measures, combined with proactive monitoring, will be implemented to minimise the impact of vibration on surrounding communities, ecosystems and structures. These include:

- Limiting heavy machinery operations: High-vibration activities like pile driving or compaction will be scheduled during times that minimise disruption to local communities and sensitive environments;
- Vibration dampening techniques: Equipment will be fitted with vibration-reducing technology, and alternative construction techniques, such as drilled piles instead of driven piles, will be considered in sensitive areas;
- Buffer zones: Buffer zones will be established near areas of high ecological or social sensitivity to reduce the impact of vibrations on communities and wildlife; and
- Monitoring: Continuous vibration monitoring will be carried out during construction to ensure that vibration levels remain within acceptable limits as prescribed by applicable international standards.

2.9.5 Air emissions

Anticipated sources

Air emissions associated with the Project will vary across different phases of the Project, notably during construction and operation. Understanding and mitigating these emissions is necessary to ensure environmental compliance and minimise impacts on air quality and public health. Table 2-23 provides an overview of the anticipated air emissions during the different phases of the Project. Recommendations for the management of air emissions is included in the ESMP (refer to Volume 2).

Table 2-23: Anticipated air emission sources

Phase	Source of air emissions	Emissions description
Construction	Dust and particulate matter (PM)	Land clearing, excavation, and other soil-disturbing activities generate significant amounts of dust and PM, affecting air quality and respiratory health.
	Exhaust emissions from vehicles and equipment	Operation of construction machinery, vehicles, and generators produces exhaust gases, including carbon monoxide (CO), nitrogen oxides, sulphur dioxide (SO ₂), and volatile organic compounds (VOCs).
	Construction materials	Certain materials used in construction emit VOCs during handling and application, such as paints, solvents, and adhesives.
Operation	Substation equipment	Electrical equipment, such as transformers and switchgear, can emit small quantities of Sulphur Hexafluoride (SF ₆) gas due to leakage. SF ₆ has a high global warming potential, despite being low in volume.
	Maintenance activities	Maintenance operations, including the use of vehicles and portable generators, can produce exhaust emissions similar to those during the construction phase but on a smaller scale.

Anticipated emissions during construction

The following air emission quantities are anticipated during construction:

- Dust and Particulate Matter (PM₁₀ and PM_{2.5}): Dust emissions during construction can reach levels of 10-20 µg/m³ depending on activity intensity. Dust suppression measures, such as water spraying, are essential to limit the spread of particulate matter. According to the WHO, the recommended limits for PM₁₀ and PM_{2.5} are 50 µg/m³ and 25 µg/m³ per day, respectively;
- Exhaust Gases (CO, NO_x, SO₂, VOCs): Construction vehicles and machinery are expected to emit carbon monoxide (CO) levels of 10-30 g/km and NO_x levels of 2-4 g/km depending on fuel type and efficiency. These emissions are regulated by Euro VI standards and Environmental Protection Agency (EPA) guidelines, which set limits on vehicular and equipment emissions; and
- Sulphur Hexafluoride (SF₆): SF₆ emissions from substations are expected to be minimal, but SF₆ has a global warming potential (GWP) of 23 500 times greater than CO₂, making even small leaks environmentally significant. Maintenance of equipment and regular inspections will help minimise leakage.

Mitigation measures

Mitigation measures, combined with ongoing monitoring, will be implemented to ensure air emissions meet applicable international standards, ensuring the protection of air quality and public health. These include:

- Dust control: Watering of construction sites, dust screens, and limiting activities during windy conditions will reduce PM levels. Trucks transporting materials will be covered to minimise dust emissions;
- Emission control on machinery: All construction vehicles and equipment should comply with Euro VI or equivalent emission standards. Regular maintenance will ensure efficiency and reduce fuel consumption and emissions;
- Low-VOC materials: Where possible, low-VOC paints, solvents, and adhesives will be used to minimise emissions during construction; and
- SF₆ leak prevention: Substation equipment will undergo regular inspections and maintenance to detect and prevent SF₆ leakage, and any leaks will be promptly repaired.

2.9.6 GHG emissions

Anticipated sources and emissions

The GHG emissions for the construction phase of the Project were calculated for Scope 1 (direct emissions from mobile fuel combustion) and Scope 2 (indirect emissions from electricity consumption). For Scope 1, emissions were determined by converting the fuel consumption of vehicles and machinery (measured in litres of diesel) into energy (in terajoules), using a calorific value of 43 TJ/Gg and a diesel density of 0.84 kg/litre. Emission factors of 74 100 kg CO₂/TJ, 3.90 kg CH₄/TJ, and 3.90 kg N₂O/TJ were applied to calculate total emissions in tCO₂eq. For Scope 2, electricity consumption (in kWh) was multiplied by an emission factor of 0.44 kg CO₂/kWh. The total Scope 1 emissions amounted to 20 045.03 tCO₂eq. No Scope 2 emissions are anticipated during the construction phase as all electricity required for construction will be directly supplied by on-site generators and will thus be considered Scope 1. A summary is presented in Table 2-24.

Operational GHG emissions for the Project are currently unknown, primarily because operational emissions data from the powerline operator (RNT) was not available at the time of drafting the ESIA. However, operational GHG emissions are expected to be negligible based on the nature of powerline operations, which typically involve minimal fuel consumption and electricity usage once construction is complete. The Gove Hydroelectric Dam will supply the electricity required for operation and as this is supplied directly from the hydropower facility, the Scope 2 emissions associated with operation are predicted to be 0 tCO₂eq. While routine maintenance and monitoring activities may contribute some emissions, including fugitive emissions from equipment such as SF₆-insulated switchgear, these emissions are anticipated to be significantly lower than those generated during the construction phase. A comprehensive assessment of operational GHG emissions must be conducted as the Project setup progresses and before construction operations, to ensure compliance with relevant standards such as Equator Principle 4 (EP4) and IFC Performance Standards (PS3). The assessment will also serve to provide a clearer picture of the Project's overall GHG emissions profile. The assessment must consider various factors, such as activity data and emission factors, to accurately estimate operational emissions.

Table 2-24: Summary of Scope 1 and Scope 2 GHG Emissions over the construction period

Category	Subcategory	Fuel/Electricity Consumption (Litres or kWh)	Total Emission (tCO ₂ eq)
Direct / Mobile Combustion	Management/Work Control (Toyota Land Cruiser)	277 200 litres	750.67

Category	Subcategory	Fuel/Electricity Consumption (Litres or kWh)	Total Emission (tCO ₂ eq)
Direct / Mobile Combustion	Management/Work Control (Toyota Land Cruiser Prado)	316 800 litres	857.91
Direct / Mobile Combustion	Management/Work Control (Toyota Fortuna)	209 000 litres	565.98
Direct / Mobile Combustion	Management/Work Control (Hilux)	418 000 litres	1 131.97
Direct / Mobile Combustion	Management/Work Control (Toyota Rav4)	167 200 litres	452.79
Direct / Mobile Combustion	Topography & Civil Construction (Toyota Hilux)	924 000 litres	2 502.25
Direct / Mobile Combustion	Topography & Civil Construction (Excavator Tracks 45 TON)	140 800 litres	381.29
Direct / Mobile Combustion	Topography & Civil Construction (Dump Trucks 26 TON)	70 400 litres	190.65
Direct / Mobile Combustion	Topography & Civil Construction (Bulldozers 60 TON)	52 800 litres	142.99
Direct / Mobile Combustion	Topography & Civil Construction (Minibus 15 to 19 Seats)	462 000 litres	1251.12
Direct / Mobile Combustion	Topography & Civil Construction (Concrete Mixers 9m ³)	42 240 litres	114.39
Direct / Mobile Combustion	Topography & Civil Construction (Generators / Fuel Tankers)	242 880 litres	657.73
Direct / Mobile Combustion	Assembly of Towers/Poles (Semi-Trailer Truck)	1 320 000 litres	3 574.64
Direct / Mobile Combustion	Assembly of Towers/Poles (Crane Truck 20 TON)	110 880 litres	300.27
Direct / Mobile Combustion	Assembly of Towers/Poles (Telescopic Crane 90 TON)	31 680 litres	85.79
Direct / Mobile Combustion	Assembly of Towers/Poles (Aerial Platform 20 Meters)	58 080 litres	157.28
Direct / Mobile Combustion	Assembly of Towers/Poles (Toyota Hilux)	484 000 litres	1 310.70
Direct / Mobile Combustion	Assembly of Towers/Poles (Minibus 15 to 19 Seats)	1 353 000 litres	3 664.01
Direct / Mobile Combustion	Conductor Stringing (Toyota Hilux)	660 000 litres	1 787.32
Direct / Mobile Combustion	Conductor Stringing (Minibus 15 to 19 Seats)	330 000	893.66
Direct / Mobile Combustion	Other (Water Pump 2")	8 360 litres	22.64
Direct / Mobile Combustion	Other (100 KVA generator / Main)	32 400 litres	87.74
Direct / Mobile Combustion	Other (40 KVA generator / Main)	43 200 litres	116.99
Total Scope 1 GHG Emissions			20 659.03
Total Scope 2 GHG Emissions (no indirect electricity source during the construction phase)			0

Mitigation measures

Mitigation measures for GHG emissions should focus on reducing both direct (Scope 1) and indirect (Scope 2) emissions, while adhering to applicable standards. For Scope 1 emissions, related to fuel consumption, the Project must implement measures such as optimising vehicle and equipment efficiency, using cleaner fuels where possible, and minimising unnecessary idling. Regular maintenance of machinery, as outlined in ISO 50001 (Energy Management), will ensure engines operate efficiently, reducing fuel use and emissions. For Scope 2 emissions, related to electricity consumption, the Project must adopt energy efficiency measures where feasible, including using energy-saving equipment and exploring renewable energy sources for on-site electricity generation, in compliance with ISO 14064 standards for GHG accounting and reporting. Integrating real-time monitoring systems where feasible will help track and control energy consumption in line with Greenhouse Gas Protocol requirements, allowing for timely interventions to reduce emissions. These strategies aim to minimise the GHG footprint and meet regulatory obligations while aligning with good international industry practice for sustainability.

As operational GHG emissions are not known, the Project must also include a comprehensive approach to assessing GHG emissions for the operational phase. Although the operational emissions are expected to be minimal, it is essential to calculate these emissions to comply with the requirements of EP4 and IFC PS3. This assessment will not only justify the assumption of negligible emissions but also provide a baseline for monitoring and managing any potential GHG impacts that may arise during operations.

Key considerations for the approach to these calculations should encompass several methodological aspects. First, accurate emission factors must be identified for the different sources of GHG emissions expected during the operational phase, including routine maintenance activities and potential fugitive emissions from equipment such as SF6-insulated switchgear. Utilising reliable references, such as the Intergovernmental Panel on Climate Change (IPCC) guidelines and national emissions inventories, will enhance the accuracy of the calculations. Additionally, gathering robust activity data will be critical; this includes understanding the frequency of maintenance tasks, the amount of electricity consumed, and the specifics of any hazardous materials used or transported.

Moreover, the assessment should consider temporal and spatial factors that may influence emissions, such as seasonal variations in operational activities and the geographical context of the powerline infrastructure. It is also important to incorporate an uncertainty analysis into the GHG emissions calculations, which will help identify the reliability of the data and highlight areas where further data collection or analysis may be necessary. Finally, ensuring alignment with local regulations and international standards, is vital for the integrity of the emissions assessment.

2.10 Land requirement for the Project

The anticipated maximum land take for the Project is around 2 237.5 ha during the construction phase, and a maximum of around 276.5 ha during the operation phase (Table 2-25). It is important to note that not all construction areas 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 2-25: Anticipated land requirement for the Project

Component	Features	Land required
Temporary		
OHL HV Right of Way (including footprint corridor, temporary laydown and assembly areas, and construction camps)	170 km of OHL X 100 m wide corridor.	1 700 ha

Component	Features	Land required
MV/LV Line Right of Way (including footprint corridor, temporary laydown and assembly areas, and construction camps)	17.5 km of MV/LV Line X 36 m wide corridor.	63 ha
Access roads	The Project will mainly follow existing roads. Existing access roads will be used outside the OHL 100 m corridor and will be upgraded/maintained. New access roads will fall within the OHL 100 m corridor. Access roads will require an 8 m Right of Way (i.e., 4 m for the access roads and a 2 m buffer on either side for the disturbance zone). 585 km X 8 m wide corridor	468-
Jamba substation	1.5 ha + construction camp (0.5 ha)	2 ha
Chipindo substation	1.5 ha + construction camp (0.5 ha)	2 ha
Cuvango substation	1.5 ha + construction camp (0.5 ha)	2 ha
Gove construction camp	Construction camp area	0.5 ha
Permanent		
Permanent towers (HV OHL)	509 towers (80 m X 50 m per tower)	204 ha
Permanent poles (MV/LV Line)	Negligible	Negligible
Maintenance road for HV OHL	170 km of OHL X 4 m wide	68 ha
Jamba substation	Substation area	1.5 ha
Chipindo substation	Substation area	1.5 ha
Cuvango substation	Substation area	1.5 ha

Although the OHL route alignment and substation locations was informed by high-level desktop and site screening to avoid sensitive environmental and social features, physical and economic resettlement is not completely avoidable. A spatial analysis was undertaken to provide a preliminary quantification of the houses / structures, as well as agricultural fields that may be affected by the proposed Project (refer to the Land Acquisition and Resettlement Framework (LARF), Volume 3, Appendix O). In total, based on the conservative buffers applied in Table 2-25, there could be 699 hectares of farmland and 1 518 houses or structures affected. The land requirements and associated compensation will be addressed in accordance with the LARF.

2.11 Demining process for the Project

2.11.1 Institutional background

Angola has a long history of landmine contamination due to its civil war, which lasted from 1975 to 2002. Although significant efforts have been made to clear landmines, they remain a threat in various regions, particularly in rural areas where infrastructure projects such as powerline construction take place.

The institutional framework for demining in Angola includes:

- National Intersectoral Commission for Demining and Humanitarian Assistance (CNIDAH): Oversees mine action and coordinates efforts between different governmental agencies and international partners;
- National Demining Institute (INAD): Executes demining operations and implements Angola's national mine action strategy; and
- NGOs and International Agencies: Various non-governmental organizations (e.g., HALO Trust, MAG) work in Angola to conduct demining and ensure safe access to contaminated areas.

The Project will be supported by these institutions to ensure that demining is done effectively and proactively in compliance with national regulations.

2.11.2 Demining criteria and reconnaissance

Before construction can begin, a thorough demining survey will be conducted to assess the level of contamination and identify hazardous areas. This is done through a Non-Technical Survey (NTS) and Technical Survey (TS):

- Non-Technical Survey (NTS): Collects information from local communities, historical data, and satellite imagery to understand the extent of mine contamination. This phase does not involve physical clearance but identifies areas of suspicion; and
- Technical Survey (TS): Based on the NTS, this phase involves ground-truthing the data, with demining teams conducting physical checks using manual, mechanical, or canine methods to confirm or refute the presence of mines.

Once areas are deemed contaminated, clearance priorities will be set based on the location of the OHL and the risk to construction teams and local communities. Clearance teams work systematically to remove mines and unexploded ordnance (UXO) along the powerline route. Clearance certificates must be issued confirming that Project personnel can begin work in specified cleared areas.

2.11.3 Land access

Access to land for the OHL construction, especially in areas with mine contamination, will require careful coordination between multiple stakeholders. The key steps include:

- Consultation with local authorities: Engagement with local governments and traditional leaders is essential to gain access to the land;
- Land rights and permissions: Landowners and local communities must be consulted to secure the rights of way for the OHL route. This includes negotiating easements or land acquisitions where necessary; and
- Surveying and mapping: Once access is granted, a detailed survey and mapping of the land will be conducted to define the construction corridor, taking into account cleared areas and safety buffers.

2.11.4 Compensation for potential damage to crops and structures

As part of the demining and subsequent OHL construction activities, there may be damage to crops, structures, or other assets located in the path of the OHL. To address such damage, the Project has developed a Land Acquisition and Resettlement Framework (LARF) that ensures fair compensation and the mitigation of impacts on affected communities. In Angola, compensation is handled under the following principles, in alignment with the LARF:

- Engagement with affected parties: Before demining or construction begins, affected communities and landowners are identified and consulted. Compensation agreements are negotiated in accordance with the LARF, ensuring that the concerns and needs of the affected parties are considered, particularly regarding the potential impact on their livelihoods;
- Assessment of losses: Detailed assessments are conducted to determine the value of lost crops, damaged structures, or other assets. This process is in line with the LARF and Resettlement Action Plan (RAP), where the valuation of losses follows established guidelines to guarantee fair compensation; and
- Payment of compensation: Compensation is paid to the affected individuals before demining and subsequent construction activities commence. The LARF ensures that compensation is not only timely but also equitable, safeguarding the financial well-being of the local communities and ensuring they are not disadvantaged by the Project.

By implementing the LARF, the Project commits to addressing any damage resulting from demining activities in a transparent and fair manner, aligned with both local regulations and good international industry practice for land acquisition and resettlement.

2.11.5 Occupational and community health and safety

Health and safety are critical aspects of any demining and subsequent construction activities. Ensuring that the workers involved in the demining operation and the local communities are protected is a priority. The following aspects are important for a safe demining process and must be incorporated during demining activities:

- **Demining safety protocols:** Deminers are highly trained and follow strict international safety standards, such as those outlined by the International Mine Action Standards (IMAS). They use personal protective equipment (PPE), and manual, mechanical, or canine teams are deployed according to the specific terrain and contamination level;
- **Construction safety:** Once the area is cleared, the construction teams must also follow strict safety guidelines. Workers are trained in handling heavy machinery, working at heights (for powerline installation), and avoiding any remaining hazards;
- **Community Awareness and Safety:** Demining organisations often engage in Mine Risk Education (MRE) to inform local communities about the risks of mines and UXO, helping prevent accidents during and after construction. Public safety messages and workshops are commonly organised to ensure that communities are aware of cleared and uncleared areas; and
- **Emergency Response Plans:** Both demining teams and construction crews should have emergency response plans in place in case of accidents, with medical teams and evacuation routes clearly defined.

3 Legal and institutional frameworks

This section presents the governance framework for environmental management as well as related sectors, including environmental, energy transmission and government structures.

3.1 Institutional framework

Angola is obliged to adopt appropriate regulatory measures for the responsible access and use of natural resources, as part of its policies on conservation, rational use of resources, and environmental management. Additionally, to ensure the proper use of Angolan land, there is a need for regulatory measures in land use and spatial planning policies. The following is a summary of the relevant legislative frameworks applicable to this Project.

3.1.1 Ministry of Environment

The Ministério do Ambiente (Ministry of the Environment) - (MINAMB) is the Ministerial Department responsible for formulating, conducting, supervising, evaluating and executing the Executive's policy in the field of protection, preservation and conservation of environmental quality, pollution control, conservation areas and valorisation of the natural heritage, as well as the preservation and rational use of mineral resources. These responsibilities, along with the implementation of strategies, programmes, and Projects to promote sustainable development, and manage the environment, are outlined in its organic structure, which is published in Presidential Decree No. 278/22, issued on 7 December.

MINAMB comprises a number of agencies and services, in particular the National Directorate of Environmental Technologies, which is the department responsible for designing and implementing environmental technologies.

As the primary authority responsible for the implementation of the Environment Framework Law, No. 5/98, the Presidential Decree No. 117/20 approving General Regulation on Environmental Impact Assessment and Environmental Licensing Procedures, and all associated Regulations, the Ministry is also responsible for the review and regulation of Environmental Impact Assessment (EIA). Depending on the type of Project to be developed, the EIA report should also be initially reviewed by the appropriate line ministry which should issue its technical comments/opinion (*parecer*). This ensures that the EIA not only addresses the requirements of the Environment Framework Law and the Decree on Environmental Impact Assessment, but also relevant sectoral legislation and guidelines (e.g., policies and plans), and applicable Terms of Reference.

3.1.2 National Directorate of Environmental Technologies

The Direcção Nacional de Tecnologias Ambientais (National Directorate of Environmental Technologies) – (DNTA) is responsible for the design and implementation of strategic policies for the prevention of environmental impacts of technologies, which establishes its legal framework, regulating its competencies, organisation and operation.

Responsibility for EIAs falls under the DNTA, which, among other things, is responsible for reviewing and commenting on EIA processes, including Project registration and Terms of Reference. All reports reviewed by DNTA are forwarded to the MINAMB with recommendations on whether an environmental licence should be granted or not. If considered necessary, the MINAMB invites different institutions and stakeholders to give comments and make suggestions on the final report. There is a growing decentralisation of decision-making to Provincial Government and Municipal Administration levels, particularly with regards to Project categorisation, especially category C and D activities.

It is therefore up to the MINAMB to be the agent responsible for the evaluation of EIAs of Projects likely to cause potential environmental and social impacts, defined under category A and B activities. The granting of an Environmental License for a proposed Project is based on the findings and recommendations of the EIA for that Project.

3.1.3 Ministry of Energy and Water

The MINEA was restructured by Presidential Decree No. 223/20 on August 28, 2020. It is the government department charged with developing and managing policies related to energy and water. MINEA oversees various central executive bodies such as the National Directorate of Electric Energy, the National Directorate of Renewable Energy and Rural Electrification, and the National Directorate General of Water.

The State National Directorate General of Electric Energy directly manages the planning, research, design, and policy implementation for the production, transport, distribution, and consumption of electric energy. The major state enterprises in the electric power sector include RNT, and the Empresa Nacional de Distribuição de Eletricidade (National Electricity Distribution Corporation Company) - (ENDE) and Companhia Nacional de Produção de Energia Elétrica (National Electricity Production Company) - (PRODEL).

3.1.4 Ministry of Agriculture and Forests

The Ministério da Agricultura e Florestas (Ministry of Agriculture and Forests) – (MINAGRIF) is a key governmental body in Angola, responsible for developing and implementing policies on agriculture, livestock, and forest management. MINAGRIF promotes sustainable agricultural practices to ensure food security and rural development while protecting natural resources. The ministry oversees crop cultivation, animal husbandry, and forest management, and supports farmers through training, research, and financial access. By fostering innovation in the sector, MINAGRIF aims to boost productivity, increase exports, and reduce rural poverty, contributing to Angola's economic growth.

MINAGRIF plays a key role in ESIA processes, particularly for agricultural and forestry projects. It ensures compliance with environmental regulations and sustainability standards, assesses project impacts on land and forests, and provides guidance to mitigate negative effects.

3.1.5 National Electricity Transmission Network and Transformation Corporation

RNT was created by the Presidential Decree No.305/14 on November 20. The organisation is dedicated exclusively to system management, market operation (single buyer) and management of the transmission network. The main purpose of the RNT is to transport electricity through the operation of the RNT, which includes the Very High Voltage (VHV) network, the interconnection network, the national dispatch facilities and the related assets and rights. RNT is also market operator (single buyer) under the terms of the Concession, the General Electricity Law and its Regulations.

3.1.6 Ministry of Public Works and Spatial Planning and Housing

The Ministério das Obras Públicas, Urbanismo e Habitação (Ministry of Public Works, Urban Planning and Housing) - (MINOPUH) was formed by merging the previous Ministries of Construction and Public Works and Land Planning and Housing. This consolidation brought together their respective responsibilities under a single entity, as specified in Presidential Decree no. 281/22, issued on 7 December that approved its organic structure. MINOPUH is responsible for proposing the formulation of policies, executing and controlling Government programs and projects in the fields of civil construction, land use planning, urban planning, housing, land management and cadastre, defining its attributions and regulating its organization in general and in particular, operation and personnel, and revoked Presidential Decree No. 158/20, of 4 June, which approved the Organic Statute of the

Ministério das Obras Públicas e Ordenamento do Território (Ministry of Public Works and Spatial Planning - MINIPOT).

3.1.7 Ministry of Territorial Administration and State Reform

The Ministério da Administração Territorial e Reforma do Estado (Ministry of Territorial Administration and State Reform) - (MAT) was established through Presidential Decree No. 156/20 on 3 June. MAT functions as the Auxiliary Ministerial Department of the President of the Republic. Its primary mission is to propose, formulate, coordinate, execute and evaluate the Executive's policies concerning Local Administration of the State and Municipal Administration. Furthermore, it oversees the implementation of reforms in the local administration of the state and other local government institutions, while also providing support during general and local elections.

MAT's responsibilities in territorial organisation and local and municipal administration also have points of intersection with the Project. This includes involvement in territorial organization instruments and authorization and licensing processes assigned to local and municipal administrations. By fulfilling its role, MAT plays a crucial part in shaping and monitoring the policies related to local governance and state administration.

MAT contributes to the efficient functioning of local authorities, ensuring effective public service delivery and supporting democratic processes during elections. The integration of these responsibilities under one ministry enhances coordination and governance efficiency, resulting in a more streamlined approach to territorial organisation and local administration in Angola.

3.1.8 Provincial government

The provincial government functions as a devolved organ of the central administration, tasked with executing sector-specific policies outlined in provincial plans and programs. Its primary role is to promote and guide socio-economic development, adhering to principles and strategic options defined by the Executive Power and the National Plan. Additionally, provincial government institutions ensure the delivery of public services within its geographic area.

The Provincial Government's responsibilities encompass planning and budgeting, urban development, spatial planning, local economic development, social and cultural development, public security and police, environment, and institutional coordination.

Municipal administrations are responsible for promoting and guiding economic and social development and providing public services within their jurisdictional areas. They also share several responsibilities in the aforementioned areas, aligning with the scope of action of provincial governments.

By having distinct yet complementary roles, both the provincial government and municipal administrations contribute to the effective implementation of policies and programs that drive socio-economic progress and enhance the well-being of communities at the provincial and local levels. This coherent division of responsibilities ensures that each level of government operates efficiently and collaboratively to foster development and public service delivery across Angola.

3.1.9 Local government

Angola is divided into 18 provinces, 164 municipalities, and 532 communes, which are made up of neighbourhoods (barrios) and populations communities (povoações). The communes represent a sub-division of municipalities consisting of administrative bodies that have been decentralized from the central government in their respective areas. All sub-national governments are appointed by the central government.

Law No. 15/16 September 12 approved the State Local Administration Law, which establishes the principles and rules for the organization and functioning of the State Local Administration bodies to

which it is applicable at the provincial, municipal and infra-municipal levels, regulating administrative control, relations with central administration bodies, coordination between the two, administrative guarantees, the staff regime and framework, the remuneration, financial and asset regime.

Provinces are headed by a Provincial Governor, who is the deconcentrated body of the Central State Administration at the level of each province, with the task of ensuring that the functions of the State are carried out in the province, based on instruments and actions to guide and promote the harmonious and sustained development of the respective territory, society and the economy, and is responsible for ensuring the management and public services necessary for the well-being and security of citizens.

The Provincial Governor is the representative of the central administration in the respective province, who is responsible, in general, for leading the governance of the province and ensuring the normal functioning of the State's Local Administration.

3.2 Legal framework

The Constitution of Angola emphasises the right to a clean and healthy environment and the duty to preserve it for future generations. This is outlined in Article 39, which was instrumental in shaping the Environmental Framework Law (Law No. 5/98). Additionally, Article 90 (e) ensures that the benefits of development reach all citizens, improving their living standards, while Article 15 allows for community land use and fair acquisition processes. The Environmental Framework Law, created to address social and environmental impacts from development Projects like infrastructure and natural resource utilisation, mandates the adoption of international standards and best practices where domestic laws are lacking or incomplete.

This section provides a high-level overview of constitutional rights, key legislation and policies related to environment, social and energy sectors. The key conventions and agreements applicable to Angola are briefly described. Relevant programs are also presented. Key legislation relevant to the Project are presented in Table 3-1.

Table 3-1: Key legislation relevant to the Project

No	Title of laws and regulations	Law number	Description
Environmental			
1	Environmental Framework Law	Law No. 5/98 of June 19th	It establishes general obligations regarding the protection of the environment and the sustainable use of natural resources, as well as their contribution to the quality of life.
2	Regulation Responsibility for Environmental Damage	Presidential Decree No. 194/11 of July 7th	Based on the principle of "polluter pays," it defines responsibilities regarding environmental risks and degradation in order to prevent and remedy environmental damage.
3	Regulation on Public Consultation	Executive Decree No. 87/12 of February 24th	Public consultation is positioned as a procedure within the framework of public participation to collect opinions and suggestions from stakeholders in the environmental impact assessment of the Project.
4	Term of Reference for the Elaboration of Environmental Impact Studies	Executive Decree No. 92/12 of March 1st	Guidelines for the preparation of studies subject to environmental impact assessment, including the layout of the minimum content to be included in the environmental and social impact assessment report
5	Regulation of Waste Management	Presidential Decree No. 190/12 of August 24th	All public and private entities that generate waste or engage in activities related to waste management must prepare a WMP before commencing their activities.

No	Title of laws and regulations	Law number	Description
8	Executive Decree Regarding Construction and Demolition Waste Management	Executive Decree No. 17/13 of January 22nd	Establish legal regulations related to the prevention, reuse, collection, transportation, storage, sorting, treatment, recovery, and management of disposal of waste resulting from the construction or demolition of buildings.
7	Forest and Wildlife Law	Law No. 6/17 of January 24th	Indicates norms aimed at guaranteeing the conservation and sustainable use of the country's forests and fauna.
8	Red List of Species of Angola	Executive Decree No. 252/18 of July 13th	This decree approves the Angolan Red List of Species, which is made up of Category A - Extinct Species (Ex), Category B - Endangered Species (AEx), Category C - Vulnerable Species (Vul) and Category D - Invasive Species.
9	Forest Regulation	Presidential Decree No. 171/18 of July 23rd	It establishes regulations for the sustainable use of forestry resources and their ecosystems and establishes norms and procedures for their conservation and sustainable use.
10	National Biodiversity Strategy and Action Plan	Presidential Decree No. 26/20 of February 6th	It aims to ensure the conservation and sustainable use of the components of biodiversity in Angola, taking into account the fair and equitable distribution of the benefits derived from the use of the resources of conservation, preservation, protection and restoration.
11	Environmental Impact Assessment Regulation and Environmental Licensing Procedure	Presidential Decree No. 117/20 of April 22nd	Approval of the General Regulations on Environmental Impact Assessment and Environmental Permitting Procedures. Establishes rules and procedures regulating impact assessment, environmental permitting, and inspection, applicable to all public or private activities that, because of their nature, location, or scale, have the potential to cause significant environmental and social impacts and directly or indirectly affect environmental factors. With its passage, Decree No. 51/04 of July 23rd and Decree No. 59/07 of July 13th were repealed.
12	Environmental License Fees	Presidential Decree No. 83/22, of April 12th	Approves the Table with the Fees to be charged for the Issue and Renewal of Environmental Licenses
13	Environmental Conservation Areas Law	Enacted by Law No. 8/20 on April 16th, 2020, and amended by Law No. 12/21 on May 5th	Establishes the legal framework for the creation, management, and protection of conservation areas in Angola. This law aims to preserve biodiversity, ecosystems, and natural resources by regulating human activities within designated conservation zones. It defines the types of conservation areas, such as national parks and reserves, and sets out the responsibilities of authorities in managing these areas. The amendment introduced by Law no. 12/21 strengthens the legal provisions, ensuring more effective conservation measures and promoting sustainable development while safeguarding Angola's environmental heritage.
Labour and safety			
14	General Regulation of Occupational Health and Safety Services	Executive Decree No. 6/96 of February 2nd	It establishes principles aimed at promoting workplace safety, health and hygiene in businesses, commercial and industrial establishments and cooperatives.

No	Title of laws and regulations	Law number	Description
15	General Regulation of Safety and Health at Work Signalling	Executive Decree No. 128/04 of November 23rd	It establishes minimum requirements for the installation and use of occupational health and safety signs in the workplace and applies to public enterprises, joint ventures, cooperatives, and private enterprises.
16	Legal System for Work- Related Accidents and Occupational Diseases	Decree No. 53/05 of August 15th	Provides a legal regime for occupational injuries and occupational illnesses, taking into account events that occur in the course of employment in enterprises and government agencies and that cause injury or physical harm to employees, resulting in partial or total, temporary or permanent inability to work or death.
17	General Labour Law	Law No. 12/23 of December 27th	It stipulates that employers are responsible for ensuring the quality of the work environment, including the adoption of appropriate and preventative measures for safety, hygiene and health at the workplace.
Energy sector			
18	Regulation on Substation Safety	Decree No. 42895, dated March 31st of 1960	For the protection of personnel and common interests in substations and transformer stations, it prescribes the technical conditions that must be met during the operation and work of the substation.
19	Regulation of the Protection of High Voltage Transmission	Decree No. 46.847 dated 1966	The following restrictions are specified for the safety of high-voltage transmission lines: i) Houses and structures are allowed as long as the distance from the transmission line axis to the top of the structure is at least 4-5 meters ii) Crops and trees are allowed as long as the distance to the transmission line axis is at least 4 meters iii) A 50 m wide protective corridor is established.
20	General Electricity Law	Law No. 14-A/96 of May 31st (changed and republished by Law No. 27/15 May 31st)	It establishes the general principles of the legal regime for the activities of production, transmission, distribution and use of electrical energy.
21	Regulation of Licensing of Installations of Production, Transport and Distribution of Energy	Decree No. 41/04 of July 2nd	The principles and rules that must be observed when authorizing the design, construction and operation of facilities for the generation, transmission and distribution of electricity for public consumption, as well as the legal and administrative provisions governing the installation and operation of the facilities.
22	Regulation of Electricity Generation, Transmission, Distribution and Supply Activities	Presidential Decree No.76/21	This Regulation establishes the legal regime applicable to the exercise of the activities of production, transmission, distribution and commercialization of electric energy, in development of the principles contained in Law No. 14-A/96, of May 31, as amended by Law No. 27/15, of December 14, which establishes the general principles of the legal regime for the exercise of the activities of production, transmission, distribution, commercialization and use of electric energy.
Water sector			
23	The Water Law	Law No. 6/02 of June 21st	It establishes the general principles of the legal system for the use of water resources.

No	Title of laws and regulations	Law number	Description
24	Regulation of Water Quality	Presidential Decree No. 261/11, of October 6th	It establishes water quality standards and criteria aimed at protecting the aquatic environment and improving the quality of water for its primary uses. It applies to inland water, including surface water and groundwater, and to water for aquaculture, livestock, agricultural irrigation, and seaside resorts.
25	Regulations on the General Use of Water Resources	Presidential Decree No. 82/14 of April 21st	establishes a regime for the planning, management and general use of water resources, including mechanisms for economic and financial sanctions. It establishes rates, tariffs, methods of payment and collection thereof, and a regime of occupation, expropriation, and easements, as well as a system of inspection and sanctions applicable to surface water and groundwater (rivers, waterways, etc.). Article 110 requires proponents to consider a buffer zone of 200m from the following areas: "water resource protection areas, beds, banks and adjacent areas of watercourses up to a distance of 200 meters".
26	Regulation of Public Water Supply and Sanitation of Wastewater	Presidential Decree No. 83/14 of April 22nd	It establishes rules governing activities related to public water supply and wastewater sanitation.
Social			
27	Spatial Planning and Urbanism Law	Law No. 3/04 of June 25th	As biophysical spaces, for all urban and rural soils and subsoils, continental shelves, and inland water bodies, the objective is to ensure actions leading to the occupation and use of these spaces through the implementation of spatial and urban planning measures.
28	The Land Law	Law No. 9/04 of November 9th	Establish a foundation for a general legal system for land that includes the assets originally held by the state, the rights imposed on land, and a general scheme for transfer, construction, exercise, and abolition.
29	Cultural Heritage Law	Law No. 14/05 of October 7th	It defines cultural heritage as all tangible and intangible property that, by virtue of its perceived value, should be subject to the authority and protection of the law, and indicates a series of acts that may be considered an infringement on cultural heritage.
30	General Regulation for Land Concession	Decree No. 58/07 of July 13th	It establishes the legal framework for the right to use available land within Angola, does not apply to private land, and indicates the obligation to always provide fair and adequate compensation to the owner and other affected right holders in the event of expropriation of land for public or temporary use.
31	Regulation on Resettlement	Presidential Decree No. 117/16 of May 30th	It establishes a system of resettlement and physical relocation in specific situations such as natural disasters, reconstruction, urban redevelopment, public works Projects, and fires, with the aim of improving social conditions for the people.

No	Title of laws and regulations	Law number	Description
32	Public Expropriation Law	Law No. 1/21 of January 7th	It establishes the principles and rules to be followed by competent bodies of government agencies when they carry out expropriations for public Projects. Within the scope of the expropriation process, several general principles must be monitored, including legality, reasonableness, proportionality, equity, public interest, fair and prompt compensation, respect for private property, and the right of the community to have and oppose land rights. It is important to note that, in addition to the national government, local governments may be allowed to expropriate, and expropriations for public and private legal entities of this nature may also be allowed, provided that the reasons for public interest are adequately explained.
General			
33	Law of Public Integrity	Law No. 3/10 of March 29 th 2010	The Law of Public is a key legal framework in Angola designed to promote transparency, accountability, and ethical conduct within public administration. This law establishes the duties and responsibilities of public officials, mandating them to act with integrity, avoid conflicts of interest, and prevent the misuse of public resources. It also outlines penalties for corruption and other forms of misconduct, aiming to strengthen public trust in government institutions by ensuring that public servants adhere to high ethical standards.
34	General Regime of Administrative Offences	Law No. 19/22 of July 7 th 2022	Provides a comprehensive framework for regulating administrative violations in Angola. This law defines the procedures and penalties for offences committed within the public administration, aiming to enhance legal compliance and accountability. It categorises administrative offences, specifies applicable fines, and outlines the rights of individuals and entities subject to administrative proceedings. The law ensures a fair and transparent process, promoting the rule of law in administrative matters and reinforcing the integrity of public administration by deterring misconduct.

3.2.1 The Constitution of Angola

The Constitution of Angola (Republic of Angola, 2010) is the supreme law of the country, adopted in 2010. It outlines the fundamental principles, rights, and duties of the citizens and sets the framework for the organization of the government and the rule of law in Angola. The Constitution provides the basis for the Basic Law on the Environment through Article 39. This Article 39 (Environmental Rights) states that:

- 1) Everyone has the right to live in a healthy and unpolluted environment and the duty to defend and preserve it;
- 2) The State shall adopt measures to protect the environment and the species of flora and fauna throughout the national territory, maintain the ecological balance, ensure the correct location of economic activities and the rational development and use of all natural resources, within the context of sustainable development, respect for the rights of future generations and the preservation of species; and
- 3) Acts which endanger or damage the conservation of the environment shall be punishable by law.

Title IV - Fundamental Rights, Duties, and Guarantees of the constitution expands on the rights and duties of citizens, including their responsibilities to the environment, health, and the state.

3.2.2 Environmental legislation

The main component of Angolan legislation is the requirement to carry out a comprehensive EIA (alternatively referred to as an ESIA in this report) for the Project. Five items of legislation, which regulate the way in which ESIA's are undertaken, which includes the following environmental licensing requirements:

- The Environmental Framework Law No. 5/98 (19/06/1998);
- Presidential Decree No. 117/20 on the General Regulation of Environmental Impact Assessment and Environmental Licensing Procedure (Repealed Decree No. 51/04 on Environmental Impact Assessment, 23 July and Decree No. 59/07 on Environmental Licensing, 13 July), (22/04/2020);
- Presidential Decree No. 83/22, approves the Table of Fees to be Charged for the Issuance and Renewal of Environmental Licences for the Assessment of Environmental Impacts (12/04/2022);
- Executive Decree No. 87/12 on Public Consultation for Projects Subject to Environmental Impact Assessment (24/2/2012);
- Executive Decree No. 92/12 in the Terms of Reference for Environmental Impact St (1/3/2012); and
- Presidential Decree No.194/11 on Environmental Damage Regulations (07/07/2012).

These are all briefly discussed below along with other relevant legislation.

Environment Framework Law

The 1998 Environment Framework Law (Lei de Bases do Ambiente) No. 5/98 of 19 June serves as the foundation for all environmental legislation and regulations in Angola, building on Article 39 of the Angolan Constitutional Law (Government of Angola, 1998). This law establishes essential definitions, including the protection, preservation, and conservation of the environment, as well as the promotion of the quality of life and responsible use of natural resources. In line with international sustainable development declarations and agendas, such as Agenda 21, the law also outlines citizens' rights and responsibilities.

Article 14 of the law empowers the establishment of environmental protection areas, along with rules governing these regions, including the identification of permitted and prohibited activities within and around these protected zones.

Addressing the impact of human activities on the environment and society, Article 16 mandates the necessity of Environmental Impact Assessments (EIAs) for all Projects that may affect the environmental and societal equilibrium. The government is to develop specific legislation on EIAs, as stated in Clause 2 of this Article. Furthermore, Article 17 focuses on environmental licensing, while Article 18 deals with environmental auditing, both of which follow the guidelines provided by the World Bank.

Decree on General Regulation on Environmental Impact Assessment and Environmental Licensing Procedures

Presidential Decree No. 117/2020 of 22 April on General Regulation on Environmental Impact Assessment and Environmental Licensing Procedures establishes the rules and procedures regulating EIAs of public and private Projects and the environmental licensing procedures for activities that, by their nature, location or dimension, are likely to cause significant environmental and social impacts. This Decree revokes Decree No. 51/04 of 23 July on Environmental Impact Assessment and Decree No. 59/07 of 13 July on Environmental Licensing. It outlines:

- The mandatory project registration procedure using the Sistema Integrado do Ambiente (Integrated Environment System) – (SIA) - an online platform created by the Ministry of Environment (Article 6);
- The categorisation of projects to be licensed (Article 7) and which are listed in annexes I, II, III, IV and V of the Decree;
- Decentralisation from MIMAMB to local administrations and provincial governments of competences, such as project evaluation, the issue of Environmental Licences (Article 8), and project pre-evaluation for further categorisation (Article 9);
- The inclusion of the mandatory Estudo de Pré-Viabilidade Ambiental e Definição do Âmbito (Environmental Pre-Feasibility Study and Scope Definition) (EPDA) which is only required for Category A projects (Article 12);
- The minimum content required for the – Estudo Ambiental Simplificado (Simplified Environmental Study) – (EAS) is presented in Article 15 and the Terms of Reference for such documents must be submitted to the Provincial Environmental Department; and
- The rules for public consultations are established in Article 16 and should be guided by the Public Consultation Regulations approved by Executive Decree No. 87/12 of 24 February.

The environmental licensing process in Angola involves several stages, as outlined in the Environmental Framework Law. According to Article 17 of the law, Projects that may cause significant environmental and social impact must obtain a license, with the EIA being the basis for granting the environmental license.

There are three types of licenses: the Environmental Installation License, the Environmental Operating License, and the Environmental Decommissioning License. The Environmental Installation License allows for the implementation of the project based on approved specifications from the overseeing entity, as stated in Article 29 of Presidential Decree No. 117/20. The Environmental Operating License, described in Article 30 of the same decree, is issued after meeting the requirements of the EAS and mitigation measures during the installation phase. An inspection is conducted to ensure compliance before the license is issued. The Decommissioning License is a document issued by the MINAMB, intended for the closure of facilities at the end of their activity so that potential environmental liabilities are properly identified and treated.

For a comprehensive Environmental License, Article 31 of the presidential decree outlines specific provisions to be included. These provisions address various aspects, such as the use of best practices and techniques for the licensed activity, emission limit values for pollutants, measures to protect soil and groundwater, control noise, promote waste management and monitor emissions to verify compliance with permit conditions. The license also entails obligations to inform the relevant environmental authority of any significant incidents and specifies the license's period of validity.

Regarding the fees for environmental licensing, the Presidential Decree No.83/22 of 12 April approves the Table of Fees to be charged for the Issue and Renewal of Environmental Licenses for Environmental Impact Assessment. The Decree establishes, in its Annex, the fees to be paid by the applicant to obtain the environmental license, and other administrative costs. Fees for Environmental Licenses for installation (construction), operation and decommissioning are based on a percentage of the Project cost, which is based on the value of the investment.

As per Article 5 of Presidential Decree No.117/20, the State and Local Authorities are exempt from paying Environmental Licensing fees.

In summary, Angola is governed by clear regulations, with different types of licenses required at various stages of a Project's lifecycle. Fees for licensing are determined based on the Project's investment value, and the licenses have specific provisions to ensure environmental protection and compliance.

Presidential Decree No. 83/22 (Table of Fees to be Charged for the Issue and Renewal of Environmental Licences for the Assessment of Environmental Impacts)

Presidential Decree No.83/22 revokes Joint Executive Decree 130/09 of 26 November and approves the Table of Fees to be Charged for the Issuance and Renewal of Environmental Licences for the Assessment of Environmental Impacts, as well as the registration and renewal of environmental consultancy firms. The Decree establishes, in its Annex, the fees to be paid by the applicant to obtain the environmental licence and other administrative costs. The fees for Environmental Licences for installation (construction), operation and decommissioning are based on a percentage of the cost of the Project, which is based on the value of the investment. The State and Local Authorities are exempt from paying Environmental Licensing fees (Article 5 of Presidential Decree 117/20).

Executive Decree No. 87/12 on Public Consultation for Projects Subject to Environmental Impact Assessment

Executive Decree No. 87/12 defines and sets out the purpose of public consultation for Projects that require an EIA. While the need for public consultation following submission of the EIS to the relevant Ministry, before approval and issuing of an Environmental License, is prescribed in legislation prior to the promulgation of Executive Decree No. 87/12, this Decree provides a more detailed and extensive explanation of the objectives of and requirements for public consultation.

The new regulations include a list of definitions related to public consultation (Article 1), the objectives and purpose of public consultation (Article 2 and 3) as well as the responsibility to preside over public consultation and their roles (Article 4 to 7). In Article 8, the requirements for information disclosure at public consultations are explained, including the role of the Non-Technical Summary. Administrative details such as the timeframe within which consultation must take place (5 — 10 days), compilation of a public consultation report and the fact that all associated with public consultation must be borne by the developer, are also set out in the regulations.

Executive Decree No. 92/12 on the Terms of Reference for Environmental Impact Studies

Decree No. 92/12 sets out the terms of reference for the EIS and specifies its general content. This Decree establishes that the EIS must be compiled in terms of the legislation on EIA and should follow the guidelines contained in any relevant sector-specific standard terms of reference for EIS. The Decree includes three annexes providing guidance for the information to be presented to the Ministry. Annex I is an application form for the Project proponent to indicate which Environmental License is being applied for and Annex 11 provides a form for the provision of simplified preliminary Project information. Annex III outlines the required content and structure for the EIS but does not provide details on the required content of each section.

Presidential Decree No.194/11 on Environmental Damage Regulations

Presidential Decree No. 194/11 of 7 July contains the Environmental Damage Regulations. It is applicable to all sectors and includes:

- The polluter pays principle;
- Strict liability (regardless of culpability) for environmental damage;
- Powers of the regulatory authority (the MIMAMB) to prevent or reduce the risk of environmental injury, including requiring businesses to develop prevention programmes and make disclosures in case of an imminent threat to the environment;
- Financial guarantees being payable for remediation or compensation of environmental damage in the form of insurance policies, bank guarantees, company reserves or other mechanisms;

- Individuals and non-governmental organisations granted locus standi (legal standing) to pursue legal action (including class action suits) to avoid, remedy and/or obtain compensation for environmental damage; and
- Strict penalties, including fines that can reach US\$100 million, as well as cancellation of Environmental Licences (Government of Angola, 1998).

3.2.3 Water legislation

Water Law 6/02 establishes the management priorities for water resources in Angola, specifically focusing on internal waters (both surface and underground). It declares water resources as state property and promotes the development of a new administrative policy for the water sector. This policy aims to protect water resources and the environment with objectives that include:

- Ensuring access to water resources;
- Maintaining a continuous balance between the availability of water resources and demand;
- Promoting research and sustainable use of existing water resources;
- Ensuring effective sewage systems; and
- Regulating the discharge of domestic effluents.

Water Quality Decree

The Water Quality Decree no. 261/11, dated 6 October, sets out water quality standards and criteria to protect the aquatic environment and improve water quality for its primary uses. This applies to inland waters (both surface and subterranean) and water used in aquaculture, livestock, irrigation, and balneotherapy (medicinal springs). The decree also includes regulations on the discharge of wastewater into national aquifers and soil, aimed at preserving the aquatic environment and protecting public health.

3.2.4 Waste legislation

Waste management

The Decree on the Regulation of Waste Management No.190/12 sets out guidelines for managing waste generation and disposal, including emissions to water and air as well as the collection, storage, and transport of waste. Its goal is to prevent or reduce the adverse effects of waste on human health and the environment. This legislation applies to all activities that might generate or dispose of waste although it does not cover radioactive waste or other wastes under specific regulations.

Construction waste

Executive Decree No. 17/13 of 22 January, outlines a legal framework for managing waste from construction or demolition activities, referred to as CDW (Construction and Demolition Waste). This legislation specifies responsibilities for all stakeholders involved in the lifecycle of CDW, from production to disposal. It does not apply to CDW from private works that are exempt from licensing. If the origin of the waste cannot be determined, the responsibility lies with the current holder. This responsibility ends when the waste is handed over to authorised waste management entities.

Key operations covered by the law include:

- Reuse of soils and rocks;
- On-site use of CDWs;
- Screening and fragmentation of CDW, necessary when on-site reuse is not feasible, to prepare materials for recycling or other recovery methods;
- Landfilling of CDW, allowed only after screening has determined no alternative uses;
- Transportation of CDW, which must be accompanied by a guide specified by government decree; and

- Licensing requirements for the storage, sorting, treatment, recovery, and disposal of CDW, including licensing for landfilling.

3.2.5 Energy supply legislation

On 25 March 2021, the Angolan Government enacted Presidential Decree No. 76/21 establishing a new legal framework for the electricity sector. This framework governs the generation, transmission, distribution and sale of electricity. It supersedes any previous conflicting legislation, including the Electricity Generation Regulations (Decree No. 47/01 of 20 July 2001) and the Electricity Distribution Regulations (Decree No. 45/01 of 13 July 2001). The regulation introduces a classification for electricity generation connected to the Public Electricity System, distinguishing between general and special regimes. The special regime applies to electricity generation from renewable sources and in isolated systems, under specific rules set out in the new regulation. Additionally, the decree outlines the foundational principles for the concession of electricity generation, the national electricity transmission grid and the electricity distribution grids. This comprehensive regulation officially came into effect on the same date it was published, 25 March 2021. Table 3-2 summarises the legislative and regulatory framework of Angola's electricity sector, detailing key aspects and functions.

Table 3-2: Summary of legislative and regulatory framework in the energy sector

Category	Details
Government Policy and Legislative Framework	Presidential Decree No. 256/11 sets the energy policy focusing on restructuring state-owned companies, renewable energy, and private investment. - The Electricity Act (Law No. 14-A/96) governs generation, transmission, distribution, and usage, emphasising supply adequacy, cost reduction, environmental protection, safety, and efficiency.
Market Organisation	The market is regulated, with activities requiring concessions or licenses. - Divided into Public Electricity System (PES) and Non-Tied Electricity System (NTES), with specific regulations for each. - Power Purchase Agreements (PPAs) between producers and the National Transmission Network (NTN) are mandatory for tied producers.
Authorisations for Construction and Operation	Generation activities require concession agreements or local authority licenses. - Construction of electric facilities needs establishment and exploration licenses, subject to safety and compliance regulations.
Grid Connection Policies	Network Access Regulation ensures non-discriminatory access to the grid. - Technical and commercial conditions for access vary by user and network type.
Alternative Energy Sources	Presidential Decree No. 88/13 promotes new environmental technologies and renewable energy, with a target to install 800MW of renewable energy by 2025.
Climate Change	Angola participates in the UN Framework Convention on Climate Change, focusing on non-binding commitments to climate change mitigation.
Regulatory Bodies	The Regulatory Institute of Electricity and Water Services (IRSEA) oversees the electricity sector, ensuring compliance with standards and resolving conflicts.
Rates and Tariffs	Tariffs and prices are regulated, with principles outlined in the Tariff Regulation, including sector sustainability, electrification, and energy efficiency. - The Tariff Regulation also specifies the calculation of costs and allowed revenues for entities in transmission and distribution.

Category	Details
Public Service Obligations	Power suppliers are subject to obligations ensuring non-discriminatory network access and consumer rights.
Acquisition and Merger Control	The Competition Regulatory Authority oversees mergers and acquisitions, with specific criteria for review. - The Electricity Act restricts transfer of concession rights without government consent.

3.2.6 Labour and occupational health and safety legislation

General Labour Law of Angola

The General Labor Law of Angola (No. 12/23 of 27 December) outlines the legal framework governing labor relations, worker rights, and employer obligations within the country. The law aims to ensure fair labour practices, promote workers' rights, and establish a balanced relationship between employers and employees. Key aspects of the law are summarised below.

Scope and application:

- Applies to all workers providing paid services under the supervision and direction of an employer;
- Includes apprentices, trainees, and both national and non-resident foreign workers; and
- Excludes civil servants, diplomatic staff, cooperative members, family workers, casual workers, and certain consultants.

Worker rights:

- Right to freely chosen work without discrimination;
- Right to equal opportunities and protection of dignity and health; and
- Prohibition of mandatory or compulsory labour except for military or public service.

Employer obligations:

- Ensure safe and healthy working conditions;
- Provide fair and timely remuneration;
- Facilitate professional training and development; and
- Collaborate with other employers in shared workplaces to ensure safety and hygiene.

Work contracts:

- Contracts must outline job roles, conditions and remuneration;
- Minors aged 14 to 18 can work with authorisation; and
- Specific provisions for special work types like domestic work, prison labour, and professional sports.

Health and safety:

- Employers must take measures to prevent workplace accidents and occupational diseases;
- Workers must use safety equipment correctly and follow safety protocols; and
- Employers are responsible for providing first aid and reporting workplace accidents.

Maternity and family rights:

- Special protections for pregnant workers and new mothers, including suitable job assignments and prohibition of night work without authorisation; and
- Right to maternity leave and protection from dismissal during pregnancy and maternity leave.

Dispute resolution and compliance:

- Establishes procedures for addressing grievances and resolving disputes; and
- The General Labor Inspectorate monitors compliance with labour laws and regulations.

This law provides a comprehensive framework to protect workers' rights while outlining employers' duties to maintain a fair and safe working environment.

Occupational Health and Safety Decree

The Occupational Health and Safety Decree (31/94 of 5 August) is designed to ensure workers' rights to a safe and hygienic work environment. It mandates:

- Provision of protective gear and regular information on workplace safety, hygiene, and health; and
- Employers to create conditions for the normal physical, mental, and social development of workers, protecting them from work accidents and occupational diseases.

Roles and responsibilities under the Decree

There are two ministries that have responsibilities under the decree and would be of relevance to the Project. The first is the Ministry of Public Administration, Employment and Social Security is responsible to:

- Develop, guide and monitors policy on safety, hygiene, and health;
- Assist and advise companies and workers in policy implementation;
- Promote insurance purchase and hygienic work habits among employees;
- Investigate and standardize safety, hygiene, and health practices;
- Halt operations when work accidents, fire hazards or breaches of safety standards pose risks to workers;
- Provide special protection for women, minors, and workers with reduced work capacity; and
- Manage data collection and dissemination related to workplace safety, hygiene, and health.

The second is the Ministry of Health, Interior, and Education, that:

- Develops measures for worker health, including early screening for occupational diseases and rehabilitation;
- Oversees implementation of these health measures;
- Proposes and applies policies for road safety and the handling of fire and explosives;
- Ensures safe working conditions and supervises fire and explosion prevention measures;
- Regulates the use, handling, and storage of explosives;
- Provides safety, hygiene, and health education to educators and students, especially in technical subjects; and
- Supports and ensures the inclusion of safety, hygiene, and health training in technical education curricula.

3.3 International conventions and national strategies and programs

Angola has ratified several international treaties and conventions relevant to the Project, which have been listed in Table 3-3.

Sections 3.3.1 to 3.3.7 describe several national strategies and programs implemented in Angola, which aim to foster environmental, social and economic benefits.

Table 3-3: International conventions and regional protocols ratified in Angola

Category	Convention	Obligation / action required
Waste and Hazardous Materials	Basel Convention on Hazardous Waste (1989)	Prior consent must be obtained from the destination country before transboundary movement of hazardous waste.
	Bamako Convention (1991)	Adhere to both the Bamako and Basel Conventions for the transboundary movement of broadly defined hazardous wastes.

Category	Convention	Obligation / action required
	Stockholm Convention (2001)	Avoid the use of listed hazardous chemicals or materials under Annexes A and B which have the ability to release persistent organic pollutants.
	Rotterdam Convention (1998)	Avoid the use or trade of listed hazardous chemicals or materials and pesticides under Annex III.
	Montreal Protocol (2000)	Avoid the production and use of ozone-depleting substances and hazardous materials listed under Annexes A and B.
Heritage	World Heritage Convention (1972)	Adhere to international standards, including IFC Performance Standard 8, for the identification and management of cultural heritage in Project development.
Labour	Abolition of Forced Labour Convention, 1957 (No. 105)	Develop and implement HR policies to prohibit forced labour.
	Minimum Age Convention, 1973 (No. 138)	Incorporate prohibitions on child employment in HR policies and ensure compliance.
	Worst Forms of Child Labour Convention, 1999 (No. 182)	Prohibit the employment of children, particularly in their worst forms, and ensure adherence to this policy.
	Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)	Recognise and protect workers' rights to associate and organise.
	Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	Explicitly forbid discrimination in employment and occupation.
Human Rights	International Convention on the Elimination of All Forms of Racial Discrimination (1969)	Prohibit all forms of racial discrimination in the workplace.
	Convention on the Elimination of All Forms of Discrimination against Women (1981) (CEDAW)	Ensure HR policies uphold non-discrimination against women.
	Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (1987)	Prohibit all forms of torture and other cruel, inhuman, or degrading treatment in all workplace environments.
	Convention on the Rights of the Child (1990)	Enforce policies that prohibit child labour.
	International Covenant on Economic, Social and Cultural Rights (1976)	Respect and uphold economic, social, and cultural rights within the Project.
	International Covenant on Civil and Political Rights (1976)	Observe and protect civil and political rights within the Project.
	United Nations Guiding Principles on Business and Human Rights	Assess potential adverse human rights impacts as per Principle 2 of the Equator Principles and the UN Guiding Principles.
Climate Change	Paris Agreement under the United Nations Framework Convention on Climate Change	Evaluate and manage emissions during design, construction, and operation phases of the Project, and address climate transition risks to enhance resilience and reduce GHG emissions.
	Vienna Convention for the Protection of the Ozone Layer (1985)	Implement measures to protect human health and the environment from modifications to the ozone layer caused by human activities.
Energy	SADC Protocol on Energy	Consider this protocol to ensure the harmonious development of national energy policies and foster balanced and equitable energy development across the Southern African Development Community (SADC) region.

Category	Convention	Obligation / action required
Water	SADC Revised Protocol on Shared Watercourses	Adopt a basin-wide approach to water management, focusing on sustainable, coordinated management, and protection of transboundary watercourses, to enhance regional cooperation.
Forestry	SADC Protocol on Forestry	Promote the conservation, sustainable management, and utilisation of forests and trees, and the trade in forest products, while protecting the environment and considering both present and future generations.

3.3.1 Angola 2025: Long-Term Strategy (Estratégia de Longo Prazo)

This strategy document reviews the significant challenges in Angola, such as very low human development, weak economic situation, institutional instability, inadequate health and education services, and regional inequality. It aims to establish strategic options up to 2025, considering the potential growth of various sectors and outlining the main activities needed to achieve this growth (Ministry of the Plan of the Republic of Angola, 2008).

3.3.2 Long-Term Development Strategy – Angola 2050

The Long-Term Development Strategy - Angola 2050 (Estratégia de Desenvolvimento de Longo Prazo — Angola 2050, ELP-2050) (as per Presidential Decree No. 225/23) is a comprehensive blueprint for Angola's socio-economic growth over the next three decades. It envisions a future of sustainable development, focusing on economic diversification, technological innovation, human capital enhancement, and environmental stewardship. A key priority of ELP-2050 is the electrification of rural areas, aimed at improving living standards, supporting agricultural productivity, and driving local economic activities. The strategy also seeks to reduce reliance on oil, promote industrialisation, and upgrade infrastructure, while tackling social challenges such as poverty, education, and healthcare.

3.3.3 Strategy to Combat Poverty (2003)

The government has developed this strategy to combat poverty, which aligns with the ongoing process of reconstruction and national development. Its primary objective is to improve the conditions of Angolan citizens, especially those who are vulnerable, by motivating their active participation in the socio-economic development process.

3.3.4 National Environmental Management Programme

The PNGA is seen as an important instrument for achieving sustainable development. The Ministry of Environment finalised it in 2009, with assistance from the UNDP. The PNGA emphasises the need for an environmental management strategy to protect the environment, even though most of Angola's natural resources are still largely intact. Importantly, the Environment Framework Law recognises that the implementation of the PNGA should be the responsibility of all sectors of government whose activities may have an influence on the environment, all private individuals and organisations that make use of natural resources as well as those individuals who may use resources unsustainably and cause pollution (Environmental Framework Act, 1998).

The PNGA has five strategic sub-programs, defined as:

- Promotion of inter-sectoral coordination;
- Protection of biodiversity, flora, and terrestrial and marine fauna;
- Ecosystem rehabilitation and protection;
- Environmental management; and

- Environmental education, information and awareness.

In 2011, an Environmental Fund was established by Presidential Decree No. 9/11 of 7 January to fund the activities highlighted in the PNGA such as scientific studies, educational programmes and natural resource surveys, to ensure that the health and well-being of citizens is not adversely affected by pollution. The Environmental Fund is a separate stand-alone agency under the MINAMB and the Ministry of Finance.

3.3.5 National Biodiversity Strategy and Action Plan (2019-2025)

In 2019, the government approved the National Biodiversity Strategy and Action Plan (Resolution No. 42/06 of 26 July) to ensure the conservation and sustainable use of biological diversity. This document aims to enable the fair and equitable sharing of the benefits of using biological resources (Government of Angola, 2020). The strategy incorporates measures for conserving and sustainably utilizing biological diversity into development policies and programs for the benefit of all Angolans. The strategy went through a two-year drafting process culminating in the new Strategy and Biodiversity Action Plan (2019-2025). It has twelve 'Strategic Goals' that were defined through a process of public consultation involving representatives of government institutions, local and traditional authorities, environmental protection institutions, the education sector, the private sector and the press.

3.3.6 National Development Plan (2018 – 2022)

The Revised National Development Plan (NDP) for Angola (2018-2022) has been updated to reflect the current financial constraints, the impacts of the COVID-19 pandemic and the volatility in oil prices and production. It continues to align with the goals of the governance programme, aiming to improve non-oil GDP growth, enhance the Human Capital Index annually until 2022 and improve the Gini coefficient by reducing regional disparities.

The NDP is a key element of Angola's planning system, designed to foster socio-economic development and integrate international developmental commitments. As per the Basic Law of the General Regime of the National Planning System, it serves as a medium-term instrument to execute the long-term strategies outlined in the Angola 2025 Long-Term Strategy. It addresses multi-dimensional development through strategic objectives such as national cohesion, human and sustainable development, economic growth, innovation, socio-cultural advancement and building a participatory society. This plan is comprehensive, covering national, sectoral, and provincial planning. It focuses on promoting economic inclusion of impoverished households, combating extreme poverty, fostering local development, protecting children, promoting gender equality and ensuring food security for vulnerable populations (Fao.org, 2024).

3.3.7 Angola Energy 2025 Vision

The "Angola Energy 2025 Vision" is an integrative strategy aligned with the national goals to promote human development, ensure sustainable growth and achieve equitable territorial development. It focuses on comprehensive electrification across all provincial and municipal capitals, striving to extend basic energy services to Angola's entire population, including rural communities. Central to this vision is the utilisation of hydropower and natural gas to ensure a secure and competitive energy supply, supported by significant infrastructure investments in both public and private sectors aimed at expanding the transmission network and integrating Angola into the regional power grid. The strategy also embraces renewable energies, aiming to enhance energy security through regional market integration and promoting long-term sustainability with measures like tariff reforms and energy efficiency enhancements. This vision aims to boost Angola's electricity sector to support economic development and improve citizen well-being through reliable and sustainable energy access (Ministry of Energy and Water, 2017).

3.3.8 Power development master plan (2018-2040)

Since the end of the civil war in 2002, Angola's economy has grown steadily, with an average growth rate of 10.7% from 2002 to 2013. To achieve sustainable growth, the government's NDP (2013-2017) focuses on diversifying industries and reducing reliance on oil, designating the power sector as a priority for restoration and development, despite challenges such as low electrification rates and high transmission losses. The MINEA has outlined the Programa de Transformação do Setor Elétrico (Electricity Sector Transformation Programme) - (PTSE) to enhance electricity access and generation capacity by 2025. The formulation of a comprehensive power development master plan up to 2040, in collaboration with Japan, aims to ensure a stable power supply through data-driven planning and capacity building among key stakeholders.

3.4 International environmental and social principles, policies and standards

This ESIA is being conducted in compliance with Angolan legislation for ESIA studies. In addition to meeting the requirements set out in national legislation and policies, the Project is informed by GIIP standards and guidelines. This ensures alignment to what is both required by law and what is generally accepted and promoted internationally. The GIIPs are intended to supplement local standards and requirements when they are insufficient for the Lenders to make a fully informed decision regarding the environmental and social impacts.

This section presents the GIIPs applicable to the Project. It also shows how the range of applicable standards and guidelines are in alignment.

3.4.1 International Finance Corporation Performance Standards

The IFC Performance Standards on Environmental and Social Sustainability (IFC, 2012) are an international benchmark for identifying and managing environmental and social risks and impacts. The following eight IFC Performance Standards should meet throughout the life of an investment:

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

The IFC Performance Standard each contain objectives and specific requirements that guide Project developers on how to avoid, mitigate, and manage key risks and impacts as a way of doing business in a sustainable way.

3.4.2 Equator Principles

The EP4 are intended to serve as a common baseline and risk management framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects. The Equator Principles Financial Institutions (EPFIs) refer to those institutions that have chosen to adopt the Equator Principles. EP4, the latest Equator Principles iteration, came into effect for all EPFIs on 1 October 2020. The principles provide a framework for an accepted international approach to the management of social and environmental issues. The intention is to ensure that Projects are

developed in a site-specific manner that is socially responsible and reflects sound environmental management practices. The EP4 are:

- Principle 1: Review and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Social and Environmental 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; and
- Principle 10: Reporting and Transparency.

3.4.3 IFC Environmental, Health and Social Guidelines

The IFC Environmental, Health and Safety (EHS) General Guidelines (currently dated April 30, 2007) and the IFC EHS Guidelines for Electricity Power Transmission and Distribution (currently dated December 10, 2007) contain the performance levels and measures that are generally considered to be achievable in new developments at reasonable costs by existing technology. The applicability of the IFC EHS Guidelines is tailored to the Project based on the risks and impacts of the Project and assist in guiding specialists in assessing impacts and developing management measures.

The IFC EHS Guidelines for Transmission and Distribution are specific to the construction, operation and decommissioning of electricity related infrastructure focussing on environmental, occupational health and safety and community health and safety.

3.4.4 United Nations Guiding Principles on Business and Human Rights

The United Nations Guiding Principles (UNGP) on Business and Human Rights (2011) are a set of guidelines for States and companies to prevent, address and remedy human rights abuses committed in business operations. The UNGP consists of 31 principles focusing on three areas:

- The States' existing obligations to respect, protect and fulfil human rights and fundamental freedoms;
- The role of business enterprises as specialized organs of society performing specialized functions, required to comply with all applicable laws and to respect human rights; and
- The need for rights and obligations to be matched to appropriate and effective remedies when breached.

It is worth noting that the Government of Angola have ratified the UNGPs (see Table 3-3) along with a number of other human rights conventions. This underscores the applicability of the guidelines to the Project.

3.4.5 United Nations Global Compact

The United Nations Global Compact is a voluntary initiative that encourages companies to align their strategies and operations with ten universal principles related to human rights, labour, environment, and anti-corruption. It aims to advance societal goals and support the implementation of the Sustainable Development Goals (SDGs). The ten principles are:

- Principle 1: Businesses should support and respect the protection of internationally proclaimed human rights;
- Principle 2: make sure that they are not complicit in human rights abuses;
- Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;

- Principle 4: the elimination of all forms of forced and compulsory labour;
- Principle 5: the effective abolition of child labour;
- Principle 6: the elimination of discrimination in respect of employment and occupation;
- Principle 7: Businesses should support a precautionary approach to environmental challenges;
- Principle 8: undertake initiatives to promote greater environmental responsibility;
- Principle 9: encourage the development and diffusion of environmentally friendly technologies; and
- Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery.

3.4.6 Sustainable Development Goals

The United Nations Sustainable Development Goals (UN SDGs) (2015) are a set of 17 global goals that are a call to action to ensure the sustainability of the planet by 2030, referred to as Agenda 2030. The goals provide a holistic framework for public and private institutions to apply, show their contribution, and manifest the sustainability roadmap for a Project. These goals include:

1. No poverty;
2. Zero hunger;
3. Good health and well-being;
4. Quality education;
5. Gender equality;
6. Clean water and sanitation;
7. Affordable and clean energy;
8. Decent work and economic growth;
9. Industry, innovation and infrastructure;
10. Reduced inequalities;
11. Sustainable cities and communities;
12. Responsible consumption and production;
13. Climate action;
14. Life below water;
15. Life on land;
16. Peace, justice and strong institutions; and
17. Partnerships for the goals.

The UN SDGs offer a powerful shared language and an opportunity to contribute to common challenges and support the global movement towards sustainability. As a comprehensive set of interrelated goals, the SDG represent an integrated approach across all dimensions of sustainable development to ensure that local Projects are carefully planned, implemented and monitored. The Government of Angola have committed to the UN SDGs and aligns national policies, strategies and programs to the goals. The country released the findings of its first Voluntary National Review of its international commitment to the implementation of United Nations Agenda 2030 in 2021 (Government of Angola, 2021).

3.4.7 International Labour Organisation

The ILO is a UN agency whose mandate is to advance social and economic justice by setting international labour standards. These promote labour and general human rights and encourage the fair protection of the workforce. The key ILO conventions considered for here include:

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87);
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98);

- Forced Labour Convention, 1930 (No. 29) & Abolition of Forced Labour Convention, 1957 (No. 105);
- Minimum Age Convention, 1973 (No. 138) & Worst Forms of Child Labour Convention, 1999 (No. 182);
- Equal Remuneration Convention, 1951 (No. 100);
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111); and
- Labour Inspection Convention, 1947 (No. 81) & Labour Inspection (Agriculture) Convention, 1969 (No. 129).

The ILO standards have been given prominence in Angola through the ratification of several of the labour conventions by the Angolan Government (see Table 3-3). These ratified conventions commit State institutions to prohibit forced and child labour, protect workers' rights and forbid discrimination in employment, among other labour aspects, and are given effect through national legislation and policies.

3.4.8 Organisation for Economic Co-operation and Development

The OECD is an intergovernmental organisation providing recommendations for addressing issues affecting economic and social well-being. Applicable OECD guidelines and recommendations that have relevance for the Project include:

- OECD Guidelines for Multinational Enterprises (2011);
- OECD Recommendations of the Council on Sustainable Lending Practices and Officially Supported Export Credits (2018); and
- OECD Due Diligence Guidance for Responsible Business Conduct.

3.4.9 Alignment of applicable standards and guidelines

Significant alignment exists between the featured GIIP standards and guidelines. Table 3-4 presents the high-level alignment of applicable standards and guidelines, using the IFC PS as a benchmark against which the Project has been assessed.

Table 3-4: GIIP alignment

IFC PS	Equator Principles	General IFC EHS Guidelines	IFC EHS Electricity Transmission and Distribution Guidelines	UN Guiding Principles on Business and Human Rights	UN Global Compact	ILO conventions	UN SDGs	OECD
Performance Standard 1	Principle 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10	Air emissions and ambient air quality	Environmental – Habitat alteration	Principle 17-21: Conduct due diligence to identify, prevent, mitigate, and account for how they address their impacts on human rights.	Principle 1, 2 (human rights, labour)	(No Direct ILO Convention) Closest Relevant - ILO Convention No. 155 (Occupational Safety and Health, 1981) - focuses on the creation of a safe working environment which is a part of managing environmental and social risks.	SDG 13 (Climate Action) and SDG 17 (Partnerships for the Goals)	Guidelines for Multinational Enterprises (Chapter VI)
		Energy conservation	Environmental – Electric and magnetic fields		Principle 7, 8, 9 (environment)			Diligence Guidance - Provides a framework for enterprises to identify and respond to risks in terms of social, environmental, and human rights.
		Wastewater and ambient water quality	Environmental – Hazardous materials management					
		Water conservation	Occupational health and safety					
		Hazardous materials management	Community health and safety					
		Waste management						
		Noise						
		Contaminated land						
		Environment						
		Community health and safety						
Performance Standard 2	Principle 2, 3 and 6	Occupational health and safety	Occupational health and safety – all	Principle 12: Businesses should respect the rights of workers.	Principle 3, 4, 5, 6 (labour)	ILO Convention No. 87 (Freedom of Association and Protection of the Right to Organise, 1948)	SDG 5 (Gender Equality) and SDG 8 (Decent Work and Economic Growth)	Guidelines for Multinational Enterprises (Chapter V)
						ILO Convention No. 98 (Right to Organise and Collective Bargaining, 1949)		Diligence Guidance - Emphasises the importance of upholding labour rights in the supply chain and corporate practices.
						ILO Convention No. 100 (Equal Remuneration, 1951)		
						ILO Convention No. 105 (Abolition of Forced Labour, 1957)		
						ILO Convention No. 111 (Discrimination in Respect of Employment and Occupation, 1958)		
						ILO Convention No. 138 (Minimum Age, 1973)		
						ILO Convention No. 182 (Worst Forms of Child Labour, 1999)		
Performance Standard 3	Principle 2 and 3	Air emissions and ambient air quality	Environmental – Hazardous materials management	Principle 13: Avoid causing or contributing to adverse human rights impacts and address such impacts when they occur.	Principle 7, 8, 9 (environment)	ILO Convention No. 155 (Occupational Safety and Health, 1981)	SDG 9 (Industry, Innovation and Infrastructure) and SDG 12 (Responsible Consumption and Production)	Guidelines for Multinational Enterprises (Chapter VI)
		Energy conservation				ILO Convention No. 170 (Chemicals, 1990)		Diligence Guidance - Encourages enterprises to manage resources efficiently and minimise environmental impacts of their operations and supply chains.
		Wastewater and ambient water quality						
		Water conservation						
		Hazardous materials management						
		Waste management						
		Noise						
		Contaminated land						

IFC PS	Equator Principles	General IFC EHS Guidelines	IFC EHS Electricity Transmission and Distribution Guidelines	UN Guiding Principles on Business and Human Rights	UN Global Compact	ILO conventions	UN SDGs	OECD
Performance Standard 4	Principle 2, 3, 4, 5 and 6	Water quality and availability	Community health and safety	Principle 13: Avoid causing or contributing to adverse human rights impacts and address such impacts when they occur.	Principle 1, 2 (human rights)	ILO Convention No. 167 (Safety and Health in Construction, 1988)	SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities) and SDG 16 (Peace, Justice and Strong Institutions)	Diligence Guidance - Includes guidance on ensuring that operations do not adversely impact the health and safety of the local communities.
		Structural safety of Project infrastructure		Principle 15: Ensure that appropriate and effective grievance mechanisms are available.				
		Life and Fire safety						
		Traffic safety						
		Transport of hazardous materials						
		Disease prevention						
		Emergency preparedness and response						
Performance Standard 5	Principle 2, 3, 4, 5 and 6			Principle 20: Carry out human rights due diligence. Principle 29: Provide for, or cooperate in, remediation through legitimate processes.	Principle 1, 2 (human rights)	(No Direct ILO Convention) Closest Relevant - ILO Convention No. 169 (Indigenous and Tribal Peoples, 1989) - Although it specifically focuses on indigenous peoples, it includes principles that are relevant to the treatment and rights of communities affected by land acquisition	SDG 1 (No Poverty), SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable Cities and Communities)	Diligence Guidance - Stresses the importance of considering impacts on local communities and mitigating adverse effects related to displacement.
Performance Standard 6	Principle 2		Environmental – Habitat alteration	Principle 13: Avoid causing or contributing to adverse human rights impacts and address such impacts when they occur.	Principle 7, 8, 9 (environment)	(No Direct ILO Convention) Closest Relevant - ILO Convention No. 184 (Safety and Health in Agriculture, 2001) - relates to safety and health practices in agriculture that indirectly support sustainable management of natural resources	SDG 13 (Climate Action), SDG 14 (Life Below Water) and SDG 15 (Life on Land)	Guidelines for Multinational Enterprises (Chapter VI)
								Diligence Guidance - Calls for due diligence in operations that affect biodiversity, ensuring sustainable use and conservation of natural resources.
Performance Standard 7	Principle 2			Principle 7: Recognize and respect the rights of indigenous peoples.	Principle 1, 2 (human rights)	ILO Convention No. 169 (Indigenous and Tribal Peoples, 1989)	SDG 10 (Reduced Inequalities) and SDG 16 (Peace, Justice and Strong Institutions)	Guidelines for Multinational Enterprises (Chapter II)
								Diligence Guidance - Recommends thorough assessments and respectful engagement practices with Indigenous Peoples to avoid adverse impacts.
Performance Standard 8	Principle 2 and 5			Principle 13: Avoid causing or contributing to adverse human rights impacts and address such impacts when they occur.	Principle 1, 2 (human rights)	(No Direct ILO Convention) Closest Relevant - ILO Convention No. 169 (Indigenous and Tribal Peoples, 1989) - while specifically for Indigenous Peoples, it touches on aspects of cultural heritage which can be broadly applicable to the protection of cultural sites and heritages in various contexts	SDG 4 (Quality Education) and SDG 11 (Sustainable Cities and Communities)	Diligence Guidance - Advises on safeguarding cultural heritage when enterprises engage in regions with significant historical and cultural sites.

3.5 Gap analysis of Angolan legislation and GIIP

The requirements set out in Angolan national legislation was used to guide the scope of specialist studies and the overall ESIA process. In instances where Angolan laws were silent, suitable GIIP requirements and applicable standards were applied. Table 3-5 provides a high-level gap analysis of Angolan legislation and the IFC Performance Standards used as the benchmark GIIP standard (based on the rationale in Table 3-4).

Table 3-5: Gap analysis of Angolan legislation and IFC Performance Standards

IFC Performance Standard	Angolan Legislation	Applicability to project or gaps, and how it is addressed in the ESIA
PS 1: Social and Environmental Assessment and Management Systems		
An 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	An ESMS will be required. This requirement is recommended in the ESMP (Volume 2).
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 an SEP, this should be developed to guide stakeholder engagement and project awareness raising. A SEP has been developed as part of the ESIA and is included in Volume 3. Appendix G. The ESIA also describes relevant stakeholder engagement that has taken place to date.
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 (ToR), but not regulated	Specialist baseline studies should be undertaken for relevant biophysical and socio-economic aspects. This specialist scope was included in the ToR and the outputs thereof have informed the environmental and social baselines.
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	Roles and responsibilities are required for ESMP implementation and is included in the ESMP (Volume 2).
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 not required by legislation, the team undertaking the ESIA should be sufficiently capacitated. For this ESIA, various specialists were contracted, and the team composition is provided in Section 1.7.
Ongoing reporting to the stakeholders and interested parties needs to be implemented	Law No. 5/98 (19/06/1998) – Environmental Framework Law. Decree No. 117/20 (22/04/2020) Executive Decree No. 87/12 (24/02/2012) Executive Decree No. 92/12 (01/03/2012)	Required by legislation and should be throughout the project life cycle. This has been addressed by stakeholder engagement to date as part of the ESIA, and continued engagement as set out in the SEP.
External grievance mechanisms need to be established to receive and facilitate resolution of	Not required by Angolan law	Although this is not required by Angolan, law a grievance mechanism should be incorporated

IFC Performance Standard	Angolan Legislation	Applicability to project or gaps, and how it is addressed in the ESIA
IAPs concerns about the project and its environmental and social performance		within this Project. The SEP (Volume 3. Appendix G) includes a Grievance Mechanism.
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 15 th	Applicable and the Angolan Regulations make adequate provision for this requirement. This requirement is included in the management measures in the ESMP.
Occupational health and safety (OHS) requires the minimisation of the causes of hazards in a manner consistent with good international industry practice, including the World Bank Group EHS Guidelines	Decree No. 31/94 (31/05/94) – Occupational Hygiene and Safety System This decree establishes the principles that aim to promote safety, hygiene and health at work General Labour Law No. 12/23 of December 27 th . 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"	Applicable and the Angolan Regulations make adequate provision for this requirement. An OHS management Plan has been included in the ESMP (Volume 2)
PS 3: Resource Efficiency and Pollution Prevention		
Guides companies in implementing practices and technologies that enhance energy efficiency, reduce resource consumption, and minimise pollution, thereby protecting human health and the environment	Environmental Framework Law (Law No. 5/98): Establishes principles for environmental protection and sustainable development, mandating the rational use of natural resources and pollution prevention General Waste Management Law (Law No. 51/21 of July 19, 2021). Addresses modern challenges in waste management, enhancing regulations for the handling, treatment, and disposal of waste, with a strong emphasis on sustainability and environmental protection. It introduces stricter controls on hazardous waste, promotes recycling and resource recovery, and sets out clear guidelines for the responsibilities of public and private entities. National Strategy for Climate Change (Resolution No. 120/14): Outlines measures for enhancing energy efficiency, reducing greenhouse gas emissions, and promoting sustainable development practices	Applicable and the Angolan Regulations make adequate provision for this requirement. The requirement has been met in the ESIA in mitigation measures from different environmental issues such as surface water resources, soils, climate change and hydrogeology – Volume 2.
PS 4: Community Health, Safety and Security		

IFC Performance Standard	Angolan Legislation	Applicability to project or gaps, and how it is addressed in the ESIA
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 No. 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. The requirement has been met in the ESIA in mitigation measures from different environmental issues (e.g. surface water resources, soils and hydrogeology) – Volume 2.
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 that they can fully understand the nature and extent of the risks. This includes the details of an Emergency Preparedness and Response Action Plan	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; Environmental Licensing Executive Decree No. 92/12 (01/03/2012) – Terms of Reference for the Development of Environmental Impact Studies	Applicable and the Angolan Regulations make adequate provision for this requirement. The ESMP includes a CHSS and OHS Management Plan (Volume 2).
PS 5: Land Acquisition and Involuntary Resettlement		
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. The SEP and LARF was developed in line with GIIP guidelines (Volume 3, Appendix G and O). Resettlement Action Planning will be implemented by the Developer.
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 No. 42/06 of July 26 - National Biodiversity Strategy and Action Plan (NBSAP) Decree N. ° 117/20 (22/04/2020) – Environmental Licensing Executive Decree No. 92/12 (01/03/2012) – Terms of Reference for the Development of Environmental Impact Studies Law No. 6/17 – Law of Forests and Wild Fauna	Applicable and the Angolan Regulations make adequate provision for this requirement. The ESIA includes an ecological baseline based on specialist investigation, impact assessment and mitigations in the ESMP. A Biodiversity Management Plan (BMP) is also included (Volume 2).

IFC Performance Standard	Angolan Legislation	Applicability to project or gaps, and how it is addressed in the ESIA
Where the project has potential impacts on legally protected or critical habitats, consultation with relevant authorities, specialists and communities must be undertaken.	Resolution No. 26/20 of February 6th- National Biodiversity Strategy and Action Plan (NBSAP) Decree No. 117/20 (22/04/2020) –Environmental Licensing Executive Decree No. 92/12 (01/03/2012) – Terms of Reference for the Development of Environmental Impact Studies	The ESIA includes an ecological baseline based on specialist investigation, impact assessment and mitigations in the ESMP. A Biodiversity Management Plan (BMP) is also included (Volume 2). Findings of the ESIA will be presented to stakeholders and interested parties for input, in accordance with the Stakeholder Engagement Approach (Section 5).
PS 7: Indigenous Peoples		
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	Not required by Angolan Law	Indigenous Groups are identified outside of the Project area of influence. These groups will be considered in the process as included in the SEP (Volume 3, Appendix G).
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	Not required by Angolan Law	Indigenous Groups are identified outside of the Project area of influence. These groups will be considered in the process as included in the SEP (Volume 3, Appendix G).
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	Indigenous Groups are identified outside of the Project area of influence. These groups will be considered in the process as included in the SEP (Volume 3, Appendix G).
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 No. 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 adequate provision for this requirement. The ESIA includes a cultural heritage baseline based on specialist investigation, impact assessment and mitigations in the ESMP. A chance find procedure is also included (Volume 2).

3.6 Applicable Project standards

This section sets out the relevant standards adopted for the Project (“Project standards”). The Project standards adopted were based on Angolan legislation and GIIP. In general, when host country (e.g. Angola) legislation differ from the levels and measures presented in GIIP standards, projects are 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. In instances where host country legislation is silent, suitable GIIP standards should be applied. Table 3-6 defines the Project standards based on a review of Angolan legislation and GIIP standards.

Table 3-6: Applicable Project standards based on Angolan legislation and GIIP

Aspect	National legislation/Standards	International Standards	Adopted Project Standards																													
Air Quality	Presidential Decree No. 138/20 approving the National Environmental Quality Programme (PNQA). Standards for air quality are currently in preparation	The WHO Air Quality Guidelines included in the IFC Safety EHS guidelines offer scientifically grounded recommendations to mitigate the health impacts associated with air pollution. These guidelines serve as a reference for establishing air quality standards aimed at safeguarding public health by reducing exposure to harmful air pollutants. The integration of WHO guidelines into IFC's EHS guidelines helps projects meet environmental, health, and safety standards, thereby mitigating the negative impacts of operations on the environment and public health. This includes monitoring air quality and implementing measures to reduce emissions through cleaner technologies and best practices. The primary goal is to minimise the burden of disease associated with air pollution and promote sustainable development by encouraging industries to adopt more efficient and environmentally friendly practices.	WHO Air Quality Guidelines (WHO, 2021)																													
			<table><tr><th>Pollutant</th><th>Averaging period</th><th>Concentration (µg/m³)</th></tr><tr><td rowspan="2">Particulate matter (PM₁₀)</td><td>Annual</td><td>15</td></tr><tr><td>24-hour^a</td><td>45</td></tr><tr><td rowspan="2">Particulate matter (PM_{2.5})</td><td>Annual</td><td>5</td></tr><tr><td>24-hour^a</td><td>15</td></tr><tr><td rowspan="2">Ozone</td><td>Peak season^b</td><td>60</td></tr><tr><td>8-hour^a</td><td>100</td></tr><tr><td rowspan="2">Nitrogen dioxide (NO₂)</td><td>Annual</td><td>10</td></tr><tr><td>24-hour^a</td><td>25</td></tr><tr><td>Sulphur dioxide</td><td>24-hour^a</td><td>40</td></tr><tr><td>Carbon monoxide</td><td>24-hour^a</td><td>4</td></tr></table>	Pollutant	Averaging period	Concentration (µg/m³)	Particulate matter (PM ₁₀)	Annual	15	24-hour ^a	45	Particulate matter (PM _{2.5})	Annual	5	24-hour ^a	15	Ozone	Peak season ^b	60	8-hour ^a	100	Nitrogen dioxide (NO ₂)	Annual	10	24-hour ^a	25	Sulphur dioxide	24-hour ^a	40	Carbon monoxide	24-hour ^a	4
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^a 99 th percentile (i.e., 3-4 exceedance days per year)																																
^b Average of daily maximum 8-hour mean O ₃ concentration in the six consecutive months with the highest six-month running -average O ₃ .																																
Note: Annual and peak season is long-term exposure, while 24 hour and 8 hour is short-term exposure.																																
Noise	No noise limits/requirements have been established in Angolan legislation	Environmental noise is a significant consideration in project development, especially in areas close to residential, institutional, or educational settings. Noise pollution can adversely affect human health and well-being, leading to issues such as stress, hearing loss, sleep disturbances, and decreased productivity.	Adopted standards for this project adhere to the IFC EHS Guidelines (2007) for managing environmental noise levels. These include:																													
			Noise Level Limits: - Daytime (07:00 - 22:00): 55 dB(A) - Nighttime (22:00 - 07:00): 45 dB(A)																													

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		IFC EHS Guidelines on Noise: The IFC EHS Guidelines (2007) provide standards for managing environmental noise levels in project development. These guidelines serve as a benchmark for GIIP and are used globally in the absence of specific national noise standards. Noise Level Limits: The IFC EHS Guidelines specify fixed noise limits for different types of areas and times of the day. These limits are designed to protect human health by minimizing the risk of noise pollution. The specified noise level limits are as follows: Residential, Institutional, Educational Areas: - Daytime (07:00 - 22:00): 55 dB(A) - Nighttime (22:00 - 07:00): 45 dB(A) Industrial and Commercial Areas: - Daytime (07:00 - 22:00): 70 dB(A) - Nighttime (22:00 - 07:00): 70 dB(A) Additional Considerations: In cases where the existing ambient noise levels are already high, the guidelines recommend that project-related noise should not increase the ambient noise levels by more than 3.0 dB(A). This recommendation is particularly important because a 3.0 dB(A) increase is typically the threshold at which changes in noise levels become perceptible to the average human ear.	- Noise should not increase ambient levels by more than 3.0 dB(A) - Implementing noise mitigation measures as needed.
Right of Way	The 2004 Land Law specifies in Article 27 that there is a designated right of way, consisting of a 30-meter strip on both sides of the HV OHL, creating a total corridor width of 60 meters	The management of Right-of-Way (ROW) for transmission lines is a critical aspect of infrastructure planning and environmental management. ROW refers to the legal right to pass through a specific route and the strip of land over which facilities such as transmission lines, pipelines, and roads are constructed. Proper ROW management ensures safety, accessibility, and minimal environmental impact. IFC EHS Guidelines on Right-of-Way: The IFC EHS guidelines provide comprehensive recommendations for the management of ROWs, especially for HV OHLs. These guidelines reflect GIIP and serve as a technical reference for project developers.	National and IFC EHS Guidelines - A right of way of a 50-meter strip on both sides of the HV OHL was adopted following a conservative approach which considered the tower height (i.e., 47 m) - For the MV and LV OHL, an 18-meter strip on both sides of the MV and LV OHL was adopted following a conservative approach which considered the pole height (i.e., 18 m)

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		ROW Width Recommendations: The IFC EHS Guidelines recommend varying ROW widths for transmission lines based on the voltage of the lines and their proximity to other rights-of-way. This variation ensures adequate safety and minimises environmental and social impacts. Transmission Lines up to 35 kV: Recommended ROW width ranges from 12 to 24 meters, which translates to 6 to 12 meters on each side of the transmission line. High-Voltage Transmission Lines (above 35 kV): ROW widths can range from 15 to 100 meters depending on the specific voltage and the proximity to other rights-of-way. This range allows for the safe operation and maintenance of the lines while minimising interference with surrounding land uses.	
Electromagnetic Fields	No electromagnetic field limits/requirements have been established in Angolan legislation	Electromagnetic fields (EMFs) are pervasive in modern society due to the widespread use of electrical and electronic devices. While EMFs are generally considered safe at low levels, high exposure can lead to health issues. Therefore, managing exposure to EMFs is crucial, especially in occupational settings and for the general public. European Union Council Recommendation (1999/519/EC): The European Union Council Recommendation (1999/519/EC) provides a comprehensive framework to protect the public from the potential adverse health effects of EMFs. This recommendation is based on guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and sets basic restrictions and reference levels for EMF exposure up to 300 GHz. Key Components of the Recommendation: Basic Restrictions: Exposure Limits: The recommendation specifies exposure limits for different frequencies of EMFs. These limits are designed to prevent thermal and non-thermal health effects. For example, the basic restrictions for whole-body exposure to EMFs are set to prevent an increase in body temperature of more than 1°C.	Adopted standards for this Project adhere to the European Union Council Recommendation (1999/519/EC) for protecting public health from electromagnetic fields (EMFs). These standards should include: Basic Restrictions and Reference Levels: - Implement exposure limits for various EMF frequencies to prevent thermal and non-thermal health effects, ensuring that whole-body exposure does not raise body temperature by more than 1°C. - Establish reference levels derived from these basic restrictions for practical compliance assessment. Frequency-Specific Exposure Limits: Apply specific exposure limits for a wide frequency range from static fields (0 Hz) to 300 GHz to address the varying effects of different EMF types. Occupational Safety Measures: Align with Directive 2013/35/EU by conducting risk assessments, implementing control measures, and providing training and information

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		Reference Levels: These are practical exposure levels that can be easily measured and are derived from the basic restrictions. They provide a means to assess compliance with the exposure limits. Frequency Ranges and Exposure: The recommendation covers a wide range of frequencies from static fields (0 Hz) to 300 GHz. Each frequency range has specific exposure limits to address the varying effects of different types of EMFs. Occupational Safety: The recommendation aligns with Directive 2013/35/EU, which provides specific guidance for managing occupational exposure to EMFs. This includes conducting risk assessments, implementing control measures, and providing training and information to workers, especially those who are particularly vulnerable, such as pregnant women. Risk Assessment and Management: The recommendation emphasises the importance of assessing the risks associated with EMF exposure. This includes identifying sources of EMFs, measuring exposure levels, and evaluating potential health effects. Employers are required to take appropriate measures to minimise exposure, such as engineering controls (e.g., shielding), administrative controls (e.g., limiting time spent near EMF sources), and personal protective equipment if necessary.	to workers, especially vulnerable groups such as pregnant women. Risk Assessment and Management: - Regularly assess EMF exposure risks by identifying sources, measuring exposure levels, and evaluating health impacts. - Minimise exposure through engineering controls (e.g., shielding), administrative controls (e.g., limiting time near EMF sources), and personal protective equipment if necessary. Adherence to ICNIRP Guidelines: Follow the latest ICNIRP guidelines, which provide detailed scientific guidance on limiting EMF exposure, and ensure these guidelines are periodically reviewed and updated.
Aviation obstruction	Angolan legislation on aviation obstacles is outlined in the Civil Aviation Law No. 31/21 of December 20th and the Regulation on the Protection of Aerodromes and Air Navigation, which mandate that structures like powerlines must not pose hazards to air navigation. These regulations require compliance with obstacle limitation surfaces (OLS), proper marking and lighting, and notification to aviation authorities.	The International Civil Aviation Organization (ICAO) has established comprehensive guidelines to ensure that such structures do not pose hazards to air navigation. ICAO Annex 14: ICAO Annex 14 provides detailed standards and recommended practices for aerodrome design and operation, including the management of obstacles that may affect aviation safety. These guidelines are critical for ensuring that new projects, such as powerlines, do not interfere with air navigation. Key Components of ICAO Annex 14: Obstacle Limitation Surfaces (OLS):	The Project will adopt the following standards based on ICAO Annex 14: Obstacle Limitation Surfaces (OLS): Ensure that the structure does not penetrate OLS defined for the nearby aerodrome. Day Marking: Use contrasting colors (e.g., orange and white) for painting the structures to enhance visibility during daylight. Night Lighting: Install appropriate lighting systems (steady or flashing red lights) to ensure visibility during nighttime and low-visibility conditions.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		• OLS are defined surfaces in the airspace around aerodromes that should be free of obstacles to ensure safe aircraft operations during takeoff, landing, and while in flight near the aerodrome. • The dimensions and shapes of OLS depend on the type and category of the aerodrome, as well as the types of aircraft using the facility. Marking and Lighting of Obstacles: • Day Marking: Structures such as powerlines must be painted with alternating contrasting bands (e.g., orange and white) to ensure visibility during daylight. • Night Lighting: Obstacles must be equipped with appropriate lighting to ensure they are visible to pilots during nighttime and in low-visibility conditions. This typically includes steady or flashing red lights at specified intervals along the structure's height. Notification to Aviation Authorities: • Developers must notify the relevant aviation authorities about new structures that could pose potential hazards to air navigation. • The notification process includes providing detailed information about the location, height, and characteristics of the proposed structure. Safety Assessments: • A comprehensive safety assessment must be conducted to evaluate the potential impacts of the structure on air navigation systems. • The assessment should consider factors such as the structure's proximity to flight paths, aerodrome operations, and potential electromagnetic interference with navigational aids. Compliance and Monitoring: • Ongoing monitoring and compliance checks are necessary to ensure that the structures remain safe for aviation throughout their operational life. • Periodic inspections and maintenance of marking and lighting systems are required to maintain compliance with ICAO standards.	• Notification: Provide detailed notifications to relevant aviation authorities about the proposed structure. • Safety Assessments: Conduct comprehensive safety assessments to evaluate potential impacts on air navigation systems. • Compliance and Monitoring: Implement ongoing monitoring and maintenance programs to ensure continued compliance with ICAO standards.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
Climate Change	The National Strategy for Climate Change 2022-2035 (Presidential Decree 216/22 of August 23rd). Outlines Angola's comprehensive approach to addressing climate change over a 14-year period. This strategy sets forth the country's goals for reducing greenhouse gas emissions, enhancing climate resilience, and promoting sustainable development. It prioritises actions in key sectors such as energy, agriculture, forestry, and water resources, aiming to mitigate the impacts of climate change and adapt to its effects. The strategy also emphasises the importance of integrating climate considerations into national policies, fostering international cooperation, and mobilising resources for climate action.	Climate change mitigation and adaptation are critical aspects of sustainable development. The IFC Performance Standards, particularly Standards 3 and 6, along with the Task Force on Climate-Related Financial Disclosures (TCFD) recommendations, provide comprehensive guidelines for managing GHG emissions and assessing climate-related risks. IFC Performance Standard 3 (Resource Efficiency and Pollution Prevention): Performance Standard 3 focuses on promoting sustainable resource use and pollution prevention. It mandates the quantification and reporting of GHG emissions for significant emitters and encourages the implementation of cost-effective measures to reduce emissions. GHG Emissions Quantification (Not Applicable) Annual Reporting: Projects that are significant sources of GHG emissions (typically those emitting more than 25,000 tonnes of CO2 equivalent per year) must quantify and report their emissions annually. Scope of Emissions: This includes both direct emissions (Scope 1) from project activities and indirect emissions (Scope 2) from the consumption of purchased electricity, heat, or steam. Reduction Measures: - Cost-Effective Measures: Projects are encouraged to implement cost-effective measures to reduce GHG emissions. This can include energy efficiency improvements, adoption of renewable energy sources, and process modifications to lower emissions. - Alternatives Analysis: An analysis of alternatives should be conducted to identify opportunities for reducing emissions during the project design, construction, and operation phases. IFC Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources): Performance Standard 6 addresses the impacts of climate change on biodiversity and ecosystems. It emphasizes the need to assess and manage these impacts to ensure the conservation of biodiversity. Climate Change Impact Assessment: - Biodiversity and Ecosystems: Projects must assess the potential impacts of climate change on biodiversity and	The Project will adopt the following standards based on IFC Performance Standards and TCFD guidelines: GHG Emissions Quantification (Performance Standard 3): - Cost-Effective Reduction Measures: Implement energy efficiency improvements, renewable energy sources, and process modifications to reduce emissions. - Alternatives Analysis: Conduct an analysis of alternatives to identify opportunities for emission reductions. Climate Change Impact on Biodiversity (Performance Standard 6): - Impact Assessment: Assess the potential impacts of climate change on biodiversity and ecosystems. - Adaptation Measures: Implement measures to enhance the resilience of ecosystems and biodiversity to climate change. Climate-Related Risk Reporting (TCFD): - Governance: Disclose how climate-related risks are managed at the governance level. - Strategy: Outline the impacts of climate-related risks and opportunities on business strategy and financial planning. - Risk Management: Describe processes for identifying, assessing, and managing climate-related risks. - Metrics and Targets: Disclose metrics and targets for managing climate-related risks, including GHG emissions and energy consumption.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		ecosystems. This includes evaluating how changes in temperature, precipitation, and extreme weather events could affect habitats and species. - Adaptation Measures: Projects should implement adaptation measures to enhance the resilience of ecosystems and biodiversity to climate change impacts. This can include habitat restoration, conservation planning, and creating ecological corridors. Task Force on Climate-Related Financial Disclosures (TCFD): The TCFD provides detailed guidance for reporting climate-related risks and opportunities. It focuses on integrating climate considerations into financial and strategic planning. Climate-Related Risk Reporting: - Governance: Projects must disclose how climate-related risks and opportunities are managed at the governance level. This includes the roles and responsibilities of the board and management in overseeing climate-related issues. - Strategy: Projects should outline the actual and potential impacts of climate-related risks and opportunities on their business, strategy, and financial planning. This includes scenario analysis to assess the resilience of the project under different climate scenarios. Risk Management: - Processes: Projects must describe the processes used to identify, assess, and manage climate-related risks. This includes integration into the overall risk management framework. - Metrics and Targets: Projects should disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities. This includes GHG emissions metrics, energy consumption, and targets for reducing emissions.	
Flora and Fauna	Angolan requirements are aligned with IFC and GIIP. MINAMB oversees environmental protection and compliance with the General	Biodiversity conservation is a fundamental aspect of sustainable development, ensuring the protection and sustainable management of natural resources and ecosystems. GIIP includes standards and guidelines such	The Project will adopt the following standards based on the EP4 and IFC PSS.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
	Environmental Law and various decrees, ensuring activities comply with environmental impact assessments, licensing, and mitigation measures. These regulations reflect international standards and practices advocated by IFC and GIIP.	as the EP4, IFC EHS Guidelines, and IFC PS. These frameworks provide comprehensive requirements for identifying, assessing, and mitigating environmental impacts, protecting natural habitats, and promoting the sustainable management of natural resources. Equator Principles (EP4): The Equator Principles are a risk management framework adopted by financial institutions to determine, assess, and manage environmental and social risks in projects. EP4 focuses on biodiversity conservation by incorporating standards that align with the IFC Performance Standards and EHS Guidelines. Environmental and Social Assessment: - Projects must conduct a thorough ESIA to identify potential impacts on biodiversity and natural habitats. - The assessment should include baseline studies to understand the existing environmental conditions and predict potential impacts. Mitigation Measures: - Projects are required to implement the mitigation hierarchy: avoid, minimise, mitigate, and, where residual impacts remain, compensate or offset. This approach ensures that impacts on biodiversity are systematically managed. - Biodiversity Action Plans (BAPs) may be developed to outline specific conservation actions and targets. Stakeholder Engagement: - Effective stakeholder engagement, including consultations with affected communities and biodiversity experts, is crucial for addressing biodiversity concerns and ensuring the successful implementation of conservation measures. IFC EHS Guidelines: The IFC EHS Guidelines provide technical reference documents with examples of Good International Industry Practice (GIIP) to manage environmental, health, and safety issues. These guidelines are integral to biodiversity conservation efforts.	Environmental and Social Assessment (EP4): - Conduct thorough Environmental and Social Impact Assessments (ESIAs) to identify potential impacts on biodiversity. - Develop and implement mitigation measures following the hierarchy: avoid, minimise, mitigate, and offset. Protection of Natural Habitats (IFC EHS): - Ensure natural habitats, including critical habitats, are identified and protected from adverse project impacts. - Implement sustainable management practices for natural resources. Sustainable Management and Pollution Prevention (IFC EHS and PS3): - Adopt resource-efficient and cleaner production processes to minimise environmental impacts. - Implement pollution prevention and control measures to protect biodiversity. Biodiversity Conservation and Sustainable Management (IFC PS6): - Identify and assess potential impacts on biodiversity and ecosystems. - Implement measures to avoid impacts on critical habitats and endangered species, and provide offsets where necessary. - Promote sustainable management practices for biological resources.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		Protection of Natural Habitats: - Projects must ensure that natural habitats, including legally protected and internationally recognized areas, are not adversely affected by project activities. - Critical habitats, which are areas with high biodiversity value, must be identified and protected. Sustainable Management of Natural Resources: - Sustainable management practices must be applied to the use of natural resources to ensure their long-term viability and health. - This includes the sustainable use of water, soil, and biological resources. Pollution Prevention and Control: - Measures must be implemented to prevent and control pollution that could harm biodiversity, such as proper waste management, air and water pollution controls, and hazardous materials management. IFC PS: The IFC Performance Standards provide guidelines for managing environmental and social risks and impacts. Performance Standards 1, 3, and 6 are particularly relevant to biodiversity conservation. Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts): - Projects must establish and maintain an Environmental and Social Management System (ESMS) to manage risks and impacts, including those related to biodiversity. - Continuous monitoring and adaptive management practices should be in place to address biodiversity concerns throughout the project lifecycle. Performance Standard 3 (Resource Efficiency and Pollution Prevention): - Projects are encouraged to adopt resource-efficient and cleaner production processes to minimise environmental impacts, including those on biodiversity.	

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		- GHG emissions should be quantified and reported, with measures taken to reduce emissions and mitigate climate change impacts on biodiversity. Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources): - Projects must identify and assess potential impacts on biodiversity and ecosystems. - Measures must be implemented to avoid impacts on critical habitats and endangered species. Where impacts cannot be avoided, projects must minimise and mitigate these impacts, and, where necessary, provide offsets to ensure no net loss of biodiversity. - Sustainable management practices should be promoted to ensure the conservation and sustainable use of biological resources.	
Freshwater resources	The General Environmental Law No. 5/98: Provides a framework for environmental protection, including the conservation and rational use of natural resources like freshwater ecosystems. Presidential Decree No. 261/11: Sets standards for water quality to protect freshwater ecosystems from pollution. Presidential Decree No. 190/12: Regulates waste management to prevent pollution of freshwater ecosystems. Presidential Decree No. 82/14: Regulates the use of water resources, aiming to prevent activities that could harm freshwater ecosystems.	Effective management of environmental risks, pollution prevention, and the protection of community health and biodiversity are critical components of sustainable project development. The IFC Standards PSs, EHS guidelines, and the EP4 collectively emphasise these aspects to ensure high standards for the sustainable use of natural resources and protection of freshwater ecosystems. Key Components of the Standards: Environmental Risk Management: The IFC PS, EHS, and EP4 frameworks provide a comprehensive approach to managing environmental risks associated with project developments. This includes identifying, assessing, and mitigating potential environmental impacts throughout the project lifecycle. Projects must establish and maintain an Environmental and Social Management System (ESMS) to ensure continuous monitoring, management, and reporting of environmental risks Pollution Prevention: Pollution prevention measures are integral to the IFC PS, EHS, and EP4 standards. Projects are required to implement best practices for minimizing pollution from various sources, including air emissions, solid waste, and wastewater discharges.	The Project will adopt the following standards based on IFC PS, EHS, EP4 and national water quality guidelines: National water quality guidelines See Section 0 Environmental Risk Management: - Establish and maintain ESMS to manage environmental risks. - Conduct continuous monitoring, management, and reporting of environmental impacts. Pollution Prevention: - Implement best practices for minimising pollution from air emissions, solid waste, and wastewater discharges. - Ensure pollution prevention measures are in place to protect community health and the environment. Community Health: - Assess and manage health risks to local communities from project activities.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		- These measures are designed to reduce the environmental footprint of projects and protect the health of local communities and ecosystems. Community Health: - Protecting community health is a priority under these standards. Projects must assess and manage health risks to communities, ensuring that they are not adversely affected by project activities. - This includes addressing potential health impacts from pollution, ensuring safe drinking water, and maintaining air quality standards. Biodiversity Conservation: - Biodiversity conservation is emphasised across all three frameworks. Projects must identify and protect critical habitats, implement measures to mitigate impacts on biodiversity, and promote the sustainable management of natural resources. - This includes developing Biodiversity Action Plans (BAPs) and integrating biodiversity considerations into project planning and operations. Protection of Freshwater Ecosystems: - The standards highlight the importance of protecting freshwater ecosystems from pollution, particularly from wastewater discharges. Projects must ensure that discharges to surface water do not exceed local ambient water quality criteria and comply with national or local regulations. Local Ambient Water Quality Criteria: - Wastewater discharges must meet or exceed local ambient water quality criteria. This ensures that the receiving water bodies are not adversely affected by the project's effluent. - Projects must monitor the quality of their discharges regularly and take corrective actions if standards are not met. Compliance with Regulations: - Compliance with national or local regulations governing wastewater discharges is mandatory. Projects must	Maintain air quality standards and ensure safe drinking water for communities.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		stay informed about regulatory changes and ensure that their treatment processes are up to date. This includes obtaining necessary permits and conducting regular audits to verify compliance.	
Soils	Angolan Law No. 9/04 promotes sustainable soil management by regulating land use, preventing soil degradation, and ensuring environmental protection, while also establishing a framework for enforcement and public participation.	Soil protection is crucial in maintaining environmental health and ensuring the sustainability of agricultural and natural ecosystems. The IFC Performance PSs, EHS guidelines, and the EP4 provide comprehensive guidelines to identify, assess, and mitigate environmental impacts on soil. These standards emphasise preventing soil degradation, contamination, and erosion through best practices and compliance with host country laws. Key Components of the Standards: Identification and Mitigation of Soil Impacts (IFC PS1 and PS3): - PS1 focuses on the assessment and management of environmental and social risks and impacts. It requires projects to identify potential impacts on soil during the ESIA process and to implement measures to mitigate these impacts. - PS3 addresses resource efficiency and pollution prevention, emphasising the need to prevent soil contamination and degradation. Projects must adopt practices that minimise the release of pollutants and manage waste effectively to protect soil quality. - Projects must implement measures to prevent soil contamination from hazardous substances, chemicals, and waste. This includes proper storage, handling, and disposal of materials that could harm soil quality. - Projects must adopt practices to prevent soil erosion, such as maintaining vegetation cover, using erosion control fabrics, and constructing terraces or retaining walls where necessary. Compliance with Host Country Laws (EP4): - The EP4 require projects to comply with host country laws and regulations related to soil protection. This ensures that projects meet or exceed national standards for environmental management.	The Project will adopt the following standards based on IFC PS, EHS, and EP4 guidelines: Identification and Mitigation of Soil Impacts (IFC PS1 and PS3): - Conduct Environmental and Social Impact Assessments (ESIAs) to identify potential impacts on soil. - Implement measures to mitigate soil degradation and contamination, following resource efficiency and pollution prevention practices. Best Practice Standards for Soil Protection (IFC EHS Guidelines): - Implement pollution prevention and control measures to protect soil from hazardous substances and waste. - Adopt erosion control practices such as maintaining vegetation cover, using erosion control fabrics, and constructing terraces. Compliance with Host Country Laws (EP4): - Ensure compliance with host country laws and regulations related to soil protection. - Adopt sustainable land management practices to prevent soil degradation, such as crop rotation, conservation tillage, and the use of organic fertilizers. Soil Degradation Prevention: - Assess potential risks to soil health and implement measures to prevent erosion, contamination, and compaction. - Use soil conservation practices and maintain ground cover to protect soil quality.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		- EP4 emphasises the adoption of sustainable land management practices to prevent soil degradation. This includes practices such as crop rotation, conservation tillage, and the use of organic fertilizers. Soil Protection Measures: Soil Degradation Prevention: - Projects must assess potential risks to soil health, including erosion, contamination, and compaction, and implement measures to prevent these issues. - Mitigation measures may include controlling land disturbance, maintaining ground cover, and implementing soil conservation practices. Soil Contamination Control: - Projects must prevent soil contamination by managing hazardous substances, chemicals, and waste effectively. This includes using containment systems, spill prevention measures, and regular monitoring of soil quality. - Remediation plans should be developed and implemented in case of accidental contamination to restore soil health. Erosion Control: - To prevent soil erosion, projects should use practices such as planting cover crops, building terraces, and installing silt fences. Maintaining natural vegetation and minimizing land disturbance are also effective strategies. - Projects in areas prone to erosion should conduct regular monitoring and maintenance of erosion control measures to ensure their effectiveness. Compliance and Monitoring: - Regular monitoring of soil quality is essential to ensure compliance with environmental standards and to detect any potential issues early. Soil sampling and testing should be conducted periodically. - Compliance with host country laws and regulations related to soil protection is mandatory. Projects must stay informed about regulatory changes and ensure that their practices remain compliant.	Soil Contamination Control: - Manage hazardous substances, chemicals, and waste effectively to prevent soil contamination. - Develop and implement remediation plans in case of accidental contamination. Erosion Control: - Conduct regular monitoring and maintenance of erosion control measures. Compliance and Monitoring: - Conduct regular soil quality monitoring and testing to ensure compliance with environmental standards. - Stay informed about regulatory changes and ensure practices remain compliant with host country laws.

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Heritage	The Environmental Framework Law No. 5/98, aligned with the Angolan Constitution, governs environmental legislation in Angola, with the MINAMB developing policies for sustainable development. Relevant laws include the Environmental Impact Assessment Law (PD 117/20), which mandates assessing socio-economic and environmental resources, and the Cultural Heritage Law (14/05), which protects material and immaterial cultural heritage. Additionally, Angola ratified both the 1972 and 1970 UNESCO conventions in 1991, demonstrating its commitment to protecting cultural heritage and combating illicit trade. As part of its obligations, Angola has adopted national measures to identify, protect, and manage cultural heritage sites and prevent the illicit movement of cultural goods.	The protection of cultural and natural heritage is crucial for preserving the historical and cultural identity of societies. UNESCO conventions, along with IFC PSSs, provide a framework for safeguarding cultural heritage and managing associated risks in infrastructure and development projects. UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) The 1972 Convention, often referred to as the World Heritage Convention, establishes a framework for identifying, protecting, and preserving cultural and natural heritage sites of outstanding universal value. Key aspects include: • Identification and Protection: Countries that ratify the convention commit to identifying and nominating sites for the World Heritage List. They also agree to protect these sites through appropriate legal, scientific, and technical measures. • International Assistance: The convention provides for international cooperation and assistance in the conservation and management of World Heritage sites. • Sustainable Use: It emphasizes the need for sustainable use of heritage sites to ensure their preservation for future generations. UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property (1970) The 1970 Convention focuses on combating the illegal trade in cultural property and includes provisions such as: • Preventive Measures: Countries are required to implement measures to prevent the illicit trafficking of cultural property, including establishing national inventories and control mechanisms. • Restitution and Cooperation: It facilitates international cooperation for the restitution of stolen cultural property to its country of origin. • Public Awareness: The convention encourages education and awareness-raising activities to highlight the importance of cultural heritage and the dangers of illicit trade.	The Project will adopt the following standards based on the UNESCO conventions and IFC PS8: UNESCO Conventions • Identification and Protection: Identify and protect cultural heritage sites as per the 1972 UNESCO Convention. • Preventive Measures: Implement measures to prevent the illicit trafficking of cultural property in line with the 1970 UNESCO Convention. IFC PS8 • Impact Assessment: Conduct comprehensive impact assessments to evaluate potential effects on cultural heritage. • Consultation and Engagement: Engage with stakeholders, including local communities and cultural heritage experts. • Chance Finds Procedure: Develop and implement a chance finds procedure to manage unexpected discoveries of cultural heritage. • Legal Compliance: Ensure compliance with national and international laws related to cultural heritage protection. • Documentation and Reporting: Maintain thorough documentation and regularly report on cultural heritage management efforts.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		IFC Performance Standard 8: Cultural Heritage IFC PS8 provides guidelines for project proponents to manage risks and impacts on cultural heritage in their development projects. Key components include: • Impact Assessment: Projects must assess potential impacts on cultural heritage and implement measures to avoid, minimise, or mitigate any adverse effects. • Consultation and Engagement: Engage with stakeholders, including affected communities and cultural heritage experts, to identify and manage cultural heritage risks effectively. • Chance Finds Procedure: Establish procedures for managing unexpected discoveries of cultural heritage during project implementation. • Legal Compliance: Ensure compliance with relevant national and international laws and conventions related to cultural heritage. • Documentation and Reporting: Maintain accurate records of cultural heritage assessments and management plans, and report on the implementation of mitigation measures.	
Visual	Angola currently does not have guidelines for assessing visual impacts	The visual impact of a project, particularly in sectors such as infrastructure and tourism, is a significant concern addressed by the IFC PSs) and EH) Guidelines. IFC PS1 and the general EHS Guidelines provide a framework for identifying, assessing, and managing these impacts to maintain visual quality and avoid significant disruptions to landscapes and visual aesthetics. IFC Performance Standard 1 (PS1): Assessment of Visual Impacts: • The Environmental and Social Impact Assessment (ESIA) process under PS1 requires a comprehensive evaluation of the potential visual impacts of a project. • Visual impacts should be considered in the context of the surrounding landscape, community perceptions, and the intrinsic visual qualities of the area. • The assessment process includes baseline studies to understand the current visual environment and predict the changes that the project may bring.	Adopted Project Standards: For the Project, the following standards should be adopted based on IFC PS1 and EHS Guidelines: Assessment: • Conduct comprehensive visual impact assessments as part of the ESIA. • Include baseline studies and predictive modelling. Mitigation: • Design modifications to minimise visual intrusion. • Use natural barriers and landscaping. • Choose materials and colours that blend with the environment.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		Mitigation Measures: - Implement design measures that integrate the project into the surrounding landscape, such as using materials and colours that blend with the natural environment. - Use of natural barriers or landscaping to minimise the visual intrusion of the project. - Ensure that the design and location of infrastructure consider the visual impact on key viewpoints and sensitive receptors. Stakeholder Engagement: - Engage with affected communities and stakeholders to understand their concerns regarding visual impacts. - Incorporate feedback from stakeholders into the project design and mitigation measures to ensure that community values and aesthetics are respected. IFC General EHS Guidelines Importance of Visual Impact Management: - Emphasises the need to assess and manage visual impacts to avoid significant disruptions to the visual environment, especially in sensitive areas and communities reliant on tourism. Assessment Process: - Identify key visual receptors, including residential areas, scenic routes, cultural sites, and natural landscapes. - Use visual simulations and modeling to predict the visual changes and assess the severity of impacts. Mitigation Strategies: - Design modifications to reduce visual prominence, such as altering the layout, scale, and orientation of structures. - Incorporation of vegetative buffers and other natural elements to screen and blend the project into the landscape. - Maintenance of cleanliness and aesthetic quality of the site, especially during construction phases.	Stakeholder Engagement: - Engage with communities to incorporate their feedback. - Address concerns about visual impacts through design and mitigation. Monitoring: - Implement ongoing monitoring programs. - Ensure compliance with visual impact mitigation measures.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		Monitoring and Compliance: - Continuous monitoring of visual impacts throughout the project lifecycle to ensure compliance with mitigation measures. - Implement corrective actions if monitoring indicates that visual impacts exceed acceptable levels.	
Occupational Health and Safety	General Labour Law No. 2/00 (2000) establishing the requirements for occupational safety and health in workplaces.	ILO Occupational Safety and Health Convention, 1981 (No. 155) and its Protocol of 2002 - Formulation, implementation, and periodic review of a coherent national policy on occupational safety and health in consultation with the most representative organizations of employers and workers - Ensuring that workers are informed of potential hazards - Providing necessary training for workers - Protecting workers through appropriate safety measures IFC PS2 (Labour and Working Conditions) - Identification and assessment of occupational health and safety risks - Implementation of preventive and protective measures - Monitoring and reporting on occupational health and safety performance - Providing training to workers on occupational health and safety issues - Establishing procedures for reporting and investigating workplace incidents.	Implementing OHS management systems as per IFC PS2. Adhering to the requirements of ILO conventions regarding worker safety, training, and hazard communication
Stakeholder Engagement	The EIA Law (Law No. 5/98) and its subsequent regulations emphasise the need for public participation in the EIA process, ensuring that affected communities and other stakeholders are informed and have an opportunity to provide input. The MINAMB oversees the implementation of these requirements, ensuring that stakeholder concerns are	IFC PS 1, Equator Principles, UNGPs, SDGs, OECD Due Diligence Guidelines, and IFC EHS Guidelines. emphasise stakeholder engagement, environmental and social risk management, inclusion of vulnerable groups, and effective grievance mechanisms. IFC Performance Standard 1 (PS1) - Stakeholder Engagement Requirements: - Stakeholder engagement must be an ongoing process in a structured and culturally appropriate manner	Adopted Project Standards: For the Project, the following standards should be adopted based on IFC PS1, EP4, UNGPs, OECD Guidelines, SDGs and IFC EHS Guidelines. IFC PS1: - Ongoing stakeholder engagement process tailored to project risks and impacts - Disclosure of relevant project information in local languages

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
	considered in project planning and decision-making.	- Includes disclosure of project-related information, consultation with affected communities, and a grievance mechanism. - Informed Consultation and Participation (ICP) - For projects with significant adverse impacts, an Informed Consultation and Participation process is required - Tailors the consultation process to the risks and impacts of the project, the project's development phase, the language preferences of affected communities, and the needs of disadvantaged and vulnerable groups. - Disclosure: - Make appropriate assessment documentation readily available to affected communities in the local language and in a culturally appropriate manner. - Early disclosure of environmental or social risks and impacts before project construction begins and on an ongoing basis. - Documentation: - Document the results of the stakeholder engagement process, including any actions agreed upon. Equator Principles (EP4) reemphasises effective stakeholder engagement as part of the environmental and social review and due diligence process - Requires a process of Informed Consultation and Participation, especially for projects affecting Indigenous Peoples and communities - Mandates that clients disclose relevant environmental and social information and consult with affected communities. United Nations Guiding Principles on Business and Human Rights (UNGPs) - Human Rights Due Diligence: - Conduct human rights due diligence, including stakeholder engagement to identify, prevent,	- Implementation of a grievance mechanism. Equator Principles (EP4): - Adhere to Informed Consultation and Participation processes - Ensure timely disclosure and consultation. UNGPs: - Conduct human rights due diligence involving stakeholder engagement. OECD Guidelines: - Follow the stakeholder engagement framework for responsible business conduct. SDGs: - Promote inclusive decision-making and partnerships. IFC General EHS Guidelines: - Implement effective stakeholder engagement and grievance mechanisms.

Aspect	National legislation/Standards	International Standards	Adopted Project Standards
		mitigate, and account for how they address their impacts on human rights - Consultation and Participation: - Engage with potentially affected stakeholders as part of human rights due diligence. OECD Due Diligence Guidance for Responsible Business Conduct - Stakeholder Engagement Framework: - Provides a framework for engaging stakeholders throughout the project lifecycle - Emphasises meaningful engagement, transparency, and responsiveness to stakeholder concerns. Sustainable Development Goals (SDGs) - Goal 16: Peace, Justice, and Strong Institutions: - Promote inclusive decision-making and public participation. - Goal 17: Partnerships for the Goals: - Encourage multi-stakeholder partnerships to achieve sustainable development. IFC General EHS Guidelines - Stakeholder Engagement: - Highlights the importance of external communication, participation, and grievance mechanisms. - Recommends effective communication strategies to engage stakeholders.	

4 Description of biophysical and social baseline

The environmental and social baseline conditions were established using existing secondary data as well as site reconnaissance and investigation by relevant specialists. This section provides an overview of the current baseline context.

4.1 Defining the Area of Influence

The Area of Influence (AoI) of a Project is defined as the geographic and environmental space susceptible to change as a result of direct or indirect impacts arising from the implementation, maintenance and operation over the lifetime of a project. MINAMB's Terms of Reference for Impact Studies requires the Project AoI to be described in terms of three divisions, namely:

- Directly Affected Area (DAA) – The area physically occupied or altered by project infrastructure and activities (i.e., Project footprint);
- Direct Influence Area (DIA) – The area affected by direct impacts associated with construction and operational activities, resulting from interactions between project infrastructure, routine activities, and the receiving environment such as dust, noise, and socio-economic effects; and
- Indirect Influence Area (IIA) – The broader region potentially affected by indirect impacts of a project, including induced development, population in-migration, changes in regional land use and access, and impacts related to unforeseen or accidental project events..

While the AoI for the Project was primarily defined in accordance with MINAMB's Terms of Reference, key cumulative impact aspects were taken into account in its delineation, particularly in defining the Indirect Influence Area (IIA). For example, the IIA was expanded beyond the immediate project footprint to encompass municipalities and geographic areas likely to experience synergistic impacts linked to the Project. This includes potential land use changes along new access routes, in-migration into project-adjacent towns due to improved electrification and employment opportunities, and increased pressure on natural resources such as woodlands and water sources. While this approach captures the broader spatial dynamics for much of the route, it is acknowledged that some areas may also be subject to in-migration and associated synergistic effects, and warrant additional monitoring or inclusion in future updates to the AoI. The inclusion of these broader spatial elements reflects an understanding of the Project's potential to generate cumulative regional change.

Other potential cumulative impacts are more difficult to spatially define at the AoI level due to uncertainty or lack of detailed information about future third-party developments, such as agricultural intensification or planned regional infrastructure. In these cases, cumulative impacts could not be reflected through a static spatial boundary but were instead assessed thematically in the dedicated CIA (Section 6.8). This allowed for a qualitative and scenario-based assessment of how the Project may interact with foreseeable trends and developments in the region over time, even if their exact location, scale, or timing remains uncertain.

It is important to note that the definition of the AoI was guided by the information on key project elements available at the time of the assessment. Recognising this, any adjustments to the project scope that may affect the defined AoI, will be managed through PAK Yatirim's Management of Change Procedure (PY-ANG-MOC-PRO-00001). This procedure is a proactive approach that identifies the significance of any potential environmental and social impacts resulting from project modifications. These modifications, for example, may include the finalised location of borrow pits and future considerations around the Gove substation.

4.1.1 Directly Affected Area (DAA)

The DAA refers to the designated footprint area essential for executing the Project, encompassing both its foundational elements and ancillary facilities. This encompasses the construction, expansion,

or renovation of private access roads, along with all other operational facets exclusively linked to the Project's infrastructure such as the towers and substations.

The DAA for the Project includes the following:

- 2 036 000 m² for permanent HV OHL towers (509 towers, 80 m X 50 m per tower);
- 4 680 000 m² for access roads, which comprises 472 km existing access roads outside the OHL 100 m corridor that will be upgraded/maintained, and 113 km new access roads falling within the OHL 100 m corridor (to also be used for maintenance). Access roads will require an 8 m Right of Way (i.e., 4 m for the access roads and a 2 m buffer on either side for the disturbance zone) (585 km of OHL X 8 m wide);
- 5 000 m² for each construction/camp site (i.e., at Gove, Chipindo, Cuvango and Jamba); and
- 15 000 m² for each substation (i.e., at Chipindo, Cuvango and Jamba).

4.1.2 Direct Influence Area (DIA)

The extent of the DIA is intricately linked to the specific environmental and social factors being assessed. It is the area of direct impacts of the Project on the natural environmental (e.g. topography, flora and fauna and water resources) and socio-economic environment (e.g. land occupation, economic activities and cultural resources). These DAA areas typically correspond to locations where physical infrastructure is established and construction activities take place. There will also be marginal areas where the impacts of the Project will be experienced directly. For example, the dispersion area of airborne pollutants emitted by vehicular traffic designated for the Project differs from the zone exposed to noise emissions generated by the same traffic. Consequently, the DIA associated with air pollution will vary from that of noise pollution.

The DIA for the Project includes the following:

- 100 m buffer around the HV 220 kV OHL;
- 2 m buffer around access roads comprising the disturbance zone;
- 18 m around MV 30kV and LV OHLs; and
- Temporary laydown areas within the 100 m buffer area.

Figure 4-1 presents the geographic location of the DIA for the Project. Volume 3, Appendix B presents detailed map sheets of the Project's DAA and DIA for reference.

4.1.3 Indirect Influence Area (IIA)

The IIA 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. The level of analysis could be established on a larger scale by assessing the impacts and benefits of the Project on a municipal and commune scale. For example, the socio-economic assessment is directly influenced by the employment opportunities generated within the Project's framework, particularly during the construction phase. Additionally, indirect effects arise from the socio-economic changes experienced by these workers and future employees, such as enhanced purchasing power leading to increased consumption of local goods and services in the region.

In this instance, the IIA includes a broader area of all communes and municipalities crossed by the Project, as presented in Table 4-1 and Figure 4-1. Volume 3, Appendix B presents detailed map sheets of the Project's DAA and DIA for reference.

Table 4-1: Municipalities and communes in the IIA

Province	Municipality	Communes
Huila	Jamba	Dongo
		Jamba

Province	Municipality	Communes
	Chipindo	Kassinga
		Bambi
		Chipindo
	Cuvango	Galangue
		Kuvango
		Vikungo

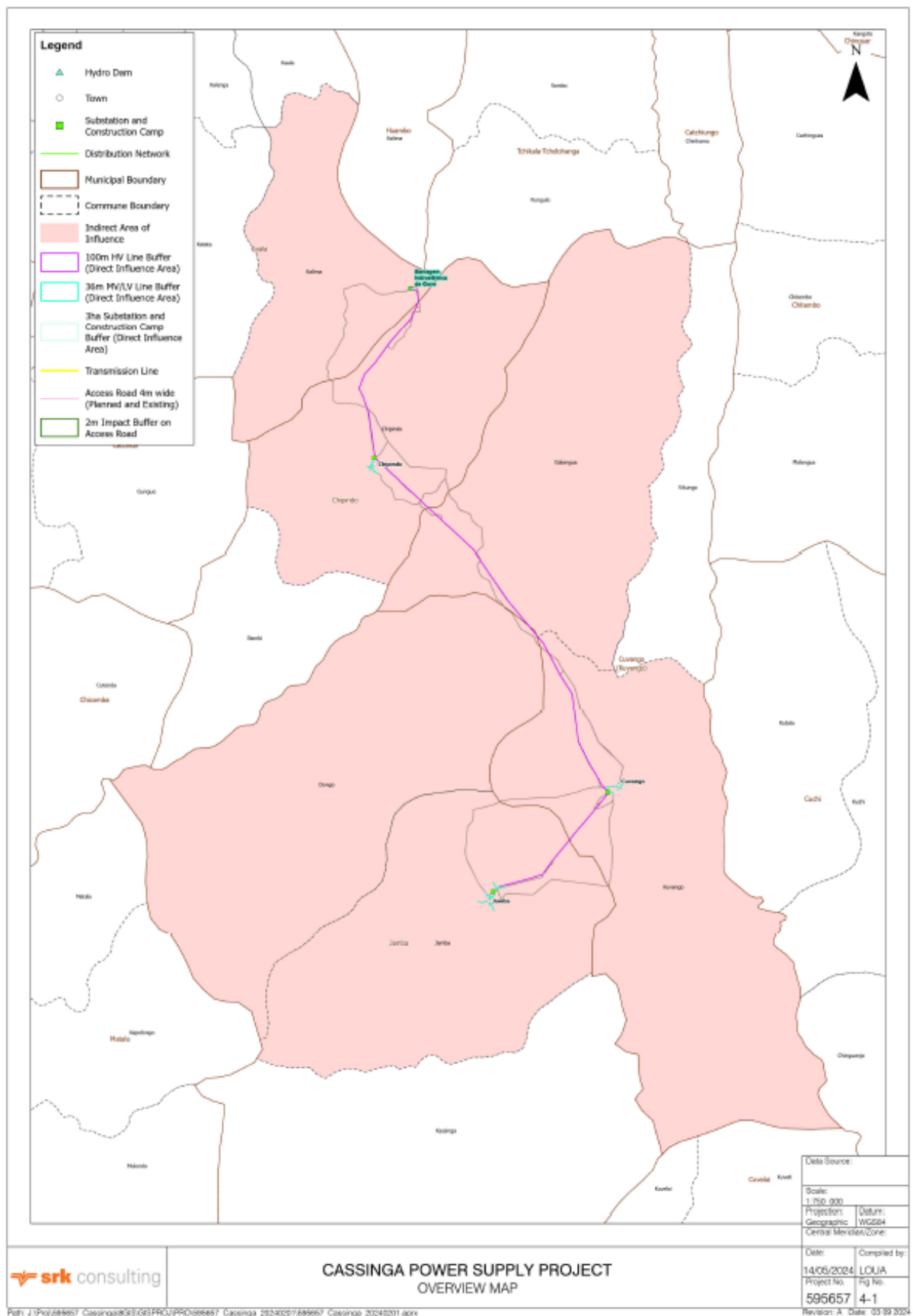


Figure 4-1: Project's Aol

4.2 Climate and meteorology

This section presents an overview of climatic conditions and meteorology that occur across the Project area. This information is drawn from the air quality assessment (SRK, 2024a) and climate change study (SRK, 2024b) conducted for the ESIA (refer to Volume 4, Appendix A and B for the detailed specialist assessments).

4.2.1 General description of climate in Angola

Angola experiences a diverse range of climatic conditions due to its vast geographical expanse and varying topography. The country lies within the tropics, encompassing both equatorial and subtropical regions. Generally, Angola's climate can be classified into three main zones:

- **Coastal Region:** The coastal area, particularly in the west, features a maritime tropical climate. It is characterised by moderate temperatures, relatively high humidity levels, and distinct wet and dry seasons. The dry season typically extends from May to September, while the wet season occurs from October to April. Average temperatures along the coast range from around 20°C to 25°C (68°F to 77°F);
- **Highland Region:** The central plateau experiences a subtropical highland climate. Temperatures here are generally milder compared to the coast, with cooler nights and warmer days. The rainy season lasts from November to April, and the dry season persists from May to October. The average temperatures range from about 14°C to 22°C (57°F to 72°F); and
- **Interior Region:** The eastern and south-eastern parts of Angola, including regions near the border with Zambia and the Democratic Republic of Congo, have a tropical savanna climate. This zone is marked by distinct wet and dry periods. The rainy season spans from November to April, while the dry season spans from May to October. Temperatures in the interior can be warmer, with averages ranging from around 20°C to 30°C (68°F to 86°F).

It's important to note that climatic patterns can exhibit variations due to factors such as altitude, proximity to the ocean, and local geography. Angola's climate is also influenced by seasonal shifts in the Inter-Tropical Convergence Zone and the Benguela Current, which contribute to the country's unique climatic characteristics.

4.2.2 Regional climate context

The Köppen Climate Classification System was used to classify the climatic conditions in and around the study area. In broad terms, Angola's North and East regions are classified as tropical humid savanna (Aw), while the central plateau enjoys a temperate rainy and moderately warm climate (Cw). The western and southern zones, along with the coastal plain, generally experience cold desert dry conditions (Bwh) and warm steppe climate (Bsh).

Huíla and Huambo provinces (Project footprint) both exhibit a subtropical highland climate classified as "Cwb" under the Köppen climate classification system, which indicates a temperate oceanic climate with dry winters. Due to their high elevations, both regions experience warm summers and cooler winters. Lubango, the capital of Huíla, exemplifies this climate pattern. Similarly, Huambo also features mild temperatures year-round, clearly delineated into a dry season and a wet season, reflecting its similar geographic and climatic conditions.

Cuvango, Chipindo, and Jamba, located in southern Angola, experience a subtropical climate with distinct wet and dry seasons. The arid lowlands from the Namibian border to Luanda transition into plateau and escarpment zones inland, which are temperate mesothermal. To the east and southeast lies the dry savanna of the Planalto region, while the north features a tropical rainforest climate. The Project locality in the southern region generally has warm to hot temperatures year-round, with mild seasonal variations. The hottest months, from October to March, see average daytime temperatures of 25°C to 30°C. The coolest months, May to August, have daytime temperatures of 15°C to 20°C. The wet season runs from November to April, with peak rainfall from December to February, resulting

in lush vegetation and productive agriculture. Annual rainfall ranges from 800mm to 1200mm, higher in the east and lower in the west.

The dry season extends from May to October, with significantly reduced rainfall. June, July, and August are the driest months, with occasional showers or thunderstorms at the beginning and end of the season. Humidity is higher during the wet season due to increased moisture from rainfall and evaporation, while the dry season has lower humidity levels, especially at its peak. Mild winds prevail year-round, but the dry season afternoons can bring gusty "Harmattan winds" from the east or northeast, carrying dust and reducing visibility.

4.2.3 Local climate context

To accurately represent the meteorological conditions in the Project area, data was collected from Modern-Era Retrospective Analysis for Research and Applications (MERRA) for the Jamba, Chipindo, and Cuvango stations for the period from January 2019 to December 2023. Data for the prevailing wind profile, average temperatures and total precipitation recorded for the study area are presented below.

Wind field

The influence of winds on pollutant dispersion depends on wind speed and direction. Higher wind speeds enhance dispersion and dilution of air pollution, while lower, more stable wind conditions lead to shorter travel distances and pollutant build-up over smaller areas. Wind speed is also crucial in dust generation, with vegetation cover and soil structure playing significant roles.

Wind roses were analysed using Lakes Environmental WRPlot freeware (Version 8.0.2) for the period January 2019 to December 2023 at three stations and show the following conditions:

- Jamba Station : The annual wind rose (Figure 4-2) shows that winds predominantly came from the east and east-northeast directions. The average wind speed during the monitoring period was 3.34 m/s, with calm conditions observed 0.67% of the time;
- Chipindo Station: The annual wind rose (Figure 4-3) indicates that winds mainly came from the east and northeast directions. The average wind speed was 3.34 m/s, with calm conditions observed 1.02% of the time; and
- Cuvango Station: The annual wind rose (Figure 4-4) reveals that winds primarily came from the east and northeast directions. The average wind speed was 3.34 m/s, with calm conditions observed 0.67% of the time.

These wind patterns are crucial for understanding pollutant dispersion and potential air quality impacts in the Project area.

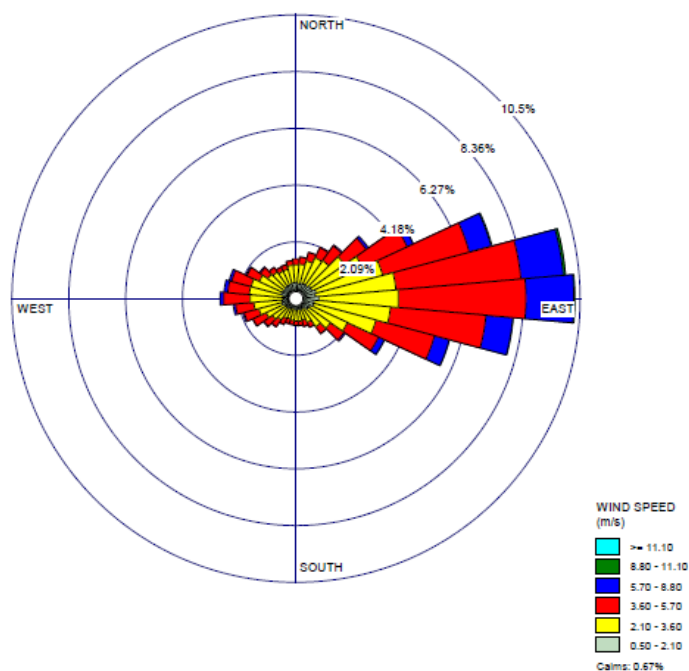


Figure 4-2: Local wind conditions period January 2019 to December 2023, using MERRA data from the Jamba Station

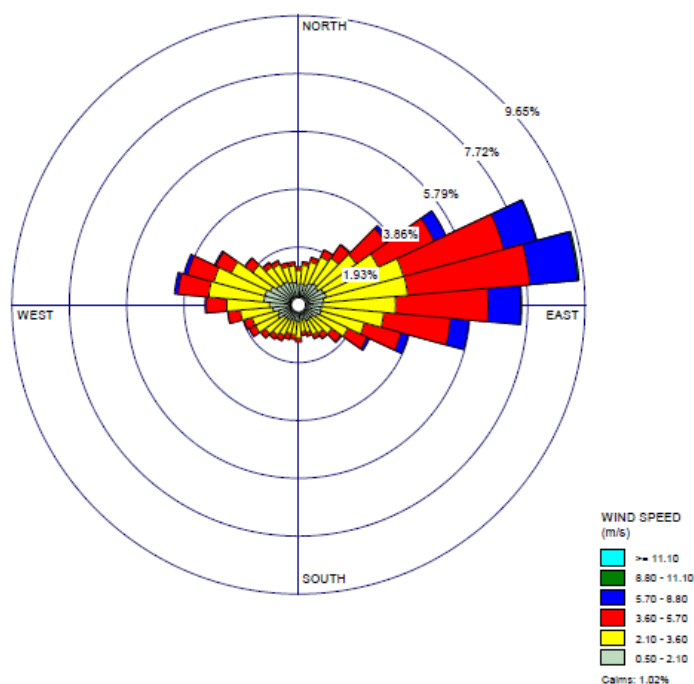


Figure 4-3: Local wind conditions period January 2019 to December 2023, using MERRA data from the Chipindo Station

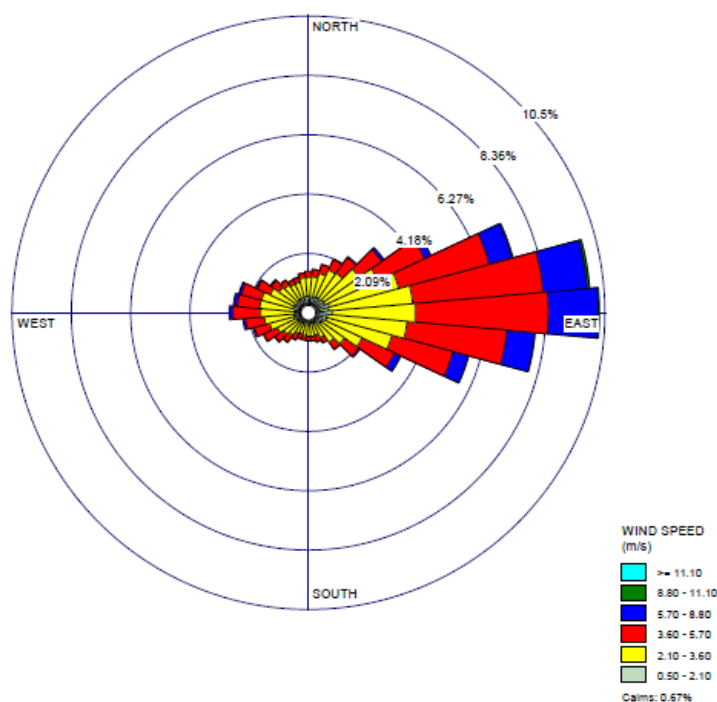


Figure 4-4: Local wind conditions period January 2019 to December 2023, using MERRA data from the Cuvango Station

Relative humidity

Humidity plays a crucial role in influencing weather patterns, particularly increasing the chances of heavier rainfall and more intense heatwaves. In the Cuanja and Cuvango regions, data shows that the relative humidity never drops below 40%, with the lowest recorded figure being 41.31% in 2015 and the highest at 71.41% in Gove during 2020. The average annual relative humidity across these areas consistently exceeds 50%, with specific averages of 51.19% in Cuanja and Cuvango, 54.68% in Chipindo, and 59.29% in Gove. This data suggests that the farther north you go towards Gove, the higher the humidity tends to be (Figure 4-5).

Further details show the average monthly relative humidity ranges significantly throughout the year. For example, in Cuanja and Cuvango, it swings from a low of 23.8% in August to a high of 73.2% in March. Similarly, in Chipindo, humidity ranges from 28.4% in August up to 74.4% in March, and in Gove, it varies from 34.6% in August to 76.7% in March. Notably, from May through October, humidity levels typically drop below the monthly averages at all monitored sites, reaching their lowest in August and peaking in March each year. These fluctuations are essential for understanding seasonal weather patterns and preparing for varying climatic conditions throughout the year.

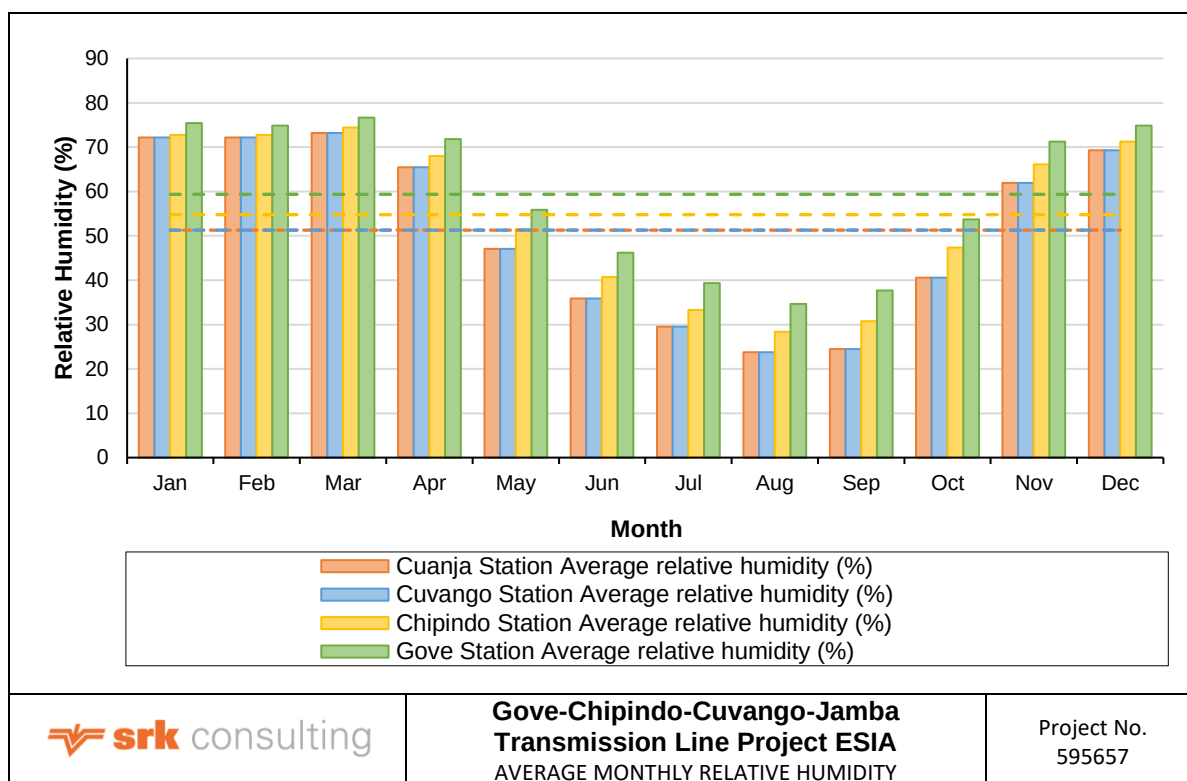


Figure 4-5: Average monthly relative humidity

Evaporation

Evaporation and plant transpiration from the Earth's surface, collectively known as evapotranspiration, are influenced by various factors including vegetation, soil properties, and atmospheric conditions. For the dataset discussed, evaporation rates were estimated using the Penman-Monteith method, which considers temperature, solar radiation, humidity, and wind speed data. The results represent potential evapotranspiration (PET), rather than actual evapotranspiration, which is the water actually removed from a surface due to evaporation and transpiration by plants.

Average annual PET values are provided for different areas: Cuanja and Cuvango have PETs of 1777 mm and 1687 mm respectively; while Chipindo and Gove have higher PETs of 1778 mm and 1541 mm. All sites recorded their highest PET in 2019, indicating a particularly intense year for evapotranspiration. For instance, Cuanja saw a maximum PET of 2029.45 mm in 2019, with a minimum in 2011 at 1550.88 mm. Similarly, Cuvango, Chipindo, and Gove also recorded their peak PET values in 2019, with minimum values occurring in 2011 or 2020.

PET is observed to increase significantly during the dry season, particularly from May to September, peaking in September. This seasonal pattern is evident across all locations and coincides with lower rainfall and humidity levels during these months, thus increasing the rate of PET. Detailed monthly PET data, which includes average, minimum, and maximum rates, are outlined in Figure 4-6, showing the lowest PET in April and the highest in September across all sites. This data is crucial for understanding water loss from the area, helping in water resource management and planning.

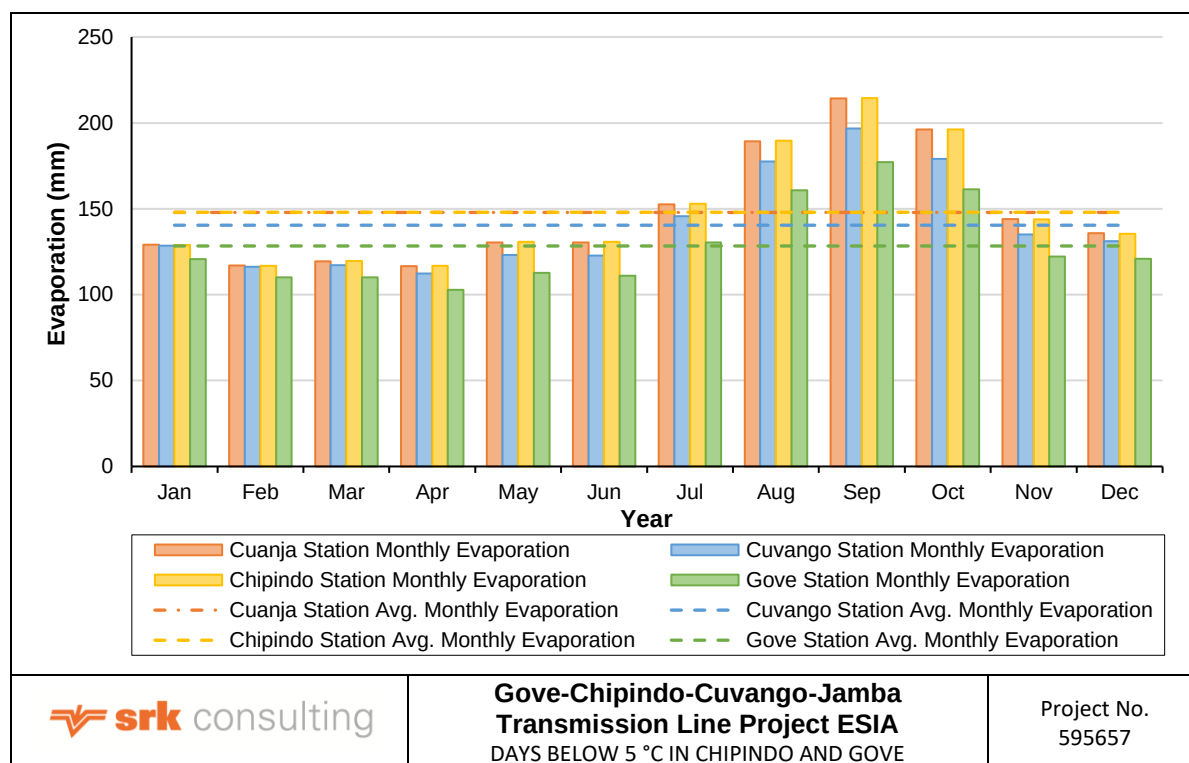


Figure 4-6: Average monthly PET

Rainfall

Rainfall is an effective removal mechanism of atmospheric pollution. It plays a significant role in air quality, as it reduces air pollution levels in the atmosphere during the rainy season. Dust emissions are also suppressed due to increases in soil moisture content and increased vegetation cover during the rainy season. During the cooler dry and hot dry seasons, natural dust emission levels are higher.

Rainfall was assessed from the Cuanja, Chipindo, Cuango and Gove met station for the area under review. Figure 4-7 illustrates the average monthly and cumulative monthly rainfall experienced at each monitoring station for the January 2019 to December 2023 period. The highest amount of rainfall (216.5mm) was measured in December, while the lowest rainfall (0mm) was recorded between May to August. Trends indicates a distinct wet and dry season.

Temperature

Ambient air temperature is crucial for determining the effect of plume buoyancy, as a larger temperature difference between the emissions plume and the ambient air allows the plume to rise higher. It also helps determine the development of mixing depth and inversion layers.

Figure 4-7 to Figure 4-10 graphically display the minimum, average and maximum daily temperatures for Cuanja, Chipindo, and Cuvango, respectively. The interpretative findings are as follows:

- Cuanja Station (Figure 4-8): The average temperature ranged from 12.39°C to 29.51°C. The minimum recorded temperature was 4.14°C, while the highest temperature peaked at 37.87°C during the review period;
- Chipindo Station (Figure 4-9): The average temperature ranged from 12.15°C to 29.78°C. The minimum recorded temperature was 4.44°C, and the highest temperature peaked at 38.33°C during the review period; and
- Cuvango Station (Figure 4-10): The average temperature ranged from 12.39°C to 29.51°C. The minimum recorded temperature was 4.14°C, with the highest temperature peaking at 37.87°C during the review period.

These datasets complement each other, revealing distinct seasonal temperature trends across the various residential areas.

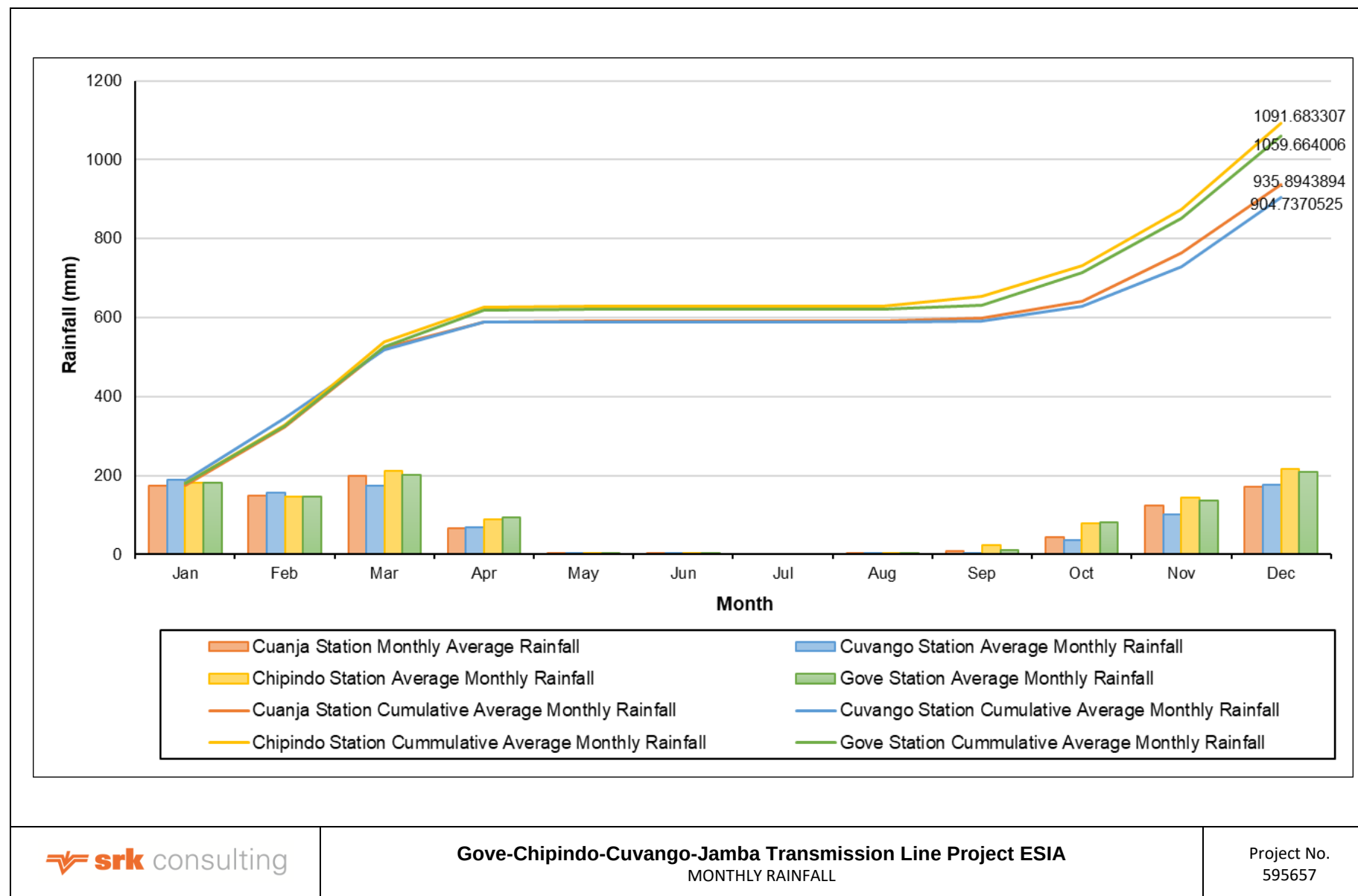


Figure 4-7: Average monthly and cumulative rainfall at each of the monitoring station

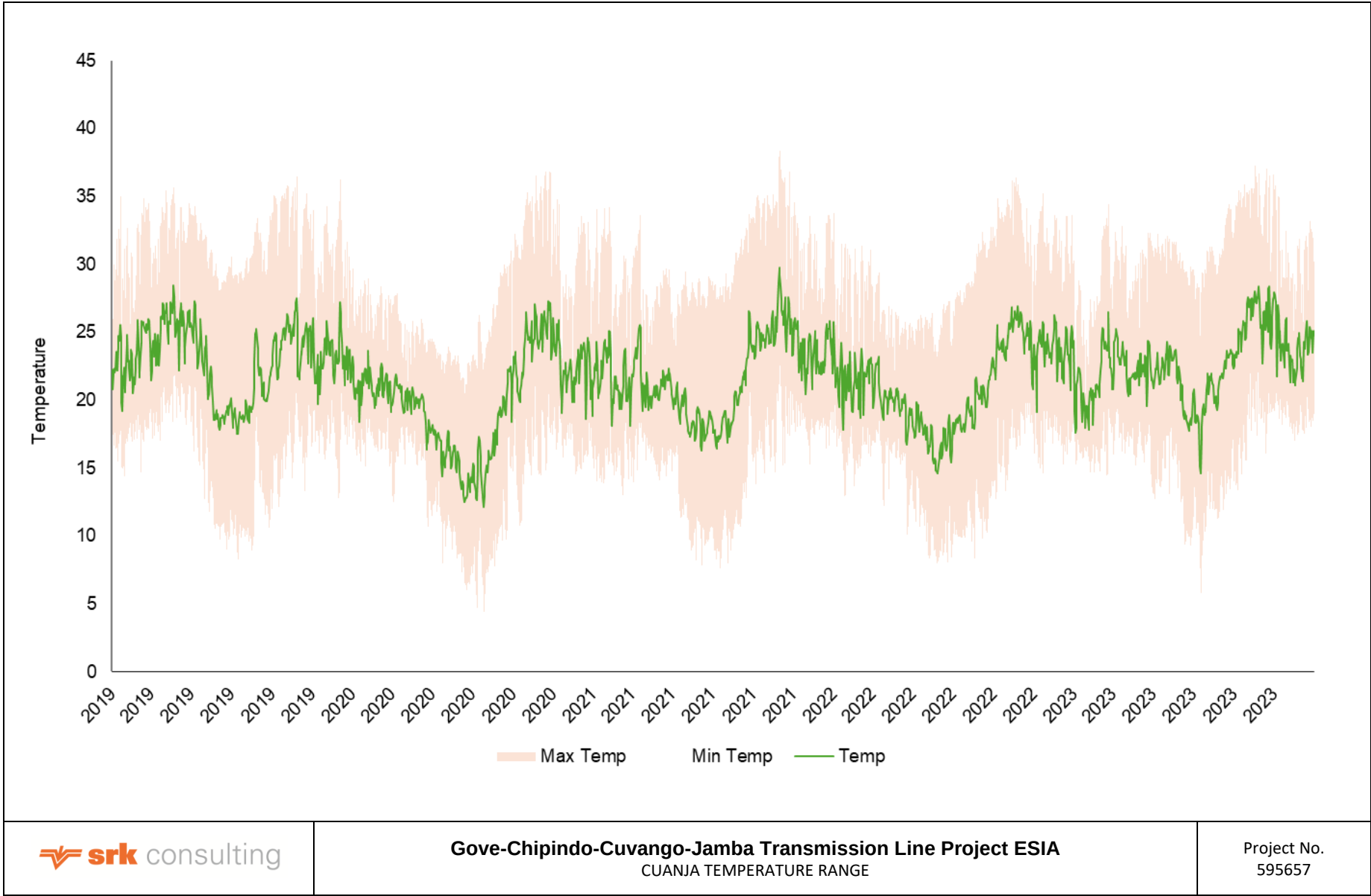


Figure 4-8: Maximum, minimum and average temperature recorded at the Cuanja Monitoring station for the 2019 to 2023 monitoring period

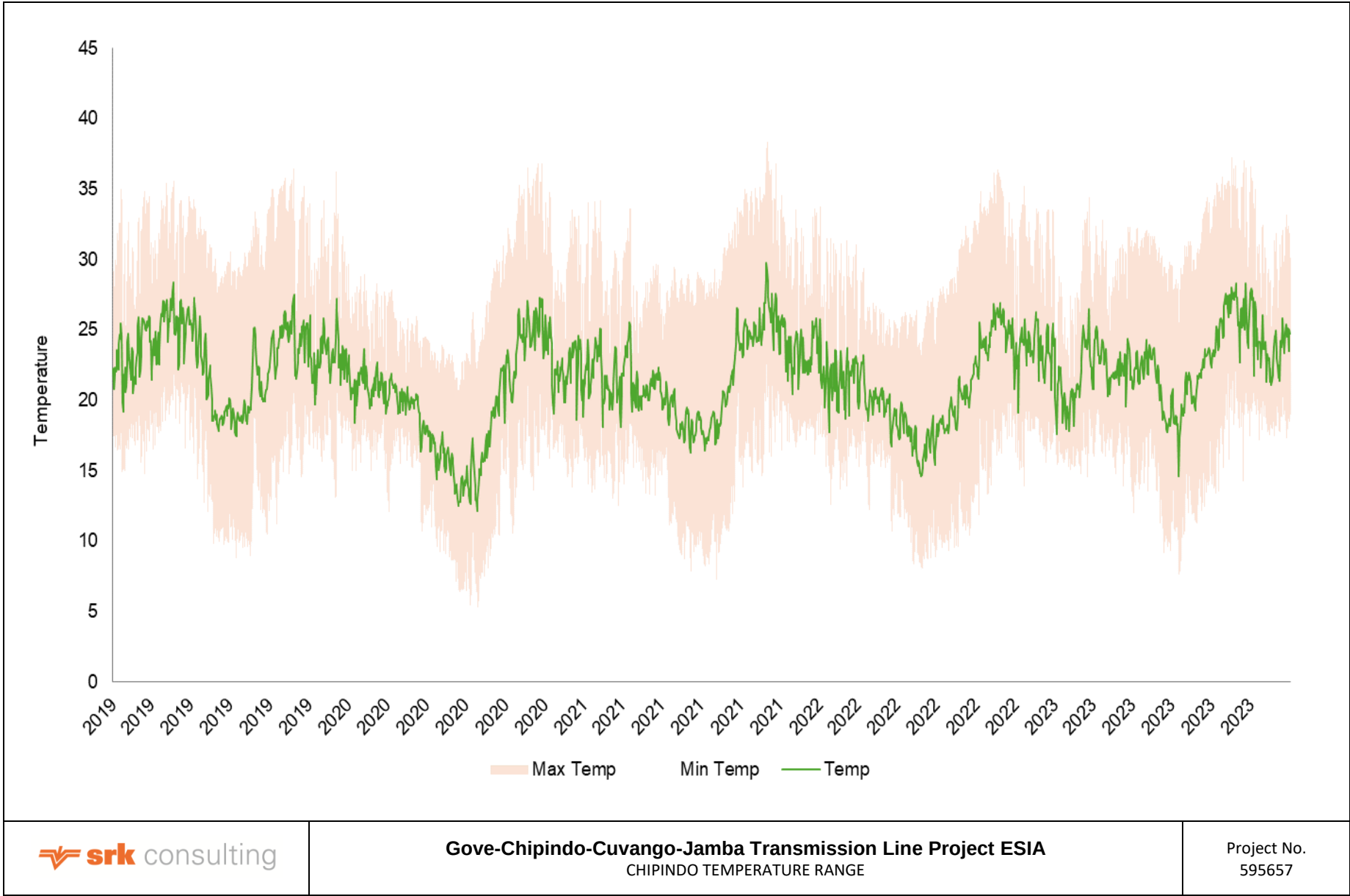


Figure 4-9: Maximum, minimum and average temperature recorded at the Chipindo Monitoring station for the 2019 to 2023 monitoring period

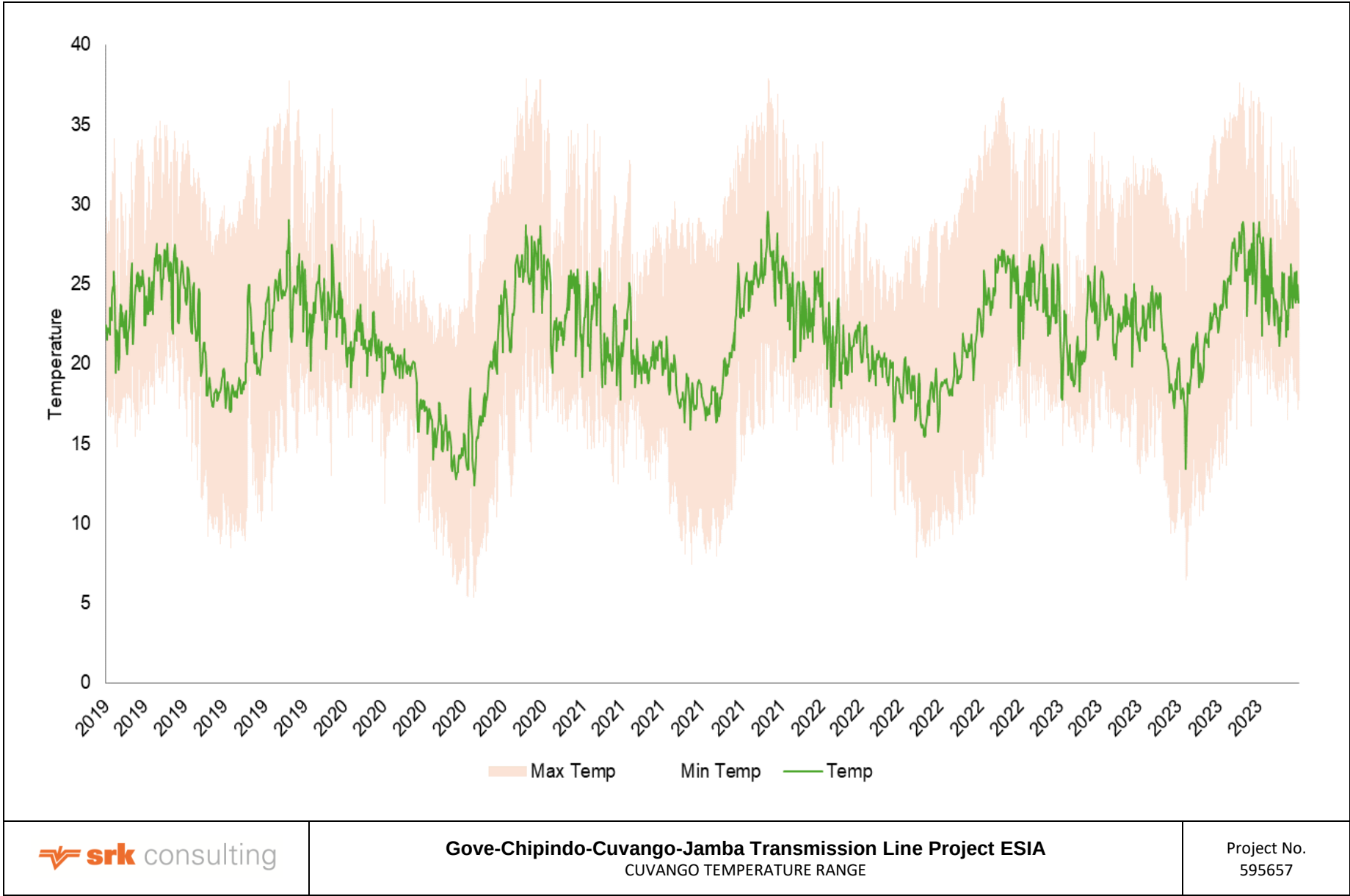


Figure 4-10: Maximum, minimum and average temperature recorded at the Cuvango Monitoring station for the 2019 to 2023 monitoring period

4.2.4 Climate change predictions

The TCFD mandates that organisations evaluate the resilience of their strategies under different climate scenarios, including a scenario where the increase in global temperature is kept to 2°C or lower. Accordingly, local climate change predictions for the site incorporate changes under several Shared Socioeconomic Pathways (SSPs), ranging from SSP1-2.6 to SSP5-8.5.

IPCC regional climate change predictions

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) report uses scenario-based climate projections to predict changes in the West Southern Africa (WSAF) region, which includes the Project site. The WSAF region is expected to experience significant changes between 1981-2010 and future periods. Mean temperatures are projected to rise between 1.7°C (SSP1-2.6, 2021-2040) and 5.1°C (SSP5-8.5, 2081-2100). Maximum temperatures will increase similarly, and total precipitation is expected to decrease by 4% to 9.2%. The maximum 1-day and 5-day rainfall events are anticipated to increase, indicating more intense but less frequent rainfall. Consecutive dry days are expected to rise, and wind speeds will also see a slight increase. Overall, the region will face higher temperatures, reduced annual rainfall, but more intense short-term rain events, and longer dry periods.

World Bank Climate Portal Provincial Climate Change Predictions

The Project is located in the Huila and Huambo provinces of Angola. The World Bank Climate Change Knowledge Portal (CCKP) predicts increases in both average and maximum annual temperatures for these provinces. For instance, by 2091-2100, average temperature increases are Projected to be as high as 1.22°C to 5.11°C under different scenarios. Rainfall predictions are more variable, with some decades showing increases and others decreases. Seasonal patterns suggest reduced rainfall at the end of the dry season (October-November) and increased rainfall in the wet season (December-February), particularly in Huambo Province. This data indicates that both provinces will experience significant climate changes, with notable impacts on local weather patterns and agricultural conditions. The predictions of climate change influences on temperature and rainfall are presented Table 4-2 and Table 4-3 respectively.

Table 4-2: Predicted Temperature Changes (CCKP)

Decades	Average (Chronic) Temperature Change in °C				Maximum (Acute) Temperature Change in °C			
	SSP (1-2.6)		SSP (5-8.5)		SSP (1-2.6)		SSP (5-8.5)	
	Huila	Huambo	Huila	Huambo	Huila	Huambo	Huila	Huambo
2001-2010	0.03	0.03	0.04	0.05	0.02	0.01	0.02	0.01
2011-2020	0.32	0.27	0.36	0.29	0.30	0.27	0.31	0.27
2021-2030	0.72	0.74	0.75	0.74	0.67	0.65	0.70	0.67
2031-2040	0.98	1.13	1.00	1.13	0.94	1.09	0.95	1.10
2041-2050	1.11	1.71	1.17	1.71	1.08	1.69	1.10	1.64
2051-2060	1.15	2.26	1.20	2.33	1.09	2.17	1.09	2.18
2061-2070	1.30	2.91	1.40	2.94	1.21	2.84	1.30	2.78
2071-2080	1.23	3.56	1.29	3.63	1.21	3.43	1.15	3.46
2081-2090	1.19	4.40	1.32	4.49	1.19	4.17	1.25	4.25
2091-2100	1.22	5.11	1.34	5.20	1.22	4.95	1.27	4.91

Table 4-3: Predicted Rainfall Changes (CCKP)

Decades	Average (Chronic) Rainfall Change in mm				Maximum (Acute) 1-day rainfall change in mm			
	SSP (1-2.6)		SSP (5-8.5)		SSP (1-2.6)		SSP (5-8.5)	
	Huila	Huambo	Huila	Huambo	Huila	Huambo	Huila	Huambo
2001-2010	0.43	-0.05	0.04	-0.10	0.12	-0.22	-0.08	-0.05
2011-2020	-1.18	-0.55	0.00	-0.07	-0.18	-0.59	0.03	-0.11
2021-2030	-0.59	0.80	0.01	0.00	-1.04	0.72	-0.02	0.10
2031-2040	-0.62	1.43	0.26	0.03	-1.77	-0.83	0.21	0.14
2041-2050	2.27	0.17	0.34	0.15	1.04	-0.77	0.15	0.27
2051-2060	0.63	-1.86	0.10	0.17	0.90	-2.49	0.05	0.29
2061-2070	0.73	-1.76	0.05	0.22	-1.54	-1.44	0.10	0.52
2071-2080	2.83	-1.74	0.19	0.60	-0.98	-2.56	0.08	0.61
2081-2090	0.33	-3.37	0.13	0.39	0.24	-2.65	-0.09	0.85
2091-2100	0.47	-4.28	0.04	0.48	-0.15	-3.16	-0.09	1.11

Local climate change predictions

The climate projections for a project area based on Coupled Model Intercomparison Project Phase 6 (CMIP6) global climate models indicate an overall trend of rising temperatures, increased rainfall, and relatively stable windspeeds under various IPCC AR6 scenarios. Specifically, mean and maximum temperatures are expected to rise by up to 1.8°C and 2.1°C respectively, potentially decreasing frost days slightly in some scenarios. Rainfall patterns are also projected to shift, with total annual rainfall generally increasing, though with some regional decreases, and extreme rainfall events becoming more frequent and intense, which could lead to shorter, heavier bursts of rain and extended dry periods in between. This suggests increased risks of both flooding and droughts, requiring adaptive strategies. Meanwhile, windspeeds show minor fluctuations depending on the scenario, but no significant changes are expected. Projections for the three timeframes (Construction Short Term (2021 – 2040), Operation Medium Term (2041 – 2060), Decommissioning Long Term (2081 – 2100)) were also considered and the worst-case scenario (SSP5-8.5) presented.

Chronic Predications

Temperature

The predicted mean temperature increases relative to 1981-2010 for the proposed Project area based on the CIMP6 are presented in Table 4-4. Near-term mean temperatures are predicted to increase up to 1.8 °C.

Table 4-4: Mean Temperature Increases Predicted for the IPCC AR6 Scenarios

Scenario	Jamba (°C)	Cuvango (°C)	Chipindo (°C)	Gove (°C)
Construction Short Term (2021 – 2040)	1.3	1.3	1.2	1.2
Operation Medium Term (2041 – 2060)	2.4	2.4	2.3	2.3
Decommissioning Long Term (2081 – 2100)	5.2	5.3	5	5
SSP1-2.6 (1.5°C)	1	1	1	1
SSP2-4.5 (2°C)	1.7	1.7	1.6	1.6
SSP3-7.0 (2°C)	1.7	1.8	1.6	1.6
SSP5-8.5 (2°C)	1.7	1.8	1.7	1.7

Rainfall

The predicted changes in total annual rainfall relative to 1981-2010 for the site based on the CIMP6 are presented in Table 4-5. Annual average rainfall is likely to increase barring a few outliers.

Table 4-5: Total Rainfall Changes Predicted for the IPCC AR6 Scenarios

Scenario	Jamba (%)	Cuvango (%)	Chipindo (%)	Gove (%)
Construction Short Term (2021 – 2040)	0	0	2.9	2.9
Operation Medium Term (2041 – 2060)	-1.7	-1.7	2.8	2.8
Decommissioning Long Term (2081 – 2100)	-1	-1	5.4	5.4
SSP1-2.6 (1.5°C)	2.1	0.6	2.6	2.6
SSP2-4.5 (2°C)	1.2	-0.6	2.2	2.2
SSP3-7.0 (2°C)	2.7	0.8	2.9	2.9
SSP5-8.5 (2°C)	1.1	-1.1	2.3	2.3

Windspeed

Site-specific windspeed predictions (presented in Table 4-6) indicate that minimal changes in average windspeeds are to be expected.

Table 4-6: Relative Change in Average Windspeed

Scenario	Jamba (m/s)	Cuvango (m/s)	Chipindo (m/s)	Gove (m/s)
Construction Short Term (2021 – 2040)	0.5	0.5	1.4	1.4
Operation Medium Term (2041 – 2060)	1.1	1.1	2.8	2.8
Decommissioning Long Term (2081 – 2100)	-0.3	-0.3	0.4	0.4
SSP1-2.6 (1.5°C)	-1.3	-1.2	-1.3	-1.3
SSP2-4.5 (2°C)	0.6	0.6	0.5	0.5
SSP3-7.0 (2°C)	2.6	2.6	2.5	2.5
SSP5-8.5 (2°C)	0.9	0.8	2.2	2.2

Acute Predictions

Temperature

The maximum temperature increases are presented in Table 4-7; changes in the predicted number of frost days are shown in Table 4-8.

Table 4-7: Maximum Temperature Increases Predicted for the IPCC AR6 Scenarios

Scenario	Jamba (°C)	Cuvango (°C)	Chipindo (°C)	Gove (°C)
Construction Short Term (2021 – 2040)	1.2	1.3	1.1	1.1
Operation Medium Term (2041 – 2060)	2.5	2.5	2.2	2.2
Decommissioning Long Term (2081 – 2100)	5.6	5.6	5	5
SSP1-2.6 (1.5°C)	1	1.1	1	1
SSP2-4.5 (2°C)	1.7	1.9	1.6	1.6
SSP3-7.0 (2°C)	1.9	2.1	1.8	1.8
SSP5-8.5 (2°C)	1.6	1.8	1.5	1.5

Table 4-8: Predicted change in the number of frost days for the IPCC AR6 scenarios

Scenario	Jamba (°C)	Cuvango (°C)	Chipindo (°C)	Gove (°C)
Construction Short Term (2021 – 2040)	0	0	-0.1	-0.1
Operation Medium Term (2041 – 2060)	0	0	-0.1	-0.1
Decommissioning Long Term (2081 – 2100)	0	0	-0.1	-0.1
SSP1-2.6 (1.5°C)	0	0	0	0
SSP2-4.5 (2°C)	0	0	-0.1	-0.1
SSP3-7.0 (2°C)	0	0	0	0
SSP5-8.5 (2°C)	0	0	-0.1	-0.1

Near-term maximum temperatures are predicted to increase up to 2.1°C. The long term temperatures are projected to increase up to 5.6°C. The number of frost days is expected to remain largely unchanged.

Rainfall

The predicted maximum 1-day rainfall changes are presented in Table 4-9 while the predicted maximum 5-day rainfall changes presented in Table 4-10. Changes in consecutive dry days relative to 1981-2010 for the site are presented in Table 4-11.

Table 4-9: Maximum 1-Day Rainfall Changes Predicted for the IPCC AR6 Scenarios

Scenario	Jamba (%)	Cuvango (%)	Chipindo (%)	Gove (%)
Construction Short Term (2021 – 2040)	7.8	7.8	7.3	7.3
Operation Medium Term (2041 – 2060)	10.9	10.9	11.8	11.8
Decommissioning Long Term (2081 – 2100)	27.6	26.3	30.3	30.3
SSP1-2.6 (1.5°C)	6.9	7.3	7.5	7.5
SSP2-4.5 (2°C)	8.6	9.9	8.2	8.2
SSP3-7.0 (2°C)	11.3	10.8	10.7	10.7
SSP5-8.5 (2°C)	9	9.8	12.6	12.6

Table 4-10: Maximum 5-Day Rainfall Changes Predicted for the IPCC AR6 Scenarios

Scenario	Jamba (%)	Cuvango (%)	Chipindo (%)	Gove (%)
Construction Short Term (2021 – 2040)	3.5	3.5	3.9	3.9
Operation Medium Term (2041 – 2060)	5	5	6.8	6.8
Decommissioning Long Term (2081 – 2100)	12.3	12.3	17.6	17.6
SSP1-2.6 (1.5°C)	4.9	3.8	3.7	3.7
SSP2-4.5 (2°C)	6.1	5.4	6.7	6.7
SSP3-7.0 (2°C)	5.4	4.3	5.5	5.5
SSP5-8.5 (2°C)	5.1	4.1	5.4	5.4

Table 4-11: Consecutive Dry Day Changes Predicted for the IPCC AR6 Scenarios

Scenario	Jamba (Days)	Cuvango (Days)	Chipindo (Days)	Gove (Days)
Construction Short Term (2021 – 2040)	5.2	5.2	4.6	4.6
Operation Medium Term (2041 – 2060)	8.6	8.6	6.8	6.8
Decommissioning Long Term (2081 – 2100)	18.3	18.3	12.6	12.6

A clear pattern of increasing maximum 1-day and 5-day rainfall is predicted. Consecutive dry days also increase, indicating that rainfall will be concentrated in short heavy bursts, ultimately increasing the potential for flooding. Drought occurrences can also be expected to increase, particularly at the end of the dry season between short periods of heavy rainfall in the wet summer months. Since the project will not require significant quantities of water during the operational phase, droughts are not considered a risk to the project.

Windspeed

Predictive models utilised do not provide any indication of changes to maximum windspeed or wind gusts. Furthermore, the models utilised are not accurate when predicting extremes. As such, the potential for short-term high-speed winds and gusts remains uncertain.

Landslides

Since the predictive models utilised do not predict the frequency and/or possibility of landslides occurring, NASA's Global Landslide Hazard Assessment Model (LHASA), NASA's Global Landslide Catalog (GLC) and the Global Landslide Susceptibility Map were used as proxies to identify risks. Additionally, the United Nations Office for Disaster Risk Reduction (UNDRR)'s SENDAI Framework landslide profile was consulted to obtain additional information specific to the Huambo and Huila regions of Angola.

Findings are summarised below:

- Three landslide events were reported in Luanda, but none occurred or were reported in Huambo and Huila (as per NASA's LHASA);
- As of April 2024, only five landslides were noted by NASA's GLC (all of the landslides noted to have occurred in Luanda);
- The Global Landslide Susceptibility Map indicates that Jamba, Cuvango and Gove have low susceptibility to landslides, Chipindo however is more susceptible to landslides with a moderate to high susceptibility rating; and
- The UNDRR's SENDAI Framework indicates that no landslides occurred in the Huila and Huambo regions of Angola.

As such, landslides are only considered probable in the vicinity of the path between Gove and Chipindo and between Chipindo and Cuvango.

4.3 Geology, geomorphology, topography and palaeontology

This section presents an overview of the geology, geomorphology, topography and palaeontology of relevance to the Project area. It draws on information presented in the hydrogeology assessment (HCV Africa, 2024) and the heritage assessment (Beyond Heritage, 2024) conducted for the ESIA (refer to Volume 4, Appendix C and D for the detailed specialist assessments/statements).

The main geological, geomorphological, topographic and palaeontological features of the Project and its surrounding region were characterised using a combination of resources. These included data extracted from available technical and scientific literature, as well as cartographic materials.

4.3.1 Geology

Angola's geology presents a complex mosaic of geological formations ranging from the Archean to the Recent, offering a unique setting for diverse geological and environmental studies. The country is divided into five main regional geological units that influence the landscape and natural resources (Mateus et al., 2019). Figure 4-11 presents a geological map of Angola.

Angolan main regional geological units

1. Quaternary to Tertiary Sedimentary Cover Deposits: Covering nearly half of Angola, especially the eastern part, this unit consists of alluvium in river valleys, floodplains, and deltas of major rivers like the Cuanza, Zaire, and Cunene. It includes loosely consolidated sandstones and unconsolidated sands and silts from the Kalahari Group, which can reach depths up to 600 m;
2. Pleistocene to Cretaceous Marine Sediments: Found primarily along Angola's coastal basins on the western margin, this unit features sedimentary rocks from the Aptian-Maastrichtian age, characterized by argillaceous sandstones with marine and evaporitic deposits;
3. Mesozoic to Palaeozoic Sediments: Located in the north, particularly within the Cassanje Graben, this unit includes consolidated sediments and volcanic rocks (dolerites) from the Karoo Supergroup;
4. Precambrian Metasedimentary Rocks: Dominating the western part of Angola, these rocks from the late Precambrian to the Lower Cambrian are part of the Bembé System and include schist-limestones, metasandstones, metaconglomerates and quartzites;
5. Upper Proterozoic fold belts (Pan African age) occur along the margins of Angola's Precambrian shield, the most important being the West-Congo, Damara and Maiombe-Maongo. Precambrian crystalline rocks of the Basement Complex and the West Congo System form the extended spine of Angola's western escarpment, highlands and plateaus. The occurrence of base metal mineralisation and a variety of industrial minerals characterises them. Scattered outcrops of igneous rocks, such as granites and volcanic rocks, such as dolerites, are found in the:
 - **Basement Complex:** Comprises a lower series of granites, gneisses, and migmatites and an upper series of metamorphosed sediments, including schists and quartzites. The terms 'lower' and 'upper' refer to older and younger geological strata, respectively; and
 - **West Congo System** overlays the Basement Complex and is a mobile belt composed of metamorphosed sedimentary rocks of the upper Precambrian. These include limestones, schists, slates and quartzites. Lower Proterozoic to Archean Rocks: These ancient crystalline rocks, including granites, form a significant part of the country's geological foundation. They are mostly overlaid by unfossiliferous carbonate and sedimentary rocks from the Mesozoic and Cenozoic eras.

Geological Setting in Huambo and Huíla Provinces

Huambo and Huíla provinces are situated within the Central Highlands of Angola, a region primarily composed of Precambrian to Archean crystalline rocks. This includes metamorphic and volcanic rocks such as granites, gneisses, schists, quartzites, migmatites and amphibolites. The region's landscape transitions from coastal plains to mountainous escarpments and then to high interior plateaus, providing a varied topography. Additionally, localised Quaternary sediments, mainly composed of sand, quartzitic sandstone, gravel and clay, occur along river valleys. These areas may present challenges such as soil erosion or landslides during the wet season. The geological setting in Jamba, Cuvango, Chipindo and Gove are described in Table 4-12.

Table 4-12: Local underlying geology

Substation	Underlying geology
Jamba	Epupa Metamorphic Complex, Schist-Quartzite-Amphibolite Complex (SQA), Jamba Group (Archaean volcano-sedimentary sequence with BIF layers), Kalahari sediments (sands and clays)
Cuvango	Upper Kalahari sediments (sands)
Chipindo	Regional granite (granitoids: granodiorites, monzogranites, syenogranites), subordinate rhyodacite volcanic to subvolcanic members, Upper Kalahari sediments (sands)
Grove	Regional granite (granitoids)

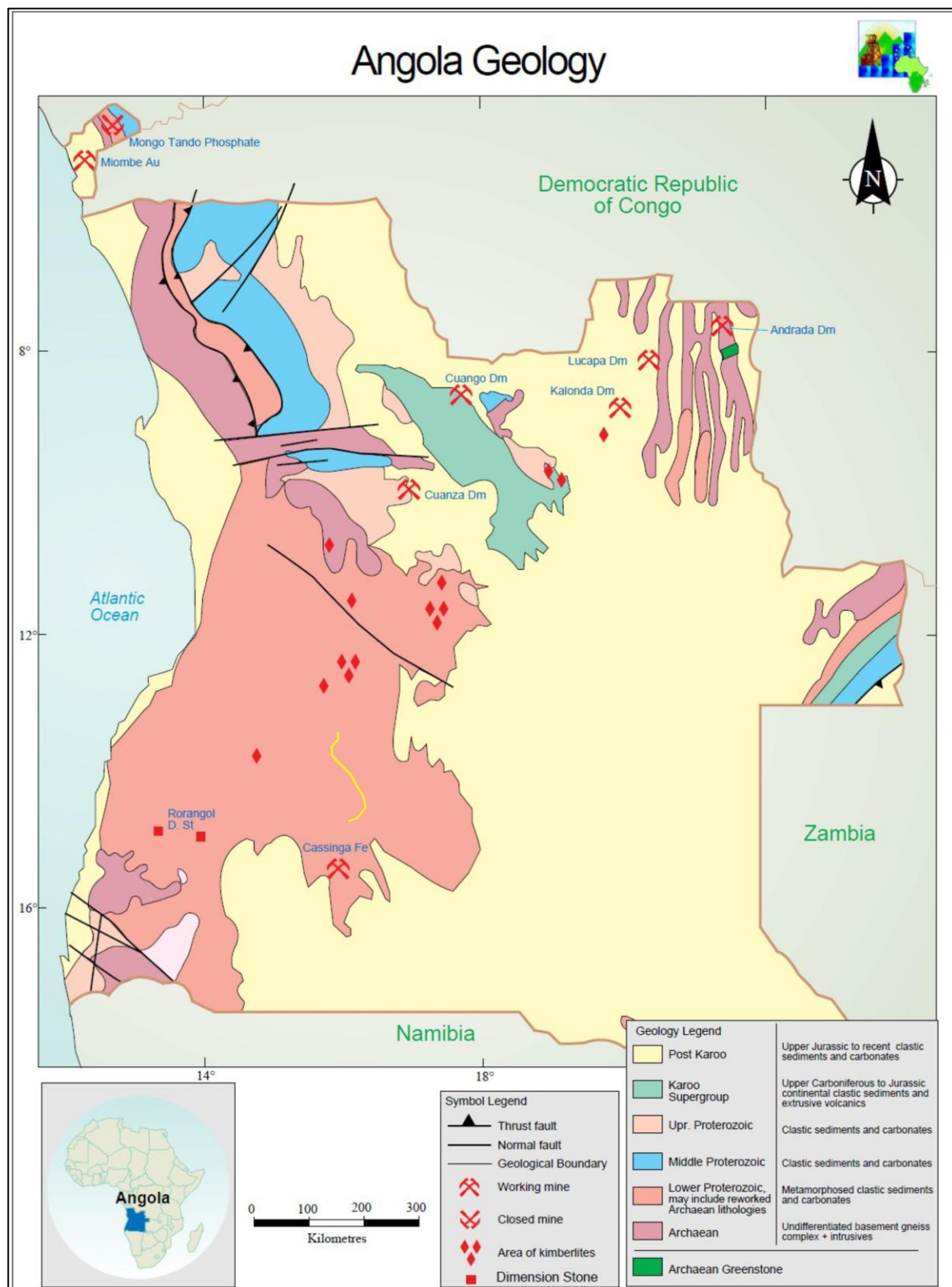


Figure 4-11: Geological map of Angola (Mindat.org, 2024)

4.3.2 Geomorphology

Angola's landscape is characterised by three distinct natural regions. First, there is the coastal lowland to the west along the Atlantic Ocean, featuring flat littoral zones with low plains and terraces. The width of this region varies from about 25 km near Benguela to over 150 km in the Cuanza River Valley, just south of the capital. The southernmost part of this area features sand dunes transitioning to dry scrub along the middle coast.

In the median zone, a series of hills and mountains stretch roughly parallel to the coast, beginning at the coast and rising into a significant escarpment between 20 km to 100 km inland. This area transitions into the third region, a vast high plateau that extends eastward and south-eastward from the escarpment. This plateau dominates much of Angola's landscape and slopes into the Kalahari Basin toward the east, with valleys that have been deepening since the Cretaceous period.

The geomorphological complexity of Angola includes 11 distinct units. The Project footprint falls within the ancient plateau. This geomorphological unit 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 (Huntley et al., 2019).

4.3.3 Topography

Angola's topography is categorised into three distinctive natural regions, each with unique characteristics. The coastal lowland, primarily composed of low plains and terraces, sits below 500 meters in altitude and stretches along the western coast adjacent to the Atlantic Ocean. This region provides a stark contrast to the dramatic rises found inland.

Moving away from the coast, the terrain transitions abruptly into hills and mountains, culminating in a significant escarpment known as the Western Angolan Scarp. The altitude in this region ranges from 1 800 to 2 200 meters, with the highest peaks including Mount Namba at 2 420 meters, Serra Mepo at 2,582 meters, and Mount Moco, the highest point in Angola, at 2,620 meters. This escarpment also features particularly rugged areas like the Serra da Neve, which approaches 2,500 meters. In the south, between Moçâmedes and Lubango, the Serra da Chela escarpment presents a sharp rise, notably at Tundavala and Bimbe, ascending 1 000 meters. The Cuanza River bisects this mountainous region; the northern part gradually ascends from the coastal area to around 500 meters with peaks reaching between 1 000 and 1 800 meters, while to the south, the hills rise sharply from the lowlands to form a high escarpment.

Finally, the high plateau extends eastward from the escarpment, gradually descending from 1 800 meters in the west to 1 400 meters in central Angola. This region features high plains that are typically flat or rolling, solidifying its position as a major geographic feature of Angola. The Project footprint will be located in an area with a relatively even topology which an overall range of 1 200 m to 1 750 m along its route.

4.3.4 Palaeontology

The Project area is situated on Lower Proterozoic rocks, comprising metamorphosed clastic sediments and carbonates, with some reworked material from underlying Archaean rocks. These geological formations, mapped using resources from Mindat, suggest a complex geological history but offer limited palaeontological sensitivity.

Fossil records in Angola are sparse and primarily focused on coastal marine and terrestrial deposits from the Cretaceous to Miocene eras. The eastern part of Angola is dominated by Quaternary sands and alluvium, which are not typically rich in fossils. Given this context and the absence of significant

palaeontological resources within the Project footprint, the Project is not expected to impact Angola's palaeontological heritage. Consequently, the Project should be authorised without concerns for fossil preservation.

4.4 Soils, Land use and Land capability

The section presents an overview of the soils, land use and land capability in the Project area of influence based on the assessment conducted by The Zimpane Research Collaborative (ZRC, 2024) for the Project (refer to Volume 4, Appendix E for the detailed specialist assessment).

4.4.1 Soils

The Project footprint is primarily dominated by Ferralsols, Acrisols, Plinthosols, Leptosols, and Anthrosols. These soils range from moderately deep to very deep, are well-drained, and exhibit red and yellow hues. The topsoil is typically sandy loam, while the subsoil has increased clay content, resulting in low infiltration rates. These soils are generally arable, with moderate to high agricultural potential, supporting a wide range of cultivated crops. Descriptions of these soil types are provided below.

- **Leptosols** are shallow due to limited rock weathering and are often found on hill slopes where soil removal occurs, leaving rocky outcrops. These soils are not suitable for intensive agriculture and are better suited for grazing, forestry, and wildlife uses;
- **Ferralsols** develop in well-drained, warm, and moist conditions, leading to iron oxide coatings on soil particles and a red coloration. Despite depth limitations, their good drainage, aeration, and sandy to loam texture make them suitable for cultivation;
- **Acrisols** are reddish, high-clay soils formed in weathered tropical environments. They have good drainage and moderate fertility, supporting crops like maize and cassava. However, they are prone to erosion and require sustainable practices, such as soil conservation and agroforestry, to maintain their productivity;
- **Plinthosols** are characterised by iron-rich plinthite, petroplinthite, or pisoliths in the subsoil. These soils can support agriculture, but their management requires careful crop selection tailored to local conditions;
- **Gleysols** are characterised by prolonged saturation, leading to gleyic and albic properties in the subsoil. High clay content and moisture create anaerobic conditions unsuitable for most crops;
- **Fluvisols** are formed from river or stream sediments and are found in floodplains and valleys. They are fertile due to nutrient-rich alluvial deposits but are prone to erosion and have low water holding capacity, requiring intensive management for productive agriculture; and
- **Anthrosols** have been physically disturbed by human activities, such as unpaved roads and railway lines, making them unsuitable for agriculture.

The dominant soil types and their respective diagnostic sequences are presented in Table 4-13. The spatial distribution of these soil types within the study area is detailed in Volume 3, Appendix C1.

Table 4-13: Dominant soil types and their diagnostic horizon within the study area

WRB Classification	Horizon
Anthrosols	N/A
Leptosols	Lithic Horizon
Fluvisols (Rivers and DLs)	Alluvial Horizon
Gleysols (Valley Bottoms)	G Horizon
Acrisols	Argic Horizon
Ferralsols (Well drained)	Ferralic Horizon
Plinthosols	Plinthic Horizon

4.4.2 Land use

The study area encompasses a variety of land uses, including agricultural fields, grazing areas, Miombo woodlands, plantations, wildlife/wilderness zones, residential areas, and water bodies. Agriculture is a primary economic activity in the rural parts of the country, with subsistence farming being prevalent. The main crops observed are maize and beans, with smaller sections dedicated to cassava. Livestock such as cattle, goats, and chickens are also present. Wood harvesting for household use and charcoal manufacturing takes place, although these activities appear to be limited in scale. Fishing, especially near rivers, is observed as an important economic activity, providing both food and income for rural communities. The diverse land use within the study area is depicted in Table 4-14. The spatial distribution of land use types within the study area is detailed in land use maps (refer to Volume 3, Appendix C2).

Table 4-14: Pictures of dominant land uses

Dominant Land Uses			
			
Cattle herding	Crop fields	Subsistence farming	Railway tracks
			
Fishing	Roads	Substations	Open field
			
Communities	Powerlines	Business	Playgrounds

4.4.3 Land capability

Agricultural land capability in the study area is primarily restricted by climatic conditions, particularly water availability (moisture retention/rainfall) and temperature. Despite similar climatic zones, soil types exhibit different land use capabilities due to their inherent characteristics. Land capability was inferred by considering physical soil properties and prevailing climatic conditions.

Climate Capability

Climate Capability, measured on a scale from 1 to 8, is used in the agricultural potential classification (Table 4-15). The study area falls into Climate Capability Class 1, indicating none to slight limitations, as the local climate is favourable for good yields of a wide range of adapted crops throughout the year.

Table 4-15: Climate capability classification (Scotney et al., 1987)

Climate capability class	Limitation rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

Land capability and potential of soils

Soils in the study area were classified into land capability and land potential classes using the Guy and Smith (1998) Classification systems (Table 4-16 and Table 4-17). Maps in Volume 3, Appendix C3 illustrate these classifications. Table 4-18 presents the dominant soil types, their respective land capability, and their areal extent in hectares and percentages.

Identified land capability limitations for the soils are detailed in comprehensive "dashboard style" summary tables in Table 4-19 to Table 4-23, presenting all pertinent information concisely and visually.

Table 4-16: Land potential classes (Adapted from Guy and Smith, 1998)

Land capability class	Climate capability class							
	C1	C2	C3	C4	C5	C6	C7	C8
I	L1.	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	(L3) wetland	(L3) wetland	(L4) wetland	(L4) wetland	(L5) wetland	(L5) wetland	(L6) wetland	(L6) wetland
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 4-17: The land capability classes description (Guy and Smith, 1998)

Land potential	Description of land potential class
L1	Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.
L2	High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures, or rainfall. Appropriate contour protection must be implemented and inspected.
L3	Good potential: Infrequent and/or moderate limitations due to soil, slope, temperatures, or rainfall. Appropriate contour protection must be implemented and inspected.
L4	Moderate potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperature, or rainfall. Appropriate permission is required before ploughing virgin land.
L5	Restricted potential: Regular and/or moderate to severe limitations due to soil, slope, temperature, or rainfall.
L6	Very restricted potential: Regular and/or severe limitations due to soil, slope, temperature, or rainfall. Non-arable.
L7	Low potential: Severe limitations due to soil, slope, temperature, or rainfall. Non-arable.
L8	Very low potential: Very severe limitations due to soil, slope, temperature, or rainfall. Non-arable.

Table 4-18: Land capability associated with soils occurring within the study area

WRB classification	Soil depth (mm)	Land capability class	Slope class	Areal extent (ha)	Extent in percentage (%)	Definition of capability class	Land potential	Definition of potential class
Ferralsols (well drained)	<1200	Class II	1 and 2	455.50	10.94	Slight limitations	L1 - Very High potential	No limitations. Appropriate contour protection must be implemented and inspected.
Acrisols	800 – 1000	Class III		2 457.70	58.99		L2 – High potential	Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
Plinthosols	700 – 900							
Leptosols	<400	Class IV	3 and 4	298.42	7.17	Limitations preclude cultivation. Suitable for perennial vegetation	L4 - Moderate Potential	Moderately regular and/or severe to moderate limitations due to soil, slope, temperature, or rainfall. Appropriate permission is required before ploughing virgin land.
Fluvisols (rivers and DLs)	400 – 500	Class V	All	298.54	0.06	Water course and land with wetness limitations.	L5 - Watercourse	Limitations due to risk of wetness and waterlogging conditions.
Gleysols (valley bottoms)								
Anthrosols	N/A	Class VIII	N/A	652.81	7.17	Extremely severe limitations. Not suitable for grazing or afforestation.	L8 - Very Low Potential	Severe limitations due to soil (Anthrosols), slope. Non- Arable
Total enclosed area				= 4 164.37	100.00			

Substation = 2,40 ha, *Anthrosols includes developed areas, roads and other infrastructure areas.

Table 4-19: Summary discussion of the arable (Class II) land capability class

Land capability: Arable (Class II) and high potential land potential			
			
Terrain Morphological Unit (TMU)	1.4% Relatively flat slope to moderately sloping	Photograph notes	View of the red apedal, yellow brown apedal and soft plinthic horizons associated with the Ferralsols occurring within the study area
Soil type (s)	Ferralsols	Area Extent	455,50 ha (10,94 %)
Physical limitations	None. These soils have enough depth (greater than 60cm) for most cultivated crops and good drainage characteristics.	Land capability and land potential These soil types are considered high potential agricultural soils with high (Class II) land capability, suitable for arable agricultural land use with minimal management interventions. Therefore, these soils are considered suitable for use for crop cultivation, and are also well-suited for other less intensive land uses such as grazing, forestry, etc. However, emphasis is directed to their agricultural crop productivity due to the scarcity of such soil resources on a national scale and food security concerns.	
Land potential	Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.		

Table 4-20: Summary discussion of the arable (Class III) land capability class associated with the Acrisols soils

Land capability: Arable (Class III)			
			
Terrain Morphological Unit (TMU)	Gently sloping landscapes of < 0.5% slope gradient.	Photograph notes	View of the red apedal underlain by lithic horizons as associated with the Nkonkoni soils occurring within the study area.
Soil type (s)	Acrisols and Plinthosols	Area Extent	2 456,70 ha (58,99 %)
Physical limitations	The occurrence of plinthite material and high clay content at moderate depth as well risk of water logging is the primary land capability limitation of these soils.	Land capability and land potential Land capability (Class III) is suitable for arable agricultural land use with minor restrict restrictions. Therefore, these soils are considered to make a moderate contribution to agricultural productivity on a regional and national scale.	
Land potential	High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures. Appropriate contour protection must be implemented and inspected.		

Table 4-21: Summary discussion of the grazing (Class V) land capability class (watercourses / dambos)

Land capability: Grazing (Class V)			
			
Terrain Morphological Unit (TMU)	Relatively flat to moderately sloping land of <1.5% slope	Photograph notes	View of the watercourses (including drainage lines) associated with the study area
Soil type (s)	Fluvisols and Gleysols	Area Extent	298,54 ha (0,06 %)
Average depth (cm)	35cm		
Physical limitations	Wetness	Land capability and land potential The identified soils are of poor (Class V) land capability due to wetness limitations. These soils, at best are suitable as watercourse or marginal grazing in some instances. Thus, require intensive management practises. These soils are therefore not considered to contribute significantly to provincial and/or national agricultural productivity.	
Land potential	L5 – Restricted potential - Due to the signs of wetness (Watercourse)		

Table 4-22: Summary discussion of the grazing (Class IV) land capability class associated with the Leptosols

Land capability: Grazing (Class IV)			
			
Terrain Morphological Unit (TMU)	Gradually sloping land of >1% slope	Photograph notes	View of the identified orthic horizon directly underlain by lithic/hard rock material associated with the Leptosols.
Soil type (s)	Leptosols	Area Extent	298,42 ha (7,17 %)
Physical limitations	Shallow effective rooting depth is the primary limitation of the land capability of the Leptosols, which is due to the occurrence of an impermeable lithic/hard rock layer at a relatively shallow depth, which hinders penetration of plant roots.	Land capability and land potential The identified Leptosols are of poor (Class VII) land capability and are not suitable for arable agricultural land use. These soils are, at best, suitable for natural pastures for light grazing. Therefore, these soils are not considered to make a substantial contribution to extensive subsistence farming on a local scale.	
Land potential	Moderate potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperature.		

Table 4-23: Summary discussion of the wildlife / wilderness (including developed areas) (Class VIII) land capability class associated with the Technosols

Land capability: Grazing (Class VIII)			
			
Terrain Morphological Unit (TMU)	Not applicable; highly disturbed areas.	Photograph notes	View of the identified Technosols formation.
Soil type (s)	Technosols	Area extent	652,81 ha (7,17%)
Physical limitations	Comprises of significantly disturbed areas due to anthropogenic activities (i.e., existing unpaved roads and railway line) to an extent that no recognisable diagnostic soil horizon properties could be identified. These soils are characterised by various limitations, primarily the absence of soil horizon as a growth medium.	Land capability and land potential These identified Technosols have very poor (Class VIII) land capability due to the significant disturbance that has occurred because historic mines, residential areas and unpaved roads. This has led to the long-term alteration of the soil physical properties such that these soils are no longer viable for agriculture. This land capability class also includes areas where the original soil has been buried and/or extensively modified by anthropogenic activities. These soils are not considered to make contribution to agricultural productivity even on a local scale.	
Land potential	Very low potential (L8): Severe limitations due to soil, slope, temperature, or rainfall. Non-arable.		

Ecosystem Services

Ecosystem services are defined as the benefits that people derive from ecosystems. These services are crucial for maintaining the well-being of humans and the health of the environment. They encompass a wide range of processes and functions that ecosystems provide, which can be broadly categorised into provisioning, regulating, supporting, and cultural services. Regarding Type I and Type II ecosystem services, the IFC categorises them as follows:

- **Type I Ecosystem Services:** These are direct benefits derived from ecosystems that can be quantified and often have direct economic value. Examples include provisioning services like food, water, and raw materials, which can be directly measured and sold in markets; and
- **Type II Ecosystem Services:** These are more indirect benefits that ecosystems provide, which might not have a straightforward economic value or may not be directly measurable. They include regulating services such as climate regulation, water purification, and pollination, as well as supporting services like soil formation and nutrient cycling. While these services are essential for maintaining ecosystem health and functionality, their economic value can be more complex to quantify and often requires broader valuation methods

Ecosystem service considerations

The impact the OHL traversing cultivated agricultural fields can affect ecosystem services in several ways, both for Type I and Type II services, which include the following.

Type I Ecosystem Services

- **Crop Yield and Quality:** The presence of OHL might affect crop growth and yield. For instance, electromagnetic fields generated by powerlines could potentially influence plant health. Additionally, physical infrastructure could lead to land disturbance or affect farming practices;
- **Land Use Efficiency:** OHLs might restrict the use of certain farming equipment or techniques, potentially leading to less efficient land use. This could impact the overall productivity of the agricultural fields; and
- **Soil Health:** Construction and maintenance activities associated with the OHLs could lead to soil compaction, erosion, or contamination, which could directly affect soil quality and, subsequently, crop yields.

Type II Ecosystem Services

- **Biodiversity and Habitat Fragmentation:** The installation of OHLs can fragment habitats and disrupt local wildlife. This could affect species diversity and the health of ecosystems that support agricultural fields. For instance, powerlines could serve as barriers to wildlife movement or lead to habitat loss; and
- **Pollination Services:** By impacting local biodiversity and habitat structures, powerlines might affect pollinator populations, which are vital for the pollination of many crops. This could lead to reduced efficiency in crop pollination.

4.5 Freshwater ecosystems

The section presents an overview of the baseline conditions of freshwater ecosystems in the Project area and draws on information contained in the freshwater ecosystem assessment (SASa, 2024) conducted for the ESIA (refer to Volume 4, Appendix F for the detailed specialist assessment).

4.5.1 General characteristics

Various desktop databases were consulted and provided the following insights:

- Protected areas: According to the World Database on Protected Areas (UNEP-WCMC, 2024), the powerline and its associated investigation area are not located within any designated protected areas;
- Aquatic ecoregion: The WWF Freshwater Ecoregions of the World (FEOW) classifies the entire Project area within the Zambezian Headwaters Ecoregion (reference number 555), which encompasses significant river systems (Figure 4-12);
- Major rivers and geography: This ecoregion includes the headwaters of major rivers like the Upper Zambezi and its tributaries such as Lungwebungu, Luanginga, Cuando, Luena, Dongwe, and Kabompo (Bell-Cross 1972). Additionally, tributaries of the Okavango, including the Cubango and Cuito (Figure 4-13), originate on the central Angolan plateau, while the Cunene River starts in west-central Angola and features notable disruptions such as rapids and the 122-meter high Ruacana Falls (Roberts, 1975);
- Regional hydrology: The fast-flowing headwater streams of this ecoregion contribute to major sub-Saharan rivers—the Zambezi and the Okavango. The ecoregion spans from the Okavango catchment in the west to the headwaters of the Kafue River in the east, crossing through the interior of Angola and parts of northern Zambia. These rivers drain steep gradient zones which, unlike typical mountain headwaters, are discontinuous; and
- Biodiversity: The rivers host diverse habitats, supporting both endangered and vulnerable fish species. Notably, while the database (Ministry of the Environment, 2018) includes a number of marine species at risk, the freshwater fish species identified (*Ethmalosa fimbriata* and *Arnoglossus capensis*) also face significant conservation challenges, emphasising the need for targeted preservation efforts in the region. Additional species according to International Union for Conservation of Nature (2024) include *Threespot tilapia* (VU) and *Oreochromis macrochir* (VU). According to the database, the *Oreochromis macrochir* species occurs in the upper Zambezi, as well as the Kafue, Okavango and Cunene Rivers. Occasionally also recorded from the Middle Zambezi. The *Threespot tilapia* mainly occurs in the Upper Zambezi, Okavango and Kafue Rivers, as well as the upper Kasai, Lake Bangweulu and the Chambeshi River. It has also been collected from the Revue River in Mozambique (Buzi system), far to the east of its natural distribution and it is possible that this is a relict population. These two species (i.e., *Threespot tilapia* (VU) and *Oreochromis macrochir* (VU)), based on habitat availability and distribution ranges, may be located within the study area. It is important that all mitigation measures as stated in this report are implemented in order to mitigate potential impacts.

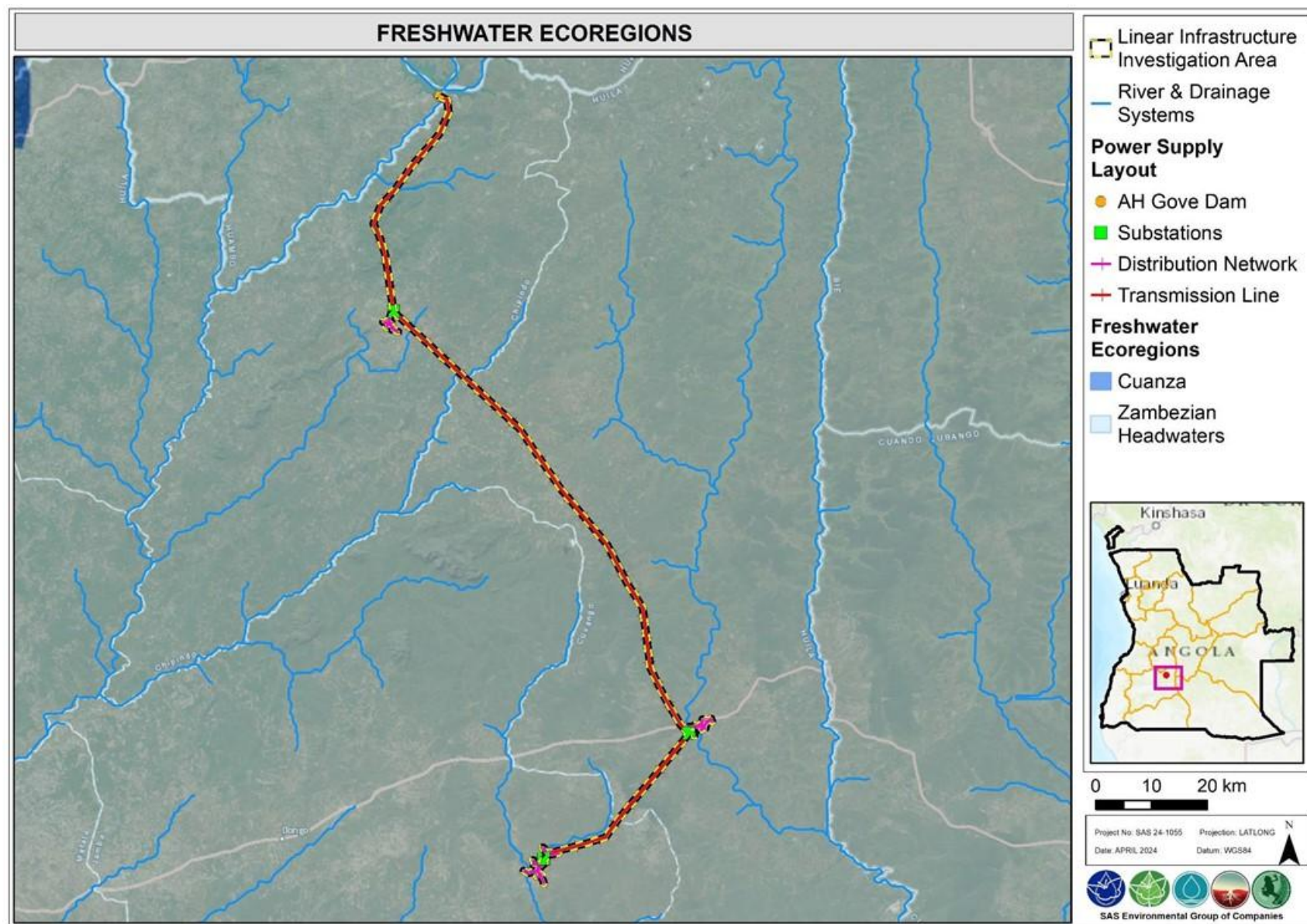


Figure 4-12: Aquatic ecoregion associated with the proposed powerline investigation area (INHR, 2016)

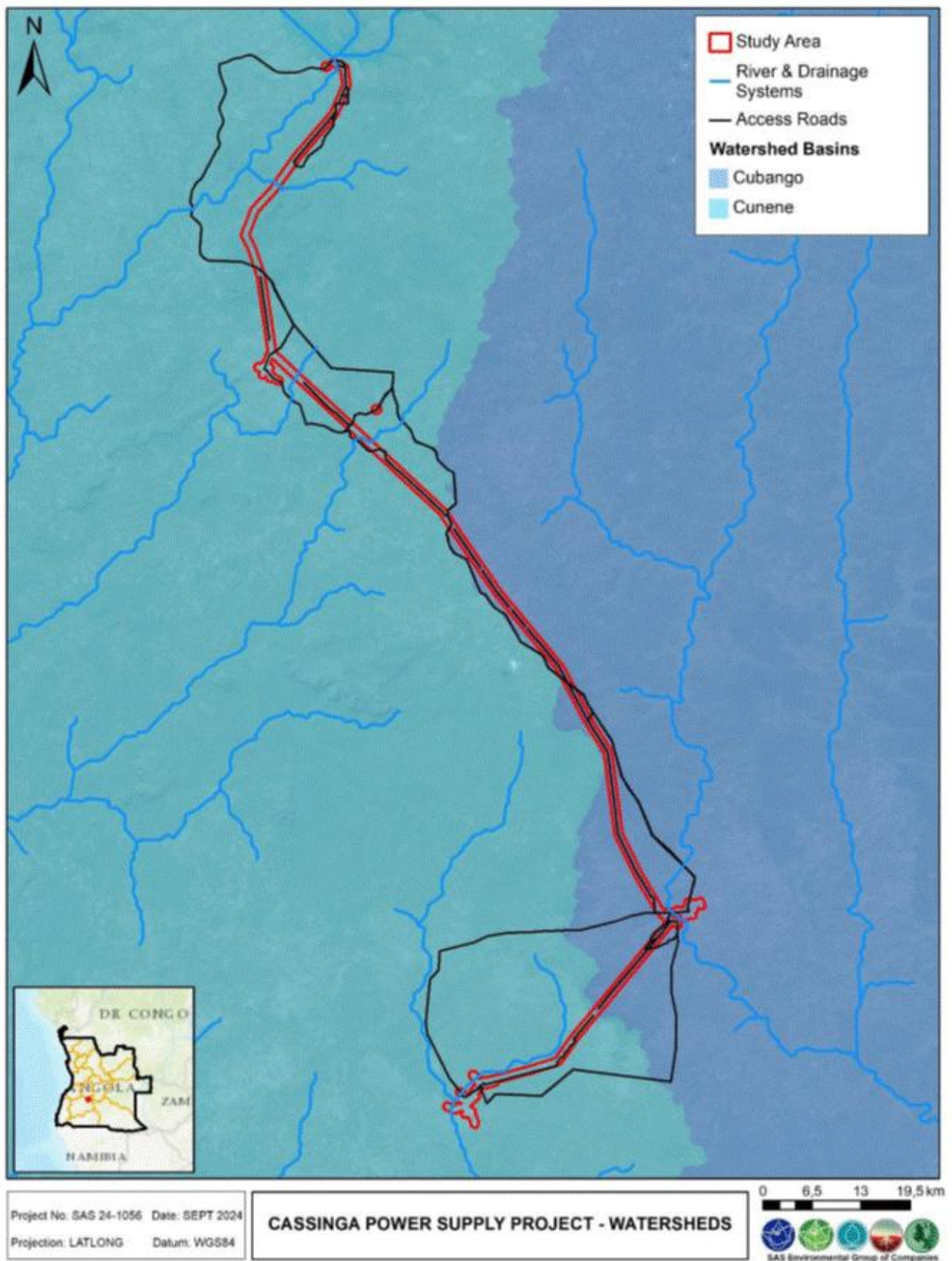


Figure 4-13: Basins, rivers and drainage systems associated with the proposed powerline and investigation areas

4.5.2 Classification

The freshwater ecosystems encountered were classified according to the guidelines by Ollis et al., (2013), (Table 4-24) but also considered local descriptions of wetlands used in Angola. High-level classification placed these watercourses within the Inland Systems category of the Zambezan Headwaters Aquatic Ecoregions. The ecosystems were further differentiated into four primary hydrogeomorphic (HGM) types: rivers with associated riparian vegetation and, in some instances, adjoining floodplains; valley bottom wetlands, which may be channelled or unchannelled; and 'dambos'. Dambos are characteristically even and low-lying areas, distinct within the local Angolan context.

Table 4-24: Summary of the Classification system for the various freshwater ecosystems identified within the study area (Ollis, 2013)

Level 2: Regional setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit
Ecoregion: The study area falls within the Zambezan Headwater Aquatic Ecoregion	Valley floor: The typically gently sloping, lowest surface of a valley	River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
		Floodplain wetland: the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank.
	Plain: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land	Channelled Valley Bottom: a valley-bottom wetland with a river channel running through it. Unchannelled Valley Bottom: a valley-bottom wetland without a river channel running through it. Dambo – seasonally or permanently wet grassy valleys, depressions, or seepage zones on slopes which are polygenetic in origin. They can be defined as a wide and low lying gently sloping treeless grass covered depression, which is seasonally waterlogged by seepage from surrounding high ground assisted by rainfall and has water tables for most part of the year in the upper 50-100 cm of the soil profile from which they drain into streams.

4.5.3 Delineation and buffer zones

The position of the various wetland systems within the study area was based on the combination of delineation methods employed, i.e. digital satellite imagery and field verification. During the field assessment, the following indicators were used to delineate the boundaries of the watercourses:

- Terrain units were used as the primary indicator, as the terrain of the study area has well-defined low-lying areas where water is likely to collect and/or move through the landscape;
- Soil morphological characteristics (Figure 4-14) typically associated with wetland conditions, such as gleying or mottling were used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50 cm of the soil surface. This indicator was used to identify gleyed soils where the soil is a greyish/greenish/bluish colour due to the leaching out of iron; and
- Vegetation was utilised in conjunction with terrain as the secondary indicator, where feasible. Due to the transformation in some areas, particularly around the cultivated/historically cultivated areas, the vegetation indicator was not always reliable. In some of the dambo systems, various sedge species, orchids, and graminoid species adapted to moist conditions were identified.



Figure 4-14: Representative photographs of soil samples within dambo wetland systems, illustrating typical soil morphological characteristics including mottling (right) and gleying (left) associated with a fluctuating water table

Figure 4-15 to Figure 4-20 depict the position of the various wetland systems within the study area based on the combination of delineation methods employed. The delineations include buffer zone recommendations from Presidential Decree No. 82/14, which mandates a 200 m protection zone around water resources. This is supplemented by experiences from neighbouring SADC countries like Zimbabwe and South Africa, which suggest a 30 m and 32 m buffer, respectively.

For this Project, a precautionary 32 m buffer is recommended to safeguard non-linear Project components like support pylons. Where impractical, a minimum 10 m buffer during construction is advised, following more flexible regional guidelines. The buffer zones aid future planning and ensure infrastructure does not encroach on sensitive watercourses.

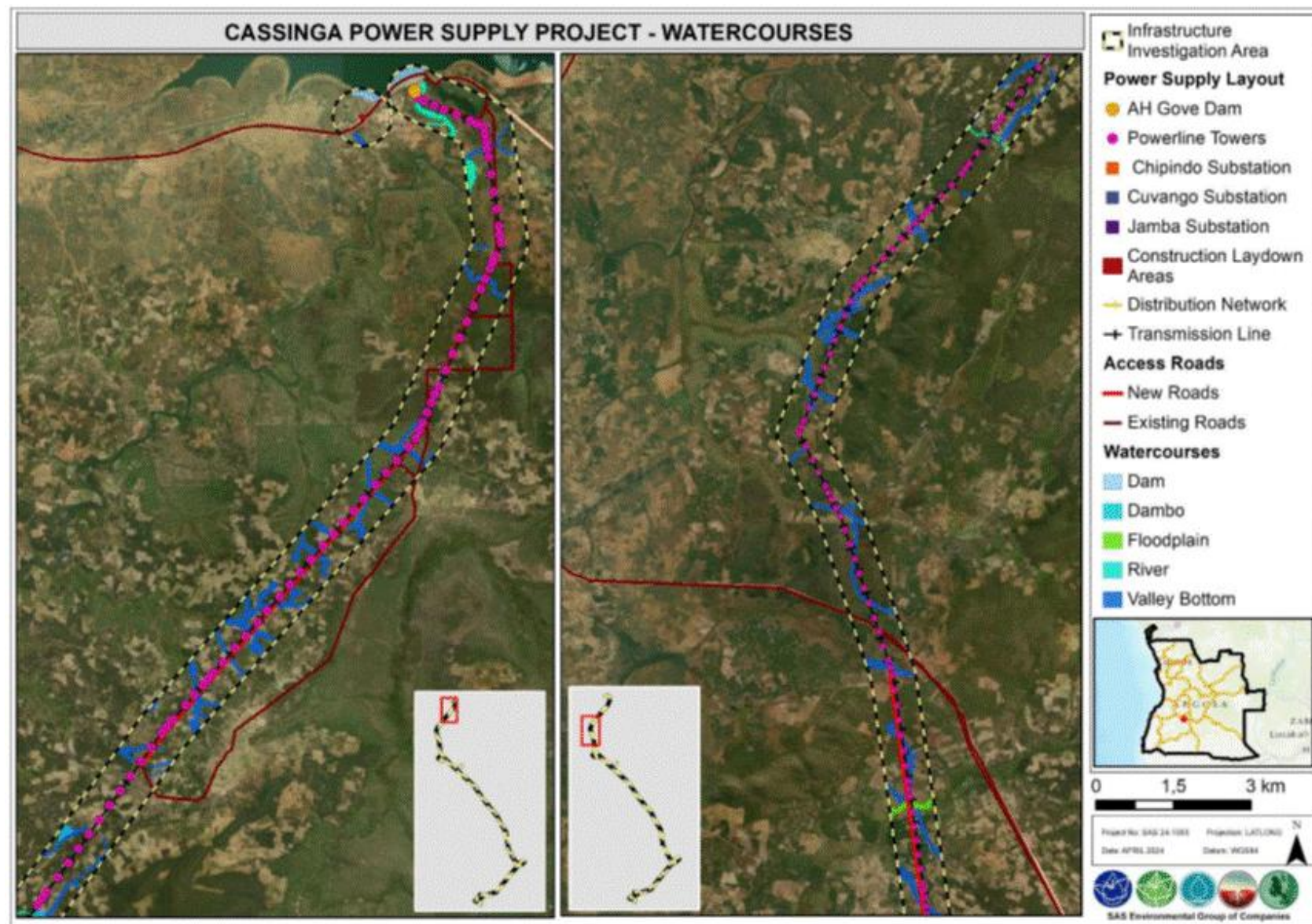


Figure 4-15: Delineated freshwater systems including buffer zones

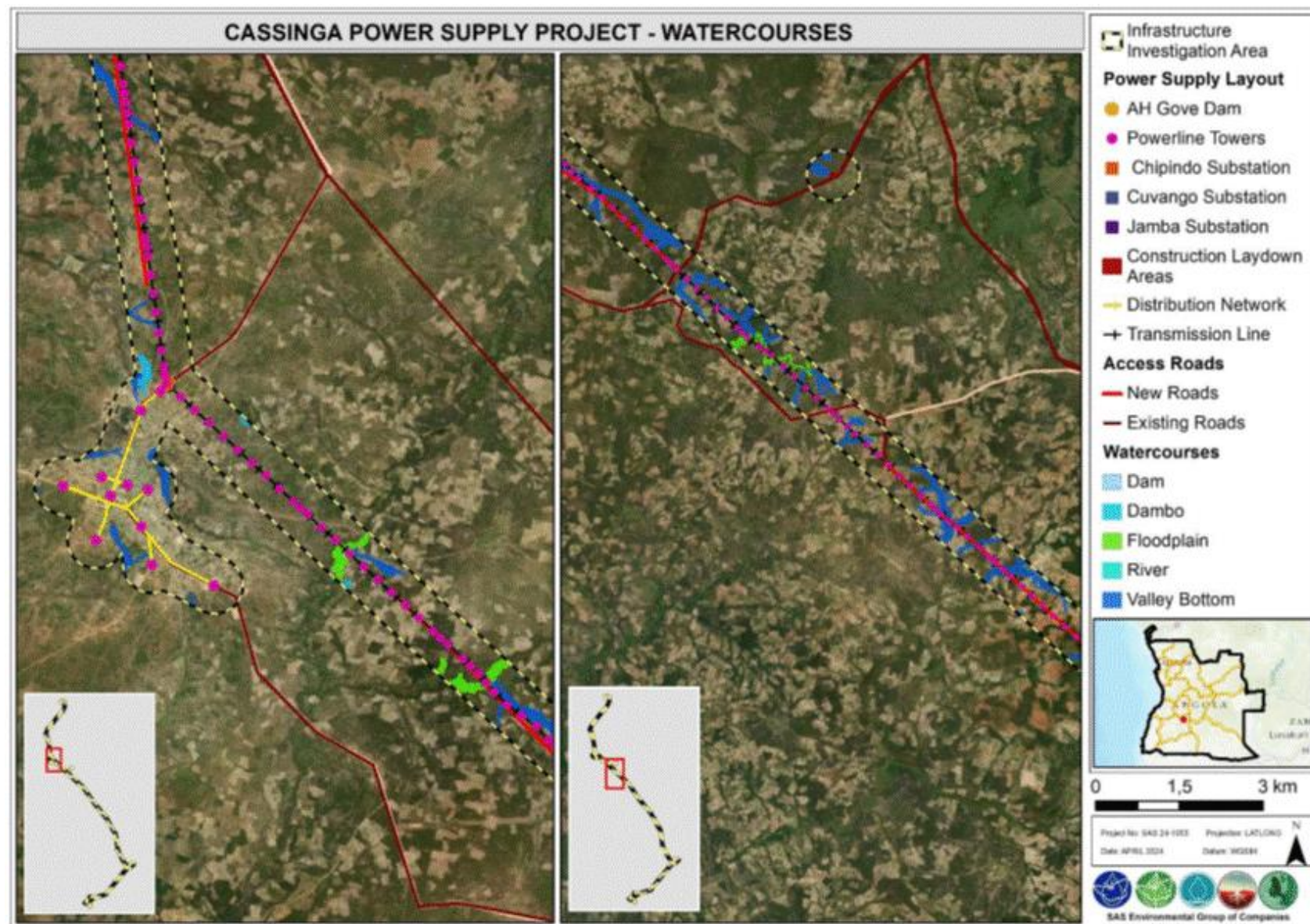


Figure 4-16: Delineated freshwater systems including buffer zones

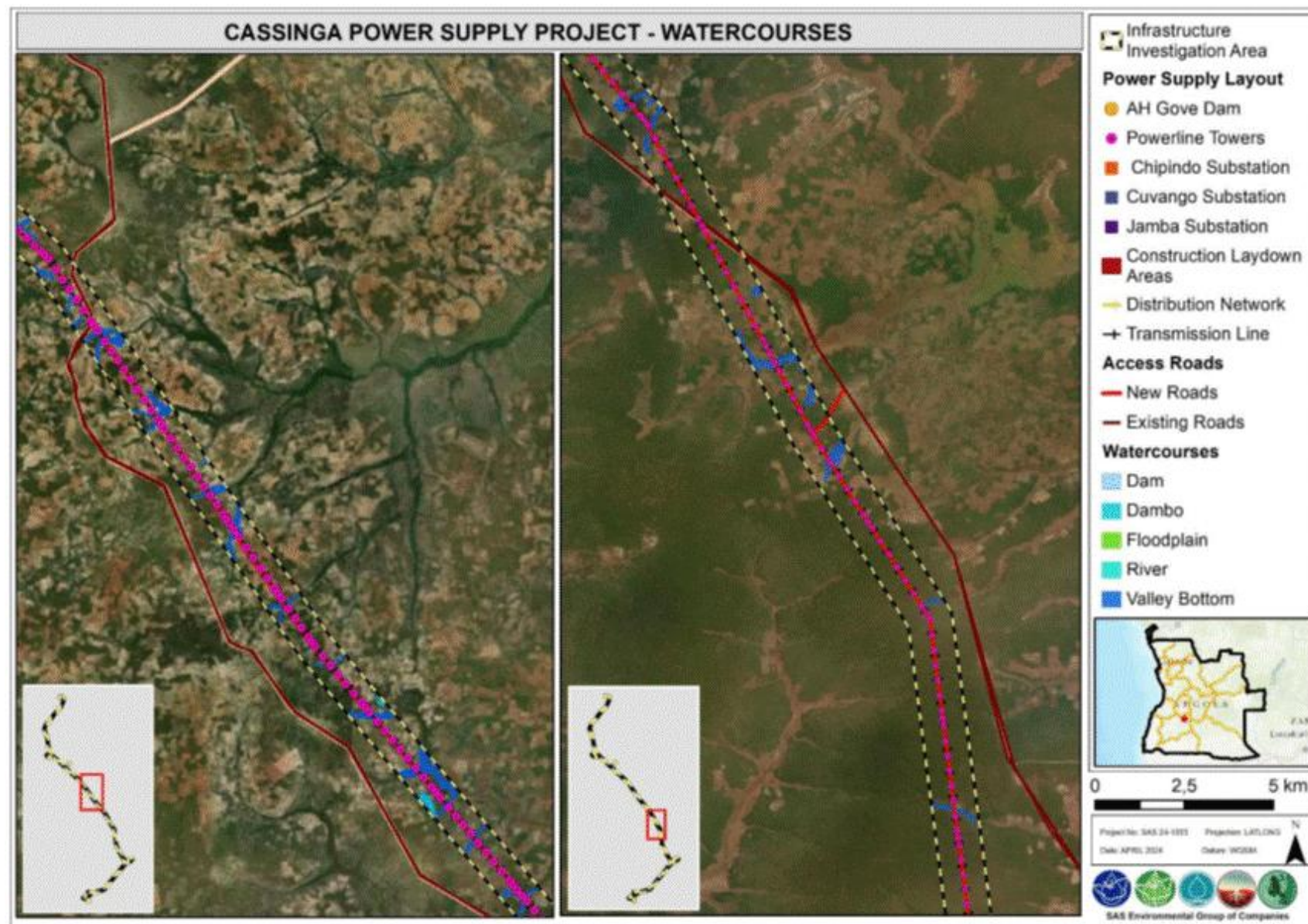


Figure 4-17: Delineated freshwater systems including buffer zones

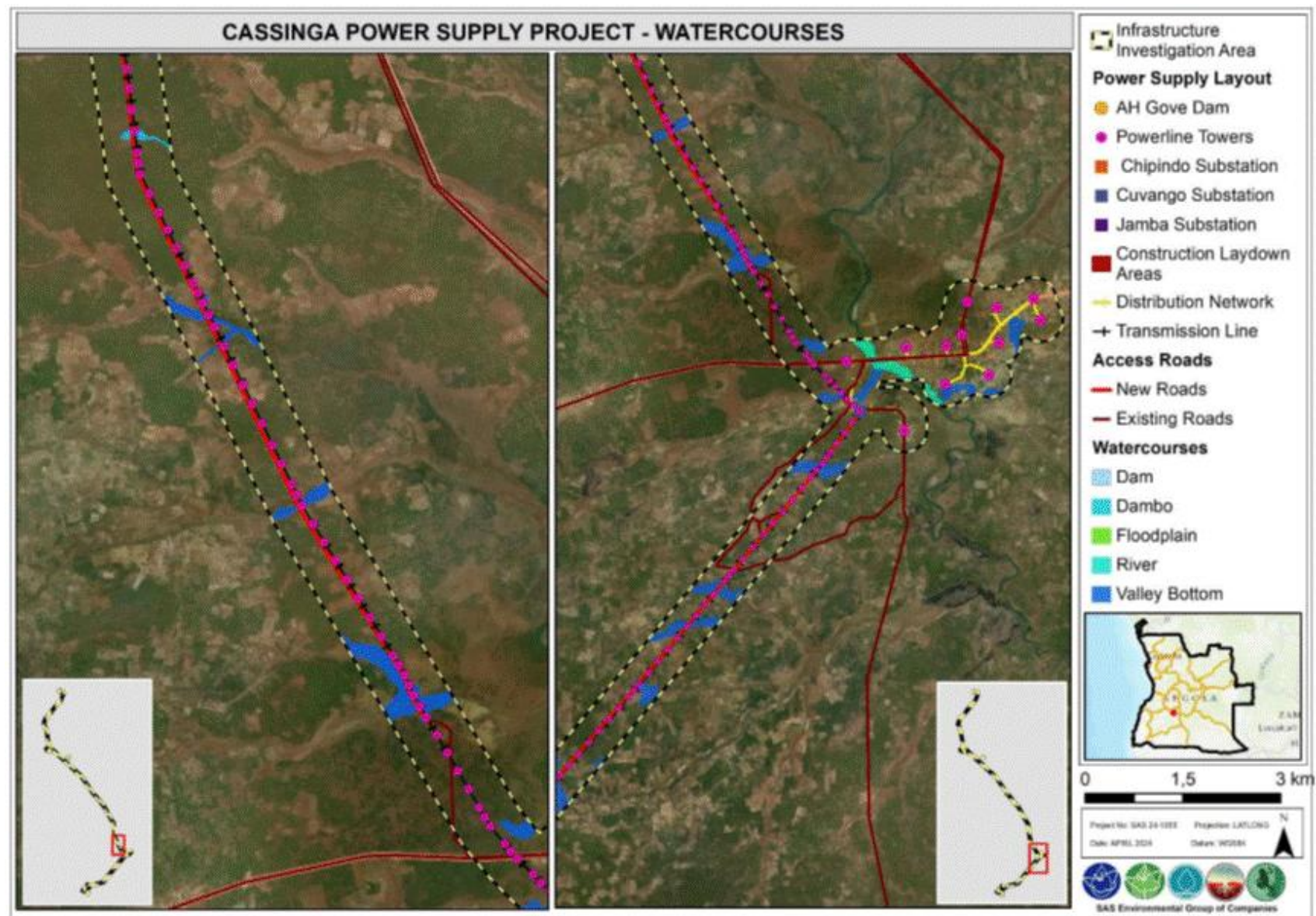


Figure 4-18: Delineated freshwater systems including buffer zones

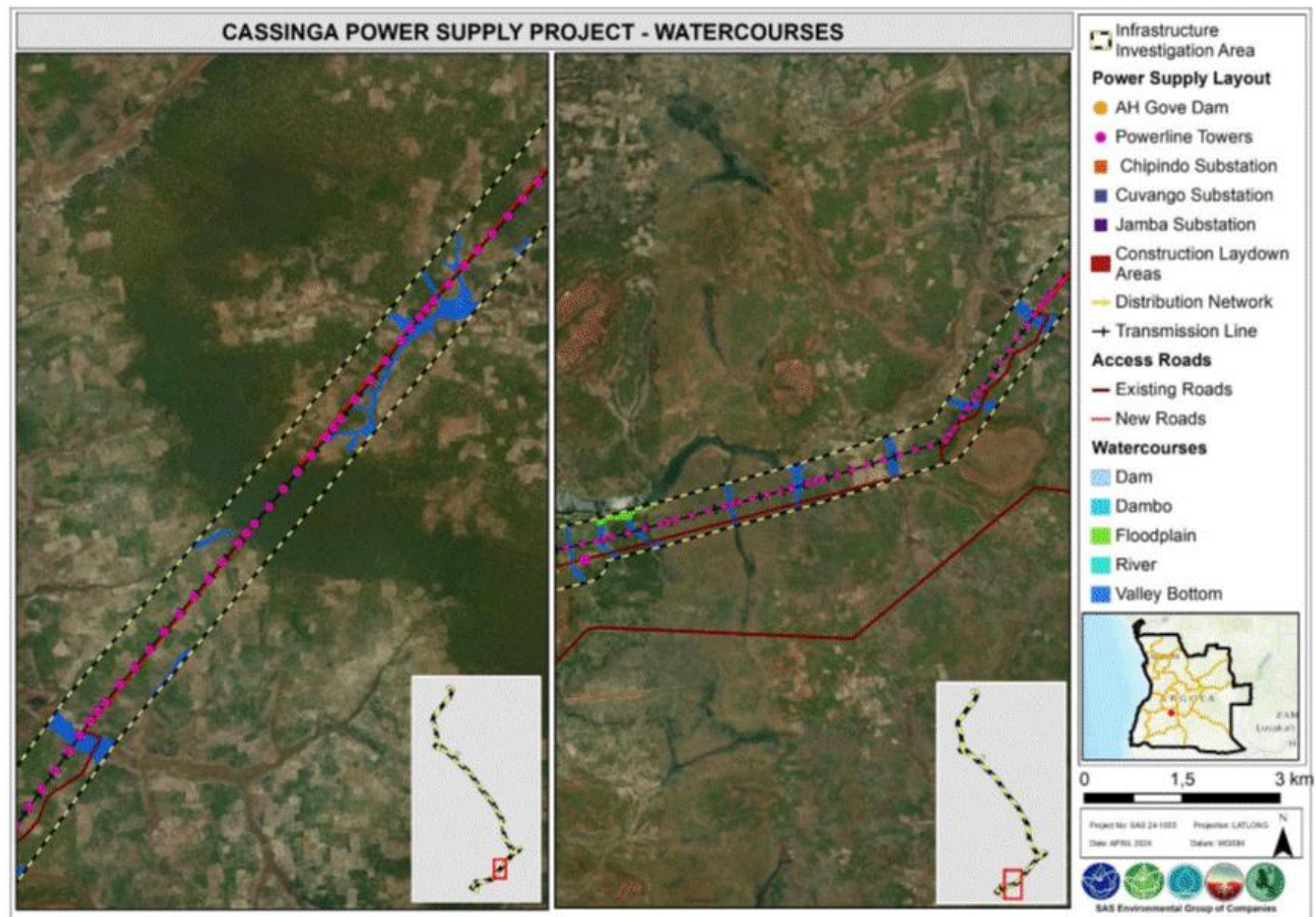


Figure 4-19: Delineated freshwater systems including buffer zones

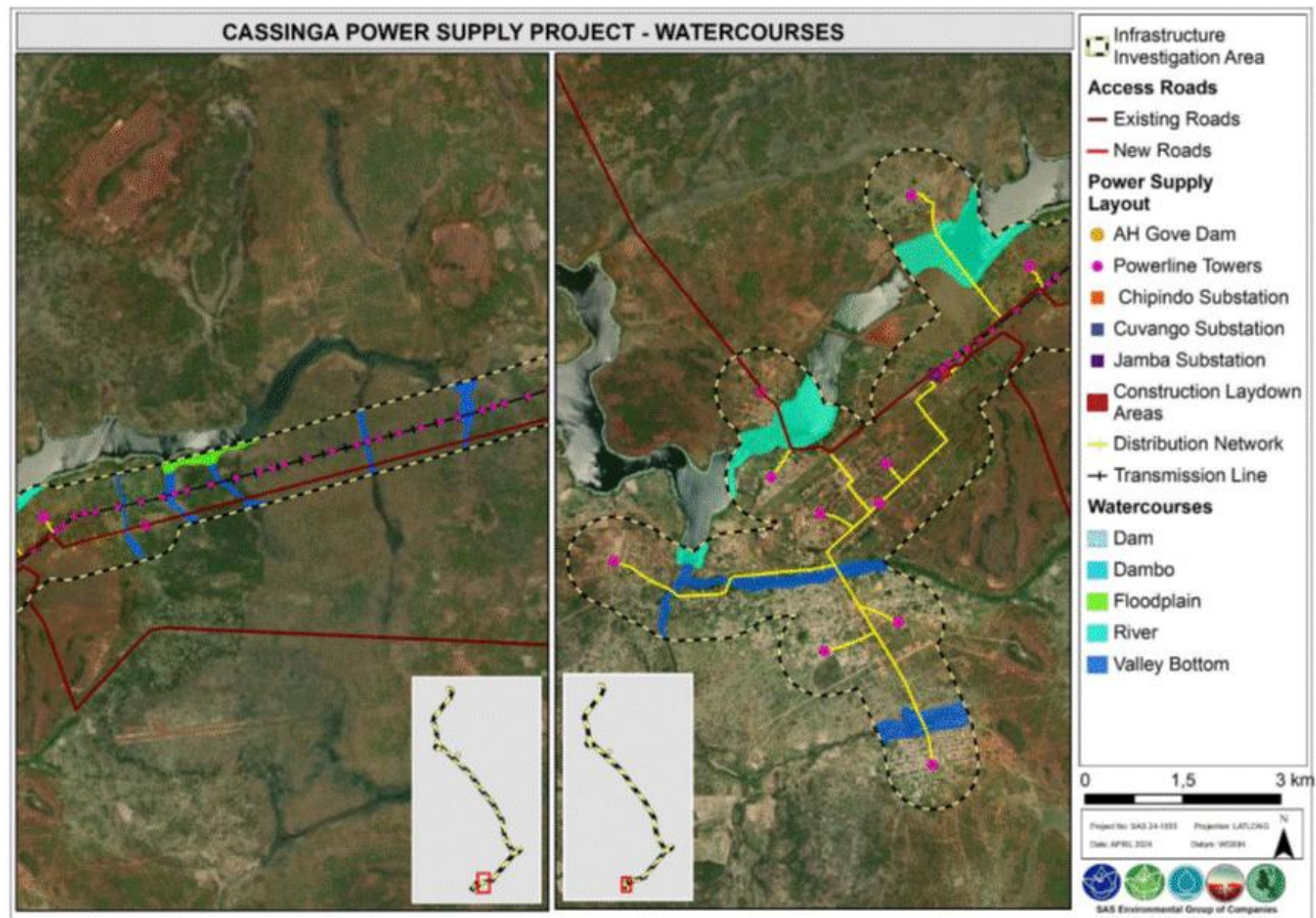


Figure 4-20: Delineated freshwater systems including buffer zones

4.5.4 Assessment

The analysis of the freshwater ecosystems showed distinct differences among various HGM types, such as rivers with riparian zones versus those with associated floodplains. However, during the site assessment, it was observed that within each HGM category, conditions tended to be homogenous. This uniformity was likely due to similar anthropogenic impacts affecting each group, including cultivation, cattle trampling, and instream crossings. As a result, aspects like ecoservice provision, hydrological regime, geomorphological characteristics, water quality, and habitat were assessed collectively for each group.

The discussion of freshwater ecosystems is structured by system type (e.g., river, channelled valley bottom, dambo), focusing on their key characteristics, ecostatus (including present ecological state (PES), ecological importance and sensitivity (EIS)) and their provision of goods and services. This latter aspect is especially crucial given the rural context of the study area, where local communities heavily depend on these ecosystems. The findings are summarised in Table 4-25 to Table 4-27.

Table 4-25: Summary of the assessment of the rivers identified. The rivers include the Cunene River (associated with Gove dam), Cubango River (located in Cuvango) and Cuanza River (located in Jamba) associated with the proposed Project

Three photographs of riverine systems. Panel A shows the Cunene River with a large dam structure and industrial buildings in the background. Panel B shows the Cubango River flowing through a flat, grassy landscape. Panel C shows the Cuanza River flowing through a similar landscape with some trees and a bridge in the distance.

Photograph notes: Representative photographs of the, A - Cunene River (associated with Gove dam), B - Cubango River (located in Cuvango) and C - Cuanza River (located in Jamba). These are the larger river systems within the investigation area and the floodplains and valley bottom systems identified form tributaries or headwaters of these larger river systems. Due to the homogeneity of these river and similarities in terms of ecological service provision, they are discussed in a combined fashion and referred to as “riverine systems”.

Present State Assessment

The radar chart compares Demand (red line) and Supply (black line) across 14 categories. The categories are: Flood attenuation, Stream flow regulation, Sediment trapping, Erosion control, Phosphate assimilation, Nitrate assimilation, Toxicant assimilation, Carbon storage, Biodiversity maintenance, Water for human use, Harvestable resources, Food for livestock, Cultivated foods, and Tourism and Recreation. The chart shows that Demand is generally higher than Supply, particularly in the 'Demand' categories like Flood attenuation, Stream flow regulation, and Sediment trapping.

Category	Demand (Red)	Supply (Black)
Flood attenuation	3.5	2.0
Stream flow regulation	3.0	1.5
Sediment trapping	2.5	1.0
Erosion control	2.0	1.0
Phosphate assimilation	1.5	1.0
Nitrate assimilation	1.0	1.0
Toxicant assimilation	1.0	1.0
Carbon storage	1.0	1.0
Biodiversity maintenance	1.0	1.0
Water for human use	1.0	1.0
Harvestable resources	1.0	1.0
Food for livestock	1.0	1.0
Cultivated foods	1.0	1.0
Tourism and Recreation	1.0	1.0

Watercourse characteristics relating to (PES and EIS) discussions:

- **Hydraulic regime**
The hydraulic regime of the assessed riverine systems has been altered by various road crossings which have in some reaches channelised the flow, presence of impoundments such as the Gove dam and Cuanza Dam which alter the natural delivery of flows and sediments to downstream reaches of the system, although these impacts are not considered significant given the volumes flowing downstream of the infrastructure.
- **Geomorphology and sediment balance**
Some evidence of moderate incision were observed along the assessed reaches at the time of the assessment. This was particularly along areas where vegetation clearing had taken place along crossing points and along areas that are utilised by communities for access into wood harvesting area. In addition, the presence of instream river crossings (including low-level bridges and low-level causeways) and impoundments has also resulted in reduction in the delivery of sediment to downstream reaches due to reduction in the stream velocity along these crossings which reduces the rivers’ ability to carry sediment.
- **Water quality**
In situ water quality parameters were measured during the low flow period.
pH: 6.53

Goods and Services Provision	The riverine systems are of high importance in the different areas they flow through for direct ecological services to communities as a source for water for consumption, watering of cattle, recreational activities and for fishing. During the assessment local communities were observed fishing in the rivers and also observed to be making use of the river as a source for bathing as well as washing clothes.	Oxygen content: 7.68 mg/l Oxygen saturation: 93.6% Temperature: 17.07° C Electroconductivity: 5.8 mS/m Total dissolved solids: 29 ppm None of these values would pose a limitation to supporting aquatic biota. ➤ Habitat and biota The rivers provide suitable habitat breeding habitat as well a good migratory corridor for fish and other aquatic biota. Furthermore, they are also important for biodiversity maintenance for avifaunal species. As noted in the PES discussion, vegetation clearing has occurred in some areas, but where clearing has not occurred the floral species composition and structure remains largely natural. This feature remained unchanged during the low flow survey.	
Ecstatus discussion	Although not formally assessed, the riverine systems are considered to be of moderate to high ecological integrity. Clearing of vegetation has occurred in some accommodate crop cultivation, although this is not at a significant scale. The remaining vegetation comprised indigenous woody species representative of the vegetation throughout the study area and greater surrounds. The impoundments including crossings noted above will have had an impact on the hydraulic regime of the system. Measured water qualities at different reaches measured significantly low electrical conductivity indicated limited impacts in terms of dissolved salts.	Extent of modification anticipated	The extent of modification of the riverine systems due to the development of the powerline and associated infrastructure is considered low given the limited extent of the footprint of the pylons and substations. This means that clearing of vegetation will be localised, minimising the potential significant impacts from incision and soil erosion. In addition, it must be ensured that the powerline pylons avoid direct encroachment on the delineated freshwater ecosystem. This is critical for maintenance of ecological functionality as well the longevity of the proposed infrastructure. Additional impacts are anticipated as a result of the clearing of vegetation along the powerline servitude.
Consideration of Integrated Environmental Management and Sustainable Development principles:			
It is recommended that general 'best practice' mitigation measures to avoid direct impacts including edge effects be implemented throughout the construction and operation phases of the project. Overall, given that the project has the potential to limit direct impacts on the rivers and that the project is considered essential for human livelihoods including socio-economic development and more broadly, for sustainable development. Therefore, it is the opinion of the specialist that the project be considered in a positively for authorisation.			

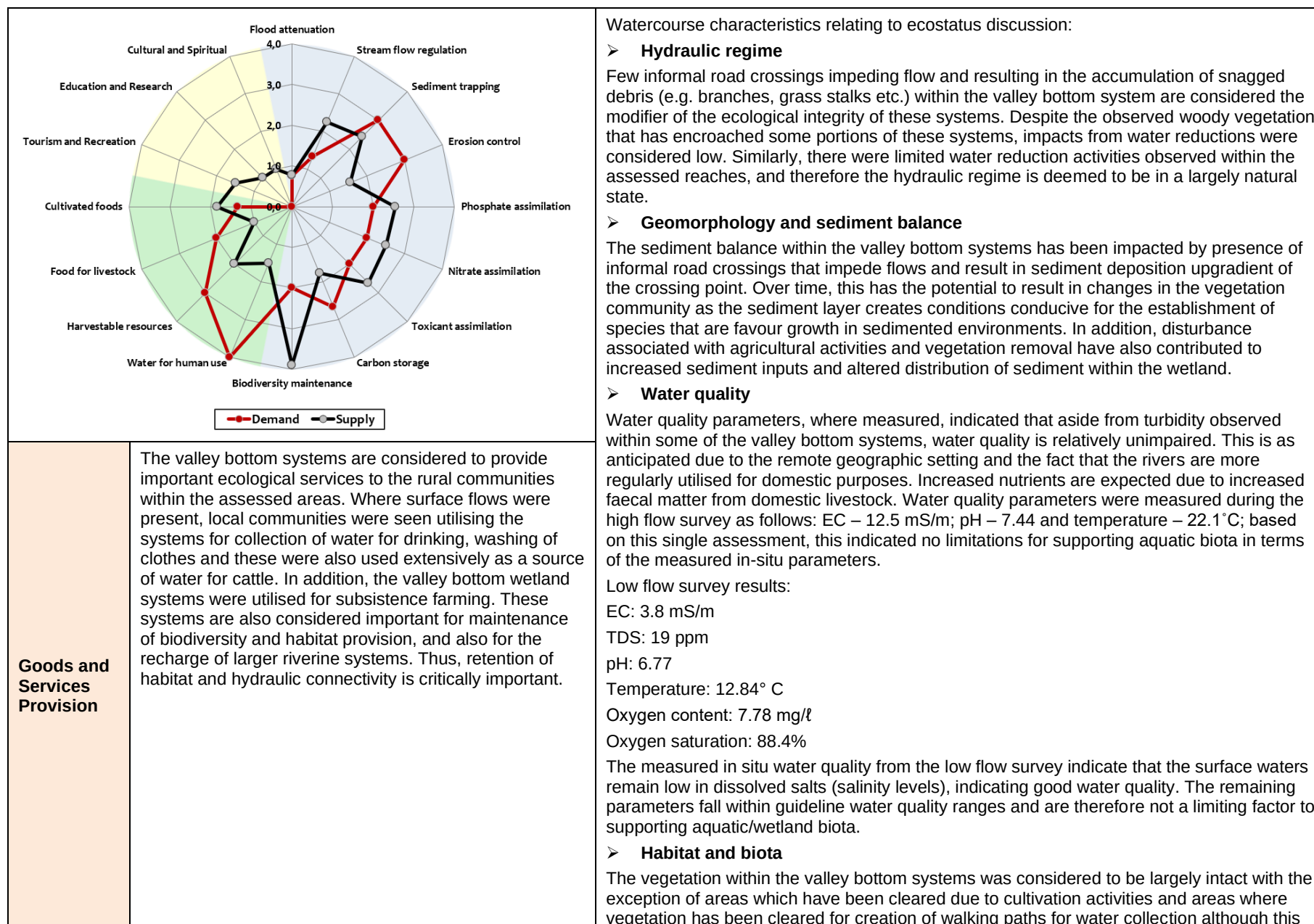
Table 4-26: Summary of the assessment of the valley bottom systems



Photograph notes: Various channelled and unchannelled valley bottom wetland systems noted during the site assessment. Significant rainfall was received during the week of the field work resulting in standing ponds observed at the time.



Photograph notes: Various channelled and unchannelled valley bottom wetland systems noted during the dry season site assessment. The surface water ecosystems, especially the valley bottom wetland units are strongly seasonal.

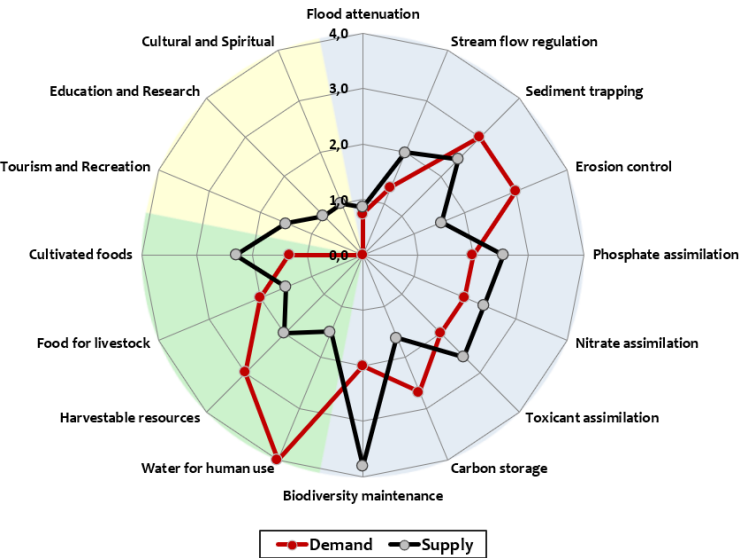


		is not severe. Species indicative of disturbance or alien and invasives species were predominantly observed along the side of the road/within the road reserve.	
Ecstatus discussion	The hydraulic regime of the valley bottom systems was impacted by presence of various crossings which hydraulic connectivity as observed in some reaches where culverts were not sufficient to convey flow to downstream reaches, resulting in flows ponding upgradient of the valley bottom crossings. Other impacts on the systems include disturbances within the edge of the valley bottom systems from agricultural activities and encroachment by woody species. Despite this, the ecological integrity of the valley bottom systems was considered largely natural with no significant modifiers observed. Observations from the dry season survey reiterated these findings.	Extent of modification anticipated	The proposed powerline will cross the delineated valley bottom systems, however given the limited spatial footprint of the infrastructure such as the supporting pylons and proposed substations, the extent of modification is anticipated to be low. Potential impacts from clearing of vegetation, ground-breaking and construction of surface infrastructure can be localised by ensuring that operational and non-operational areas are clearly demarcated prior to any site preparation/construction activities and ensuring that sediment control devices are installed prior to any activities within the site. In terms of the proposed access roads, the layout indicates that some proposed new roads will traverse the valley bottom wetland systems, and this will result in a medium impact. Therefore, it is recommended that any in-stream construction works associated with the access roads must ideally be done during the winter season where the flows are at the lowest.
Consideration of Integrated Environmental Management and Sustainable Development principles:			
It is recommended that general 'best practice' mitigation measures to avoid edge effects be implemented throughout the construction and operation phases of the project. In terms of the layout of the powerline infrastructure, it must be ensured that the powerline pylons are spanned appropriately to avoid direct encroachment within the valley bottom systems, this is critical for maintenance of ecological functionality as well the longevity and protection of the proposed infrastructure as the infrastructure. The layout indicates that some proposed new roads will traverse the valley bottom wetland systems, and this will result in a medium impact. Therefore, it is recommended that any in-stream construction works associated with the access roads must ideally be done during the winter season where the flows are at the lowest. It is further recommended that formal crossing infrastructure be used where roads cross over/through watercourses. These must be designed in such a way that the natural flow of water is not hindered. For roads that cross wider valley bottom wetland units, multiple culvert pipes/drains must be used so that the flow of water is spread across the width of the watercourse and not restricted to a single flow path, which will cause siltation at the upstream side and erosion at the downstream end. Overall, given that the project has the potential to limit direct impacts on the freshwater ecosystems and that the project is considered essential for human livelihoods including socio-economic development and more broadly, for sustainable development. Therefore, it is the opinion of the specialist that the project be considered in a positively for authorisation.			

Table 4-27: Summary of the assessment of the dambos and floodplain wetland systems



Photograph notes: Various dambo systems noted during the site assessment. Significant rainfall was received during the week of the field work resulting in standing ponds observed at the time of the assessment.



Watercourse characteristics relating to ecostatus discussion:

➤ **Hydraulic regime**

Few informal road crossings impeding flow and resulting in the accumulation of natural debris within the wetland system are considered the most prominent modifier of the ecological integrity of these systems. Some areas are also largely dominated by cultivation, which has resulted in disturbance of soil in the catchment and altered the natural distribution and retention of water in the landscape due to presence of various artificial drainage channels related to agricultural activities.

➤ **Geomorphology and sediment balance**

Sediment laden runoff has likely increased over time within some of the wetland systems due to catchment wide activities (soil disturbances related to cultivation and vegetation clearing). The sediment balance has also been impacted by presence of inform road crossings which impede flows and result in sediment deposition upgradient of the crossing point. Over time, this has the potential to result in changes in the vegetation community as the sediment layer creates conditions that are suitable for establishment of reeds.

➤ **Water quality**

In-situ water quality parameters, where measured, indicated water quality is relatively unimpaired. Water

Goods and Services Provision	The dambo systems were observed to be with no major impacts. The primary modifiers noted were impacts to the vegetation, primarily as a result of some cultivation activities, trampling by domestic livestock and footpaths used during water collection/wood harvesting. The resulting reduction in natural vegetation cover has led to encroachment by floral species associated with disturbance, however this is not considered to be significant.	quality parameters were measured as follows, EC – 12.5 mS/m; pH – 7.44 and temperature – 22.1°C. This is as anticipated due to the remote geographic setting and the fact that the rivers are more regularly utilised for domestic purposes. ➤ Habitat and biota The vegetation was considered largely intact with the exception of areas which have been cleared due to cultivation activities and areas where vegetation has been cleared for creation of walking paths for water collection although this is not severe. The presence of encroacher and alien species indicative of disturbance was noted, these included <i>Bidens pilosa</i> and <i>Tagetes minuta</i>
Ecstatus discussion	The valley bottom systems are considered to provide important ecological services to the rural communities within the assessed areas. Where surface flows were present, local communities were seen utilising the systems for collection of water for drinking, washing of clothes and these were also used extensively as a source of water for cattle. In addition, the valley bottom wetland systems were utilised for subsistence farming. These systems are also considered important for maintenance of biodiversity and habitat provision, and also for the recharge of larger riverine systems. Thus, retention of habitat and hydraulic connectivity is critically important.	Extent of modification anticipated The proposed powerline will cross the delineated dambos, however given the spatial footprint of the infrastructure such as the supporting pylons and proposed substations, the extent of modification is anticipated to be low. Potential impacts from clearing of vegetation, ground-breaking and construction of surface infrastructure can be localised by ensuring that operational and non-operational areas are clearly demarcated prior to any site preparation/construction activities and ensuring that sediment control devices are installed prior to any activities within the site. In terms of the proposed access roads, the layout indicates that some proposed new roads will traverse the valley bottom wetland systems, and this will result in a medium impact. Therefore, it is recommended that any in-stream construction works associated with the access roads must ideally be done during the winter season where the flows are low.
Consideration of Integrated Environmental Management and Sustainable Development principles:		
It is recommended that general 'best practice' mitigation measures to avoid edge effects be implemented throughout the construction and operation phases of the project. In terms of the layout of the infrastructure, it must be ensured that the powerline pylons are spanned appropriately to avoid direct encroachment, this is critical for maintenance of ecological functionality as well the longevity and protection of the proposed infrastructure as the infrastructure. In terms of the layout of the infrastructure, it must be ensured that the powerline pylons are spanned appropriately to avoid direct encroachment within the valley bottom systems, this is critical for maintenance of ecological functionality as well the longevity and protection of the proposed infrastructure as the infrastructure. The layout indicates that some proposed new roads will traverse the dambos and floodplain systems, and this will result in a medium impact. Therefore, it is recommended that any in-stream construction works associated with the access roads must ideally be done during the winter season where the flows are at the lowest.		

Ecosystem Service considerations

Ecosystem services classified as Type I directly benefit human well-being by providing tangible goods or services, such as water quality regulation, flood control, and biodiversity maintenance through habitat provision. Type II ecosystem services support the functioning of ecosystems and enable Type I services.

For the OHL and associated infrastructure, construction activities like vegetation clearing and ground disturbance may increase erosion and affect soil stability in freshwater ecosystems, impacting Type II services like erosion control and nutrient assimilation. The hydraulic regime of these ecosystems could also be altered, affecting streamflow regulation and flood attenuation, which are crucial for hydrologically connected systems.

Additionally, the construction and operation of the powerline could impact Type I services, such as the loss of freshwater habitat, particularly due to road construction, leading to habitat fragmentation and a reduced ability of wetlands to support biodiversity. This cumulative habitat loss could also reduce opportunities for tourism and recreation by diminishing the aesthetic value of freshwater ecosystems, though this service is not the most significant in the assessed areas. Freshwater ecosystems provide essential services like water for human use and livestock. Groundbreaking activities and increased vehicle movement, which may generate dust, could affect water quality and thus impact these direct services.

4.6 Water Resources

The section presents an overview of baseline hydrological characteristics and features in the vicinity of the Project area and draws on information contained in the hydrology assessment (HCV Africa, 2024) conducted for the ESIA (refer to Volume 4, Appendix G for the detailed specialist assessment). It also provides a high-level perspective on baseline hydrogeology conditions in the Project area of influence. Due to poor access following heavy rains, water sampling and analysis as part of the hydrology study could not be conducted at targeted points of interest (for turbidity, suspended solids, nitrates, nitrites, orthophosphates, ammonia, sulphates, chloride, coliforms, COD and metals). Water sampling and analysis will instead be conducted in the dry season and the data presented in the updated ESIA report.

4.6.1 Hydrology

Methodology

Baseline conditions were determined by analysing rainfall and evaporation, delineating catchment boundaries, and defining water chemistry and flow regimes. Peak rainfall was calculated using CHIRPS rainfall data, employing statistical analyses like Log Pearson Type 3 and Log Extreme Value Type 1 distributions. Catchment delineation used the FABDEM DEM to identify impacted streams, while stormwater flows and mean annual runoff were estimated through methods such as the Rational method, SCS method, and Francou Rodier envelope curves. Water quality was assessed through dry-season sampling at specific monitoring points, with results compared to Angolan water quality standards shown in Table 4-28.

Table 4-28: Angolan water quality criteria

Determinant	Units	Max recommended value	Max allowable value
Coliform Bacteria	Counts/100ml	50	
E coli	Counts/100ml		
Feacal coliforms	Counts/100ml	20	
Number of colonies @ 22°C	Counts/ml	20	
Number of colonies @ 37°C	Counts/ml	100	
Enterococcus	Counts/100ml	10	
Pseudomonas aeruginosa	Counts/100ml		
Salmonella	Counts/ml	Absent in 5000ml	
Ammonium	mg/l NH ₄	0.05	
Boron	mg/l B	1	
Cadmium	mg/l Cd	0.001	0.005
CBO ₅ (Biochemical oxygen demand)	mg/l O ₂	3	
Smell @ 25°C	Dilution factor	3	
Lead	mg/l Pb		0.05
Cyanide	mg/l Cn		0.05
Chloride	mg/l Cl	200	
Total Chlorine	mg/l Cl ₂		
Copper	mg/l Cu	0.02	0.05
Electrical conductivity	µS/cm	1000	
APHA colour	mg/l PtCo	10	20
COD (Chemical oxygen demand)	mg/l O ₂		
Chromium (VI)	mg/l Cr		0.05
Anionic detergents	mg/l	0.2	

Determinant	Units	Max recommended value	Max allowable value
Iron	mg/l Fe	0.1	0.3
Fluoride	mg/l F	0.7-1	1.5
Phosphates	mg/l P ₂ O ₅	0.4	
Total hydrocarbons	mg/l		
Manganese	mg/l Mn	0.05	
Nickel	mg/l Ni		
Nitrate	mg/l NO ₃	25	50
Dissolved oxygen	% saturated O ₂	70	
pH		6.5-8.5	
Total suspended solids	mg/l	25	
Sulphate	mg/l SO ₄	150	250
Total organic carbon	mg/l C		
Zinc	mg/l Zn	0.5	3

Findings

The Project spans 170 km and intersects 104 river or stream crossings (refer to Volume 3, Appendix D1), predominantly first-order streams, which are tributaries feeding into larger river systems. Conservative estimated floodline offsets are included in Volume 3, Appendix D2 for these stream crossings. If pylons are required to be placed within these offsets, detailed survey and floodline calculations will be required at applicable crossings.

The main rivers in the study area include the Cuandeja River (a tributary of the Cunene River), the Cubango River and the Cunene River (Figure 4-21). These waterways are vital for the region's hydrology, and their daily average stream flow and mean annual runoff are documented in Volume 3, Appendix D2. The recorded flows of these waterways align with site observations, indicating that they accurately represent the river systems' hydrological patterns.

Agricultural practices in the catchment areas have led to significant deforestation, primarily within Miombo woodlands, to create space for subsistence and low-intensity commercial farming. This deforestation primarily affects areas away from larger rivers, where forests tend to remain intact. The alteration of forest cover influences how the catchments respond to rainfall events. Contrary to the common belief that deforestation always increases runoff, the reality is more nuanced. Reduced canopy storage due to deforestation means more water is available for runoff. However, drier and more exposed soils might absorb more initial rainfall, and ploughing could increase surface water storage, offsetting the loss of canopy interception.

Runoff

The impact of deforestation on runoff is complex and influenced by several factors, including agricultural methods, topography, geomorphology, geology, catchment size and rainfall event characteristics. These factors collectively determine whether deforestation increases or decreases runoff. Increased infiltration and surface storage could enhance groundwater recharge, returning to streams as baseflow over time, though with some delay. Due to the lack of data from the period when forests were untouched, it is challenging to confirm whether runoff has increased or decreased as a result of deforestation. Most deforestation occurred long before the Project's inception, so its precise impact on runoff within the area of influence remains speculative. However, it is suggested that deforestation might not significantly affect runoff in the Project area.

Water Quality

Water quality samples were collected from 16 monitoring points (Table 4-29). Water quality assessments indicate poor bacteriological conditions across most sampling locations, with Salmonella and coliform bacteria present even in areas with limited upstream agricultural activity. Elevated iron levels were detected in samples from certain locations but are attributed to natural background conditions rather than human activities. Ammonium and biochemical oxygen demand (CBO5) levels are elevated at all sampling sites. Notably, hydrocarbons and elevated salts and metals are absent, suggesting that while there is significant human impact on water quality, it does not include industrial pollutants. Details of water quality from each monitoring point can be seen in Table 4-30. A map presenting the locations of water monitoring points is provided for in the Addendum to the ESIA (Volume 6).

Table 4-29: Water quality monitoring points

Monitoring location	Latitude (dec degrees)	Longitude (dec degrees)	Comments
WQ1	-14.70138	16.01271	The Cuandeja River
WQ2	-14.70074	16.01788	An urban stream
WQ3	-14.65397	16.12751	A small river system in the south of the study area
WQ4	-14.47555	16.28810	The Cuvango river
WQ5	-14.47377	16.27242	A stream near the Cuvango sub station site
WQ6	-14.42506	16.26814	Cuvango River tributary with lots of agriculture in catchment, cf WQ7
WQ7	-14.37385	16.25100	Cuvango River tributary with little agriculture in catchment, cf WQ6
WQ8	-14.27123	16.20490	Relatively undisturbed catchment
WQ9	-14.23304	16.18337	Stream between two villages
WQ10	-14.21959	16.17434	Heavily developed catchment, cf WQ7
WQ11	-14.00743	16.01150	First order stream
WQ12	-13.90192	15.89650	Large river system in the Cunene River catchment
WQ13	-13.85438	15.81973	Large river system in the Cunene River catchment potentially impacted by Chipindo
WQ14	-13.69514	15.78318	Lightly impacted stream in the Cunene River catchment
WQ15	-13.58624	15.94196	Large river system in the Cunene River catchment
WQ16	-13.52556	15.98448	Large river system in the Cunene River catchment

Table 4-30: Water quality results

Determinant	Units	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ8	WQ9	WQ10	WQ12	WQ13	WQ14	WQ16	WQX
Coliform Bacteria	Counts/10 0ml	52	236	52	24	308	261	179	1414	6	326	108	727	649	75
E coli	Counts/10 0ml	4	3	1	<1	4	<1	<1	3	<1	1	4	11	39	<1
Feacal coliforms	Counts/10 0ml	11	9	13	<1	8	<1	15	5	<1	3	9	28	73	15
Number of colonies @ 22°C	Counts/ml	68	>100	>100	>100	>100	>100	88	>100	82	63	>100	>100	>100	78
Number of colonies @ 37°C	Counts/ml	89	>100	>100	>100	>100	>100	74	>100	83	49	>100	>100	>100	56
Enterococcus	Counts/10 0ml	2	2	1	<1	19	15	1	17	2	<1	<1	9	81	11
Pseudomonas aeruginosa	Counts/10 0ml	1	2	<1	<1	<1	<1	<1	>2420	<1	<1	<1	1	<1	<1
Salmonella	Counts/ml	Present	Present	Present	Absent	Absent	Present	Present	Absent	Present	Present	Present	Present	Present	Present
Ammonium	mg/l NH ₄	0.37	0.26	0.48	0.14	0.06	1	0.24	1	0.09	0.27	0.18	0.32	0.07	0.16
Boron	mg/l B	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	0.09
Cadmium	mg/l Cd	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)	<0.005 (DL)
CBO₅ (Biochemical oxygen demand)	mg/l O ₂	5	6	5	4	4	6	5	14	6	9	2	8	7	5
Smell @ 25°C	Dilution factor	0	0	2	0	0	3	0	0	0	0	0	0	0	0
Lead	mg/l Pb	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)

Determinant	Units	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ8	WQ9	WQ10	WQ12	WQ13	WQ14	WQ16	WQX
Cyanide	mg/l Cn	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)
Chloride	mg/l Cl	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)	<10 (DL)
Total Chlorine	mg/l Cl ₂	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)
Copper	mg/l Cu	<0.01 (DL)	<0.01 (DL)	0.01	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)
Electrical conductivity	µS/cm	68	94	75	41	172	137	51	141	155	48	28	29	<20 (DL)	32
APHA colour	mg/l PtCo	3	17	0	0	0	0	0	20	0	0	0	0	0	0
COD (Chemical oxygen demand)	mg/l O ₂	<15 (DL)	<15 (DL)	<15 (DL)	<15 (DL)	<15 (DL)	32	<15 (DL)	36	<15 (DL)	<15 (DL)	<15 (DL)	<15 (DL)	<15 (DL)	<15 (DL)
Chromium (VI)	mg/l Cr	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)	<0.03 (DL)
Anionic detergents	mg/l	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)	<0.06 (DL)
Iron	mg/l Fe	0.19	0.29	0.08	0.1	0.06	0.04	<0.03 (DL)	0.09	0.08	0.12	0.1	0.13	0.07	0.09
Fluoride	mg/l F	0.12	0.26	0.15	<0.1 (DL)	0.11	0.16	<0.1 (DL)	<0.1 (DL)	0.13	<0.1 (DL)	<0.1 (DL)	<0.1 (DL)	<0.1 (DL)	<0.1 (DL)
Phosphates	mg/l P ₂ O ₅	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)	<0.15 (DL)
Total hydrocarbons	mg/l	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)	<1 (DL)
Manganese	mg/l Mn	0.01	0.01	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	0.01	<0.01 (DL)	<0.01 (DL)	0.01	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)	<0.01 (DL)
Nickel	mg/l Ni	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)	<0.05 (DL)
Nitrate	mg/l NO ₃	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)

Determinant	Units	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ8	WQ9	WQ10	WQ12	WQ13	WQ14	WQ16	WQX
Dissolved oxygen	% saturated O ₂	119	116	116	116	117	116	116	116	116	116	116	114	116	116
pH		7.1 (22°C)	7.0 (22°C)	6.4 (22°C)	7.2 (22°C)	6.9 (22°C)	6.9 (22°C)	6.2 (22°C)	6.8 (22°C)	7.6 (22°C)	7.4 (22°C)	7.0 (22°C)	6.8 (22°C)	6.9 (22°C)	7.0 (22°C)
Total suspended solids	mg/l	6	25	243	8	33	89	87	102	18	16	10	35	35	45
Sulphate	mg/l SO ₄	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)	<5 (DL)
Total organic carbon	mg/l C	3	6	<2 (DL)	<2 (DL)	<2 (DL)	5	2	7	2	2	<2 (DL)	<2 (DL)	<2 (DL)	<2 (DL)
Zinc	mg/l Zn	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)	<0.2 (DL)

Shaded values exceed recommended allowable limits

4.6.2 Hydrogeology

Although most of Angola's population relies on surface water, groundwater remains crucial, especially in the arid south and coastal zones where water availability is lower than in the central and northern regions. Rural areas heavily depend on groundwater from boreholes, hand-dug wells, and springs. In areas without functioning water supply systems, surface water is more commonly used (Miguel, 2018).

The country's hydrogeology can be divided into four regions:

- **Northwest Quadrant:** Includes Zaire, Uíge, Malanje, Kwanza-Norte, and Bengo provinces. Here, fissured and/or karstified rocks with medium to high permeability support aquifers with good flow rates (5 to 10 l/s) and good water quality;
- **Northeast Quadrant:** Covers Lundas and Moxico provinces, where intergranular aquifers with very high permeability and flow rates around 5 l/s are found. Water quality is generally good but may have high iron content at depth;
- **Southwest Quadrant:** Encompasses Benguela, Huambo, Huíla, and Namibe provinces, which encompasses this Project area. This region has compact fissured rocks with medium to low permeability and flow rates ranging from 3 to 5 l/s. Local aquifers with similar flow rates exist, with generally good groundwater quality, though some areas have quality issues; and
- **Southeast Quadrant:** Includes Cuando-Cubango province, featuring extensive granular aquifers with high permeability and variable in-depth flow. Some aquifers have higher salinity, affecting groundwater quality.

Angola's annual renewable groundwater resources (Figure 4-22) are estimated at around 58 km³/year. While wells are found across the country, groundwater reserves are not significantly developed due to the easy availability of surface water. The most important aquifers are in sedimentary deposits, with groundwater depths ranging from 10 to 30 m in the Central Plateau around Huambo, 5 to 30 m in the coastal zone, and over 200 m in the semi-arid south in the Kunene basin, where well yields are low (AHT, 2017).

Limited research has been conducted on groundwater, and no national resource estimates are available. There is no available data on groundwater quality, but some alluvial aquifers have high iron and sulphate concentrations, likely due to low precipitation and high evapotranspiration.

Groundwater use in Jamba, Cuvango and Chipindo

In Jamba, Cuvango, and Chipindo municipalities, groundwater is a crucial resource for daily life. Based on site surveys, residents typically source their water from hand-dug wells, known locally as cacimbas, which can reach depths of up to 20 meters. These wells provide untreated water for drinking, cooking, and other domestic uses. In Jamba, some areas also rely on a solar-powered borehole, although it is often inoperative. Similarly, Cuvango has a solar-powered borehole that is not fully functional, while Chipindo uses both cacimbas and a community fountain. Despite the availability of some solar-powered solutions, the lack of reliable electricity and formal water treatment means that most water consumed remains untreated.

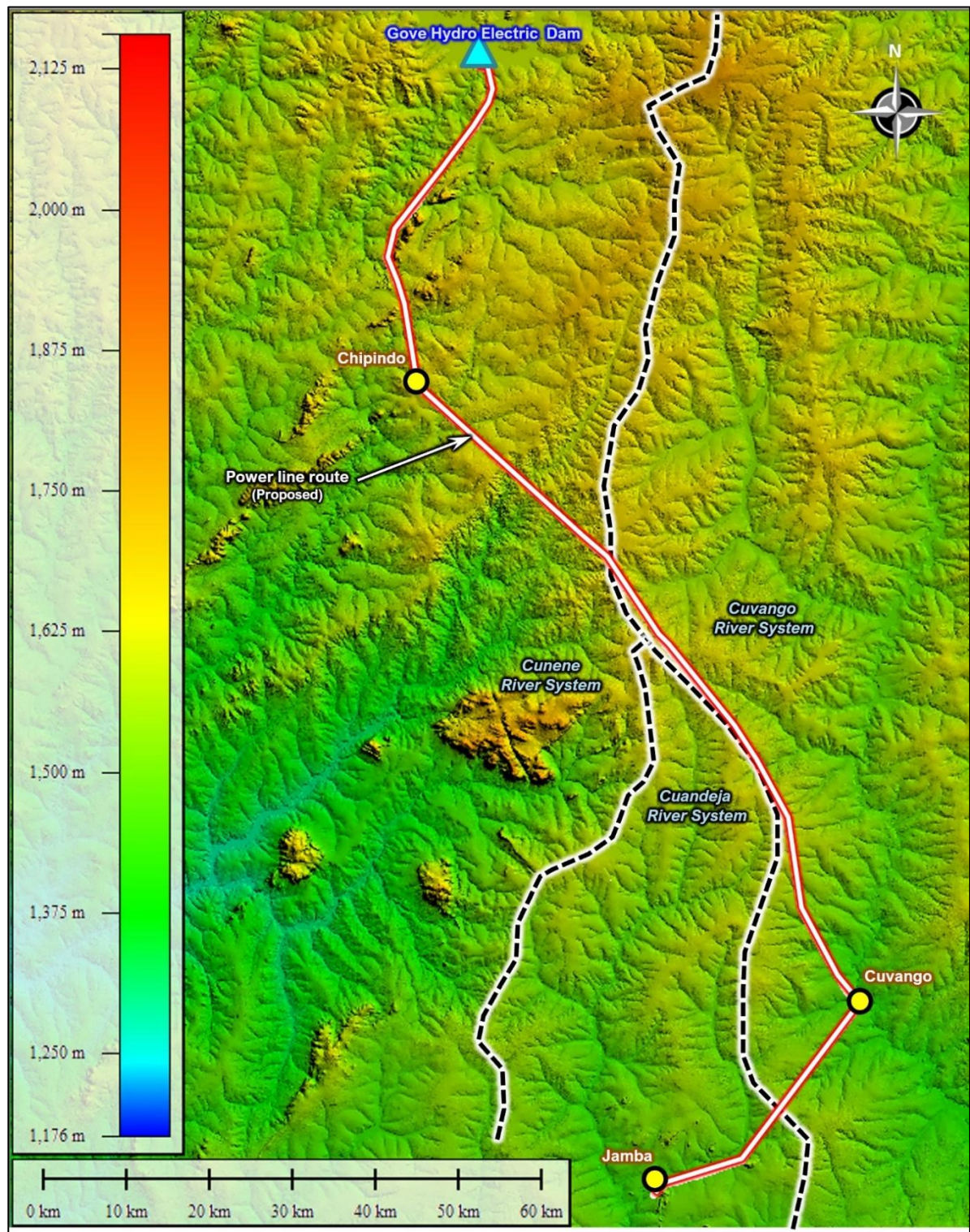


Figure 4-21: Main river systems

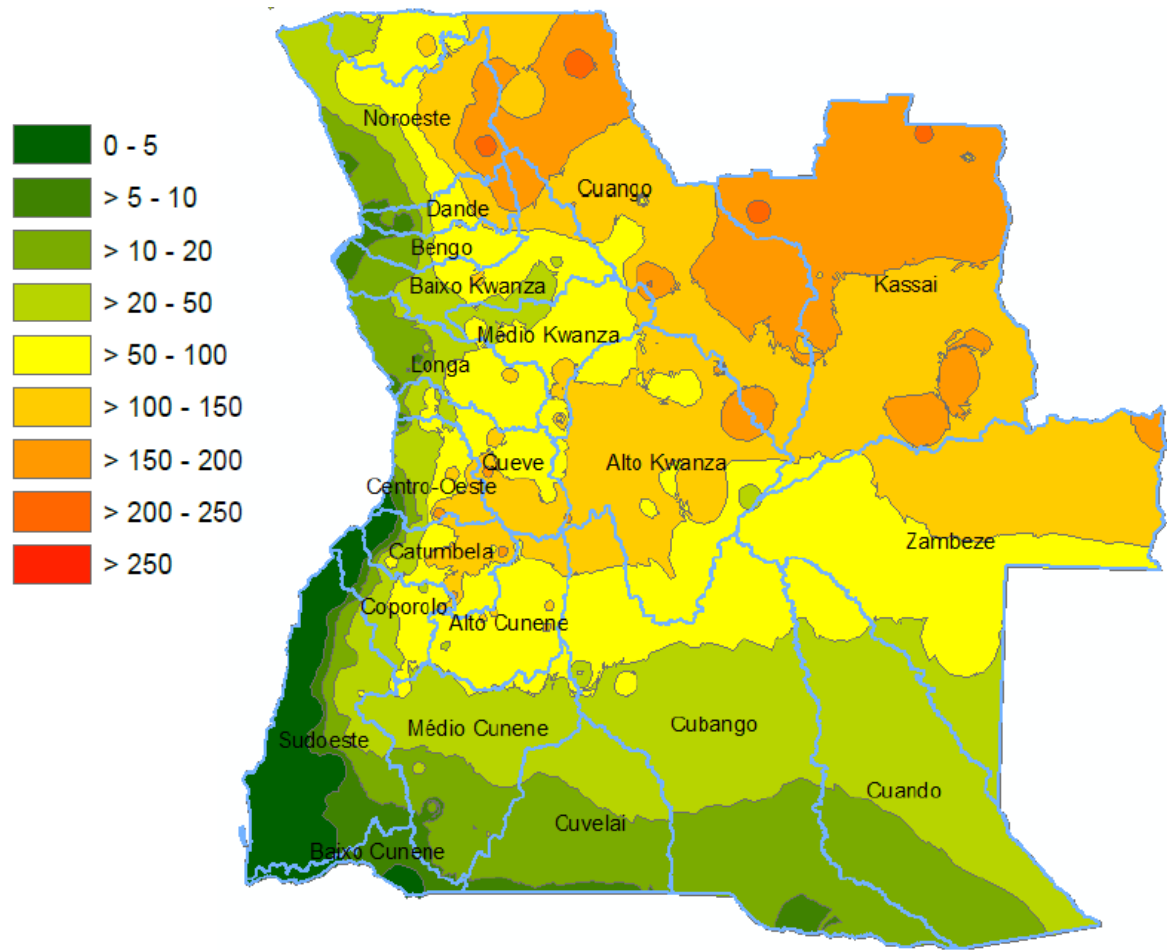


Figure 4-22: Angola's groundwater recharge (mm/year) (INRH, 2018)

4.7 Biodiversity

This section presents an overview of the flora and fauna for the Project area and draws on information contained in the flora and fauna assessments (STA, 2024a) and (STA, 2024b) conducted for the ESIA Terrestrial (refer to Volume 4, Appendix H and Appendix I for the detailed specialist assessments).

4.7.1 Flora

Floral habitats

The study area's reference vegetation type is Woodland (White, 1983), typically comprising open stands of trees up to eight metres high, with a field layer often dominated by grasses (Kindt et al., 2012). During the field assessment, several habitat units were identified and refined to indicate variations in habitat integrity, species diversity, and vegetation structure. The habitat units are presented below with detailed descriptions provided in Table 4-31 to Table 4-34, and mapping of habitat units in Volume 3, Appendix E.

- **Miombo Woodland Habitat** (± 1948 hectares (ha) within the study area), comprising several deciduous tree species, where trees exceeded eight (8) m in height, with large predominantly interlinking canopies. This habitat unit was observed primarily in areas further away from communities within the study area. This habitat however is continually being impacted upon and decreasing in extent due to the harvesting of timber for informal charcoal production, leading to the ongoing transformation of miombo woodland species and fragmentation of this habitat. The Miombo Woodland Habitat is classified as “natural habitat” according to the IFC categories;
- **Secondary Miombo Habitat** (± 935 ha within the study area). The characteristics of this habitat unit were varied, with some of the more degraded areas being noted to have fewer characteristic/typical miombo floral species. This habitat unit is in a state of secondary succession, the floral species diversity is less species rich and consequently supports a lower diversity and abundance of floral species. The Secondary Miombo Woodland is classified as “modified habitat” according to the IFC categories;
- **Freshwater Habitat** (± 306 ha within the study area), comprising of rivers, flood plains wetland, channelled valley bottom wetlands, unchanneled valley bottom wetland, and dambos (seasonally or permanently wet grassy valleys). This habitat unit has been notably impacted upon as a result of vegetation clearance for agriculture (grazing and crop cultivation). The dambos and rivers convey large amounts of water through the study area, however the large-scale removal of vegetation has resulted in increased peak water flows leading to erosion within the dambos and that of the riverbanks. The Freshwater Habitat is classified as “natural habitat” according to the IFC categories; and
- **Transformed Habitat** (± 972 ha within the study area). Includes cultivated fields and areas where vegetation has been cleared within and around villages, serving to facilitate increased grazing for livestock. This occurs both in proximity to villages and at more distant locations where new fields are being cleared. In the northern section of the study area the proposed powerline goes through plantations of *Eucalyptus* sp. The Transformed Habitat is classified as modified habitat according to the IFC categories.

Table 4-31: Habitat Unit 1 - Miombo Woodland

Habitat Overview
Miombo woodlands are known for their expansive canopy of broadleaf, predominantly deciduous trees. From a floral perspective, this habitat unit showcases remarkable diversity, harbouring a plethora of plant species specifically adapted to the region's pronounced seasonal fluctuations. Characteristic of this habitat unit is the prominent hardwood taxa e.g., <i>Brachystegia boehmii</i> and <i>Julbernardia paniculata</i>, which dominate the landscape. The floral richness extends throughout the vertical strata, harbouring a diverse array of understory shrubs, herbaceous plants, and creeping plants. Miombo Woodland confronts escalating anthropogenic impacts (deforestation, agriculture, logging, and the production of charcoal) and these activities pose a significant risk to vegetation structure and communities within the habitat unit. These anthropogenic activities have resulted in the fragmentation and isolation of Miombo Woodland areas, where areas are unsuitable for agricultural activities. The Miombo Woodland provides important ecoservices as the increase in floral species adds to the biodiversity of the area with medicinal floral species being present and a low probability of erosion as vegetation cover is high. The Miombo Woodlands further provide essential ecosystem services as they support the livelihoods of many rural people, i.e., providing “non-timber products such as fruit, honey, fodder and fuelwood”. Ecological processes (nutrient cycling, fire dynamics, and species interaction) within the Miombo Woodland influences the floral diversity as preferred habitat is created.
 Representative photographs illustrating the typical habitat associated with the Miombo Woodland Overall, the Miombo Habitat is representative of the reference vegetation type in terms of species composition and vegetation structure. Characteristic species recorded within the Miombo Woodland Habitat included: ➤ The woody layer was well developed with good structure, with a subset of shrubby species was recorded, e.g., <i>Julbernardia paniculata</i>, <i>Brachystegia boehmii</i>, <i>Pterocarpus angolensis</i>, <i>Dichrostachys cinerea</i> and <i>Terminalia brachystemma</i> ➤ The graminoid layer was well-developed, comprising of the following species: <i>Digitaria eriantha</i>, <i>Heteropogon contortus</i> and <i>Panicum sp.</i> ➤ The herbaceous layer consisted mostly of common, widespread species, such as <i>Commelina africana</i> ➤ AIP proliferation was low. Recorded species included <i>Tagetes minuta</i> and <i>Lantana camara</i>

Table 4-32: Habitat Unit 2 - Secondary Miombo Woodland**Habitat Overview**

The floral species within the Secondary Miombo Woodland habitat unit adds to the biodiversity of the area with medicinal floral species being present (although in lower numbers than what was observed in the Miombo Woodland) and areas with good vegetation cover will have a lower probability of erosion. The Secondary Miombo Woodland still provides essential ecosystem services as the livelihood of many rural people are supported by non-timber products such as fruit, honey, fodder, and fuelwood. The ecological services within the Secondary Woodland still influences the floral diversity within the study area although at a lower level compared to the Miombo Woodland habitat unit. Across the study area, the vegetation community exhibits varying characteristics due to differing levels of anthropogenic impacts. In areas where trees were historically cleared, several miombo woodland species (*Terminalia brachystemma* and *Combretum zeyheri*) were dominant, with coppices and saplings evident, while larger trees have been harvested for charcoal production. In less disturbed areas, *Julbernardia paniculata* and *Brachystegia boehmii* were dominate the habitat unit.

The Secondary Miombo Woodland habitat has significant levels of disturbance and vegetation clearing, leading to compromised habitat integrity and the diminishing of the distinctive landscape of this habitat unit. Despite historical and ongoing anthropogenic activities impacting this habitat unit, it still provides important ecoservices. Despite its secondary state, the Secondary Miombo Woodland plays a vital role in the ecosystem, contributing to biodiversity through the presence of various floral species, including medicinal species, and maintaining low erosion potential due to its dense vegetation cover. Ecological processes such as succession, nutrient cycling, and species diversity are instrumental in driving the recovery and development of this habitat unit following disturbance, ultimately influencing floral diversity and enhancing ecosystem resilience.



Representative photographs illustrating the typical habitat associated with the Secondary Miombo Woodland

Overall, the Secondary Miombo Woodland was representative of the reference vegetation type in terms of species composition but lacking in vegetation structure. Characteristic species recorded within the **Secondary Miombo Woodland Habitat** included:

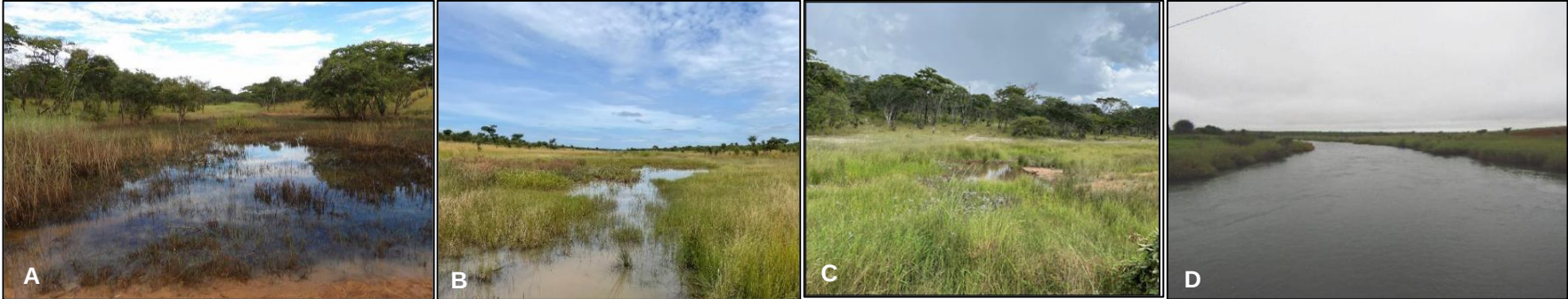
- The woody layer was poorly developed, with certain areas (close to villages) lacking large trees, although a subset of shrubby species was recorded, e.g. *Terminalia brachystemma*, *Julbernardia paniculata*, *Brachystegia boehmii*, *Parinari curatellifolia*, *Dichrostachys cinerea*, and *Diospyros kirkii*;
- The graminoid layer was well-developed, comprising of the following species: *Sporobolus africanus* and *Digitaria eriantha*
- The herbaceous layer consisted mostly of common, widespread species, such as *Commelina africana* and *Hibiscus nigricaulis*
- AIP proliferation was moderate. Recorded species included *Tagetes minuta* and *Lantana camara*

Table 4-33: Habitat Unit 3 - Transformed Habitat

Habitat Overview
The transformed habitat does not provide important ecosystem services like the Miombo Woodland, lacking in medicinal floral species and having a higher probability of erosion due to reduced vegetation cover. The habitat unit does support rural livelihoods by offering non-timber products such as fruit, fodder, and some fuelwood. Within the transformed habitat, ecological processes like nutrient cycling, fire dynamics, and species interactions do not significantly influence floral diversity, as the habitat is less conducive to creating preferred habitats for various plant species. The Transformed habitat is characterised by areas affected by anthropogenic activities which include agricultural activities (planting of <i>Zea mays</i> (Maize) and <i>Glycine max</i> (Soybean) and areas cleared of vegetation where homesteads were observed. Large areas have been cleared for agricultural activities, where trees have been cleared for local charcoal production. In the northern section of the study area, plantations were observed where native trees were removed and <i>Eucalyptus sp.</i> were planted. This agricultural conversion starkly contrasts with the reference Miombo Woodland vegetation characteristic of the region. While vital for food production, agricultural lands exhibit a markedly reduced floral species diversity and notable habitat integrity loss. Furthermore, they lack uniqueness as habitats and do not contribute significantly to the overall conservation status or ecological value of the region. The Transformed habitat will have low ecoservices as the floral species diversity and richness is low and will not add to the biodiversity of the area. A low number of medicinal floral species were present. The potential for erosion will be high as vegetation cover within the habitat unit was low with a lot of the areas being open ground. The ecological processes within the Transformed habitat is negatively altered as a result of the anthropogenic activities present, thus altering nutrient cycling and floral diversity within the habitat unit.

Representative photographs illustrating the typical habitat associated with the Transformed Habitat.
Overall, the Transformed Habitat starkly contrasts the reference vegetation type in terms of species composition and vegetation structure. Characteristic species recorded within the Transformed Habitat included: ➤ The woody layer was poorly developed and was largely lacking, although a subset of shrubby species was recorded, e.g., <i>Terminalia sericea</i>, <i>Dichrostachys cinerea</i>, <i>Piliostigma thonningii</i>, and <i>Erythrina zeyheri</i> ➤ The graminoid layer was well-developed in areas where ground was covered by vegetation, comprising of the following species: <i>Hyparrhenia spp</i>, <i>Cynodon dactylon</i>, <i>Melinis repens</i> and <i>Eragrostis biflora</i> ➤ The herbaceous layer <i>Cassytha filiformis</i> and <i>Hibiscus nigricaulis</i> ➤ AIP proliferation was fairly prolific. Recorded species included <i>Zea mays</i>, <i>Cucurbita sp</i>, <i>Tagetes minuta</i>, <i>Lantana camara</i> and <i>Bidens pilosa</i>

Table 4-34: Habitat Unit 4 - Freshwater Habitat

Habitat Overview			
The Freshwater Habitat extensively spans the study area, featuring dambos (smallest of the Freshwater Habitat subunits within the study area, i.e., approximately 4 ha), and riparian zones characterised by elevated floral species diversity, a typical trait of such environments. Many floral species observed in these regions are exclusive to these habitats preferring areas with higher soil moisture content. Riparian areas, which are associated with rivers (of which approximately 29 ha occur in the study area), largely retain their integrity despite agricultural encroachment, with the remaining vegetation primarily consisting of woody species. Local communities utilise valley bottom wetlands (largest of the Freshwater Habitat subunits within the study area, i.e., approximately 262 ha), both channelled and unchannelled, for water collection, as water sources for livestock, and for washing clothes. Agricultural activities were noted on the edges of these wetlands. Cultivation activities and livestock grazing have impacted dambos and floodplains, leading to a reduction in natural vegetation cover and, in some instances, the encroachment of woody species. Despite enduring anthropogenic pressures, the overall integrity and diversity of the Freshwater Habitat (all subunits) remain moderately high. Recognised for its significance in ongoing species conservation and habitat provision, the Freshwater Habitat stands out in the landscape due to its high species diversity including the unique species associated with these habitats. The Freshwater Habitat play a crucial role in providing ecosystem services such as water purification, flood regulation, carbon sequestration, habitat provision, and floral species diversity. Freshwater Habitat provides very important ecological processes as including habitat for floral species that prefer saturated soil.			
			
Representative photographs illustrating the typical habitat associated with the Freshwater Habitat. A.) various valley bottom wetlands, c.) and d.) - Cubango River (located in Cuvango) Overall, the Freshwater Habitat is representative of the reference vegetation type in terms of species composition and vegetation structure. Characteristic species recorded within the Freshwater Habitat included: ➤ Some woody species were present within the riparian areas, and the woody layer was poorly developed and was largely lacking within the floodplains, valley bottom wetlands and dambos. Riparian woody species typically associated with the rivers included, e.g., <i>Ficus sycomorus</i>, <i>Mucuna coriacea</i> and <i>Vitex doniana</i> ➤ The graminoid layer was well-developed, comprising of the following species: <i>Cynodon dactylon</i>, <i>Cyperus sp.</i>, and <i>Cyperus tenuiflorus</i> ➤ The herbaceous layer comprising of the following species: <i>Floscopa glomerata</i> and <i>Ethulia conyzoides</i> ➤ AIP proliferation was moderate. Recorded species included <i>Tagetes minuta</i> and <i>Bidens pilosa</i>			

Floral Species of Conservation Concern (SCC)

Only two floral species as Vulnerable (VU) by the Executive Decree No. 252/18, Angola's Red List, was observed, namely *Pterocarpus angolensis* and *Brachystegia spiciformis*. However, according to the International Union for Conservation of Nature (IUCN), these species are listed as Least Concern (LC). These species were observed within the Miombo Woodland habitat unit. However, species such as *Brachystegia boehmii* and *Julbernardia paniculata* are of concern due to declining population numbers resulting from overharvesting for wood. Additionally, small bulbous species like *Boophone disticha*, although classified as least concern by the IUCN, face pressure from harvesting for medicinal purposes and species collections.

Floral species listed under IUCN

The floral species recorded within the assessed Project areas were cross-referenced with the IUCN Red List to determine if any species were classified as threatened. However, no threatened floral species were identified within the study area. A Probability of Occurrence (POC) assessment was conducted for a list of threatened SCCs derived from the IUCN for the region. Table 4-35 presents the floral species in the study area and highlights the floral species with a medium to high POC, based on the presence of potentially suitable habitat within Miombo Woodland, Secondary Woodland and Freshwater habitat units. Given the fragmented nature of the landscape, large stretches of degraded habitat, and high levels of human activity within and around the study area, none of the species assessed were found to have a high POC.

Table 4-35: Floral SCC with the potential to occur within the study area (or within the surrounding natural areas)

Species name	IUCN Status	Habitat and Direct threats	POC
<i>Albizia ferruginea</i>	NT	It occurs mainly in lowland semi-deciduous and its density is lower in evergreen forests. Main threats to this species include deforestation due to logging, agricultural expansion, and infrastructure development. These activities contribute to habitat loss and fragmentation, putting pressure on the species and reducing its natural populations.	Low
<i>Ansellia africana</i>	VU	This species is widespread, often in hot dry mixed deciduous woodlands at medium to low altitudes, in riverine vegetation and mopane or miombo woodlands near rivers, growing on trees and shrubs. The species faces threats from habitat loss due to deforestation, over-collection for the ornamental trade, and climate change affecting its environmental conditions. Conservation efforts should focus on habitat protection, regulating collection, and promoting sustainable cultivation practices.	High
<i>Baphia dewevrei</i> <i>subsp. marquesii</i>	VU	<i>Baphia dewevrei</i> subsp. <i>marquesii</i> is found in the lowland forests of Central Africa, including parts of Cameroon and the Congo Basin. It typically inhabits humid, tropical forests with well-drained soils and high levels of rainfall. This subspecies faces threats from deforestation, illegal logging, and habitat fragmentation due to agricultural expansion. Conservation efforts should focus on protecting its forest habitat and regulating logging activities to prevent further population decline.	Low
<i>Barleria cyanea</i>	NT	This species occurs in a variety of habitats including among open sandy flats with <i>Colophospermum mopane</i> and <i>Catophractes alexandri</i> woodland and thickets, at the	Low

Species name	IUCN Status	Habitat and Direct threats	POC
		bases of and among rocky areas such as koppies, and in dry bushland along river margins. The species faces threats from habitat loss due to deforestation, land conversion for agriculture, and overgrazing.	
<i>Barleria namba</i>	VU	This species is recorded from open rocky hillslopes. The primary threats to this species include habitat loss due to deforestation, agricultural expansion, and land conversion, which lead to habitat fragmentation and reduced population sizes.	Low
<i>Combretum aureonitens</i>	NT	Is a shrub or small tree native to tropical Africa, commonly found in dry, deciduous forests and savannas. It thrives in well-drained soils and areas with seasonal rainfall, adapting to both open and semi-wooded environments. The primary threats to <i>Combretum aureonitens</i> include habitat loss due to deforestation, land conversion for agriculture, and overgrazing by livestock.	Low
<i>Croton gossweileri</i>	EN	This species is endemic to tropical Africa, often found in moist, lowland forests and along riverbanks. It thrives in shaded, well-drained soils with consistent moisture. The primary threats to <i>Croton gossweileri</i> include deforestation, habitat fragmentation, and land conversion for agriculture.	Medium
<i>Ctenolophon englerianus</i>	NT	Is a tree species native to tropical Africa, particularly found in lowland and montane forests with well-drained, fertile soils. It thrives in humid, shaded environments typical of dense rainforests. The main threats to this species include habitat loss due to deforestation, logging, and agricultural expansion.	Low
<i>Dactyladenia floribunda</i>	NT	Native to tropical Africa, typically found in lowland and montane forests with well-drained soils. It thrives in humid, shaded environments, often in forest undergrowth. The primary threats to <i>Dactyladenia floribunda</i> include habitat destruction due to deforestation, agricultural expansion, and logging.	Low
<i>Dalbergia macroperma</i>	EN	Tree species native to tropical Africa, found in lowland and upland forests with well-drained soils. It thrives in humid, tropical climates and is known for its high-quality wood. The main threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion.	Low
<i>Daniellia alsteeniana</i>	NT	It occurs in lowland woods, dry forests and savannah at low elevations. It thrives in humid, tropical environments and is often a component of dense rainforests. The primary threats to <i>Daniellia alsteeniana</i> include deforestation, habitat fragmentation due to logging, and agricultural expansion.	Low
<i>Disa aequiloba</i>	EN	This species is found growing in swamp areas, dambo, wet grassland, wet meadow; terrestrial. The main threats to this species include habitat loss due to agricultural expansion, overgrazing by livestock, and climate change, which can alter its habitat conditions.	Medium
<i>Drypetes euryodes</i>	CR	<i>Drypetes euryodes</i> is known from a woody rocky cliff and was collected at around 1,000 m in elevation. The primary	Low

Species name	IUCN Status	Habitat and Direct threats	POC
		threats to <i>Drypetes euryodes</i> include habitat loss due to deforestation, logging, and agricultural expansion.	
<i>Entandrophragma angolense</i>	NT	It is most commonly found in moist semi-deciduous forest, though it can also be found in evergreen forest. It is a non-pioneer light-demanding tree species that occurs in lowland and mid-altitude rainforest, but sometimes also in gallery forest and thickets, at elevations up to 1,800 m. The main threats to this species include deforestation, illegal logging, and habitat fragmentation due to agricultural expansion.	Low
<i>Eugenia dewevrei</i>	VU	Native to the rainforests of Central Africa, typically found in lowland and upland forest areas with well-drained, fertile soils. It thrives in humid, tropical environments and plays a role in the biodiversity of its forest habitat. The primary threats to <i>Eugenia dewevrei</i> include habitat loss due to deforestation, illegal logging, and agricultural expansion, which fragment and degrade its natural environment.	Low
<i>Fernandoa ferdinandi</i>	VU	Native to tropical Africa, particularly found in semi-deciduous and riverine-evergreen forest mosaic with well-drained, fertile soils. It thrives in humid, tropical environments and is an integral part of its forest ecosystem. The main threats to <i>Fernandoa ferdinandi</i> include deforestation, habitat fragmentation due to logging, and agricultural expansion.	Low
<i>Genlisea angolensis</i>	EN	Carnivorous plant species native to the tropical regions of Africa, typically found in damp, acidic soils within savannas and wetlands. It thrives in moist, nutrient-poor environments where it captures insects to supplement its nutrient intake. The primary threats to this species include habitat loss due to drainage of wetlands, agricultural expansion, and land conversion.	Medium
<i>Gnetum africanum</i>	NT	Is a vine species native to tropical Africa, found in primary and secondary semi-deciduous, humid forests, in some cases where the forest had been degraded substantially. The species tolerates both dense forests and the transition of anthropogenous grass savanna to forest at exposed, sunny locations. The primary threats to <i>Gnetum africanum</i> include deforestation, habitat fragmentation due to logging, and agricultural expansion, which impact its natural habitat and reduce its availability.	Low
<i>Guibourtia carissoana</i>	VU	Typically found in dry forest and dry coastal lowlands. The main threats to this species include deforestation, illegal logging, and habitat fragmentation due to agricultural expansion.	Low
<i>Inversodicraea cristata</i>	VU	This species is endemic to Central African countries (Cameroon, Gabon, Equatorial Guinea, Central Africa Republic, Angola). Although very gregarious plant where it grows, its specialization into very narrow habitat (waterfall) tends to make of it a low abundant plant. Known from four to five sites in Cameroon (three in Flora of Cameroon; plus Tello and possibly Vina: J.-P. Gogue pers. comm. 2008).	Low
<i>Inversodicraea warmingiana</i>	VU	Aquatic herb, annual, submerged or not, growing fixed on rocks in waterfalls and rapids. It grows fixed by a thallus on	Low

Species name	IUCN Status	Habitat and Direct threats	POC
		rocks or any other hard object. Threats to this species include dams, misuse of water management that will negatively impact on preferred habitat.	
<i>Isolona pilosa</i>	VU	Tree species native to the tropical rainforests of Central Africa. It typically grows in humid, lowland forest environments with well-drained, fertile soils. The primary threats to this species include deforestation, habitat fragmentation due to logging, and land conversion for agriculture, which adversely impact its natural habitat.	Low
<i>Khaya anthotheca</i>	VU	Tree species native to tropical Africa, found in lowland and swamp forests with well-drained, fertile soils. It thrives in humid, tropical environments and is valued for its high-quality, durable timber. The main threats to this species include deforestation, illegal logging, and habitat loss due to agricultural expansion.	Low
<i>Khaya senegalensis</i>	VU	Tree species native to tropical Africa, found in a range of habitats including savannas, woodlands, and riverine forests with well-drained soils. It thrives in humid to semi-arid environments and is highly valued for its high-quality, durable timber. The primary threats to this species include deforestation, illegal logging, and habitat loss due to agricultural expansion.	Low
<i>Lysimachia elegantula</i>	NT	Annual herb, rarely biannual of swampy savannas and meadows. Threats to this species include development of housing and urban areas, including annual and perennial non-timber crops.	Medium
<i>Mesanthemum glabrum</i>	NT	This species grows in wet peaty soil of dambos, shallow pools, swamps or marshy ground near rivers; 1,100–1,500 m. The primary threats to this species include habitat destruction due to housing/ urban development, deforestation, logging, and agricultural expansion, which degrade and fragment its natural environment.	Medium
<i>Mesanthemum reductum</i>	NT	The species grows submerged in fast flowing rivers, forming patches and rooting in the sandy substrate; 1,230–1,290 m. Further study is needed to assess the threats faced by this species.	Low
<i>Millettia gracilis</i>	VU	It is found in thickets on forest margins, in secondary thickets, where it is sometimes sporadic, and in riverine forest. It thrives in humid, tropical environments and contributes to the biodiversity of its forest habitat. Primary threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion. These activities lead to fragmentation and degradation of its natural habitat, impacting the species survival.	Low
<i>Millettia nudiflora</i>	EN	It is found in evergreen moist forest and also in riverine forest and thrives in humid, tropical environments and plays a role in maintaining forest biodiversity. Main threats to this species include habitat loss from deforestation, illegal logging, and agricultural expansion, which lead to the fragmentation and degradation of its natural habitat.	Low
<i>Mitragyna stipulosa</i>	NT	It occurs in swamps and marshy localities and on the edge of wetlands. It is a light-demanding species dispersed by	Low

Species name	IUCN Status	Habitat and Direct threats	POC
		wind. This species occurs mainly in gallery forest in the dry forest and savanna zone. Main threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion, which result in fragmentation and degradation of its natural habitat.	
<i>Monotes pearsonii</i>	VU	It occurs on wooded slopes on shallow rocky soils (Meerts et al. 2017). It occurs in woodland associated with <i>Brachystegia</i> and other <i>Monotes</i> species. Main threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion, which cause fragmentation and degradation of its natural habitat.	Low
<i>Monotes rubriglans</i>	VU	Occurs in xerophilous Miombo woodland, savanna woodland and wooded savanna. Primary threats to this species include habitat loss from deforestation, illegal logging, and agricultural expansion, which result in the fragmentation and degradation of its natural habitat.	High
<i>Pavetta gossweileri</i>	EN	It is found in moist Guinea-Congolian coffee forests, including in Kumbira Forest which is the most southerly of the small isolated patches of this habitat type. Primary threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion, which result in fragmentation and degradation of its natural environment.	Low
<i>Piptostigma exellii</i>	CR	It is known to be sporadically found in humid gallery forests. Due to alluvial diamond extraction, we infer the species is threatened by habitat loss. Moreover, the area where the species is known to occur, has been affected by civil war from 1975 to 2002.	Low
<i>Pogostemon micangensis</i>	VU	This is recorded in river marshes, drying sandy riverbeds, flooded meadows and swamps at 600–1,300 meters elevation. Given this species preference for semi-aquatic habitats such as river marshes, drying sandy riverbeds and flooded meadows the most plausible future threats to this species are unsustainable extraction of sand from rivers, drought due to climate change and increased pressure from grazing and watering of livestock.	Low
<i>Polyscias letestui</i>	EN	This species is known from secondary vegetation in areas of rainforest, between 730 and 1,300 m in elevation. The natural habitat is probably the open vegetation along streams in mountainous areas. Main threats to <i>Polyscias letestui</i> include habitat loss due to deforestation, illegal logging, and agricultural expansion, which cause fragmentation and degradation of its natural habitat.	Low
<i>Prunus africana</i>	VU	This species occurs in evergreen forests near the coast (South Africa), inland mistbelt forests and Afromontane forests up to 2,700(–3,000) m. In most of its range it occurs primarily in moist montane forest above 1,800 m, occurring at lower altitudes in southern Africa. Primary threats to this species include overharvesting for medicinal use, deforestation, and habitat loss due to agricultural expansion and logging.	Low

Species name	IUCN Status	Habitat and Direct threats	POC
<i>Rotala smithii</i>	VU	This species is endemic to Central Africa (the Democratic Republic of Congo (DRC) and Angola). It is often found growing into the mud, at the marshland borders. Water pollution is a major threat to this species.	Medium
<i>Schumanniohyton hirsutum</i>	NT	Native to tropical Africa, typically found in moist, shaded forest environments with well-drained soils. It thrives in humid, tropical habitats and is often associated with specific microhabitats within forests. Primary threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion, which lead to fragmentation and degradation of its natural habitat.	Low
<i>Scleria pulchella</i>	CR	This species grows in wet grasslands together with short grasses. Little is known about this species except that it was found growing near the river close to Humpata and Palanca in the Huíla Province. It was last collected in 1952. This whole area is now largely covered with small and large agricultural fields.	Low
<i>Turraeanthus africanus</i>	VU	The species is commonly found in moist semi-deciduous forest, often in poorly drained places. Its growth is considered gregarious in moist environments. The species is also found in coastal forests and alongside streams or lakes. The primary threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion, which cause fragmentation and degradation of its natural habitat.	Low
<i>Utricularia bracteata</i>	NT	Carnivorous plant species native to tropical Africa, commonly found in moist, swampy environments and wetlands with nutrient-poor, acidic soils. The main threats to this species include habitat loss due to drainage of wetlands, deforestation, and land conversion for agriculture, which lead to the degradation and fragmentation of its natural habitat.	Medium
<i>Vepris welwitschii</i>	NT	It is found in dry bushy rocky hills and mountainous rocky places. From satellite imagery on Google Earth there appears to be land use change in recent years from agriculture and settlement, in areas where this species occurs, particularly closer to Luanda. However, it is uncertain whether the rocky habitat of this species is significantly impacted. More research is needed into the threats of this species.	Low
<i>Vigna procera</i>	NT	A perennial herb with several annual erect stems arising from woody rootstock. It has pink to purple flowers and is found in moist areas near lakes, in grassland and by seasonal rivers and dambos. It is often associated with recent burning and is found in sandy or clay loam soil. Primary threats to this species include habitat loss due to deforestation, land conversion for agriculture, and overgrazing, which lead to degradation and fragmentation of its natural habitat.	Medium
<i>Vitex cuspidata</i>	VU	This species is a tree growing in lowland forests. Primary threats to this species include habitat loss due to deforestation, illegal logging, and agricultural expansion,	Low

Species name	IUCN Status	Habitat and Direct threats	POC
		which result in fragmentation and degradation of its natural habitat.	
<i>Albizia ferruginea</i>	NT	It occurs mainly in lowland semi-deciduous and its density is lower in evergreen forests. Main threats to this species include deforestation due to logging, agricultural expansion, and infrastructure development. These activities contribute to habitat loss and fragmentation, putting pressure on the species and reducing its natural populations.	Low

Non-threatened of SCC

Species such as *Brachystegia boehmii* and *Julbernardia paniculata* are of concern as their known population numbers are declining due to overharvesting for wood. Apart from these woody species, there are also small bulbous species like *Boophone disticha*, which, although classified as LC by the IUCN, face pressure from harvesting for medicinal purposes and species collections. As such, the placement of the proposed Project infrastructure should take cognisance of these species. Where possible, infrastructure placements should be limited within the Freshwater Habitat and Miombo Woodland Habitat as these are the preferred habitats for floral SCC.

International best practice

Table 4-36 summarises the IFC habitat categories and Project requirements to meet the IFC PS 6.

Table 4-36: IFC habitat categories and project requirements

Modified Habitat
Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands. PS 6 applies to those areas of modified habitat that include significant biodiversity value, as determined by the risks and impacts identification process required in PS 1. Actions should be taken to minimise impacts on such biodiversity and implement mitigation measures as appropriate.
Natural Habitat
Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. The proponent will not significantly convert or degrade natural habitats, unless all of the following are demonstrated: • No other viable alternatives within the region exist for development of the project on modified habitat; • Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and • Any conversion or degradation is mitigated according to the mitigation hierarchy. In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible. Appropriate actions include: • Avoiding impacts on biodiversity through the identification and protection of set-asides; • Implementing measures to minimise habitat fragmentation, such as biological corridors; • Restoring habitats during operations and/or after operations; and • Implementing biodiversity offsets.
Critical Habitat
Critical habitats was based on species level, ecosystem level and landscape level criteria with high biodiversity value and includes (i) habitat of significant importance to CR and/or EN species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique

ecosystems; and/or (v) areas associated with key evolutionary processes.

In areas of critical habitat, the proponent will not implement any project activities unless all of the following are demonstrated:

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
- The project does not lead to a net reduction in the global and/or national/regional population of any CR or EN species over a reasonable period of time; and
- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme is integrated into the client's management programme.

In such cases where a proponent is able to meet the requirements defined in paragraph 17, the project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated.

In instances where biodiversity offsets are proposed as part of the mitigation strategy, the proponent must demonstrate through an assessment that the project's significant residual impacts on biodiversity will be adequately mitigated to meet the requirements of paragraph 17.

Five (5) criteria are used to define a Critical Habitat. The habitat units in the Project area were assessed based on these criteria to confirm or refute the presence of Critical Habitat.

Species level

- Criterion 1: None of the plant species recorded during the wet and dry season are listed by the IUCN as CR or EN on an international level. However, *Disa aequiloba*, *Genlisea angolensis* and *Croton gossweileri* which are listed as EN species may occur within the study area. Although no individuals were observed, a precautionary approach is suggested in terms of CH classification. Therefore, Criterion 1a is triggered in terms of these species for the Miombo, Secondary Miombo and Freshwater Habitats; and
- Criterion 2: Only two floral SCC listed as VU (Executive Decree No. 252/18) were observed during the field assessments, namely *Pterocarpus angolensis* and *Brachystegia spiciformis*. However, the IUCN assessed these species as having a LC threat status. These species have been recorded throughout topical regions in Africa and are not reliant on habitats that are unique. Both species also have an Extent of Occurrence (EOO) that exceeds 50 000 square kilometres (km²) and are thus also not considered "restricted-range" species. Based on this assessment, none of the habitats within the proposed Project area trigger Criterion 2.

Ecosystem level

- Criterion 3: Does not apply to plant species or vegetation types. Refer to Part C for a discussion on Criterion 3; and
- Criterion 4: None of the habitat units identified within the study area is considered to be highly threatened and/or unique ecosystems. While the Miombo Woodland is under threat from mining activities and local over-utilisation, the broader landscape contains similar and ecologically more intact habitats than what was observed within the study area. Based on this assessment, from a botanical perspective, none of the habitats that are present and that will be impacted by the proposed Project can be considered as Critical Habitat.

Table 4-37 presents a description of the IFC habitat categories for each vegetation unit.

Table 4-37: IFC PS 6 Habitat categories for the vegetation units identified in the study area

Vegetation Unit	Description of the IFC habitat categories
Miombo Woodland, Secondary Miombo Woodland, and Freshwater Habitat	Critical Habitat The Miombo Woodland, Secondary Miombo Woodland and Freshwater Habitat are areas of natural habitat that are composed of viable assemblages of plant and/or animal species of largely native origin and where the surrounding anthropogenic activities (i.e., wood harvesting, agricultural) activities have not yet modified the area's primary ecological functions and species composition. However, ecological function and species composition may be lower with regards to the Secondary Miombo Woodland.
Transformed Habitat	Modified Habitat The Transformed Habitat is an area that contains a moderate to high proportion of plant and/or animal species of non-native origin and include areas that have substantially been modified by human activity (i.e., agricultural activities). Areas where the primary ecological functions and species composition have been modified.

It is however important to note that further assessments for potential critical habitat species must be undertaken during the pre-construction monitoring. Should such assessments indicate that these species are not present in sufficient densities to qualify for CH, the CH must be noted only as natural habitat.

Floral exotic and invasive species

Alien floral species in the study area were mostly associated with villages and in particular agricultural areas. Table 4-38 lists the exotic and invader species identified during the assessment along with their basic methods of control (i.e., remove and destroy, preventing seed dispersal). *Mangifera indica* (Mango) and *Psidium guajava* (Guava) have an important social and economic use in the communities as a seasonal supply of food. Removal or destruction of these trees should be avoided where possible.

Table 4-38: Exotic or invasive species listed and identified

Scientific name	Common name	Listed under Category D of Executive Decree No. 252/18	Control options
Terrestrial Species			
<i>Acacia saligna</i>	Orange wattle	Invasive species	Chemical and mechanical control
<i>Acacia mearnsii</i>	Black wattle	Not listed	Chemical and mechanical control
<i>Argemone mexicana</i>	Mexican prickly poppy	Invasive species	Chemical and mechanical control
<i>Bidens pilosa</i>	Spanish Blackjack	Not listed	Pre-emergence herbicide, mechanical control
<i>Cosmos sulphureus</i>	Sulfur cosmos	Not listed	Chemical and mechanical control
<i>Chromolaena odorata</i>	Triffid weed	Invasive species	Chemical and mechanical control
<i>Eucalyptus sp.</i>	Gum tree	Not listed	Chemical and mechanical control
<i>Lantana camara</i>	Lantana	Not listed	Mechanical control, herbicide
<i>Leucaena leucocephala</i>	River tamarind	Not listed	Chemical and mechanical control
<i>Mangifera indica</i>	Mango	Not listed	None, agricultural use
<i>Opuntia ficus-indica</i>	Prickly Pear	Not listed	Mechanical control, herbicide
<i>Opuntia stricta</i>	Prickly pear	Invasive species	Chemical and mechanical control

Scientific name	Common name	Listed under Category D of Executive Decree No. 252/18	Control options
<i>Prosopis glandulosa</i>	Honey mesquite	Not listed	Chemical and mechanical control
<i>Prosopis juliflora</i>	Mesquite	Not listed	Chemical and mechanical control
<i>Psidium guajava</i>	Guava	Not listed	None, agricultural use
<i>Ricinus communis</i>	Castor oil plant	Invasive species	Chemical control
<i>Solanum mauritianum</i>	Bugweed	Invasive species	Chemical and mechanical control
<i>Tagetes minuta</i>	Tall Khaki Weed	Not listed	Pre-emergence herbicide, mechanical control
<i>Tithonia diversifolia</i>	Mexican sunflower	Invasive species	Mechanical control
Aquatic Species			
<i>Arundo donax</i>	Giant reed	Invasive species	Chemical and mechanical control
<i>Azolla filiculoides</i>	Red water fern	Not listed	Biological and mechanical control
<i>Eichhornia crassipes</i>	Common water hyacinth	Invasive species	Chemical, Biological and mechanical control
<i>Myriophyllum aquaticum</i>	Parrot feather	Not listed	Mechanical control
<i>Pistia stratiotes</i>	Water lettuce	Not listed	Biological and mechanical control
<i>Salvinia molesta</i>	Giant salvinia	Not listed	Chemical and mechanical control

Medicinal plant species

Table 4-39 presents a list of plant species with traditional medicinal value, plant parts traditionally used, and their main applications. The majority of the plants identified in the study area all have medicinal properties and are considered to be common to the region, especially within the Miombo Woodland Habitat and Secondary Miombo Woodland Habitat. It is important that the local traditional healers be consulted to ensure that the proposed infrastructure locations will not lead to the unnecessary removal of important medicinal plants.

Table 4-39: Traditional medicinal plants identified during the field assessment.

Scientific name	Medicinal use
<i>Adenia senensis</i>	An infusion of the bark is used as a remedy for mental disorders and snakebite. The leaves and bark are boiled, and the decoction inhaled to treat fever and influenza.
<i>Aframomum albobviolaceum</i>	The plant is used as a febrifuge.
<i>Annona senegalensis</i>	The bark is used medicinally to treat gastrointestinal ailments and the gum from the bark is used for sealing cuts and wounds
<i>Bidens pilosa*</i>	Its roots, leaves, and seeds are reported to have antibacterial, antidiarrhetic, anti-inflammatory, antimicrobial, antimalarial, diuretic, hepatoprotective, and hypotensive properties. In Africa, <i>B. pilosa</i> is used to treat headaches, ear infections, hangovers, diarrhoea, kidney problems, malaria, jaundice, dysentery, burns, arthritis, ulcers, and abdominal problems. It is also used as an anaesthetic, coagulant, and treatment to ease childbirth. In sub-Saharan Africa, its fresh or dried shoots and young leaves are eaten as a leaf vegetable, especially in times of food scarcity.
<i>Boophone disticha</i>	The outer covering of the bulb is applied to boils and abscesses; fresh leaves are used to stop bleeding of wounds.
<i>Brachystegia spiciformis</i>	An infusion provides treatment for dysentery and diarrhoea. A decoction is applied as an eyewash for conjunctivitis.

Scientific name	Medicinal use
<i>Cassytha filiformis</i>	An infusion of the stems is used in the treatment of digestive problems such as indigestion, biliousness and diarrhoea; feverish conditions including malaria; urinary system problems, including nephritis and oedema; headache, hepatitis, piles, sinusitis and spermatorrhoea. It is also often used by women to stimulate menstruation, hasten parturition and to suppress lactation after a stillbirth. The pounded stems are given as a vermifuge and for other intestinal troubles. A decoction of the stems is drunk to relieve itch and eczema. Externally, the stems are widely used to treat a range of skin complaints, including itchy conditions, eczema, ulcers and parasitic conditions of both skin and scalp. It is also used, in an infusion, as an eyewash. The whole plant is often used for treating venereal discharges, urethritis, gonorrhoea and syphilis. The stems are normally used fresh but can also be dried for later use.
<i>Combretum zeyheri</i>	The gum of <i>Combretum zeyheri</i> has antibiotic properties. The roots of the tree are used to make baskets, necklaces for young girls and fishing traps. Pounded roots mixed with fats are used for an ointment to relieve haemorrhoids. Powdered roots are taken orally in porridge to stop a bleeding nose and to ease kidney pains. Leaves mixed with oil are used as an embrocation (liquid for rubbing on the body to relieve pain), to ease a stiff neck and backache. Crushed leaves are mixed with water and the resultant fluid.
<i>Ficus sycomorus</i>	The bark is used for the treatment of scrofula, coughs, and throat and chest diseases. The milky latex is used for treatment of dysentery and chest diseases or is applied to inflamed areas.
<i>Flacourtia indica</i>	The leaf is carminative, astringent and used as a tonic, an expectorant and for asthma, pain relief, gynaecological complaints and as an anthelmintic, and treatment for hydrocele, pneumonia and intestinal worms.
<i>Mangifera indica</i> *	Charred and pulverized leaves make a plaster to remove warts and also act as a styptic. Seeds are used to treat stubborn colds and coughs, obstinate diarrhoea and bleeding piles. The bark is astringent, homeostatic and antirheumatic.
<i>Opuntia ficus indica</i>	Prickly pear cactus might lower blood sugar and cholesterol levels by reducing how much the stomach absorbs. People most commonly use prickly pear cactus for diabetes.
<i>Ozoroa insignis</i>	The roots and bark are considered to be cholagogue, purgative and vermifuge. A decoction is used to treat kidney and liver complaints; ulcers and hernias; throat infections; chest pain; diarrhoea; schistosomiasis.
<i>Parinari curatellifolia</i>	An infusion of the roots is used to treat toothache and a leaf decoction is either drunk or used in a bath as a remedy for fevers. The crushed or pulped leaves are used in a dressing for fractures or dislocations, and for wounds, sores and cuts
<i>Pericopsis angolensis</i>	Included in treatment for ringworm, stabbing pains, eye problems, malaria, blackwater fever, stomach problems and to increase the supply of breast milk
<i>Piliostigma thonningii</i>	Tender leaves are chewed, and the juice swallowed to treat stomach-ache, coughs and snakebite. The roots are used to treat prolonged menstruation, haemorrhage and miscarriage in women and also for the treatment of coughs, colds, body pain and STDs.
<i>Senna singueana</i> (<i>Cassia singueana</i>)	Extracts of the root bark have shown significant analgesic, antipyretic, anthelmintic and antiplasmodial activity. An infusion of the leaves is used as a remedy for venereal disease, malaria, convulsions, epilepsy, coughs, intestinal worms, constipation, heartburn and stomach-ache
<i>Steganotaenia araliacea</i>	The stem bark contains a number of dibenzocyclo-octadiene lignans. These have displayed cytotoxic (antimitotic) activity in a manner similar to colchicine on 11 human tumour cell lines. The lignans steganangin (the most abundant analogue), steganacin and steganolide A were most abundant. Saponins isolated from the leaves have shown antileukemic activity. An infusion of the plant is strongly emetic. The roots are used in treating snake bites and painful chest conditions.

Scientific name	Medicinal use
<i>Strychnos cocculoides</i>	The fruit is mixed with honey or sugar and used to treat coughing. The fruit is used in making eardrops for treating ear complaints. The root can be chewed to alleviate stomach disorders, eczema and sores on the skin. It is also an alleged cure for gonorrhoea.
<i>Terminalia sericea</i>	The leaves and roots are boiled in water and the infusion is taken orally for the treatment of coughs, diarrhoea and stomachache. The leaves can be used as an antibiotic for wounds. In the case of bleeding, a paste can be made by cooking the leaves in water and placing them on the wounds.
<i>Vachellia sieberiana</i>	In Central Africa, a bark/root decoction is used for inflammation of the urinary passages. Leaf, bark and resin are used as an astringent for colds/chest problems, diarrhoea, haemorrhage and eye inflammation. In Tanzania, bark is used to treat gonorrhoea.
<i>Vangueria infausta</i>	The root is anthelmintic, antidote and purgative. A popular snake-bite remedy, it is also used to treat a variety of complaints such as malaria, pneumonia, coughs and other chest troubles. A warm decoction of the roots is considered to be an effective remedy for heart ailments in Namibia. The leaves are applied externally as a treatment for swellings on the legs; inflammation of the navel in children; abdominal pain; and for the relief of dental pain.
<i>Ziziphus mucronata</i>	A concoction of the bark and the leaves is used for respiratory ailments and other septic swellings of the skin. Pastes of the root and leaves can be applied to treat boils, swollen glands, wounds and sores. Steam baths from the bark are used to purify and improve the complexion.

Medicinal applications and application methods are also presented. Exotic and invasive species are marked with an asterisk (*)

Ecosystem Services

The term 'ecosystem services' refers to the products or goods and services that ecosystems provide to society. The term encompasses both the ecosystems which deliver the services and the people who benefit from them (Le Maitre et al, 2007). These services range widely from products like food through to stabilising and regulatory services such as disease control, and life quality-enhancing functions such as environments for recreation and spiritual inspiration (Le Maitre et al, 2007). Ecosystem services are interlinked and often inter-dependent (Le Maitre et al, 2007) and that an impact on one service may have a significant knock-on impact on other services.

This section focuses on the suite of ecosystem services provided by the ecosystems within the proposed Project area. Habitat transformation and modification is extensive throughout the Project area and surrounds, however, many of the habitats have recovered well and are contributing to ecosystem services. Several of the habitats have historically been excluded from significant direct impacts and transformation and thus are increasingly important for ecosystem services. PS 6 defines ecosystem services as "the benefits that people, including businesses, obtain from ecosystems" (paragraph 2), which aligns with the definition provided by the Millennium Ecosystem Assessment (GN106). As described in paragraph 2 and footnote 1 of PS 6, ecosystem services are organised into three major categories which include; Provisioning, Regulating and Supporting ecosystem services.

Table 4-40 provides a summary of the ecosystem services provided by various habitat units.

Table 4-40: Important ecosystem services provided by the habitats within the study area

Ecosystem Services	Habitats in the study area that support these services.
Provisioning Services	
These are the products obtained from ecosystems, including: Food	Food, fuel, and ethnobotanical plants are obtained from the habitats within the study area, especially from the Miombo Woodland and Secondary Woodland.

Ecosystem Services	Habitats in the study area that support these services.
- Fuel - biological materials serve as sources of energy (wood) - Ethnobotanical plants - Freshwater	Sources and uses of water are relied on from the Freshwater Habitats within and surrounding the study area.
Regulating Services	
These are the benefits obtained from the regulation of ecosystem processes, including: - Air quality regulation - Climate regulation. Ecosystems influence climate both locally and globally. For example, at a local scale, changes in land cover can affect both temperature and precipitation. At the global scale, ecosystems play an important role in climate by either sequestering or emitting greenhouse gases - Water regulation. The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas - Erosion regulation. Vegetative cover plays an important role in soil retention and the prevention of landslides - Disease regulation. Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes - Pollination. Ecosystem changes affect the distribution, abundance, and effectiveness of pollinators	Miombo Woodland, Secondary Woodland, and Freshwater Habitat are most important for these ecosystem services.
Supporting Services	
Supporting services are essential for the creation of all other ecosystem services. They contrast with provisioning, regulating, and cultural services in that their effects on humans are usually not immediate or happen gradually, whereas changes in the other groups have more immediate and direct effects on people. - Soil Formation - Photosynthesis - Primary Production - Nutrient cycling - Water cycling	The supporting services provided by vegetation are dependent on intact vegetation cover and on reasonable levels of plant diversity. As such, most of the habitats within the study area contribute towards supporting services (except where lands are bare and poorly vegetated). In this regard, Miombo Woodland, Secondary Woodland, and the Freshwater Habitat are most important.

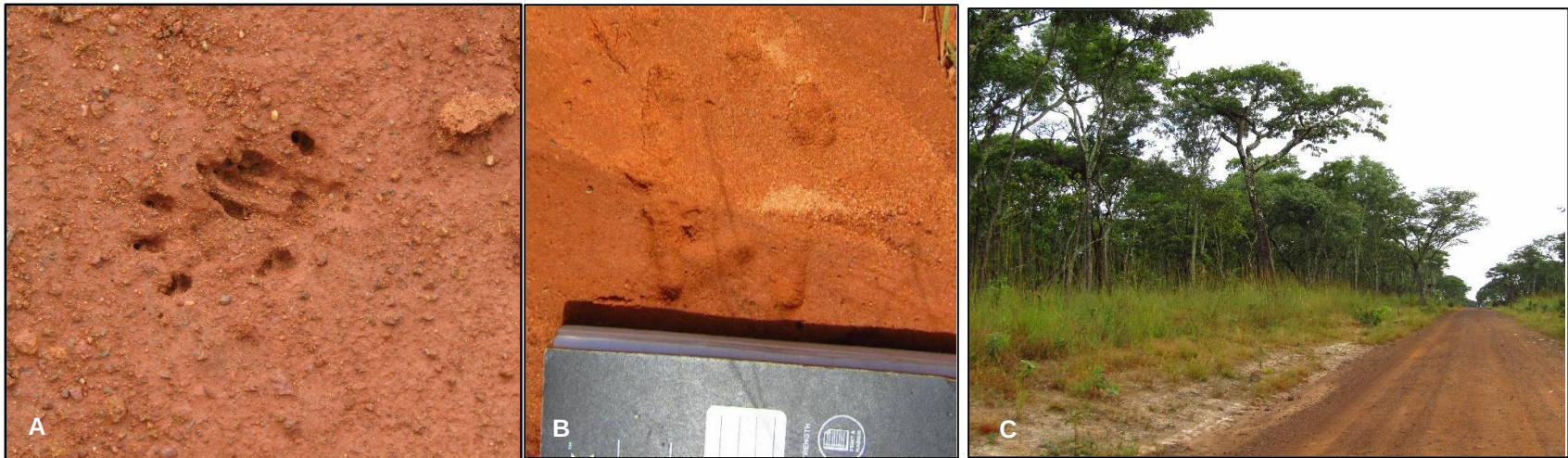
4.7.2 Terrestrial fauna

The Project area traverses a mosaic of Miombo Woodland, Secondary Miombo Woodland, freshwater systems, agricultural fields and urban areas/villages. Habitat suitability for fauna species was varied, and largely dependent on the habitat integrity and habitat connectivity. The Miombo woodlands and freshwater systems supported the highest diversity of faunal species, with diversity levels decreasing notably in the more degraded habitats. Habitat connectivity along the freshwater systems is still functional, serving as important movement corridors for fauna.

An overview of the likely fauna associated with the Project area is detailed in Table 4-41 to Table 4-44, which includes mammals, avifauna, herpetofauna (reptiles and amphibians), general invertebrates and arachnids. A POC estimation was used to assess faunal SCC, considering various factors to

determine their likelihood of occurrence. Species with known distribution ranges and habitat preferences were also considered.

Table 4-41: Mammal species within the study area

Species recorded in the study area				
 a) <i>Funisciurus congicus</i> (Congo Rope Squirrel) tracks; b) <i>Lepus victoriae</i> (African Savannah Hare) tracks; c) Typical Miombo Woodland habitat				
Mammal SCC				
Species	Discussion	Angolan status	IUCN status	POC
<i>Epomophorus angolensis</i> (Angolan Epauletted Fruit Bat)	Known from wetter miombo woodlands, likely predominating in areas of riverine forest and other forest areas with fruit-bearing trees. May be seen roosting in trees either singularly or in loose colonies.	N/A	NT	Medium
<i>Hydrictis maculicollis</i> (Spotted-necked Otter)	The Spotted-necked Otters inhabit freshwater systems where water is unsilted, unpolluted, and rich in small to medium sized fishes (Reed-Smith 2010, d'Inzillo Carranza and Rowe-Rowe 2013). This species predominantly feeds on fish, but is known to supplement prey intake with crabs, frogs, insects and birds.	Category C (VU)	NT	Medium
<i>Aonyx capensis</i> (African Clawless Otter)	Selects rocky shores near permanent water but can tolerate episodic rivers, even those that are polluted. Otters have a wide variety of prey items, often inhabiting freshwater/estuarine systems that are abundant in crabs and fish on which they can feed. Otter scat was observed along the banks of the larger river systems.	N/A	NT	Confirmed
<i>Smutsia temminckii</i> (Temminck's Ground Pangolin)	Dispersed throughout southern, central, and east Africa, <i>S. temminckii</i> is the only species found in southern and eastern Africa. It prefers savannah woodland with moderate amounts of scrub at low elevations, feeding only on termites and ants, often being very selective as to which species they will feed upon.	Category C (VU)	VU	Medium

<i>Civettictis civetta</i> (African Civet)	It often inhabits savannahs, forests, and sometimes near rivers as the tall grasses and thickets present provide them with necessary cover during the day. This species is an omnivore, feeding on both plant material (seeds and fruits) as well as small prey items such as reptiles, amphibians, birds and rodents.	Category C (VU)	LC	Medium
<i>Caracal caracal</i> (Caracal)	A very secretive species which is often hard to detect. They are typically nocturnal, though some activity may be observed during the day as well. This species is carnivorous, typically feeding on small mammals and birds, but is known to also feed upon lizards, snakes and insects. Caracals are known to also prey upon livestock, notably sheep and goats.	Category C (VU)	LC	Medium
<i>Sylvicapra grimmia</i> (Common Duiker)	A very widespread species throughout Africa, they are found in habitats with sufficient vegetation cover to allow them to hide. At present there are 14 subspecies described, with varying colourations. The common duiker has a wide diet; beyond browsing for leaves, flowers, fruits and tubers, they will also eat insects, frogs, small birds and mammals, and even carrion	Category B (EN)	LC	Medium
Mammal discussion				
During the field assessment very limited signs of mammal species were observed. The low observation rates are likely two-fold. It is likely that as a result of the habitat loss and increased human population in areas, many species have migrated to areas which are deemed safer/less accessible to people whilst. An increase in human populations has likely further led to an increase in hunting activities, which will further negatively impact mammal abundances and diversity in the study area and surrounding habitats. Clearance of vegetation for agricultural activities has led to habitat fragmentation across the length of the study area, further impacting on faunal species diversity. The Miombo Woodland and intact Freshwater habitats are considered important for the remaining mammal species in the region in terms of habitat provisioning, with the adjacent Secondary Miombo Woodland likely providing a supporting role in terms of general foraging grounds (for small inconspicuous species mammal species) as well as movement corridors between more intact habitat. In addition, the Freshwater systems will also serve as movement corridors for mammal species, allowing them to traverse the study area under cover, minimising detection.				

Table 4-42: Avifaunal species within the study area

Species recorded in the study area				
 a) <i>Turdoides jardineii</i> (Arrow-marked Babler); b) <i>Terathopius ecaudatus</i> (Bateleur); c) <i>Cinnyris cupreus</i> (Copper Sunbird) and d) <i>Vidua funerea</i> (Variable Indigobird); e) <i>Circaetus pectoralis</i> (Black-chested Snake-Eagle) and f) <i>Alcedo semitorquata</i> (Half-collared Kingfisher)				
Avifaunal SCC				
Species	Discussion	Angolan status	IUCN status	POC
<i>Terathopius ecaudatus</i> (Bateleur)	The bateleur is a common to fairly common resident with preference for partially open savanna country and of woodland within Sub-Saharan Africa. During breeding, it tends to require closed-canopy savannah-woodland habitats, including Vachellia savanna as well as mopane and miombo woodlands. Bateleurs forage almost entirely based on opportunity and have no particular specialization on any particular prey type, spending extended periods in flight and traveling extensive distances whilst foraging.	N/A	EN	Confirmed
<i>Gyps africanus</i> (White-backed Vulture)	White-backed vultures are obligate scavengers with a high level of specialization on carrion. Their primary food sources are the carcasses of large, grazing animals found the wooded savannahs where it lives. There is an inverse relationship between the amount of human activity (farming, ranching, etc.) and the amount of vulture nesting activity areas. The study area provides limited food (Carrion) resources for this species, with current observation records only being in Bicuar National Park to the south west of the study area. Flights over the OHL will likely be on foraging forays where they will be flying high and will avoid any collision risk with the OHL.	NA	CR	Medium

<i>Aquila rapax</i> (Tawny Eagle)	Tawny eagles occur in fairly open country at varied elevations but usually live in drier areas, typically inhabiting wooded savanna such as dry Acacia savanna and semi-desert to desert areas, though within the miombo woodland, the tawny eagle tends to be more scarce. A single individual has been recorded in Bicuar National Park to the south west of the study area in 2023.	NA	VU	Medium
<i>Bucorvus leadbeateri</i> (Southern Ground Hornbill)	Southern ground hornbills are carnivorous and hunt mostly on the ground. Their food ranges from insects to small vertebrates. The bird's classification is heavily tied to its slow reproductive rates. Habitat loss, changes due to the agriculture, deforestation, electrocution from power lines, accidental poisoning, and persecution are the major factors that affect their populations.	NA	VU	High
<i>Trigonoceps occipitalis</i> (White-headed Vulture)	The white-headed vulture is widely spread throughout and prefers mixed, dry woodland at low altitudes, generally avoiding human habitation and is considered to be restricted to protected areas. This species was recorded during the IESC site visit in the AgriCuvango farm (approximately 6.5 km east of the OHL). This species is not commonly recorded within Angola. As the study area is unlikely to provide suitable sources of carrion (due to the low number of mammal species and predators), it is unlikely that this individual is resident to the area, and was likely observed transitioning between more suitable, protected areas. Given that individuals will be flying in the area, it is imperative that suitable mitigation measures be taken to minimise collision risks. It is considered unlikely however that individuals will be nesting within or adjacent the OHL.	NA	CR	Confirmed ¹
<i>Neotis denhami</i> (Denham's Bustard)	The Denham's bustard occupies grassland habitats. Mainly they are distributed in savanna and may be found at any elevation up to 3,000 m (9,800 ft). They can be found in a considerable range of secondary habitats including dense shrubland, light woodland, farmland, dried marsh and arid plains. Hunting is the primary cause of declines across the Sahel and West Africa, but in eastern and southern Africa, conversion of grassland to agriculture is a greater threat.	NA	NT	Medium
<i>Aquila nipalensis</i> (Steppe Eagle)	Although the breeding range is rather extensive, the steppe eagle is essentially confined to nesting in only four large nations: Russia, Kazakhstan, Mongolia and China.	NA	EN	Medium

¹ Although not a common species in Angola with very few recorded sightings, the White-headed Vulture was sighted after both seasons of biodiversity field assessments during the IESC site visit during September 2024. The sighting was at AgriCuvango farm (-14.304273° / 16.261351°).

<i>Sagittarius serpentarius</i> (Secretarybird)	The Secretarybird is endemic to sub-Saharan Africa and is generally non-migratory, though it may be locally nomadic as it follows rainfall and the resulting abundance of prey. Its range extends from Senegal to Somalia and south to Western Cape, South Africa. Foraging opportunities do exist though breeding due to increase anthropogenic presence is unlikely.	NA	EN	High
<i>Torgos tracheliotos</i> (Lappet-faced Vulture)	This vulture prefers to live in dry savannah, thornbush, arid plains, deserts with scattered trees in wadis, open mountain slopes. They are usually found in undisturbed open country with a scattering of trees and apparently prefer areas with minimal grass cover. While foraging, they can wander into denser habitats and even into human inhabited areas, especially if drawn to road kills. Foraging in the study area is considered to be very limited for this species due to the lack of larger mammal species.	NA	EN	Medium
<i>Necrosyrtes monachus</i> (Hooded vulture)	Although hooded vultures have relatively small home ranges, they are widely distributed across Africa. It typically scavenges on carcasses of wildlife and domestic animals. According to the IUCN, this species is considered to be extinct from the region in which the study area occurs. Dispersing individuals may however pass near the study area.	NA	CR	Medium
<i>Gyps coprotheres</i> (Cape Vulture)	It is a long-lived (Oatley et al. 1998) carrion-feeder specialising on large carcasses. It flies long distances over open country, although usually found near steep terrain, where it breeds and roosts on cliffs (Mundy et al. 1992). It was shown to display a preference for protected areas and woody vegetation for foraging (Martens et al. 2018).	NA	VU	Medium
<i>Egretta vinaceigula</i> (Slaty Egret)	It inhabits river floodplains, marshes, and temporary shallow wetlands, preferring areas where water levels are receding from their seasonal peak (Hancock et al. 1978, Hancock and Kushlan 1984, Kushlan and Hancock 2005). This species is mostly sedentary (del Hoyo et al. 1992), but moves seasonally within wetlands, apparently in response to rains (Hancock et al. 2006a), which cause seasonal variation in habitat conditions (Tyler 2005). IUCN records indicate species in Angola are non-breeding.	NA	VU	Medium
<i>Falco vespertinus</i> (Red-footed Falcon)	The species breeds in open lowlands with trees and plenty of insects and small vertebrates, on which it feeds, including open woodland, agricultural areas with shelterbelts and, in the north-east, boggy areas and taiga edge. The species is migratory, with birds travelling great distances to their wintering grounds in southern Africa. Although not expected to be resident or breed within the study area, individuals may pass through the study area whilst migrating.	NA	VU	Medium
<i>Polemaetus bellicosus</i> (Martial Eagle)	It inhabits open woodland, wooded savanna, bushy grassland, thornbush and, in southern Africa, more open country and even subdesert, from sea level to 3,000 m but mainly below 1,500 m (Ferguson-Lees and Christie 2001). The main prey is sizeable mammals, birds and reptiles. The continued expansion of agricultural areas within and adjacent the study	NA	EN	Medium

	area will likely limit the occurrence of this species, as they are known to be largely absent from agricultural dominated areas.			
<i>Mirafraga angolensis</i> (Angola Lark)	The range of the Angola lark is sizable, and is found in Angola, Democratic Republic of Congo, Tanzania and Zambia. Its natural habitats are subtropical or tropical dry, or seasonally wet, lowland grassland.	Category C (VU)	LC	Medium
<i>Bradornis boehmi</i> (Böhm's Flycatcher)	Its natural habitat is subtropical or tropical dry forests, namely the miombo woodlands where it actively forages for prey items (insects).	Category C (VU)	LC	Medium
Avifaunal discussion				
Habitat structure/heterogeneity is generally accepted as a primary determinant for avifaunal diversity. The miombo woodlands within the study area were relatively heterogenous in structure, comprises tall woody species as well as a complex layer of shrubs and herbaceous plant species in the understory. This structure viability would serve to support a diversity of avifaunal species, from small insectivorous and granivorous species to larger raptors. Habitat loss and fragmentation resulting from vegetation clearance activities for agriculture have significantly impacted overall avifaunal abundance in the region, as the cleared areas have a notably lower carrying capacity for species. Habitat fragmentation and loss has resulted in avifaunal species being forced to move/fly further during foraging activities in order to satisfy their energy requirements. During the site assessment the avifaunal SCC <i>Terathopius ecaudatus</i> (Bateleur) was observed on several occasions flying overhead between Cuvango and Chipindo. This species is known to forage over extensive areas in search of prey items/carrion. The large trees in the miombo woodland habitat may provide suitable nesting opportunities for this species, which will need to be taken into consideration during construction / vegetation clearance activities. Nine migratory avifaunal species may be associated with the Project area, however none of these species were observed within the area of study or adjacent sites. It is further noted that iNaturalist does not have any records at present for these species in or adjacent to the study area, whilst many of these species have no records for Angola, or only peripheral records. Angola appears to be less favoured by these species, which may be attributed to the low prey availability / food resources. Several of the species listed are north-south / south-north east migratory, and as such may fly along the OHL and not necessarily cross over it directly. Such flight paths may limit the risk of species collisions, however cannot completely discard the collision risks. Suitable mitigation measures as stipulated in Section 7 need to be incorporated into the OHL design to further minimise collisions and electrocution risks.				

Table 4-43: Herpetofaunal species within the study area

Species recorded in the study area	
 A  B  C  D a) <i>Sclerophrys pusilla</i> (Eastern Flat-backed Toad) b) <i>Ptychadena taenioscelis</i> (Small Ridged Frog); c) <i>Boaedon fuliginosus</i> (Brown House Snake); d) <i>Lygodactylus bradfieldi</i> (Bradfield's Dwarf Gecko).	
Herpetofaunal SCC	
Following the assessment of the IUCN and iNaturalist databases, it has been determined that no reptile or amphibian SCC are associated with the study area at present.	
Herpetofaunal discussion	
Although not readily observed, the freshwater habitats are likely to support a relatively high diversity and abundance of amphibian species. The low observation rates are likely a result of the high rainfall events (leading to increased soil moisture) and extensive freshwater systems, allow for amphibians to disperse over greater areas and as such, can be harder to detect during short assessment periods. Furthermore, the natural predator avoidance behaviour of many species further hinders observation rates during site assessments. Amphibian species are often a good bio-indicator of ecosystem health, notably that of freshwater systems, as they are generally susceptible to pollution and unnatural toxicants in the water. Although the study area has been subjected to habitat alteration in several areas for agriculture and construction of dams, it is evident that the water systems are still in good health. The interconnectedness of the freshwater habitat further ensures that the overall habitat integrity for amphibian species remains high, allowing for the free and relatively easy movement of such species throughout the study area. Insect diversity was notably higher around the wetland systems, ensuring that amphibian species had a relatively constant (commensurate with insect life cycles) supply of prey items. Similar to amphibians, reptile observations within the study area were limited, with the majority of species being observed either within, or in close proximity to urban areas. Small geckos and skinks were readily observed in and around buildings and old rubble piles, whilst a single dead snake (<i>Boaedon fuliginosus</i>) was observed outside a village along the road. Reptile species show significant resilience to varying degrees of habitat degradation, often able to continue thriving in these changed environments. This is largely due to their ability to live in and amongst human populations and thrive, still finding adequate food resources to sustain themselves. Insects are the primary food resources for smaller lizards' and skinks' which were abundant in the urban areas due to the attraction of nocturnal lighting as well as several flowering ornamental plant species. Larger predatory snakes are also likely to occur in the urban areas as they prey upon small rodents and other reptiles, though, this comes with an increased risk of human-wildlife conflict and a potential increase in snake mortality rates.	

Table 4-44: Insect species within the study area

Species recorded in the study area				
				
a) <i>Palpopleura portia</i> (Portia Widow); b) <i>Palpopleura jucunda</i> (Yellow-veined Widow); c) <i>Zizeeria knysna</i> (African Grass Blue); d) <i>Neptis laeta</i> (Albizia Sailer); e) <i>Cyrtophora citricola</i> (Tropical Tent-web Spider).				
Invertebrate SCC				
<i>Umma femina</i> (Angola Sparklewing, VU) appears to select shady mountain streams; such habitat was not present in the study area; however the wetland systems may provide suitable similar habitat for this species. As such, this species is considered to have a medium POC.				
Invertebrate discussion				
Insects were the most abundant species observed within the study area, though, abundance levels were lower than expected. This may be attributed to the increased rainfall experience each day, hampering insect activity, but also the time of year as several insect species transition into different lifecycle stages. As expected, diversity and abundances around the freshwater habitat was highest, scaling downwards towards the agricultural and urban areas. During the site assessment, the Orders Orthoptera, Hymenoptera and Lepidoptera were the most prevalent, but this is likely to change based on seasons and the time of year. Insect species play not only important and necessary ecological roles, helping manage ecosystem functions (detritus removal etc), but also serve as a base food resource for other classes of fauna. Arachnid species are notoriously hard to detect over a relatively short period of time, which can often lead to the under estimation of diversity and abundance. As such, it is necessary to take into consideration the habitat conditions for arachnids as well as available food resources, whilst also consulting available databases. During the field assessment particular attention was paid to searches for arachnid species as best as possible within the confines of access and movement restrictions imposed during the site assessment. No scorpion species were observed within the assessment areas whilst very few spiders were observed. When considering available online databases however, it is evident that the study area is likely to support an increased diversity of arachnids, notably plant based/web building spiders.				

Faunal Species of Conservation Concern

Two faunal SCC were observed during the site assessment, namely *Terathopius ecaudatus* (Bateleur, EN) and *Aonyx capensis* (African Clawless Otter, NT). Post the seasonal biodiversity assessments, an additional faunal SCC was observed in the Project area, namely *Trigonoceps occipitalis* (White-headed Vulture, CR). In terms of the Bateleur, both an individual and a pair were observed during the wet and dry season flying between Cuvango and Chipindo as they foraged. This species is known to forage over a large area and is a generalist feeder, actively hunting prey species but equally eating carrion. Scat of *Aonyx capensis* (African Clawless Otter) was observed along the river banks, with this species likely moving along the freshwater systems as they forage for food resources.

In terms of the *Trigonoceps occipitalis* (White-headed Vulture, CR), although the POC is considered medium, sightings in Angola and the Project area are rare and are not known to breed in the region however they may on occasion visit the region during non-breeding seasons. This species is not commonly recorded within Angola. As the study area is unlikely to provide suitable sources of carrion (due to the low number of mammal species and predators), it is unlikely that this individual is resident to the area, and was likely observed transitioning between more suitable, protected areas.

The OHL poses a collision and electrocution risk to not just *Terathopius ecaudatus* (Bateleur, EN) and *Trigonoceps occipitalis* (White-headed Vulture, CR), but also *Epomophorus angolensis* (Angolan Epauletted Fruit Bat, NT). Although no active/inactive raptor nests, specifically those of *Terathopius ecaudatus* (Bateleur) were observed, there remains the possibility that such may be encountered along the OHL route, as not all areas of the route could be accessed.

Critical habitat analysis

Central to the IFC's stance on sustainable development, is the preservation of Critical Habitat (CH) and the important biodiversity supported by it. The identification and delineation of CH represents the foundations upon which all of the principles and best practice guidelines of PS6 are based (IFC PS6, 2012). When considering Performance Standard 6 (PS6), the IFC PS6 recognises four main types of habitats: Critical; Natural; Modified; and Protected habitats. This section aims to define the abovementioned habitat units in terms of the IFC-defined habitat categories based on biodiversity value and those which are likely to be most susceptible to environmental impacts associated with development. The definitions and potential implication for the client / developer as stipulated in IFC PS6 (2012) are given in Table 4-45.

Table 4-45: Descriptions of the IFC habitat categories and project requirements to meet IFC Performance Standards

Modified Habitat
Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands. This PS applies to those areas of modified habitat that include significant biodiversity value, as determined by the risks and impacts identification process required in PS 1. The client should minimise impacts on such biodiversity and implement mitigation measures as appropriate.
Natural Habitat
Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated: No other viable alternatives within the region exist for development of the project on modified habitat;

- Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and
- Any conversion or degradation is mitigated according to the mitigation hierarchy.

In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible. Appropriate actions include:

- Avoiding impacts on biodiversity through the identification and protection of set-asides;
- Implementing measures to minimise habitat fragmentation, such as biological corridors;
- Restoring habitats during operations and/or after operations; and
- Implementing biodiversity offsets.

Critical Habitat

Critical habitats were based on species level, ecosystem level and landscape level criteria with high biodiversity value and includes **(i)** habitat of significant importance to CR and/or EN species; **(ii)** habitat of significant importance to endemic and/or restricted-range species; **(iii)** habitat supporting globally significant concentrations of migratory species and/or congregatory species; **(iv)** highly threatened and/or unique ecosystems; and/or **(v)** areas associated with key evolutionary processes.

In areas of critical habitat, the client will not implement any project activities unless all of the following are demonstrated:

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
- The project does not lead to a net reduction in the global and/or national/regional population of any CR or EN species over a reasonable period of time; and
- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.

In such cases where a client is able to meet the requirements defined in paragraph 17, the project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated.

In instances where biodiversity offsets are proposed as part of the mitigation strategy, the client must demonstrate through an assessment that the project's significant residual impacts on biodiversity will be adequately mitigated to meet the requirements of paragraph 17.

In order to achieve a fair and comparable designation of CH across the board, a set of definitions, criteria and thresholds are published in the IFC Guidance Note 6 (GN6), a document which was updated in 2019 (IFC GN6, 2019). The latest definitions and thresholds for the identification of CH are given in Table 4-46.

Table 4-46: Summary of CH criteria and thresholds

Criterion	Threshold
1: Critically Endangered (CR) and Endangered (EN) Species	A: Areas that support globally important concentrations of an IUCN Red-listed Endangered (EN) or Critically Endangered (CR) species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units (GN16) of such a species. B: Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to Endangered (EN) or Critically Endangered (CR) and meet the thresholds in GN72(a). C: As appropriate, areas containing important concentrations of a nationally or regionally listed Endangered (EN) or Critically Endangered (CR) species.
2: Endemic and Restricted-range Species	Areas that regularly hold $\geq 10\%$ of the global population size AND ≥ 10 reproductive units of a species.
3: Migratory and Congregatory Species	A: Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. B: Areas that predictably support ≥ 10 percent of the global population of a species during periods of environmental stress.

Criterion	Threshold
4: Highly Threatened or Unique Ecosystems	A: Areas representing $\geq 5\%$ of the global extent of an ecosystem type meeting the criteria for IUCN status of Critically Endangered (CR) or Endangered (EN). B: Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.
5: Key Evolutionary Processes	Case by case basis

Table 4-47 below presents a list of species obtained from the IUCN, GBIF and iNaturalist database for the study area, which may qualify for CH consideration. Each species was evaluated against distribution range, habitat and food resource suitability and where possible previous occurrence records. A probability of occurrence (POC) (Appendix A) was assigned to each species. Species with a medium, high or confirmed POC were further assessed in terms of the CH qualifying criteria.

Table 4-47: Initial screening of CH-qualifying Species Confirmed or Likely to Occur in the Study Area

Scientific Name	Common Name	IUCN STATUS	Probability of Occurrence	Rationale for Critical Habitat Screening
<i>Sagittarius serpentarius</i>	Secretarybird	EN	High	Included in assessment.
<i>Torgos tracheliotos</i>	Lappet-faced Vulture	EN	Low	They are usually found in undisturbed open country with a scattering of trees and apparently prefer areas with minimal grass cover. Much of Angola's population is considered to be extinct according to the IUCN. The study area provides little to no suitable food resources in terms of large mammal carcasses.
<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	Low	A migratory species which is not known to venture inland of Angola, opting to stick to the coastal areas of the country.
<i>Smutsia temminckii</i>	Temminck's Pangolin	VU	Medium	Included in assessment.
<i>Gyps coprotheres</i>	Cape Vulture	VU	Medium	Included in assessment.
<i>Panthera pardus</i>	Leopard	VU	Low	Excluded due to persecution by local residents and the lack of suitable prey items. IUCN further indicates that this species is extinct from much of the area which the powerline traverses.
<i>Egretta vinaceigula</i>	Slaty Egret	VU	Medium	Included in assessment.
<i>Aquila nipalensis</i>	Steppe Eagle	EN	Medium	Included in assessment.
<i>Diceros bicornis</i>	Black Rhino	CR	Low	Species occur only in protected conservation areas. The powerline route and associated habitat is not associated with such areas which would offer protection to this species.
<i>Falco vespertinus</i>	Red-footed Falcon	VU	Medium	Included in assessment.
<i>Pluvialis squatarola</i>	Grey Plover	VU	Low	Not included in the assessment as they are associated with the coastal region for Angola.
<i>Gyps africanus</i>	White-backed Vulture	CR	Low	It is a long-lived (Oatley et al. 1998) carrion-feeder specialising on large carcasses. It flies long distances over open country, although usually found near steep terrain, where it breeds and roosts on cliffs (Mundy et al. 1992). It was shown to display a preference for protected areas and woody vegetation for foraging (Martens et al. 2018). IUCN indicates that it is possibly extinct from the study area region. Lack of the presence of large animals (carcasses) further precludes this species from the assessment.
<i>Acinonyx jubatus</i>	Cheetah	VU	Low	Species primarily associated with protected conservation areas, with some areas in South Africa known to host several free roaming individuals. The powerline route and associated habitat is not associated with such areas which would offer protection to this species.

Scientific Name	Common Name	IUCN STATUS	Probability of Occurrence	Rationale for Critical Habitat Screening
<i>Panthera leo</i>	Lion	VU	Low	Species primarily associated with protected conservation areas, with much of the Angolan population either extinct or possibly extinct outside of protected areas. The powerline route and associated habitat is not associated with such areas which would offer protection to this species.
<i>Bitis heraldica</i>	Angolan Adder	VU	Medium	Included in assessment.
<i>Polemaetus bellicosus</i>	Martial Eagle	EN	Medium	Included in assessment.
<i>Terathopius ecaudatus</i>	Bateleur	EN	Confirmed	Included in assessment.
<i>Aquila rapax</i>	Tawny Eagle	VU	Medium	Included in assessment.
<i>Lophocebus aterrimus</i>	Black Mangabey	VU	Low	Not included in the assessment as the only known population on the border of Angola and the DRC is considered to be extinct.
<i>Phymeurus chianga</i>	Huambo Agile Grasshopper	VU	Low	Not included in the assessment as population, both extant and possibly extant are located outside of the study area.
<i>Galagoides kumbirensis</i>	Angola Dwarf Galago	NT	Low	Not included in the assessment as known population occurrence is located in the west of the country, near Luanda.
<i>Phymeurus machadoi</i>	Moco Agile Grasshopper	VU	Low	Not included in the assessment as the known distribution range of this species does not intersect with the study area.
<i>Miopithecus talapoin</i>	Southern Talapoin Monkey	VU	Low	Not included in the assessment as the known distribution range of this species does not intersect with the study area.
<i>Kobus ellipsiprymnus</i> ssp. <i>defassa</i>	Defassa Waterbuck	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
<i>Cercopithecus nictitans</i> ssp. <i>nictitans</i>	Eastern Putty-nosed Monkey	VU	Low	Excluded from the assessment. Species is restricted to forest habitats which are not located in the study area. Records for this species are largely restricted to central african countries.
<i>Ardeotis kori</i>	Kori Bustard	NT	Low	It occurs in flat, arid, mostly open country such as grassland, karoo, bushveld, thornveld, scrubland and savanna but also including modified habitats such as wheat fields and firebreaks (del Hoyo et al. 1996). No records from the study area or surrounding landscapes exist.
<i>Hydricus maculicollis</i>	Spotted-necked Otter	NT	Medium	Included in assessment.
<i>Kobus ellipsiprymnus</i>	Waterbuck	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
<i>Neotis denhami</i>	Denham's Bustard	NT	Medium	Included in assessment.

Scientific Name	Common Name	IUCN STATUS	Probability of Occurrence	Rationale for Critical Habitat Screening
<i>Bucorvus leadbeateri</i>	Southern Ground Hornbill	VU	High	Included in assessment.
<i>Equus quagga</i>	Plains zebra	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
<i>Aonyx capensis</i>	African Clawless Otter	NT	Confirmed	Included in assessment.
<i>Giraffa camelopardalis</i>	Giraffe	VU	Low	Species restricted to protected game reserves within Angola, outside of the study area.
<i>Hippopotamus amphibius</i>	Hippo	VU	Low	Species largely restricted to protected areas within Angola, outside of the study area.
<i>Lycaon pictus</i>	African Wild Dog	EN	Low	Species restricted to protected game reserves within Angola, outside of the study area.
<i>Trigonoceps occipitalis</i>	White-headed Vulture	CR	Confirmed	Included in assessment.
<i>Bugeranus carunculatus</i>	Wattled Crane	VU	Low	Species appears to be largely restricted to the eastern extent of Angola. The study area is not located in the expected range of this species nor are there any nearby observations.
<i>Necrosyrtes monachus</i>	Hooded vulture	CR	Low	Although hooded vultures have relatively small home ranges, they are widely distributed across Africa. It typically scavenges on carcasses of wildlife and domestic animals. According to the IUCN this species is considered to be extinct from the region in which the study area occurs.
<i>Pternistis swierstrai</i>	Swierstra's spurfowl	VU	Low	Species restricted to the Afromontane forests of mountain peaks. No such habitat occurs within or nearby the study area. The study area falls outside of the known distribution range of this species.
<i>Kobus leche</i>	Lechwe	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
<i>Umma femina</i>	Angola Sparklewing	VU	Medium	Included in assessment.

Considering the above tables, the qualifying criteria for CH was applied to the various habitats and or species discussed in Table 4-47 which had a medium or high POC, or which were confirmed on site. The discussion that follows evaluates the habitat/species based on these criteria to confirm or refute the presence of CH.

As part of the CH assessment, an Ecologically Appropriate Area of Analysis (EAAA) was determined for the study area. The EAAA is area used to assess the potential ecological impacts of the project, through consideration of species distributions, ecosystem functions, and relevant ecological patterns and processes. The EAAA often extends beyond the immediate project site, depending on the type of project involved. This ensures that a wider area that might be affected by the project's activities, is considered as part of the CH analysis. The EAAA helps to ensure that an appropriate spatial scale for analysing ecological impacts based on the specific ecosystem and its connectivity is determined. It is important to note that the physical loss of habitat, due to the small footprints of the pylons and laydown areas, equates to a limited loss of physical habitat. The estimated total area to be cleared per habitat is; Miombo Woodland (+- 45 ha), Secondary Woodland (+- 23 ha), Freshwater Habitat (+- 4 ha) and Transformed Habitat (+- 11 ha).

In the case of the Project, the actual footprint areas that will be impacted upon is considered to be limited. Whilst the OHL is extensive in nature, only the footprint areas and some ancillary roads (not extensive), will be cleared. Provided that the pylon footprints, roads and any laydown areas are not placed in important habitat, such as the freshwater systems, and that appropriate measures for impact minimisation are followed, the OHL is not expected to have a significant or widespread impact on the receiving environment or the species therein.

Given the length of the OHL and the mosaic pattern of habitats through which it traverses, it is difficult to determine the EAAA purely on an ecological basis. Furthermore, many of the species considered as part of the CH assessment are wide ranging species. Based on this, an appropriate unit of measurement for the EAAA needs to make allowance for these wide-ranging species in conjunction with the type of project and potential impacts to the receiving ecosystem.

Given that the habitat both within the study area and the local region is degraded in varying extents, many species, if present, will occur at far lower densities and have larger home ranges in order to meet their caloric intake requirements, notably for predatory avifaunal species (food resources are highly limited due to long term subsistence hunting and land transformation). As such, a 20 km buffer around the OHL has been used, giving a total EAAA of the terrestrial DMU is 808 400 hectares (ha) or 8 084 km². This area allows consideration of direct impacts, as well as indirect and cumulative impacts. This EAAA is considered to be an appropriate unit of analysis for the project. The EAAA is depicted on a map below (Figure 4-23).

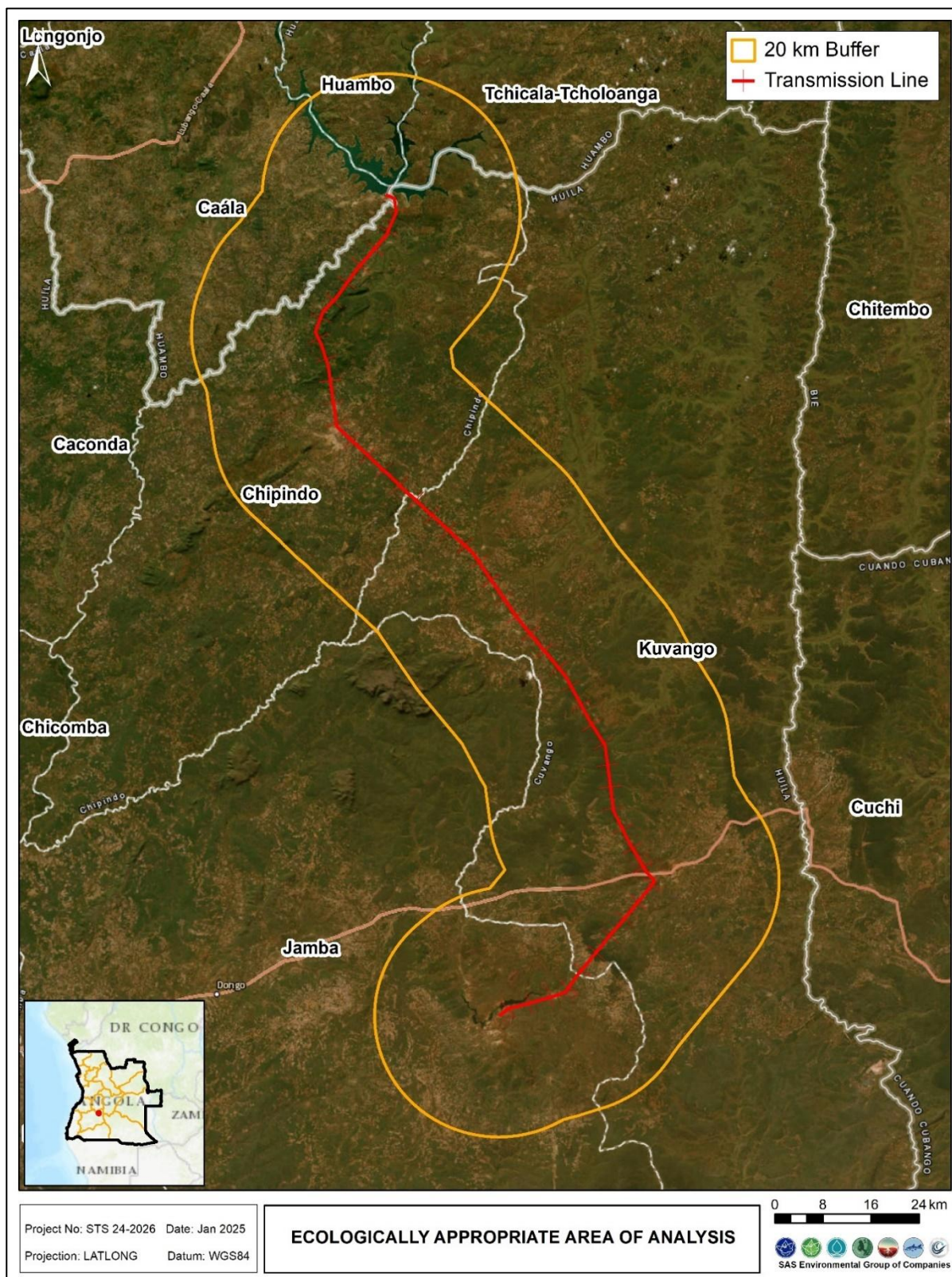


Figure 4-23: Ecologically Appropriate Area of Analysis for Critical Habitat determination

The discussion below presents analyses of the species listed in Table 4-47 and the EAAA of 8 084 km² in terms of Criterion 1 – 5 for CH determination.

Criterion 1 (Threatened Species)

For Criterion 1, CR, EN and VU species as listed in Table 4-47, which were either confirmed or determined to have a medium or high POC, have been assessed in terms of CH below.

Terathopius ecaudatus (Bateleur, EN)

Three Individuals were observed flying high near the OHL. This species is neither endemic nor range-restricted and has an extensive range, spanning across west and east Africa, central Africa and southern Africa, covering approximately 42 countries, with a range extent of approximately 23 500 000 km². Previous population numbers were estimated to be in the tens of thousands in 2001 (Ferguson-Lees and Christie 2001)). Current estimates by the IUCN indicate that populations could range between 10 000 to 100 000 individuals. Given that much of the literature indicates that this species has declined across much of its range, for the purpose of this report, a cautionary approach has been applied and the lower population estimate of 10 000 individuals has been used. When considering the range extent of this species, the EAAA comprises 0.03% of this species overall range, whilst the number of species observed equates to 0.03% of assumed population. Limited food resources and continued disturbances for local villagers will likely limit overall population numbers of this species in the region.

Trigonoceps occipitalis (White-headed Vulture, CR)

A single *Trigonoceps occipitalis* (White-headed Vulture, CR) was recorded during the IESC site visit in the AgriCuvango farm (approximately 6.5 km east of the OHL). There are currently an estimated 2 500 individuals of this species remaining according to the IUCN, with the single individual observed equating to 0.04% of the potential population being associated with the OHL and surrounding areas. This species has an extensive range across Africa, with a total range extent of approximately 21 100 000 km². Considering the EAAA of 8 084 km², this equates to 0.04% of the total range extent for this species. As the study area is unlikely to provide suitable sources of carrion, it is unlikely that this individual is resident to the area, and was likely observed transitioning between more suitable, protected areas.

Sagittarius serpentarius (Secretarybird, EN)

No individuals of this species were observed during the site visit, nor did the databases indicate any recent observation records. There is however suitable foraging and nesting habitat for this species, though it is acknowledged that the presence and movement of people in the area may hinder nesting opportunities. This species has an extensive range covering a large expanse of Africa, with an estimated range extent of approximately 23 200 000 km². The current estimated population for this species is 6 700 individuals. When considering the EAAA of 8 084 km², the EAAA equates to approximately 0.04% of the known range extent for this species.

Aquila nipalensis (Steppe Eagle, EN)

No individuals of this species were observed during the site visit, nor did the databases indicate any recent observation records. It is however acknowledged that the presence and movement of people and subsequent low prey base will notably limit individual occurrences. This species has an estimated range extent of approximately 12 600 000 km². The current estimated population for this species is no more than 37 000 breeding pairs (50 000 – 75 000 individuals). When considering the EAAA of 8 084 km², the EAAA equates to approximately 0.06% of the known range extent for this species.

Polemaetus bellicosus (Martial Eagle, EN)

No individuals of this species were observed during the site visit, nor did the databases indicate any recent observation records. It is however acknowledged that the presence and movement of people and subsequent low prey base will notably limit individual occurrences. This species has an estimated range extent of approximately 26 000 000 km². The global population has not been quantified, but was estimated as probably 'in tens of thousands' by Ferguson-Lees and Christie (2001). When considering the EAAA of 8 084 km², the EAAA equates to approximately 0.03% of the known range extent for this species.

Considering the above data and species observed and/or, indicated to potentially occur within the study area and the EAAA, and the fact that the region in which the OHL is located is largely unstudied with limited site/region specific data available, it is considered prudent, from a precautionary principle point of view, to list the Miombo and Secondary Miombo Woodlands as critical habitat at this stage of the study. Future monitoring studies (pre-construction) and walkdowns can be used to collect further data to better understand the region and potential CH qualifying species presence. Such additional data can then be used to relook at the CH assessment and make a final determination on the validity of CH presence.

In terms of Criterion 1b, the following species were considered:

- *Aquila rapax* (Tawny Eagle, VU);
- *Smutsia temminckii* (Temminck's Ground Pangolin, VU);
- *Bucorvus leadbeateri* (Southern Ground Hornbill, VU);
- *Gyps coprotheres* (Cape Vulture, VU);
- *Egretta vinaceigula* (Slaty Egret, VU);
- *Falco vespertinus* (Red-footed Falcon, VU);
- *Bitis heraldica* (Angolan Adder, VU);
- *Aquila rapax* (Tawny Eagle, VU); and
- *Umma femina* (Angola Sparklewing, VU).

The population thresholds and extensive ranges of these vulnerable species likely preclude their eligibility as a CH trigger species (as the loss of habitat and/or species within the study or adjacent areas is unlikely to result in the upgrading of these species global conservation status to Endangered (EN). Most of these species are considered to have a medium POC, and their occurrence within or near the study area is expected to be marginal.

Criterion 2 (Endemic or Range-restricted Species)

Although the study area has the potential to provide habitat to a diversity of faunal species, it does not meet Criterion 2 in terms of regularly holding $\geq 10\%$ of the global population size and ≥ 10 reproductive units of any range restricted or endemic species. The only range restricted/endemic species whose distribution overlaps with that of the study area (and EAAA) is *Bitis heraldica* (Angolan Adder, VU). Habitat conditions within the study area are however not considered favourable for this species, as it is primarily associated with forest habitats which are not found with the study area.

Criterion 3 (Migratory and Congregatory Species)

The study area and EAAA may be associated with some migratory avifaunal species such as *Egretta vinaceigula* (Slaty Egret, VU), *Aquila nipalensis* (Steppe Eagle, EN) and *Falco vespertinus* (Red-footed Falcon, VU). These species are expected to occur in low densities if present due to the widespread degradation of habitat and notably, decrease in food resources. As such, the study area and EAAA are not expected to sustain $\geq 1\%$ of the known populations of these species. Though the study area may host several bat species, it is not considered to be an important locality for such congregatory species. In both instances, the study area and the EAAA do not meet Criterion 3 (A or B) for global populations being present.

Criterion 4 (Highly Threatened or Unique Ecosystems)

None of the habitat units identified within the study area or the EAAA are considered to be highly threatened and/or unique ecosystems. The extent of the remaining habitats does not meet the criterion 4 requirements.

Criterion 5 (Key Evolutionary Processes)

From a faunal species perspective, the study area and EAAA are not considered particularly important in terms of Key Evolutionary Processes.

Based on the outcomes of the above assessments, the habitat units observed within the Project area have been grouped accordingly in terms of the IFC habitat categories (Table 4-50).

Table 4-48: IFC PS 6 Habitat categories for the vegetation units identified in the study area

Vegetation/Habitat Unit	Description of the IFC habitat categories
Miombo Woodland and Secondary Miombo Woodland	Critical Habitat The Miombo Woodland and Secondary Miombo Woodland are composed of viable assemblages of plant and/or animal species of largely native origin and where the surrounding anthropogenic activities (i.e., wood harvesting, agricultural) have not yet modified the area's primary ecological functions, although faunal species composition has been significantly impacted upon.
Freshwater Habitat	Natural Habitat The Freshwater Habitat are areas of natural habitat that are composed of viable assemblages of plant and/or animal species of largely native origin and where the surrounding anthropogenic activities (i.e., wood harvesting, agricultural) activities have not yet modified the area's primary ecological functions, although faunal species composition has been significantly impacted upon.
Transformed Habitat	Modified Habitat The Transformed Habitat is an area that contains a moderate to high proportion of plant and/or animal species of non-native origin and include areas that have substantially been modified by human activity (i.e., agricultural activities, towns, villages etc). Areas where the primary ecological functions and species composition have been modified.

Ecosystem Services

Table 4-49 provides an overview of the ecosystem services fauna provide within the Project area.

Table 4-49: Important ecosystem services provided by habitats (fauna)

Ecosystem Services	Habitats in the study area that support these services.
Provisioning Services	
These are the products obtained from ecosystems, including: • Food • Freshwater	Historically, food resources in terms of hunting faunal species was obtained from the habitat units. More recently, due to extensive overharvesting and habitat degradation, the availability of these resources has dwindled. The Freshwater Habitats provide a source of water to both people and livestock, though the increasing populations are leading to increased pollution and contamination risks to this resource. Given that the OHL is located in a landscape that has already been impacted on in terms of faunal provisioning services, the proposed OHL is not likely to have significant additional impacts to provisioning services, provided mitigation measures are implemented.
Regulating Services	
These are the benefits obtained from the regulation of ecosystem processes, including: • Air quality regulation • Climate regulation.	The Miombo Woodland, Secondary Miombo Woodland and Freshwater Habitat support these services, however continued expansion of communities and villages (population growth) are placing increased stress on these systems.

Ecosystem Services	Habitats in the study area that support these services.
Ecosystems influence climate both locally and globally. For example, at a local scale, changes in land cover can affect both temperature and precipitation. At the global scale, ecosystems play an important role in climate by either sequestering or emitting greenhouse gases • Water regulation. The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas. • Erosion regulation. Vegetative cover plays an important role in soil retention and the prevention of landslides. • Pollination. Ecosystem changes affect the distribution, abundance, and effectiveness of pollinators.	Continued vegetation clearance activities to make way for agriculture and wood harvesting are impacting faunal species numbers. Such impacts and loss of species will have cascading impacts downwards on other species and ecological services. Considering the landscape in which the OHL is located, the OHL is not likely to have significant additional impacts to regulating services, provided mitigation measures are implemented.

4.7.3 Flora and fauna habitat sensitivities

The Site Ecological Importance (SEI) was determined for each habitat unit within the Project area. The SEI categories are based on each habitat unit's ecological integrity, conservation value, the presence of species of conservation concern and the ecosystem processes. The SEI is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and Receptor Resilience (RR) (its resilience to impacts). Where BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor. Table 4-50 and Table 4-51 conceptually illustrates the floral and faunal SEI respectively. Sensitivity maps are included in Volume 3, Appendix E.

Table 4-50: Floral SEI for the different habitat units within the study area

Habitat unit	CI	FI	BI	RR	SEI	Development constraints
Transformed habitat	Low No confirmed or highly likely populations of SCC.	Low Several major current negative ecological impacts.	Low	Very High Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed.	Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.
Freshwater habitat	Low No confirmed or highly likely populations of SCC.	High Good habitat connectivity with potentially functional ecological corridors. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.	Medium	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed	High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to Project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities."
Secondary Miombo Woodland	Medium > 50% of receptor contains natural habitat with potential to support SCC.	Medium Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity. Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.	Medium	High Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed.	Low	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.

Habitat unit	CI	FI	BI	RR	SEI	Development constraints
Miombo Woodland	Medium > 50% of receptor contains natural habitat with potential to support SCC.	High Good habitat connectivity with potentially functional ecological corridors. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.	Medium	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor. The species that are currently in this habitat are common and largely homogenous and may have a moderate likelihood of returning to a site once the disturbance or impact has been removed	Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.

Table 4-51: Faunal SEI for the different habitat units within the study area

Habitat unit	CI	FI	BI	RR	SEI
Mimbo Woodland	Medium *Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals.	High *Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches.	Medium	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality.	Medium Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities
Secondary Mimbo Woodland	Low *No confirmed or highly likely populations of SCC. *No confirmed or highly likely populations of range-restricted species	Medium *Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. *Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.	Low	High Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality.	Very Low Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.
Freshwater habitat	Medium *Habitat may potentially support several SCC directly and indirectly. *Habitat serves as an important movement corridor within the landscape.	High *Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches.	Medium	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality.	High Avoidance mitigation wherever possible. Minimisation mitigation – changes to Project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable.
Transformed habitat	Medium *No confirmed and highly unlikely populations of SCC	Low *Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat.	Very Low	High Habitat that can recover relatively quickly (~ 5–10 years) to restore.	Very Low Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

4.8 Quality of the environment

4.8.1 Air quality

This section provides an overview of the air quality baseline conditions in the vicinity of the Project area and is drawn from information contained in the air quality assessment (SRK, 2024a) conducted for the ESIA (refer to Volume 4, Appendix A for the detailed specialist assessment).

Baseline emission sources

There are several key emission sources within the Project area. These include agricultural emissions, domestic fuel burning, unpaved and paved road dust, industrial activities, and mining operations. In particular, PM and diesel fuel organics (DFO) are highlighted as primary concerns. Agriculture, a major land use in the area, contributes emissions through activities such as ploughing, burning of crop residue, and chemical applications, with the extensive coffee production in Huíla noted for its economic significance. Additionally, dust from vehicles on unpaved roads is a notable source of airborne particulates, exacerbated by factors like vehicle speed and dry conditions.

Domestic energy consumption in the region transitions from traditional sources like wood and dung to modern ones, including electricity and renewable energy. However, all forms contribute pollutants like carbon monoxide, nitrogen oxides, and particulate matter to the atmosphere, reflecting a progression in residential energy use patterns. Similarly, mining operations, although not extensive in Huíla Province compared to other regions, potentially contribute to local air pollution through activities such as land clearing and materials handling.

Lastly, industrial activities, particularly those linked to coffee production, span from agricultural operations to processing stages like drying and milling. These stages emit various pollutants, including greenhouse gases and volatile organic compounds.

Identified receptors

Sensitive receptors, as defined by the United States Environmental Protection Agency (USEPA), include locations like hospitals, schools, and elderly housing, where vulnerable populations are at heightened risk from exposure to pollutants such as toxic chemicals and pesticides. In the context of the Project, residential, educational, and recreational areas within a 10 km radius of Chipindo, Cuvango, and Jamba have been designated as sensitive receptors. These receptors were pinpointed using 1:6300 digital raster graphic maps and further verified through Google Earth Pro, ensuring accurate identification of locations where sensitive individuals such as those in retirement homes or medical facilities could be affected by the Project's environmental impacts. These findings are detailed and illustrated in Table 4-52 to Table 4-54 and Figure 4-24 to Figure 4-26.

Table 4-52: Chipindo receptors

ID	Description	X-Coordinate (mE)	Y-Coordinate (mS)	Elevation (m)	Distance to substation (km)
SR1	Chipindo Municipal Hospital	584961.78	8472446.01	1613	2.13
SR2	School	585354.74	8471940.69	1613	2.17
SR3	Church	586435.72	8471011.47	1613	3.28
SR4	Clinic	585239.55	8472279.52	1613	2.47
SR5	Buloteque Health Post	585952.83	8473624.55	1613	0.67

Table 4-53: Cuvango receptors

ID	Description	X-Coordinate (mE)	Y-Coordinate (mS)	Elevation (m)	Distance to substation (km)
SR6	Hostel	639224.29	8400480.26	1340	2.64
SR7	Secretariat Geral	639409.09	8400733.77	1340	2.91
SR8	Residential area 1	638376.72	8400428.71	1340	1.94
SR9	Capelongo	638982.55	8399971.18	1340	2.11
SR10	Municipal Hospital	639436.64	8401567.42	1340	3.54

Table 4-54: Jamba receptors

ID	Description	X-Coordinate (mE)	Y-Coordinate (mS)	Elevation (m)	Distance to substation (km)
SR11	Jamba hospital	611577.04	8376556.01	1497	0.39
SR12	Cuanja Municipal Hospital	610456.70	8375200.94	1497	2.07
SR13	Park	610926.13	8375335.31	1497	1.74
SR14	School	611393.91	8375882.84	1497	0.96
SR15	Jamba Residential area 1	611840.97	8372462.53	1497	4.29
SR16	Jamba Residential area 2	611350.49	8374138.35	1497	2.71
SR17	Jamba Residential area 3	610585.79	8373826.46	1497	3.16
SR18	Jamba Residential area 4	609922.68	8376595.39	1497	1.94
SR19	Jamba Residential area 5	608360.25	8374862.37	1497	3.94

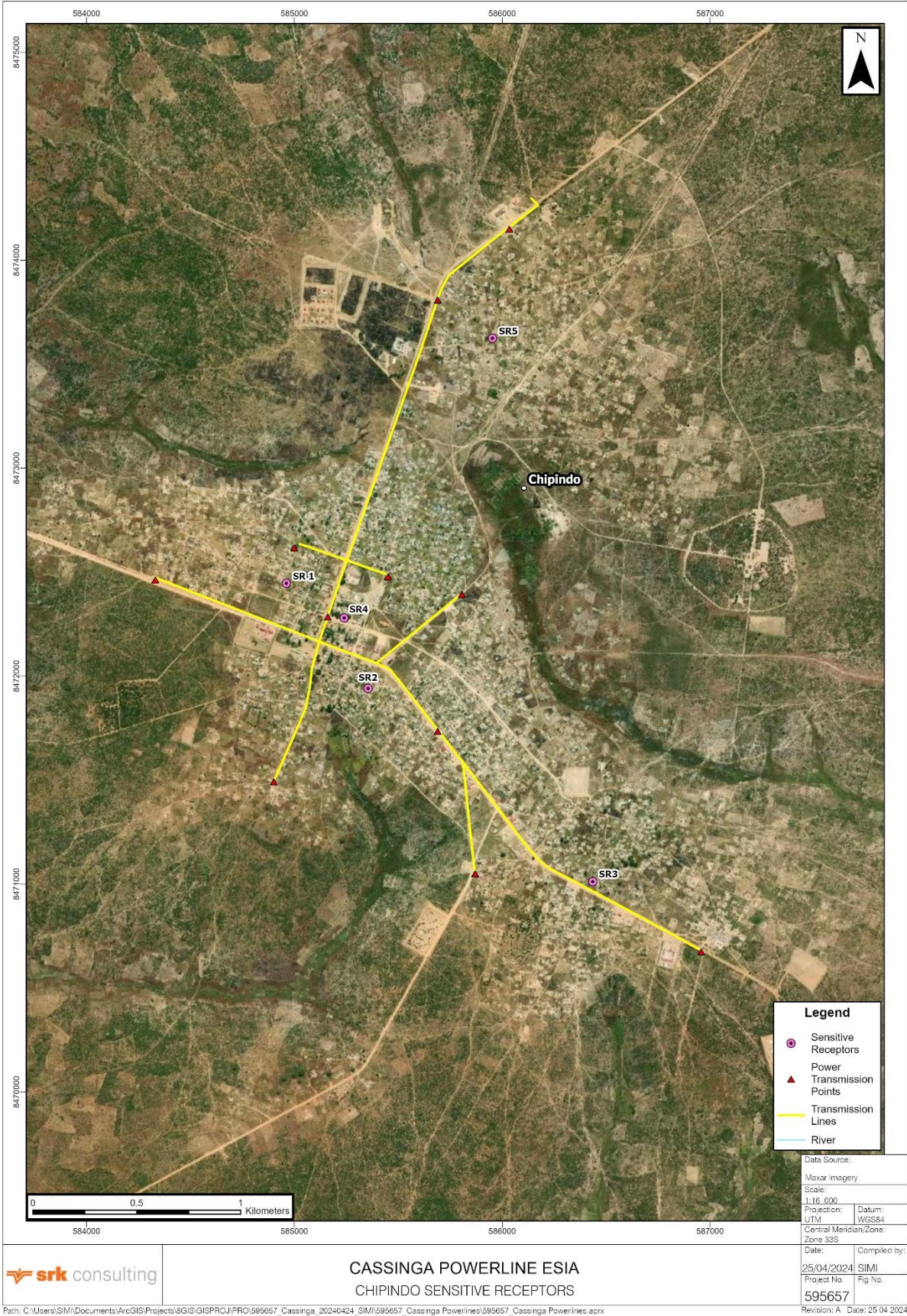


Figure 4-24: Chipino sensitive receptors

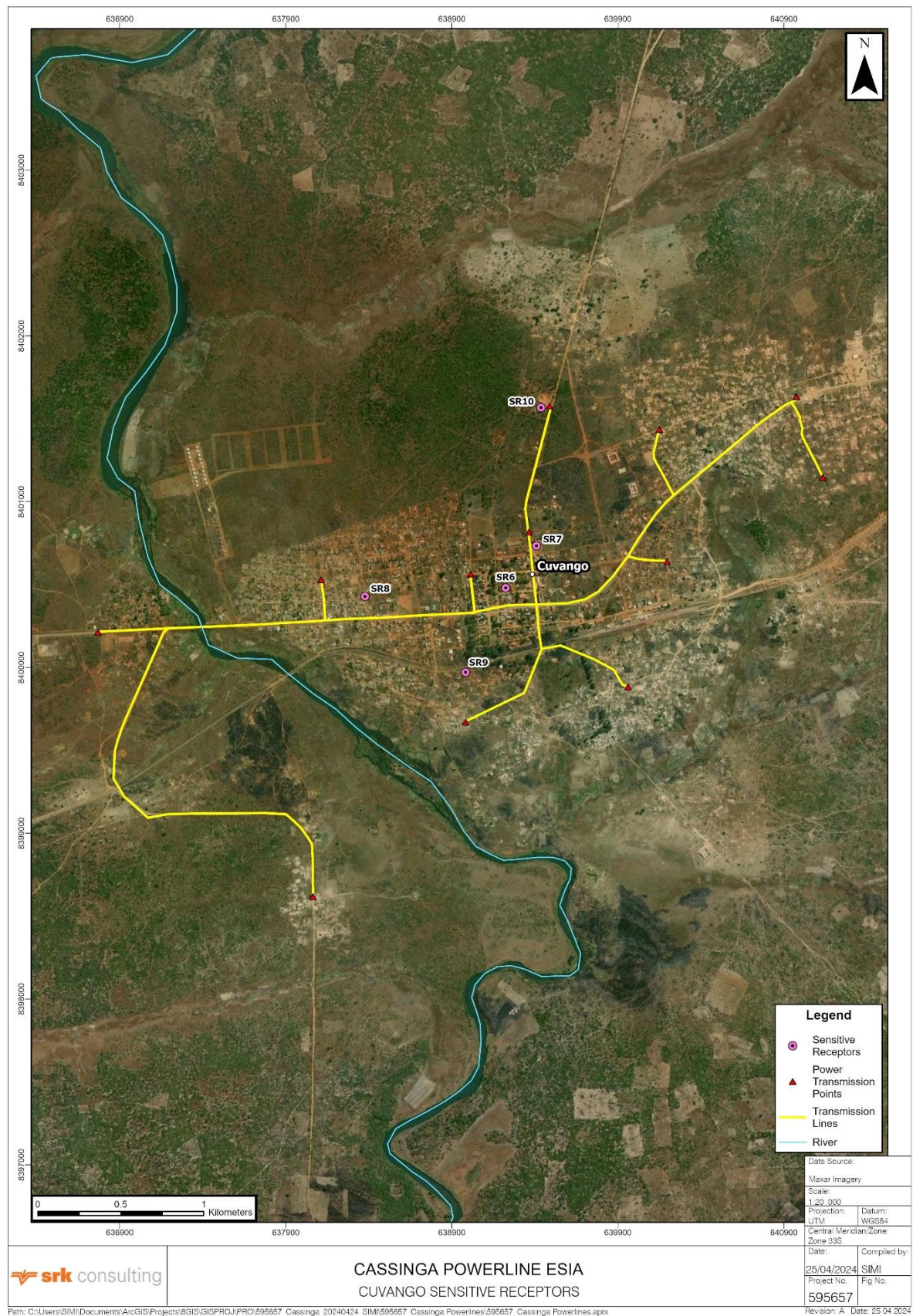


Figure 4-25: Cuvango sensitive receptors

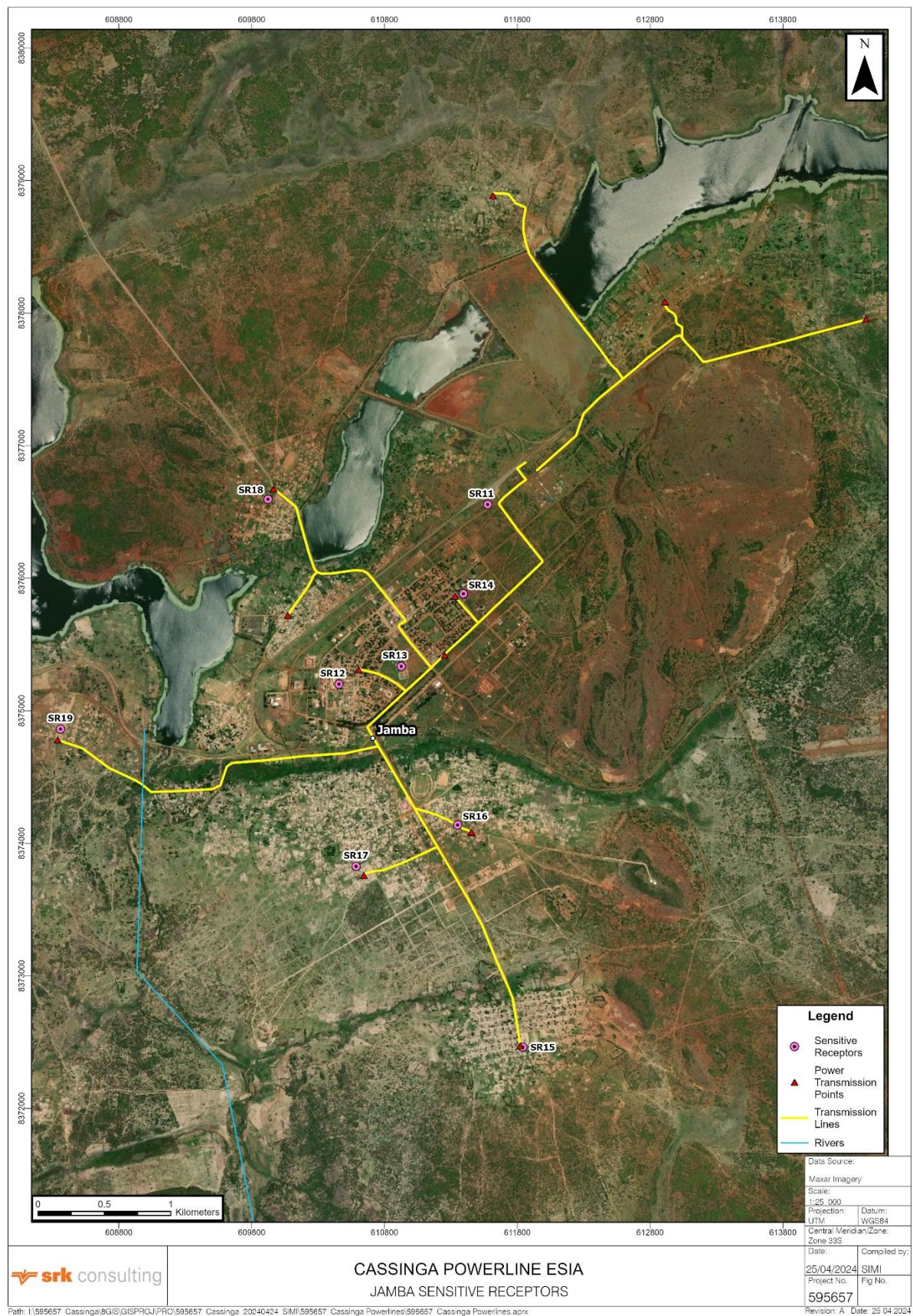


Figure 4-26: Jamba sensitive receptors

Air quality guidelines

The IFC provides EHS guidelines which serve as technical reference materials incorporating both general and industry-specific international best practices. These guidelines outline acceptable performance measures for the IFC and World Bank across various Project stages—construction, operation, and decommissioning—and stress the use of feasible technological solutions at reasonable costs. In cases where local standards, such as those in Angola, differ from these EHS Guidelines, Projects must adhere to the stricter regulations. Additionally, sector specific EHS guidelines address the unique challenges of different industries, with specific relevance to electric power transmission and distribution for this Project. These guidelines serve as a framework for maintaining air quality within internationally recognised limits, ensuring that Project impacts are minimally significant.

In terms of Angolan air quality legislation, standards for air quality are currently in preparation. In the absence of national standards, guidelines used by the WHO, are applied for air quality. The WHO guideline values are intended to confer a maximum degree of protection, specifically for developing countries. Interim targets (IT) are incremental goals designed to facilitate the gradual attainment of ambient air quality guidelines. The most recently published WHO air quality interim targets and guidelines are shown in Table 4-55 (World Health Organization, 2021).

Table 4-55: WHO Air Quality Guidelines, 2021

Pollutant	Averaging period	Concentration ($\mu\text{g}/\text{m}^3$)
Particulate matter (PM_{10})	Annual	15
	24-hour ^a	45
Particulate matter ($\text{PM}_{2.5}$)	Annual	5
	24-hour ^a	15
Ozone	Peak season ^b	60
	8-hour ^a	100
Nitrogen dioxide (NO_2)	Annual	10
	24-hour ^a	25
Sulphur dioxide	24-hour ^a	40
Carbon monoxide	24-hour ^a	4
^a 99 th percentile (i.e., 3-4 exceedance days per year) ^b Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running -average O_3 . Note: Annual and peak season is long-term exposure, while 24 hour and 8 hour is short-term exposure.		

4.8.2 Noise

This section presents an overview of ambient noise baseline conditions in the vicinity of the Project area and is drawn from information contained in the noise assessment (HCV Africa, 2024) conducted for the ESIA (refer to Volume 4, Appendix J for the detailed specialist assessment).

Baseline noise sources

The prevailing ambient noise levels in the vicinity of the Project area were created by subsistence farming activities, intermittent traffic along the main road (EN120) and roads in villages. The residential areas consist of single housing units, cluster houses and villages with formal and informal gravel roads. The residents of remote villages are already exposed to motorised traffic such as cars and motorcycles, whereas those living near the main and feeder roads experience noise from cars, heavy-duty vehicles, and motorcycles. The height above mean sea level (AMSL) at the villages differs throughout the study area due to the undulating conditions within the study area.

Noise monitoring

A noise monitoring was done in terms of the "*Guia Prático para Medicoes de Ruído Ambiente*" (Practical guide to Environmental Noise Measurements) and based on the Portuguese Norm NP ISO 1996 and the requirements of the IFC EHS Guidelines General Environmental Health Standards Guidelines: Environmental Noise Management, 2007. A Larson Davis 831 integrated Class 1 noise level meter was used to do the noise survey at the different measuring points. The instrument and hand calibrator are calibrated at an approved laboratory on an annual basis. The calibration certificate numbers of the instruments are 2024-AS-0006 (Larson Davis LD831) and 2024-AS-0004 (Larson Davis Handheld Calibrator). Sampling periods ranged from 20 minutes to 1 hour per locality to capture representative noise levels. The survey included measurements during different times of the day, including daytime, evening, and nighttime periods, to assess variations in ambient noise levels. Measurements were taken at a height of 1.2 to 1.5 meters above ground level and at least 3.5 meters away from any reflective surfaces to avoid interference, as per the stipulated methodology. This approach ensured that the data accurately reflected the environmental noise conditions at each location.

The noise surveys were conducted in the vicinity of:

- The main feeder road (EN120) and in the vicinity of residential properties along the route between Jamba to Chipindo; and
- Residential properties, internal roads and the EN roads at Jamba, Kuvango and Chipindo.

The measuring points are illustrated in Table 4-56 and Figure 4-27 to Figure 4-30.

Table 4-56: Geographical information of the measuring points

Measuring point	Latitude	Longitude	Approximate distance to project infrastructure (m)	Remarks
1	14° 41.340'S	16° 2.019'E	67	Jamba Village.
2	14° 40.812'S	16° 2.367'E	40	Jamba Village.
3	14° 39.753'S	16° 3.308'E	600	Jamba Village.
4	14° 39.160'S	16° 7.280'E	310	Comunidade 14 to the east of Jamba.
5	14° 28.008'S	16° 16.114'E	72	Kuvango Village.
6	14° 27.816'S	16° 16.107'E	428	Kuvango Village.
7	14° 17.069'S	16° 12.433'E	940	Comunidade 12
8	14° 12.885'S	16° 10.251'E	920	Comunidade 11
9	14° 10.451'S	16° 7.642'E	1 150	Along the EN120.
10	14° 8.500'S	16° 5.722'E	1 540	Along the EN120.
11	14° 6.320'S	16° 4.241'E	1 060	Along the EN120.
12	14° 3.074'S	16° 2.045'E	830	Along the EN120.
13	13° 59.000'S	16° 0.899'E	1 700	Along the EN120.
14	13° 58.871'S	16° 0.723'E	1 560	Along the EN120.
15	13° 56.789'S	16° 0.723'E	N/A	No noise survey due to inaccessibility of village.
16	13° 54.849'S	15° 54.643'E	730	Comunidade 5.
17	13° 52.979'S	15° 51.158'E	N/A	No noise survey due to inaccessibility of village.
18	13° 48.972'S	15° 47.445'E	30	Chipindo Village.
18A	13° 49.024'S	15° 47.338'E	80	Chipindo Village.
18B	13° 49.028'S	15° 47.364'E	130	Chipindo Village.
19	13° 48.006'S	15° 47.755'E	120	Chipindo Village.

Measuring point	Latitude	Longitude	Approximate distance to project infrastructure (m)	Remarks
20	13° 48.081'S	15° 47.951'E	32	Chipindo Village.
21	13° 40.755'S	15° 47.759'E	2 300	No noise survey due to inaccessibility of village.
22	13° 27.426'S	15° 51.650'E	1 200	Permission not granted to access the site.

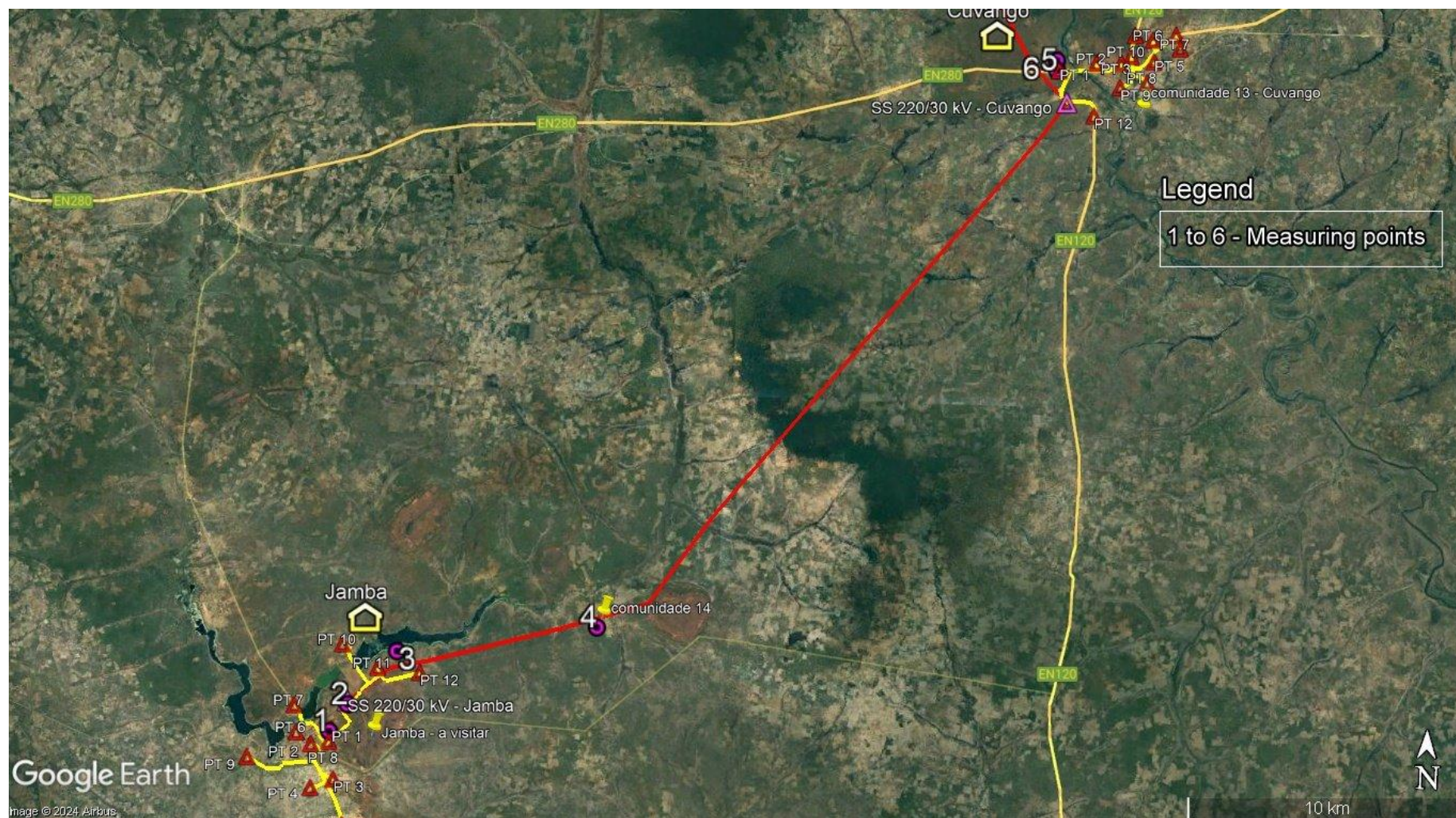


Figure 4-27: Noise monitoring points – Southern section

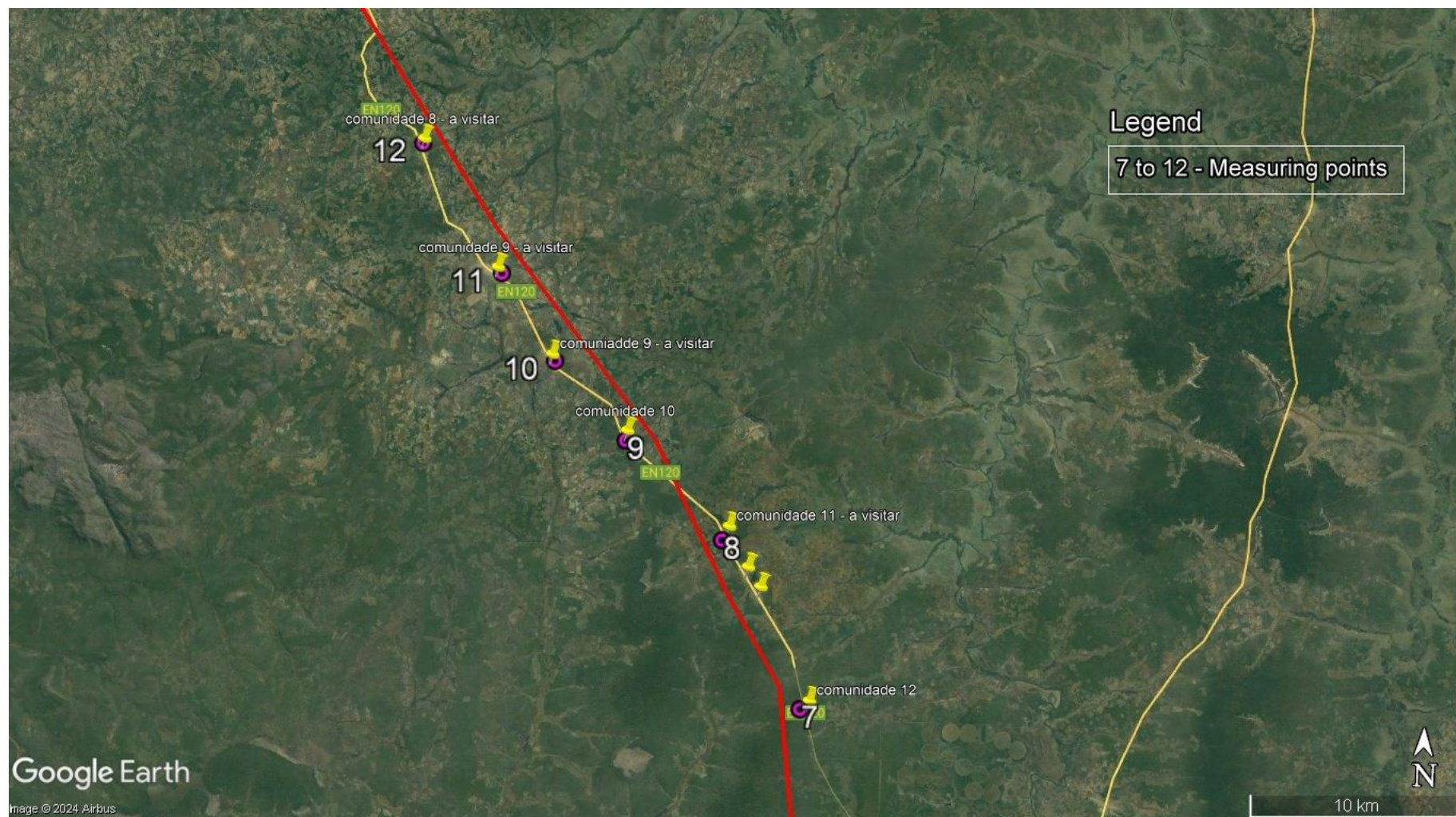


Figure 4-28: Noise monitoring points – Middle section

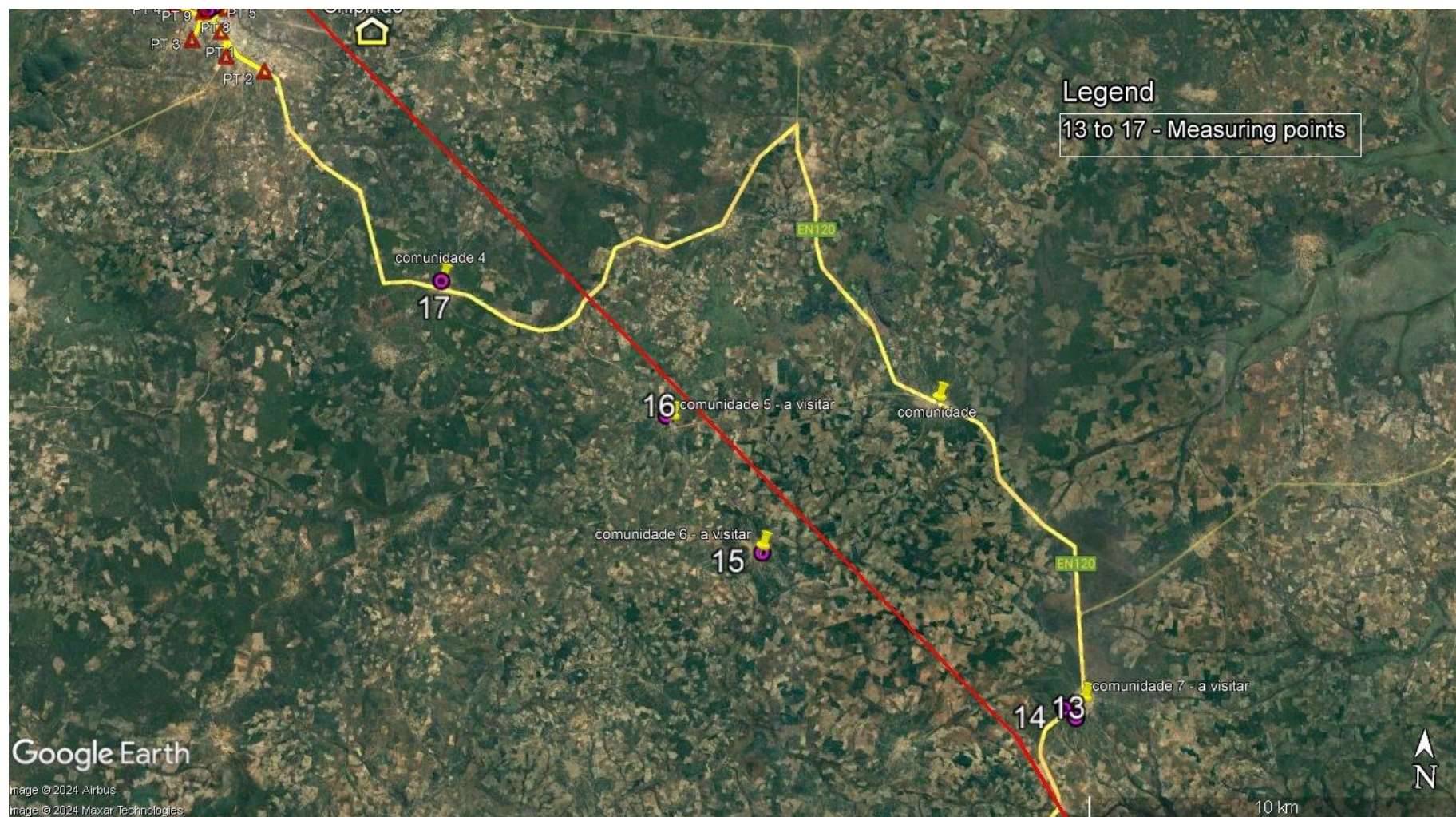


Figure 4-29: Noise monitoring points – Northern section

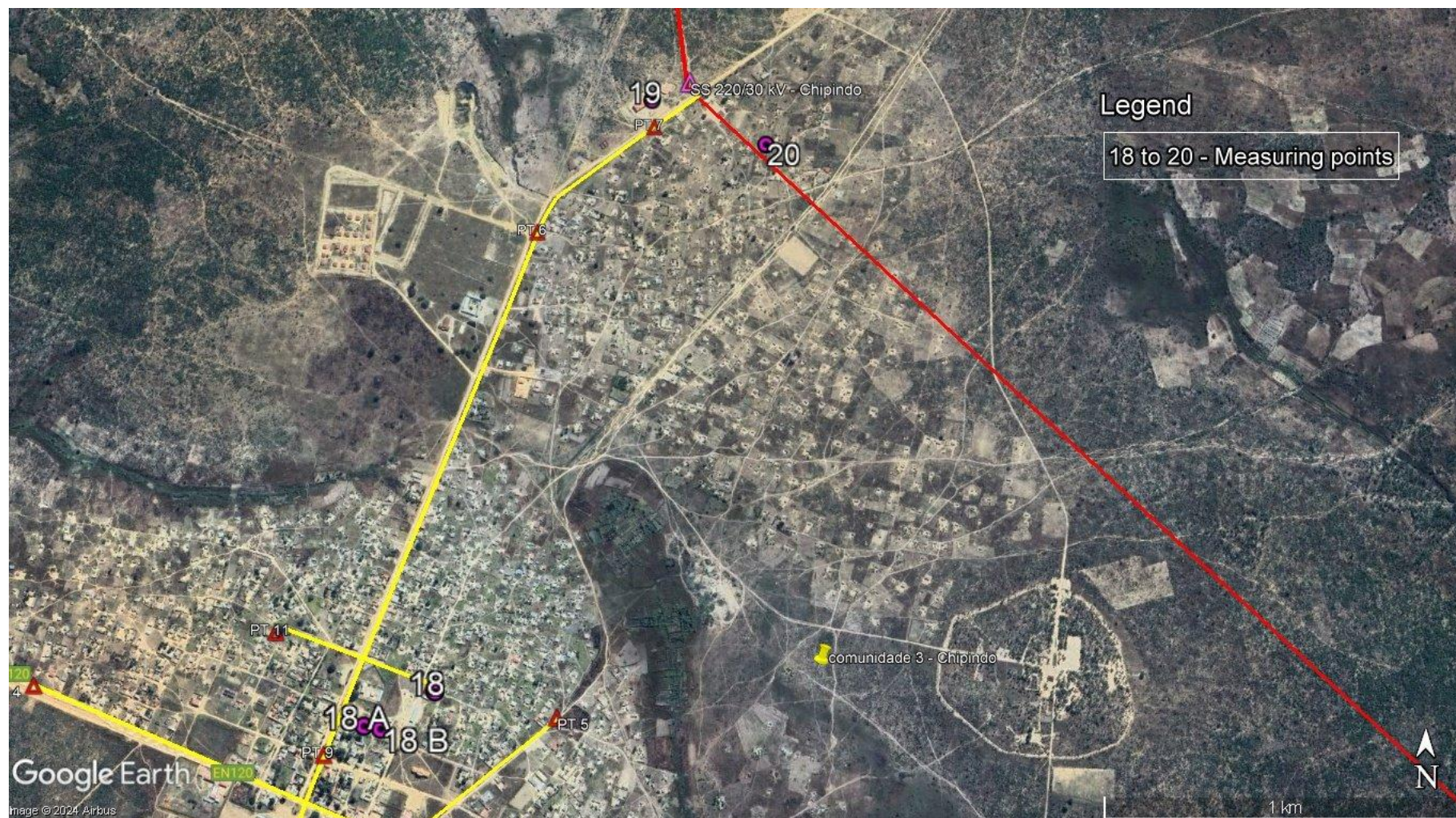


Figure 4-30: Noise monitoring points Northern section

Baseline noise levels

The results illustrates that the noise levels were evaluated in the vicinity of the roads due to motorized traffic such as motor vehicles, heavy duty vehicles and motorcycles with the result that the noise levels were higher in the vicinity of the roads and lower in the vicinity of the villages because there were less noise sources, which could increase the noise levels. The distance between the point and linear noise sources will determine the level of the environmental noise source. The results of the noise survey are presented in Table 4-57. The L90 value is a statistical value, which is an indication of the ambient noise level.

Table 4-57: Measured noise levels

Measuring point	Location	L _{Aeq}	L _{Max}	L _{Min}	L90	Remarks	Distance from OHL - meters
1	Jamba	37.7	59.3	31.2	33.1	Domestic, birds and distant traffic.	1 280
2	Jamba	50.6	70.3	28.7	33.8	Motorbikes, wind.	160
3	Jamba	41.4	65.0	29.6	34.8	Domestic and distant traffic.	600
4	Com 14	45.9	63.8	35.0	38.9	Domestic and distant traffic.	290
5	Kuvango	46.5	68.9	29.7	34.0	Domestic and distant traffic.	580
6	Kuvango	37.5	62.2	30.9	33.1	Distant water, insects, and birds.	820
7	Com 12	38.0	55.6	25.5	29.8	Distant domestic, people, traffic, and birds.	980
8	Com 11	38.0	55.6	25.5	29.8	Domestic and distant traffic.	885
9	Com10	38.3	66.2	26.7	30.7	No people at village, distant traffic.	1053
10	Com9 – along ENS120	42.2	67.5	38.8	37.6	Animals, domestic and children playing.	1480
11	Com9 – along ENS	42.2	67.5	38.8	37.6	Domestic, distant generator, animals, and insects.	1079
12	Com8 – along ENS120	45.1	65.0	35.8	39.3	Domestic, wind and distant mill.	819
13	Com 7 North	49.6	68.4	37.8	42.8	Wind and domestic.	1526
14	Com7 South	49.5	67.4	37.9	42.9	Wind and domestic.	1533
15	Com6	1.45km from OHL and not accessible.					1450
16	Com5	49.6	71.6	38.1	43.6	Wind and domestic.	700
17	Com4	2.5km from OHL and not accessible.					2500
18	Chipindo	60.9	87.3	43.3	48.9	Motor bikes and people.	1975
18A	Chipindo	53.0	71.2	46.0	48.2	Distant generator, motorbikes	
18B	Chipindo	46.3	63.8	37.7	41.5	School ground and distant domestic	1956
19	Chipindo	41.3	68.5	26.8	31.1	Motor bikes and people.	113
20	Chipindo	43.2	62.0	30.7	35.2	Motor bikes and people.	40

Noise survey conclusions

The following key conclusions are made on the noise survey:

- Prevailing ambient noise levels in and around villages may increase with the introduction of electricity however this is anticipated to be insignificant at noise receptors;
- Villages abutting the EN120 were exposed to prevailing ambient noise levels between 38.1dBA to 45.5dBA due to intermittent traffic, a grain mill, animals and/or domestic activities; and
- The communities of Jamba, Cuvango and Chipindo are already exposed to multiple noise sources increasing the prevailing ambient noise levels (37.6dBA to 52.4dBA) such as motor vehicles, heavy-duty vehicles and motorcycles.

Environmental noise guidelines

Due to a lack of recommended environmental noise levels for new developments in Angola, the IFC EHS Guidelines (IFC 2007) were applied. The guidelines values are specified as either a fixed noise limit or an increase of 3.0dB over the prevailing ambient noise levels. The guideline levels are set out in Table 4-58. The guidelines advise that, where noise levels attributable to an installation or operation exceed the guideline values at the façade of the nearest noise receptor, appropriate noise mitigation measures should be adopted. It is evident from the baseline data, the noise levels are relatively low across the Project area and typical for residential, institutional and educational receptors. Higher ambient noise levels occur near roads and intersections.

Table 4-58: Recommended noise levels for residential areas and industrial areas

Receptor	Either		Or
	Period		Where baseline exceeds IFC guideline
	Daytime (07:00 – 22:00)	Night-time (22:00 – 07:00)	
Residential, institutional, and educational	55	45	3 dB increase over baseline
Industrial and commercial	70	70	

4.8.3 Visual

This section presents an overview of the baseline visual character, sense of place and visual quality in the vicinity of the Project area and draws on information contained in the visual assessment (SRK, 2024c) conducted for the ESIA.

Visual character

The Project area is characterised by a predominantly rural landscape interspersed with natural features and several significant towns and villages including Gove, Bunjei, Chipindo, Catala, Cului, Cuvango, and Jamba. These areas are connected by main roads such as EN 358, EN 270, EN 120, EN 280, and HLA 125. The region hosts Gove Dam and a hydroelectric plant to the north, adding a distinct industrial element amidst the otherwise rural setting. The predominant activities in the area include subsistence agriculture, artisanal and small-scale mining, except near Gove where gold prospecting is reported, along with areas dedicated to natural forests, plantations, grasslands, and residential communities.

The visual character of this diverse landscape is assessed using the Hassel matrix Table 4-59, which rates areas from unmodified natural landscapes (scored highest for minimal human impact) to highly modified urban and industrial landscapes (scored lowest due to substantial development). Most of the study area falls into the category of a natural transition landscape, indicating a blend of natural and slightly modified rural zones. Specific sites for new substations in Chipindo, Cuvango, and Jamba are

also classified within this transition landscape, suggesting a balance between rural and light industrial features.

Table 4-59: Land use character rating system

Description	Value	Typical character / use
Unmodified landscape/natural	5	No / minimal impact associated with the actions of man. National parks, coastlines, pristine forest areas.
Natural transition landscape	4	A changing landscape character associated with the interface between natural areas and modified rural / pastoral or agricultural zones.
Modified rural landscape	3	Typical character is rural landscape, defined by field patterns, forestry plantations and agricultural areas and associated small-scale roads and buildings.
Transition landscape	2	Transitional landscape associated with the interface between rural, agricultural area and more developed suburban or urban zones.
Highly modified landscape, urban/industrial.	1	Substantially developed landscape. High levels of visual impact associated with buildings, factories, roads and other related infrastructure.

Sense of place

In terms of 'sense of place,' which relates to the distinctiveness and identity of a location shaped by both physical and cultural elements, the overall area exhibits a low sense of place due to its diverse but undefined character. However, towns like Gove, with notable features such as the dam, exhibit a higher sense of place, offering a more memorable and identifiable setting.

Visual quality

Visual quality in this context is determined by the vividness, intactness, and unity of the landscape, where factors such as topographical diversity, water features, and the blend of natural versus man-made elements enhance the aesthetic value. Conversely, visual clutter and prominent man-made structures like roads and factories detract from the visual quality, making the landscape less appealing. Visual quality assessments, therefore, hinge on the degree of natural coherence and the impact of human alterations, which are inherently subjective and vary widely across different areas of the Project site. Therefore, the United States Department of Transport: Visual Impact Assessment for Highway Projects (USDOT, 1981) and the Landscape Institute with the Institute of Environmental Management and Assessment (2002), are used to determine visual quality can be calculated as per the equation below, where:

- **Vividness** is defined as the extent to which a landscape is memorable – this is associated with the distinctiveness, diversity, and contrast of visual elements.
- **Intactness** is defined as the integrity of visual order within the landscape, as well as the extent to which the landscape is free from visual intrusions.
- **Unity** is defined as the extent to which visual intrusions are sensitive to the existing landscape.

$$\text{Visual Quality} = \frac{\text{Vividness} + \text{Intactness} + \text{Unity}}{3}$$

Visual quality was calculated according to the above equation and was based on the following rating criteria specified in Table 4-60.

Table 4-60: Visual quality rating criteria

Rating	High (5)	Medium (3)	Low (1)
Vividness	The visual impression received is highly memorable, as contrasting landscape elements combine to form distinctive visual patterns.	The visual impression received is moderately memorable, with some distinctive patterns moderately defined landscape or landforms are present.	The visual impression received is of low memorability. Little visual pattern is formed because landscape elements do not combine to form a striking or distinctive pattern.
Intactness	There is high visual integrity between the natural and man-made landscape to the extent that the landscape is free from visual encroachment.	There is an average visual integrity between the natural and man-made landscape. Some visual encroachment on to the landscape is present.	There is low visual integrity between the natural and man-made landscape features. Visual encroachment onto the landscapes very apparent.
Unity	The visual elements of the landscape join to form a moderately coherent, harmonious visual pattern. Manmade and natural elements blend together.	The visual elements of the landscape join to form a moderately coherent, harmonious visual pattern. Manmade elements blend with natural elements; however, the visual order is disrupted.	Visual resources do not join together to form a coherent harmonious visual pattern. Manmade elements do not have a visual relationship to natural landforms or land cover patterns and visual order is lacking.

The visual quality of the study area is calculated and summarised in Table 4-61 to Table 4-63. Figure 4-31 shows the land cover as classified by the European Space Agency. Figure 4-32 shows the land cover reclassified based on the visual quality rating related to the land use.

Table 4-61: Visual quality rating of the OHL for the Gove-Chipindo-Cuvango-Jamba Transmission Line Project

Criteria	Overhead line: Gove-Chipindo-Cuvango		Overhead line: Cuvango-Jamba	
	Rating	Description	Rating	Description
Vividness	2	The vividness of the study area can be classified as low-to-medium. There are very few memorable patterns. Some distinctive patterns form around within and in the direct vicinity of the three towns and the Gove Dam is a memorable landscape feature. The sloping topography adds to the receiving visual impression.	3	Although clear boundaries between different land uses are not existing, general residential, farmland and natural vegetation zones are apparent. Large streams such as the Colui and Cuandeja contribute to the memorability of the area. The vividness is classified as medium .
Intactness	3	The intactness of the study area is classified as medium. The natural forest is interspersed with plantations and land used for subsistence farming (these are the main land uses in the study area). The major roads, small communities and Gove, Chipindo and Cuvango towns cause some visual encroachment.	4	Significant areas of undisturbed natural vegetation exist in this portion of the study area. Cuvango, Jamba, main roads, the railway and bare areas (possibly from artisanal and small-scale mining activities) decrease the intactness of this portion of the study area. The intactness is classified as medium-to-high .

Criteria	Overhead line: Gove-Chipindo-Cuvango		Overhead line: Cuvango-Jamba	
	Rating	Description	Rating	Description
Unity	3	The unity of the study area can be classified as medium. The visual order is mainly broken by the more densely built-up town areas and large extents of cropland that surround the towns. The areas between the town's farming land is generally interspersed with natural vegetation and the built-up footprint of the communities is small. In this area man-made and natural features blend more harmoniously together.	4	The unity of the area is classified as medium-to-high . Visual order is somewhat disrupted by the towns, bare land and farmland, however indistinct transition borders between land uses are evident and natural vegetation is interspersed between the man-modified landscape.
Calculation	$Visual\ Quality = \frac{2 + 3 + 3}{3}$ $= 2.67\ (MEDIUM)$		$Visual\ Quality = \frac{3 + 4 + 4}{3}$ $= 3.66\ (MEDIUM - HIGH)$	

Table 4-62: Visual quality rating of the substations for the Gove-Chipindo-Cuvango-Jamba Transmission Line Project

Criteria	Substation: Chipindo		Substation: Cuvango		Substation: Jamba	
	Rating	Description	Rating	Description	Rating	Description
Vividness	2	The predominant land uses in the study area for Chipindo substation is shrubland, farmland and grassland. The vividness is classified as low-to-medium . The Chipindo town breaks the harmonious mixture of the other three predominant land uses.	3	Cropland is interspersed amongst natural vegetation. However, the town and Cubango River that flows on the western border of the town are memorable landscape features. Main roads (EN 120 and EN 280) converge in the town and a railway line runs through the study area. The vividness is classified as medium .	4	The vividness of the Jamba substation study area is medium-to-high . Colui and Cuandeja streams in Lagoa do Eiela. Multiple main roads and a railway line lead into Jamba town and there's a small airport on the eastern side of the town.
Intactness	2	The built-up area, farmland and areas of cleared/bare land decrease the intactness of the area, however the largest portion of the study area remains classified as shrubland. Intactness is classified as low-to-medium .	3	The intactness is classified as medium . The majority of the Cuvango substation study area is covered in shrubland, grassland and trees, however a significant area is dedicated to roads, railway, farmland and town infrastructure.	3	The intactness is classified as medium . Majority of the area comprises vegetation. Built-up town area, roads, railway and cropland cause visual encroachment on the natural landscape.
Unity	3	The unity of the study area can be classified as medium . Natural and modified area is moderately coherent.	3	The unity of the area is classified as medium . Cropland and shrubland within the town aids marginally in blending the town with surrounding area. However, the visual order is disrupted by the significant built-up area as opposed to the more vegetated land that covers the rest of the study area.	3	Unity of the study area is classified as medium . Built-up area and transport infrastructure stand out from the rest of the vegetated areas and waterbodies.
Calculation	$\text{Visual Quality} = \frac{2 + 2 + 3}{3} = 2.33$ (LOW – MEDIUM)		$\text{Visual Quality} = \frac{3 + 3 + 3}{3} = 3.00 \text{ (MEDIUM)}$		$\text{Visual Quality} = \frac{4 + 3 + 3}{3} = 3.33 \text{ (MEDIUM)}$	

Table 4-63: Visual quality rating of the distribution network for the Gove-Chipindo-Cuvango-Jamba Transmission Line Project

Criteria	Distribution networks	
	Rating	Description
Vividness	4	The vividness is classified as medium-to-high . Within the towns along the roads of where the distribution networks run, the predominant land cover comprises small-scale households and small plots of land which is distinct from the more sparsely modified surrounding area.
Intactness	2	Intactness is classified as low-to-medium .
Unity	2	The unity of the study area can be classified as low-to-medium . The denser concentration of buildings and bare land cause disruption to the visual order of the surrounding area.
Calculation	$Visual\ Quality = \frac{4 + 2 + 2}{3} = 2.66$ (LOW – MEDIUM)	

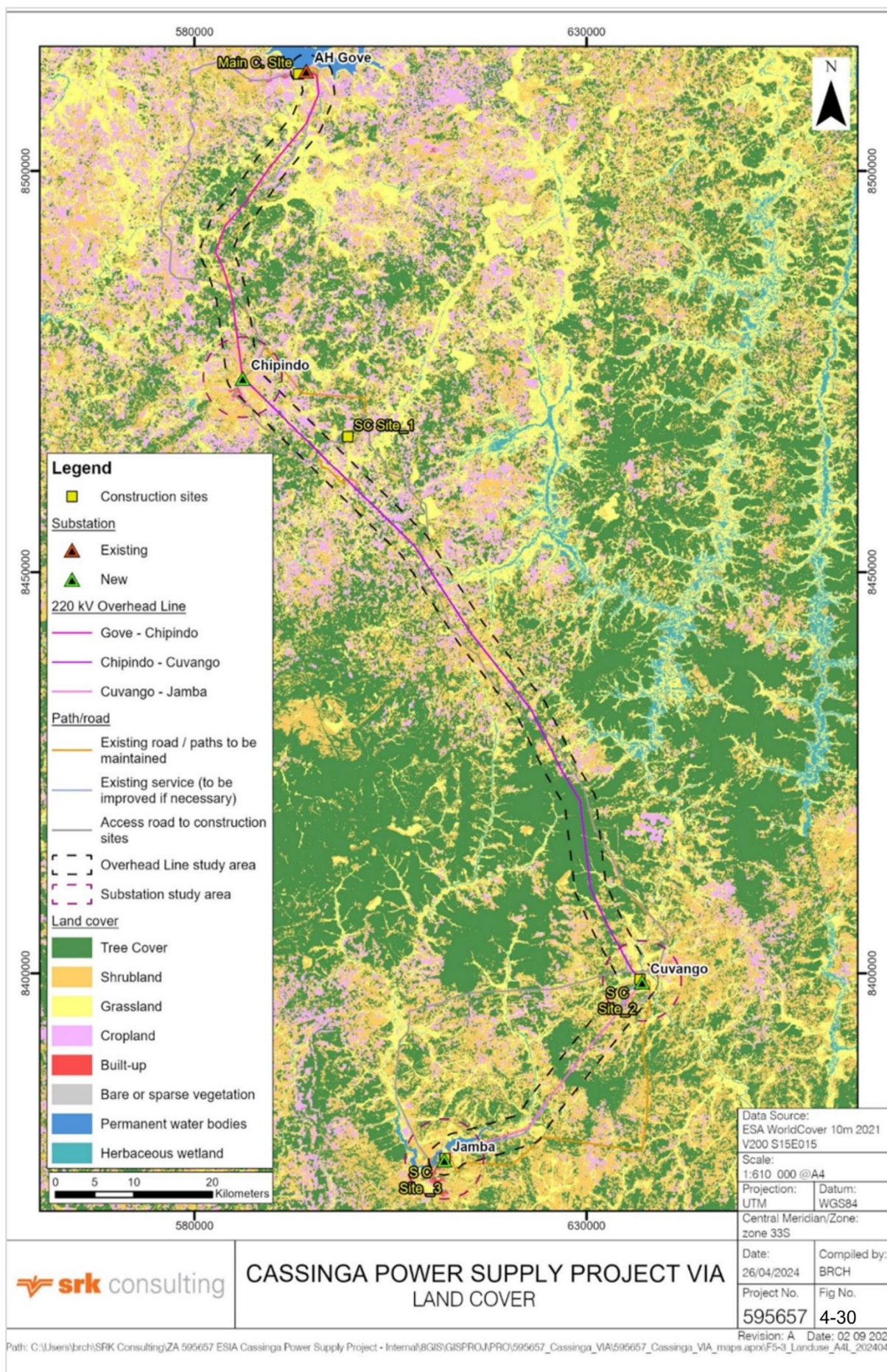


Figure 4-31: Land cover map of Project area

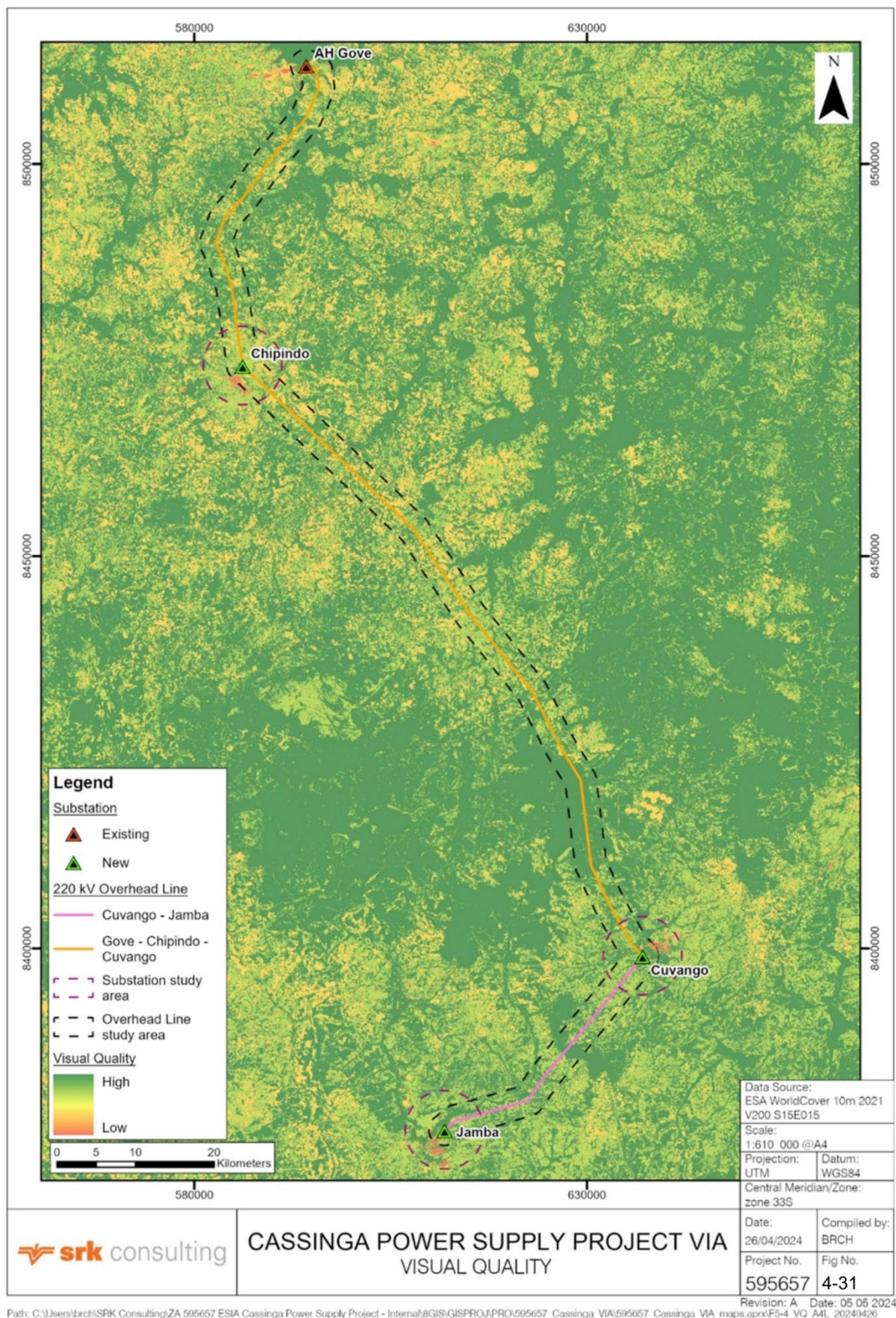


Figure 4-32: Visual quality map

4.9 Heritage

This section presents a detailed overview of baseline heritage conditions in the Project area of influence drawing information contained in the heritage assessment (Beyond Heritage, 2024) conducted for the ESIA (refer to Volume 4, Appendix D for the detailed specialist assessment).

4.9.1 Brief history

Portuguese Angola, located in southwest Africa, was the first European colony on the continent. The Portuguese settlement in Angola began in 1571 and involved the acquisition of slaves for the Atlantic island colonies and Portuguese Brazil, continuing until the end of the Atlantic slave trade in the 19th century. The capital, Luanda, served as a base for Portuguese efforts to gain control of the interior while facing resistance from local kingdoms like Kongo, Ndongo, and Matamba. The Angolan Wars saw shifting tribal alliances and assistance from Brazil in maintaining the slave trade. The process of decolonization in the mid-20th century was violent and chaotic, leading to prolonged civil conflict even after independence in 1975. Portuguese exploration in West Africa led to the colonization of São Tomé and Príncipe in the late 15th century. Slaves were brought from Kongo to these Portuguese colonies and the North Atlantic, particularly Madeira, where sugar plantations were established. The Portuguese aimed to establish their own slave expeditions in the African interior, leading to tensions with Kongo. Portuguese-Brazilian expeditions led by Paulo Dias de Novais established the first European colony in Africa in 1571 (Cartwright, 2023). The Portuguese focused on controlling the coast, while interior expansion was marked by conflict with indigenous populations, including battles with the Kingdom of Matamba and the influential Queen Nzinga (Figure 4-33).



Figure 4-33: Photograph showing Queen Nzinga (Devéria, and Cartwright, 2023)

The cultural heritage of Huambo and Huíla provinces is predominantly linked to their pre-colonial and colonial histories, indigenous practices and the natural landscape. Important heritage sites often include ancient ruins, colonial buildings and significant battle sites related to both the resistance against Portuguese rule and the civil war.

In Huambo province, key heritage sites include the Ovimbundu Kingdom's remnants and the city's colonial architecture, which reflects the administrative and military significance of the region during Portuguese rule. The province's cultural heritage is also marked by its role during the civil war, with numerous memorials and sites of historical significance. The Huíla province's heritage is rich in both natural and cultural landmarks. The Chela Mountains and the Tundavala Fissure offer not only natural beauty, but also historical significance as areas of refuge and resistance. The city of Lubango, the provincial capital, is the site of colonial-era buildings. The well-known Christ the King statue overlooks the city and is a symbol of the region's historical and spiritual significance.

Both provinces have several traditional festivals and practices, which are considered intangible cultural heritage. These include the Ovimbundu's Olyaka lyOmuenho (New Yam Festival) and the Vatapa, a culinary tradition that reflects the blend of indigenous and Portuguese influences.

4.9.2 Archaeological heritage

The archaeological sequence of the study area includes the Stone Age, Iron Age and the historical period as described below.

Stone age

In archaeology south of the Sahara, the Stone Age is classified differently from contemporary European and North African palaeolithic classifications, instead trifurcating the palaeolithic into the Early Stone Age (ESA), Middle Stone Age (MSA) and Later Stone Age (LSA) (Barham and Mitchell, 2008).

- The Early Stone Age spans from 2.6 million years ago (mya) until around 280 000 years ago and includes the Acheulean and Olduvai cultures (Mcbrearty & Brooks, 2000);
- The Middle Stone Age spans from 280 000 years ago until about 40 000 years ago, marked by the arrival of modern Homo sapiens and a change in knapping technologies (Barham and Mitchell, 2008; Hublin, et al., 2017; Kiura, 2019); and
- The Later Stone Age dates to around 40 000 years ago until the introduction of metallurgy, which in the southern African subcontinent, occurred at around AD 200 (Barham and Mitchell, 2008; Daggett, 2015, p. 2).

Angola can be classified into three ecological-cultural Stone Age zones (Figure 4-34), as posited by John Desmond Clark, namely the Congo Zone in the north, the Zambezi Zone in the south-east and the South-Western zone in the south-west. The site in discussion falls within the transitional zone between Zambezi and South-Western, as classified according to the Clark ecological-cultural zones of Angola (de Matos, et al., 2021).

Angola is known for its rich presence of open-air Stone Age sites, including Acheulean deposits in areas such as the coastal regions at Baía Farta and areas in the hinterland such as Bentiaba, Lucira, Moçamedes, Ponta do Giraul and Capangombe-Velho. In the wider area of planned development, there are four known Stone Age sites:

- Capelongo 2 (339-2) is a site hailing from the LSA (University of Lisbon, n.d.) and is located 86 km WSW of Jamba. It has a central GPS co-ordinate of 14°56'24.58"S; 15°15'7.24"E;
- Oci 1 (359-1) is also a LSA site situated in Huíla, 75 km SW of Jamba. It is considered to form part of the Magosian culture. Its central co-ordinate is 15°4'51.92"S; 15°24'45.00"E;
- Oci 2 (359-2) is another site dating from the LSA and is situated 87 km SW of Jamba (Poloni, 2012; University of Lisbon, n.d.). It is possibly related to Oci 1 as the two sites are in close vicinity to one another. Its central GPS co-ordinate is 15°8'48.55"S; 15°19'19.34"E; and
- Matala Vila Folgares (339-4) is an ESA site 106 km west of Jamba and is considered to form part of the Acheulean culture (Clark, 1966). It has a central co-ordinate of 14°43'32.57"S; 15°0'19.14"E.

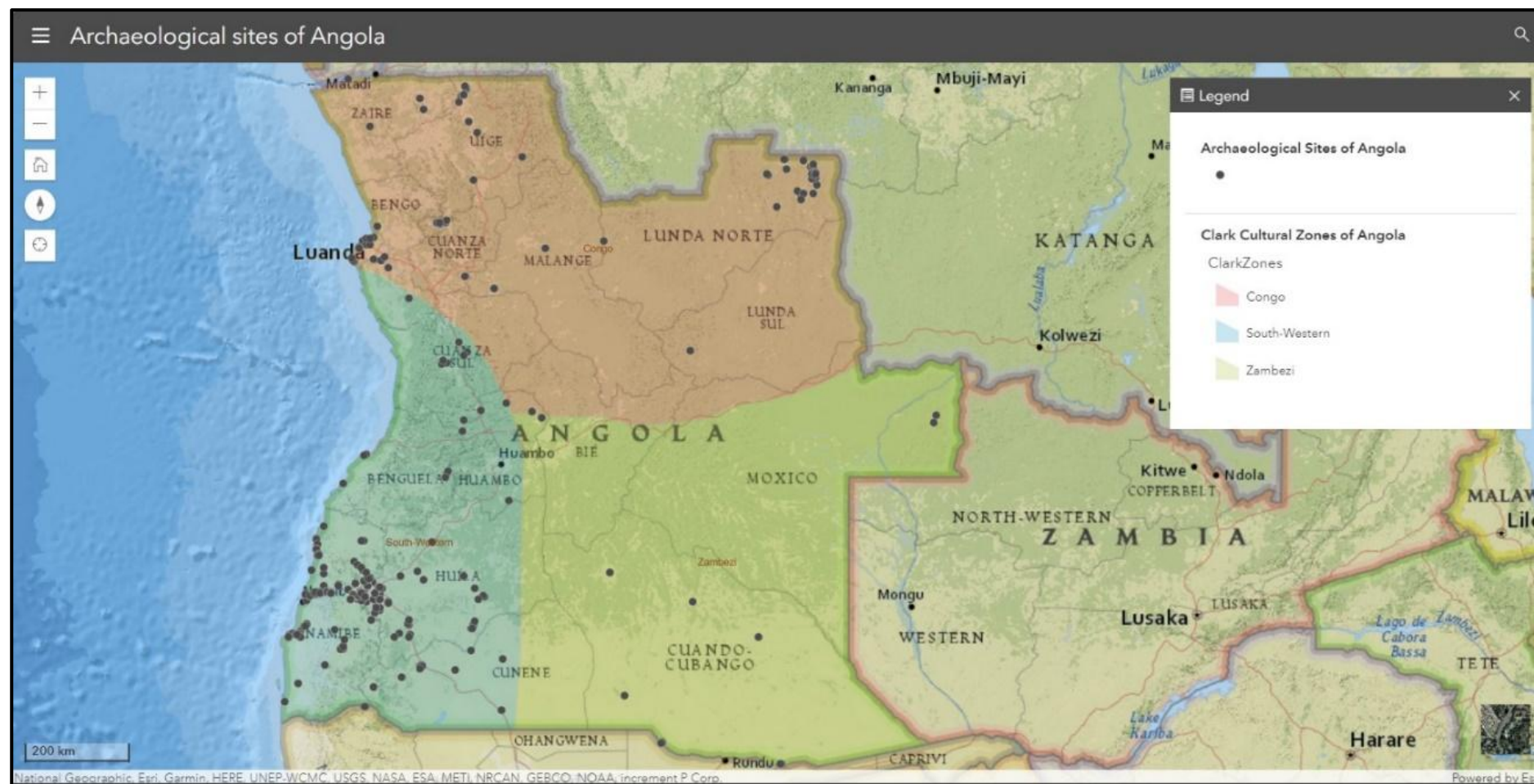


Figure 4-34: Map illustrating the three ecological-cultural Stone Age zones and know heritage sites in Angola

Iron age

The Iron Age in Africa south of the Sahara lasted from around AD 300 with the arrival of the Bantu, until the advent of the historical age, which differs between regions. Like the Stone Age, Thomas Huffman (Huffman and Woodborne also trifurcated the Iron Age in Africa into the Early Iron Age, Middle Iron Age and Later Iron Age:

- The Early Iron Age (EIA) lasted from around AD 300 until around AD 900 and was marked by the adoption of metallurgy;
- The Middle Iron Age (MIA) spanned from AD 900 – 1300; and
- The Later Iron Age (LIA) lasted from AD 1300 until the 19th century.

There are three known Iron Age sites in the wider landscape of the proposed development, namely:

- Povoado Fortificado de Quitavava (254-2) is a LIA site (Jorge V, 1975; Jorge S. O., 1976) situated 130 km NW of the Gove hydroelectric plant and is situated at 12°56'0.83"S; 14°47'15.68"E;
- Povoado Fortificado de Pumbala (254-1) is also a LIA site (Jorge V., 1975; University of Lisbon, n.d.; Jorge S. O., 1976) just 4 km NNE of Povoado Fortificado de Quitavava, with a co-ordinate of 12°54'6.24"S; 14°47'56.91"E; and
- Feti (280) is a possible EIA site (University of Lisbon, n.d.) that falls within 4 km of the area of planned development. The indicated co-ordinates of 13°25'12.12"S; 15°52'18.40"E fall directly opposite a body of water to the Gove hydroelectric plant (Figure 4-35). It should be considered as having the possibility of being affected by development.



Figure 4-35: The position of Feti (280) Iron Age site in relation to the Gove hydroelectric plant

Historical age

The Historical Age is considered to be the age that follows the Iron Age, where written records first appeared in the area. In southern Africa, this date varies greatly, however, many agree that this period started between the 16th and 18th centuries and carries on into modern times. Angola has experienced several unrests and wars since the advent of the Historical Age, most notably the Angolan War of Independence (1961-1974), the South African Border War (1966-1990) and the Angolan Civil War (1975-2002). The battles and skirmishes took place all over the country and number in the hundreds, if not thousands. It is therefore not possible to mention all the battles that took place within the wider landscape of the area of planned development.

During the Angolan War of Independence, Angolans initially revolted against Portugal's forced cultivation of cotton on its foreign territory of Angola, however, this soon culminated into a war of independence between three factions (Marcum, 1969 and Marcin, 1977). After Angola gained its independence from Portugal in 1975, the persisting struggle for power between the communist and the anti-communist factions resulted in a civil war that would last 26 years, and which would claim the lives of 500-800,000 people (United Nations High Commissioner for Refugees, 2000).

The South African Border War was a war waged against the South African government due to its occupation of Namibia (South-West Africa at the time) (Hooper, 1988). Factions such as the South West Africa People's Organization (SWAPO), the People's Armed Forces of Liberation of Angola (FAPLA) the South West Africa National Union (SWANU), Cuba, Zambia and the African National Congress (ANC) took up arms against South Africa, backed by Portugal, the National Union for the Total Independence of Angola (UNITA) and the National Front for the Liberation of Angola (FNLA) (Hooper, 1988). Due to the Union of Soviet Socialist Republics and Cuba's material involvement in the war, it soon culminated into a proxy war stemming from the Cold War, with Western countries offering material support to South Africa, UNITA and FNLA to curb the spread of communism (Kangumu, 2011). Several battles took place around the area of planned development, including Cunene, Jamba, Cuando, Cassinga and Mulondo.

Angola has a rich history with many different cultures having played significant roles over the course of its history. Due to this rich history, there may be several sites present in and around the area of development which have not been identified during this baseline survey.

4.9.3 Cultural heritage

The cultural heritage sequence of the study area includes the tangible cultural heritage with strong intangible elements and intangible heritage. These two cultural heritage aspects located within the vicinity of the Project, are discussed below.

Tangible cultural heritage with strong intangible elements

Places of worship

Several places of worship exist within the larger Project area, with almost every village having at least one. Notable sites include the ruins of the Sanguene Catholic Mission in Chipindo, which illustrate the Catholic Church's historical influence. The socioeconomic baseline study (Geolab, 2024) notes a proposal to classify buildings such as the Padre Ernesto Lecont Historical Monument and the Parish of Vila (Imaculada da Conceição) in the municipal center of Cuvango.

Father Ernesto Lecont historical monument

Built in honour of Father Ernesto Lecont, who arrived in Angola in 1884 to evangelise the southern peoples, including the Ngagela people. The monument (Figure 4-36) commemorates his contribution and his execution by Mwene Thyawako. The feature is located approximately 58 m from the powerline, the existing access road is close to the structure and all activities should be restricted to the existing road and infrastructure.



Figure 4-36: Front of the Father Ernesto Lecont Monument

Town parish

Founded in 1940 by Spiritan Missionaries, the parish church (Figure 4-37) is constructed from locally produced raw bricks. It is one of Cuvango's historical and cultural monuments, located about 25 meters from the proposed powerline.



Figure 4-37: Front of the Vila parish church

Graves and cemeteries

The socioeconomic baseline study (Geolab, 2024) identified several cemeteries:

- Tchicunho, Cuvango municipality: Two small cemeteries (Figure 4-38);
- Ngokue, Cuvango municipality: Two small cemeteries; and
- Capuca, Chipindo municipality: One cemetery approximately 3.5 km from the village.

These cemeteries are away from the proposed Project, so no direct impact is expected. Additional graves and cemeteries may be found during pre-construction surveys. The locations of these heritage features and several other is presented Table 4-64. Note that additional references to cemeteries were mentioned in the questionnaires and have not been georeferenced. Exact locations must be determined during the pre-construction survey. Burial sites are of (social) high significance.



Figure 4-38: Tchicunho village cemetery

Table 4-64: Recorded heritage features

Municipality	Heritage feature	Distance to nearest infrastructure (m)	Coordinates
Jamba	Jamba Municipal cemetery	650	S 14°42'30.44664" E 16°2'28.64436"
Cuvango	Cemetery, Tchicunho village	2 000	S 13°58'59.26296" E 16°1'5.9106"
Chipindo	Vila parish church	32	S 14° 27' 57.708" E 16° 17' 29.688"
	Father Ernesto Lecont historical monument	60	S 14° 27' 51.696" E 16° 17' 34.008"
	Catholic Mission of Sanguve	4 400	S 13°53'18.19968" E 15°50'4.54812"
	Municipal Cemetery	500	S 13°49'14.24496" E 15°46'47.90208"

Intangible heritage

Religious and other intangible cultural heritage sites are difficult to define due to their lack of fixed locations, boundaries or physical entities. When they do have physical forms (e.g., a sacred tree), their importance may be shared over a wider area. In the study area, religious communities are predominantly Catholic and Protestant (I.E.C.A), with some Adventists and Jehovah's Witnesses (JW). Traditional festivals include:

- Alambamento (traditional marriage);
- Efiko (transition of girls from adolescence to adulthood);
- Evanda (male circumcision festival);
- Eyele (first harvest ceremony); and
- Ekuivalenca.

Leisure activities include football, socialising and children's recreational activities on commemorative dates (Geolab, 2024). Recently, on 18 April 2024, the Ministry of Culture declared Tchianda and Kizomba (traditional dances) and Quissanje and Marimba (traditional instruments) as National Intangible Heritage (www.verangola.net).

The Project and its components are not expected to negatively impact the intangible cultural aspects of the surrounding communities.

Heritage sites and predictive modelling

The Project area includes various known heritage sites such as burial sites, Iron Age and Stone Age sites and places of worship. To identify areas of potential heritage significance along the powerline corridor, a heritage sensitivity predictive model was developed. This model considered existing landscape use paradigms and specific landscape features to pinpoint areas that might have heritage potential.

This model incorporated both landscape use paradigms (Table 4-65) and ecological sensitivity maps. Key natural criteria considered in the model include elevation, drainage lines and local geology. These criteria were assessed using GIS methodologies to create a detailed map of heritage sensitivity.

Table 4-65: Summary of main land use paradigms

Historical period	Focal point or landform	Key sources
Earlier Stone Age	Standing water	Klein 2000
	Spring eyes & seasonal seeps	Sampson 1998
	Raw material	Kuman 2003
	Raw material & water	Hallinan & Parkington 2017
	Water (stenotopic)	Deacon 1998
	Focal points like kopjes for vantage points and shelter and alluvial gravels for raw material	Le Baron et al. 2010
	Avoiding water. Focussing on raw material	Sampson 1985 & 2001
	Raised hilltop locations for observing animals or other groups	Kandel & Connard 2012
Middle Stone Age	Raw material & accessible supply of water	de la Pena et al., 2016
	Along major rivers, rocky areas and higher topography	Hallinan & Parkington 2017
	Ephemeral riverbed	Marks 2015
	Spring eyes & seasonal seeps	Sampson 1998

Historical period	Focal point or landform	Key sources
Later Stone Age	Widespread	Deacon 1998
	Ephemeral riverbed	Marks 2015
	On pan or stream-bed margins, near springs, bedrock depressions containing seasonal water, hollows on dunes, and on the flanks or crests of koppies	Beaumont et al. 1995
Iron Age	Cultivable soil, koppies and hills	Huffman 2007

Using the landscape use paradigms and features, a map was created to illustrate potential heritage-sensitive areas within 2 km of the proposed Project. Figure 4-39 visually represent these areas, highlighting regions that might require management to preserve heritage sites.

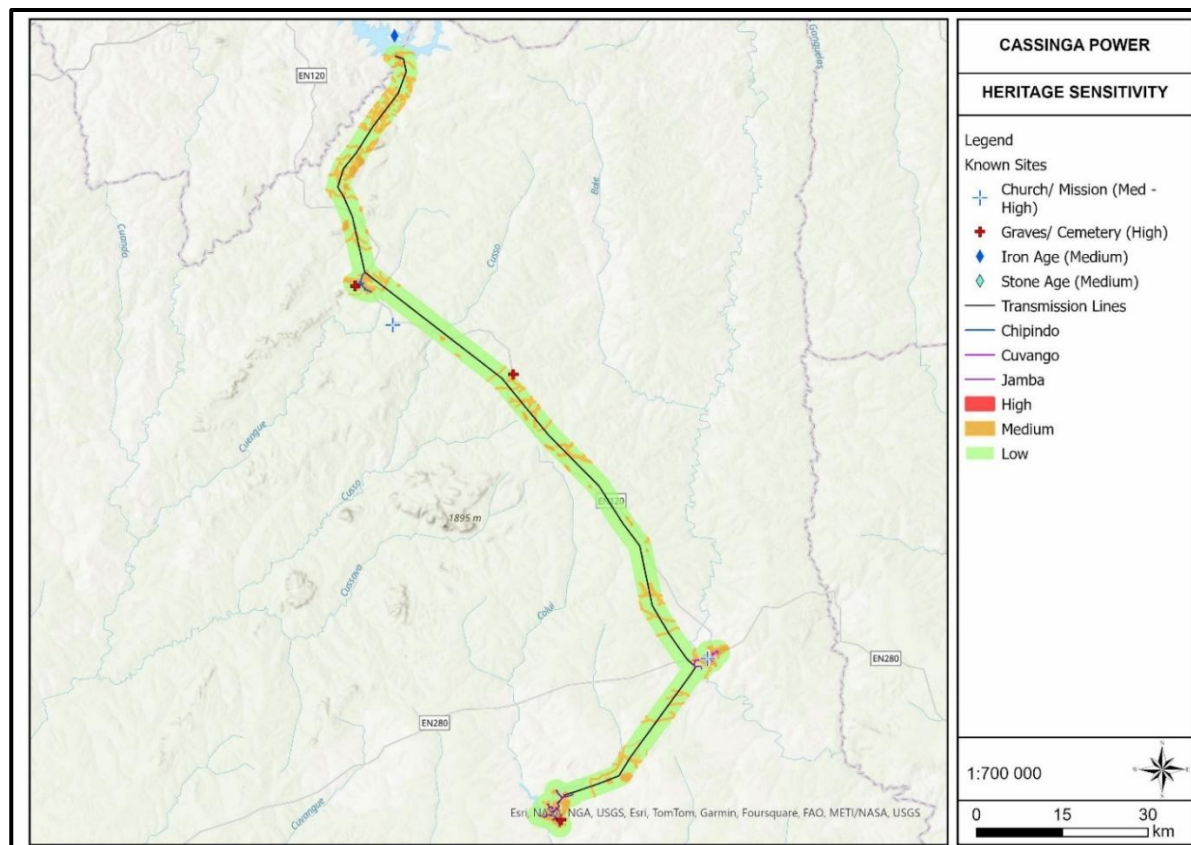


Figure 4-39: Potential heritage sensitivity of the Project area

Limited information is available about the trends in the condition of cultural heritage sites around the Project area. Activities such as agriculture, expansion of new settlements, infrastructure development, and mining have negatively impacted these sites. Although no sites within the area of influence are considered to have outstanding universal value based on professional assessments, this does not reduce their potential archaeological interest or the cultural values they represent.

A precautionary principle is applied, recognising that tangible cultural heritage sites, even if they appear similar to others, may be unique. Therefore, the approach treats these tangible features as finite and valuable resources, ensuring their preservation and careful management.

Cultural value of ecosystem services

Cultural services, a subset of ecosystem services, are the non-material benefits people obtain from ecosystems, including cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation, and ecotourism. According to Hølleland et al. (2017), there is no consensus on

what cultural heritage encompasses within the ES context, and these services are often seen as subjective, intangible, and hard to quantify monetarily (Xu et al. 2019).

Cultural services must show a significant relationship between ecosystem structures and functions within the biophysical domain. Cultural ecosystem services are derived from ecosystems and are intrinsically linked to nature, often defined as landscapes. Intangible heritage, such as religious beliefs, rituals, traditions and customs, often includes conservation ethics that influence an ecosystem's biophysical conditions. Examples of such landscapes are sacred groves and fountains (Xu et al. 2019). However, no such landscapes are recorded in the study area, so the Project is not expected to severely impact the cultural value of the ecosystems.

In terms of ecosystem services, the socioeconomic baseline study and stakeholder consultation (Geolab, 2024) indicated that the communities in the Project area depend on the land for subsistence and well-being. The ecosystem's provisioning services include:

- Soil; supporting agricultural activities and livelihoods;
- Water: abstracted from rivers;
- Groundwater: sourced from cacimbas and wells for domestic and drinking purposes;
- Wood and firewood: used for fuel and building houses;
- Hunting: for food and livelihoods; and
- Charcoal production: some residents produce charcoal to sell for income.

This highlights the crucial role that ecosystem services play in supporting the livelihoods and well-being of the communities in the Project area.

4.10 Socio-economic

This section presents a comprehensive overview of baseline socio-economic conditions in the Project area of influence drawing on information contained in the socio-economic study (SRK, 2024d) conducted for the ESIA (refer to Volume 4, Appendix K for the detailed specialist assessment).

4.10.1 National context

Angola is a vast country in Southern Africa, bordered by Namibia, Botswana, Zambia, and the Democratic Republic of the Congo. It has a significant coastline and shares cultural ties with Portugal/Brazil due to its Portuguese-speaking heritage. The country's population is over 33 million as of 2022. The Angolan economy has historically relied on global oil demand, resulting in volatile growth and persistent poverty and inequality. Recent reforms have aimed to enhance macro-economic management and public sector governance. These reforms include flexible exchange rates, central bank autonomy, prudent monetary policies, and fiscal consolidation. Legal changes have encouraged greater private sector involvement, promoted financial sector stability and reduced the impact of oil price fluctuations on public finances (World Bank – Angola, 2022).

Challenges persist, with the majority of jobs being informal, particularly in subsistence work and the primary sector. Urban and youth unemployment remain high, contributing to the country's ills. Economic diversification is critical, especially as oil production declines and global decarbonization trends loom. To address these issues, Angola needs to focus on removing obstacles to private sector investment, fostering economic diversification, and creating jobs to reduce poverty.

Investing in human capital and poverty reduction is imperative, given the prevailing job crisis, high poverty rates, and rapid population growth. Insufficient access to quality healthcare and education limits the potential productivity of Angolan children. Recent strides have been made in education and health, accompanied by the implementation of a social registry and cash transfer programs to rural households. A more extensive social safety net could substantially alleviate extreme poverty, mitigate

household shocks, and promote human capital development. In 2022, Angola's economic growth accelerated to around 3.5%, primarily due to increased oil production and revenues (World Bank – Angola, 2022). This marked the first time since 2014 that growth outpaced population expansion. Higher oil prices facilitated fiscal expansion, supporting public investments and domestic demand. The non-oil sectors, such as agriculture, fisheries, and services, also contributed to the growth trajectory.

Despite positive developments, challenges remain, including the need for sustained economic diversification, solid institutions, and political commitment to shift from an oil-dependent model to an inclusive, private-sector-led growth paradigm. The political landscape features the MPLA as the ruling party, securing a second term for President João Lourenço in the 2022 elections. Angola is also active in promoting peace and stability in Africa, particularly in the Democratic Republic of Congo. Looking ahead, while growth is expected to moderate due to decreased oil production and fiscal influence, efforts to reduce poverty continue, though rapid population growth poses a challenge. Angola's journey toward sustainable economic transformation and social progress necessitates persistent reforms and a balanced approach to development.

4.10.2 Regional context

Demographic characterisation

The civil war in Angola had a profound impact on the country's demographic structure, triggering a significant migration from rural areas to urban centres. This migration resulted in large population clusters and fragmented urban growth across the country. As of 2020, Angola's population was estimated at 33 million, with a notably young demographic profile, as almost two-thirds (66%) of the population are under the age of 25. The fertility rate stands at 6.2 children per woman, and the annual population growth rate is 3.2%, indicating that the population could double within twenty years. To leverage this demographic dividend, the National Development Plan (2020-2022) focuses on strategic investments in education, health, and employment, targeting the youth to foster socio-economic opportunities that align with the Sustainable Development Goals (UNFPA, 2020).

Population

In Huíla province, the 2014 Census recorded a population of 2 497 422, which constitutes about 10% of the national population. This province exhibits a significant rural majority, with 67% of its population living in rural areas compared to 33% in urban settings. Huíla's population is distributed across various municipalities, with Lubango being the most populous, housing about 31% of the province's population. In contrast, the municipalities of Cuvango and Chipindo have populations under 100 000, reflecting the varied demographic distribution within the province. The population distribution of all provinces in Angola is shown in Figure 4-40 with the population distribution by municipality within Huíla province presented in Figure 4-41.

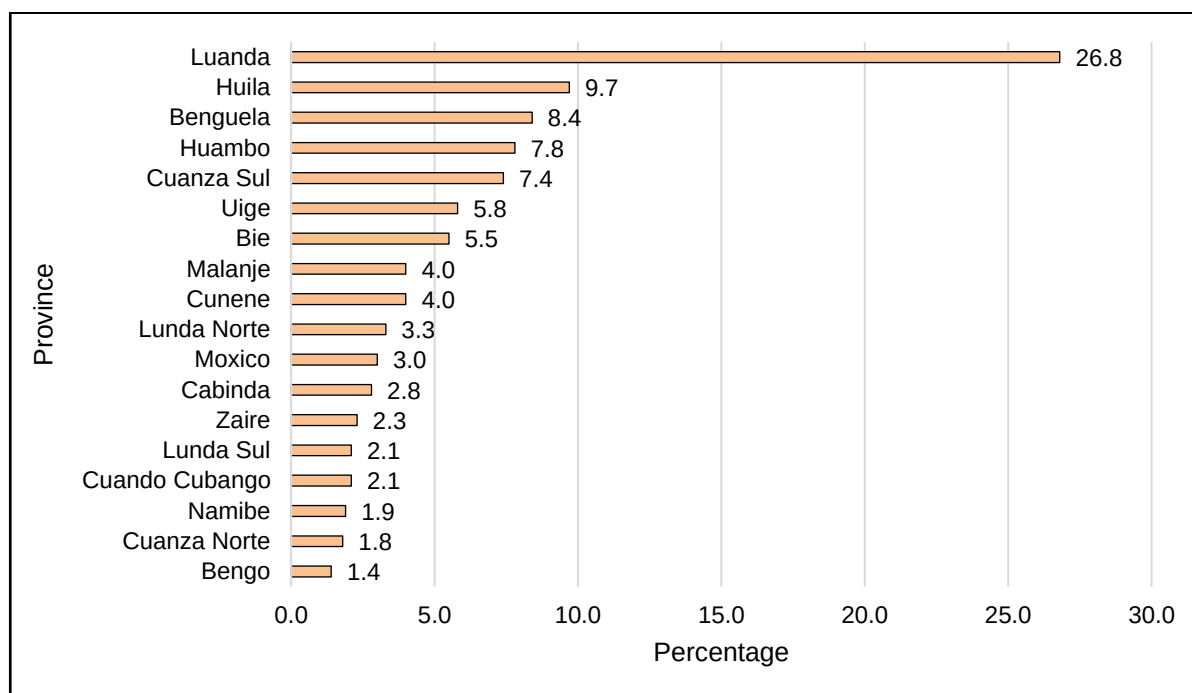


Figure 4-40: Percentage distribution of population by province (INE, 2016)

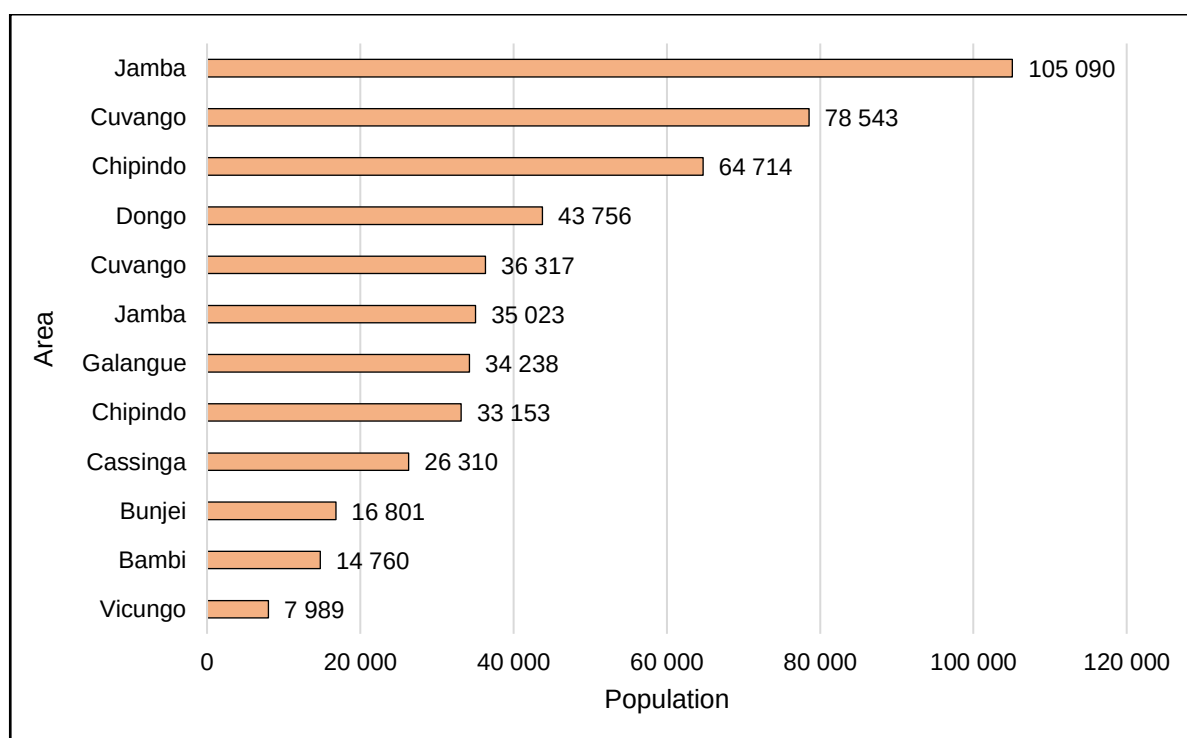


Figure 4-41: Population distribution by municipality in Huila province (INE, 2016)

Population age structure

Angola shows a youthful demographic profile with an average age of 21. The labour force, aged 15-64, constitutes about 50% of the national population. Children aged 0-14 represent 47% of the populace, while the elderly (65 and over) make up just 3%. The majority of the population, 52%, are women, with a gender ratio of 94 men per 100 women. In Huíla province, the percentage of children is higher than the national average, with significant figures in Chipindo (54.2%), Cuvango (50.2%), and Jamba (48.4%). The elderly population in Huíla province is below 3%, with the highest proportions in Chibia and Gambos.

Household structures in Huíla vary, with 20% consisting of seven or more members, and smaller households comprising only 8.3%. The average household size across the province is 4.8. Ethnolinguistically, the centre-south regions include groups like Ovimbundu and Ocindonga, with Portuguese being predominantly spoken by 54% of population in Huila province, particularly in urban areas (85%). Umbundo is the second most common language, highlighting the rich linguistic diversity within the region.

Ethnicities and languages

The centre-south regions of Angola are culturally rich, characterised by a diverse array of ethnolinguistic groups, including Ovimbundu, Ocindonga, Owambo, Nyaneka-Humbe, Ovingangela, and Herero. In these regions, Umbundu emerges as the most widely spoken language, followed by Nhaneca, Herero, Kwanyama, and Cindonga. In Huíla province, more than half of the population (54%) speaks Portuguese, with a higher prevalence in urban areas (85%) compared to rural areas (39%). Umbundo is the second most prevalent language at 32%, with Nyaneka and Muhumbi also significant at about 24% and 11%, respectively. Within the specific municipalities of Cuvango, Jamba, and Chipindo, Nganguela and Umbundo are the predominant languages. Figure 4-42 provides a summary of the most spoken languages in Huila provinces.

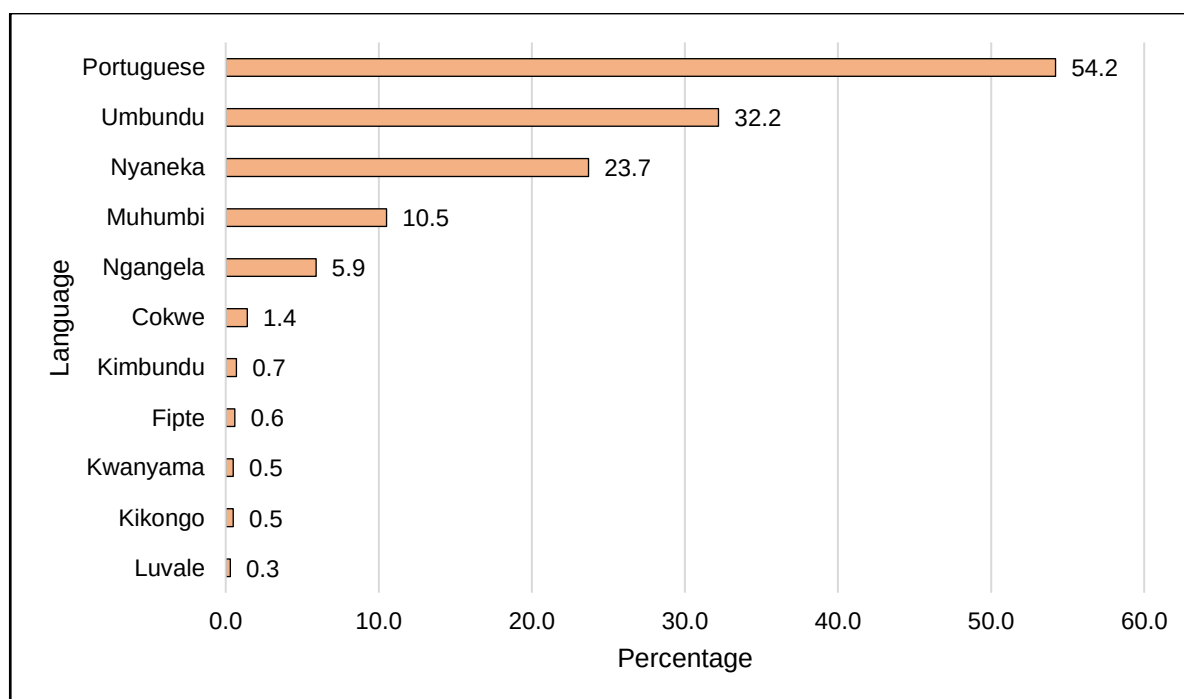


Figure 4-42: Most spoken languages in Huila province (INE, 2016)

Social characterisation

Education

The expansion of the educational system in Angola, as highlighted in the Angola 2050 Development Strategy (ELP-2050), is a critical component for enhancing human development in the nation. Over seven years, student enrolment in the education system increased by 2.5 million, rising from 5.8 million in 2009 to approximately 10 million by the 2018 academic year. This growth helped boost the literacy rate among young people and adults to 75%, a significant increase from less than 50% at the start of the century. The NDP aligns with the United Nations 2030 Agenda, specifically Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The NDP has set several priorities for improving education in Angola. These include adapting teacher training programs to meet current and future demands,

expanding the network of preschools to ensure compulsory education for children from age five, increasing enrolment rates at all levels of education, and enhancing the quality of higher education institutions by offering more courses and improving teaching standards. Despite these efforts, disparities in education remain, particularly between urban (79% literacy rate) and rural areas (41% literacy rate), and between genders, with men having an 80% literacy rate compared to 53% for women.

In Huíla province, the literacy rate reflects significant disparities between urban and rural settings as well as between genders. Overall, 51% of the population is literate, with a higher literacy rate of 80% in urban areas compared to just 36% in rural areas. Men generally exhibit higher literacy levels at 64%, while only 40% of women can read and write. Among the municipalities, Chibia records the lowest literacy rate, where only 21% of the population can read and write. The educational infrastructure in Huíla also varies, with 40.8% of villages reporting at least one primary school, which is above the national average. However, accessibility remains a challenge, with some needing to travel up to three hours to reach the nearest school. Figure 4-43 shows the literacy rate of municipalities in the Huíla province.

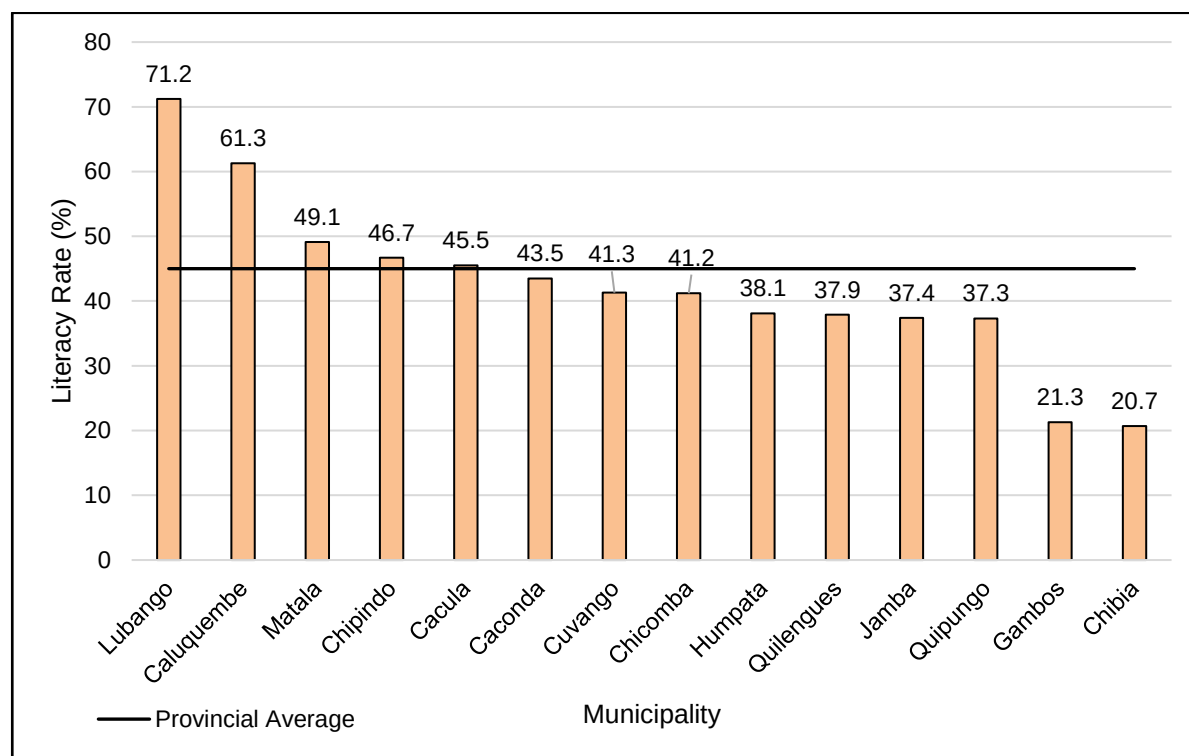


Figure 4-43: Literacy rate by municipality

In Jamba, the education sector is actively supporting a substantial number of students with 36 178 children enrolled across various educational levels for the current academic year. The educational structure includes 61 schools comprising two preschools, 55 primary schools, two secondary schools, one secondary teacher training school, and one technical and professional institute. Despite the broad educational offerings, there are 1 080 children not currently participating in the education system. Efforts to combat poverty include providing school meals, with five schools participating under the official programme and an additional 15 under the sponsorship of Grupo Carrinho Comércio Lda.

Cuvango manages a larger network of 117 schools, out of which 16 are permanently built and 101 are constructed with less durable materials. This network supports 21 768 pupils, taught by a total of 746 teachers, across various education subsystems for the academic year 2023/2024. The commitment to education in Cuvango is evident despite the challenges posed by the infrastructure.

Chipindo's educational system for the current academic year caters to a diverse student body with a total of 28 623 pupils distributed across different educational stages. There are 20 143 pupils in primary education, 2 199 in the first cycle of secondary education, 602 in the second cycle, 4 789 in preschool, and 890 in adult education. This distribution highlights Chipindo's extensive educational engagement across all levels, ensuring comprehensive educational access from early learning to adult education.

Health

Angola's national health sector faces significant challenges in infrastructure and human resources, which are underscored by the scarcity and uneven distribution of medical professionals across the country, despite international efforts to bolster staffing. The National Health Policy highlights these gaps, which contribute to Angola's classification as a country of average human development. Health indicators show some improvement, with life expectancy rising from 51.9 years in 2013 to 55.8 years in 2016, though mortality rates remain high. According to UNDP data, there are only 1.4 doctors and 8 hospital beds per 10 000 inhabitants, with maternal mortality rates alarmingly high at 477 per 100 000 live births as of 2015 (UNDP, 2019).

Malaria is a critical public health issue and the leading cause of death, followed by HIV/AIDS and tuberculosis, the latter exacerbated by co-infections with HIV and issues such as limited access to diagnostic services and high treatment dropout rates. Other significant health challenges include a range of neglected diseases like Leprosy and Human African Trypanosomiasis, which continue to impair socio-economic development in affected areas. Additionally, the prevalence of chronic non-communicable diseases such as diabetes, cardiovascular diseases, and cancer is rising, compounded by a general lack of public awareness about these conditions. Recent years have also seen outbreaks of infectious diseases such as cholera, yellow fever and dengue fever, stressing the health system further. In terms of malaria prevalence, there is a stark contrast between provinces, with Bengo recording one of the lowest rates at 9%, while Moxico faces much higher rates of both malaria and anaemia. These disparities highlight the ongoing and complex public health challenges facing Angola.

Angola is actively pursuing a comprehensive national strategy through its "Angola 2025" Long-Term Development Strategy and the National Health Development Plan spanning from 2012 to 2025. Despite these efforts, significant gaps in health service provision remain, particularly in rural areas. According to the Agro-Livestock and Fisheries Census (RAPP 2019-2020) conducted by the National Statistics Institute (INE), a vast majority of villages lack health facilities. Out of 23 832 villages surveyed, only 14% (3 230 villages) reported having a health unit such as a hospital, centre, or medical post. Conversely, 86% of villages (20 602) indicated they do not have any health units.

The distribution of health services varies significantly across provinces. Lunda Sul and Bengo have the highest relative health coverage, with 28% and approximately 27% of villages having health units, respectively. In contrast, provinces like Bié, Huambo, Huíla, Lunda Norte, Malange and Benguela report much lower coverage, with about 9% to 11% of villages having access to medical facilities. This disparity underscores the ongoing challenges in meeting health service needs across Angola's diverse regions. Figure 4-44 shows the number of villages with health centres within each province.

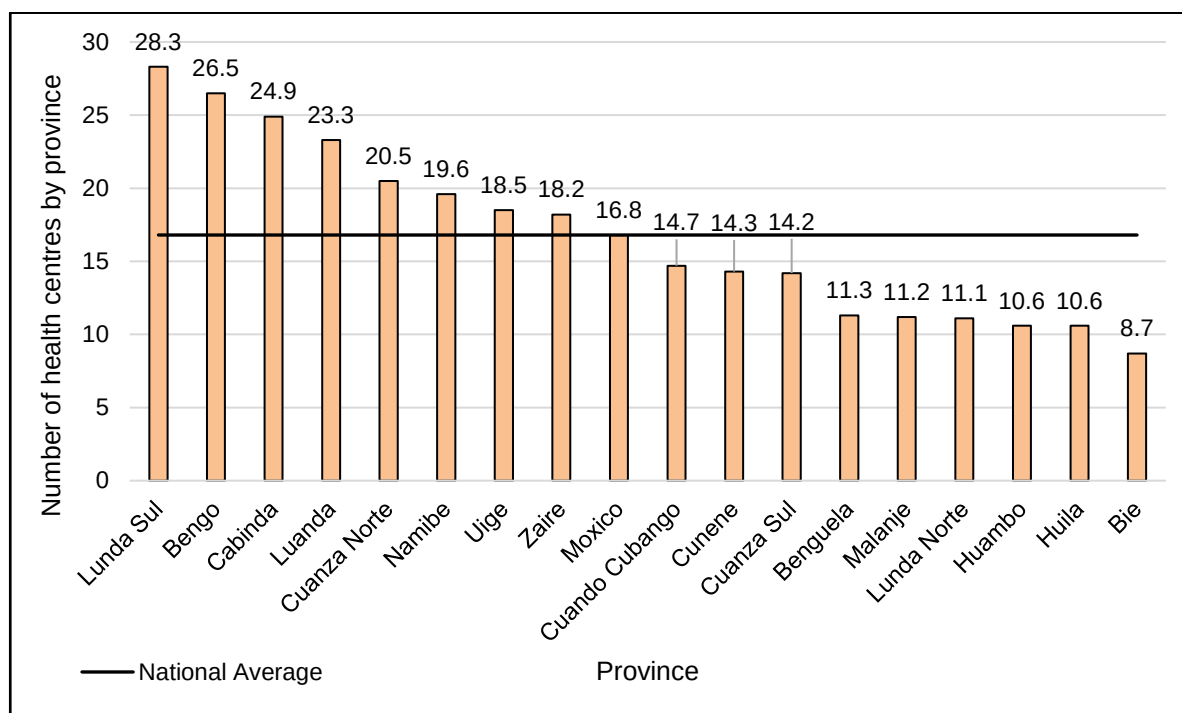


Figure 4-44: Villages with a health centre by province (National Statistics Institute, 2017)

In the Municipality of Jamba, health facilities are primarily concentrated in communal centers, encompassing a variety of services. The municipality boasts 19 health units including a hospital, three health centers, a mother and child center, and numerous specialized facilities like a blood bank and an operating theatre. It also features extensive support for vaccination and essential medicines, ensuring comprehensive healthcare coverage:

- Total Health Units: 19;
- Hospital Beds: 153;
- Health Units with Laboratories: 1;
- Operating Theatres: 1;
- Blood Banks: 1;
- Vaccination Posts: 14; and
- Health Centers with Essential Medicines: 16.

Cuvango oversees 30 health units staffed by 10 doctors, 124 technical staff, and 39 administrative personnel. Despite the significant resources, the staffing levels are still deemed insufficient to meet local healthcare demands. Common health issues in the area include malaria, respiratory diseases, diarrhoeal diseases, and malnutrition, particularly affecting children.

Chipindo's healthcare infrastructure (Figure 4-45) includes seven health units, six of which are permanently built and one constructed of adobe. The units vary widely in size and capability, ranging from a larger municipal hospital to smaller community health centres:

- Municipal Hospital: 84 beds, built between 2007 and 2013 (Bed to Patient Ratio = 1:298);
- Bambi Health Centre: 13 beds, built between 2005 and 2006 (Bed to Patient Ratio = 1:1409);
- Bunjei Health Centre: 5 beds, built in 2004 (Bed to Patient Ratio = 1:3028);
- Buloteque Health Centre: 4 beds, built between 2011 and 2012 (Bed to Patient Ratio = 1:1558);
- Chiyoya Health Centre: 2 beds, built in 2006 (Bed to Patient Ratio = 1: 3179);
- Ndovala Health Centre: 4 beds, built in 2011 (Bed to Patient Ratio = 1: 1278); and
- Capembe Health Centre: 4 beds, built between 2012 and 2013 (Bed to Patient Ratio = 1:1588).

Malaria remains the most prevalent illness treated in Chipindo, particularly in the municipal hospital which is staffed by 11 doctors, 73 nurses, and 19 diagnostic technicians. This setup highlights the ongoing challenges and efforts to provide adequate medical services in these regions.



Figure 4-45: Cuvango (left) and Chipindo (right) municipal hospitals

Water supply and distribution network

In Angola, over half of the households (53%) have access to suitable sources of drinking water, with a significant disparity between urban (67%) and rural areas (32%). In urban settings, 22% of households benefit from piped water inside their homes or yards, considered appropriate sources. Conversely, 21% of urban households rely on less suitable sources such as tanker trucks, carts, or three-wheeled motorbikes. In rural areas, 39% of households obtain their drinking water from lakes, ponds, streams, or irrigation canals, which are not deemed appropriate. From 2008-2009 to 2015-2016, there was a notable 12 percentage point increase in the accessibility of suitable drinking water, particularly in urban areas (INE, 2017).

In Huíla province, only 35.5% of households have access to appropriate drinking water, with urban households faring better at 70.4% compared to only 19.4% in rural settings. Among the municipalities in Huíla province, Lubango shows the highest access rate at 62%, whereas Cacula has the lowest at just 11.9%. Other municipalities like Chipindo (33.7%), Jamba (25.7%), and Cuvango (24.1%) also fall below the average for the province in terms of access to suitable water sources. The percentage of households in each municipality that have access to appropriate drinking water within the province of Huila is presented in Figure 4-46.

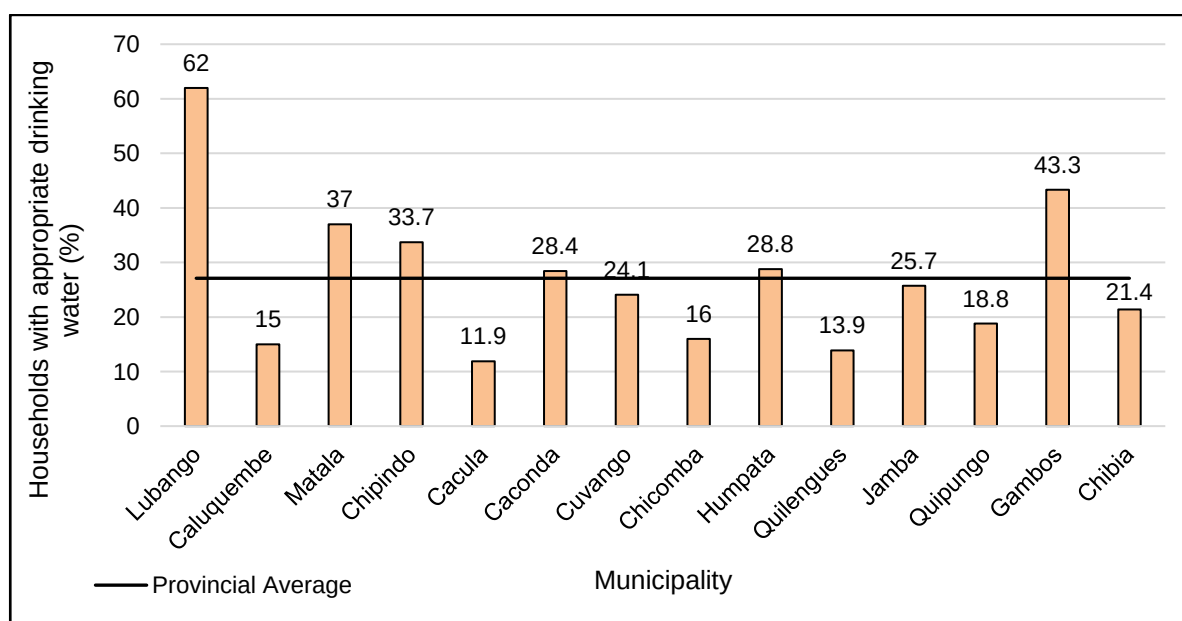


Figure 4-46: Households using appropriate sources of drinking water by municipality

In the Municipality of Jamba, the "Water for All" Project has significantly enhanced household water connectivity, benefitting 35 023 residents in Jamba commune alone, with substantial water infrastructure including 25 water points and 42 fountains among others. Meanwhile, the Municipality of Cuvango features a colonial-era water collection system, rehabilitated in 2010, that includes a catchment from the Cubango River and a 200m³ reservoir, serving the community with 263 connections. This system is vital as the local population mainly relies on 15 water points and two small water systems to meet their water needs.

Electricity supply and distribution network

According to Angola's National Development Plan for 2018-2022, improving the electricity infrastructure is crucial for enhancing economic competitiveness, diversification, and the quality of life for its citizens. As of 2014, only 32% of Angolan households had access to mains electricity. The level of electrification varies significantly across the country; interior provinces like Bié and Moxico have very low access rates at 8% and 10%, respectively, while coastal areas such as Luanda and Cabinda are much higher, with access rates of 66% and 52% (Aser and Aler, 2022). These disparities highlight the concentration of electrification efforts near urban and coastal regions. The electricity sector in Angola has undergone significant restructuring and expansion, focusing on hydro, thermal, and renewable energy production. This expansion is driven by the need to keep up with the growing economy and population, resulting in a substantial increase in both the supply of and demand for electricity. By 2021, Angola's total installed capacity for electricity production reached 5 880.19 MW, distributed among hydroelectric (3 676.12 MW), thermal (2 169.07 MW), and hybrid (solar + diesel) sources (35.00 MW). This capacity expansion underscores ongoing efforts to enhance the national energy grid and promote wider access across the country.

As of 2014, only 16% of households in Huíla province had access to electricity supplied by the public grid, indicating limited infrastructure in this area. Detailed data shows varied sources of lighting across the province's urban and rural areas. In urban settings, a large number of households use mains electricity, while in rural areas, non-conventional sources like firewood, lamps, and lanterns dominate due to the scarcity of grid electricity. The breakdown of lighting types across different municipalities in Huíla (Table 4-66) further highlights the disparity: In urban centers such as the province capital, the majority use mains electricity, but in smaller municipalities like Cuvango, Jamba, and Chipindo, many rely on more primitive sources like firewood and lanterns. For instance, in Chipindo, only two households are connected to mains electricity, while a significant number use firewood and lanterns.

Table 4-66: Type of lighting for Cuvango, Jamba and Chipindo (INE, 2016)

Municipality	Number of households	Type of lighting						
		Mains electricity	Lamp	Sail	Firewood	Generator	Lantern	Other
Urban								
Cuvango	555	24	12	5	101	43	370	0
Jamba	3 788	155	169	54	89	612	2 694	15
Chipindo	2 285	2	159	65	139	464	1 452	0
Rural								
Cuvango	16 081	271	683	97	3 314	657	11 031	27
Jamba	20 269	216	449	54	4 590	548	14 377	34
Chipindo	10 974	78	962	133	1 697	466	7 637	1
Huila Province	514 412	82 144	42 345	17 346	86 876	30 530	254 660	512

Adding to the provincial infrastructure, the Matala Dam on the Cunene River, operational since 1959, plays a crucial role in regional energy supply. It has a capacity of approximately 100 MW and provides electricity to both Huíla and the neighbouring Namibe province. This facility is pivotal in meeting some of the energy needs of the region, although the overall access to electricity remains low.

In Jamba, the electrical infrastructure includes one thermal power station, two electrical stations, and a mix of medium and low-voltage networks. The municipality has five power transformers and 801 household connections, benefiting a total of 4 445 residents. The electrification rate stands at 34.4%, with 772 low-voltage post-paid customers. The area lacks mini-hydro and solar power plants but includes one private power station with an installed capacity of 2.5 MW.

Cuvango features a distribution network supported by 528 kVA and 500 kVA generator sets, along with a 1 250 kVA monoblock to increase voltage for the medium-voltage network. The commune has installed three 250 kVA rural-type transformer substations along a 2 355-meter distribution line, enhancing the local electrical infrastructure and improving power supply reliability.

Sanitation

Sanitation conditions significantly impact public health, contributing to diseases such as cholera and typhoid fever. In Angola, 32% of households have appropriate, non-shared sanitation facilities, with urban areas (46%) faring much better than rural areas (11%). Shared facilities are used by 15% of households, more commonly in urban areas (23%) than rural areas (3%). Over half of households (53%) use unsuitable facilities, with this figure reaching 86% in rural areas and 32% in urban areas (INE, 2016).

In Huíla province, only 8.3% of households dispose of rubbish appropriately, with 72.5% of urban and 93.1% of rural households discarding waste in the open. Merely 11% of urban households use bins. The disparity is also evident in sanitation facilities: only 26.4% of households use appropriate defecation sites, with 68.1% in urban areas compared to 7.1% in rural areas. Lubango municipality has the highest use of proper sanitary facilities at 57%, while Cacula and Gambos have the lowest at 2.8% and 2.1%, respectively.

Poverty reduction

Poverty in Angola is marked by significant income inequality and a large portion of the population living under minimal conditions. The Integrated Plan for Local Development and Combating Poverty 2018-2022 aims to reduce poverty by addressing national objectives and priorities. Key initiatives under this plan include municipalizing social action services through Centros Sociais Integrados (Integrated Social Centres) - (CASI), creating a database of vulnerable individuals, providing cash or in-kind benefits to families in extreme poverty, and ensuring primary healthcare in all municipalities. The plan also aims to exempt the most vulnerable families from health and education fees and expand the work of Agentes Comunitários e de Desenvolvimento da Saúde (Community and Health Development Agents) - (ADECOS).

In 2017, the Ministry of Social Action, Family and Women's Promotion launched the Municipalisation of Social Action Programme, establishing CASI. These centres, supported by community social activists, identify and refer individuals in vulnerable situations, such as victims of domestic violence, abandoned children, and people with disabilities, to appropriate state services like justice, health, and education. Key Actions to Combat Poverty include:

- **Municipalising social action services:** Promoting the creation of;
- **Building a vulnerability database:** Registering social action beneficiaries;
- **Providing social benefits:** Offering cash or in-kind support to families in extreme poverty;
- **Ensuring primary healthcare:** Guaranteeing primary health care in all municipalities;
- **Exempting fees:** Ensuring the most vulnerable are exempt from health and education fees; and

- **Expanding ADECOS:** Increasing the work of Community and Health Development Agents.

Poverty in Angola is characterised by significant income inequality and a substantial portion of the population living in conditions lacking dignity and citizenship. The Integrated Plan for Local Development and Combating Poverty (PIDLCP) 2018-2022 aims to address these issues by revising national objectives and priorities to reduce poverty and extreme poverty rates. According to the Multidimensional Poverty Index by Municipality (IPM-M), 65 of Angola's 164 municipalities have poverty incidences above 90%, meaning at least 9 out of every 10 people are multidimensionally poor. In Huíla province, 10 out of 14 municipalities have extremely high poverty rates. Chibia has the highest Multidimensional Poverty Index in Huíla province at 0.643, while Lubango has the lowest at 0.272, highlighting significant disparities within the province.

The Government of Angola has received a US\$ 320 million loan from the World Bank to implement the National Social Protection System Strengthening Project - KWENDA. This Project aims to enhance the Social Protection Sector's capacity to implement poverty mitigation measures by increasing the purchasing power of poor families through monthly income support and establishing an effective national social protection system. However, none of the villages in the Project area have yet benefited from the KWENDA Project.

A 2020 survey by the Presidency of Angola, International Policy Centre for Inclusive Growth, and UNDP identified and analysed 36 social programmes managed by various institutions to combat poverty in Angola. In Jamba, several community development programmes were identified, including the Local Development and Combating Poverty Programme, the Rural Development Extension Programme, the Programme to Promote and Strengthen Community Organisation, the Integrated Municipal Intervention Programme, and the Carrinho Agri Project.

Economic characterisation

The Angolan economy is characterised by a heavy reliance on its oil sector, which, despite a Projected average decline of 2.0% from 2018 to 2022, continues to play a pivotal role in the nation's GDP. The government's NDP 2018-2022 anticipates an overall GDP growth of 3.0% during this period, driven largely by a robust expansion in the non-oil sector, which is expected to grow at an average rate of 5.1%. Efforts to diversify the economy include significant investments in agriculture, infrastructure, and social programs aimed at reducing poverty and improving living standards. These initiatives, combined with Projects like KWENDA and various local development programs, aim to foster sustainable growth and reduce the country's economic vulnerability to oil price fluctuations.

Agriculture and livestock

Family farming forms the backbone of Angolan agriculture, with peasants utilising family labour to produce and sell surplus crops like cassava, maize, beans, potatoes, vegetables, and fruit. This sector is crucial, accounting for approximately 80% of cereals, 90% of roots and tubers, and 90% of pulses and oilseeds (Government of Angola, 2018). In contrast, entrepreneurial agriculture involves medium and large-scale investments aimed at market supply and national self-sufficiency, enhancing economies of scale, product quality, and export potential. In 2016, 46% of households engaged in agricultural activities, with Kwanza Sul having the highest participation, while Cabinda, Namibe, and Luanda had the lowest. Additionally, 6% of households were involved in fishing activities (INE, 2016).

During the 2018/2019 Agricultural Year, funding of 5 699 533 080.00 Kwanzas enabled the support of 81 579 families through technological packages, alongside co-financed Projects (MOSAP II) assisting 28,568 families, totalling 110 147 families or 4% of those registered with the Instituto de Desenvolvimento Agrário (Agrarian Development Institute) - (IDA). This period saw a production of nearly 2 million tonnes of vegetables, a 2.6% increase from the previous year, predominantly from the

central region, which contributed over 72% of the total production, with onions and tomatoes being the main crops (MINAGRIF, 2019).

The 2019-2020 Agricultural and Fisheries Census (RAPP) identified 5 858 Agricultural and Aquaculture Businesses nationwide. Benguela, Huambo, and Kwanza Sul had the highest numbers of these businesses, with 811 550, and 487 farms respectively, representing 14%, 9%, and 8% of the total. The provinces of Cabinda, Cuando Cubango, and Moxico had the fewest, each with less than 2% of the total (INE, 2022).

According to the Agricultural and Fisheries Census, maize is a staple crop in Angola, with about 64% of Agricultural and Aquaculture Businesses (AEs) cultivating it. In the roots and tubers category, cassava is predominant, grown by 46% of farms, followed by sweet potato at 23%. For pulses and oilseeds, butter beans are grown by 32% of farms, and ginguba by approximately 16%. Among vegetables, tomatoes are the most commonly grown (34%), followed by onions (27%), cabbage (19%), and kale (18%) (INE, 2022).

In the municipality of Jamba, agriculture is primarily based on family farming, with significant contributions across various sectors. The area produces a range of crops, including cereals, roots, tubers, pulses, oilseeds, fruits, vegetables, and sugarcane. Additionally, there is a substantial livestock population. The municipality of Cuvango shows significant growth potential, supported by cooperatives, associations, and large farms. Initiatives like CarrinhoAgri provide essential support to farming families, helping them improve productivity and market access. Huíla province is notable for its large cattle population, contributing significantly to livestock farming in Angola.

Employment levels

In 2014, the employment rate in Angola was 40 per cent, with Kwanza Sul and Malanje provinces having the highest figures (INE, 2016). In Huíla province, Gambos and Chipindo municipalities recorded the highest employment rates at 63% and 61% respectively, while Matala had the lowest at 23 per cent. Jamba and Cuvango were below the provincial average at 38.5% and 34.2% respectively. Agriculture and fishing are the dominant economic activities in Huíla, particularly in Chibia with 12.5% of the employed population. Figure 4-47 shows the main activities and their contributions to employment in Angola.

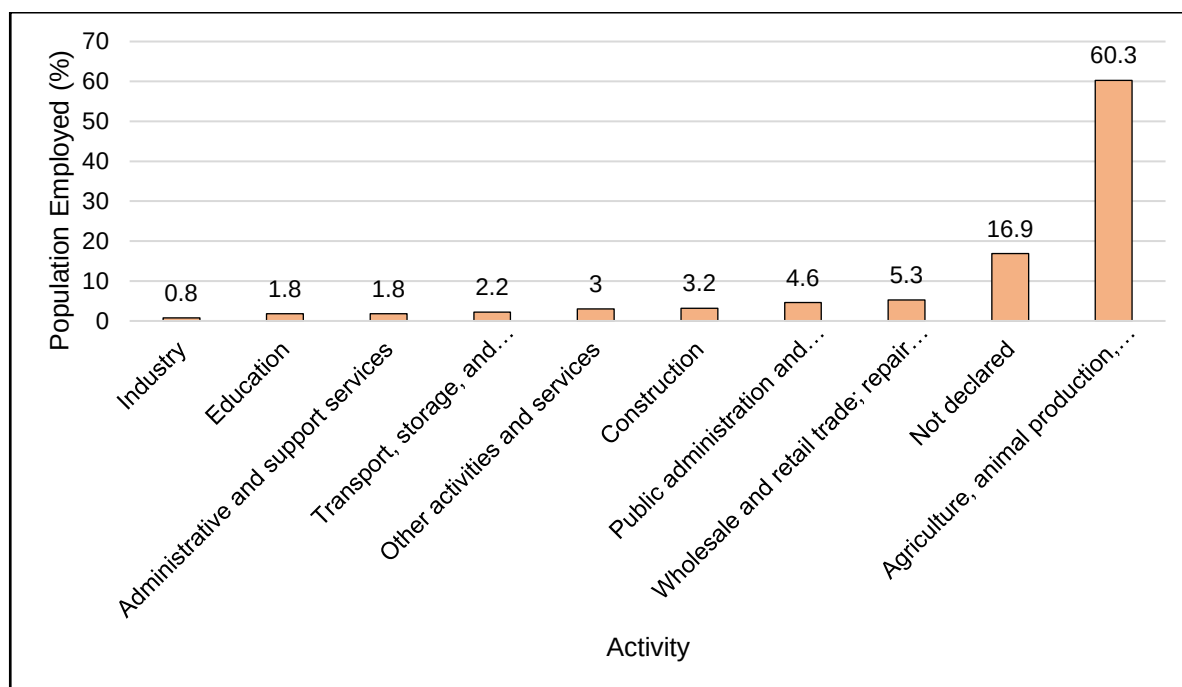


Figure 4-47: Employed population by activity

According to data from the RAPP, Angola's Agricultural and Aquaculture Businesses employ approximately 87,897 workers. Of these, 2.5% are in managerial positions, 1.7% have higher education, 8.2% are mid-level workers, and 2.4% are specialised workers in agriculture, livestock, or related areas. Untrained workers constitute 78.9%, while other categories make up 6.3%. The demand for temporary workers peaks at the beginning of the agricultural season, particularly in September (27.8%), October (37.8%), and November (35.5%), due to the need for land preparation. In contrast, April sees the lowest demand for temporary workers, with only 10% of the workforce required.

The highest average number of temporary workers per agricultural business is in the province of Bié, with around 67 workers, followed by Huambo with 55. The provinces of Uíge and Cabinda employ the fewest temporary workers, averaging 17 and 16 workers per business, respectively (RAPP, 2019-2020).

Hospitality and tourism

Angola's hotel and tourism sector faces several challenges, including a lack of diversity in tourist offerings, limited recognition in source markets, an unfavourable quality-price ratio compared to other regional destinations, accessibility issues, poorly trained human resources, and low private investment. To address these issues, the Hotel and Tourism Development programme aims to create conditions for a structured development of the sector, enhancing and diversifying the hotel and tourism offerings with private investment support, to attract both domestic and foreign tourists, increase revenue and employment, and improve Angola's balance of services with the rest of the world (GoA, 2018).

Huíla province is notable for its high concentration of hotels and similar establishments, thanks to its various natural leisure options. By the third quarter of 2013, the province had 799 hotel units and complementary services across 14 municipalities. In Cuvango, there is only one public hotel, the AGRS guest house, with 10 rooms, while in the Municipality of Chipindo, there are no hotels. The municipality of Jamba is a potential tourist destination, with attractions like the Coluí and Kwandja rivers. In Chipindo, the geological formations and ruins of the Catholic Mission of Sanguene are notable tourist sites.

Transport and traffic²

The primary form of transportation in the study area is motorbikes, which are mostly driven by men. They are also used to transport passengers and cargo (Figure 4-48). Three-wheel motorbikes with passenger/cargo carriers are commonly used in the Project area (Figure 4-49). The more urbanised areas have a wider variety of transportation, such as private motor vehicles and minibus taxis (referred to locally as *candongueiros*, Figure 4-50). Roads are mostly unsurfaced, even in urban areas. Despite the various modes of transport, traffic volumes in the area are generally low, particularly in rural and less developed areas.

² Detailed traffic data for the project Aol was not available from authorities at the time of writing this report, and traffic counts were not included in the socio-economic primary data collection undertaken for the social baseline.



Figure 4-48: A passenger and goods being carried on a motorbike in a rural area



Figure 4-49: A three-wheel motorbike carrying passengers



Figure 4-50: A minibus taxi or *candonguero* in front of a store.

In terms of rail transport, the Moçâmedes Railway (*Caminho de Ferro de Moçâmedes*, CFM), founded on 28 September 1905, has its headquarters in the city of Lubango and the railway runs from the city of Namibe (formerly Moçâmedes) to Menongue, in the Province of Kuando-Kubango. The Matala/Dongo section runs through the municipality of Jamba where there is a railway station (Figure 4-51). The operation of the Jamba railway branch line began in 2018 and at the time it was expected to transport more than two million tonnes of pig iron³ that would be concentrated in the municipality of Jamba (Huíla).

The road network in the Project area mainly comprises unpaved dirt roads except in the municipality of Jamba (Figure 4-52). The road linking the city of Lubango to Matala is asphalt as well as the National Road (EN 280) connecting Huíla to Cuando-Cubango and the secondary road between Colui and Jamba. Between Cuvango to Chipindo there is a 105 km dirt road. Cuvango to Jamba are connected by a 35 km asphalted road (EN-280). Travelling on dirt roads in the Project area becomes increasingly difficult in the wet season as some sections become inaccessible and bridges are damaged by flooding events (Figure 4-53).



Figure 4-51: CFM station at Jamba



Figure 4-52: Paved road linking Jamba to Cuvango

³ Pig iron is a solid, hot metal that is a raw material for steel production.



Figure 4-53: Navigating unpaved roads is difficult during the wet season

In the municipal centres, traffic is characterised by motorbikes transporting people and goods, as well as light and heavy vehicles belonging to private individuals, government institutions and some companies.

Most road accidents in the Project area reportedly involve motorbikes. According to accident data from the Jamba Municipal Command for the second quarter of 2024, nine road accidents were recorded compared to the previous period, averaging at three accidents per month. The accidents were categorised as follows: two collisions (22.22%); three hit-and-run accidents (33.33%); and four crashes (44.44%) causing five deaths, eight serious injuries, three minor injuries as well as the death of three head of cattle and material damage. Speeding, mechanical breakdowns and lack of warning signs were identified as the main causes of these traffic incidents.

Road inspections were carried out by the Jamba Municipal Command for the same period on the National Road 280 linking Huíla and Cuando-Cubango and the secondary road connecting Colui and Jamba. A total of 1 238 vehicles and motorbikes were inspected culminating in the seizure of nine motor vehicles, 53 single motorbikes and the imposition of 14 fines.

Safety and security

Crime

The municipalities in the Project area have a Municipal Command of the National Police in the key municipal centres. Reports on the public security situation in the Project area indicate that conditions are calm compared to the provincial capitals. According to data from the Operations and Information Section of the Municipal Commands and the results of surveys of families and traditional leaders, the most common crimes are motorbike theft and cattle rustling. Cattle theft is one of the most common “crimes”, but this is an issue that is usually resolved through conflict resolution facilitated by the *sobas*. Free-roaming livestock, including cattle, goats and pigs, were observed in the Project area and pose a collision hazard for traffic.

Other crimes that were recorded include offences against the physical integrity of people using field tools like machetes or axes, sexual abuse and scams.

According to data from the Public Security Report, in the municipality of Jamba during the first half of 2024, 42 crimes of various kinds were reported, which represents around seven crimes per month. The Jamba municipality had a crime rate of 0.14 per 1 000 inhabitants in the first quarter of 2024 and 0.15 in the second quarter. The crime rate in Cuvango municipality for the first half of 2024 was 0.045 offences per 100 187 inhabitants, compared to (0.229) in the previous period, mostly in the main commune (town) of Cuvango.

Artisanal and Small-scale Mining

During the reconnaissance site visit, ASM activities were observed within the Project area. Given that these activities are often informal or illegal, there is a risk that tensions may arise if ASMs feel their operations are threatened. ESIA representatives were informed that certain government officials, including members of the military, may be involved in or benefiting from ASM in Angola. ASM sites are often guarded by armed militia, posing significant safety and security risks, particularly for Project personnel who may inadvertently enter these areas without prior knowledge and respond inappropriately.

Unexploded ordnances

Certain areas within the Project footprint are located in a former conflict zone where there is a risk of unexploded ordnances (UXOs). UXOs are not limited to landmines and can include unexploded ammunition, remnants of war and other improvised explosive devices.

Based on knowledge of conflict areas, local finds and incidents, three confirmed minefields have been identified within the Project area and must be avoided, until they have been cleared by trained teams (refer to Figure 4-54). There is a risk that additional minefields exist in the Project area and are yet to be identified, especially between the villages of Jamba and Cuvango to the south. Further details on UXO identification and management are provided in Section 2.11 and the ESMP and associated plans.



Figure 4-54: Identified minefields in the project area (HALO Trust, 2024). Note the powerline routing is indicated in red.

4.10.3 Local context

Surveys were conducted in the neighbourhoods and villages of Chipindo, Cuvango, and Jamba, close to the route of the 220 kV OHL and future beneficiaries of household electricity connections. The social baseline across these rural municipalities in Huíla province is similar, involving subsistence methods, informal commerce, farming, beekeeping, gold mining, and some river fishing. Most income derives from selling field produce, with households earning between AKZ 38,000 and AKZ 180,000 monthly. In municipal centres, additional income sources include civil service, schools, health posts, and government subsidies for former combatants and traditional authorities.

Land for housing and agriculture is typically inherited or granted by traditional authorities (sobas). Infrastructure is inadequate, with no electricity except in municipal centres where thermal generators provide six hours of power daily. Most families use wood and charcoal for cooking and solar panel lanterns for lighting. Water is sourced from hand-dug wells and streams, except in Jamba, where households have home water connections via the Water for All Project. Each village has at least one primary school, often utilizing local temples or churches as classrooms.

There are vulnerable groups, i.e. a group of people belonging to a minority who, for various reasons, have reduced or denied access, participation and/or opportunities to universal goods and services available to the rest of the population. This includes people with disabilities and the non-Bantu Khoisan ethnic group. The Khoisan are one of the primitive groups in Africa who are at serious risk of extinction in terms of their socio-historical and anthropological aspects. They are traditionally hunter-gatherers and nomads. In Jamba and Cuvango, two of the three municipalities where the Project will be carried out, some Khoisan households occasionally live. They are located near Kassindi and Vilombelo in the municipality of Cuvango and in the commune of Cassinga in the villages of Tchamutete and Mutiapulo, which are located approximately 70 km from this commune that forms part of the municipality of Jamba (Figure 4-55).

According to the social department manager of Cuvango Municipality, there are two groups of ethnic minorities. The one group of four families is made up of 20 people and located in Kassindi, with 2 people in the boarding school of the Catholic Mission of Cuvango. The other group is located in Vilombelo. This group comprises 18 families totalling 56 people. The Municipal Administration supports these groups with food, medical assistance and medicines and other means of current use.

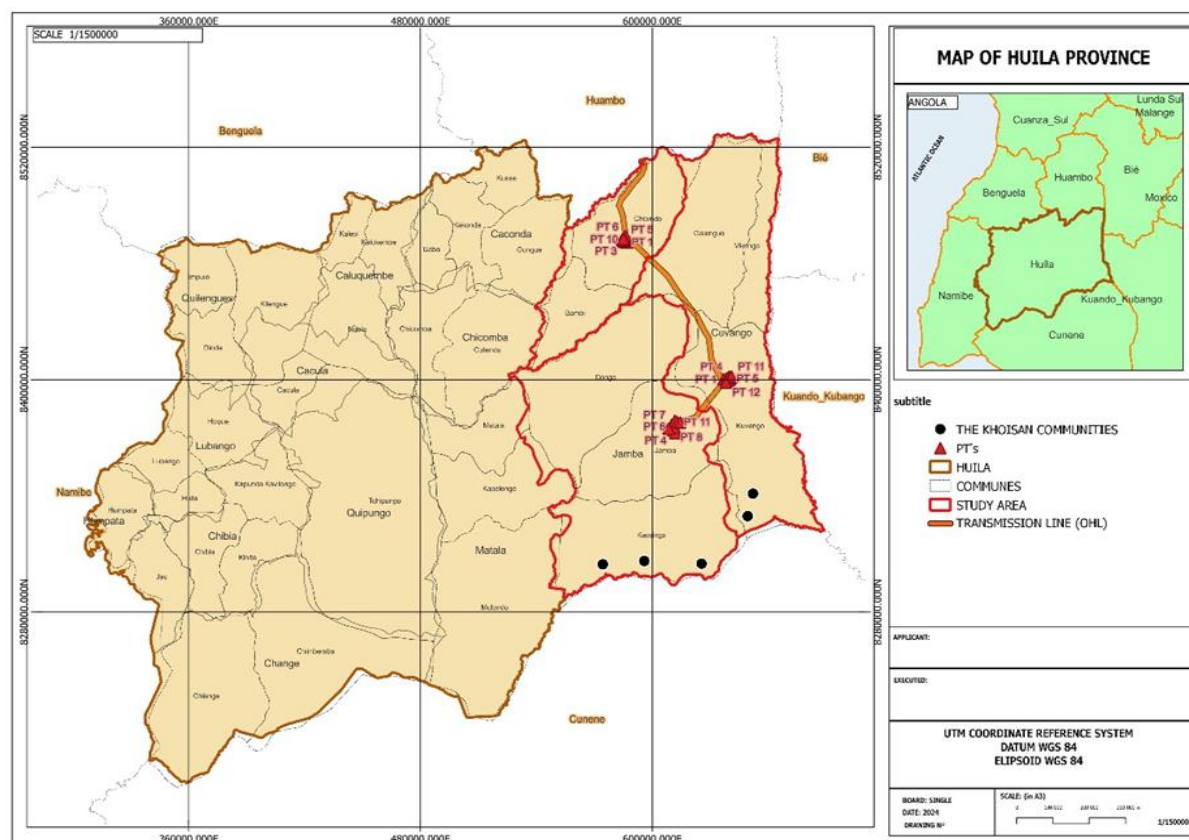


Figure 4-55: Known locations of Khoisan communities in relation to the Project area

Local governance structures are clearly defined, and without infrastructure and service investment, these communities will likely remain unchanged. The survey covered multiple communities in the municipalities of Chipindo, Cuvango, and Jamba, focusing on demographics, land ownership, ethnic groups, and income sources. Key findings include that most communities are established on inherited land and consist predominantly of Bantu ethnic groups, with subsistence farming being the primary source of income. Communities like Cacola, with a population of 19 051, have a significant number of households (3 590) and diverse income sources, including civil service. Incomes vary widely, with monthly earnings ranging from AKZ 25 000 to 220 000, depending on the community and additional income activities such as artisanal mining and informal trade. For example, Kuandja has 2 344 residents and earns between AKZ 35 000 to 200 000 monthly from subsistence farming and artisanal mining. Similarly, Hill I, established in 1981, has a population of 1 480 and income ranging from AKZ 45 000 to 220 000, indicating a reliance on both farming and mining. Volume 3, Appendix F provides an overview of the social, economic and environmental aspects of the surveyed villages/neighbourhoods.

4.10.4 Indigenous Peoples

The following information was extracted from the KWENDA Social Protection Strengthening Programme's Policy Framework for Ethnolinguistic Minorities which was compiled by Instituto de Desenvolvimento Local – Fundo de Apoio Social (Institute for Local Development – Social Support Fund) (IDL-FAS, 2022), the Angola Agricultural Transformation Project (MOSAP 3) Indigenous Peoples Policy Framework (GoA, 2022), and Angola's Social Support Fund's Vulnerable Groups Planning Framework (MASFAMU, 2019).

Angola does not officially recognise the term "Indigenous Peoples" as defined in international law. Despite its diverse ethnic makeup, Angola's Constitution and other laws and policies do not specifically mention Indigenous Peoples or minorities (but it does obligate the state to promote and guarantee

certain universal rights). The San and certain pastoralist groups, such as the Ovatwa, Ovatjimba, Ovazemba, Kwisi, and Kwepe, are classified as “Vulnerable Groups”. They, along with people with disabilities, rural women, and the extremely poor, receive support from rural programs of the Angolan government, but are not formally identified based on ethnic lines. In specific references, these groups are collectively referred to as “*autóctone*”, which is similar but not identical to the concept of Indigenous Peoples.

The San in Angola

The term “San”, as used henceforth, was chosen by San political representatives at regional meetings in 1998 and 2003, attended by San from Botswana, Namibia, South Africa, and Angola. It is a term or collective name for diverse groups of San origin in southern Africa. They have comparable hunter-gatherer heritages and languages utilising click consonants⁴, but each group has its own names, customs, culture, history and language. The groups typically identify themselves by their specific names rather than by general terms like San, Khoisan (Khoesan)⁵, Bushmen, “*vassequele*” “*kamussequele/camussequele*” or “*mucuancalas*”, the latter two terms being regarded as discriminatory. The San people are among the oldest and most genetically diverse human groups studied worldwide. Archaeological evidence indicates their presence in southern Africa for at least 20 000 years, with some estimates suggesting they have been there for up to 150 000 years. The San are the original inhabitants of southern Africa, living in the region before Bantu and colonial migrations. Groups like the !Kung (also referred to as !Xun or Mpungu !Xun) and Khwe in Angola have resided in the same areas for millennia, maintaining a strong connection with the land and its natural resources. There are between 130 000 and 200 000 San people in 15 main groups, spread over Angola, Zambia, Zimbabwe, Botswana, Namibia and South Africa (see Figure 4-56).

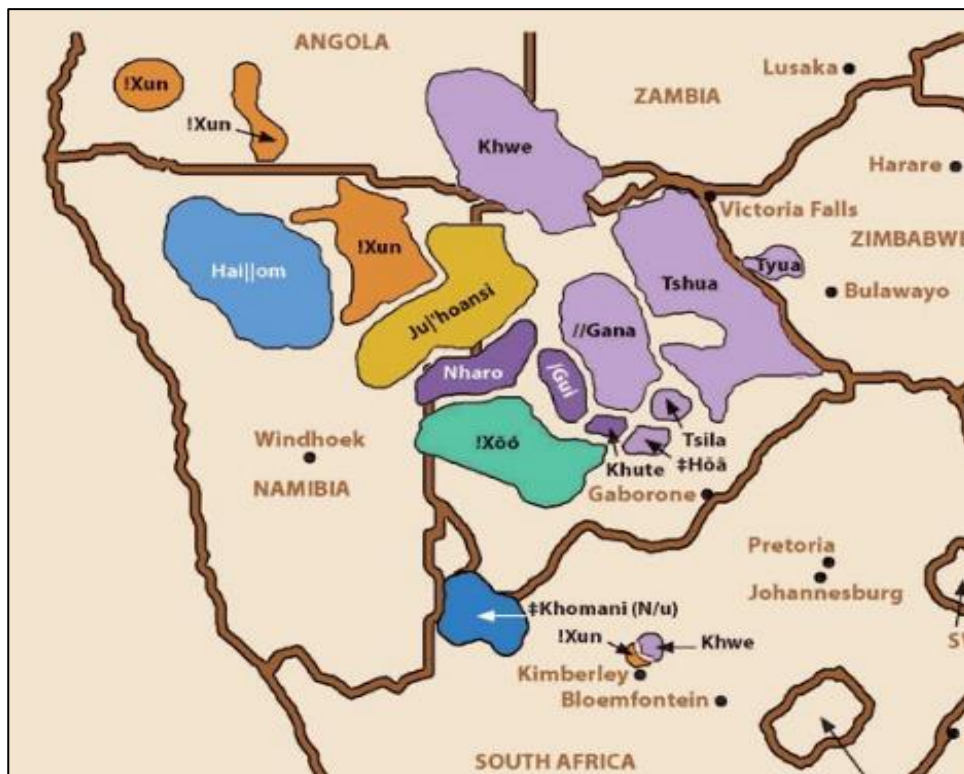


Figure 4-56: Geographical spread of the various “San” groups.

⁴ Different clicks are denoted by the symbols |, ||, !, ‡, and O.

⁵ Khoisa/Khoesan) is also the term for the larger family of languages within which San languages are categorised, and in South Africa denotes members of groups related but distinct to the San, such as Griqua and Nama.

In previous decades, anthropologists estimated that the population of San in Angola number around 5 000. This population figure is now reportedly between 10 000 and 25 000 based on government and NGO findings. In 2016, MINARS (*Ministério da Assistência e Reinserção Social*, now integrated into MASFAMU) registered 8 092 San people consisting of 985 (12%) adult men, 1 311 adult women (16%), 2 303 boys (28%) and 3 493 girls (43%) in Angola alone. This means that Angola has the third largest San population in Southern Africa, following Botswana (approx. 60 000 people) and Namibia (approx. 40 000 people). It is estimated that 35.5% (7 580) of all indigenous peoples in Angola are people from the San ethnolinguistic group.

Historically, the San community inhabited various regions of Angola, including Namibe, Huíla, Cunene, Cuando Cubango in the south-west, and Moxico in the east⁶. Their movements are believed to have followed a north-south direction; a pattern observed in other parts of Africa.

The presence of the San in Southern Angola is evidenced by historical records, including rock art, cultural artifacts, colonial accounts, and the use of Khoisan languages in the region. The largest population of San in Angola is currently believed to reside in the Provinces of Cunene and Cuando Cubango, with additional San communities found in Huíla, and the southern areas of Moxico. Their provincial distribution is shown in Figure 4-57.

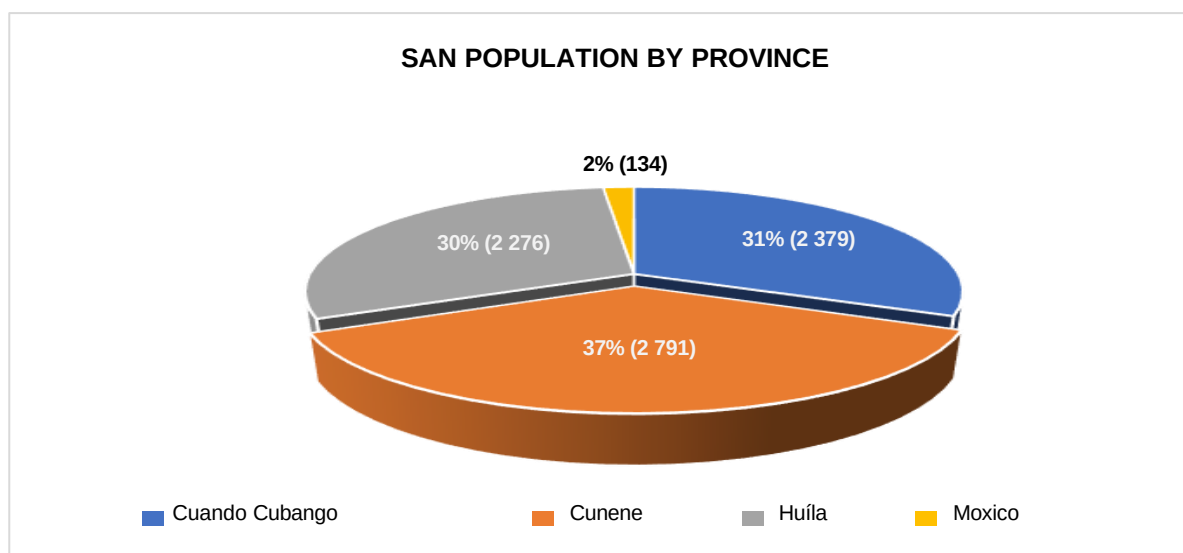


Figure 4-57: Distribution of total number of San people by Province, with those in Huíla making up 30% (IDL-FAS, 2022)

San communities in Angola primarily consist of the !Xun (!Kung) people, residing mainly in Huíla, Cunene, and to a lesser extent in Cuando Cubango, alongside the Khwe community, predominantly located in Cuando Cubango. There are also small populations of San, likely Khwe, in Moxico. These groups are also present in the northern regions of Namibia and Botswana. At the International Conference on Minority Communities held in Lubango in November 2021, some historians and anthropologists suggested using the name “!Kung of Angola” to refer to all San communities in Angola.

Languages of the San

Angola’s !Xun speak one of three to five dialects, while two dialects exist for Khwe speakers (Pakleppa & Kwononoka, 2003). There may a small population of Kede speakers (also known as Hai||om) or their descendants in Cuando Cubango. While the San languages of !Xun and Khwedam are spoken within their communities, use may be decreasing due to a lack of mother tongue education, economic

⁶ Available at https://upload.wikimedia.org/wikipedia/commons/thumb/7/70/Angola_Ethnic_map_1970-en.svg/800px- Angola_Ethnic_map_1970-en.svg.png.

pressures and discrimination. Hence many San speak the languages of neighbouring Bantu groups. The San reportedly find it easy to learn other languages spoken by Bantu groups such as Umbundu, Ganguela, and Tchokwe.

Socio-economic challenges of the San

Based on NGO reports, studies research, news articles and survey recently carried out by IDL-FAS (August to October 2021), it was found that the San in Angola share similar socio-economic challenges, such as marginalisation and deprivation, common to some countries in the region. These challenges have been exacerbated by more than 25 years of civil war and cross-border changes since 1966⁷. Reports of San marginalisation are mostly from the Cuando Cubango area. These take the form of discriminatory labour and social relations with neighbouring groups, poverty, and poor access to education and health services. In focus groups held by IDL-FAS in August 2021 with the San community of Mucovongo (in Baixo Longa, Cuito Cuanavale), men and women shared their reasons for withdrawing their children from school. According to the testimonies, the children faced discrimination and even aggression from other children in Bantu communities and from teachers who did little or nothing to protect them.

Government support for San communities varies by region, depending on the knowledge and sensitivity of public officials or technicians. There is a lack of strong national and international political representation for Angolan San, and there is no specific institution dedicated to ensuring their adequate representation or advocacy. However, the San in Angola receives some media coverage at the national level, with the national broadcaster TPA airing short reports about them and some coverage is provided in national newspapers.

Recent consultations undertaken for the MOSAP3 project showed that San literacy levels were low to very low. The surveys also showed that their access to communication is limited. While some mobile phone owners have periodic reception, internet access is generally poor or unavailable. Radio coverage is limited. This highlights the importance of in-person information dissemination through meetings, with translation when necessary. In some areas, limited use of telephones and radio programs is possible. Limited nutrition has also been reported.

San livelihoods

The Khoesan (!Kung), live in “camps” scattered throughout the southern region (Cunene, Huíla) and the eastern region (Cuando Cuango, Moxico). Factors such as the Bantu expansion, the country's civil war, and accelerated deforestation have led to the San community settling more permanently in certain regions from 2013 to 2021, where they typically seek livelihoods for survival.

They are a people deeply connected to nature, which is essential for their livelihood and forms the basis of their socio-cultural, economic, and community heritage. Governed by oral traditions and a code of coexistence, they follow “non-formal” rights and duties within their community. However, due to the distance of camps from forests and an increase in poaching, the San have reduced traditional activities of hunting, mead production, and the collection of wild fruits. Instead, they have intensified subsistence agriculture (growing *massango*, corn, and *massambala*), mainly through dryland farming as access to irrigation is limited. The shortage of draught animals means that ploughing is often done by hand. Cattle is usually collectively owned for ploughing. Craft activities such as iron casting and basketry continue on a small scale, as well as honey cultivation.

⁷ Many San fled Angola for Namibia, joining or being co-opted for military service by the South African Defence Force (SADF) during Namibia's independence struggle which included a range of Angolan forces (principally FNLA/UNITA alongside the SADF and FAPLA/MPLA alongside Namibia's PLAN) and their allies. For this reason, a significant number of Angola's !Kung and their descendants live in eastern Namibia and the Northern Cape region in South Africa.

The San are a significant source of informal manual labour (e.g. as domestic workers for wealthier households, small businesses, or field labour), but they receive inadequate pay (Gomes & Satiaca, 2019) or are paid in food. Their trade is primarily barter based (goods, goods, and services), and they have limited experience using money. They also depend on food aid for survival.

In recent years, there has been increasing attention on the San people in Angola, with documentaries and publications highlighting their culture and challenges. The national media has broadcast documentaries and covered news about the San, and several books and publications have been dedicated to their community. The International Conference on Minority Communities “Leaving no one behind” in 2021 further underscored this interest, aiming to share knowledge, promote protection of ethnic minorities, and engage national and international stakeholders. These efforts reflect a growing recognition of the San as a distinct group deserving special attention and inclusion in the country’s social agenda.

The San access and use water resources in similar ways as other villages located in the Project area. This includes locally dug wells, springs, and less frequently boreholes and river water.

San land

Some communities have legal land titles provided by the government, while others do not. This can impact their ability to obtain Free, Prior, and Informed Consent (FPIC) for investments that may affect them and can affect their ability to invest securely. In Cuando Cubango, several San communities live on State land without title, and some live on private land with established leaseholds. In Huíla, one San community reported restricted access to Bicuari National Park, limiting traditional livelihood activities. Drought and unpredictable climate patterns affect all settlements.

During 2007-2008, the Angolan government, in collaboration with OCADEC (*Organizacao Crista de Apoio ao Desenvolvimento Comunitario* / Christian Organisation for Community Development Support) and the Food and Agriculture Organization (FAO), successfully facilitated the registration of ancestral land for one San community. Unfortunately, no other community has been able to register ancestral land since then. The land registration process and the responsible agencies have also undergone changes.

San governance structures

The San community in Angola has minimal political representation and traditionally follows more egalitarian leadership structures compared to the chiefdoms or kinship-based hierarchies of other Angolan ethnic groups. Their culture and traditional way of life differ significantly from those of other Angolan communities, lacking the pastoralist or agrarian heritage typical in most Angolan societies.

San in Cuvango and Jamba

A little less than one-third (30%) of the San people of Angola occur in the Huíla Province. According to the IDL-FAS report, they occur mostly in the municipalities of Lubango, Chibia, Jamba, Quipugo and Cacula, although verbal and email communications with the Cuvango Municipality indicated that they also occur in Cuvango area (Cambinda, 2024).

Figure 4-58 shows the locations of the Khoisan people in the Jamba and Cuvango municipalities. It shows that they are located more than 70 km south of the Project area at the closest points. However, since initial site visits and stakeholder engagement, a small group of Khoisan was noted to be approximately 20 km south of the Project area.

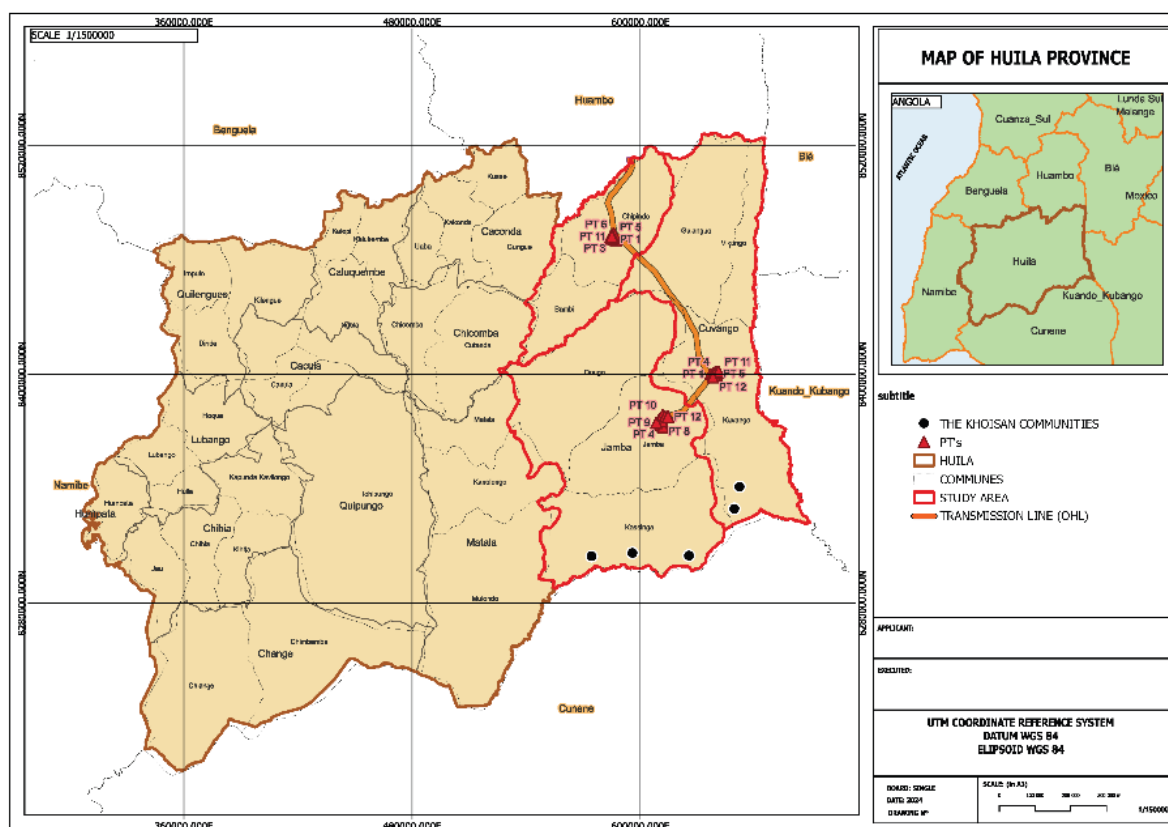


Figure 4-58: Map showing the location of the Khoisan community in the municipalities of Jamba and Cuvango

Recent communications with the Municipal Director dealing with social matters at the Cuvango Municipal Administration, Mr Meireless Cambinda, indicated that there are two San groups in Cuvango Figure 4-59. The first group consists of four families making up 20 people in the town of Kassindi, where two people are in the boarding school of the Catholic Mission of Cuvango. The second group occurs in the town of Vilombelo and comprises 18 families, totalling 56 people (Cambinda, 2024). The Cuvango Municipal Administration supports them with food, health services, medication and other means of current use within the scope of the ordinary resources of the treasury and the PIDLCP, both of which are approved by the Angolan executive.



Figure 4-59: Khoisan household in Cuvango municipality (AMC, 2023)

Support for San communities

Support is provided to San communities in the form of food and other goods by MASFAMU and through partnerships with NGOs and churches. These efforts focus on citizenship rights, access to land, and other relevant issues.

NGOs

Three non-governmental organisations (NGOs) registered in Angola do specific work with San communities. They are:

- OCADEC (*Organizacao Crista de Apoio ao Desenvolvimento Comunitario* / Christian Organisation for Community Development Support): OCADEC is located in Lubango, primarily assisting San communities in Huíla Province. It has conducted education, human rights, and advocacy initiatives in Cuando Cubango, Cunene, and Moxico. The organisation has previously managed projects focused on providing access to HIV/AIDS services and education for San communities and maintains a close partnership with the Provincial Government;
- MBAKITA (*Missão de Beneficência Agro-pecuária do Kubango, Inclusão, Tecnologia e Ambiente* / Mission of Agricultural and Livestock Beneficence of Kubango, Inclusion, Technology, and Environment): Headquartered in Menongue, MBAKITA primarily focuses on agricultural training, health, livelihoods, and human rights matters within San communities in Cuando Cubango. Additionally, MBAKITA conducts some activities in Huíla, Cunene, and Moxico; and
- ACADIR (*Associação de Conservação do Ambiente e Desenvolvimento Integrado Rural* / Association for Environmental Conservation and Integrated Rural Development): Located in Menongue, this NGO collaborates with San communities, focusing on education, advocacy, and human rights initiatives.

OCADEC, MBAKITA, and ACADIR have published various reports detailing their efforts with San communities. Like many Angolan NGOs, they face challenges due to limited funding for civil society. Additionally, organisations such as the Irish Catholic Agency for World Development (TROCAIRE), OSISA, Windhoek-based Working Group of Indigenous Minorities in Southern Africa (WIMSA), Terre des Hommes, and the Catholic Church, have been involved in assisting San communities in southern Angola, but specific details about the extent of their support are not readily accessible.

Government of Angola

The Angolan government implements programs targeting San and specific pastoralist groups, both through national line ministries and provincial governments. UN agencies, such as FAO and UNICEF, in partnership with the government, also carry out various support programs for livelihoods and education among San and pastoralist communities in Angola.

MASFAMU is tasked with supporting and integrating San communities and pastoralist groups into the mainstream economy as part of its broader mandate to assist vulnerable groups. MASFAMU's mission includes implementing social policies and programs for vulnerable populations, combating poverty, enhancing family welfare, promoting women's rights, fostering community development, and ensuring gender equality and equity.

In early 2014, the Ministry of Social Welfare (MINARS, now MASFAMU), with support from OCADEC and funding from the French Embassy, provided oxen, ploughing equipment, seeds, and food relief to 150 San families in Huíla Province. This initiative was part of a two-year project that began in 2013. As some San have been settling in peri-urban areas in Huíla, they may also benefit from the Social Safety Net Programme.

The Ministries of Health and Education implement programs that specifically target San and pastoralist communities. These communities receive direct services from provincial and municipal administrations, which often have more detailed data than the central government.

Support for these San communities includes food aid, agricultural equipment, training, and investments in schools, clinics, and sometimes housing. Despite various activities being conducted, the lack of comprehensive reporting on government projects hinders the ability to create a unified national overview or evaluate their impacts. A significant event in late 2021 was the International Conference on Minority Communities held in Lubango, organised by MASFAMU. This conference, which included both local and international (remote) participation, focused on the inclusive

development of the San and other minority communities, as well as regional cooperation. A report on the conference outcomes is pending.

The government also offers different levels of technical support to San farmers, such as establishing monitoring groups to distribute agricultural inputs, providing seeds, offering vaccinations, and conducting treatment campaigns during livestock disease outbreaks. However, there are no training facilities or agricultural schools available to San communities in these regions.

IFC PS 7

Due to the current and known locations of the San people in Angola, as well as the consultations undertaken with them during the ESIA process, it has been determined that the risk of alienation from or exploitation of their land and access to natural and cultural resources as a result of the Project is low. Furthermore, no relocation of San people is foreseen nor are impacts on critical cultural heritage as described in the sub-sections above. For this Project, the requirements of IFC PS 7 concerning Free, Prior, and Informed Consent (FPIC) do not apply. This is because the Project does not impact Indigenous Peoples in a manner that meets the FPIC criteria outlined in IFC PS 7. Specifically, while there are Indigenous Peoples (Khoisan) in the broader region, the Project's footprint does not result in their relocation, restriction of access to natural resources on which they depend, or significant adverse impacts on their cultural heritage. As such, while engagement with Indigenous Peoples is a key component of the Project's stakeholder engagement process, the formal FPIC process is not required.

However, special mitigation measures for this vulnerable group have been compiled for inclusion in the ESMP.

IPs in the immediate project area

The Addendum to the ESIA (Volume 6) provides further details on IPs that are currently not occurring in the immediate project area.

5 Stakeholder engagement and information

5.1 Introduction

This section describes the Stakeholder Engagement (SE) approach for the ESIA. Stakeholder engagement forms a key component of the ESIA process. Geolab, an Angolan-based environmental consultancy specialising in public consultation, was requested by SRK to undertake the SE for the ESIA.

The ongoing engagement with identified stakeholders during the construction and operational phases of the Project will be guided by the SEP developed for this ESIA process, which can be found in Volume 3, Appendix G. A SEP is a strategic document that outlines a structured approach to engage with various stakeholders, including communities affected by a project or initiative. Its primary purpose is to promote effective communication, transparency and collaboration throughout the project's lifecycle. The SEP typically includes details on stakeholder identification, methods of engagement, communication channels and a timeline for interactions. It aims to address social concerns, gather input, and build positive relationships with stakeholders to ensure that the project aligns with their needs and expectations. Additionally, the SEP may outline measures to mitigate social impacts, promote community development, and ensure responsible and ethical practices in line with the project's goals and objectives.

5.2 Objectives and approach to stakeholder engagement

The objectives of SE are to share information about the Project and seek the opinions, questions and comments of stakeholders and interested parties (i.e., people affected directly or indirectly by the Project).

According to Angolan legislation, the main forum for the participation of interested parties and the general public will be a public hearing/consultation organised and coordinated by MINAMB following the presentation of the ESIA. This event is required under Article 16 of Presidential Decree No. 117/20. The conclusions of the public consultation help the authorities to decide on whether a project should proceed.

The SE's general objectives for ESIA are:

- Giving interested parties access to project information;
- Presenting information in a way that can be easily understood by stakeholders (i.e., materials are presented in a culturally sensitive way and geared towards literacy levels);
- Hold meetings in places accessible to all who wish to attend;
- Consult vulnerable or minority groups, using appropriate socio-cultural mechanisms;
- Establish a high level of awareness among communities and other stakeholders about the nature of the project, its likely impact and the mitigation measures proposed;
- Ensure stakeholder input on proposed mitigation measures and integrate them into management planning;
- Managing expectations among communities and other stakeholders by presenting clear, consistent and realistic messages; and
- Have clear mechanisms for responding in a timely manner to questions, concerns and comments from stakeholders.

In addition, international standards such as the IFC Performance Standards (2012) and the Equator Principles (2013) also provide guidelines for stakeholder engagement that is fit-for-purpose and takes place at key stages throughout the ESIA process.

Informed by national and international requirements, SE for the Project to date has been carried out with representatives or spokespeople from a range of sectors of society, including government, businesses and communities. Special efforts have been made to obtain the contributions from all groups and/or people who may be directly affected by the proposed Project, particularly marginalised groups such as women and young people. A stakeholder database has been developed and will be updated during imminent engagements, recording details of individuals and organisations.

5.3 Methodology for stakeholder engagement

This section outlines the structured approach and strategies employed to effectively involve key stakeholders and interested parties in our initiatives. This ensures a collaborative and informed decision-making process throughout the Project.

5.3.1 Stakeholder mapping and analysis

During this initial phase, stakeholders are mapped and analysed to determine which stakeholder relations should be established, maintained or improved and what the approach to engagement should be. A mapping and analysis exercise of the stakeholders in the Project area must take place periodically or as the Project's risks change over time.

The objectives of the mapping and analysis exercise are to:

- Identify key stakeholders including vulnerable or disadvantaged peoples;
- Determine stakeholder needs and their expectations of the Project;
- Assess stakeholders' current perceptions of the Project;
- Ascertain stakeholders' level of interest in and/or level of influence on the Project, along with their current level of support for the Project;
- Identify strengths and weaknesses in past and current stakeholder engagement activities (e.g., which was done on nearby or similar projects);
- Determine stakeholders' preferences for modes and frequency of engagement;
- Obtain feedback on the appropriateness of the proposed Grievance Mechanism;
- Gauge the possibility of opportunities for partnership and collaboration with stakeholders; and
- Identify requirements for implementing the SEP, including staffing and capacity-building requirements.

5.3.2 Preparation

The preparation phase includes the groundwork for the information disclosure and the construction of the engagement action 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.

One of the most important steps in the preparation phase is creating a stakeholder engagement action plan which identifies what engagement activities need to occur and which stakeholders should be engaged. It includes the frequency of the engagement and the engagement methods (i.e., how the engagement will occur), which take into account the needs of vulnerable people. The plan also considers the logistics involved in the engagements and the key personnel responsible for carrying them out.

5.3.1 Engagement

The engagement phase 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.

5.3.2 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.

5.4 Project stakeholders

5.4.1 Stakeholder identification

The IFC (2012) defines stakeholders as:

- Individuals, groups or local communities that could be affected by the Project, positively or negatively, and directly or indirectly; and
- Parties who may be able to influence the Project because of their legal mandate, knowledge and/or social or political influence.

Project stakeholders and affected parties are categorised at the national, municipal and local levels as follows:

- National and / or regulatory authorities;
- State agents;
- Provincial government authorities;
- Municipal government authorities;
- Communal government authorities;
- Traditional authorities (*soba grande* and *sobas*);
- Project Affected Communities (PACs), including directly affected land users (e.g. landowners, residents and small-scale farmers);
- Neighbouring land users; and
- Civil Society Organisations (CSOs) including Non-governmental Organisations (NGOs) and Faith-Based Organisations (FBOs).

It is worth noting that each communal administration has a further governance structure that oversees the villages/villages in each commune. This local governance structure is shown in Figure 5-1. Traditional authorities are located at three hierarchical levels, which officially translate today into the *regedor* (indicated as “Governor” in the diagram below, also referred to as *soba grande*), the *soba* and the *sobeto / secúlo*. The *soba* is the chief in the villages. The *soba grande (regedor)* is the *soba* who leads the other *sobas* in the community. The territory where the *Regedor* exercises his power is called *Regedoria* and *Ombala* (in Umbundu). A *Regedoria* or *Ombala* is a group of villages or settlements.

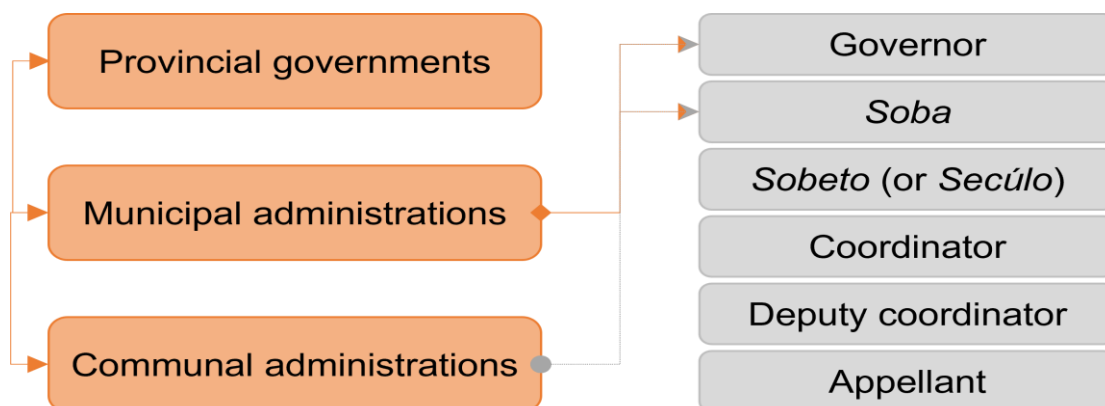


Figure 5-1: Diagram of the local government structure

Key stakeholders and interested parties were identified through a reconnaissance site visit and consultations undertaken by SRK and Geolab personnel, field surveys by Geolab, the delineation of the Project's AoI and desktop reviews of existing information on similar projects in the area. A stakeholder database has been developed and will be updated during ongoing engagements. The Project stakeholders identified thus far are presented in Table 5-1.

Table 5-1: Identified Project stakeholders and affected parties

Stakeholder category	Identified stakeholders and affected parties
National and / or regulatory authorities	• MINEA • Ministry of Finance • MINAMB • <i>Ministério da Agricultura e Florestas</i> / Ministry of Agriculture and Forestry (MINAGRIF) • Ministry of Social Action, Families, and the Promotion of Women (MASFAMU)
State agents	• RNT • National Energy Distribution Company / <i>Empresa Nacional de Distribuição de Electricidade</i> • State Electricity Generation Agency / <i>Empresa Pública de Produção de Electricidade</i> (PRODEL - EP) • National Police • Moçâmedes Railway
Provincial authorities	• Huíla Provincial Government • Huamba Provincial Government
Municipal authorities	• Jamba Municipality • Chipindo Municipality • Cuvango Municipality • Dongo Municipality • Galangue Municipality • Kalima Municipality
Commune authorities	• Jamba commune • Chipindo commune • Cuvango commune
Traditional authorities	• Mr Anibal Tsialo (<i>Soba grande</i>, Cacola) • Mr Paulo Tyamba (<i>Soba</i>, Lucunga A) • Mr José Cassanga Calulu (<i>Soba</i>, Kuandja) • Mr Constatino Rosário Tyamba (<i>Soba</i>, Eyela) • Mr Francisco Ndala Nyemo (<i>Soba</i>, Morro I) • Mr Pedro Tchindjamba (<i>Soba</i>, Km 50) • Mr Sabino Calungo (<i>Soba</i>, Tchicunho) • Mr Marcelino Manico (<i>Soba</i>, Aunge) • Mr Zacarias Bunanga (<i>Soba</i>, Ngokue) • Mr José Baptista Ntyamba (<i>Soba</i>, Cavinga) • Mr Paulino Lutiki (<i>Soba</i>, Bairro 1º de Maio) • Mr Manuel Capitango (<i>Soba</i>, Vingolo) • Mr Faustino Tchimbungo (<i>Soba</i>, Buloteque) • Mr Celestino Chivela Numa (<i>Soba</i>, Capuca) • Mr José Tchiconguele (<i>Soba</i>, Oko) • Mr António Matias João (<i>Soba</i>, Operário A) • Traditional Ombala Ya Nduma jurisdiction authorities (Ngokue Village)

Stakeholder category	Identified stakeholders and affected parties
Project Affected Communities (PACs)	- Villages in Jamba Municipality: - Cacola - Lucunga A - Kuandja - Eyela - Morro I - Villages in Cuvango Municipality: - Km 50 - Tchicunho - Aunge - Ngokue - Cavinga - Villages in Chipindo Municipality: - Bairro 1o de Maio - Vingolo - Buloteque - Capuca - Oko - Operário A
Neighbouring land-users (farms)	- Mumba - AgriCuvango - Kapunda
CSOs	- Rural Development Extension Programme - Programme to Promote and Strengthen Community Organisation - Integrated Municipal Intervention Programme - CarrinhoAgri Project - Local Development and Combating Poverty Programme - MOSAP II - Farmer Field Schools - Agrarian Development Institute - Agricultural Development Stations - Agricultural cooperatives and associations - Integrated Social Centres

5.4.2 Vulnerable groups

Stakeholders who could experience adverse impacts from a project more severely than others are considered vulnerable or disadvantaged groups. Tailored engagement strategies, as outlined in the SEP, are required to ensure that these stakeholders are meaningfully engaged and can effectively participate in the Project. Vulnerable and disadvantaged groups in the Project area were identified through field surveys conducted by Geolab and are presented in Table 5-2.

Table 5-2: Vulnerable / disadvantaged groups identified during field surveys

Vulnerable / disadvantaged group	Potential impact on vulnerability
Women and elderly	- Limited understanding of Portuguese among women and elderly could hinder their ability to understand important Project information and meaningfully participate in the Project. - Increased gender marginalisation in communities where women may have limited decision-making powers.

Vulnerable / disadvantaged group	Potential impact on vulnerability
	- Widows who are heads of households could unintentionally be overlooked in the consultation process. - Engagements normally occur during working hours when women might be preparing agricultural fields, harvesting, collecting water, washing clothes, or bathing.
Community members without security of tenure	Most households in the PACs do not have security of tenure as their homesteads and fields have been inherited or provided by <i>sobas</i> without records thereof. This makes them vulnerable to exploitation by officials or other parties when being consulted, particularly when it comes to compensation.
Migrant / internally displaced community members (i.e. community members who have migrated to the project-affected villages after the civil war)	Community members, <i>sobas</i> , or government officials might inadvertently dismiss the need to meaningfully consult internally displaced people or involve them in local recruitment if they have not fully integrated into the community.
Disabled persons	Disabled persons in the PACs include: - People with lower-limb disabilities resulting from armed conflict - Children with paralysis caused by polio - Elderly people with paralysis caused by strokes Disabled individuals are often not mentioned as part of a household, which could result in them being excluded from consultations and stakeholder engagements. These individuals may also be discouraged from participating in SE activities (e.g. community meetings) if the venues are inaccessible to them.
Indigenous San groups	The field surveys found that San groups reside south of the Project-affected area, specifically in the Cuvango and Jamba municipalities. Current widespread discrimination or inadvertent exclusion of San groups could limit their ability or willingness to participate in Project-related activities if engagements are necessitated with them.
Artisanal and small-scale (ASM) miners	Although ASM is regarded as illegal in the Project Aol, some artisanal and small-scale miners observed close to the proposed Project area were locals from the PACs. ASMs vulnerability could increase due to abuse by security personnel.
Project Affected Peoples (PAPs) / Project Affected Households (PAHs) i.e. people displaced by Project	Displacement could exacerbate PAPs and PAHs existing vulnerabilities and introduce new vulnerabilities including: - Poverty and economic instability due to loss of livelihoods - Emotional distress caused by loss of social networks - Exposure to poor living conditions resulting from inadequate resettlement sites and replacement housing.
Unemployed persons in municipal centres	Unemployed persons might be employed during the construction phase, but this will likely be temporary and for general work. Very few people may be absorbed permanently, if they are skilled and if opportunities are available.
Individuals/groups that are economically or socially marginalised due to their historical pasts, or political or social beliefs	Community members, <i>sobas</i> , or government officials might inadvertently dismiss the need to meaningfully consult socially marginalised people or involve them in local recruitment due to their political, cultural or religious affiliations being in the minority or not in line with that of the current authorities.

5.4.3 Stakeholder mapping and analysis

Stakeholders are evaluated against three key criteria to establish the level of effort (time and resources) to be allocated to engagements, namely: level of influence/interest; level of support; and priority of engagement. Usually, the stakeholders who are most affected by and/or have the greatest

level of influence over a project require the most substantial engagement effort. The criteria are defined as follows:

- Level of influence: The level of influence that a stakeholder has or may have on the Project and/or its reputation;
- Level of interest: The level of interest that a stakeholder has in the Project's operations; and
- Level of support: The level of alignment between the Project and stakeholder's values/interests which equates to the level of support that the stakeholder has for the Project.

A scale from 1 to 3 is used to derive a rating for each attribute where 1 represents a low level, 2 represents a medium level and 3 represents a high level. Therefore, the higher the score, the higher the priority should be to engage a particular stakeholder – they can halt or delay the Project, become a partner for successful Project implementation, and/or impact the Project or the Proponent's reputation.

The criteria and rating scales, for the stakeholder mapping are presented in Table 5-3, along with the resultant approach to be used when engaging the stakeholder. A stakeholder matrix is provided in Table 5-4. This stakeholder matrix must be updated regularly to ensure that ratings and the engagement approach as set out in the SEP remains contextually relevant and appropriate.

Table 5-3: Stakeholder mapping rating criteria

Criterion	Rating		
	Low (1)	Medium (2)	High (3)
Level of influence	The stakeholder has limited ability to influence the Project and/or its reputation.	The stakeholder has moderate ability to influence the Project and/or its reputation.	The stakeholder can substantially influence the Project or influence its reputation.
Level of interest	The stakeholder is detached and/or has limited interest in the Project.	The stakeholder has a moderate interest in the Project.	The stakeholder has a strong interest in the Project.
Level of support	The stakeholder strongly supports or is positive towards the Project.	The stakeholder has a neutral attitude or moderate level of support toward the Project.	The stakeholder has limited support for the Project or has a negative sentiment towards it.
Score	3	4-6	7-9
Approach	The only engagement required is to provide information to the stakeholder on a periodic basis, such as biannually.	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities	The stakeholder must be informed, consulted, involved and collaborated with on a regular basis and/or as required for specific issues or activities.

Table 5-4: Current stakeholder matrix for the Gove-Chipindo-Cuvango-Jamba Transmission Line Project

Stakeholder group	Level of influence	Level of interest	Level of support	Approach
National government / regulatory authorities				
MINAMB	3	3	1	The stakeholder must be informed, consulted, involved and collaborated with on a regular basis and/or as required for specific issues or activities.
MINEA	3	3	1	
MINFIN	3	3	1	
MINAGRIF	3	3	2	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities.
MASFAMU	3	3	2	
State agents				

Stakeholder group	Level of influence	Level of interest	Level of support	Approach
RNT	3	3	1	The stakeholder must be informed, consulted, involved and collaborated with on a regular basis and/or as required for specific issues or activities.
ENDE	3	3	1	
PRODEL-EP	3	3	1	
National Police	2	1	2	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities.
Moçâmedes Railway	1	1	1	The only engagement required is to provide information to the stakeholder on a periodic basis, such as biannually.
Provincial government				
Huíla Provincial Government	3	3	1	The stakeholder must be informed, consulted, involved and collaborated with on a regular basis and/or as required for specific issues or activities
Huambo Provincial Government	2	2	1	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities
Municipal government				
Cuvango Municipality	2	3	1	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities.
Chipindo Municipality	2	3	1	
Jamba Municipality	2	3	1	
Dongo Municipality	1	2	2	
Galangue Municipality	1	2	2	
Kalima Municipality	1	2	2	
Cuvango Municipal Directorate of Culture	1	1	1	The only engagement required is to provide information to the stakeholder on a periodic basis, such as biannually.
Commune authorities				
Cuvango commune	1	3	1	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities.
Chipindo commune	1	3	1	
Jamba commune	1	3	1	
Traditional authorities				
All Sobas	2	3	2	The stakeholder must be informed, consulted, involved and collaborated with on a regular basis and/or as required for specific issues or activities.
PACs				
All PACs	2	3	2	The stakeholder must be informed, consulted, involved and collaborated with on a regular basis and/or as required for specific issues or activities.
Neighbouring land users				
Mumba	1	2	2	The stakeholder must be informed, consulted and involved in the Project on a regular basis
AgriCuvango	1	2	2	

Stakeholder group	Level of influence	Level of interest	Level of support	Approach
Kapunda	1	2	2	and/or as required for specific issues or activities.
CSOs / NGOs / Government support programmes				
All CSOs	1	3	2	The stakeholder must be informed, consulted and involved in the Project on a regular basis and/or as required for specific issues or activities.

5.5 Stakeholder engagement activities

Stakeholder engagement will be an ongoing process throughout the Project lifecycle. The SEP has been developed for stakeholder engagement activities during pre-construction, construction, operations and decommissioning.

As part of the ESIA, several rounds of consultations were conducted, which include:

- Initial round – the ESIA core team met with the main local stakeholders and interested parties within the Project area of influence during the reconnaissance visit;
- Round one – engagements were held with stakeholders and interested parties by the social team during the socio-economic survey focussing on communities that were located in close proximity to key Project infrastructure; and
- Round two – consultations with stakeholders and interested parties were undertaken after completion of the draft ESIA to present the preliminary results and to receive contributions. Stakeholders along the OHL route within the Huila province was prioritised.

During the planning of the stakeholder engagement process, a thorough analysis was conducted to identify key stakeholders whose lives, livelihoods, or environments could be directly impacted by the Project. The Gove villages in Huambo and their respective Sobas were identified as potential stakeholders due to their proximity to the Gove Dam. However, the stakeholder engagement strategy prioritised communities directly along the OHL route which included those within the Jamba, Cuvango and Chipindo municipalities, where the Project's effects are likely to be most pronounced. These included consultations with local residents, farmers, landowners, and Sobas whose land and livelihoods could be influenced by the OHL. By concentrating resources and efforts on these directly impacted stakeholders, the engagement process aimed to maximise the effectiveness of communication, address concerns specific to those affected, and develop targeted mitigation strategies. The SEP developed will enable engagement with all stakeholders including the Gove villages and their Sobas, as the Project enters the construction and operational phases. This will ensure that there is awareness about Project activities and knowledge of the mechanism to share any grievances should impacts be experienced.

5.5.1 Initial consultations (Reconnaissance visit)

A site reconnaissance visit was undertaken between 26 and 29 February 2024 by SRK and Geolab consultants, who were accompanied by representatives of PAK Yatirim and RNT. In addition to site familiarisation and logistical planning, the site visit allowed:

- Consultations with the local municipal authorities of Jamba, Cuvango and Chipindo, as well as PRODEL-EP (*Empresa Pública de Produção de Electricidade*) and representatives at Gove Dam to present the Project, about the planned ESIA process, household surveys and specialist fieldwork;
- Engagement with representatives of the national police and local companies who were also present in the municipal authority meetings; and

- Notification of the Huíla Provincial Government representatives, which were informed about the Project but unable to meet in person at the time of the visit. The provincial authority was however made aware of the Project.

During the meetings, the Project was presented and background information documents (BIDs) in Portuguese were provided to participants (refer to Volume 3, Appendix H). Additional BIDs were left at the municipal offices for distribution to interested parties. A register of comments, questions and answers of these interactions was compiled (refer to Volume 3, Appendix I). All comments on the Project or additional information (e.g. whereabouts of Indigenous peoples) were captured.

5.5.2 Round one consultations

Geolab collected primary data between 18 and 21 March 2024 through socio-economic surveys. The methodology included a sampled household-level face-to-face survey in most of the affected villages within the AoI, coupled with stakeholder engagements in the form of key informant interviews. The following activities were conducted:

- Formal meetings with the municipal and communal administration and traditional leaders (*sobas* or *regedores*). During these meetings the Project was presented and BIDs in Portuguese were provided to participants;
- Interviews with *sobas* to collect basic socio-economic information on village demographics, the number of households, livelihood activities, available services and infrastructure and other important information, such as qualitative inputs into perceptions of the Project;
- Before the surveys were carried out, BIDs and a brief presentation of the Project were provided in Portuguese. When necessary, it was translated into the local language, as not all heads of household are fluent in Portuguese;
- Surveys of a sample of households in each of the selected villages, using a predeveloped questionnaire. The aim was to survey at least four households per village, based on the remoteness/location of the communities, accessibility and the parameters of available time. Paper questionnaires were undertaken;
- Visits to sacred sites, infrastructure (such as wells) and social amenities (such as schools and health facilities) were undertaken;
- Requests were made from municipal authorities for basic information on the community profiles and master plans for various disciplines, to support the preparation of the ESIA; and
- The engagements not only aimed to gather basic socio-economic information, but also provided an opportunity to build trust and establish relationships with the key stakeholders and interested parties, which should continue throughout the life of the Project.

Table 5-5 provides an overview of the number of surveys administered to households and *sobas*, the dates of the surveys, and the municipalities under which the surveyed villages fall. It should be noted that, in many instances, collective feedback was obtained from households which typically comprised the household head and vulnerable groups such as women, children and elderly.

Table 5-5: Number and dates of surveys undertaken in Jamba, Cuvango and Chipinido

Municipality	Community	No. of household surveys	No. of <i>soba</i> surveys	Date
Jamba	Cacola	4	1	18 March 2024
	Lucunga A	4	1	
	Kuandja	4	1	
	Eyela	4	1	
	Morro I	4	1	
Cuvango	Km 50	4	1	19 March 2024
	Tchicunho	4	1	
	Aunge	4	1	

Municipality	Community	No. of household surveys	No. of soba surveys	Date
Chipindo	Ngokue	4	1	
	Cavinga*	2	1	
	Bairro 1º de Maio	4	1	20 March 2024
	Vingolo*	3	1	
	Buloteque	4	1	
	Capuca*	3	1	
	Oko*	2	1	21 March 2024
	Operário A	4	1	

**Fewer than four questionnaires were carried out in these villages because the houses were closed, or there were children and elderly people who were unable to answer the questionnaire, or the adults and heads of households were occupied by agricultural activities.*

5.5.3 Round two consultations

Building on the engagements that were held during the first round of consultations, a second round of consultations with stakeholders and interested parties was undertaken between 15-17 July 2024. This process included community leaders and members who were presented with the preliminary results from the draft ESIA and afforded the opportunity to provide comments.

During this round, the following meetings were held:

- Meetings with the municipal and communal administration and traditional leaders (sobas or regedores), defence and security bodies, and civil society;
- Meetings with focal groups (women and youth representatives) in Jamba and Cuvango municipality;
- Meeting with a household (4 members) from Khoisan community at Kassindi village, in Cuvango; and
- Informal meeting with one of the Khoisan families in Kassindi village, 25 km from Cuvango. The other families had already departed for the fields.

Content of meeting presentation

For each meeting, the stakeholder engagement team (i.e. Geolab's social specialists supported by the RNT technician) gave a presentation. The presentation explained the objectives of the process, described the Project, highlighted baseline conditions for the biophysical and socio-economic environment, listed potential impacts that had been identified in the different phases of the Project and featured the livelihood and resettlement framework.

The following documentation was disseminated and/or shared during the consultation process:

- Flyers with information about the Project and on environmental and social findings were provided to meeting participants;
- A Non-Technical Summary (NTS) was distributed to municipal administrators and relevant officials;
- Posters with the Project location and ESIA phases were placed in the meeting rooms; and
- A pre-prepared power point presentation was used during the meetings with institutional authorities.

The stakeholder engagements aimed to build trust and establish relationships with the key stakeholders and interested parties, a process that should continue throughout the life of the Project. The purpose was also to receive their concerns and gather feedback regarding the Project for inclusion in the final version of the ESIA. All comments/questions and responses thereto were registered and can be found in Appendix J1

Overview of stakeholder meetings

Table 5-6 provides an overview of the meetings undertaken during the consultations in Jamba, Cuvango and Chipindo municipalities, the entities the social team met, number of participants and respective dates. It should be noted that collective feedback was obtained from the general meetings and from the vulnerable groups such as women and youth.

Photographs from the consultations are presented in Appendix J2.

Table 5-6: Meetings in Jamba, Cuvango and Chipindo, between 15 and 17 July

Date	Entity / Village	Total number of participants
15 July 2024	Meeting with officials from the municipal administration and from the Jamba commune and the Dongo commune, traditional leaders, residents and civil society from the headquarters commune, Jamba and the Dongo commune	27
	Meeting with youth representatives from Jamba commune and Dongo commune	5
	Meeting with youth representatives from Jamba commune and Dongo commune	6
16 July 2024	Meeting with officials from the municipal and commune administrations from Cuvango and the Galengue commune, traditional leaders, residents and civil society from the Cuvango and Galengue communes and the Chief Police	27
	Meeting with youth representatives from Cuvango commune and Galengue commune	9
	Meeting with women representatives from Cuvango commune and Galengue commune	8
	Meeting with a household from Khoisan community at Kassindi village in Cuvango	1 household (4 members)
17 July 2024	Meeting with officials from the municipal and commune administrations from Chipindo, traditional leaders, residents and civil society from Chipindo commune	51

Participant attendance

The stakeholder meetings were generally attended by the following collective participant groups:

- Officials from the Municipal Administrations and Communes;
- Traditional leaders;
- Defence and security bodies;
- Residents (including farmers and landowners);
- Civil society;
- Youth representatives;
- Women representatives; and
- *Khoisan* community.

The approach to the meetings was a general (initial) meeting followed by focus group meetings with vulnerable groups (women and youth representatives). With regards to recording the number of participants, the attendance lists for the meetings at Jamba were signed separately since the youth and women's focus groups did not take part in the general meeting (initial meeting). In other words, there was one attendance list for the general meeting and separate lists for the meetings with representatives of the focus groups, as can be seen in Appendix J3.

In the municipality of Cuvango, a single attendance list was signed which included both general meeting participants and focus group participants, this was due to the fact that the focus group representatives attended part of the general meeting and signed at that time. The brief meeting held in the village of Kassindi with the family of the *Khoisan* community, did not have an attendance list due to the informal nature of the event.

There were no focus group meetings were held in the Chipindo community. The team was informed that there were some constraints in mobilising these groups. There was a delay in communicating the activity between the provincial government office and the municipal administration. With regards to other vulnerable groups, it was not possible to bring together groups of disabled people due to difficulties in locating and mobilising them by the administrations' social services.

5.6 Stakeholder consultation outcomes

This section summarises the key views and concerns regarding the proposed Project expressed by stakeholders to date, including local administrations (municipal governments), traditional authorities (*sobas*, *regedores*), business representatives and the local community at large (households).

5.6.1 Municipal administrations

The Project received significant support from the municipal administrations during the SE process. This included national police, defence and security offices and businesses present during engagements in the reconnaissance survey engagements. It is viewed as an important government investment project in the electricity sector. The distribution of electricity to communities also received favourable comment as it will be an essential asset for the well-being of families and the community as a whole. Participants requested that the distribution of electricity be extended to more communes. The economic benefits of job creation and business opportunities was also emphasised, particularly during the construction phase of the Project.

Participants highlighted the importance of having the municipal administration involved in the process of compensating families for the loss of fields during construction. Empresa Nacional de Distribuição de Electricidade (ENDE's) absence from meetings was questioned by participants.

One key issue raised during the consultations was the negative impact of a lack of energy as it hampers the start-up of various investment projects in mining, industry and agriculture. The lack of regular power in the municipal offices prevents evening classes from starting, which means that many adults and heads of household, who are at work during the day, are unable to continue their studies after work. On the whole, the Project is viewed with enthusiasm given its potential to boost investment in the region and promote the start-up of projects.

5.6.2 Traditional leadership and households

Feedback from households comprise collective feedback from the household head, women, children and elderly. These stakeholders mentioned that the government often builds high-voltage power transmission lines, but that the benefits of this infrastructure are often not realised within local communities.

Many community members used the consultation platform as an opportunity to express their current challenges, notably the lack of basic services, schools, health units, drinking water and inadequate support for former war combatants and the elderly. These backlogs in services placed a greater burden on communities.

Some of the existing schools and churches were built by community members themselves and structures were precarious and potentially unsafe. Schools have few resources and, in some cases,

pupils have to bring their own water to school as there is no reliable potable water supply. School equipment such as chairs is also not available.

Farmers raised concerns about the loss of fields in places where government and private projects install infrastructure. It was noted that often these areas are the only fertile fields available to grow crops. The livestock farmers in the communities wanted to know how they would be able to continue their livestock practices in the presence of high-voltage power transmission towers. The views of women, youth and elderly were captured as part of the in-depth household interviews.

5.6.3 Youth representatives

The feedback and concerns from youth and their challenges they face in the communities were collected during the general and specific focus group meetings, and are summarised as follows:

- There is a lack of higher education schools in the municipal centres, to continue their studies;
- There are few job opportunities, in construction work for example;
- Many youth leave the municipality to work on construction sites in the neighbouring provinces of Huambo, Benguela and Cunene;
- There are no professional training centres, but in some cases, courses are promoted by the National Institute for Employment and Professional Training, in partnership with the municipal administration;
- Some youth who benefit from training or professional qualification, struggle with the lack of resources or kits for entrepreneurship;
- The majority of youth are involved in agriculture and more recently, they have been driving motorbike taxis for work;
- Few youth are computer literate;
- The youth requested that the proponent should work with the municipal administration to identify local labour opportunities;
- It was requested that Contractor's are advised to invest in local labour and to promote specialised professional training courses;
- There are limited youth associations;
- In addition to providing employment opportunities for youth, the Project should allow people to access television and radio to follow national and international news about sport and other developments; and
- In the commune of Galangue, the youth highlighted the need for sports fields and recreation centres, which will help youth and teenagers.

5.6.4 Women representatives

Women took part in general meetings as well as discussion groups where they presented their views and feedback on the Project. The questions/concerns and comments made by women are summarised as follows:

- There is a lack of water in the cacimbas (water well handmade). With electricity they will be able to have access water in the fountains;
- In Galangue representatives indicated that they do not have access to seeds. Sometimes they are unable to plant on the fields;
- They understood that the families owning plots along the power line may lose crops, which will be compensated;
- The benefits arising from the Project in terms of employment opportunities could reduce family conflict;
- Representatives requested that the Project pay attention to women when recruiting; and
- Representatives were concerned about reports of national and foreign workers sexually abusing children in the areas where they work, although it was confirmed that this had never happened in the Jamba community.

5.6.5 *Khoisan* family

Feedback from the *Khoisan* family in Kassindi village, municipality of Cuvango, was not directly related to the Project. They requested the SE team to thank the Municipal Directorate for Social Affairs for the support they have received in the form of farming tools. There were no apparent areas of concern relating to the planned Project.

6 Environmental and social impact assessment

6.1 Introduction

This section of the report describes the findings of the assessment in terms of identified environmental and social impacts associated with activities linked to the Project lifecycle. An overview of the impact assessment methodology is provided followed by the results of the assessment. Finally, the significance of the biophysical and socio-economic impacts is rated both before and after management measures have been assumed to be in place. The findings of these impacts will inform the cumulative impact assessment which is also presented in this section. Relevant environmental and social issues expressed by stakeholder groups are also featured.

6.2 Summary of Biophysical and Socio-economic Impacts

Table 6-1, Table 6-2 and Table 6-3 provide summaries of the biophysical and socio-economic impacts for the Project during construction, operational and decommissioning phases. It is noted that all negative impacts can be suitably managed (reduced to a lower significance) after implementation of mitigation measures. In addition, positive impacts (benefits) can be enhanced by applying optimisation measures. These impacts will require attention and management.

More detail about the specific impact description, assessments and mitigation relating to identified biophysical and socio-economic impacts are provided in Section and Section 6.5.

Table 6-1: Summary of impact assessment during the construction phase

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biophysical aspects		
Climate change		
CC1 - Increased runoff and erosion	Low	Low
CC2 – Increased possibility of landslides due to the geomorphic changes associated with land clearance	Medium	Low
Soils, land use and land capability		
SLU1 - Loss of agricultural land capability	Medium	Low
SLU2 - Soil erosion resulting from footprint clearing and excavation	Medium	Low
SLU3 - Soil compaction due to movement of construction vehicles	Medium	Low
SLU4 - Soil contamination because of spillage of hydrocarbons	High	Low
Hydrology		
SW1 - Siltation of river systems, local disturbance to riverbanks and channels	Medium	Medium
SW2 - Indirect siltation of river systems	Low	Low
SW3 - Hydrocarbon pollution	Medium	Low
SW4 - River pollution from effluent	Medium	Low
Hydrogeology		
GW1 - Impact on community wells and available groundwater resources	Low	Low
GW2 - Potential alteration or deterioration in groundwater quality	Low	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biodiversity – Flora		
BFL1 - Loss of floral habitat and species diversity – Transformed habitat	Low	Low
BFL1 - Loss of floral habitat and species diversity – Freshwater habitat	Medium	Low
BFL1 - Loss of floral habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFL1 - Loss of floral habitat and species diversity – Miombo woodland habitat	High	Low
BFL2 - Loss of floral SCC – Transformed habitat	Low	Low
BFL2 - Loss of floral SCC – Freshwater habitat	Low	Low
BFL2 - Loss of floral SCC – Secondary Miombo habitat	Low	Low
BFL2 - Loss of floral SCC – Miombo Woodland habitat	Medium	Low
BFL3 - Floral habitat fragmentation – Transformed habitat	Low	Low
BFL3 - Floral habitat fragmentation – Freshwater habitat	Medium	Low
BFL3 - Floral habitat fragmentation – Secondary Miombo habitat	Medium	Low
BFL3 - Floral habitat fragmentation – Miombo Woodland habitat	Medium	Low
Biodiversity – Fauna		
BFA1 - Loss of faunal habitat and species diversity – Miombo Woodland habitat	Medium	Low
BFA1 - Loss of faunal habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFA1 - Loss of faunal habitat and species diversity – Freshwater habitat	Medium	Low
BFA1 - Loss of faunal habitat and species diversity – Transformed habitat	Medium	Low
BFA2 - Loss of potential faunal SCC – All habitats	Medium	Low
BFA3 - Habitat fragmentation – All habitats	Medium	Low
BFA4 - Avifaunal collisions with overhead powerlines – Miombo Woodland and Freshwater habitats	High	Medium
BFA5 - Avifaunal collisions with overhead powerlines – Secondary Miombo Woodland and Transformed habitats	High	Medium
Biodiversity – Freshwater ecosystems		
FE1/2/3/4 - Changes in runoff, smothering and disturbance of aquatic biota, increased erosion and sedimentation, changes to surface water quality, loss of foraging and breeding habitat, loss of faunal migratory corridors, proliferation of alien and invasive species	Medium	Low
FE5 - Potential temporary in-channel diversion of the freshwater crossing to allow for excavations for road crossing to take place; loss of freshwater habitat and ecological structure resulting in impacts on biota; altered runoff patterns and alteration to flow patterns, leading to increased erosion and sedimentation of the freshwater system; disturbances of soils leading to increased alien vegetation proliferation, and in turn to further altered riverine habitat; and increased risk of pollution of surface water.	Medium	Medium

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Air quality		
AQ1 - Addition of excess dust and gaseous emissions to ambient air quality	Low	Very Low
Noise		
N1 - Increase in the noise levels during land clearing	Medium	Low
N2 - Increase in the ground vibration and/or air pressure levels at the residential areas during potential blasting	Medium	Low
N3 - Increase in the noise levels during construction of OHL and associated infrastructure	Medium	Low
N4 - Increase in the noise levels during construction of internal roads and infrastructure	Medium	Low
Visual		
V1 - Visual impact associated with the construction of the OHL	Medium	Medium
V2 - Visual impact associated with the construction on the substations	Medium	Medium
Impacts due to demining of landmines		
DM1 - High-risk environmental and social impacts due to demining activities, including safety risks, habitat disturbance, and contamination	High	Medium
Social aspects		
Socio-economic		
SE1.1 - Reduced income-earning opportunities due to a loss of, or access to, farming or grazing land or access to such land	High	Medium
SE1.2 - Increased food insecurity due to loss of farming or grazing land or access to such land	High	Medium
SE1.3 - Reduced income-earning opportunities for artisanal miners due to the loss of available artisanal mining areas	Medium	Medium
SE1.4 - Disruption of access in and between communities and sites used by Khoi San people due to the presence of the transmission and distribution powerlines and substations	Medium	Low
SE1.5 - Altering the sense of place of community members and Khoi San people due to the presence of the transmission line	High	Medium
SE1.6 - Underpayment as part of economic displacement compensation conducted by state entities	High	Medium
SE1.7 - Undercompensating physically displaced PAH/ PAPs	High	Medium
SE1.8 - Increased gender marginalisation and vulnerability resulting from compensation payments to mostly male household heads	High	Medium
SE1.9 - Reduced community and Khoi San ecosystem services as a result of construction activities	High	Medium
SE2.1 - Social disruption due to disruption of access to gravesites	Medium	Low
SE2.2 - Discrimination or inadvertent exclusion of indigenous peoples (Khoi San) in consultation processes (for work opportunities or general project awareness)	High	Medium
SE3.1 - Improved household incomes and livelihoods as a result of temporary employment opportunities	Medium (+)	Medium (+)

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
SE3.2 - Increased gender marginalisation and vulnerability as a result of temporary employment opportunities	Medium	Medium
SE3.3 - Increase in social pathologies as a result of migrant worker influx and increased spending power	High	Medium
SE3.4 - Increase in the local economy as a result of increased income and spending by temporary workers/ contractors	Low (+)	Medium (+)
SE4.1 - Increased safety hazards and accidents to community members, Khoi San and livestock due to unfenced project infrastructure, unsafe access routes or speeding heavy vehicles	Medium	Medium
SE4.3 - Nuisance impacts due to air, water and noise pollution	Medium	Medium
SE4.4 - Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members	High	Medium
SE4.5 - Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	High	Medium
SE4.6 - Improved community safety after removal of UXOs from project construction footprint (Pre-construction)	Medium	High (+)
SE4.7 - Safety risk to community and personnel during removal of UXOs in project footprint (Pre-construction)	High	Medium
Cultural heritage		
CH1 - Damage to or destruction of recorded cemeteries/ burial sites	Medium	Low
CH2 - Damage to or destruction of places of worship/ sacred sites and monuments	Medium	Low
CH3 - Damage to or destruction of heritage resources	Medium	Low
Impact of upstream and downstream services		
SC1 - Supply chains and safety risks from hazardous material transport	High	Medium
SC2 - Improper waste management, and exposure to hazardous substances.	High	Low

Table 6-2: Summary of impact assessment during the operational phase

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biophysical aspects		
Climate change		
CC3 - Temperatures exceed the designed operational limits of the equipment causing equipment malfunction	Medium	Low
CC4 - Increased staff heat stress, demand for cooling and associated increase in GHG emissions	Medium	Low
CC5 - Uncontrolled release of hazardous materials or waste to surrounding environment due to flooding events	Medium	Low
CC6 - Failure of wastewater treatment facilities resulting in discharge of contaminated water to the environment	Medium	Low
CC7 - Operational disruptions or damage to Project infrastructure due to flooding	Low	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
CC8 - Operational disruptions or damage to project infrastructure due to lightning	Medium	Low
CC9 - Operational disruptions or damage to project infrastructure due to high windspeeds	Low	Low
CC10 - Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods	Medium	Low
CC11 - Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility	Medium	Low
CC12 - Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months	Low	Low
CC13 - Disruption of transportation routes due to offsite/ remote flooding related infrastructure damage.	Medium	Low
CC14 - Health and safety risks to staff associated with flooding	Medium	Low
CC15 - GHG impacts through use of SF ₆ as quencher for the substations given its high global warming potential	High	Medium
CC16 - Increasing the availability of electricity resulting in a reduction in the use of non-renewable fuels	High	High
Soils, land use and land capability		
SLU5 - Loss of high potential agricultural resources and land use resulting from placement of infrastructure on arable and cultivated fields	Medium	Low
SLU6 - Soil erosion resulting from vegetation clearing/ maintenance	Medium	Low
SLU7 - Soil compaction due to movement of vehicles	Medium	Low
SLU8 - Soil contamination because of spillage of hydrocarbons	Medium	Low
Hydrology		
SW5 - Hydrocarbon pollution from leaking substations/ transformers	Medium	Low
SW6 - Hydrocarbon pollution from vehicle traffic, overnight laydown and in-field servicing	Medium	Low
SW7 - Siltation of river systems from access roads use and possible river crossings	Medium	Low
SW8 - Siltation of river systems from pylon foundation scouring	Low	Low
SW9 - Increase in flood level due to climate change related factors	Low	Low
Hydrogeology		
No impacts are anticipated during operation	n/a	n/a
Biodiversity – Flora		
BFL3 - Loss of floral habitat and species diversity – Transformed habitat	Low	Low
BFL3 - Loss of floral habitat and species diversity – Freshwater habitat	Medium	Low
BFL3 - Loss of floral habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFL3 - Loss of floral habitat and species diversity – Miombo Woodland habitat	Medium	Low
BFL4 - Loss of floral SCC – Transformed habitat	Low	Low

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
BFL4 - Loss of floral SCC – Freshwater habitat	Low	Low
BFL4 - Loss of floral SCC – Secondary Miombo habitat	Medium	Low
BFL4 - Loss of floral SCC – Miombo Woodland habitat	Medium	Low
BFL5 - Floral habitat fragmentation – Transformed habitat	Low	Low
BFL5 - Floral habitat fragmentation – Freshwater habitat	Medium	Low
BFL5 - Floral habitat fragmentation – Secondary Miombo habitat	Medium	Low
BFL5 - Floral habitat fragmentation – Miombo Woodland habitat	Medium	Low
Biodiversity – Fauna		
BFA6 - Loss of faunal habitat and species diversity – Miombo Woodland habitat	Medium	Low
BFA6 - Loss of faunal habitat and species diversity – Secondary Miombo habitat	Medium	Low
BFA6 - Loss of faunal habitat and species diversity – Freshwater habitat	Medium	Low
BFA6 - Loss of faunal habitat and species diversity – Transformed habitat	Medium	Low
BFA7 - Loss of potential faunal SCC – All habitats	Medium	Low
BFA8 - Habitat fragmentation – All habitats	Medium	Low
BFA9 – Avifaunal and bat collisions with overhead powerlines – Miombo Woodland and Freshwater habitats	High	Medium
BFA10 – Avifaunal and bat collisions with overhead powerlines – Secondary Miombo Woodland and Transformed habitats	High	Medium
Biodiversity – Freshwater ecosystems		
FE6 - Changes in flow, pattern and timing due to increased impermeable surfaces	Low	Low
FE7 - Increased impermeable surfaces due to the presence of surface infrastructure (substations) leading to changes in runoff in the landscape	Low	Medium
FE8 - Altered timing and pattern of flows within the catchment; change in freshwater hydroperiod and changes in flood peaks; and Potential desiccation of downstream reaches of freshwater ecosystems due to blocked culverts.	Medium	Low
Air quality		
AQ2 - Addition of excess dust emissions to ambient air quality	Low	Very Low
AQ3 - Potential emission of SF ₆ from transformers and substation switchgears	Low	Very Low
Noise		
N5 - Increase in the noise levels from transformer noise, colling fans and other noise sources	Medium	Low
N6 - Increase in the noise levels from transformers at the pylons which can be intrusive	Medium	Low
N7 - Increase in the noise levels during maintenance activities	Medium	Low
Visual		
V3 - Visual impact associated with the operation and maintenance of the OHL	High	High

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
V4 - Visual impact associated with the operation and maintenance of the substations	High	High
Social aspects		
Socio-economic		
SE1.1 - Reduced income-earning opportunities due to a loss of, or access to, farming or grazing land or access to such land	High	Medium
SE1.2 - Increased food insecurity due to loss of farming or grazing land or access to such land	High	Medium
SE1.3 - Reduced income-earning opportunities for artisanal miners due to the loss of available artisanal mining areas	Medium	Medium
SE1.4 - Disruption of access in and between communities and sites used by Khoi San people due to the presence of the transmission and distribution powerlines and substations	Medium	Low
SE1.5 - Altering the sense of place of community members and Khoi San people due to the presence of the transmission line	High	Medium
SE1.6 - Underpayment as part of economic displacement compensation conducted by state entities	High	Medium
SE1.7 - Undercompensating physically displaced PAH/ PAPs	High	Medium
SE1.8 - Increased gender marginalization and vulnerability resulting from compensation payments to mostly male household heads	High	Medium
SE1.9 - Reduced community and Khoi San ecosystem services as a result of project activities	High	Medium
SE2.1 - Social disturbance due to disruption of access to gravesites	Medium	Low
SE2.2 - Discrimination or inadvertent exclusion of indigenous peoples (Khoi San) in consultation processes (for work opportunities or general project awareness)	High	Medium
SE4.2 - Safety hazards and accidents to people and livestock	High	Medium
SE4.5 - Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	High	Medium
SE5.1 - Improved access to electricity due to presence of transmission and distribution lines	High (+)	High (+)
SE5.2 - Downstream economic development	High (+)	High (+)
Cultural heritage		
CH4 - Damage to and destruction of recorded cemeteries/ burial sites	Medium	Low
CH5 - Damage and destruction of places of worship/ sacred sites and monuments	Medium	Low
CH6 - Damage to and destruction of heritage resources	Medium	Low

Table 6-3: Summary of impact assessment during decommissioning

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Biophysical aspects		
Climate change		
CC12 - GHG impacts resulting from SF ₆ emissions from substations	High	Medium
Soils, land use and land capability		
No significant impacts are anticipated during decommissioning	n/a	n/a
Hydrology		
No significant impacts are anticipated during decommissioning	n/a	n/a
Hydrogeology		
No significant impacts are anticipated during decommissioning	n/a	n/a
Biodiversity – Flora		
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Low	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Low	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Medium	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Medium	Low
BFL4 - Floral habitat fragmentation – Miombo Woodland habitat (Decommissioning)	Low	Low
Biodiversity – Fauna		
No significant impacts are anticipated during decommissioning	n/a	n/a
Biodiversity – Freshwater ecosystems		
FE9 - Soil erosion and sedimentation of freshwater due to disturbance in the landscape; Increase in bare areas including changes in runoff patterns in the landscape; proliferation of alien and invasive species within the freshwater habitat; and disturbance to aquatic biota.	Low	Low
Air quality		
AQ4 - Potential emission of SF ₆ from transformers and substation switchgears	Low	Very Low
Noise		
N8 - Increase in the noise levels during the removal of all structures through demolition	Medium	Low
N9 - Increase in the noise levels during the rehabilitation of disturbed areas	Medium	Low
N10 - Increase in the noise levels during revegetation activities	Medium	Low
Visual		
V5 - Visual impact associated with the decommissioning of the OHL	Low	Low
V6 - Visual impact associated with the decommissioning of the substations	Low	Low
Social aspects		

Impact	Impact significance	
	Before mitigation / enhancement	After mitigation / enhancement
Socio-economic		
No significant impacts are anticipated during decommissioning	n/a	n/a
Cultural heritage		
No significant impacts are anticipated during decommissioning	n/a	n/a

6.3 Impact Assessment Methodology

This section presents the impact assessment methodology utilised for this ESIA as well as the methodology applied to assess potential human rights impacts. These qualitative methodologies align and standardise specialist findings in a comprehensive impact assessment to determine the significance of identified potential impacts, whether direct, indirect and/or cumulative. The impact assessment methodology for biophysical and socio-economic aspects is presented in Section 6.4 and the methodology for human rights impacts is presented in Section 6.3.3.

The core ESIA team was responsible for integrating the specialist impact assessments. As such, it was possible to adjust certain statements and management measures to ensure that these are practical and contextually relevant.

6.3.1 Defining an impact

The following categories of impacts have been considered in the detailed impact tables further on in this section:

- Direct Impacts – impacts that are caused directly by an activity;
- Indirect Impacts – impacts caused by the direct impact but occur later in time or further in distance; and
- Cumulative Impacts – total combined impacts on the receiving environment from past, present and future activities.

Activities which were identified as the cause of the potential impact, as well as the relevant Project phase the activities are associated with are summarised in Table 6-4 below:

Table 6-4: Project activities

Project Phase	Activities
Pre-construction	Route study and survey
	Project design
	Land acquisition
	Demining
Construction	Pre-stripping
	Vegetation stripping
	Soil Stripping
	Suspension of metallic towers
	Tension of metallic towers
	Laying of concrete foundations
	Stringing of conductors
	Access roads and potential river crossings
	Contractors offices and other facilities

Project Phase	Activities
	Employment (construction workers and security)
	Establishment of Network 30kV
	Construction of transformation stations
	LV Network and Lighting
	Home Connections
	Construction of concrete poles
	Construction camp (and water management)
	Temporary laydown areas
Operation	Substation energization
	Operation of electrical infrastructure including OHL and substations
	Routine maintenance of infrastructure
	Monitoring system performance
	Storage and handling of hazardous materials
	Waste handling
	Water supply
	Cooling water discharge
	Wastewater treatment facilities
	Employment
	ASM in Project area
De-commissioning and closure	Decommissioning of the 220kV overhead lines
	Decommissioning of the substations
	Dismantling of infrastructure after de-commissioning
	Rehabilitation of construction areas
	Monitoring
	Decommissioning of temporary roads
	Waste management

6.3.2 Impact significance rating for biophysical, socio-economic and cultural heritage aspects

Practicable management measures will be recommended that avoid, and if avoidance is not possible, then reduce, restore, compensate/offset negative impacts, enhance positive impacts and assist Project design. The impact significance rating system is presented in Table 6-5 and involves three parts:

- Part A: Defines impact consequence using the three primary impact characteristics of magnitude, spatial scale and duration;
- Part B: Uses the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and
- Part C: Uses the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from Part B) and the probability of occurrence.

Table 6-5: Method for rating the significance of impacts

PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE					
Use these definitions to define the consequence in Part B					
Impact characteristics		Definition		Criteria	
MAGNITUDE	Major -		Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded		
	Moderate -		Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded		
	Minor -		Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded		
	Minor +		Minor improvement; change not measurable; or threshold never exceeded		
	Moderate +		Moderate improvement within or better than the threshold; or no observed reaction		
	Major +		Substantial improvement; within or better than the threshold; or favourable publicity		
SPATIAL SCALE OR POPULATION	Site		The area that is directly exposed to Project facilities (i.e. Project footprint)		
	Local		The area affected by the Project's direct impacts, i.e. impacts that result from the direct interaction between Project's infrastructures, routine Project activities and the receiving environment		
	Regional		the wider geographic area affected by the indirect impacts of the Project's infrastructures and activities and/or impacts resulting from unforeseen (accidental) Project activities, specifically the potential impacts in the unlikely event to occur		
DURATION	Short term		Up to 18 months.		
	Medium term		18 months to 5 years		
	Long term		Longer than 5 years		
PART B: DETERMINING CONSEQUENCE RATING					
Rate consequence based on definition of magnitude, spatial extent and duration					
			SPATIAL SCALE/ POPULATION		
			Site	Local	Regional
MAGNITUDE					
Minor	DURATION	Long term	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	DURATION	Long term	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium

PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE					
Use these definitions to define the consequence in Part B					
Major	DURATION	Long term	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High
PART C: DETERMINING SIGNIFICANCE RATING					
Rate significance based on consequence and probability					
		CONSEQUENCE			
		Low	Medium	High	
PROBABILITY (of exposure to impacts)	Definite	Medium	Medium	High	
	Possible	Low	Medium	High	
	Unlikely	Low	Low	Medium	

Notes: + denotes a positive impact.

Using the matrix, the significance of each described impact is initially rated. This rating assumes the management measures inherent in the Project design are in place.

Management recommendations and post management significance

Practicable **management measures** were then suggested:

“Recommendations for management should focus on *avoidance*, and if avoidance is not possible, then to *reduce, restore, compensate/offset negative impacts*, enhance positive impacts and assist Project design.”

The significance of impacts was then re-assessed **with** assumed management measures in place (“**after management**”). Specialists also recommended and described appropriate **monitoring** and review programs to track the efficacy of management measures.

An example of the table used to report the significance rating for each impact before and after the implementation of mitigation / management measures, and listing these measures, is provided as Table 6-6.

Table 6-6: Impact significance rating and mitigation measures for the impact

Activity: XXXX								
Project phase: XXXX								
Impact Summary: XXXXX								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Long term	Site / local	Medium	Possible	Medium	-	Medium
Management Measures:								
After Management	Minor	Short term	Site / local	Low	Unlikely	Low	-	Medium

6.3.3 Human rights impact assessment methodology

The human rights impact assessment methodology is based on international good practice standards and guidance such as the International Bill of Rights and the UNGP.

Drawing on the assessment team's experience and stakeholder feedback, the potential risks and impacts of the Project were prioritised according to the UNGP criteria, focusing on the severity and likelihood of risks to people. As illustrated in the text box below, the UNGPs enable companies to concentrate their attention and resources on their "salient human rights issues", provided they prioritise based on the potential severity of human rights impacts in a principled manner.

UNGP 24: Where it is necessary to prioritise actions to address actual and potential adverse human rights impacts, business enterprises should first seek to prevent and mitigate those that are most severe or where delayed response would make them irremediable.

This means that while business enterprises should address all their adverse human rights impacts, it may not always be feasible to address them all at once. In the absence of specific legal guidance, if prioritisation is required, businesses should start with the human rights impacts that are most severe, acknowledging that a delayed response may impact the ability to remedy the situation. In this context, severity is a relative concept, compared to the other human rights impacts the business has identified.

Severity

According to the UNGPs, **severity** is determined by three factors: the **scale** (gravity) of the impact, the **scope** (number) of affected stakeholders, and **irremediability** (the limits on the ability to restore those affected to their prior situation). The five levels of severity that can be assigned based on these considerations are summarised in Table 6-7. While determining severity is not an exact science, the following considerations are taken into account:

- Not all criteria need to be present to constitute a severe impact. For instance, a significant and irremediable impact on a single individual, such as a fatality, can still be severe;
- Certain human rights impacts are inherently severe or egregious, such as violations of freedom from torture or forced labour; and
- Some human rights impacts are interconnected and may lead to more severe consequences. For example, infringement on trade union rights can affect other workers' rights, and displacement can impact several human rights.

Table 6-7: UNGP severity ratings

Severity	UNGP criteria	Examples
Level 5	• Major impact • Multiple stakeholders affected • Cannot be fully remediated	• Possibility of fatality or loss of life • Something shocking to the conscience such as torture
Level 4	• Significant impact • Multiple stakeholders affected • Difficult to remediate	• Possibility of serious injury, disability or long-term illness • Interconnected impacts such as land and displacement • Systematic or discriminatory impacts on a vulnerable group
Level 3	• Moderate impact • Small number of stakeholders affected • Can be remediated with compensation	• Although they can be addressed, they still have a serious implication or perception and could potentially escalate without remediation

Severity	UNGP criteria	Examples
Level 2	- Minor impact - Individual stakeholders affected - Limited remediation required	A more “technical breach” of human rights standards that can be repaired through policy changes, apologies and commitment to address the problem
Level 1	- Negligible impact - Individual stakeholders affected - Little or no remediation not required	Social, environmental or human resource issues or impacts that have not been raised to a level of a human rights impact, but still should be monitored in case of escalation or cumulative impacts

Likelihood

Likelihood is the second factor in assessing human rights impacts and positioning them on a human rights heat map. The levels of likelihood that can be assigned are summarised in Table 6-8. Factors to consider when assessing likelihood include:

- Gaps in national laws, policies, and their implementation/enforcement can increase the likelihood of impacts;
- Corruption can also elevate the likelihood of impacts by weakening accountability and the rule of law;
- Poverty raises the likelihood of impacts on a range of human rights; and
- Certain types of projects have a higher likelihood of impacts (e.g., ASM, agriculture, informal businesses).

Table 6-8: UNGP likelihood ratings

Level 5	Level 4	Level 3	Level 2	Level 1
- Virtually certain - Is occurring or has occurred in the past and root causes have not been addressed	Probable that an impact will occur in the short- or medium-term	Possible that an impact will occur at some point over the lifespan of the operation	Unlikely, but it is not impossible in the context	- Very unlikely in the context - Has not occurred in the past

Other factors

Vulnerability and mitigation measures can also influence severity and likelihood ratings as follows:

- The vulnerability of individuals and groups can make them more likely to experience adverse impacts and to experience those adverse impacts more severely than others; and
- Mitigation measures can reduce the likelihood of an impact occurring, as well as the potential severity of the impact.

Heat map

The human rights heat map combines the outcomes of the severity and likelihood ratings. The outcome of the Project’s human rights heatmap is shown in Section 6.5.3. According to the UNGPs, severity is the primary consideration, which is why there are more red squares on the heat map, even for some low-likelihood impacts.

Cause, contribution and direct linkage

Another crucial aspect of the HRIA process is understanding how the Project is associated with the various identified impacts. A project can be linked to human rights impacts in different ways. According to the UNGPs, a company’s responsibility varies based on whether it “causes, contributes to, or is directly linked” to the human rights impact. Table 6-9 outlines these distinctions.

Table 6-9: Type of mitigations assigned based on project relationship with human rights impact (OHCHR, 2017)

If a project:	Causes an impact	Contributes to an impact	Is linked to an impact
Then it should:	Prevent or mitigate the impact	- Prevent or mitigate its contribution to the impact - Use or increase its leverage with other responsible parties to prevent or mitigate the impact - Contribute to remediate the harm of the impact to the extent of its contribution	- Use or increase its leverage with other responsible parties to prevent or mitigate the impact - No responsibility to remediate, but the project should consider how to enable remedy

It is important to recognise that the Project might not directly or solely cause the potential impacts. However, determining whether the Project contributes to the impact (versus being directly linked) requires a fact-specific inquiry. This involves assessing whether the Project could actively incentivise, passively permit certain activities by third parties, and/or fail to exercise sufficient control over third parties. If there are impacts that are known or easily predictable, the Project may contribute to those impacts if it does not conduct adequate due diligence and implement appropriate controls over third parties.

The assessment of cause, contribution, or linkage may change over time.

Additionally, from a reputational perspective, external stakeholders often do not make nuanced distinctions between cause, contribution, and linkage and may hold a project, company, or entity responsible for all impacts associated with the project, perceiving it as complicit in those impacts.

6.4 Biophysical Impacts

The sections that follow outline the potential biophysical impacts associated with all phases the Project (i.e. construction, operation and decommissioning) for climate change, soils, water resources, biodiversity, air quality, noise and visual aspects. For additional information on the impacts related to waste management and natural resource consumption, please refer to the Addendum to the ESIA (Volume 6).

Each impact area is briefly described based on the current baseline conditions or modelled outputs, impacts are stated, and their respective assessments presented as well as the impact tables.

6.4.1 Climate change impacts

Baseline conditions and predicted changes

Hazards identified in terms of local climate change predictions (refer to Section 4.2.4) arising from the current baseline conditions and CIMP6 are:

- A trend of increasing temperatures;
- A small increasing trend in annual rainfall up to 2.9%;
- An increase in maximum 1-day and 5-day rainfall, with the potential risk of flooding most likely to occur in January; and
- An increased in I number of consecutive dry days resulting in droughts as rainfall is predicted to decrease at the beginning and end of the dry season.

These climate change predictions present several risks to Project infrastructure and staff, which can induce impacts.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The following impact associated with construction activities such as land clearing has been identified:

- Chronic - Increased runoff and erosion resulting in exacerbated loss of soil resources and impacts to water resources if clearance is undertaken during the wet season or large cleared areas are left unvegetated; and
- Acute - Increased possibility of landslides near Chipindo due to the geomorphic changes associated with land clearance and if large, cleared areas are left unvegetated.

The following direct impacts related to the operational activities of the Project have been identified:

- Temperatures exceed the designed operational limits of the equipment, ultimately affecting operation and increasing energy demand;
- Increasing temperatures are likely to result in heat stress to staff working outside, additional cooling requirements, and therefore, a greater GHG emission footprint;
- Uncontrolled release of hazardous materials to surrounding environment could occur should hazardous storage facilities flood;
- Failure of wastewater treatment facilities to contain increased volumes of contaminated water may result in overflow of contaminated water to the environment;
- Operational disruptions or damage to project infrastructure due to flooding;
- Operational disruptions or damage to project infrastructure due to lightning;
- Operational disruptions or damage to project infrastructure due to high windspeeds;
- Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods;
- Increased prevalence or intensity of wildfires during extended dry periods; and
- Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility.

Indirect impacts which may influence operations are as follows:

- Chronic - Increased prevalence of vector borne diseases (e.g. malaria) due to higher temperatures and rainfall in certain months;
- Acute - Disruption of electricity supply due to damage to infrastructure caused by flooding;
- There are a number of transitional impacts and opportunities, namely:
 - Chronic - GHG impacts from the use of Sulfur Hexafluoride (SF₆) as a substation arc quencher due to its significant global warming potential; and
 - Chronic/Long-term - Increasing the availability of electricity (hydroelectric) may in turn reduce the use of non-renewable fuels like paraffin or Liquefied Petroleum Gas (LPG). This is therefore a transitional opportunity or positive impact of the Project.

The following impact was identified during the decommissioning phase of the Project:

- GHG impact from the use of SF₆. While SF₆ emissions during normal equipment operation are small, end-of-life treatment is a significant source of emissions. This release would be once-off but as GHG's remain in the atmosphere long term the impact would be chronic.

Impact description

Climate change induced impacts are presented in the section below and in Table 6-10 to Table 6-12 for the construction, operational and decommissioning phases.

Vegetation clearance undertaken during the construction phase exposes land to more rapid geomorphic changes. This is especially exacerbated during flood events, which are predicted to increase in December and January each year for all climate change scenarios. This is, however, not

anticipated to be a highly significant risk for the site (based on the extent of land clearance required). The sensitive receptors for increased runoff and erosion are the local water sources and community members relying on them, considered vulnerable, hence resulting in a higher magnitude impact. For landslides, the receptors include nearby community members and site infrastructure. Although the community is vulnerable, the infrastructure is replaceable, contributing to a moderate magnitude impact.

During the operation phase, risks to the Project arising from climate change and its associated indirect impacts are largely influenced by the resilience. Resilience is defined in the IPCC's Fourth Assessment Report (AR4) as "*The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization and the capacity to adapt to stress and change*". Hence, while the Project and community would experience the same impact, the operator would have the skills, resources, and financial means to recover quickly in contrast to the surrounding community that may not have access to the resources required to recover as quickly. The significance of the impact to the community would therefore be higher than for the Project, despite the activity and consequence of the impact being the same. Following this approach, the significance of the impacts identified is described in more detail below.

Increased temperature

Given the hot climate conditions (i.e. a maximum temperature of approximately 38°C) in the study area, the predicted increase in maximum temperature (i.e. up to 2.1 °C) is expected to be significant. Equipment operating thresholds may be exceeded during episodes of extreme high temperature resulting in a drop in production, an increase in the operational energy demand, or complete equipment failure. Although it is noted that the electrical reticulation infrastructure has been designed for a maximum temperature of 50°C, it is unclear whether the rest of the distribution network and substations have been designed to withstand the same maximum temperature. Increasing temperatures are also likely to result in heat stress to staff working outside, additional cooling requirements, and thus, a greater GHG emissions footprint.

Increased prevalence of extreme weather

The increase in annual rainfall, and more importantly the 1-and-5-consecutive-day maximum rainfall events, may potentially disrupt operations and damage hazardous storage infrastructure. In this instance, significant downstream impacts could arise during a flooding event if hazardous materials are released into streams and rivers. This is exacerbated by the fact that the planned OHLs cross numerous watercourses that serve as a water source and provisioning service to local communities and ecosystems respectively.

In addition, should wastewater treatment facilities not be designed to accommodate the changing rainfall patterns (i.e. increased rainfall and flood frequency), it is possible that these facilities could be damaged and release contaminated water into surface water resources.

Although flooding offsite could disrupt electricity transmission and road transportation, onsite operations are considered resilient to these risks and resultant impacts. Damage to Project infrastructure due to flooding, lightning strikes or high windspeeds can disrupt electricity supply to energy users (e.g. government offices, businesses and communities). Furthermore, longer dry periods in the middle of the year is likely to increase the prevalence and intensity of fires, which may start naturally after lightning strikes or arise at Project infrastructure such as the substations. These fires can impact substations and distribution networks as well as surrounding communities.

Indirect risks

It is anticipated that there will be an increase in the prevalence of vector borne diseases following the predicted increases in temperature, rainfall and relative humidity. This is particularly notable for malaria, which is a major health problem in Angola. There was a total of 8.8 million cases of malaria in the country in 2021, with 17,836 related deaths in the same year (WHO, 2023). Given the prevalence

of malaria in the region, it is expected that lost time injuries will be incurred. Angola faces several vector borne diseases associated with water and/ or domestic effluent management.

Onsite and wider flooding could damage road infrastructure and potentially impact Project operations and disrupt and/or temporarily sever the supply of maintenance equipment and access to goods and services such as clinics and hospitals. Interruptions to transportation routes are known to currently occur in and surrounding the study area, and this expected to worsen considering the predicted climate changes.

Transitional risks and opportunities

SF₆ will be used in the Project substations. SF₆ gas is compressed and stored in high-pressure reservoirs within circuit breakers. During operation and mainly when arcs occur in the breaker, SF₆ gas is released through the arc and collected in a lower-pressure reservoir. This gas is then pumped back to the high-pressure reservoir for reuse.

SF₆-containing equipment (substations, for example) will be designed to prevent gas emissions into the atmosphere. However, leaks can occur during various stages of the equipment's lifecycle. Furthermore, aging equipment may develop significant leaks, ultimately allowing SF₆ to escape. Although the amount of SF₆ in the substations has yet to be quantified, it is likely to result in a substantial impact if released given the Global Warming Effect of the gas.

The increased availability of electricity in towns in the Huíla and Huambo provinces may lead to a reduction in the use of non-renewable fuels by some residents. Presently, wood and charcoal are largely used for cooking and diesel generators provide lighting. The Project therefore offers a transitional opportunity (positive impact).

While SF₆ emissions during normal operations are considered negligible and are only likely to occur due to leaks in aging equipment, end-of-life treatment of equipment during decommissioning activities could result in significant emissions. According to the IPCC's Fifth Assessment Report (AR5), the Global Warming Potential for SF₆ is 23 500. This means that one tonne of SF₆ has the same impact on global warming as 23 500 tonnes of CO₂. The release of this gas could impact Angola's ability to achieve their NDC commitments.

Impact assessment

The impact significance ratings of the identified potential climate change related impacts for all Project phases are provided in Table 6-10 to Table 6-12. Management measures are also presented in the tables.

Table 6-10: Assessment of climate change impacts (construction phase)

Activity: Land Clearance								
Project phase: Construction								
CC1 – Impact Summary: Increased runoff and erosion resulting in further loss of soil resources and impacts to water resources if clearance is undertaken during the wet season or large cleared areas are left unvegetated.								
Risk Type: Chronic								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Minor (-)	Short term	Local	Low	Possible	Low	-	Medium
Management Measures:								
1. Clearing of land must kept to a minimum and should only take place immediately prior to the start of construction activities as per the Vegetation and Land Clearance Management Plan;								

2. Rehabilitation of cleared areas must take place as soon as construction activities have been concluded as per the Rehabilitation and Revegetation Management Plan; and 3. Land clearing should be avoided during December and January when heavy rainfall is most likely to occur. Should this not be possible, erosion management measures should be implemented in line with the BMP.								
After Management	Minor (-)	Short term	Local	Low	Unlikely	Low	-	Medium
CC2 – Impact Summary: Increased possibility of landslides near Chipindo due to the geomorphic changes associated with land clearance and if large cleared areas are left unvegetated.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate (-)	Short term	Local	Medium	Possible	Medium	-	Low
Management Measures:								
1. Construction activities must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of works and rehabilitated as soon as possible thereafter. 2. Land clearing should be avoided during December and January when heavy rainfall is most likely to occur.								
After Management	Minor (-)	Short term	Local	Low	Unlikely	Low	-	Medium

Table 6-11: Assessment of climate change impacts (operation phase)

Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC3 - Impact Summary: Temperatures exceed the designed operational limits of the equipment causing equipment malfunction and electricity disruptions.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate (-)	Short term	Local	Medium	Possible	Medium	-	Medium
Management Measures:								
1. Ensure all equipment is appropriately designed for temperatures up to 50°C; and 2. Ensure substations are fitted with a fire suppression system which is regularly inspected and maintained in line with the EPRP and Fire Risk and Prevention Management Plan.								
After Management	Moderate (-)	Short term	Local	Medium	Unlikely	Low	-	Medium
CC4 - Impact Summary: Increased staff heat stress, demand for cooling and associated increase in GHG emissions.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Minor (-)	Short term	Site	Low	Definite	Medium	-	Medium
Management Measures:								
1. Ensure actions and management measures are in line with the OHS Management Plan; 2. Develop and roll out a toolbox talk to educate staff of heat stress and preventative measures; 3. Tailor work schedules to limit employee exposure during the hottest times of the day; and 4. Make sufficient water and other PPE available to limit sun/ heat exposure.								
After Management	Minor (-)	Short term	Site	Low	Possible	Low	-	Medium

Activity: Management of hazardous materials								
Project phase: Operation								
CC5 - Impact Summary: Uncontrolled release of hazardous materials or waste to surrounding environment due to flooding events.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate (-)	Medium term	Local	Medium	Possible	Medium	-	Low
Management Measures:								
1. Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent the flooding and damage to hazardous storage/management areas; and 2. Store all hazardous materials in enclosed buildings and containers as specified in the Material Safety Data Sheets (MSDS) as per the Hazardous Materials Management Plan.								
After Management	Minor (-)	Medium term	Local	Low	Unlikely	Low	-	Low
Activity: Management and disposal of general cleaning and maintenance wastewater and cooling water discharge								
Project phase: Operation								
CC6 - Impact Summary: Failure of wastewater treatment facilities resulting in discharge of contaminated water to the environment.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate (-)	Medium term	Local	Medium	Possible	Medium	-	Low
Management Measures:								
1. Oil traps and other wastewater containment and treatment facilities should be designed to accommodate additional annual and extreme rainfall predicted; and 2. Oil traps and other wastewater containment and treatment facilities should be regularly inspected and drained as appropriate as per the Oil Spill Response Plan in terms of prevention and the Pollution Prevention and Abatement Management Plan.								
After Management	Minor (-)	Medium term	Local	Low	Possible	Low	-	Low
Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC7 - Impact Summary: Operational disruptions or damage to Project infrastructure due to flooding								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate	Short Term	Site	Low	Possible	Low	-	Medium
Management Measures:								
1. Adhere to conservative offsets from the stream centrelines as indicated in Volume 3, Appendix D2 and as per the Flood Management Plan. If pylons and infrastructure are required to be placed within these offsets, detailed surveys and floodline calculations will be required at the crossings; 2. Ensure all substations are located outside of the 1:100 year flood line; and 3. Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent any hazardous storage areas flooding as per the Stormwater Management Plan and Hazardous Materials Management Plan.								

After Management	Moderate	Short Term	Site	Low	Unlikely	Low	-	Medium
Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC8 - Impact Summary: Operational disruptions or damage to project infrastructure due to lightning								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate	Short Term	Local	Medium	Possible	Medium	-	Low
Management Measures:								
1. The infrastructure will be fitted with lightning protection to reduce risks. The Disaster Management Plan (or EPRP) should include measures to address damage to infrastructure as a result of lightning.								
After Management	Minor	Short Term	Local	Low	Unlikely	Low	-	Low
Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC9 - Impact Summary: Operational disruptions or damage to project infrastructure due to high windspeeds.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Minor	Short Term	Site	Low	Possible	Low	-	Low
Management Measures:								
1. Update baseline meteorological data sets every 5 years with available monitoring data and implement infrastructure upgrades/ reinforcement as applicable.								
After Management	Minor	Short Term	Site	Low	Unlikely	Low	-	Medium
Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC10 – Impact Summary: Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods.								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate	Medium term	Local	Medium	Possible	Medium	-	Low
Management Measures:								
1. Ensure the Emergency Preparedness and Response Plan (EPRP) addresses the safety risk of fires to Project infrastructure and communities. The plan should detail measures to reduce fire risk and manage the extent of damage as a result of fires in line with the Fire Risk and Prevention Management Plan.								
After Management	Moderate	Short Term	Local	Medium	Unlikely	Low	-	Low
Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC11 – Impact Summary: Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence

Before Management	Moderate	Medium term	Local	Medium	Possible	Medium	-	Low
Management Measures: 1. Ensure that all areas have been revegetated as required in the ESMP. 2. Undertake monitoring of steep slope areas to identify areas that become denuded of vegetation.								
After Management	Minor	Medium term	Local	Low	Unlikely	Low	-	Medium
Activity: Operation of electrical infrastructure including OHLs and substations								
Project phase: Operation								
CC12 - Impact Summary: Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months.								
Risk Type: Chronic								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate	Short Term	Site	Low	Possible	Low	-	Medium
Management Measures: 1. Create and roll out a staff awareness campaign to educate staff of vector borne diseases (e.g. malaria) and preventative measures as per the OHS and CHSS Management Plans; and 2. Provide any equipment/ vaccines or other materials to support staff in preventing disease as per the OHS and CHSS Management Plans.								
After Management	Moderate	Short Term	Site	Low	Unlikely	Low	-	Medium
Activity: Maintenance of electrical infrastructure including lines and substations								
Project phase: Operation								
CC13 - Impact Summary: Disruption of transportation routes due to offsite/ remote flooding related infrastructure damage.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Major	Short term	Site	Medium	Definite	Medium	-	Medium
Management Measures: 1. Identify and map all alternative access route as per the Traffic and Transportation Management Plan and Flood Management Plan; and 2. Identify local community members to be upskilled to undertake emergency maintenance (e.g., safely empty oil traps during heavy rainfall).								
After Management	Moderate	Short term	Site	Low	Possible	Low	-	Medium
Activity: Maintenance of electrical infrastructure including lines and substations								
Project phase: Operation								
CC14 – Impact Summary: Health and safety risks to staff associated with flooding.								
Risk Type: Acute								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Major	Short term	Site	Medium	Possible	Medium	-	Low
Management Measures: 1. Include emergency evacuation routes and protocols during flood events for staff that may be undertaking infrastructure maintenance in the Disaster Management Plan (or EPRP). The emergency evacuation routes and protocols must form part of induction and be included annually in safety training.								

After Management	Moderate	Short term	Site	Low	Unlikely	Low	-	Low
Activity: Operation of electrical infrastructure including lines and substations								
Project phase: Operation								
CC15 - Impact Summary: GHG impacts through use of SF₆ as quencher for the substations given its high global warming potential.								
Risk Type: Chronic								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Moderate	Long Term	Regional (Global)	High	Definite	High	-	High
Management Measures:								
1. A comprehensive assessment of operational GHG emissions must be conducted as the Project setup progresses and before construction operations, to ensure compliance with relevant standards such as EP4 and IFC PS3 and to provide a clearer picture of the Project's overall GHG emissions profile. This assessment will assist with the management of fugitive emissions from equipment, including SF₆, and will aid in the implementation of strategies to effectively manage and reduce GHG impacts; 2. Regular maintenance of the substations, specifically the arc quenchers (breakers), must be undertaken to limit the potential for gas leaks as per the Maintenance Management Plan and Pollution Prevention and Abatement Management Plan; and 3. Consider the use of alternative refrigerants with a lower global warming potential.								
After Management	Minor	Medium	Regional (Global)	Medium	Definite	Medium	-	Medium
CC16 - Impact Summary: Increasing the availability of electricity resulting in a reduction in the use of non-renewable fuels.								
Risk Type: Chronic								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Minor	Long Term	Regional (Global)	High	Definite	High	+	Medium
Management Measures:								
1. As part of community development activities, promote the use of affordable electrical appliances over non-renewable energy alternatives through subsidies and awareness-raising.								
After Management	Moderate	Long Term	Regional (Global)	High	Definite	High	+	High

Table 6-12: Assessment of climate change impacts (decommissioning phase)

Activity: Decommissioning of substations OHL infrastructure								
Project phase: Decommissioning								
CC17 - Impact Summary: GHG impacts resulting from SF₆ emissions from substations.								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ / -	Confidence
Before Management	Major	Long Term	Regional (Global)	High	Definite	High	-	High
Management Measures:								
1. Consider the use of alternative refrigerants with a lower global warming potential in line with the Pollution Prevention and Abatement Management Plan; and 2. Alternatively, investigate options to capture all SF₆ gas during decommissioning.								
After Management	Moderate	Medium	Regional (Global)	High	Possible	Medium	-	Medium

6.4.2 Soils, land use and land capability impacts

Baseline conditions

The Project footprint areas are dominated by Ferralsols, Acrisols, Plinthosols, Leptosols and Anthrosols. These soils range between moderately deep to very deep and are well-drained, red and yellow soils. The topsoil of most soils has a sandy loam texture, but the clay content increases in the subsoil horizon, thus causing a low infiltration rate in the subsoils. The soil types associated with the Project can be classified as arable and are of moderate to high agricultural potential and can support a wide range of cultivated crops. A detailed overview of the baseline conditions is provided in Section 4.

Stakeholder issues and concerns:

Farmers are concerned about the loss of fertile fields where infrastructure is installed.

Impact identification

Key potential impacts of the Project on soils, land use and land capability include:

- The loss of high potential agricultural resources and land use resulting from placement of infrastructure on arable and cultivated fields;
- Soil erosion resulting from footprint clearing and excavation activities;
- Soil compaction due to movement of construction vehicles of good potential agricultural soils; and
- Soil contamination because of spillage of hydrocarbons.

Impact description

Loss of agricultural land capability

The powerline traverses actively cultivated agricultural fields which are utilised for subsistence farming within the rural communities. Therefore, the perceived overall impact on the loss of agricultural land capability is anticipated to be medium without mitigatory measures being implemented and low with adequate mitigation measures put in place to minimise potential impacts.

Soil erosion

Soil erosion is largely dependent on land use and soil management and is generally accelerated by anthropogenic activities. In the absence of detailed guidelines on erosion classification, the erosion potential and interpretation are based on field observations as well as observed soil profile characteristics. In general, soils with high clay content have a high-water retention capacity and are thus less prone to erosion in comparison to sandy textured soils, which in contrast are more susceptible to erosion. The proposed Project development footprint is located on a gradually sloping terrain. Soils that are vegetated will be more susceptible to erosion during the construction phase if left bare or if not vegetated before the rainy season as they will be exposed to wind and storm water. The severity of this impact is anticipated to be medium. However, with the appropriate mitigation measures the significance of this impact can be reduced to low.

Soil compaction

Heavy equipment traffic during the Project construction activities is anticipated to cause soil compaction. The soils within the study area will be subjected to compaction as there will be a significant increase in the use of vehicles and heavy machinery during the construction phase. Construction work that takes place when the soil is wet may increase the soils susceptibility to compaction. However, the

significance of the impact is perceived to be medium to low if unmanaged and low with mitigation measures. It is anticipated that this impact will be localised and restricted to access roads, vehicle hardstand areas and equipment and machinery laydown areas.

Potential soil contamination

Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during the construction and operational phases. Thus, all the identified soils are considered equally predisposed to potential contamination. The significance of soil contamination is anticipated to be high for all identified soils (except Technosols) without mitigation and medium with mitigation. This largely depends on the nature, volume and/or concentration of the contaminant of concern as well as the rate at which contaminants are transported by water in the soil. If the management protocols are not well executed, this will more likely lead to:

- Contaminants leaching into the soil and thus potentially rendering the soil sterile thereby reducing the yield potential of soils; and
- Potential reduction of water quality used as a resource by communities and their livestock.

Impact assessment

The impact significance ratings of the identified potential impacts on soils, land use and land capability during construction and operation phases are provided in Table 6-13 to Table 6-14. Management measures are also presented in the tables. Impacts associated with the decommissioning phase are considered to be similar to those of the construction phase, albeit less severe.

Table 6-13: Soil impact assessment (construction phase)

Activity: Site preparation and removal of soils as part of infrastructure establishment								
Project phase: Construction								
SLU1 – Impact Summary: Loss of high potential agricultural resources and land use resulting from placement of infrastructure on arable and cultivated fields								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Long term	Site	Medium	Definite	Medium	-	Medium
Management Measures: 1. The footprint of the proposed development and construction activities should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible as per the Vegetation and Land Clearance Management Plan; 2. Infrastructure footprint areas should be clearly demarcated to avoid unnecessary disturbance of adjacent soils; 3. Where possible the pylons should be located outside actively cultivated plots to ensure that the agricultural activities remain uninterrupted during all Project phases; 4. Access roads should be aligned to the existing roads as far as practically possible to avoid further potential impacts on agricultural soils through unnecessary soil disturbance as per the BMP; 5. Uncontrolled construction vehicle and heavy machinery/equipment movement should be limited to the Project construction and operational areas to avoid unnecessary compaction of adjacent soils; 6. Revegetate adjacent areas with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions as per the Rehabilitation and Revegetation Management Plan; 7. In working areas that are close to sensitive receptors (e.g. communities), bare soils within the access roads should be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted in line with the Air Quality and Dust Control Management Plan; 8. Contamination prevention measures should be addressed in the ESMP for the proposed Project, which should be implemented by all contractors and onsite construction crew; 9. A spill prevention and emergency spill response plan, as well as dust suppression and fire prevention plans should also be compiled to guide the construction works based on the EPRP; 10. An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur as well as prevent contamination; and 11. Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium

Project phase: Construction								
SLU2 - Impact Summary: Soil erosion resulting from footprint clearing and excavation activities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-12 presented in SLU1.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Project phase: Construction								
SLU3 - Impact Summary: Soil compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-12 presented in SLU1.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Project phase: Construction								
SLU4 - Impact Summary: Soil contamination because of spillage of hydrocarbons								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Local</i>	High	<i>Possible</i>	High	-	<i>Medium</i>
Management Measures: Apply measures 1-12 presented in SLU1.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>

Table 6-14: Soils impact assessment (operation phase)

Activity: Operation, servicing, and maintenance of infrastructure								
Project phase: Operation								
SLU5 - Impact Summary: Loss of high potential agricultural resources and land use resulting from placement of infrastructure on arable and cultivated fields								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: - Maintenance vehicles should be checked for oil leaks prior to commencement of maintenance activities; - Monitoring of erosion should occur after every major rainstorm until such a time that vegetation has fully established in line with the BMP. Any erosion should be captured and recorded and reported during the Environmental Compliance Officer (ECO) site visit; - Maintenance vehicles should be restricted to demarcated access roads as far as practically possible to minimise soil compaction on adjacent soils as per the Erosion and Soil Management Plan; and - Disturbed areas adjacent to the footprint area should be revegetated with indigenous grass mix to limit potential soil erosion as per the Rehabilitation and Revegetation Management Plan.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>

Activity: Operation, servicing, and maintenance of infrastructure								
Project phase: Operation								
SLU6 - Impact Summary: Soil erosion resulting from vegetation clearing/ maintenance								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-4 presented in SLU5.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Project phase: Operation								
SLU7 - Impact Summary: Soil compaction due to movement of vehicles of good potential agricultural soils								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-4 presented in SLU5.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Project phase: Operation								
SL8 - Impact Summary: Soil contamination because of spillage of hydrocarbons								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-4 presented in SLU5.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>

6.4.3 Water resources impacts

The following section provides the assessment of Project induced impacts on water resources, including hydrology and hydrogeology.

Hydrology

Baseline conditions

Surface water resources in the Project area predominantly include first order streams being tributaries of larger river systems, which include the Cuandeja River, Cubango River and Cunene River. The OHL route crosses multiple smaller rivers where it is anticipated that construction related impacts will be evident. A more detailed description of hydrology is presented in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The key identified potential impacts on surface water resources in the Project area include:

- Siltation of receiving streams;
- Hydrocarbon pollution in receiving streams; and
- River pollution from grey and black water.

The key potential impacts are similar across the Project phases, namely construction, operation and decommissioning, and vary in terms of impact significance.

Impact description

During the construction phase, Project activities are likely to give rise to impacts including the siltation and potential hydrocarbon pollution of nearby first and second order streams due to vehicle movement in close proximity to and crossing watercourses. These activities could lead to the disturbance of riverbanks and channels resulting in siltation of watercourses. It is anticipated that these impacts will be limited to the wet season where normal surface runoff will wash the pollutants and sediment into the receiving streams and rivers. Additionally, grey and black water effluent arising from construction camps ablution facilities can potentially enter watercourses through leaks and mismanagement.

Project activities associated with the operational phase have the potential to give rise to similar impacts to construction based largely on maintenance activities. Maintenance activities and vehicle movement in close proximity to watercourses have the potential of causing increased siltation and hydrocarbon pollution in streams and rivers. Once again, these impacts will be largely limited to the wet season where normal surface runoff will wash the pollutants and sediment into the receiving streams and rivers. High flow events may cause scouring around pylon foundations if they are constructed within flow zones. Additionally, these impacts may be exacerbated by an increase in flood events and flood peaks possibly attributed to climate change.

During the decommissioning phase, several activities (e.g. removal of equipment, dismantling of infrastructure and rehabilitation of access roads) will be undertaken requiring the movement of vehicles and trucks within the Project area. As in the case of other Project phases, these activities in close proximity to watercourses can potentially result in the siltation and hydrocarbon pollution of receiving streams and rivers. These impacts will be limited to the wet season where normal surface runoff will wash the pollutants and sediment into the receiving streams and rivers.

The perceived overall hydrological impacts are anticipated to be medium to low without mitigatory measures being implemented and low with adequate mitigation measures put in place to minimise potential impacts.

Impact assessment

The impact significance ratings of the identified potential impacts on surface water during all Project phases are provided in Table 6-15 to Table 6-16. Management measures are also presented in the tables. Impacts associated with the decommissioning phase are considered to be similar to those of the construction phase, albeit less severe.

Table 6-15: Hydrology impact assessment (construction phase)

Activity: Access roads (and possible river crossings) construction and construction camp removal								
Project phase: Construction								
SW1 - Impact Summary: Siltation of river systems, local disturbance to riverbanks and channels								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures:								
1. Where possible, the revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase in line with the Rehabilitation and Revegetation Management Plan.								
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Activity: Pylon foundation construction								
Project phase: Construction								
SW2 - Impact Summary: Indirect siltation of river systems								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Management Measures:								
Apply measure presented in SW1.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Activity: Construction vehicle traffic, overnight laydown and in-field servicing								
Project phase: Construction								
SW3 – Impact Summary: Hydrocarbon pollution								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures:								
1. Regular inspections (and repair when necessary) of construction plant and machinery; and 2. In-field service areas to be roofed and bunded.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>

Activity: Construction camp grey and black water management								
Project phase: Construction								
SW4 - Impact Summary: River pollution from effluent								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Short term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: 1. Management of effluent in line with the Waste Management Plan; 2. French drains to be adequately sized if used; and 3. Septic tanks to be emptied regularly if used.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>

Table 6-16: Hydrology impact assessment (operation phase)

Activity: Transformers at the substations may leak (or discharge if ruptured) oil								
Project phase: Operation								
SW5 - Impact Summary: Hydrocarbon pollution								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Short term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: 1. Transformers to be located within bunded areas in line with the Pollution Prevention and Abatement Management Plan.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Construction vehicle traffic, overnight laydown and in-field servicing								
Project phase: Operation								
SW6 - Impact Summary: Hydrocarbon pollution								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-2 presented in SW3.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Activity: Access roads (and possible river crossings) construction								
Project phase: Operation								
SW7 - Impact Summary: Siltation of river systems								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: 1. Erosion gullies repaired immediately as per the BMP, the Erosion and Soil Management Plan and the Rehabilitation and Revegetation Management Plan.								
After Management	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>

Activity: Pylon foundation scouring								
Project phase: Operation								
SW8 - Impact Summary: Siltation of river systems								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Management Measures: 1. <i>Pylons to be constructed outside of the 100-yr floodlines where practical. Conservative offsets from the stream centrelines have been provided for in order to approximate the 100-yr floodlines; and</i> 2. <i>Pylons that need to be built within these offsets require detailed survey and floodlines to be calculated at these locations as per the Flood Management Plan.</i>								
After Management	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Climate change								
Project phase: Operation								
SW9 - Impact Summary: Increase in flood level								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>High</i>
Management Measures: 1. <i>No mitigation required. The impacts are less than typical wave heights.</i>								
After Management	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>High</i>

Hydrogeology

Baseline conditions

The local underlying geology along most of the OHL route is Kalahari sediments underlain by Regional Granite, the Epupa Metamorphic Complex, the SQA complex and the Jamba Group (Banded iron formations). Based on the various geological units underlying the Project area, shallow aquifer conditions are most likely to occur in localised areas only. The aquifer conditions should be assessed on a localised scale and it is recommended that a high-level census within a 200m radius of the site infrastructure be carried out, together with the results of the geotechnical study, which will confirm if shallow localised aquifer conditions occur within close proximity of the development areas. The potential impacts on the deeper, semi – confined/confined aquifers are regarded as negligible. A more detailed overview of the groundwater characteristics of the Project area is provided in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

Key identified potential impacts on hydrogeology in the Project area include:

- Impact on community wells and available groundwater resources; and
- Potential alteration in groundwater quality.

The potential impacts, if notable, are likely to arise from construction phase activities such as land clearing, excavation, building works, establishment of access roads and erection of towers.

Impact description

Construction activities could impact community wells within close proximity to Project infrastructure although the foundations of tower footings and substations are unlikely to alter groundwater flow paths.

Potential impacts on wells are mainly limited to the immediate development area (foundations). Any wells that are identified within the Project development area should be monitored.

The Project will generate waste oil that can become a source of pollution. Construction activities can also result in hydrocarbons spillages from mechanical equipment and vehicles, which could contaminate groundwater if not adequately managed. Diesel storage tanks could potentially leak or spill, impacting the shallow aquifer over time. These are potential point sources of contamination, however the risk of impacting the ecology or communities is deemed to be very low if the correct management measures are used.

The perceived overall hydrogeological impacts are anticipated to be low with and without mitigatory measures being implemented.

Impact assessment

The impact significance ratings of the identified potential hydrogeology impacts during the construction phase are presented in Table 6-17. Management measures are also presented in the table.

Table 6-17: Hydrogeology impact assessment (construction phase)

Activity: Construction of foundations – potential alteration/blockage of groundwater flow paths and potential localised dewatering								
Project phase: Construction								
GW1 - Impact Summary: Impact on community wells and available groundwater resources								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Local	Low	Possible	Low	-	Low
Management Measures: 1. Hydrocensus to be undertaken to identify sensitive receptors in terms of the Groundwater Management Plan; and 2. Groundwater level monitoring in line with the Groundwater Management Plan.								
After Management	Minor	Medium term	Local	Low	Unlikely	Low	-	Low
Activity: Contamination from on-site activities and infrastructure (e.g. diesel spillages)								
Project phase: Construction								
GW2 - Impact Summary: Potential alteration or deterioration in groundwater quality								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Local	Low	Possible	Low	-	Low
Management Measures: 1. Clean-up of spills as soon as they occur as per the Oil Spill Response Plan; 2. Implement proper sanitation procedures and dispose used oils at proper facilities in terms of the Waste Management Plan; and 3. Groundwater quality monitoring as per the Groundwater Management Plan.								
After Management	Minor	Medium term	Local	Low	Unlikely	Low	-	Low

6.4.4 Terrestrial biodiversity impacts

Biodiversity related impacts are presented in the sub-sections that follow and cover terrestrial biodiversity in the Project area, notably flora and fauna.

Terrestrial floral biodiversity

Baseline conditions

In terms of floral biodiversity, the Project area comprises various habitat types, including the Miombo Woodland Habitat (natural habitat), secondary Miombo Woodland (modified habitat), Freshwater Habitat (natural habitat), and Transformed Habitat (modified habitat) and impacts to each of the habitat units were assessed independently for each phase. Two species of concern were identified in Project area, *Pterocarpus angolensis* and *Brachystegia spiciformis*, which are classified as Vulnerable according to Angola's Red List of species, however the IUCN classify them as Least Concern. A more detailed overview of baseline conditions is presented in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The key potential impacts on floral biodiversity include:

- Loss of floral habitat and species diversity;
- Loss of potential floral SCC;
- Habitat fragmentation; and
- Alteration of species diversity and occurrences.

Impact description

During the construction phase, Project activities could lead to the loss of floral habitat and species diversity, the loss of potential floral SCC as well as habitat fragmentation. The perceived overall impacts to floral SCC and habitats are anticipated to be high to low without mitigatory measures being implemented and low with adequate mitigation measures put in place to minimise potential impacts.

Loss of floral habitat and species diversity

Impacts on floral habitat and species diversity include:

- Site clearing and the removal of indigenous vegetation leading to a loss of floral diversity and species composition;
- The total area per habitat loss for the Miombo Woodland (+- 45 ha), Secondary Woodland (+- 23 ha), Freshwater Habitat (+- 4 ha) and Transformed Habitat (+- 11 ha);
- Proliferation of Alien Invasive Plant (AIP) species in areas of increased disturbances and that outcompete native species, including the further transformation of adjacent natural habitat;
- Dumping of construction material within areas where no construction is planned, thereby leading to further habitat disturbance and AIP proliferation;
- Risk of contamination from construction vehicle spills which may pollute receiving environment;
- Poor management can give rise to unrehabilitated areas of compacted, bare or eroded soils outside the development of approved footprint leading to ongoing proliferation of AIP species in disturbed areas and subsequent spread to surrounding natural areas altering the floral habitat; and
- Possible increased fire frequency during construction.

Loss of potential floral SCC

Impacts on floral SCC include:

- Site clearing and the removal of floral SCC;
- Potential failure to identify floral SCC within the development footprint to be marked for rescue and relocation to a suitable habitat outside the development footprint within the study area;
- Proliferation of AIP species that colonise in areas of increased disturbances and that outcompete potential floral SCC; and
- Dumping of construction material within areas where no construction is planned, thereby leading to further habitat disturbance and AIP proliferation.

Habitat fragmentation

Impacts on habitat fragmentation include:

- Clearing vegetation will lead to habitat fragmentation in the landscape, particularly in larger intact areas of the Miombo Woodland; and
- With the increased accessibility to the area may, it may lead to increased wood harvesting and expansion of agricultural land, hereby exacerbating fragmentation across the landscape.

In terms of the operational phase, impacts arising from Project activities are similar those caused during to the construction phase and include the loss of floral habitat and species diversity and loss of potential floral SCC.

Impacts on floral habitat and species diversity include:

- Increased introduction and proliferation of AIPs due to a lack of maintenance activities, or poorly implemented AIP Management programme, leading to ongoing displacement of natural vegetation outside of the proposed footprint area;
- Potentially poorly managed edge effects: Potential ineffective rehabilitation of compacted areas, bare soils, or eroded areas outside of the development footprint areas leading to ongoing proliferation of AIP species in disturbed areas and subsequent spread to surrounding natural areas altering the vegetation communities surrounding footprint areas;
- Increased human presence in the area once operational, potentially leading to Illegal harvesting/ collection of medicinal plants or an increased risk of fire frequency impacting on floral communities outside of the development footprint; and
- Ongoing disturbance during operational phase may lead to erosion and sedimentation of surrounding floral habitat.

Impacts on floral SCC include:

- Increased introduction and proliferation of AIPs due to a lack of maintenance activities, or poorly implemented AIP Management programme, leading to habitat loss for floral SCC.

In addition to the potential impacts presented above, there is a possibly that effects may be experienced on the edge of Project areas if poorly managed, namely:

- Potential ineffective rehabilitation of compacted areas, bare soils, or eroded areas outside of the development footprint areas leading to ongoing proliferation of AIP species in disturbed areas and subsequent spread to surrounding natural areas altering the preferred habitat for floral SCC; and
- Increased human presence in the area once operational, potentially leading to unlawful harvesting/ collection of floral SCC or an increased risk of fire frequency impacting on floral SCC outside of the development footprint.

Impact assessment

The impact significance ratings of the identified potential terrestrial flora biodiversity impacts during construction and operation are presented in Table 6-18 to Table 6-21. Management measures are also presented in the tables.

Table 6-18: Floral impact assessment (construction phase)

Activity: Site preparation prior to commencement of construction with focus on floral habitat and diversity								
Project phase: Construction								
BFL1 - Impact Summary: Loss of floral habitat and species diversity								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	<i>Minor</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>High</i>
Freshwater	<i>Moderate</i>	<i>Long term</i>	<i>Local</i>	High	<i>Possible</i>	Medium	-	<i>High</i>
Secondary Miombo	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>High</i>
Miombo Woodland	<i>Moderate</i>	<i>Long term</i>	<i>Local</i>	High	<i>Possible</i>	Medium	-	<i>High</i>
Management Measures:								
1. The construction footprint must be kept as small as possible to minimise the impact on the surrounding environment (edge effect management); 2. Construction footprint areas should be clearly demarcated to monitor footprint extent and avoid footprint creep; 3. Removal of vegetation must be restricted to what is necessary and should remain within the approved development footprint in terms of the Vegetation and Land Clearance Management Plan and the BMP; 4. Clearing of vegetation should take place in a phased manner if feasible as to keep bare soil areas as small as possible to limit the erosion potential as per the Vegetation and Land Clearance Management Plan; 5. Access roads should be kept to existing roads and tracks as far as is feasible to reduce fragmentation of existing natural habitat (and to reduce the risk of AIP being introduced into natural habitats); 6. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimal; 7. No indiscriminate movement of construction vehicles or personnel are allowed in the Freshwater Habitat particularly during intense rainfall events as water may flow with greater intensity within these areas; 8. Care should be taken during the construction of the proposed development to limit edge effects to surrounding natural habitat in line with the AIP Control Plan. At minimum, this can be achieved by: (i) Demarcating all footprint areas during construction activities, (ii) No construction rubble or cleared AIPs are to be disposed of outside of demarcated areas and should be taken to a registered waste disposal facility and (iii) manage the spread of AIP species, which may affect remaining natural habitat within surrounding areas. Any areas that have been left bare or disturbed because of the construction activities should be rehabilitated using indigenous species. Ensure AIP vegetation cuttings/propagules are disposed of adequately, i.e., it must be ensured that the spread of these species is prevented. Designated spots for cuttings are highly recommended, or potentially make use of registered waste sites; 9. No chemical control of AIP is permitted within the 32 m buffer of any Freshwater Habitat unless it has been approved as safe for use in wetlands, and the application of herbicide should only be carried out by suitably trained personnel as per the AIP Control Plan and Hazardous Materials Management Plan; 10. Any onsite fires by construction personnel must be restricted to designated areas only, and no uncontrolled fires whatsoever must be allowed as per the Fire Risk and Prevention Management Plan; 11. No temporary dump sites must be allowed in areas with natural vegetation. It is advised that waste disposal containers and bins be provided during the construction phase for all construction rubble and general waste as per the Waste Management Plan; 12. No dumping of general or hazardous waste must take place. If any spills occur, they should be immediately cleaned up, and be disposed of at a registered waste facility as per the Oil Spill Response Plan and Waste Management Plan; 13. Avoid soil sealing (i.e., the destruction or covering of the ground by an impermeable material). Ensure that a vegetation layer is maintained (where possible). In this regard, use of indigenous plants from the reference vegetation type is recommended for best biodiversity outcomes; and 14. Maintain vegetation corridors along the OHL servitudes as per the BMP. Contributing towards conserving the regional genetic diversity of plants in these areas must be ensured through revegetating with indigenous species from the area. AIP control in revegetated sections must take place. By using native seeds/propagules and plants that are suitable for the site and that have been collected from within a defined source region, it is possible to reduce loss of regional plant genetic diversity.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Definite</i>	Low	-	<i>Medium</i>
Freshwater	<i>Moderate</i>	<i>Long term</i>	<i>Site</i>	Medium	<i>Possible</i>	Low	-	<i>Medium</i>

Secondary Miombo	Minor	Long term	Site	Medium	Definite	Low	-	Medium
Miombo Woodland	Minor	Long term	Site	Medium	Possible	Low	-	Medium
Activity: Vegetation clearing activities for construction with focus on floral SCC								
Project phase: Construction								
BFL2 - Impact Summary: Loss of floral SCC								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Local	Low	Unlikely	Low	-	High
Freshwater	Moderate	Short term	Local	Low	Unlikely	Low	-	High
Secondary Miombo	Moderate	Short term	Local	Low	Unlikely	Low	-	High
Miombo Woodland	Major	Short term	Local	Medium	Definite	Medium	-	High
Management Measures:								
1. Monitor, where applicable, the success or failures of relocated floral SCC as per the BMP; 2. Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC resulting from construction activities outside that of the proposed development footprint area, notably where disturbance footprints are near areas of increased suitability for SCC to be present as per the BMP; 3. Impact must be limited to the footprint area and kept to what is essential only; 4. Demarcate and monitor the floral SCC populations outside of the footprint areas to ensure construction activities do not infringe onto these species as per the BMP; 5. Traditional healers should be consulted on the removal of important/medicinal plants to ensure the preservation of important/medicinal plants, as they hold valuable knowledge on the sustainable use and cultural significance of these species 6. Should any threatened floral species be encountered during the walkdown, rescue and relocation of the species are recommended. For this, an expert (botanist familiar with the species and traditional healers) must be consulted and should assess the feasibility of the plant rescue and relocation activities; 7. Provide training and raise staff awareness of biodiversity requirements (such as protecting native floral species, preserving habitats, and preventing the spread of AIP), ensuring that all activities are aligned with the protection of local ecosystems and the conservation of floral species; 8. In the event that smaller bulbous species are identified in a proposed infrastructure footprint, they should be carefully excavated and replanted in an area of suitable habitat close to the disturbance footprint. This should be overseen by a suitably qualified specialist; 9. No chemical control of AIP is permitted within the 32 m buffer of any Freshwater Habitat unless it has been approved as safe for use in wetlands, and the application of herbicide should only be carried out by suitably trained personnel; 10. Minimise the impact of floral habitat fragmentation and interference with habitat connectivity in freshwater habitats (including temporary crossings/roads). In this regard it is crucial to implement mitigation measures such as preserving and restoring riparian vegetation, and ensuring that construction practices avoid disturbing important plant habitats and thus hindering the movement and dispersal of species; and 11. No collection or harvesting of floral SCC or floral species should be allowed by construction personnel as per the BMP.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Site	Low	Unlikely	Low	-	Medium
Freshwater	Minor	Short term	Site	Low	Unlikely	Low	-	Medium
Secondary Miombo	Minor	Short term	Site	Medium	Unlikely	Low	-	Medium
Miombo Woodland	Moderate	Medium term	Site	Low	Possible	Low	-	Medium

Table 6-19: Floral impact assessment (operation phase)

Activity: Operation and maintenance activities with focus on floral habitat and diversity								
Project phase: Operation								
BFL3 - Impact Summary: Loss of floral habitat and species diversity								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Transformed	<i>Minor</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>High</i>
Freshwater	<i>Major</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Secondary Miombo	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Miombo Woodland	<i>Major</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	High	-	<i>Medium</i>
Management Measures:								
1. Disturbed areas are to be rehabilitated to a similar state as that of pre-disturbance conditions as per the Rehabilitation and Revegetation Management Plan. Where this is not possible due to operational and maintenance requirements, it is recommended that at a minimum a suitable herbaceous layer is maintained within the footprint of the proposed Project to ensure that no erosion occurs; 2. All areas of increased ecological sensitivity beyond the approved Project footprint must be designated as No-Go areas and be off-limits to all operational and maintenance vehicles and personnel; 3. No additional habitat is to be disturbed during the operational phase of the Project outside of the demarcated approved footprints; 4. Monitor the Miombo Woodland and Freshwater Habitat within the 200 m buffer surrounding the footprint areas to ensure that floral communities are not degraded; 5. Ongoing erosion and stormwater monitoring and control to be implemented throughout the operational phase in line with the Erosion and Soil Management Plan and the Stormwater Management Plan; 6. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the operational activities; Manage the spread of AIP species, which may affect remaining natural habitat within surrounding areas in line with the AIP Control Plan; 7. Ongoing AIP monitoring and clearing/control should take place throughout all phases of the Project activities. The Project perimeters should regularly be checked for AIP proliferation to prevent spread into surrounding natural areas as per the AIP Control Plan; 8. Monitor the success of rehabilitation efforts of disturbed areas seasonally as per the Rehabilitation and Revegetation Management Plan; 9. Monitor and maintain the vegetation corridors that were created along the OHL servitudes to contribute to reduced habitat fragmentation, and improved regional plant genetics; and 10. No illicit fires must be allowed during the operational phases as per the Fire Risk and Prevention Management Plan.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Transformed	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Freshwater	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Secondary Miombo	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Miombo Woodland	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Activity: Operation and maintenance activities with focus on floral SCC								
Project phase: Operation								
BFL4 - Impact Summary: Loss of floral SCC								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Transformed	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>
Freshwater	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>

Secondary Miombo	Moderate	Medium term	Local	Medium	Possible	Medium	-	Medium
Miombo Woodland	Moderate	Medium term	Local	Medium	Possible	Medium	-	Medium
Management Measures:								
1. Harvesting of protected and threatened floral species by operational and maintenance personnel must be strictly prohibited, including collection of floral material by such personnel; 2. Monitoring of any rescued and relocated floral SCC (if applicable) must commence during the construction phase and this should be continued until it is evident that relocated species have successfully established and population are stable as per the BMP; 3. Maintenance activities must ensure that floral SCC and protected flora (where present outside of the footprint areas) will not be adversely impacted; and 4. Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed development footprint area as per the BMP.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Site	Low	Unlikely	Low	-	Medium
Freshwater	Minor	Short term	Site	Low	Unlikely	Low	-	Medium
Secondary Miombo	Minor	Short term	Site	Low	Possible	Low	-	Medium
Miombo Woodland	Minor	Short term	Site	Low	Possible	Low	-	Medium

Table 6-20: Floral impact assessment (all phases)

Activity: Vegetation clearance activities with focus on floral habitat fragmentation								
Project phase: All phases								
BFL5 - Impact Summary: Floral habitat fragmentation								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Local	Low	Possible	Low	-	High
Freshwater	Major	Medium term	Local	Medium	Possible	Medium	-	High
Secondary Miombo	Moderate	Medium term	Local	Medium	Possible	Medium	-	High
Miombo Woodland	Major	Medium term	Local	High	Possible	Medium	-	High
Management Measures:								
Apply measures 1-3, 6-7 and 14 presented in BFL1.								
1. Development should be prioritised in habitats of decreased sensitivity wherever possible given the linear nature of the Project; 2. Access roads should be kept to existing roads where possible so to reduce further fragmentation of existing natural habitat as per the BMP; and 3. A rehabilitation plan should be developed that will promote habitat reinstatement in disturbed sites and allow for increased habitat connectivity during the operation and maintenance phase of the Project as per the Rehabilitation and Revegetation Management Plan.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Site	Low	Unlikely	Low	-	Medium
Freshwater	Moderate	Short term	Site	Medium	Unlikely	Low	-	Medium
Secondary Miombo	Minor	Short term	Site	Medium	Unlikely	Low	-	Medium
Miombo Woodland	Moderate	Short term	Site	Medium	Unlikely	Low	-	Medium

Table 6-21: Floral impacts (decommissioning phase)

Activity: Re-vegetation activities with focus on floral habitat restoration								
Project phase: Decommissioning phase								
BFL6 - Impact Summary: Floral habitat fragmentation								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Local	Low	Possible	Low	-	High
Freshwater	Major	Medium term	Local	Medium	Possible	Low	-	Medium
Secondary Miombo	Moderate	Medium term	Local	Medium	Possible	Medium	-	Medium
Miombo Woodland	Major	Medium term	Local	Medium	Possible	Medium	-	Medium
Management Measures: Apply measures 1-4 presented in BFL4. - Decommissioning and rehabilitation footprint areas should be clearly demarcated to monitor footprint extent and avoid footprint creep; - The decommissioning and rehabilitation footprint must be kept as small as possible to minimise the impact on the surrounding environment (edge effect management); - No additional habitat is to be disturbed during the decommissioning phase of the project outside of the demarcated approved footprints; - Disturbed areas are to be rehabilitated to a similar state as that of pre-disturbance conditions. Where this is not possible, it is recommended that at a minimum a suitable herbaceous layer is maintained within the footprint of Project development and infrastructure so as to ensure that no erosion occurs; - Access roads should be kept to existing roads as far as is feasible so as to reduce fragmentation of existing natural habitat (and to reduce the risk of AIP being introduced into natural habitats); - Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the decommissioning activities; - All areas of increased ecological sensitivity beyond the approved footprint must be designated as No-Go areas and be off-limits to all decommissioning phase vehicles and personnel; - Management of AIPs during the decommissioning phase activities must be focused on limiting their spread. For example, roadsides should be monitored, as they serve as common corridors along which AIP species are introduced and dispersed, and disturbed areas should regularly be monitored for AIP recruitment until successfully rehabilitated; - Monitor and maintain the vegetation corridors that were created along the OHL servitudes to contribute to reduced habitat fragmentation and improved regional plant genetics; and - No illicit fires must be allowed during the decommissioning phase.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Transformed	Minor	Short term	Site	Low	Unlikely	Low	-	Medium
Freshwater	Moderate	Short term	Site	Medium	Definite	Low	-	Medium
Secondary Miombo	Minor	Short term	Site	Medium	Possible	Low	-	Medium
Miombo Woodland	Minor	Short term	Site	Medium	Possible	Low	-	Medium

Terrestrial faunal biodiversity

Baseline conditions

The Project area traverses a mosaic of Miombo Woodland, Secondary Miombo Woodland, Freshwater systems, Agricultural Fields and urban areas/villages. Habitat suitability for fauna species was varied, and largely dependent on the habitat integrity and habitat connectivity. The Miombo Woodlands and freshwater systems supported the highest diversity of faunal species, with diversity levels decreasing notably in the more degraded habitats. Habitat connectivity along the freshwater systems is still functional, serving as important movement corridors for fauna. Two faunal SCC were observed during

the site assessment, namely *Terathopius ecaudatus* (Bateleur, EN) and *Aonyx capensis* (African Clawless Otter, NT). Post the seasonal biodiversity assessments, an additional faunal SCC was observed in the Project area, namely *Trigonoceps occipitalis* (White-headed Vulture, CR). Based on habitat suitability and ever-present anthropogenic impacts/threats, further potential SCC occurrences are considered to have a moderate probability of occurrence. A more detailed overview of baseline conditions is presented in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The key potential identified impacts on faunal biodiversity include:

- Loss of faunal habitat and species diversity;
- Loss of potential faunal SCC;
- Habitat fragmentation; and
- Avifaunal and bat collision with overhead lines and electrocution risks.

Impact description

Impacts on faunal biodiversity can occur during the construction and operational phases of the Project and are presented below. The perceived overall impacts to faunal SCC and habitats are anticipated to be high to medium without mitigatory measures being implemented and medium to low with adequate mitigation measures put in place to minimise potential impacts.

Construction activities can potentially impact faunal habitat and species diversity in the following ways:

- Site clearing and removal of vegetation within the footprint areas associated with each habitat unit resulting in habitat loss;
- Loss of faunal species diversity from the footprint areas and potentially the adjacent habitats due to species displacement, potential hunting/snaring of fauna and increased mortality rates due to human-wildlife conflict and/or collisions with construction vehicles; and
- Development of new access roads will further enhance access to remote areas which may lead to further wood harvesting and clearance of land for agricultural activities.

In addition, the Project can impact potential faunal SCC as follows:

- Loss of habitat through vegetation clearance may lead to the displacement of faunal SCC;
- Increased human presence/movement may lead to loss of faunal SCC through human-wildlife conflict and hunting/snaring activities; and
- Development of access roads will further enhance access to remote areas which may support isolated SCC populations.

Vegetation clearance for the OHL and associated access roads will lead to further habitat fragmentation within the Project landscape, notably in the larger, intact areas of Miombo Woodland. An increase in access to remote areas may lead to further wood harvesting and agricultural land development resulting in further habitat fragmentation.

Volant species such as birds and bats face further collision risks due to the presence of the OHL and tensions cables. Collision risks cannot be avoided due to the overall length of the OHL and the fact that it traverses habitats inhabited by these species. In order to minimise impact and electrocution risks, mitigation measures have been provided for. As the freshwater systems and larger contiguous patches of Secondary Miombo and Miombo Woodland were noted to be areas of increased avifaunal activity and are more likely to serve as the main flight paths, bird flappers / diverters must be installed

at these localities. Whilst it is noted that avifaunal species will also fly over the transformed areas through which the OHL traverses, such habitats were noted to have less avifaunal movement in comparison to the freshwater and Miombo Woodland habitats. As installation of bird flappers across the entire OHL is likely to be costly, similarly the maintenance thereof, it is recommended that the final bird diverter layout/locations be determined following the pre-construction avifaunal monitoring. This will also help guide any micro-siting of pylons should it be needed. In addition to the already listed mitigation measures, it is recommended that avifaunal monitoring is undertaken to further ascertain the operational phase impacts so as to further refine mitigation measures as needed.

During the operational phase, impacts on faunal habitats, species diversity and SCC could arise from servitude maintenance that will require the trimming and clearance of vegetation. There is the potential for increased mortality rates due to human-wildlife conflict and/or collisions with vehicles. In addition, the lack of sufficient cover can lead to erosion. Similar to the construction phase, medium and large avifauna species may collide with overhead powerlines and structures, leading to increased injuries and mortalities. Avifaunal species nesting or roosting on pylon structures may be electrocuted and injured.

Impact assessment

The impact significance ratings of the identified potential terrestrial faunal biodiversity impacts during construction and operation are presented in Table 6-22 to Table 6-23 for each habitat type. Management measures are also presented in the tables. Impacts associated with the decommissioning phase are considered to be similar to those of the construction phase, albeit less severe.

Table 6-22: Faunal impact assessment (construction phase)

Activity: Site preparation and clearance of vegetation for pylons, the OHL, laydown areas and access roads and the movement of construction vehicles and personnel								
Project phase: Construction								
BFA1 – Impact Summary: Loss of faunal habitat and species diversity								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Miombo Woodland	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Secondary Miombo	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Freshwater	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Transformed	<i>Minor</i>	<i>Medium term</i>	<i>Site</i>	Low	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures:								
1. Project footprints are to be kept as small as possible; 2. As far as possible, no pylon footprints are to be placed within any of the freshwater habitats; 3. Existing roads are to be utilized as far as possible in order to access the OHL route. Where new access roads are required, the bare minimum needed for access should be constructed; 4. Vegetation clearance below the OHL is to be limited to only that which is needed, and excessive vegetation clearance is to be avoided. As far as possible only tall trees should be trimmed, leaving as much of the remaining vegetation as possible (with acknowledgement of health and safety requirements for overhead lines); as per the Vegetation and Land Clearance Management Plan; 5. No hunting/trapping of faunal species is to be allowed by construction personnel; 6. No illicit fires on site are to be allowed as per the Fire Risk and Prevention Management Plan. Where fires for cooking are needed, they are to be located in designated sites at the contractor camps and all, measures to ensure that runaway fires do not occur must be taken;								

7. Construction activities, especially those taking place near freshwater habitats, must be undertaken in the dry season to limit impacts such as erosion and increased sediment runoff into the freshwater habitats in line with the Erosion and Soil Management Plan;
8. All waste material should be cleared away from site and disposed of at a pre-determined disposal site away from sensitive habitats as per the Waste Management Plan;
9. Waste material or excavated soil are not to be disposed of in or adjacent to freshwater habitats in line with the Erosion and Soil Management Plan;
10. Should any raptors, notably *Terathopius ecaudatus* (Bateleur eagle), be found nesting in the proposed route, or within 500m of the proposed route, construction plans need to be duly updated to ensure that these areas are avoided during the breeding season in line with the Avifauna Monitoring Programme and BMP. Active nests are not to be disturbed during breeding season and should be given a 500m exclusion buffer until after the breeding season. Construction/vegetation clearance activities must continue on in a different locality until such a time that it is feasible to return to the area (post breeding);
11. To minimise this risk of bat collisions and electrocutions, overhead power cables should be spaced sufficiently wide (>60cm) enough beyond the size of the wingspan of the largest bat known or suspected to use the area. Where this is not possible, suitable insulation of the cables may be considered;
12. No snakes, small reptiles or arachnids are to be killed or harmed by staff during the construction phase. Should any of these species be encountered, they should be carefully and safely relocated to an area outside of the disturbance footprint by a suitably trained and competent staff member in line with the BMP;
13. Bird flappers / diverters should be fitted along the entire length of the OHL. Should the pre-construction avifaunal monitoring however indicate that certain areas are not high frequency avifaunal areas/ flight paths, then the placement of such bird flappers in areas can be reconsidered based on the additional monitoring data;
14. Any tension cables up to 1.5 m on each side of support posts and substations must be insulated /covered with rubber tape/plastic piping to decrease electrocution risks as per the BMP; and
15. All pylons / electrical infrastructure must be fitted with anti-perching/nesting devices to deter species from using these structures for nest construction/perching – notably larger raptors as per the BMP.

After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Miombo Woodland	Minor	Medium term	Site	Low	Possible	Low	-	Medium
Secondary Miombo	Minor	Medium term	Site	Low	Possible	Low	-	Medium
Freshwater	Minor	Medium term	Site	Low	Possible	Low	-	Medium
Transformed	Minor	Medium term	Site	Low	Possible	Low	-	Medium

Project phase: Construction

BFA2 - Impact Summary: Loss of potential faunal SCC

Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Moderate	Medium term	Local	Medium	Possible	Medium	-	Medium

Management Measures:

Apply measures 1-17 provided in BFA1.

After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor	Medium term	Local	Low	Possible	Low	-	Medium

Project phase: Construction

BFA3 - Impact Summary: Habitat fragmentation

Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Moderate	Medium term	Local	Medium	Definite	Medium	-	Medium

Management Measures:

Apply measures 1-17 provided in BFA1.

After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor	Medium term	Site	Low	Definite	Low	-	Medium
Project phase: Construction								
BFA4 – Impact Summary: Avifaunal and bat Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Major	Long term	Local	High	Definite	High	-	Medium
Management Measures: Apply measures 1-17 provided in BFA1.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor	Long term	Local	Medium	Possible	Medium	-	Medium
Project phase: Construction								
BFA5 - Impact Summary: Avifaunal and bat Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Moderate (-)	Long term	Local	High	Possible	High	-	Medium
Management Measures: Apply measures 1-17 provided in BFA1.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor (-)	Long term	Local	Medium	Possible	Medium	-	Medium

Table 6-23: Faunal impact assessment (operation phase)

Activity: Infrastructure Maintenance including vegetation cutting / clearance, limited earthworks and movement of vehicles and personnel								
Project phase: Operation								
BFA6 - Impact Summary: Loss of faunal habitat and species diversity								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Miombo Woodland	Minor	Medium term	Site	Low	Definite	Medium	-	Medium
Secondary Miombo	Minor	Medium term	Site	Low	Definite	Medium	-	Medium
Freshwater	Minor	Medium term	Site	Low	Definite	Medium	-	Medium
Transformed	Minor	Medium term	Site	Low	Definite	Medium	-	Medium
Management Measures: 1. No additional clearing of vegetation beyond that which is needed for maintenance activities is to be undertaken; 2. No new roads are to be cleared/constructed. Roads used during the construction phase are to maintained as needed and used during the operational phase; 3. Should access roads used during the construction phase no longer be needed, they should be decommissioned and rehabilitated accordingly; 4. Old access roads and laydown areas which are no longer required should be decommissioned and rehabilitated;								

5. Vegetation clearance below the OHL is to be limited to only that which is needed, excessive vegetation clearance is to be avoided in line with the Vegetation and Land Clearance Management Plan;
6. No hunting/trapping of faunal species is to be allowed by operations and maintenance personnel;
7. No illicit fires on site are to be allowed as per the Fire Risk and Prevention Management Plan;
8. As far as possible, maintenance activities, notably for areas around freshwater habitats, must be conducted during the dry season to avoid excess water runoff, sedimentation and erosion in line with the Erosion and Soil Management Plan;
9. All waste material should be cleared away from site and disposed of at a pre-determined disposal site away from sensitive habitats as per the Waste Management Plan;
10. Waste material is not to be disposed of in or adjacent to freshwater habitats;
11. No snakes, small reptiles or arachnids are to be killed or harmed by personnel. Should any of these species be encountered, they should be carefully and safely relocated to an area outside of the disturbance footprint by a suitably trained and competent staff member in line with the BMP;
12. Any maintenance activities that may need to take place within 500m of any recorded bateleur nests should be restricted to the non-breeding season, when the fledglings have left the nest;
13. Bird-flappers / diverters are to be replaced as and when needed should they become dislodged from the powerline. These devices should part of the regular inspection activities undertaken for the OHL as per the Avifauna Monitoring Programme and the BMP;
14. Ensure the insulated covering on the support / tension cables is intact to minimise risk of electrocution; and
15. Inspect and maintain anti-perching/nesting devices fitted.

After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Miombo Woodland	Minor	Medium term	Site	Low	Possible	Low	-	Medium
Secondary Miombo	Minor	Medium term	Site	Low	Possible	Low	-	Medium
Freshwater	Minor	Medium term	Site	Low	Possible	Low	-	Medium
Transformed	Minor	Medium term	Site	Low	Possible	Low	-	Medium

Project phase: Operation

BFA7 - Impact Summary: Loss of potential faunal SCC

Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor	Medium term	Site	Low	Possible	Medium	-	Medium

Management Measures:

Apply measures 1-15 provided in BFA6.

After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor	Medium term	Site	Low	Possible	Low	-	Medium

Project phase: Operation

BFA8 - Impact Summary: Habitat fragmentation

Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Moderate	Long term	Local	Medium	Definite	Medium	-	Medium

Management Measures:

Apply measures 1-15 provided in BFA6.

After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
All habitats	Minor	Long term	Site	Low	Definite	Low	-	Medium

Project phase: Operation

BFA9 - Impact Summary: Avifaunal and bat Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats

Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence

All habitats	<i>Major</i>	<i>Long term</i>	<i>Local</i>	High	<i>Definite</i>	High	-	<i>Medium</i>
Management Measures: Apply measures 12-15 provided in BFA6.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
All habitats	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Medium	<i>Definite</i>	Medium	-	<i>Medium</i>
Project phase: Operation								
BFA10 - Impact Summary: Avifaunal and bat Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
Before Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
All habitats	<i>Moderate</i>	<i>Long term</i>	<i>Local</i>	High	<i>Possible</i>	High	-	<i>Medium</i>
Management Measures: Apply measures 12-15 provided in BFA6.								
After Management	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
All habitats	<i>Minor</i>	<i>Long term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

6.4.5 Freshwater ecosystem impacts

Baseline conditions

The Project area comprises of four different primary hydrogeomorphic types which include rivers with associated riparian vegetation and in some cases with associated floodplains, valley bottom wetlands (both channelled and unchannelled), and what are referred to locally in Angola as 'dambos' – the latter being characterised by relatively even topography and situated in low-lying areas. The ecological integrity of these freshwater ecosystems is largely intact due to the remoteness with ecological modifiers being river crossings, subsistence cultivations activities, domestic water use and impoundments. A detailed overview of baseline conditions is provided in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The key potential impacts of the Project on freshwater ecosystems include:

- Loss of freshwater ecosystem habitat and ecological structure;
- Changes to the socio-cultural and service provision;
- Impacts on the hydrology and sediment balance of the freshwater ecosystems; and
- Impacts on water quality within the freshwater ecosystems.

Impact description

It is anticipated that the Project will impact freshwater ecosystems during the construction and operational phases. These potential impacts are described below.

Loss of habitat and ecological structure

Some loss or degradation of freshwater habitat has occurred as a result of subsistence agriculture, particularly in the shallow dambo areas which are commonly utilised for cultivation of crops by local communities. Construction of powerline infrastructure may lead to further alterations to habitat and ecological structure, primarily through vegetation losses necessitated during construction preparation, but also potentially by impeding or altering the movement of water through the landscape.

Changes to ecological and socio-cultural service provision

The loss or alteration of freshwater habitat and ecological structure as a result of the various activities, particularly during the construction phase, will inevitably lead to changes in the ability or capacity of the freshwater ecosystems to provision certain ecological services, such as sediment trapping, flood attenuation and assimilation of excess nutrients. Changes in socio-cultural service provision are less likely to occur given that the proposed powerline infrastructure can avoid direct encroachment on the freshwater ecosystems.

Hydrological function and sediment balance

Impacts on hydraulic and geomorphological regimes may result in altered extents (hydroperiod) of freshwater ecosystems, as well as changes to floral assemblages. The presence of instream man-made structures such bridge crossings has the potential to result in changes in the delivery of flows and sediment to downstream reaches of the freshwater ecosystems. Instream structures have the potential to result in sediment deposition upstream and potential desiccation of freshwater habitat downstream if hydraulic connectivity is not sufficiently maintained.

Impacts on water quality

During the construction phase, increased vehicular activity and increased human presence carries the potential for direct and indirect impacts on water quality. Spills from vehicles and construction machinery, disturbances to soils and hygiene requirements of construction personnel are amongst potential impacts which may adversely affect water quality with specific mention of suspended solids, oil and grease spills and contamination with human waste.

Impact assessment

The impact significance ratings of the identified potential freshwater ecosystem impacts during construction and operation are presented in Table 6-24 and Table 6-25. Management measures are also presented in the tables. Impacts associated with the decommissioning phase are considered to be similar to those of the construction phase, albeit less severe.

Table 6-24: Freshwater ecosystem impact assessment (construction phase)

Activity: Site preparation prior to the commencement of construction								
Project phase: Construction								
FE1 - Impact Summary: Removal of vegetation leading to increased bare areas and changes in runoff in the landscape; and smothering of freshwater habitat due to dust generated from cleared areas								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Medium term	Local	Medium	Definite	Medium	-	Medium
Management Measures: 1. All development footprint areas should remain as small as possible and vegetation clearing be limited to what is essential; 2. As far as possible, existing roads must be utilised to gain access to sites; 3. All vegetation cleared as part of the site clearing activities (specifically where large areas need to be cleared) should be appropriately stockpiled in a small area. Vegetation which is suitable for use in reinstatement may be temporarily stockpiled, outside of delineated freshwater systems. Plant material suitable for use as firewood or which would normally be harvested by communities may be given to the community. No Alien or Invasive Plants (AIPs) may be donated to the local communities to limit spread as per the AIP Control Plan; 4. Freshwater systems situated downgradient and within 32 m of any construction site must be protected by means of construction of a silt trap, erected along the boundary of the freshwater system in line with the Stormwater Management Plan. Silt traps must be monitored closely, and accumulated sediment removed as regularly as required, preferably by hand if feasible. Removal with machinery may take place provided that no indiscriminate movement of machinery occurs within freshwater systems; 5. Contractor laydown areas and material storage facilities must remain within the designated contractor camp and batching plant footprint; and 6. No vegetation may be removed from any delineated freshwater system or directly adjacent thereof where no infrastructure is planned, as this provides a natural buffer zone around the freshwater systems which disperse surface runoff into the freshwater systems, and thus prevents sedimentation and erosion thereof in line with the Vegetation and Land Clearance Management Plan and the Erosion and Soil Management Plan.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium
Activity: Site preparation prior to the commencement of construction								
Project phase: Construction								
FE2 - Impact Summary: Increased bare areas and changes in runoff in the landscape; generation of dust in the cleared areas and miscellaneous activities by construction personnel								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Medium term	Local	Medium	Definite	Medium	-	Medium
Management Measures: 1. All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; 2. Suitable procedures for the disposal of construction waste and hazardous materials must be developed; 3. Containment systems to prevent contamination of groundwater and surface water such as drip trays must be installed; 4. All vegetation cleared as part of the site clearing activities (specifically where large areas need to be cleared) should be appropriately stockpiled in a small areas. Vegetation which is suitable for use in reinstatement may be temporarily								

stockpiled, outside of delineated freshwater systems. Any plant material suitable for use as firewood or which would normally be harvested by communities may be given to the community; and								
5. No Alien or Invasive Plants (AIPs) may be donated to the local communities to limit spread.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium
Activity: Groundbreaking activities for construction of the support structures and spanning of the proposed powerline over freshwater ecosystems including preparation of the 'right of way' (servitude)								
Project phase: Construction								
FE3 - Impact Summary: Smothering of freshwater habitat due to dust generated from cleared areas; increase in bare areas including changes in runoff patterns in the landscape; proliferation of alien and invasive species within the freshwater habitat; increased erosion and sedimentation of the freshwater systems; alteration of surface water quality from concrete casting; and disturbance to aquatic biota								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Medium term	Local	Medium	Definite	Medium	-	Medium
Management Measures:								
- Careful planning of pylons for the OHLs must take place, ensuring that as far as practical (considering any restrictions relating to spanning of freshwater ecosystems) pylons are not placed within 10m of the delineated edge of the freshwater systems, to minimise potential loss of vegetation, erosion or sedimentation of the freshwater system during construction works; - During excavation activities, the topsoil and vegetation must be stockpiled separately from other material outside of the delineated freshwater system in line with the Vegetation and Land Clearance Management Plan and the Erosion and Soil Management Plan; - Excavation of pits for the pylons within close proximity to a freshwater system may cause excessive sediment to enter into the freshwater systems, specifically if works are undertaken during the rainy months. As such, during excavation of the foundations, soil must be stockpiled upgradient of the excavated pit. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum. Excess soil as a result of bulking must be spread evenly in the landscape given that the excavated pits are to be filled with concrete. Alternatively excess soil must be used in rehabilitation processes of adjacent areas, immediately after installation of the pylon in line with the Rehabilitation and Revegetation Management Plan; - Excavated materials must not be contaminated, and it should be ensured that the minimum surface area is taken up by any stockpiled materials. The mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later use as backfill material after construction has commenced as per the Erosion and Soil Management Plan; - All exposed excavated soil stockpiles should be protected from wind using suitable geo-textile or by not stockpiling more than 3 m tall and removing or infilling of stockpiled soils as per the Erosion and Soil Management Plan; - Suitable drainage must be ensured along the hardstand areas to ensure that water does not pond on the hardstand or does not drain in a concentrated manner into the freshwater systems for towers that are associated with watercourses and/or wetlands. This must be incorporated into the stormwater management plan and be overseen by a freshwater ecologist; and - Rehabilitation of the construction footprint areas must be in line with the Rehabilitation and Revegetation Management Plan and includes: - Rehabilitating construction areas and be overseen by a suitably qualified Environmental Site Officer (ECO) with freshwater and biodiversity resource management experience. The ECO must sign off the rehabilitation before the relevant contractors leave site - Ensuring that soils are replaced in the correct layers, ripped and re-profiled, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-condition state as a minimum - The construction areas should regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium
Activity: Construction activities associated with the development of infrastructure of new substations								
Project phase: Construction								
FE4 – Impact Summary: Increased soil erosion and formation of preferential flow paths in the landscape; sedimentation of the freshwater system due to disturbance in the landscape resulting in changes in the instream substrate; smothering of freshwater habitat due to dust generated from cleared areas; changes in flow, pattern and timing due to increased impermeable surfaces; loss of foraging and breeding habitat and faunal migratory corridors; and proliferation of alien and invasive species within the freshwater habitat								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence

Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	<i>Medium</i>	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures:								
1. Silt/sediment traps are to be used during the construction phase, to limit additional sediment associated with construction activities from reaching the freshwater habitat as per the Stormwater Management Plan; 2. Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent contamination of surface and resources present; 3. Adequate stormwater management must be incorporated into the design of the substation infrastructure in order to prevent erosion and the associated sedimentation of the freshwater habitat. In this regard, the Stormwater Management Plan should make special mention of: a. Sheet runoff from cleared areas, paved surfaces and/or access roads needs to be curtailed b. Runoff from paved surfaces should be slowed down by the strategic placement of berms c. All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff from the facilities; 4. Erosion arising as a consequence of the development of surface infrastructure must be remedied immediately and included as part of an ongoing Rehabilitation and Revegetation Management Plan; 5. Where construction activities have taken place, footprint areas must be monitored for alien and invasive vegetation encroachment and all alien vegetation/weeds must be removed according to the AIP Control Plan; 6. If any solid materials do enter the freshwater environment, if deemed safe, they should be immediately removed and disposed at a registered waste disposal facility. Material that may be re-used must be re-used and material that will not be re-used must be disposed of in line with the Waste Management Plan; 7. Control measures specific to concrete works are as follows: a. Fresh concrete and cement mortar must not be mixed near the freshwater ecosystems. Mixing of cement may be done within the construction camp, however, may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete. The designated concrete mixing areas must be approved by the ECO b. No mixed concrete shall be deposited directly onto the ground within the freshwater ecosystems (outside of the designated area). A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing c. A washout area should be designated outside of the freshwater ecosystems, and wash water should be treated on-site or discharged to a suitable sanitation system d. Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream e. Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided; and 8. Rehabilitation measures of the construction footprint areas must be implemented in a phased manner shortly after the construction activities as per the Rehabilitation and Revegetation Management Plan.								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Site</i>	<i>Low</i>	<i>Possible</i>	Low	-	<i>Medium</i>
Activity: Construction activities associated with the development of access roads								
Project phase: Construction								
FE5 - Potential temporary in-channel diversion of the freshwater crossing to allow for excavations for road crossing to take place; loss of freshwater habitat and ecological structure resulting in impacts on biota; altered runoff patterns and alteration to flow patterns, leading to increased erosion and sedimentation of the freshwater system; disturbances of soils leading to increased alien vegetation proliferation, and in turn to further altered riverine habitat; and increased risk of pollution of surface water.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major</i>	<i>Medium term</i>	<i>Local</i>	<i>Medium</i>	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures:								
1. General construction mitigation measures outlined for Activity 1 and 2 (site preparation activities) for clearing of vegetation, management of spills, waste, and usage of storage facilities are considered applicable; 2. It is highly recommended that all construction and site clearing should ideally take place during the period when flows are low (outside of the rainfall season) in order to minimise impacts on the freshwater ecosystems as well those downstream as a result of the construction activities; 3. Implementation of erosion and sediment control measures must be implemented to prevent excessive sedimentation during construction; 4. Sandbags should be used to create a coffer dam around the construction area, if applicable (for temporary diversion), which can then be dewatered. Water must be diverted into the downstream reach of the freshwater ecosystem around the coffer area and allowed to always flow to the downstream reach; 5. Any diversion for construction activities must mimic natural flow patterns and maintain sediment transport; and 6. All alien and invasive vegetation species, debris and litter removed from the road reserve must be removed from site.								
After Management	<i>Moderate</i>	<i>Short term</i>	<i>Local</i>	<i>Medium</i>	<i>Possible</i>	Medium	-	<i>Medium</i>

Table 6-25: Freshwater ecosystems impact assessment (operation phase)

Activity: Operation of the proposed linear infrastructure (OHPL and powerline corridors)								
Project phase: Operation								
FE6 - Impact Summary: Changes in flow, pattern and timing due to increased impermeable surfaces; and altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Site	Low	Definite	Low	-	Medium
Management Measures:								
1. An Emergency Preparedness and Response Plan must be developed to manage any infrastructure failure, which may impact on the freshwater ecosystems should any fault necessitate usage of heavy machinery and clearing of vegetation to access site; 2. The OHL servitude must be monitored for alien and invasive vegetation encroachment and all alien vegetation/weeds must be removed according to the AIP Control Plan. Annual follow up should be undertaken for at least 3 years post-construction; and 3. Disturbances within the footprint area should be limited to what is essential for long-term maintenance in line with the mitigation measures presented herein.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium
Activity: Operation of the proposed surface infrastructure (substations)								
Project phase: Operation								
FE7 - Impact Summary: Increased impermeable surfaces due to the presence of surface infrastructure (substations) leading to changes in runoff in the landscape								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Site	Low	Definite	Low	-	Medium
Management Measures:								
1. Construction areas must be rehabilitated. Implementation of these rehabilitation measures must be overseen by a suitably qualified ECO with freshwater and biodiversity resource management experience and the ECO must sign off the rehabilitation before the relevant contractors leave site as per the Rehabilitation and Revegetation Management Plan; 2. Ensure that soils are replaced in the correct layers, ripped and re-profiled, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-condition state as a minimum as per the Rehabilitation and Revegetation Management Plan; 3. Regular inspections of all stormwater infrastructure must be conducted. During the inspection data must be recorded and kept for the purposes of tracking and reporting as per the Stormwater Management Plan; and 4. Bare areas should be revegetated within suitable indigenous vegetation species as per the Rehabilitation and Revegetation Management Plan.								
After Management	Minor	Medium term	Site	Medium	Possible	Medium	+	Medium
Activity: Operation of the proposed new access roads								
Project phase: Operation								
FE8 - Impact Summary: Altered timing and pattern of flows within the catchment; change in freshwater hydroperiod and changes in flood peaks; and Potential desiccation of downstream reaches of freshwater ecosystems due to blocked culverts.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Short term	Local	Medium	Possible	Medium	-	Medium
Management Measures:								
1. Regular inspection of the access roads and associated culverts must be done in order to ensure structural stability during the operation of the road;								

2. Where culverts are proposed, spots for the build-up of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand. This is particularly important following heavy rainfall events since any blockages may result in back-flooding of the freshwater ecosystems systems; 3. Any erosion or gully formation must be identified on an ongoing basis and re-profiled and revegetated accordingly; and 4. Any litter from maintenance activities must be cleared from the site and discarded at suitable registered facility.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium

Table 6-26: Freshwater ecosystems impact assessment (decommissioning phase)

Activity: Decommissioning of infrastructure associated with the Project								
Project phase: Decommissioning								
FE9 - Impact Summary: Soil erosion and sedimentation of freshwater due to disturbance in the landscape; Increase in bare areas including changes in runoff patterns in the landscape; proliferation of alien and invasive species within the freshwater habitat; and disturbance to aquatic biota.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Site	Low	Definite	Low	-	Medium
Management Measures: 1. Decommissioning vehicles should be checked for leakages of hydrocarbons prior to commencement of decommissioning and closure; 2. Vehicles should utilise existing access roads and minimise compaction of adjacent areas; 3. Disturbed areas adjacent to the decommissioning sites should be revegetated in order to limit potential soil erosion; 4. Rehabilitation measures around areas where decommissioning took place must be developed and implemented. Implementation must be overseen by a suitably qualified Environmental Site Officer with freshwater and biodiversity resource management experience and the ESO must sign off the rehabilitation before the relevant contractors leave site; 5. Ensure that soils are replaced in the correct layers where infrastructure has been removed/decommissioned, ripped and re-profiled, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-mining state as a minimum; and 6. Monitor spread of alien and invasive species during the decommissioning phase.								
After Management	Minor	Short term	Site	Low	Possible	Low	-	Medium

6.4.6 Air quality impacts

Baseline context

Ambient air quality conditions within the Project area are driven by a number of emission sources, including agricultural activities, domestic fuel burning, mining activities, fugitive dust from unpaved roads and other activities and business activities in and around towns. Of particular concern are emission sources that contribute PM and DFO and dust to the ambient air quality.

The key potential impact to air quality within the Project area is related to the production and emission of dust predominantly due to construction related activities such as vehicle movement, excavation, potential blasting and vegetation clearing. A more detailed overview of the baseline context is presented in Section 4.

Stakeholder issues and concerns:

None mentioned.

For the air quality assessment, a qualitative assessment was undertaken which excluded air quality monitoring, quantification of emissions and modelling. The qualitative assessment relies on studies from the US EPA's AP42 document, a widely recognised source containing emissions factors and process information for over 200 air pollution source categories. This particular study, focusing on the

impacts of construction, used "data" from source tests, material balances, and engineering estimates to evaluate the likely environmental effects of construction activities.

Evidence of air quality impact without quantitative assessment can be gathered through qualitative methods, which include observable, experiential, and anecdotal data. Key forms of evidence include:

- Visual Observations – noticing increased dust or particulate deposition during or after construction activities;
- Community Complaints – increased reports of nuisance dust;
- Surface soiling – noticing increased dust and soot accumulation on buildings, street or other infrastructure during or after construction activity; and
- Construction activity correlation – correlating the onset of any air quality issues with specific construction activities such as earth moving, demolition or material handling.

While qualitative evidence may lack numerical precision, it can still provide compelling and actionable insights into the impact on air quality through comprehensive documentation and community engagement.

Impact identification

The key potential impacts of the Project on air quality during all phases include:

- Addition of excess dust emissions to ambient air quality;
- Addition of excess dust emissions to ambient air quality; and
- Potential emission of SF₆ from transformers and substation switchgears.

Impact description

Emissions during construction are associated with land clearing, drilling, potential blasting, ground excavation, cut and fill operations and the movement of heavy construction vehicles on temporary roads. Heavy construction activity is a source of dust emissions that can have a significant but transient impact on local air quality. The amount of dust emitted from construction operations depends on the area of land being worked, the proportion of land lying exposed at any time, the clearing and dozing equipment used, the number and type of vehicles on temporary roads and the duration of the construction phase. The majority proportion of dust emissions result from heavy vehicle traffic movement on temporary gravel roads at the construction site.

The quantity of dust emissions from construction operations is proportional to the area of land being worked and to the level of construction activity. Emissions from heavy construction are positively correlated with the silt content of the soil and the weight and speed of the average vehicle and negatively correlated with the soil moisture content (USEPA, 1995). Pollutants associated with construction activities are typically Total Suspended Particulates (TSP), PM₁₀ and PM_{2.5} with lesser contributions of CO, NO₂, SO₂ and C₆H₆ from vehicle exhausts.

PM refers to solid or liquid particles suspended in the air. PM varies in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. Particles can be classified by their aerodynamic properties into coarse particles, PM₁₀ (particulate matter with an aerodynamic diameter of less than 10 µm) and fine particles, PM_{2.5} (particulate matter with an aerodynamic diameter of less than 2.5 µm). In addition to reduced visibility, particulate air pollution poses health risks associated with the respiratory system. Particle size controls how far into the respiratory system particles can permeate. Fine particles have been found to be more damaging to human health than coarse particles as larger particles are less respirable in that they do not penetrate deep into the lungs compared to smaller particles. PM_{2.5} can enter the bloodstream via capillaries in the lungs with the potential to be laid down as plaques in the cardiovascular system or brain. Reported health effects to PM include eye, nose, and throat irritation, coughing, reduced lung function, inflammation of the lungs, angina, myocardial infarction, and bronchitis.

Dust emissions from these activities vary substantially day to day, depending on the level of activity, the specific operations and the prevailing meteorological conditions at the time. Dust entrainment from the movement of construction vehicles over temporary roads and around the construction site can also be expected. If not properly mitigated, construction sites could generate high levels of dust (typically from concrete, cement, wood, stone, silica) and this has the potential to travel for large distances.

Combustion engines also emit emissions of CO, HC, NO_x and CO₂. A potentially source of PM_{2.5} on construction sites comes from the diesel engine exhausts of on- and off-road utility vehicles and heavy equipment as well as stationary combustion sources. These particles are known as Diesel Particulate Matter (DPM), and consist of soot (unburnt organic material), sulphates and silicates, all of which may readily combine with other compounds in the atmosphere, increasing the health risks of particle inhalation. Other noxious vapours may also originate from oils, glues, thinners, paints, treated woods, plastics, cleaners and other hazardous chemicals that may be used on construction sites.

The Project's impact on surrounding sensitive receptors is low. The area currently has good ambient air quality, with only occasional minor impacts from local fires. The Project's operations are not expected to adversely affect regional or local air quality, as it does not involve significant sources of emissions. Modern, energy-efficient technology will be used, and any minor emissions will remain within regulatory limits. Design and location considerations take account of natural factors that help disperse pollutants. Given the stable baseline air quality and lack of new pollution sources, the Project's environmental impact is minimal, warranting a qualitative assessment of potential air quality impacts.

Operational air emissions are generally lower and differ in nature from those during construction which include the following:

- **Substation Equipment:** Electrical equipment, such as transformers and switchgear, can emit small quantities of SF₆ gas, a potent greenhouse gas, due to leakage. Although these emissions are low in volume, SF₆ has a high global warming potential; and
- **Maintenance Activities:** Maintenance operations, including the use of vehicles and portable generators, can produce exhaust emissions similar to those during the construction phase but on a smaller scale.

Activities and emissions associated with the decommissioning phase are considered to be similar to those of the construction phase.

Considering the proposed site and location sensitive receptors from the proposed development site, atmospheric impacts from dust emissions during the temporary decommissioning phase are anticipated to be low. With the implementation of appropriate control measures, the impact on neighbouring sensitive receptors will be reduced further and assessed to be very low.

Once decommissioning activities cease, the only associated emissions may include wind-blown dust from exposed land on the site footprint. Post closure, the site should revegetate relatively quickly limiting this wind-blown dust and creating no permanent air quality issues going forward. Atmospheric impacts from dust emissions during the post-closure phase are therefore anticipated to be very low.

Impact assessment

The impact significance ratings of the identified potential air quality impacts during all phases are presented in Table 6-27 to Table 6-29. Management measures are also presented in the tables.

Table 6-27: Air quality impact assessment (construction phase)

Activity: Activities during the construction phase including vehicle movement, excavation, potential blasting and vegetation clearing
Project phase: Construction

AQ1 - Impact Summary: Addition of excess dust and gaseous emissions (e.g. from diesel generators and vehicles) to ambient air quality								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	Moderate	Short term	Local	Low	Possible	Low	-	Low
Management Measures:								
1. Reduce or stop work (notably land clearing) during very dry and windy conditions as per the Air Quality and Dust Control Management Plan; 2. In areas close to sensitive receptors, apply dust abatement measures (e.g. water the construction site) to suppress dust and prevent it from becoming airborne as per the Air Quality and Dust Control Management Plan; 3. Enclosing the construction site with temporary fencing and covering materials like tarps can help reduce dust and other pollutants from escaping the site in line with the Air Quality and Dust Control Management Plan; 4. Limit the amount of earth-moving and excavation work and control the speed and movement of heavy equipment to reduce the amount of dust generated during the construction process in line with the Air Quality and Dust Control Management Plan; 5. Regular monitoring of air quality at the construction site can help identify potential air pollution issues and enable timely corrective measures as per the Air Quality and Dust Control Management Plan; 6. Awareness training on air emissions should be carried out at all levels for the workforce (workers, foremen, managers), and can be included in induction courses. Training should focus on promoting understanding as to why mitigation measures are in place as per the EHS Training and Awareness Plan; and 7. Develop and implement a complaints system and make the community aware of the complaints procedure maintained by site management as per the Grievance Mechanism.								
After Management	Moderate	Short term	Local	Low	Possible	Very Low	-	Low

Table 6-28: Air quality impact assessment (operation phase)

Activity: Activities during the operational phase including maintenance activities								
Project phase: Operation								
AQ2 - Impact Summary: Addition of excess gaseous emissions (from vehicles) to ambient air quality								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Short term	Local	Low	Possible	Low	-	Low
Management Measures:								
All measures should be in line with the Pollution Prevention and Abatement Management Plan and includes: 1. Ensure all vehicles are maintained according to the manufacturer's requirements; 2. Encourage driving practices that reduce fuel usage (e.g., measured acceleration and reduced driving speeds); 3. Replace older vehicles with newer vehicles that are more fuel-efficient; 4. Convert vehicles to cleaner fuels where feasible; and 5. Install and maintain emission control devices (e.g., catalytic converters).								
After Management	Moderate	Short term	Local	Low	Possible	Very Low	-	Low
Activity: Operation of transformers and substations								
Project phase: Operation								
AQ3 - Impact Summary: Potential emission of SF₆ from transformers and substation switchgears								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Short term	Local	Low	Possible	Low	-	Low
Management Measures:								
1. Carry out leak detection bi-annually, both visually and with suitable gas leak detection equipment/testing as per the Pollution Prevention and Abatement Management Plan; and 2. Scheduled maintenance and inspection routines ensure that equipment is in optimal condition, reducing the likelihood of leaks and emissions as per the Maintenance Management Plan.								
After Management	Moderate	Short term	Site	Low	Possible	Very Low	-	Low

Table 6-29: Air quality impact assessment (decommissioning phase)

Activity: Operation of transformers and substations								
Project phase: Decommissioning								
AQ4 – Impact Summary: Potential emission of SF₆ from transformers and substation switchgears								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Short term	Local	Low	Possible	Low	-	Low
Management Measures:								
1. Reduce or stop work during very dry and windy conditions, where possible; 2. Vegetate areas that could be a source of windblown dust emissions as per the Rehabilitation and Revegetation Management Plan; 3. Regularly watering the area of under closure can help suppress dust and prevent it from becoming airborne in line with the Air Quality and Dust Control Management Plan; and 4. Enclosing solid and material stockpiles at the decommissioning site with temporary fencing and covering materials like tarps can help reduce dust and other pollutants from escaping the site.								
After Management	Minor	Short term	Site	Low	Possible	Very Low	-	Low

6.4.7 Noise impacts

Baseline conditions

Villages and receptors in the Project area are classified as rural districts and increases to prevailing noise levels are largely due to motorised traffic, generators, domestic-type noises and localised noise sources. Traffic (e.g. motor-vehicles, trucks, and motorbikes), generators, domestic noise (e.g. barking dogs, animals and people) contribute the most to the increased ambient noise levels. A more detailed overview of baseline conditions is provided in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The key potential noise impacts for all Project phases include:

- Increased noise levels from clearing and grubbing activities prior to construction;
- Increased air pressure and vibration levels from potential blasting if required;
- Increased noise levels from construction activities for the OHL and for associated infrastructure;
- Increased noise from transformers and cooling fans at substations;
- Increased noise from maintenance activities; and
- Increased noise from demolition and other decommissioning activities.

Impact description and predictions

Noise, air pressure and vibration impacts have been assessed for the construction, operational and decommissioning phases of the Project.

In terms of the construction phase, the impacts are anticipated to be more significant and include increased noise impacts from construction related activities such as heavy machinery, vehicle movement, excavation and vegetation clearance and general noise from construction camps. There is a potential, albeit a minor potential, that blasting may be required for areas where rocky outcrops/terrain are unavoidable. This activity would impact noise as well as air pressure, exceeding 140 dB and 12.5 mm/s for noise and ground vibration respectively.

In terms of the operational phase, the noise impacts are largely caused by maintenance activities and the operation of transformers and cooling systems at substations. Maintenance activities can include the operation of machinery and vehicle movement.

Anticipated impacts during the decommissioning phase are similar to the construction phase as there will be the movement of heavy machinery and vehicles and dismantling of pylon infrastructure.

Impact assessment

The impact significance ratings of the identified potential noise impacts during all Project phases are presented in Table 6-30 to Table 6-32. Management measures are also presented in the table.

Table 6-30: Noise impact assessment (construction phase)

Activity: Clearing and grubbing of the footprint areas at the OHL, Substation, Pylons, and Transformation Stations, Access roads, Laydown areas, and Campsites

Project phase: Construction

N1 – Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures:								
<i>All measures should be in line with the Noise and Vibration Management Plan and include:</i> <i>1. Ensure that all machinery with noise sources exceeding 80.0dBA are adequately acoustically screened off as far as and possible and where feasible;</i> <i>2. Noisy machinery (in excess of 80.0dBA) to be utilised during the day when the prevailing ambient noise levels area higher; and</i> <i>3. Noise complaints must be assessed within 8 hours after receipt of a noise complaint.</i>								
After Management	<i>Minor</i>	<i>Medium term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Blasting at OHL, Substation, Pylons, and Transformation Stations footprints – if required								
Project phase: Construction								
N2 - Impact Summary: Increase in the ground vibration and/or air pressure levels at the residential areas in that the ground vibration level of 12.5mm/s and/or air pressure levels of 140dB is exceeded during – blast - if required								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures:								
<i>1. If required, no blasting should be conducted within 500m from any residential area as per the Blast Management Plan;</i> <i>2. Safe blasting techniques must be used during a blast;</i> <i>3. Blasting procedure / method statement as part of the Blast Management Plan to be prepared before any blasting can take place;</i> <i>4. Blast design to be conducted before a blast; and</i> <i>5. Ground vibration and/or air pressure levels must be monitored as per the Noise and Vibration Management Plan.</i>								
After Management	<i>Minor</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Construction activities at OHL and infrastructure – Construction of the different sections of the electrification process of the footprint areas at the OHL, Substation, Pylons, and Transformation Stations.								
Project phase: Construction								
N3 - Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate (-)</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures:								
Apply measures 1-2 presented in N1.								
After Management	<i>Minor</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Civil construction activities – Construction of internal roads, infrastructure, and buildings								
Project phase: Construction								
N4 - Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities.								

	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-2 presented in N1.								
After Management	<i>Minor</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>

Table 6-31: Noise impact assessment (operation phase)

Activity: Noise from transformers, cooling fans and other noise sources								
Project phase: Operation								
N5 - Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 1-2 presented in N1.								
After Management	<i>Minor</i>	<i>Medium term</i>	<i>Local</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Transformers at the pylons make a noise which is intrusive								
Project phase: Operation								
N6 – Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: All measures should be in line with the Noise and Vibration Management Plan and include: 1. Ensure that all machinery with noise sources exceeding 50.0dBA are adequately acoustically screened off as far as possible and where feasible; 2. Noisy machinery (in excess of 80.0dBA) to be utilised during the day when the prevailing ambient noise levels are higher; and 3. Noise complaints must be assessed within 8 hours after receipt of a noise complaint.								
After Management	<i>Minor</i>	<i>Medium term</i>	<i>Site</i>	Low	<i>Unlikely</i>	Low	-	<i>Medium</i>
Activity: Maintenance activities at the OHL, Substations and Transform stations								
Project phase: Operation								
N7 – Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during maintenance activities.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: All measures should be in line with the Noise and Vibration Management Plan and include: 1. Ensure that all machinery with noise sources exceeding 50.0dBA to 80.0dBA are adequately acoustically screened off as far as possible and where feasible;								

2. Noisy machinery (in excess of 80.0dBA) to be utilised during the day when the prevailing ambient noise levels are higher; and								
3. Noise complaints must be assessed within 8 hours after receipt of a noise complaint.								
After Management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

Table 6-32: Noise impact assessment (decommissioning phase)

Activity: Removal of all structures – demolition of all structures at the different footprint areas								
Project phase: Decommissioning								
N8 – Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Medium term	Site	Medium	Possible	Medium	-	Medium
Management Measures: Apply measures 1-2 presented in N1.								
After Management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium
Activity: Rehabilitation of disturbed areas – restore the different footprint areas to its natural form								
Project phase: Decommissioning								
N9 - Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the above activities.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Medium term	Site	Medium	Possible	Medium	-	Medium
Management Measures: Apply measures 1-2 presented in N6.								
After Management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium
Activity: Revegetation activities at the OHL, Substations and Transformer stations								
Project phase: Decommissioning								
N10 - Impact Summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during maintenance activities.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Medium term	Site	Medium	Possible	Medium	-	Medium
Management Measures: Apply measures 1-2 presented in 7.								
After Management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

6.4.8 Visual impacts

Baseline conditions

The visual character of the Project area can predominantly be described as agricultural land (subsistence farming), forest (natural and plantations) and built-up (community) areas. The towns are not highly developed areas.

In terms of sense of place, most of the Project area can be classified as very low. The area within towns and villages such as Gove, Chipindo, Cuvango and Jamba will have a higher sense of place as the more densely built-up areas form more distinct landscape patterns, making these areas more memorable. Gove is also defined by the large Gove Dam which is a very significant landscape feature and hence the sense of place in Gove will be high in comparison to the rest of the study area.

The visual quality of the Project area as calculated ranges from medium to medium-to-high for the OHL and substation areas and low-to-medium for the distribution networks. Visual quality decreases when elements deter from the natural environment such as manmade features such as roads, mines and factories. A more detailed overview of baseline conditions is provided in Section 4.

Stakeholder issues and concerns:

The Project is viewed with enthusiasm as it will benefit the towns.

Impact identification

The key potential visual impacts of all Project phases include:

- Construction activities of the overhead lines and the substations;
- Operational presence of the overhead lines and substations; and
- Visual disturbance of decommissioning activities.

Impact description and predictions

The magnitude of the visual impact requires consideration of several factors such as visual exposure, visual distance and visibility, visual absorption capacity, landscape/ townscape compatibility and sensitivity of viewers. The respective methodologies for assessing these factors is included in Volume 3, Appendix K for reference and results are presented below.

Visual exposure

Visual exposure is determined by an object's "zone of visual influence" or how visible an object may be in the landscape. The visual exposure of the overhead line was determined to be marginally visible (2.29) for the Gove-Chipindo-Cuvango OHL and marginally visible-to visible (2.96) for the Cuvango-Jamba OHL. The visual exposure of the substations was determined as follows: Chipindo marginally visible (2.33), Cuvango marginally visible-to-visible (3) and Jamba marginally visible-to-visible (2.66). It is expected that the visual exposure to visual receptors in the area will be limited to residents within close proximity of the infrastructure.

Visual distance and visibility

The distance of a viewer from a proposed new development or infrastructure is an important determinant of the magnitude of the visual impact. This is due to the visual impact of an object diminishing / attenuating as the distance between the viewer and the object increases. The final viewing distance and visibility rating were distant middle ground-to-middle ground (2.5) for the Gove-Chipindo-Cuvango overhead line and middle ground (3) for the Cuvango-Jamba overhead line. For the substations, calculating the viewing distance and visibility rating was done based on the buildings identified in the open buildings. The majority of all buildings fell into the middle ground (3) for all substations.

Visual absorption capacity

The Visual Absorption Capacity (VAC) is the potential for the area to conceal / mitigate the impact of the Project through natural or man-made features in the landscape. VAC is influenced by factors such

as: topography and vegetation that can provide screening and increase the visual absorption capacity of a landscape; the degree of urbanisation compared to open space. A highly urbanised landscape is better able to absorb the visual impacts of similar developments; an interrelated landscape comprising a unified environment; the scale and density of surrounding developments.

The topography of the area can be described as hilly. Besides for the four towns (i.e. Gove, Chipindo, Cuvango and Jamba), communities and scattered farming households, roads and railway lines there is little other infrastructure in the study area. Large portions of the study area are vegetated however 50 m tall transmission towers will likely rise above most of the vegetation. The VAC for the surrounding area of the high voltage overhead lines and transmission towers are predicted to be medium (3).

In the areas where new substations are proposed, a higher concentration of infrastructure and disturbed land occurs. However, the majority of the infrastructure comprises small-scale, single-storey buildings and natural and modified vegetated land still dominates these areas. The VAC for the area surrounding the substations is predicted to be medium-to-high (2).

The distribution network will be positioned along existing roads within the town area. By nature, the distribution network is made up of infrastructure that due to its small surface area is easily absorbed into the background in most landscapes. However little/no similar infrastructure currently exists throughout the towns.

Landscape / townscape compatibility

Landscape or townscape compatibility refers to the compatibility of the proposed infrastructure with the existing landscape or townscape. Besides for the existing hydroelectric power plant and substation in Gove, very little electricity infrastructure is evident in the rest of the study area. For the high voltage OHLs and towers, the Landscape/townscape compatibility is predicted to be low (5).

Currently, no substations exist within the areas identified for the three new substations. For the Chipindo and Cuvango substations, the landscape/townscape compatibility rating is predicted to be low-to-moderate (4). There is a train station and railway line near the location identified for the Jamba substation and the site was previously a thermal power plant. Some of the infrastructure still remains. The landscape/townscape compatibility rating for Jamba substation is moderate-to-high (2).

Little or no similar infrastructure to the proposed Project currently exist, however all infrastructure is within town areas and along existing roads.

Sensitivity of viewers

The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon. Residents living near the proposed infrastructure are considered to be more sensitive towards the Project compared to those travelling through the study area. Based on the analysis the most sensitive viewers are considered to include:

- The residents in the Gove, Chipindo, Cuvango and Jamba towns;
- Communities and household residents located within 600m of the overhead lines and/or 1km of the new substations; and
- Motorists travelling along the main roads and railway users. However, these motorists and railway users are expected to only have transient views of the Project infrastructure.

The viewer sensitivity is predicted to be low-to-medium (2). In Gove, the substation already exists and is associated with the operational hydroelectric power plant. Residents are unlikely to be sensitive to additional OHLs leaving the existing plant. In Chipindo, Cuvango and Jamba, many residents do not have access to electricity and the Project will address their requirements. Residents who are likely to be most sensitive to the Project are those in communities in close proximity to the planned infrastructure but are not benefitting directly. Motorists and railway users are not considered as

sensitive as static viewers (residents). It must be noted that the main mode of transport is motorbikes. Motorcyclists will have a greater scope of view than those in closed vehicles.

The assumed view catchment of the distribution network is limited to town residents who will benefit from streetlights and/or electricity supply to their homes, therefore the sensitivity of the viewers towards the infrastructure is suspected to be low. According to the stakeholders, the general perception is that this will benefit the town.

Magnitude of visual impacts

The magnitude of the visual impact, which is a subjective measure, is calculated based on an average between all criteria listed in Table 6-33.

Table 6-33: Summary of the magnitude of visual impacts

Criteria	OHL: Gove-Chipindo-Cuvango	OHL: Cuvango-Jamba	
Visual Character	4	4	
Visual Quality of the Environment	2.67	3.66	
Visual Exposure	2.29	2.96	
Visibility and Distance	2.5	3	
Visual Absorption Capacity	3	3	
Landscape Compatibility	5	5	
Viewer Sensitivity	2	2	
Magnitude	3.07	3.37	

Criteria	Substation: Chipindo	Substation: Cuvango	Substation: Jamba
Visual Character	4	4	4
Visual Quality of the Environment	2.33	3.00	3.33
Visual Exposure	2.33	3.00	2.66
Visibility and Distance	3	3	3
Visual Absorption Capacity	2	2	2
Landscape Compatibility	4	4	2
Viewer Sensitivity	2	2	2
Magnitude	2.24	2.42	2.14

The magnitude is ranked from Major (5) to Minor (1), is used to inform the overall assessment of the visual impacts.

Impact assessment

The impact significance ratings of the identified potential visual impacts during all Project phases are presented in Table 6-34 to Table 6-36. Management measures are also presented in the table.

Table 6-34: Visual impact assessment (construction phase)

Activity: Construction of the 220kV overhead lines								
Project phase: Construction								
V1 - Impact Summary: Negative visual impact is imminent however only for a medium-term duration.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Medium term	Local	Medium	Definite	Medium	-	Medium
Management Measures: 1. Minimise vegetation clearing where possible, especially at construction camps, along access roads, around laydown areas and the Project site as per the Vegetation and Land Clearance Management Plan; 2. Use manmade barriers around laydown areas and construction camps where sensitive viewers exist; 3. Adhere to the management measures regarding dust provided by the air quality specialist and in line with the Air Quality and Dust Control Management Plan; 4. Use existing paths and roads to access the Project site; 5. Ensure the construction sites and camps are kept neat and tidy (minimise litter); and 6. If construction is happening at night, lighting should face inwards to ensure excess light does not escape to the surrounding areas as per the Lighting Management Plan.								
After Management	Moderate	Medium term	Local	Medium	Definite	Medium	-	Medium
Activity: Construction of the substations								
Project phase: Construction								
V2 – Impact Summary: Visual impact of medium significance. Impacts are expected to be felt at a local scale.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Medium term	Local	Medium	Definite	Medium	-	Medium
Management Measures: Apply measure 1-6 presented in V1.								
After Management	Moderate	Medium term	Local	Medium	Definite	Medium	-	Medium

Table 6-35: Visual impact assessment (operation phase)

Activity: Operation and maintenance of the 220kV overhead lines								
Project phase: Operation								
V3 – Impact Summary: Significance of visual impact expected to be high at a local extent.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Long term	Local	Medium	Definite	High	-	Medium
Management Measures: 1. If maintenance is done at night, lights should be faced inwards towards the site to avoid disturbing the surrounding area as per the Lighting Management Plan; and 2. Make sure Project site is kept neat and tidy (ensure all litter and any maintenance waste is removed as per the Waste Management Plan).								
After Management	Moderate	Long term	Local	Medium	Definite	High	-	Medium

Activity: Operation and maintenance of the substations								
Project phase: Operation								
V4 – Impact Summary: Highest visual impact significance rating. Mainly attributed to the visual impacts being felt for a long-term period.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Moderate	Long term	Local	Medium	Definite	High	-	Medium
Management Measures: - Where possible lighting should be faced inward or shielded from viewers. Low foot lighting should be used where deemed safe as per the Lighting Management Plan; - Physical barriers and covers can be used to prevent excess light leaving the Project site as per the Lighting Management Plan; - External signage should be kept to a minimum and placed on existing buildings where possible; and - Make sure Project site is kept neat and tidy (ensure all litter and any maintenance waste is removed).								
After Management	Moderate (-)	Long term	Local	Medium	Definite	High	-	Medium

Table 6-36: Visual impact assessment (decommissioning phase)

Activity: Decommissioning of the 220kV overhead lines								
Project phase: Decommissioning								
V5 – Impact Summary: During decommissioning the visual impact significance is expected to be low.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Local	Low	Possible	Low	-	Low
Management Measures: - Ensure all infrastructure is removed from site; and - Plant natural vegetation in cleared corridor to increase VAC of the project site in line with the Rehabilitation and Revegetation Management Plan.								
After Management	Minor	Medium term	Local	Low	Possible	Low	-	Low
Activity: Decommissioning of the substations								
Project phase: Decommissioning								
V6 - Impact Summary: Decommissioning the substations is expected to significantly reduce the visual impact.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium term	Local	Low	Possible	Low	-	Low
Management Measures: - Ensure all infrastructure is removed from site; and - Plant natural vegetation in around substations to reduce the visibility of the substations and associated infrastructure, where technically feasible and safe to do so in line with the Rehabilitation and Revegetation Management Plan.								
After Management	Minor	Medium term	Local	Low	Possible	Low	-	Low

6.5 Social Impacts

The following section present the impact assessment of social aspects, which include socio-economic, human rights and cultural heritage.

6.5.1 Socio-economic impacts

Socio-economic impacts are difficult to quantify since they can be true/real/actual or felt/perceived. They can occur as soon as the Project or a rumour thereof enters the public domain. In addition, some groups may experience an impact as positive while another feels it is negative, with some nuance. To this end, the methodology used to determine socio-economic impacts includes consideration of social change processes and social impacts, as distinguished below.

Baseline conditions

Social change processes

Social change processes are caused by projects and can be intended (for instance, increased electricity availability) or unintended (for instance, an influx of job-seekers) (Slootweg, Vanclay and van Schooten, 2001). Social change processes are dynamic, interactive, and non-linear (Rossouw and van der Merwe, 2024). They might *lead* to social impacts under certain conditions, depending on the characteristics of the Project Affected Party (PAP), Household (PAH) or Community (PAC) and the mitigation measures implemented. Whether the social change processes lead to social impacts, depends on the conditions and the characteristics of the impacted community and mitigation measures (Vanclay, 2002). Social change processes can include the following types (Vanclay, 2002):

- Demographic: changes in population numbers as a result of migration and displacement;
- Economic: the means of production and distribution in a society;
- Geographical: spatial availability and access to natural resources;
- Institutional and legal: governing structures and enforcement capabilities;
- Emancipatory and empowerment: capacity building and inclusivity; and
- Socio-cultural: beliefs, ideas, values, customs, conventions, and institutions.

It is anticipated that a Project of this magnitude will lead to several social change processes in and around the project site, which in turn may lead to social impacts. According to Vanclay and Smyth (2017), social change processes may lead to changes or impacts in the context of one or more of the seven categories or “themes”, as shown in Figure 6-1. These themes have been used as a guide in developing and contextualising the social change processes (and impacts).



Figure 6-1: Social change processes (Smyth & Vanclay, 2017)

Stakeholder issues and concerns:

- The Project is supported by municipal government, traditional leadership and communities;
- The Project is viewed with enthusiasm as it will boost investment in the region, promote the start-up of projects and lead to job creation;
- The project will provide residents with electricity; and
- Farmers are concerned about the loss of fertile fields where infrastructure is installed.

Identification of impacts

Social impacts are experienced or felt in corporeal (physical) or cognitive (perceptual) terms by the PAP, PAH or PAC. What is experienced depends on the effectiveness of stakeholder engagement, the social acceptability of the Project, whether the PAPs, PAHs or PACs have historically been impacted by other projects, their resilience, and the effectiveness of the mitigation measures (Esteves,

Factor, Götzmann and Moreiro, 2017). Resettlement, for example, is not a social impact but causes social impacts such as anxiety and stress, disruption to daily living, and impacts such as homelessness. The same impact can be felt as the result of many different social change processes which, in turn, result from a project's activities.

Within each phase of the Project, specific change processes and the associated impacts could occur or continue between Project phases. Such overlaps are shown in the impact assessment. Project activities can directly or indirectly trigger social change. The experience of an impact can prompt second-order impacts. Therefore, both social change processes and impacts are assessed.

Impact description and assessment

Potential socio-economic impacts have been identified and assessed across five themes. It should be noted that special precautions are highlighted in the impact tables where vulnerable groups have been identified as being potentially impacted, which may require additional safeguards over and above the listed mitigation measures. Impacts are divided into five themes (i.e. land acquisition, culture and religion, employment, health and safety and socio-economic development) and assessed.

Theme one: Land acquisition

This theme refers to the land required to construct the transmission line, including the placement of pylon foundations, establishing access roads, OHL corridor, construction camp placement, and laydown areas. It aligns with the “*Livelihood Assets and Activities*”, “*Land and Natural Resources*” and “*People’s capacities, abilities, and freedoms to achieve their goals*” themes described by Vanclay and Smyth (2017). It relates to ecosystem services, competing land use demands, food security, gender divisions, basic human rights and household strengths and vulnerabilities.

Impact SE1.1: Reduced income-earning opportunities due to a loss of, or access to, farming and livestock grazing land

Access to farmland could be affected by construction site establishment, activities and vehicle movement, as farmers and livestock owners might have to walk further to reach their land used for cultivation and grazing. If households need to be relocated from under the OHL due to safety concerns or unacceptably high noise levels, for instance, this impact will be more severe and long-term. Farmland might be permanently lost if farming activities cannot continue under the transmission line. Changes to access to farmland affect the income and land-based livelihoods of villagers, as a large percentage of households depend on farming and livestock for their income. The impact rating before and after mitigation measures are applied is described in Table 6-37.

Table 6-37: Reduced income-earning opportunities due to a loss of, or access to, farming and livestock grazing land

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.1 - Impact Summary: Reduced income-earning opportunities due to a loss of, or access to, farming or grazing land or access to such land								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium
Management Measures:								
1. Ensure the Project design is adapted to avoid any impacts on farming or grazing land; 2. If avoidance is not possible, provide alternative land of the same or better carrying capacity and at the same travelling distance as the affected land; 3. If land is not available and cash compensation is preferred, this can also be considered, however, it needs to be implemented together with the necessary livelihood restoration measures since the PAP's livelihood might not change								

from traditional practices e.g. subsistence farming to another income-generating opportunity if they cannot find land elsewhere; 4. Compile and implement an IFC-compliant SEP, including a grievance mechanism; 5. Compiling an IFC-compliant Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) for any physical or economic displacement as determined after the implementation of the LARF; and 6. Any farmland that is impacted by construction activities must rehabilitated to the pre-construction standard or better as per the Rehabilitation and Revegetation Management Plan. If this is not possible, replacement land must be provided to the affected farmers.								
After Management	Moderate	Long-term	Local	Medium	Possible	Medium	-	Medium

Impact SE1.2: Increased food insecurity due to loss of farming or grazing land or access to such land

Food security refers to the steady and predictable availability of sufficient food with adequate nutritional value. Households rely heavily on their farming and livestock practices for income to purchase food, and for self-consumption. Farmland might be permanently lost if farming activities cannot continue under the transmission line, or if affected farmland is inadequately rehabilitated. Reducing access to farmland, even if temporary, could lead to food insecurity. The reasons for this are:

- Fewer farming activities and hence food (less food availability and affected food utilisation);
- Fewer farming activities and hence less income to purchase food (reduced food access and stability); and
- Further distances to walk to farmland, resulting in lower farm production and yield.

The impact rating before and after mitigation measures are applied is described in Table 6-38.

Table 6-38: Increased food insecurity due to loss of farming or grazing land or access to such land

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.2 - Impact Summary: Increased food insecurity due to loss of farming or grazing land or access to such land								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium
Management Measures:								
1. Determine if any of the existing agricultural projects, institutes or facilities, such as the PEDR, Carrinho Agri (run by Grupo Carrinho Comercio Lda), Agricarrinho in the ECAs, CartAgri, MOSAP II, IDA, EDAs, agricultural cooperatives and associations, could be leveraged during the construction period, when the highest land-based impact is expected; 2. Ensure that replacement land of the same or better carrying capacity and at the same travelling distance as the affected land is provided to affected farmers/households; 3. If land is not available and cash compensation is preferred, this can also be considered, however, it needs to be implemented together with the necessary livelihood restoration measures since the PAP's livelihood might not change from traditional practices e.g. subsistence farming to another income-generating opportunity if they cannot find land elsewhere; 4. Construction activities should be limited to demarcated areas and avoid farming or grazing land used by local communities; 5. Note that such land might not be very close to villages using it and it might not be apparent that it is used for grazing. This should be determined before site establishment; 6. Any impacts resulting from construction activities on farmland and resources, such as soil compaction due to vehicle traffic, hydrocarbon spills and water contamination, should be rehabilitated or cleared immediately after occurrence as per the Rehabilitation and Revegetation Management Plan; and 7. Consultation with sobas and local municipal administrations will be important to ensure that farmland is identified and avoided prior to site establishment.								
After Management	Moderate	Long-term	Local	Medium	Possible	Medium	-	Medium

Impact SE1.3: Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas

Although ASM is regarded as illegal in the Project-affected areas, there will nonetheless be an impact on artisanal miners' livelihoods if land required for the transmission line intersects that used for ASM activities. Furthermore, some artisanal miners observed close to the Project area were locals from the PACs.

The impact rating before and after mitigation measures are applied is described in Table 6-39.

Table 6-39: Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.3 - Impact Summary: Reduced income-earning opportunities for artisanal miners due to the loss of available artisanal mining areas								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>High</i>
Management Measures: <i>Liaise with local law enforcement, police and/or other security entities on their strategies for managing ASM activities in the area;</i> <i>Provide employment opportunities for unskilled labour from the PACs as far as possible; and</i> <i>Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness of the land that is in RNT's possession and that will be used for the transmission line (or ENDE's land for the distribution network) in line with the SEP.</i>								
After Management	<i>Moderate</i>	<i>Medium-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

Impact SE1.4: Disruption of access in and between communities and sites used by Khoi San people

The construction and placement of the OHLs, and the substations on the outskirts of the three beneficiary towns, could lead to minor disturbances of the access roads used by community members. Footpaths, bike and *kupapata* paths, and roads that currently pass through or that are very close to these infrastructure sites, will no longer be accessible or will be diverted slightly, as these areas will have to be cordoned off for construction safety buffers and the construction and placement of the actual infrastructures. Community members currently informally use these thoroughfares to move between villages, waterbodies, schools, households and agricultural sites. The unrestricted movement of nomadic Indigenous peoples (for hunting or harvesting purposes, as well as seasonal travel to another site) might also be affected by the presence of project infrastructure.

This impact does not refer to formal roads between towns such as Cuvango and Chipindo as regional road diversions are not anticipated.

The impact rating before and after mitigation measures are applied is described in Table 6-40.

Table 6-40: Disruption of access in and between communities and sites used by Khoi San people

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.4 - Impact Summary: Disruption of access in and between communities and sites used by Khoi San people due to the presence of the transmission and distribution powerlines and substations								

	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Minor</i>	<i>Long-term</i>	<i>Regional</i>	Medium	<i>Definite</i>	Medium	-	<i>High</i>
Management Measures: 1. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness of the land that is in RNT's possession and that will be used for the transmission line (or ENDE's land for the distribution network); 2. Construction and no-entry areas should be clearly marked prior to site establishment and maintained once substations are constructed, to ensure that no unauthorised entry takes place which can lead to safety risks; 3. Construct new roads which could be used safely by villagers (i.e., with fenced walking side paths) outside of any buffer areas required by the biodiversity-related mitigation measures; 4. Consult the local municipalities shortly before the commencement of construction to ensure that no Khoi San people are expected to move through the project area.								
After Management	<i>Minor</i>	<i>Short-term</i>	<i>Regional</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>

Impact SE1.5: Altering the sense of place of community members and Khoi San people due to the presence of the powerlines and substations

Changes in well-being and in “sense of place” are difficult to measure. As a result, these impacts are frequently underestimated. The impact refers to the bonding that occurs between individuals and their environments, and their accustomed ways of using those environments. Three aspects (or dimensions) of a “sense of place” should be considered, namely attachment from a personal or group perspective (community land and values), from a psychological standpoint (villagers’ feelings toward the living environment), and the physical attributes of a place (for example the beauty of the area or farming potential). Considering these together, a “sense of place” can be affected by:

- How long an individual has lived in the area;
- An individual's personal or family experience on the land, land memory and knowledge;
- Their social and physical attraction to the land and its natural, as well as built environment; and
- The effect that the land has on them, such as instilling a sense of pride, love, or memories.

The transmission and distribution lines and three substations will have an impact on how the areas are perceived by community members due to their visual impression, the presence of complex and hazardous technologies, the perceived effects of low-frequency radiation, and the humming sound emitted by substations. In Chipindo, for instance, an agricultural field was being prepared adjacent the proposed substation location.

Furthermore, although Indigenous peoples (Khoi San) are not currently present in the project area, they might see the transmission line from a distance, thus affecting how they perceive the area. Given their nomadic way of living, they may come across construction activities as they hunt or harvest natural resources.

The impact rating before and after mitigation measures are applied is described in Table 6-41

Table 6-41: Altering the sense of place of community members and Khoi San people due to the presence of the transmission line

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.5 - Impact Summary: Altering the sense of place of community members and Khoi San people due to the presence of the transmission line								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Regional</i>	High	<i>Definite</i>	High	-	<i>Medium</i>
Management Measures:								

1. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness and education of the physical Project components. This could include awareness posters or other print media, or community meetings with presentations on the safety of non-ionising radiation emitted by substations in the form of Extremely Low Frequency electromagnetic radiation; 2. Visuals and simple text in Umbundu, Nganguela, !Kung and Portuguese should be used, the former languages being very important to ensure that women, the elderly and the Khoi San people (all of whom are identified as vulnerable groups in this Project) who do not understand Portuguese are also equally informed; and 3. Ensure that the siting of the substations is as far as possible and within the land in RNT's possession, from established villages and community activities such as agriculture.								
After Management	Minor	Long-term	Regional	Medium	Possible	Medium	-	Medium

Impact SE1.6: Undercompensating economically displaced PAHs/PAPs

Agricultural plots, grazing land and other structures may be lost to land acquisition, temporarily during construction or permanently due to infrastructure siting. Compensation provided for the loss of livelihood, or structures, might be cash or in-kind. The LARF produced as part of this Project's ESIA prescribes that whichever compensation is provided should be of equal or higher value.

State involvement (or ownership of) in the compensation process could lead to non-compliance with GIIP on displacement, as national standards might be more "relaxed" than, for instance, IFC PS5. Compensation rates might also undervalue current crops or assets.

Furthermore, if cash compensation is provided, it might seem like a fairly quick and apparently simple way to compensate affected land users, but it does not necessarily have the positive impact of providing long-term livelihood restoration. Sudden access to large sums of money, where it had never been part of an individual or family's frame of reference, should **not** be assumed to be beneficial, as it might lead to changes in power dynamics within compensated households and families, and it could also expose them to debt and a sudden loss of the only livelihood they had ever been involved in – farming.

Although positive impacts could result from the compensation enhancements described in the table below, it must be noted that any form of displacement should only take place as a last resort when no alternatives are available. Compensation provided should not be regarded as a favour or benefit to the affected stakeholders but as an absolute minimum requirement for the disruptive impact of displacement.

The impact rating before and after mitigation measures are applied is described in Table 6-42.

Table 6-42: Undercompensating economically displaced PAHs/PAPs

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.6 - Impact Summary: Underpayment as part of economic displacement compensation conducted by state entities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium
Management Measures:								
1. Compile and implement an IFC-compliant LARF. The process should not only meet national standards, but also comply with GIIP, such as IFC PS5. If economic displacement is found to be unavoidable, compile and implement an IFC-compliant LRP; 2. Externally monitor the valuation and compensation process undertaken to determine which plots are affected and what kind of compensation is provided, especially if undertaken by government agents. This will ensure that current valuations are used (taking inflation into account if the latest published guidelines are pre-2024 or whichever year the compensation will take place); 3. Repeated planting of the same crops and decreasing rainfall are believed by local farmers to be the leading causes of the deterioration of fertile soil. If replacement land and livelihood restoration support are provided, the land should be of better								

quality and potential assistance or support for agricultural resources provided. PAPs/PAHs would then have access to resources that they normally do not, such as expensive fertiliser and other crop types or seeds to do rotational farming; 4. Any livelihood restoration and transitional support must be accompanied by education and awareness raising on responsible and sustainable farming practices. There might be other cost-effective, waterwise and sustainable farming practices based on new technologies or research; 5. Any cash compensation should be provided along with relevant education on financial literacy and responsible spending; and 6. Visuals and simple text in Umbundu, Nganguela and Portuguese should be used in awareness and education sessions on sustainable farming and financial literacy as part of transitional support and livelihood restoration. Communicating in Umbundu and Nganguela is very important to ensure that women and the elderly (who are identified as vulnerable groups in this Project) who do not understand Portuguese are also empowered to undertake sustainable farming.								
After Management	Moderate	Long-term	Local	Medium	Possible	Medium	-	Medium

Impact SE1.7: Undercompensating physically displaced PAH/PAPs

Although the OHL route alignment and substation locations was informed by high-level desktop and site screening to avoid sensitive environmental and social features, physical and economic displacement is not completely avoidable. Compensation provided for the loss of dwellings such as sleeping and living quarters, cooking and other household structures, might be cash or in-kind. The LARF produced as part of this Project's ESIA prescribes that whichever compensation is provided should be of equal or higher value.

State involvement (or ownership of) in the compensation process could lead to non-compliance with GIIP on displacement, as national standards might be more "relaxed" than, for instance, IFC PS5. Compensation rates might also undervalue current structures and assets.

Furthermore, if cash compensation is provided, it might seem like a fairly quick and apparently simple way to compensate affected households, but it does not necessarily have the positive impact of providing secure housing and shelter. Sudden access to large sums of money, where it had never been part of an individual or family's frame of reference, should **not** be assumed to be beneficial, as it might lead to changes in power dynamics within compensated households and families, and it could also expose them to debt and increased costs of building and maintaining a replacement house. For instance, building a house of adobe and thatch might not be possible and might now have to be constructed of bricks, cement and corrugated iron sheeting based on available materials. Maintenance costs on such houses might also be higher than the original dwellings.

Most households in the PACs do not have security of tenure as their houses have been inherited or provided by *sobas* without records thereof. This makes these households especially vulnerable to exploitation by officials or other parties when calculating compensation, who to provide secure tenure to in a given household, family or even the community.

Any form of physical displacement, demolition of structures, or the movement of physical assets should only take place as a last resort when no alternatives are available. Compensation provided should not be regarded as a favour or benefit to the affected stakeholders but as an absolute minimum requirement for the disruptive impact of physical displacement.

The impact rating before and after mitigation measures are applied is described in Table 6-43.

Table 6-43: Undercompensating physically displaced PAH/PAPs

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.7 - Impact Summary: Undercompensating physically displaced PAH/PAPs								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium

Management Measures:								
1. Avoid any form of physical displacement, resettlement, or relocation. If it can absolutely not be avoided, it should be limited as far as possible and mitigated proportionally; 2. Compile and implement an IFC-compliant LARF. The process should not only meet national standards, but also comply with GIIP, such as IFC PS5. If physical displacement is found to be unavoidable. Compile and implement an IFC-compliant RAP and LRP; 3. Externally monitor the valuation and compensation process undertaken to determine which households and their structures (as well as communally owned and used structures such as mills) are affected and what kind of compensation is provided, especially if undertaken by government agents. This will ensure that current valuations are used (taking inflation into account if the latest published guidelines are pre-2024 or whichever year the compensation will take place); 4. Externally monitor the physical relocation process to ensure that GIIP, IFC PS5, and RAP requirements are adequately implemented and periodically reviewed; 5. Any cash compensation should be provided along with relevant education on financial literacy and responsible spending; 6. Any changes to residential locations should be accompanied by security of tenure; 7. The necessary support should be provided to the vulnerable elderly and disabled during any movements to new replacement houses or locations. This includes not only physical transportation of them and their possessions, but also assistance with construction or sourcing of replacement housing; 8. Counselling and training on house maintenance and the management of household budgets should be provided; 9. Livelihood restoration mitigation measures described in Impact SE1.6: Underpayment of economically displaced PAHs/PAPs should also be taken into account if there will be changes to farming locations.								
After Management	Moderate	Long-term	Local	Medium	Possible	Medium	-	Medium

Impact SE1.8: Increased gender marginalisation and vulnerability resulting from compensations to mostly male household heads

Displacement compensation (whether cash, land, or specific resources) can increase women's vulnerability. The reason is that household financial management in these villages is largely the domain of men, whereas women (often one of many wives) may have limited decision-making powers. This could increase domineering behaviour from men towards women, the elderly, or disabled persons, as these groups are not consulted by the male household heads on how compensation cash is spent, or which livelihood restoration measures would be most appropriate for their household or family. This could also subject children to the deprivation of various basic needs such as food, clothes, or adequate housing. Adolescents or teenagers might be more enterprising and engage in illicit activities such as ASM if deprived of essentials by a parent or caretaker who has not managed the household's compensation responsibly. At worst, cash compensations might be spent on items or services that are not beneficial to anyone else in the household in any way.

Apart from females, other vulnerable groups include war veterans. They currently receive government subsidies, are often elderly and some of them are disabled. Other vulnerable groups include internally displaced individuals or families that have migrated to the Project-affected villages after the civil war. If they have not fully integrated into the community, the community members, sobas, or government officials might inadvertently dismiss the need to meaningfully consult or compensate them, especially when it comes to communal land and assets.

The impact rating before and after mitigation measures are applied is described in Table 6-44.

Table 6-44: Increased gender marginalisation resulting from compensation payments to mostly male household heads

Activity: Land acquisition								
Project phase: Construction and operation								
SE1.8 - Impact Summary: Increased gender marginalisation and vulnerability resulting from compensation payments to mostly male household heads								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium

Management Measures:								
1. Avoid any form of physical or economic displacement, resettlement, or relocation. If it can absolutely not be avoided, it should be limited as far as possible and mitigated proportionally; 2. Compile and implement an IFC-compliant LARF. The process should not only meet national standards, but also comply with GIIP, such as IFC PS5. If displacement is found to be unavoidable, compile and implement an IFC-compliant RAP and LRP; 3. When determining which dwellings or other household assets are affected, ensure that the census takes into account every single member of the household. Disabled persons are often not mentioned as part of the household; 4. When determining which agricultural plots are affected, ensure that every person who uses it is identified, as some households share the use of a single plot. The sobas can help verify this information; 5. Care should be taken not to overlook households that were not born in the affected villages, but who have migrated there after the war; 6. Externally monitor the valuation and compensation process undertaken to ensure that government agents, which might be mostly male, do not overlook female household heads such as widows, or undervalue their compensations; 7. Any livelihood restoration and transitional support must be accompanied by education and awareness raising on responsible and sustainable farming practices for both male and female farmers; 8. Ensure that, when any engagements related to displacement compensation take place, all adult members of the household are present. Females might be preparing agricultural fields, harvesting, collecting water, washing clothes, or bathing during normal working hours when these surveys or negotiations are done; 9. Any cash compensation should be provided along with relevant education on financial literacy and responsible spending; 10. Visuals and simple text in Umbundu, Nganguela and Portuguese should be used in negotiations, awareness and education sessions on sustainable farming and financial literacy as part of transitional support and livelihood restoration. Communicating in Umbundu and Nganguela is very important to ensure that women and the elderly who do not understand Portuguese understand what the compensation entails and what their rights are as PAPs (and not just a household member); 11. Care should be taken to avoid younger, or any other household members taking advantage of elderly war veterans based on the argument that they "already have money", if compensations are paid or entrusted to these elderly persons; 12. Inform and consult with Sobas and traditional leaders, including female representatives, prior to the construction phase; 13. Tailor requirements and consultations to the specific needs of each location, as only a limited number of communities were consulted in the SEIA. Provide a basic overview of the Project's aims, objectives, and consultation principles; and 14. Ensure community leaders are aware of issues such as sexual exploitation and abuse prevention, and the Project Grievance Mechanism.								
After Management	Moderate	Long-term	Local	Medium	Possible	Medium	-	Medium

Impact SE1.9: Reduced community and Khoi San ecosystem services as a result of construction activities

Ecosystem services used by community members that were identified during the baseline research included water from rivers, wells (*cacimbas*), boreholes, soil, wood, medicinal plants, game, pastures, and fish. The socio-economic baseline engagements noted that the availability of wildlife for hunting is decreasing as a result of *inter alia* deforestation. The practice of deforestation as well as urban expansion and development (such as this Project) further impacts this aspect of local communities and indigenous people's way of life. This also impacts the Khoi San's practices of gathering wild fruit, extracting honey for consumption and collecting medicinal plants – practices that are already in jeopardy due to Bantu neighbours not allowing them to carry out these activities in the territories close to their villages (IDL-FAS, 2022).

Access to natural resources by villagers and Khoi San people might be affected, as the locations impacted by the Project footprint could reduce the ease with which, or the time it takes to reach the resource locations as they have to find other paths to them. The quality of ecosystem services could also be impacted by Project activity, such as hydrocarbon spillages during the construction phase, which could impact soil and water quality. Furthermore, continuous vehicle movement compacts soils that might have to be used for agricultural purposes again, once construction is complete. Any groundwater abstraction for concrete batching could also reduce groundwater availability from wells or boreholes. If substation-land is currently used for grazing, hunting, medicinal plant or wood collection, the availability of these resources would also be substantially reduced. Construction workers might engage in hunting and fishing as recreation while off duty, resulting in fewer of these resources being available for community members and Khoi San people who depend on them.

The impact rating before and after mitigation measures are applied is described in Table 6-45.

Table 6-45: Reduced community and Khoi San ecosystem services as a result of construction activities

Activity: Construction activities								
Project phase: Construction and operation								
SE1.9 - Impact Summary: Reduced community and Khoi San ecosystem services as a result of construction activities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Regional</i>	High	<i>Definite</i>	High	-	<i>Medium</i>
Management Measures:								
1. Establish and monitor conservation corridors; 2. Establish safe access routes to natural resource-use areas; 3. All site establishment and vegetation clearing activities should be preceded by an opportunity given to villagers to harvest natural resources or materials they could use; 4. No recreational hunting or fishing should take place by construction workers on- or off-duty; 5. Vegetation clearing should be limited to the absolute minimum; 6. Hydrocarbon spills should be prevented as prescribed in the ESMP and as per the Oil Spill Response Plan; 7. Any construction activities should be restricted to the established and demarcated construction sites; 8. Vehicle movement should be restricted to existing roads; and 9. Locations of medicinal plants should be identified prior to site establishment to ensure that they can be avoided or replanted.								
After Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

Theme two: Culture and religion

This theme refers to the cultural aspects of the PACs that could be affected by the proposed Project and all its associated activities. The change processes are related to graves, heritage and indigenous peoples.

Impact SE2.1: Cultural heritage disturbance due to disruption of access to graves and culturally significant sites

Accessing graves and cemeteries is a culturally important activity and any changes to access could potentially impact this cultural practice. Two cemeteries were identified in the village of Tchicunho, one in Ngokue and one in Capuca. (Although the municipal cemeteries of Jamba and Chipindo were also identified these are unlikely to be affected by the Project as they are within the urban areas where the physical Project footprint is limited). There may be more cemeteries or smaller gravesites that are unmarked or that are unknown by local authorities and community members. These might only be uncovered during the construction phase as site clearing or minor excavations take place.

The impact rating before and after mitigation measures are applied is described in Table 6-46.

Table 6-46: Cultural heritage disturbance due to disruption of access to graves and culturally significant sites

Activity: Land acquisition								
Project phase: Construction and operation								
SE2.1 - Impact Summary: Cultural heritage disturbance due to disruption of access to gravesites								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Low</i>
Management Measures:								

- Care should be taken to identify any features that can potentially indicate unmarked graves prior to site establishment and vegetation clearing as per the Cultural Heritage Management Plan; - If any graves are identified, these should be avoided, work stopped if needed, and the relevant authorities contacted as per the Chance Find Procedure. Exhumation should only be considered as a last resort and it must be in line with local customs; and - If access to graves is altered in any way, new footpaths should be identified which could be used safely by villagers (i.e., with fenced walking side paths) outside of any buffer areas required by the biodiversity-related mitigation measures.								
After Management	Minor	Medium-term	Local	Low	Possible	Low	-	Low

Impact SE2.2: Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)

Khoi San people might want to apply for temporary employment positions during the construction phase. Systematic discrimination has been recorded (IDL-FAS, 2022) and it might flow over into the recruitment process and workplace.

The impact rating before and after mitigation measures are applied is described in Table 6-47.

Table 6-47: Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)

Activity: Land acquisition								
Project phase: Construction and operation								
SE2.2 - Impact Summary: Discrimination or inadvertent exclusion of indigenous peoples (Khoi San) in consultation processes (for work opportunities or general Project awareness)								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium
Management Measures:								
- Liaise with the local municipal administration of Cuvango that has intelligence on the Khoi San groups' whereabouts on the engagement structures to be followed if any consultations are required; - This is especially important when awareness is raised on the Project timing, where the sites will be, and any safety and security considerations are being publicised through meetings or other media. It cannot be assumed that Khoi San people will attend or have access to such awareness-raising. They must be consulted separately as they might not feel comfortable joining a "normal" community meeting, might not understand the language used, and they might be nomadic; - Any assistance that is provided to local communities should not be assumed to also benefit the Khoi San groups, as they face widespread discrimination and exclusion. Any such benefits should be provided in a separate forum (e.g., mobile) and in a location that is distant from Bantu communities; - Where employment opportunities are advertised, especially local employment of unskilled labour, care should be taken not to discriminate against Khoi San applicants. Consider informing Khoi San people of potential temporary employment opportunities in a separate forum as above and in the !Kung language spoken by them; - Where Khoi San applicants are successful in obtaining even temporary employment, the occurrence of workplace discrimination, harassment and bullying should be monitored closely; - When establishing which households receive electricity connections as a result of this Project, care should be taken to connect Khoi San households as well; - Ensure compliance with IFC PS 8 during ongoing engagements with Khoi San people in the Project area of influence; - Ensure compliance with IFC PS 2 (Labour and Working Conditions) and the relevant ILO conventions where indigenous people are recruited and employed in any component of the Project; - Create cultural awareness among contactors' employees around the presence of Khoi San in the Project area, since some of the workers might be migrant workers who are unfamiliar with the area, or who simply do not have any cultural awareness of the sensitivities around Khoi San peoples. This could be done through visual media and toolbox talks on site; and - Ensure that honey collection sites are not destroyed, disturbed, or access thereto denied during construction activities.								
After Management	Moderate	Medium-term	Regional	Medium	Possible	Medium	-	Medium

Theme three: Employment

This theme includes the impacts arising from the employment of construction workers and subsequent local spending in the PAC. It aligns with the “*People’s capacities, abilities, and freedoms to achieve their goals*” and “*Livelihood Assets and Activities*” themes. The change processes are related to the receipt of wages through employment, increases in gender divisions, and changes in household strengths and vulnerabilities. Employment is also known to increase/worsen certain social pathologies, largely where it is coupled with an influx of job seekers.

Impact SE3.1: Improved household incomes and livelihoods as a result of temporary employment opportunities

The Project is expected to employ some local general labour for the construction phase. This will be from the Angolan labour component that will comprise 59% of the total labour force. Employment of community members in the PACs will provide a cash injection to their households. It can provide relief in terms of now being able to buy additional agricultural equipment, fertilisers or seeds, medicine for livestock, satisfy the need to travel further if needed for, say, medical reasons, and meet other basic needs.

The impact rating before and after mitigation measures are applied is described in Table 6-48

Table 6-48: Improved household incomes and livelihoods as a result of temporary employment opportunities

Activity: Employment								
Project phase: Construction								
SE3.1 - Impact Summary: Improved household incomes and livelihoods as a result of temporary employment opportunities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Short-term</i>	<i>Regional</i>	Medium	<i>Possible</i>	Medium	+	<i>Medium</i>
Management Measures: 1. <i>Where local skill sets are available, the Project should aim to employ these persons as far as practicable. Skills databases can be obtained from local municipal administrations;</i> 2. <i>Include financial literacy awareness and education in toolbox talks, inductions, and other passive awareness media such as posters in dining and ablution areas;</i> 3. <i>Ensure that the main construction contractor has a preferential recruitment policy in place that requires a certain number of local employees from within all six affected municipalities, not just the three beneficiary municipalities;</i> 4. <i>Establish a mobile labour desk prior to the construction phase, so that potential workers residing in the villages, and not just the municipal urban centres, also get a fair chance to apply through a single channel; and</i> 5. <i>Awareness raising of application opportunities should be done beforehand with the support of local municipal administrators and sobas to ensure that applicants can prepare the relevant documents.</i>								
After Management	<i>Moderate</i>	<i>Short-term</i>	<i>Regional</i>	Medium	<i>Definite</i>	Medium	+	<i>Medium</i>

Impact SE3.2: Increased gender marginalisation and vulnerability as a result of temporary employment opportunities

Although the creation of employment opportunities and the subsequent increase in disposable income is generally perceived as a positive impact, it can also increase women’s vulnerability. Since the employment opportunities that will be available in the PACs will mostly be for general labour, women are unlikely to apply or to be successful if they do as it might be perceived as jobs “for men”. Furthermore, since women (often one of many wives) tend to have limited decision-making powers when it comes to financial management, male household heads might exhibit domineering behaviour towards women, the elderly, their children, or disabled persons, as these groups are not consulted by

the male household heads on how his wages are to be spent. The opportunity that children might have had, to now receive improved basic needs such as food and clothes, might be removed if the household head does not manage the household's temporary income responsibly. Wages might be spent on items or services that are not beneficial to anyone else in the household in any way, such as luxuries, or, at worst, alcohol, prostitution, drugs, or other illicit items.

Apart from females, other vulnerable groups include internally displaced individuals or families that have migrated to the Project-affected villages after the civil war, or other socially or politically marginalised people. They are vulnerable to discrimination if they have not fully integrated into the community. Any involvement by the community members, sobas, or government officials in the recruitment of locals might exclude them.

Furthermore, when women, disabled, or internally displaced persons apply for employment opportunities, they might face discrimination during the recruitment process and the course of employment by recruitment processes, co-workers, or elderly males instructing young women not to apply to begin with, as it is "not their place".

If there is any current political influence on who usually is favoured for temporary employment opportunities, certain unemployed individuals might not be considered. This would leave them unemployed while others benefit, perhaps unfairly due to political alignment.

The impact rating before and after mitigation measures are applied is described in Table 6-49.

Table 6-49: Increased gender marginalisation and vulnerability as a result of temporary employment opportunities

Activity: Employment								
Project phase: Construction								
SE3.2 - Impact Summary: Increased gender marginalisation and vulnerability as a result of temporary employment opportunities								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Medium-term	Regional	Medium	Possible	Medium	-	Medium
Management Measures:								
- Where possible, designate employment opportunities for women and disabled persons employees from within all six affected municipalities, not just the three beneficiary municipalities; - Where local skill sets are available, the Project should aim to employ these persons as far as practicable. Skills databases can be obtained from local municipal administrations; - Ensure compliance with IFC PS 2 (Labour and Working Conditions) and the relevant ILO conventions where women, disabled, and migrant (internally displaced) workers are recruited and employed in any component of the Project; - Create awareness among contactors' employees on the importance of inclusivity and non-discrimination in the workplace. This could be done through visual media and toolbox talks on site, and other passive awareness media such as posters in dining and ablution areas; - Establish a mobile labour desk prior to the construction phase, so that potential workers residing in the villages, and not just the municipal urban centres, can all get a fair chance to apply through a single channel; - Awareness raising of application opportunities should be done beforehand with the support of local municipal administrators and sobas to ensure that applicants can prepare the relevant documents. Capacity building with municipal administrators and sobas on the importance of inclusivity and non-discrimination might be necessary to ensure true support; - Ensure that, when any engagements related to employment opportunities and financial management take place, all adult members of the household are present. Females might be preparing agricultural fields, harvesting, collecting water, washing clothes, or bathing during normal working hours when these engagements are conducted; - Any wage payments should be provided along with relevant education on financial literacy and responsible spending; and - Visuals and simple text in Umbundu, Nganguela and Portuguese should be used in workplaces, awareness and education sessions on inclusion and financial literacy. Communicating in Umbundu and Nganguela is very important to ensure that women who do not understand Portuguese know their rights as employees.								
After Management	Moderate	Medium-term	Regional	Medium	Possible	Medium	-	Medium

Impact SE3.3: Increase in social pathologies as a result of migrant worker influx and increased spending power

There is a possibility that awareness of the Project might cause an influx of job seekers to the areas close to the Project footprint.

Although influx is considered outside the direct control of Project developers, the IFC guidelines on Project-induced in-migration suggest that influx can threaten 'Project security' and that it should be managed as a Project threat (IFC, 2009). Direct and indirect impacts associated with an influx of migrant job seekers may include some of the following:

- Creating tension and conflicts between locals and migrants concerning natural resources, infrastructure, and employment opportunities;
- Inflating local food and produce prices;
- Placing increased pressure on already limited social and natural resources;
- Increasing the incidence of so-called 'social ills', including prostitution, alcohol abuse, and crime;
- Increasing the prevalence of communicable diseases, such as sexually transmitted infections (STIs), sanitation-related illnesses or symptoms such as diarrheal diseases, and vector-borne diseases, such as malaria;
- The creation of "poverty gaps", such as inequalities in terms of income and wealth accumulation between locals and migrants; and
- Unplanned pregnancies.

The presence of expatriate construction workers during the construction phase could also increase tension, crime and social pathologies.

Labour-based and economic migration patterns generally align with the demand for workers created by projects. Typically, the construction phase requires the largest workforce. As a project transitions from construction to operations, the workforce needs decrease, becoming smaller and more stable (World Bank, 2009). As a result, recent migrants may leave due to fewer job opportunities and a decline in the local population's disposable income. The high demand for labour during the construction phase often leads to boom-and-bust cycles, with an influx of workers during construction followed by out-migration when the workforce requirements decrease in the operational phase.

The impact rating before and after mitigation measures are applied is described in Table 6-50.

Table 6-50: Increase in social pathologies as a result of migrant worker influx and increased spending power

Activity: Employment								
Project phase: Construction								
SE3.3 - Impact Summary: Increase in social pathologies as a result of migrant worker influx and increased spending power								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Regional</i>	High	<i>Possible</i>	High	-	<i>Medium</i>
Management Measures:								
1. Where there is increased pressure on local municipal infrastructure as a result of migrant workers, provide support where possible. This could include promoting STI prevention programmes and providing support to local clinics for family planning and reproductive health services, especially for women, youth and mobile workers through mobile clinics or partnerships with multistakeholder forums; 2. Where local skill sets are available, the Project should aim to employ these persons as far as practicable. Skills databases can be obtained from local municipal administrations;								

3. Include sexual health awareness and education in toolbox talks, inductions, and other passive awareness media such as posters in dining and ablution areas. Provide condoms in ablution areas if culturally appropriate; 4. Ensure that adequate insurance policies are in place; 5. It might be useful to create awareness around these same issues in the villages and towns affected (especially among young and adolescent women) by the Project to abate the impacts of unplanned pregnancies due to the influx of construction workers; 6. Khoi San women might also be affected by unplanned pregnancies. These issues are to be addressed in focused engagements with these groups; 7. Ensure that the main construction contractor has a preferential recruitment policy in place that requires a certain number of local employees from within all six affected municipalities, not just the three beneficiary municipalities; 8. Establish a mobile labour desk prior to the construction phase, so that job seekers are provided with an opportunity to apply without needing to travel to the construction sites when it is already too late; 9. Awareness raising of application opportunities should be done beforehand with the support of local municipal administrators and sobas to ensure that PACs are aware of the limitations to the numbers of potential employment opportunities; 10. Publicise the required qualifications, years of experience, and professional certifications/registrations required for any positions that might be available; 11. Compile influx management plan to manage construction impacts and economic downturn once construction stops to: a. Promote economic growth; b. Plan access routes and control, material transportation, worker transportation, and worker housing (if applicable); c. Collaborate with multi-stakeholder forums to build capacity and manage resource allocation; d. Providing assistance for PAPs to access banking services, micro-finance or enterprise development initiatives; and e. Strengthen capacity of local security, governance, spatial planning, housing, water and sanitation proportionate to project impacts. 12. Collect specific data on the following aspects prior to finalisation of detailed management plans: a. Traffic incidents and accidents within the Project's direct Area of Influence. This information should be collected as part of the development of the Construction Traffic Management Plan; and b. Crime incidents within the Project's direct Area of Influence. This information should be collected as part of the development of the Security Management Plan, or the Gender-Based Violence and Harassment (GBVH) Prevention and Response Plan.								
After Management	Moderate	Medium-term	Local	Medium	Possible	Medium	-	Medium

Impact SE3.4: Increase in the local economy as a result of increased income and spending by temporary workers/contractors

In-migration may also have a positive influence in terms of providing locals with small business opportunities due to an increased demand for local produce and other goods, as well as opportunities for cultural exchange. More people in the area could also increase disposable income and hence increase local purchasing power. The impact rating before and after mitigation measures are applied is described in Table 6-51.

Table 6-51: Increase in the local economy as a result of increased income and spending by temporary workers/contractors

Activity: Employment								
Project phase: Construction								
SE3.4 - Impact Summary: Increase in the local economy as a result of increased income and spending by temporary workers/contractors								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Minor	Medium-term	Local	Low	Possible	Low	+	Medium
Management Measures:								
1. Where local small, medium and micro enterprises (SMMEs) are available, the project should aim to make use of their products or services where possible. SMME databases might be available from local municipal administrations; and 2. Where local SMMEs are supported, ensure that it does not cause division between those with whom the contractor does business and those with whom it does not.								

After Management	Moderate	Medium-term	Local	Medium	Possible	Medium	+	Medium

Theme four: Health, safety and security

This theme includes the impacts arising from the presence of construction equipment and workers, as well as security forces around the PACs. It aligns with the “Community/Social Supports and Political Context” and “People’s capacities, abilities, and freedoms to achieve their goals” themes. The change processes are related to safety, security and health hazards, as well as fears, anxieties and conflicts.

Impact SE4.1: Increased safety hazards and accidents to community members, Khoi San, and livestock during construction

It is expected that any construction sites, laydown areas, or camps will be demarcated, and access controlled. However, construction activities associated with linear projects such as this one, might be more difficult to contain. Some construction equipment, vehicles, or chemicals might be left unattended. Light duty vehicles might speed along the line and check certain points as it is being constructed. Heavy duty vehicles and plant might also be present all around the Project sites. Excavations might not be fenced off adequately.

These movements and changes to the physical environment as a result of the construction activities and sites being present, could lead to safety hazards for both community members (pedestrians and road users) and their livestock, many of which was observed to roam freely or were being herded close to the proposed route. Although Khoi San people occur at some distance from the project area and are increasingly less nomadic (IDL-FAS, 2022), some might venture close to construction areas as they travel to new sites, hunt, or harvest natural resources.

The impact rating before and after mitigation measures are applied is described in Table 6-52.

Table 6-52: Increased safety hazards and accidents to community members, Khoi San, and livestock

Activity: Construction activities								
Project phase: Construction								
SE4.1 - Impact Summary: Increased safety hazards, traffic and accidents to community members, Khoi San, and livestock due to unfenced Project infrastructure, unsafe access routes or speeding heavy vehicles								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Medium-term	Regional	Medium	Possible	Medium	-	Medium
Management Measures:								
1. Ensure that the Community Health, Safety and Security (CHSS) plan included in contract documents of the main contractor and that it is implemented, including the Traffic and Transport Management Plan; 2. Continually conduct risk assessments and comply with the relevant Health and Safety measures to ensure that the site and any hazards are access-controlled and isolated; 3. Require contractor personnel to drive at appropriate speed limits and enforce this where possible; 4. Include community safety in inductions and toolbox talks, along with the usual OHS measures; 5. Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access; 6. The contractor must publicise, implement and evaluate a grievance mechanism so that PAPs who are affected by construction activities (e.g. loss of livestock due to a speeding truck) can report incidents. The grievance mechanism allows the grievance to be investigated and closed out timeously in a systematic and proactive way. This will also help to identify trends of areas that need improvement; and 7. The grievance mechanism must be accessible by all PAC members, including vulnerable groups such as the elderly, illiterate, disabled, Khoi San, and women. PAC members must be able to raise grievances through a variety of platforms to ensure that it is widely accessible, but all grievances must be recorded by the Community Liaison Officer (CLO) or similar role player. This might include visits to the villages to hear and record any complaints or grievances. As explained in the SEP and grievance mechanism that has been prepared as part of this Project's ESIA, complaints might be cleared up before they turn into grievances if managed proactively.								

After Management	<i>Moderate</i>	<i>Medium-term</i>	<i>Regional</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

Impact SE4.2: Safety hazards and accidents to people and livestock during operations

Although the Project will aim to ensure that the transmission line and substations are structurally sound and access controlled where needed, there is a possibility that community members may be exposed to hazards. Climate events such as strong winds or sabotage could undermine the structural integrity of the pylons, leading to falls and the exposure of live wires. Human error could also lead to the neglect of access control measures at sub-stations, for instance.

The impact rating before and after mitigation measures are applied is described in Table 6-53.

Table 6-53: Safety hazards and accidents to people and livestock

Activity: Powerline operation								
Project phase: Operation								
SE4.2 - Impact Summary: Safety hazards, traffic and accidents to people and livestock								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major</i>	<i>Long-term</i>	<i>Regional</i>	High	<i>Possible</i>	High	-	<i>Medium</i>
Management Measures:								
1. Ensure that the CHSS plan is implemented by the transmission and distribution line operators, including a Traffic and Transport Management Plan. 2. Continually conduct risk assessments and comply with the relevant Health and Safety measures to ensure that the site and any hazards are access-controlled and isolated when conducting maintenance activities; 3. Consult the relevant local municipal administrations when maintenance activities are being conducted; 4. Consider including participatory monitoring by the community members if anything out of place is observed along the powerlines; 5. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness and education of the physical Project components. This could include awareness posters or other print media, or community meetings with presentations on the safety of non-ionising radiation emitted by substations in the form of Extremely Low Frequency electromagnetic radiation; 6. The operators of the transmission and distribution lines must publicise, implement and evaluate a grievance mechanism so that PAPs who are located close to the transmission and distribution lines and substations can report incidents. The grievance mechanism allows the grievance to be investigated and closed out timeously in a systematic and proactive way. This will also help to identify trends of areas that need improvement; 7. The grievance mechanism must be accessible by all PAC members, including vulnerable groups such as the elderly, illiterate, disabled, and women. PAC members must be able to raise grievances through a variety of platforms to ensure that it is widely accessible, but all grievances must be recorded by a CLO or similar role player appointed by the operator of the transmission and distribution lines and substations. This might include visits to the villages to hear and record any complaints or grievances. As explained in the SEP and grievance mechanism that has been prepared as part of this Project's ESIA, complaints might be cleared up before they turn into grievances if managed proactively; and 8. Visuals and simple text in Umbundu, Nganguela and Portuguese should be used, the former language being very important to ensure that women and the elderly (who are identified as vulnerable groups in this Project) who do not understand Portuguese are also equally informed.								
After Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

Impact SE4.3: Nuisance impacts due to air, water and noise pollution

The movement of construction vehicles and plant might increase dust, especially during the dry season. These vehicles and generators will also increase air emissions through exhaust gases that are harmful not only to workers' health but also to the members of the PACs located close to the Project sites. Noise levels will increase due to activities such as vehicle movement, vehicles idling, generators, shouting, and clanging of objects being raised by cranes. Surface water can be contaminated through runoff containing hydrocarbon spillages from construction sites. There could also be litter (such as oil containers, cement bags, food containers, food waste, rags and plastic bottles) if improper waste management practices are not enforced on construction sites.

The impact rating before and after mitigation measures are applied is described in Table 6-54.

Table 6-54: Nuisance impacts due to air, water and noise pollution

Activity: Construction activities								
Project phase: Construction								
SE4.3 - Impact Summary: Nuisance impacts due to air, water and noise pollution								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Medium-term</i>	<i>Local</i>	<i>Medium</i>	<i>Definite</i>	Medium	-	<i>Medium</i>
Management Measures:								
1. All mitigation and monitoring measures in the Air Quality, Noise, and Hydrology Impact Assessments must be taken into consideration by the contractor, along with the ESMP; 2. Highlight potential nuisance impacts during the stakeholder engagements to ensure that there is awareness and understanding of the temporary nature of the impacts among the PACs; 3. The contractor must publicise, implement and evaluate a grievance mechanism so that PAPs who are affected by construction activities (e.g., excessive noise and dust after hours) can report incidents. The grievance mechanism allows the grievance to be investigated and closed out timeously in a systematic and proactive way. This will also help to identify trends of areas that need improvement; and 4. The grievance mechanism must be accessible by all PAC members, including vulnerable groups such as the elderly, illiterate, disabled, and women. PAC members must be able to raise grievances through a variety of platforms to ensure that it is widely accessible, but all grievances must be recorded by the CLO or similar role player. This might include visits to the villages to hear and record any complaints or grievances. As explained in the SEP and grievance mechanism that has been prepared as part of this project's ESIA, complaints might be cleared up before they turn into grievances if managed proactively.								
After Management	<i>Minor</i>	<i>Medium-term</i>	<i>Local</i>	<i>Low</i>	<i>Definite</i>	Medium	-	<i>Medium</i>

Impact SE4.4: Increased crime and vulnerability of villagers due to harassment or tension between construction and security workers, and community members

Conflict may occur between Project security personnel and local villagers. This may occur where locals are allowed access to particular areas of the Project site, as well as where they are restricted from using areas inside the site. The friction may be exacerbated when workers from outside areas are used as security personnel. Incidents of harassment might also occur if people need to move their households or farming activities as part of any required resettlement.

This impact is linked to vulnerability, as it could make villagers vulnerable or increase the vulnerability of already marginalised villagers such as women, the elderly, or the disabled.

The impact rating before and after mitigation measures are applied is described in Table 6-55.

Table 6-55: Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members

Activity: Presence of security forces and construction workers								
Project phase: Construction								
SE4.4 - Impact Summary: Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major</i>	<i>Long-term</i>	<i>Regional</i>	<i>High</i>	<i>Possible</i>	High	-	<i>Medium</i>
Management Measures:								
1. Communicate the IFC-compliant grievance mechanism in the PACs; 2. Ensure that agreements with the appointed security company include the following:								

- When hiring security personnel, a reasonable effort must have been made to screen them for past abuses - Security personnel need to be properly trained in the use of force and, most importantly, appropriate conduct towards villagers - Severe penalties/disciplinary action should be taken against any security personnel involved in theft or abuse - A code of conduct must be developed and enforced for the security personnel - The code of conduct must be consistent with the UN Code of Conduct for Law Enforcement Officials, the UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials, and the Voluntary Principles on Security and Human Rights. (VPSHR); - All workers are to be informed about the roles and responsibilities of the security personnel; and - Ensure that the CHSS plan is included in contract documents of the main contractor and implemented by them and transmission and distribution line operators, including the Gender Based Violence and Harassment (GBVH) Prevention and Response Plan.								
After Management	Moderate	Medium-term	Local	Medium	Possible	Medium	-	Medium

Impact SE4.5: Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police

Conflict and tension might occur between artisanal miners, regarded as illegal by members of the PACs, security companies and locals. They might be ill-treated on the premise that they are “criminals”, where security guards, law enforcement or police act outside of their mandates or use unnecessary force. Artisanal miners might, during the operational phase, start mining in areas close to the transmission line which could impact its stability. This will likely require them to be escorted from these sites to ensure that the transmission line’s stability is not undermined.

The impact rating before and after mitigation measures are applied is described in Table 6-56.

Table 6-56: Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police

Activity: Presence of security forces to ensure ASM does not enter construction areas does not impact / undermine transmission line stability								
Project phase: Construction and operation								
SE4.5 - Impact Summary: Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	Major	Long-term	Regional	High	Possible	High	-	Medium
Management Measures:								
- Communicate the IFC-compliant grievance mechanism in the PACs; - Ensure that agreements with the appointed security company include the following: - When hiring security personnel, a reasonable effort must have been made to screen them for past abuses; - Security personnel need to be properly trained in the use of force and, most importantly, appropriate conduct towards villagers; - Severe penalties/disciplinary action should be taken against any security personnel involved in theft or abuse; - A code of conduct must be developed and enforced for the security personnel; and - The code of conduct must be consistent with the UN Code of Conduct for Law Enforcement Officials, the UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials, and VPSHR. - All workers are to be informed about the roles and responsibilities of the security personnel; - Liaise with local law enforcement, police and/or other security entities on their strategies for managing ASM activities in the area; - Provide employment opportunities for unskilled labour from the PACs as far as possible; and - Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness of the land that is in RNT’s possession and that will be used for the transmission line (or ENDE’s land for the distribution network); and - Ensure that the CHSS plan is included in contract documents of the main contractor and implemented by them and the transmission and distribution line operators.								
After Management	Moderate	Medium-term	Local	Medium	Possible	Medium	-	Medium

Impact SE4.6: Improved safety resulting from removal of UXOs

UXOs will be removed from the areas during the pre-construction and construction phases for safe access. This will result in increased safety for community members who might have been at risk of inadvertently triggering these devices.

The impact rating before and after enhancement measures are applied is described in Table 6-57.

Table 6-57: Impact 4.6: Improved safety resulting from removal of UXOs

Activity: Removal of UXOs								
Project phase: Pre-construction and Construction								
SE4.6 - Impact Summary: Improved community safety after removal of UXOs from project construction footprint								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Site</i>	Medium	<i>Possible</i>	Medium	+	<i>Medium</i>
Management Measures:								
- Ensure that all relevant safety measures are implemented before conducting removals/deactivations to ensure safety of personnel involved. - Inform community members or local authorities timeously about planned UXO removal or deactivation processes.								
After Management	<i>Moderate</i>	<i>Long-term</i>	<i>Site</i>	High	<i>Likely</i>	High	+	<i>Medium</i>

Impact SE4.7: Safety risks to personnel and community members during UXO removal processes

UXOs are reportedly present in a number of areas in the Project development footprint, notably around certain towns. Prior to commencing any construction activities, trained personnel will need to remove any UXOs from construction areas. Failure to identify and clear these UXOs can pose a potential safety risk to community members and Project personnel if a UXO is inadvertently triggered during the pre-construction phase.

The impact rating before and after mitigation measures are applied is described in Table 6-58.

Table 6-58: Impact 4.7: Safety risks to personnel and community members during UXO removal processes

Activity: Removal of UXOs								
Project phase: Pre-construction and Construction								
SE4.7 - Impact Summary: Safety risk to community and personnel during removal of UXOs in project footprint								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Major</i>	<i>Short-term</i>	<i>Local</i>	High	<i>Likely</i>	High	-	<i>Medium</i>
Management Measures:								
- Ensure that all relevant safety measures are implemented before conducting removals/deactivations to ensure safety of personnel involved. - Inform community members or local authorities timeously about planned UXO removal or deactivation processes.								
After Management	<i>Moderate</i>	<i>Short-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

Theme five: Socio-economic development

This theme refers to the benefit that the OHL provides in enabling electricity delivery to three towns and, in the long term, other connections. It aligns with the theme of “*Infrastructure and Services*”. It relates to utilities and public services.

Impact SE5.1: Improved access to electricity due to presence of transmission and distribution lines

The OHL will ensure the delivery of electricity generated at the hydroelectric plant at Gove dam. From there it is switched to lower voltages for distribution in the three beneficiary towns of Jamba, Cuvango and Chipindo. The electricity provision need not be limited to the 1 000 connections envisaged per town. Electricity could be provided to health facilities, schools, street lighting, administration offices, businesses or retail shops, or private households. Once the infrastructure is there, further future connections such as these can be made. This could include connections to Khoi San households that have settled, such as those identified 20 km south of the project area.

The impact rating before and after mitigation measures are applied is described in Table 6-59.

Table 6-59: Improved access to electricity due to presence of transmission and distribution lines

Activity: Operation and functioning of transmission line and distribution network								
Project phase: Operation								
SE5.1 - Impact Summary: Improved access to electricity due to presence of transmission and distribution lines								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major (+)</i>	<i>Long-term</i>	<i>Regional</i>	<i>High</i>	<i>Definite</i>	<i>High</i>	<i>+</i>	<i>Medium</i>
Management Measures: <i>The long-term functioning and maintenance of the powerlines and substations must be sustained to ensure that it benefits the PACs permanently;</i> <i>Expansions from the newly constructed transmission line (after this Project) would further increase the geographical reach of the benefits associated with electricity availability;</i> <i>The potential to include remote groups such as the settled Khoi San families should also be considered in long-term strategic planning for the expansion of the transmission network.</i>								
After Management	<i>Major (+)</i>	<i>Long-term</i>	<i>Regional</i>	<i>High</i>	<i>Definite</i>	<i>High</i>	<i>+</i>	<i>Medium</i>

Impact SE5.2: Downstream economic development

Electricity is a key factor in the economy, and there is a clear positive relationship between energy and economic growth. Electricity is an essential component of production for businesses, and the Angolan government will now benefit from increased electricity supply to provide public services like education and health. It will also enable improved communication, transportation, and can contribute to sectors such as agriculture by reducing inefficiencies.

The impact rating before and after mitigation measures are applied is described in Table 6-60.

Table 6-60: Downstream economic development

Activity: Provision of electricity								
Project phase: Operation								
SE5.2 - Impact Summary: Improved access to electricity due to presence of transmission and distribution lines								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Regional</i>	<i>High</i>	<i>Possible</i>	<i>High</i>	<i>+</i>	<i>Medium</i>

Management Measures:								
<i>The long-term functioning and maintenance of the powerlines and substations must be sustained to ensure that it benefits the PACs permanently.</i> <i>Expansions from the newly constructed transmission line (after this Project) would further increase the geographical reach of the benefits associated with electricity availability.</i> <i>Shortly before the connections through the distribution network are implemented in the different beneficiary areas, create awareness on using electricity efficiently to ensure that the Project remains cost-effective and that the demand does not exceed the available supply.</i> <i>Ensure that ongoing stakeholder engagement takes place to mitigate potential dissatisfaction caused by unfulfilled expectations about long-term benefits and opportunities from the operation of the project.</i>								
After Management	<i>Moderate</i>	<i>Long-term</i>	<i>Regional</i>	High	<i>Possible</i>	High	+	<i>Medium</i>

6.5.2 Cultural heritage impacts

Baseline conditions

Heritage resources within the Project area are at risk of being damaged through direct and indirect impacts, especially during the Project's construction phase. The decommissioning phase might pose an additional risk as it involves the removal of unwanted infrastructure which could cause accidental damage. Moreover, inadequate erosion control during decommissioning might have negative effects on buried sites or those sites avoided during the implementation of the recommended Heritage Management Measures. The timing of these impacts would be immediate and their duration permanent if no management or mitigation measures are implemented. Damage to cemeteries and places of worship will affect local communities but this, and other impacts can be mitigated to minimise the impact. The Vila parish church is located 25 m from OHLs associated with the electrification of Cuvango in a built-up area and no direct impact is expected on the feature by the Project as the surrounding area has been developed and electrification Project infrastructure is located along existing infrastructure and roads. It should also be noted OHLs have a relatively small impact on heritage features due to the small footprint of the pylons.

The Jamba substation location is disturbed from a heritage point of view through the previous thermal plant and no heritage features are expected within the development footprint and impacts to heritage resources is low in this area. Burial sites can occur in the corridor that could be indirectly impacted during the construction phase. The Project footprint could also be of archaeological interest and these aspects should be considered further during a pre-construction survey. A more detailed overview of baseline conditions is presented in Section 4.

Stakeholder issues and concerns:

None mentioned.

Impact identification

The key potential cultural heritage impacts from the construction and operation phases include:

- Damage or destruction of non-renewable heritage resources; and
- Restriction of access to burial sites for family members.

These potential impacts are described below and consider the construction (including pre-construction activities) and operational phases.

Impact description

In terms of the damage or destruction of non-renewable heritage resources, the majority of impacts will potentially be felt during the construction phase activities. Activities such as land clearance, excavations and general construction activities (vehicle and personnel movement) could lead to the loss of archaeological and palaeontological records/resources as well as an altered sense of place.

In terms of the restriction of access to burial sites and potential impacts to burial/sacred sites, the main impacts will potentially be during construction phase activities, as above, however the presence of the OHL and associated infrastructure may cause access issues during operation as well. Cemeteries provide a cultural link to ancestors and the restriction of access causes a discord with the environment.

Impact assessment

The impact significance ratings of the identified potential cultural heritage impacts for the construction and operational phases are presented in Table 6-61 and Table 6-62. Management measures are also presented in the table. It should also be noted that although impacts to surface sites can be avoided or mitigated, there is a chance that completely buried sites could still be impacted on however this cannot be quantified.

Table 6-61: Impact assessment on cultural heritage resources (construction phase)

Activity: Construction activities including land clearance, excavations and vehicle movement.								
Project phase: Construction								
CH1 - Impact Summary: Impact of the Project on recorded cemeteries/ burial sites								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	<i>High</i>	<i>Unlikely</i>	<i>Medium</i>	-	<i>Medium</i>
Management Measures:								
1. Pre-construction heritage survey of the final route alignment specifically in areas of land-clearing, excavation and construction activities; 2. Monitoring of heritage features during construction and routine monitoring of demining and land-clearing activities; 3. Implementation of a chance find procedure; 4. Avoidance and management of known features, recorded sites should be avoided by all stringing activities; 5. Development of a heritage site development plan that address access protocols for safe access to burial sites; and 6. Contractors, subcontractors, and employees should be sensitized to the procedures that must be followed in case of a discovery and the potential presence of archaeological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	<i>High</i>	<i>Unlikely</i>	<i>Low</i>	-	<i>Medium</i>
Project phase: Construction								
CH2 - Impact Summary: Impact of the Project on places of worship/ sacred sites and monuments								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	<i>Medium</i>	<i>Possible</i>	<i>Medium</i>	-	<i>Medium</i>
Management Measures:								
Apply measures 1-4 and 6 presented in in CH1.								
After Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	<i>Medium</i>	<i>Unlikely</i>	<i>Low</i>	-	<i>Medium</i>
Project phase: Construction								
CH3 - Impact Summary: Impact of the Project on heritage resources								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	<i>Medium</i>	<i>Possible</i>	<i>Medium</i>	-	<i>Medium</i>
Management Measures:								
Apply measures 1-4 and 6 presented in in CH1.								
After Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	<i>Medium</i>	<i>Unlikely</i>	<i>Low</i>	-	<i>Medium</i>

Table 6-62: Impact assessment on cultural heritage resources (operation phase)

Activity: Operational phase activities including maintenance.								
Project phase: Operation								
CH4 - Impact Summary: Impact of the Project on recorded cemeteries/ burial sites								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	High	<i>Unlikely</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 2-6 presented in in CH1.								
After Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Unlikely</i>	Low	-	<i>Medium</i>
Project phase: Operation								
CH5 - Impact Summary: Impact of the Project on places of worship/ sacred sites and monuments								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Moderate</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 2-6 presented in in CH1.								
After Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Unlikely</i>	Low	-	<i>Medium</i>
Project phase: Operation								
CH6 - Impact Summary: Impact of the Project on heritage resources								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>
Management Measures: Apply measures 2-6 presented in in CH1.								
After Management	<i>Minor</i>	<i>Long-term</i>	<i>Local</i>	Medium	<i>Unlikely</i>	Low	-	<i>Medium</i>

6.5.3 Human rights

Baseline conditions

An overview of the potential human rights impacts considered in the HRIA process is shown in Table 6-63. This list was developed based on research of the assessment team on the Angolan human rights context, the nature of linear infrastructure construction and implementation projects, and fieldwork undertaken as part of the reconnaissance site visit, socio-economic household surveys and key informant interviews.

Table 6-63: Potential human rights impacts

Human rights of community members	Human rights of workers
- Community members' human rights: - Land and ecosystem service use - Unjust process and modality of land acquisition - Labour impacts - CHSS during construction - CHSS during operations - Violations of rights to freedom of opinion, expression, association and assembly - Reduced access to information, consultation and participation - ASM: - Child labour in ASM - Inadequate OHS standards in ASM - Interactions with security forces in ASM	- Discrimination - Freedom of association - Just and favourable working conditions - Safe and healthy working conditions - Forced labour - Child labour
Cross-cutting human rights impacts applicable to community members and workers	
- Discrimination against women in the workplace - Reduced safety and access to resources	

Impact identification

Eighteen (18) salient community-related human rights issues were identified. These include human rights impacts that can be potentially experienced by PACs, workers employed by PAK Yatirim, RNT, and their contractors and suppliers, artisanal miners and women in the PACs or who are employed (the latter is discussed as a cross-cutting issue).

Impact description

The identified human rights impacts have been plotted on two heat maps below for the pre- and post-mitigation scenarios to illustrate the potential severity and likelihood of different human rights impacts and to prioritise the salient human rights impacts of the Project. The heat maps consolidate the outcomes of the severity and likelihood assessments of the identified potential human rights impacts.

Note that some of the ratings do not change pre- and post-mitigation, as the impacts are impacts that the Project does not have control over by not causing or contributing to it. In these cases, the Project is responsible only to not exacerbate the human rights impacts that are already being observed in connection with these activities (such as the potential for child labour in ASM).

Secondly, the reader must note that the threshold for a human rights impact is very low. This means that a lot of impacts occur in the red area of the heat map and, when compared to an impact table of

the ESIA, it might look disproportionately severe. This is not to assign blame or to place undue pressure on the Project, but to emphasise the importance of considering any potential contribution, including those that are unintended, in the Project going forward – primarily for the sake of rights-holders, but also to ensure Social Licence to Operate and avoid reputational risk.

Human rights impacts were assessed using the specific methodology presented in Section 6.3.3.

The human rights heat map pre-mitigation is shown in Table 6-64 below.

Table 6-64: Pre-mitigation human rights heat map

Severity of potential adverse human rights impact on rights-holders	5			Unsafe and unhealthy working conditions		
	4		Forced labour and modern slavery	CHSS impacts during operations Violations of rights to freedom of opinion, expression, association and assembly Interactions with security forces in ASM	CHSS impacts during construction Reduced safety and access to resources Discrimination of PAK Yatirim, RNT, contractor and supplier workers	Land and ecosystem service use Unjust process and modality of land acquisition Discrimination against women in the workplace
	3			Unjust labour practices and marginalisation in the community Child labour in ASM Inadequate OHS standards in ASM Lack of freedom of association Unjust and unfavourable working conditions	Reduced access to information, consultation and participation	
	2					
	1					
		1	2	3	4	5
Likelihood that human rights impact occurs						

The human rights heat map post-mitigation is shown in Table 6-65 below.

Table 6-65: Post-mitigation human rights heat map

Severity of potential adverse human rights impact on rights-holders	5					
	4			CHSS impacts during construction		
	3		Violations of rights to freedom of opinion, expression, association and assembly Forced labour and modern slavery	CHSS impacts during operations Child labour in ASM Inadequate OHS standards in ASM Interactions with security forces in ASM Discrimination of PAK Yatirim, RNT, contractor and supplier workers Unsafe and unhealthy working conditions	Land and ecosystem service use Unjust process and modality of land acquisition Reduced safety and access to resources	Discrimination against women in the workplace
	2			Unjust labour practices and marginalisation in the community Reduced access to information, consultation and participation Lack of freedom of association Unjust and unfavourable working conditions		
	1					
		1	2	3	4	5
		Likelihood that human rights impact occurs				

Impact assessment

The following sub-section assesses the potential adverse human rights impacts of the Project on community members in the AoI. The identified impacts are categorised into four themes (i.e. land and ecosystem service use, women's rights, ASM and worker's rights) and assessed.

Impact theme 1: Community members' human rights

Human rights impact HR1.1: Land and ecosystem service use

Inappropriate Project siting that neglects existing land uses—such as customary land and resource use, cultural sites, natural habitats, and sites providing ecological services or other community priorities—can lead to the loss of land tenure, natural resources, ecosystem services, and locally prioritised land uses. This human rights impact is mainly associated with physical and economic displacement, but also ecosystem services such as the PACs' use of groundwater, surface water, land for grazing and soil for agriculture, and the collection of wood, honey and medicinal plants. Community access to natural resources, such as water, forests, fisheries, and cultural resources, may be temporarily or permanently restricted or lost due to Project land acquisition, pollution, or overuse of resources.

The priority and larger strategy of the Project may not be known, valued, or prioritised by local communities (OHCHR, 2017). Additionally, those implementing various Project components on the ground may fail to recognise certain rights or adequately value community land use and cultural sites.

As per the LARF prepared for this Project, preliminary estimations noted that more than 1 400 houses or structures might be affected by the HV and MV OHL and substation buffer areas, as well as more than 400 ha of cultivated or fallow farmland.

The Project could cause or contribute to this impact.

The impact rating before and after mitigation measures are applied is described in Table 6-66.

Table 6-66: Land and ecosystem service use

Activity: Project planning and siting						
Project phase: Pre-construction and construction						
HR1.1 - Impact Summary: Land and ecosystem service use						
	Scale Gravity	Scope No. of affected rights-holders	Irremediability	Severity	Likelihood	Heat map rating
Before Management	Significant	Multiple SH affected	Difficult	4	5	
Management Measures:						
1. Ensure the Project design is adapted to avoid any impacts on farming or grazing land; 2. If avoidance is not possible, provide alternative land of the same or better carrying capacity and at the same travelling distance as the affected land; 3. If land is not available and cash compensation is preferred, this can also be considered, however, it needs to be implemented together with the necessary livelihood restoration measures since the PAP's livelihood might not change from traditional practices e.g. subsistence farming to another income-generating opportunity if they cannot find land elsewhere; 4. Compile and implement an International Finance Corporation Performance Standard (IFC PS) 1-compliant SEP, including a grievance mechanism; 5. Compile and implement an IFC PS5-compliant LARF; 6. Compiling an IFC-compliant RAP and LRP for any physical or economic displacement as determined after the implementation of the LARF; 7. Any farmland that is impacted by construction activities must be rehabilitated to the pre-construction condition or better. If this is not possible, replacement land must be provided to the affected farmers; 8. Determine if any of the existing agricultural projects, institutes or facilities, such as the PEDR, CarrinhoAgri (run by Grupo Carrinho Comercio Lda), Agricarrinho in the ECAs, CartAgri, MOSAP II, IDA, EDAs, agricultural cooperatives and associations, could be leveraged during the construction period, when the highest land-based impact is expected;						

9. Construction activities should be limited to demarcated areas and avoid farming or grazing land used by local communities; 10. Note that such land might not be very close to villages using it and it might not be apparent that it is used for grazing. This should be determined before site establishment; 11. Any impacts resulting from construction activities on farmland and resources, such as soil compaction due to vehicle traffic, hydrocarbon spills and water contamination, should be rehabilitated or cleared immediately after occurrence; 12. Consultation with sobas (local community/village traditional authority) and local municipal administrations will be important to ensure that farmland is identified and avoided prior to site establishment; 13. Liaise with local law enforcement, police and/or other security entities on their strategies for managing ASM activities in the area; 14. Provide employment opportunities for unskilled labour from the PACs as far as possible; 15. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness of the land that is in RNT's possession and that will be used for the transmission line (or ENDE's land for the distribution network); 16. Establish and monitor conservation corridors; 17. Establish safe access routes to natural resource-use areas; 18. All site establishment and vegetation clearing activities should be preceded by an opportunity given to villagers to harvest natural resources or materials they could use; 19. No recreational hunting or fishing should take place by construction workers on- or off-duty; 20. Vegetation clearing should be limited to the absolute minimum; 21. Hydrocarbon spills should be prevented as prescribed in the Project ESMP; 22. Any construction activities should be restricted to the established and demarcated construction sites; 23. Vehicle movement should be restricted to existing roads; and 24. Locations of medicinal plants should be identified prior to site establishment to ensure that they can be avoided or replanted.						
After Management	Moderate	Small number of SH affected	Difficult	3	4	

Human rights impact HR1.2: Unjust process and modality of land acquisition

Issues related to the process and modality of acquisition of land include land expropriation, land grabs, forced or premature sales under threats or intimidation, forced eviction and relocation, loss of land tenure rights, and losses due to lack of formal title or a cadastral system. Additional concerns involve the loss of or access to communal land, cultural resources, natural resources, productive assets, and shelter, as well as the adverse impacts of relocation on livelihoods and living standards. Compensation provided for the loss of land, productive assets, and shelter may be insufficient to maintain existing livelihoods and adequate standards of living.

These impacts can also affect rights related to work, health, education, and adequate housing, including shelter, access to water and sanitation, and locational advantages, such as proximity to family members, community services, work, or school.

In addition to land tenure issues, significant injustice arises when those who bear the burden of infrastructure projects do not receive any of the benefits. For instance, individuals might have to relocate to accommodate the Project, but might not immediately gain access to the electricity transmitted to the target areas.

The Project could cause or contribute to this impact.

The impact rating before and after mitigation measures are applied is described in Table 6-67.

Table 6-67: Unjust process and modality of land acquisition

Activity: Land acquisition process						
Project phase: Pre-construction and construction						
HR1.2 - Impact Summary: Unjust process and modality of land acquisition						
	Scale Gravity	Scope No. of affected rights-holders (RHS)	Irremediability	Severity	Likelihood	Heat map rating
Before Management	Significant	Multiple RHS affected	Difficult	4	5	

Management Measures:						
1. Compile and implement an IFC-compliant LARF. The process should not only meet national standards, but also comply with GIIP, such as IFC PS5. If economic displacement is found to be unavoidable, compile and implement an IFC-compliant LRP; 2. Externally monitor the valuation and compensation process undertaken to determine which plots are affected and what kind of compensation is provided, especially if undertaken by government agents. This will ensure that current valuations are used (taking inflation into account if the latest published guidelines are pre-2024 or whichever year the compensation will take place); 3. Repeated planting of the same crops and decreasing rainfall are believed by local farmers to be the leading causes of the deterioration of fertile soil. If replacement land and livelihood restoration support are provided, the land should be of better quality and potential assistance or support for agricultural resources provided. PAPs/PAHs would then have access to resources that they normally do not, such as expensive fertiliser and other crop types or seeds to do rotational farming; 4. Any livelihood restoration and transitional support must be accompanied by education and awareness raising on responsible and sustainable farming practices. There might be other cost-effective, waterwise and sustainable farming practices based on new technologies or research; 5. Any cash compensation should be provided along with relevant education on financial literacy and responsible spending; 6. Visuals and simple text in Umbundu, Nganguela and Portuguese should be used in awareness and education sessions on sustainable farming and financial literacy as part of transitional support and livelihood restoration. Communicating in Umbundu and Nganguela is very important to ensure that women and the elderly (who are identified as vulnerable groups in this Project) who do not understand Portuguese are also empowered to undertake sustainable farming; 7. Avoid any form of physical displacement, resettlement, or relocation. If it can absolutely not be avoided, it should be limited as far as possible and mitigated proportionally; 8. Compile and implement an IFC-compliant LARF. The process should not only meet national standards, but also comply with GIIP, such as IFC PS5. If physical displacement is found to be unavoidable. Compile and implement an IFC-compliant RAP and LRP; 9. Externally monitor the valuation and compensation process undertaken to determine which households and their structures (as well as communally owned and used structures such as mills) are affected and what kind of compensation is provided, especially if undertaken by government agents. This will ensure that current valuations are used (taking inflation into account if the latest published guidelines are pre-2024 or whichever year the compensation will take place); 10. Externally monitor the physical relocation process to ensure that GIIP, IFC PS5, and RAP requirements are adequately implemented and periodically reviewed; 11. Any changes to residential locations should be accompanied by security of tenure; 12. The necessary support should be provided to the vulnerable elderly and disabled during any movements to new replacement houses or locations. This includes not only physical transportation of them and their possessions, but also assistance with construction or sourcing of replacement housing; and 13. Counselling and training on house maintenance and the management of household budgets should be provided.						
After Management	Moderate	Small number of RHs affected	Difficult	3	4	

Human rights impact HR1.3: Unjust labour practices and marginalisation in the community

Individuals displaced from their land for Project development, as well as local general labour or job seekers, might end up working for construction companies in poor conditions. The construction industry can negatively impact construction workers in various ways, including wages, working conditions (encompassing the four core labour standards), worker accommodation, and retrenchment.

Additionally, the influx of foreign labour can hinder local labour forces and small and medium-sized enterprises (SMEs) along the powerline route from benefiting from the Project. When enterprises investing abroad bring their own workforce and source inputs from other countries, it can negatively impact the livelihoods of local communities and SMEs operating along the corridor.

The Project could cause or contribute to this impact. The impact rating before and after mitigation measures are applied is described in Table 6-68.

Table 6-68: Unjust labour practices and marginalisation in the community

Activity: Employment of local and foreign labour, services, and supplies						
Project phase: Construction						
HR1.3 - Impact Summary: Unjust labour practices and marginalisation in the community						
	Scale Gravity	Scope	Irremediability	Severity	Likelihood	Heat map rating

		No. of affected rights-holders				
Before Management	Moderate	Small number of RHs affected	Can be remediated	3	3	
Management Measures:						
- Where local skill sets are available, the Project should aim to employ these persons as far as practicable. Skills databases can be obtained from local municipal administrations; - Include financial literacy awareness and education in toolbox talks, inductions, and other passive awareness media such as posters in dining and ablution areas; - Ensure that the main construction contractor has a preferential recruitment policy in place that requires a certain number of local employees from within all six affected municipalities, not just the three beneficiary municipalities; - Establish a mobile labour desk prior to the construction phase, so that potential workers residing in the villages, and not just the municipal urban centres, also get a fair chance to apply through a single channel; - Awareness raising of application opportunities should be done beforehand with the support of local municipal administrators and sobas to ensure that applicants can prepare the relevant documents; - Where possible, designate employment opportunities for women and disabled persons employees from within all six affected municipalities, not just the three beneficiary municipalities; - Ensure compliance with IFC PS 2 (Labour and Working Conditions) and the relevant ILO conventions where women, disabled, and migrant (internally displaced) workers are recruited and employed in any component of the Project; - Create awareness among contractors' employees on the importance of inclusivity and non-discrimination in the workplace. This could be done through visual media and toolbox talks on site, and other passive awareness media such as posters in dining and ablution areas; - Establish a mobile labour desk prior to the construction phase, so that potential workers residing in the villages, and not just the municipal urban centres, can all get a fair chance to apply through a single channel; - Awareness raising of application opportunities should be done beforehand with the support of local municipal administrators and sobas to ensure that applicants can prepare the relevant documents. Capacity building with municipal administrators and sobas on the importance of inclusivity and non-discrimination might be necessary to ensure true support; - Ensure that, when any engagements related to employment opportunities and financial management take place, all adult members of the household are present. Females might be preparing agricultural fields, harvesting, collecting water, washing clothes, or bathing during normal working hours when these engagements are conducted; - Any wage payments should be provided along with relevant education on financial literacy and responsible spending; and - Visuals and simple text in Umbundu, Nganguela and Portuguese should be used in workplaces, awareness and education sessions on inclusion and financial literacy. Communicating in Umbundu and Nganguela is very important to ensure that women who do not understand Portuguese know their rights as employees.						
After Management	Minor	Small number of RHs affected	Can be remediated	2	3	

Human rights impact HR1.4: CHSS impacts during construction

Health and safety impacts on communities during construction will range from minor nuisances like noise and dust to major issues such as property damage, environmental health deterioration, and fatalities from construction accidents. Construction activities could attract numerous job seekers (influx) and service providers, potentially creating a boomtown effect that can lead to public disorder, threats to public health, safety, and security, unplanned pregnancies, sexually transmitted and other diseases, increased prostitution, and incidents of gender-based violence. Where the construction sites will require protection by public or private security forces, their conduct can adversely impact nearby communities.

The Project could cause or contribute to this impact. As influx is a contextual factor and root cause of other human rights risks and impacts that are associated with Project activities, there is a need to address influx with other actors to mitigate those other risks and impacts.

The impact rating before and after mitigation measures are applied is described in Table 6-69.

Table 6-69: CHSS impacts (construction phase)

Activity: Construction activities
Project phase: Construction
HR1.4 - Impact Summary: CHSS impacts

	Scale Gravity	Scope No. of affected rights-holders	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Significant</i>	<i>Multiple RHs affected</i>	<i>Can be remediated</i>	4	4	
Management Measures:						
1. Consult with government and other companies about the best platforms and initiatives to discuss and contribute to mitigation of the adverse impacts of influx; 2. Develop a local employment strategy and work with contractors and suppliers to ensure its effective implementation; 3. Carefully manage the implementation and communication about jobs and procurement opportunities with the support of local leadership to minimise risks of conflict and manage expectations; 4. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness of the land that is in RNT's possession and that will be used for the transmission line (or ENDE's land for the distribution network); 5. Construction and no-entry areas should be clearly marked prior to site establishment and maintained once substations are constructed, to ensure that no unauthorised entry takes place which can lead to safety risks; 6. Construct new roads which could be used safely by villagers (i.e., with fenced walking side paths) outside of any buffer areas required by the biodiversity-related mitigation measures; 7. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness and education of the physical Project components. This could include awareness posters or other print media, or community meetings with presentations on the safety of non-ionising radiation emitted by substations in the form of Extremely Low Frequency electromagnetic radiation; 8. Visuals and simple text in Umbundu, Ngunquela and Portuguese should be used, the former language being very important to ensure that women and the elderly (who are identified as vulnerable groups in this Project) who do not understand Portuguese are also equally informed; 9. Ensure that the siting of the substations is as far as possible and within the land in RNT's possession, from established villages and community activities such as agriculture; 10. Ensure that the CHSS plan included in contract documents of the main contractor and that it is implemented; 11. Continually conduct risk assessments and comply with the relevant H&S measures to ensure that the site and any hazards are access-controlled and isolated; 12. Require contractor personnel to drive at appropriate speed limits and enforce this where possible; 13. Include community safety in inductions and toolbox talks, along with the usual OHS measures; 14. Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access; 15. The contractor must publicise, implement and evaluate a grievance mechanism so that PAPs who are affected by construction activities (e.g. loss of livestock due to a speeding truck) can report incidents. The grievance mechanism allows the grievance to be investigated and closed out timeously in a systematic and proactive way. This will also help to identify trends of areas that need improvement; 16. The grievance mechanism must be accessible by all PAC members, including vulnerable groups such as the elderly, illiterate, disabled, and women. PAC members must be able to raise grievances through a variety of platforms to ensure that it is widely accessible, but all grievances must be recorded by the CLO or similar role player. This might include visits to the villages to hear and record any complaints or grievances. As explained in the SEP and grievance mechanism that has been prepared as part of this Project's ESIA, complaints might be cleared up before they turn into grievances if managed proactively; 17. All mitigation and monitoring measures in the Air Quality, Noise, and Hydrology Impact Assessments must be taken into consideration by the contractor, along with the ESMP; and 18. Highlight potential nuisance impacts during the stakeholder engagements to ensure that there is awareness and understanding of the temporary nature of the impacts among the PACs.						
After Management	<i>Moderate</i>	<i>Small number of RHs affected</i>	<i>Can be remediated</i>	4	3	

Human rights impact HR1.5: CHSS impacts during operations

During the operations phase, the intense adverse impacts that typically peak during construction, are expected to transition to sustained impacts. While these are often moderate in nature and scope, they can include potentially serious issues, such as the H&S of workers and nearby communities, as well as environmental degradation. Additionally, failure to maintain infrastructure can pose significant safety threats to surrounding communities.

Poorly designed or built infrastructure without the requisite reinforcements and safety features could result in accidents and fatalities of people in its vicinity. This could be the result of damage, collapse, or poorly maintained infrastructure components.

This is exacerbated by the tendency of maintenance failure to be, partly, a political issue: Governments often prioritise constructing new infrastructure over maintaining existing assets. This burden typically falls on local rather than national governments, despite local governments often having fewer financial resources to fund maintenance.

These CHSS impacts could also be associated with poor rehabilitation or changes to the landscape post-construction, increasing the risk of landslides and barren land.

Note that health impacts associated with living near a transmission line, substation or transformer, is still a subject of debate (Copes, 2008). The Project could cause or contribute to this impact.

The impact rating before and after mitigation measures are applied is described in Table 6-70.

Table 6-70: CHSS impacts (operation phase)

Activity: Powerline and substation maintenance						
Project phase: Operation						
HR1.5 - Impact Summary: CHSS impacts						
	Scale Gravity	Scope No. of affected rights-holders	Irremediability	Severity	Likelihood	Heat map rating
Before Management	Major	Multiple RHs affected	Can be remediated	4	3	
Management Measures:						
1. Ensure that the CHSS plan is implemented by the transmission and distribution line operators; 2. Continually conduct risk assessments and comply with the relevant H&S measures to ensure that the site and any hazards are access-controlled and isolated when conducting maintenance activities; 3. Consult the relevant local municipal administrations when maintenance activities are being conducted; 4. Consider including participatory monitoring by the community members if anything out of place is observed along the powerlines; 5. Conduct stakeholder engagement prior to site establishment to ensure that there is widespread awareness and education of the physical Project components. This could include awareness posters or other print media, or community meetings with presentations on the safety of non-ionising radiation emitted by substations in the form of Extremely Low Frequency electromagnetic radiation; 6. The operators of the transmission and distribution lines must publicise, implement and evaluate a grievance mechanism so that PAPs who are located close to the transmission and distribution lines and substations can report incidents. The grievance mechanism allows the grievance to be investigated and closed out timeously in a systematic and proactive way. This will also help to identify trends of areas that need improvement; 7. The grievance mechanism must be accessible by all PAC members, including vulnerable groups such as the elderly, illiterate, disabled, and women. PAC members must be able to raise grievances through a variety of platforms to ensure that it is widely accessible, but all grievances must be recorded by a CLO or similar role player appointed by the operator of the transmission and distribution lines and substations. This might include visits to the villages to hear and record any complaints or grievances. As explained in the SEP and grievance mechanism that has been prepared as part of this Project's ESIA, complaints might be cleared up before they turn into grievances if managed proactively; 8. Visuals and simple text in Umbundu, Ngunquela and Portuguese should be used, the former language being very important to ensure that women and the elderly (who are identified as vulnerable groups in this Project) who do not understand Portuguese are also equally informed; 9. No-entry areas should be clearly marked and maintained once substations are constructed, to ensure that no unauthorised entry takes place which can lead to safety risks;						

10. Construct new roads which could be used safely by villagers (i.e., with fenced walking side paths) outside of any buffer areas required by the biodiversity-related mitigation measures; 11. Ensure that the siting of the substations is as far as possible and within the land in RNT's possession, from established villages and community activities such as agriculture; 12. Continually conduct risk assessments and comply with the relevant H&S measures to ensure that the site and any hazards are access-controlled and isolated; 13. Require personnel to drive at appropriate speed limits and enforce this where possible; 14. Include community safety in employee training, along with the usual OHS measures; 15. Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access; and 16. All long-term mitigation and monitoring measures in the Air Quality, Noise, and Hydrology Impact Assessments must be taken into consideration by the contractor, along with the ESMP.						
After Management	Moderate	Small number of RHs affected	Can be remediated	3	3	

Human rights impact HR1.6: Violations of rights to freedom of opinion, expression, association and assembly

Violations of rights to freedom of opinion, expression, association and assembly can occur at any stage of the Project. For instance, security forces might be deployed to protect installations during the construction and operation phases. Intimidation of workers and community members, use of force (including militarised force) at public gatherings and protests, and restrictions or prohibitions on public protests against projects are potential violations. Women are particularly vulnerable to these threats. Based on the country's context and past instances of impedance by the state on freedom of assembly, this impact is possible, but not likely, due to these incidents occurring mostly in urban areas.

The Project could contribute to this impact.

The impact rating before and after mitigation measures are applied is described in Table 6-71.

Table 6-71: Violations of rights to freedom of opinion, expression, association and assembly

Activity: Interactions with external stakeholders						
Project phase: All phases						
HR1.6 - Impact Summary: Violations of rights to freedom of opinion, expression, association and assembly						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	Moderate	Multiple RHs affected	Can be remediated	4	3	
Management Measures:						
1. Communicate the IFC-compliant grievance mechanism in the PACs; 2. Ensure that agreements with the appointed security company include the following: - When hiring security personnel, a reasonable effort must have been made to screen them for past abuses; - Security personnel need to be properly trained in the use of force and, most importantly, appropriate conduct towards villagers; - Severe penalties/disciplinary action should be taken against any security personnel involved in theft or abuse; - A code of conduct must be developed and enforced for the security personnel; - The code of conduct must be consistent with the UN Code of Conduct for Law Enforcement Officials, the UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials, and the VPSHR; and - All workers are to be informed about the roles and responsibilities of the security personnel; and - Train security personnel on VPSHR and Gender Based Violence and Harassment (GBVH).						
After Management	Moderate	Small number of RHs affected	Can be remediated	3	2	

Human rights impact HR1.7: Reduced access to information, consultation and participation

Proactive information disclosure and consultation with affected stakeholders should be conducted at various stages throughout an infrastructure Project's lifespan. However, in practice, communities often lack access to information or the opportunity to express their preferences and concerns. While stakeholder consultation activities are intended to help communities access information regarding the anticipated impacts of infrastructure planning, construction, and operation, they often end once the ESIA is finished. Sometimes, disclosures tend to favour commercial stakeholders over individuals affected by projects. The information disclosed is often technical and challenging for the public to comprehend. Failure to involve stakeholders in the Project design and selection phase and throughout the Project's life cycle can lead to or prolong misalignment of development priorities at local, national, and regional levels, and may undermine social cohesion.

The Project could contribute to this impact.

The impact rating before and after mitigation measures are applied is described in Table 6-72.

Table 6-72: Reduced access to information, consultation and participation

Activity: Interactions with external stakeholders						
Project phase: All phases						
HR1.7 - Impact Summary: Reduced access to information, consultation and participation						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Moderate</i>	<i>Multiple RHs affected</i>	<i>Can be remediated</i>	3	4	
Management Measures:						
Apply measures 1-2(a-f) presented in HR1.6						
After Management	<i>Minor</i>	<i>Small number of RHs affected</i>	<i>Can be remediated</i>	2	3	

As shown in the SEIA, there are no known occurrences of indigenous peoples (San) in the Project area. Based on the records received, the nearest San group is located approximately 70 km to the south of the Project site (Geolab, 2024). Since initial site visits and stakeholder engagement, a small group of Khoisan was noted to be approximately 20 km south of the Project area. The whereabouts of these nomadic families are being monitored by the municipalities of Jamba and Cuvango. The San in Angola are currently far less nomadic than they traditionally were, due to increased pressures associated with urbanisation and systematic discrimination (IDL-FAS, 2022). This impact is therefore not assessed as the Project will have no direct impact on San groups.

However, the Project may indirectly result in activities that could impact the San people's human rights as it pertains to the use of ecosystem services in *Human rights impact 1.1: Land and ecosystem service use*, general project awareness as assessed in *Human rights impact 1.7: Reduced access to information, consultation and participation*, and employment opportunities as assessed in *Human rights impact 1.3: Unjust labour practices and marginalisation in the community*. For this reason, the mitigation measures suggested under these impacts must be implemented in order to avoid adverse impacts on the San people's human rights.

As noted in Section 6.5.1, Impact SE1.4 notes that the Project could impact the Khoi San's practices of gathering wild fruit, extracting honey for consumption and collecting medicinal plants – practices that are already under threat (IDL-FAS, 2022).

Access to natural resources by Khoi San people might be affected, as the locations impacted by the Project footprint could reduce the ease with which, or the time it takes to reach the resource locations as they have to find other paths to them. The quality of ecosystem services could also be impacted by Project activity, such as hydrocarbon spillages during the construction phase, which could impact soil and water quality. Any groundwater abstraction for concrete batching could also reduce groundwater availability from wells or boreholes. If substation-land is currently used for grazing, hunting, medicinal plant or wood collection, the availability of these resources would also be substantially reduced. Construction workers might engage in hunting and fishing as recreation while off duty, resulting in fewer of these resources being available for community members and Khoi San people who depend on them.

Impact theme 2: Women's rights

This impact is discussed under its own themes as it is a cross-cutting issue in both the communities and Project employees. Women's rights were identified as a cross-cutting issue to underscore the importance of addressing the status of women and gender equality across various workplace and community concerns. This prioritisation took into account the broader context and issues related to the protection and respect for women's rights in the country, including the high incidence of discrimination, harassment, and gender-based violence. Despite progress in women's rights and gender equality, significant cultural, social, religious, political, and legal barriers to full equality still persist.

Human rights impact HR2.1: Discrimination against women in the workplace

The likelihood of risks and impacts is high, given the expectation that very few local women will be included in the Project workforce, coupled with prevailing cultural attitudes towards women and gender roles in the country. They might face workplace discrimination and unequal pay.

Female employees may encounter issues related to sexual harassment in the workplace. Due to the high levels of sexual harassment and gender-based violence in society, raising awareness and conducting thorough due diligence on these issues should be a priority for the Project and its supply chain. There may also be stereotypical perceptions of women being unsuitable for certain types of work, as well as the unintended exclusion of female applicants based on language skills, their access to application platforms, or their need for flexible working hours because of household and family responsibilities.

Although no information on either PAK Yatirim or RNT's employment policies was provided, recommendations are provided to reduce any potential contribution of these employers to this impact.

The Project could **cause** this impact in its direct workforce and be directly linked to impacts related to discrimination by contractor and suppliers' workers.

The impact rating before and after mitigation measures are applied is described in Table 6-73.

Table 6-73: Discrimination against women in the workplace

Activity: Employment of local and foreign labour, services, and supplies						
Project phase: All phases						
HR2.1 - Impact Summary: Discrimination against women in the workplace						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	Significant	Multiple RHs	Difficult	4	5	
Management Measures:						

1. Create awareness about non-discrimination and more opportunities for women to be recruited and advance; 2. For more serious risks or impacts related to harassment or GBV, implement an internal employee grievance mechanism, such as a hotline that can be used to report issues or incidents; 3. Policies to address equality, opportunity, diversity and inclusion should be in place and implemented by both employers on this Project, PAK Yatirim and RNT; 4. To enhance women's participation and advancement in the workforce there is a need for greater investment in educational opportunities for girls to increase the number of qualified female graduates entering the job market; 5. More specialised training opportunities could be provided for women already in the workforce to help them progress into supervisory and management positions; 6. Develop a comprehensive long-term strategy for the education, training, recruitment, and advancement of women in the workforce, and encourage contractors and suppliers to adopt similar strategies. Ensure that local employment initiatives include specific measures to target women in the community; 7. Prioritise non-discrimination and gender equality in ongoing engagement, monitoring, and auditing processes with contractors and suppliers; and 8. Ensure that those who manage the grievance mechanisms both internally and externally are prepared to receive complaints related to inappropriate behaviour, harassment or other gender-based issues.						
After Management	Moderate	Small no. of RHs	Difficult	3	5	

Human rights impact HR2.2: Reduced safety and access to resources

Women and girls are vulnerable to additional impacts if there are challenges for community members to access ecosystem services because of the presence of the Project, particularly during construction. They might have to travel further as they need to take detours to reach water, school, agricultural areas, and so on. This might also put them at higher risk of abuse or intimidation by construction workers if travelling alone. Women and girls are vulnerable to the most severe impacts of influx in relation to adverse health impacts, criminality and gender-based violence. The impact evaluation takes into account the significant scope of the issue of influx and the challenges in remediating or reversing influx once it occurs.

The Project might cause or contribute to this impact.

The impact rating before and after mitigation measures are applied is described in Table 6-74.

Table 6-74: Reduced safety and access to resources

Activity: Construction activities						
Project phase: Construction						
HR2.2 - Impact Summary: Reduced safety and access to resources						
	Scale Gravity	Scope No. of affected rights-holders	Irremediability	Severity	Likelihood	Heat map rating
Before Management	Significant	Multiple RHs	Difficult	4	4	
Management Measures:						
1. Create awareness about non-discrimination and more opportunities for women to be recruited and advance; 2. For more serious risks or impacts related to harassment or GBV, implement an internal employee grievance mechanism, such as a hotline that can be used to report issues or incidents; 3. Provide ongoing training on freedom from harassment and GBV for both employees and contractor workers, especially security personnel; 4. Undertake ongoing stakeholder engagement with women in the community to manage potential impacts, increase their participation in the Project (e.g. through participatory monitoring or any social investment projects), and ensure ongoing strengthening of accessibility and trust in the community grievance mechanism; and 5. Ensure that those who manage the external grievance mechanism are prepared to receive complaints related to inappropriate behaviour, harassment or other gender-based issues associated with the Project such as construction workers and security forces.						
After Management	Moderate	Small no. of RHs	Difficult	3	4	

Impact theme 3: ASM

The following section assesses the human rights impacts that could be associated with the interactions between ASM and the Project. As will be discussed below, interactions with ASM are a pervasive and complex challenge for numerous African countries⁸.

The main human rights impacts are associated with the most severe forms of child labour, inadequate OHS standards, and engagements with security forces. These challenges stem from underlying factors such as extreme poverty and the appeal of ASM as a means of livelihood. They also result from insufficient efforts to establish viable ASM sites, unfair pricing and price fluctuations for ASM miners, and pervasive corruption within the profitable ASM value chain.

ASM is not active and pervasive in the entire Project area. It was only identified in three communities i.e., two in Jamba municipality (Kuandja and Morro I) and one in the Chipindo municipality (Vingolo).

It is crucial to clarify from the start that any potential connections between the Project and ASM result from the physical proximity of ASM activities to the Project area. This physical proximity is what establishes the association (or linkage) from a human rights standpoint. There is no implication that the Project is directly sourcing minerals from ASM activities or is otherwise promoting or benefiting from ASM activities within its supply chain.

The scope and complexity of ASM are beyond what one project entity can manage on its own. While it is important that the Project can demonstrate that it is not contributing to further human rights impacts associated with ASM in the Project area, it also needs to find strategies to use and increase its leverage—notably through multistakeholder action with the government, ASM associations, civil society actors and NGOs to find more sustainable approaches to managing ASM.

A crucial initial step for multistakeholder action is to conduct a participatory study. This study should aim to enhance the overall understanding of the various ASM activities in the Project area and to establish consensus among relevant stakeholders regarding the strategies needed for more sustainable engagement with ASM.

Human rights impact HR3.1: Child labour in ASM

It was not observed that young children were employed in ASM, but those who were, could have been adolescents and under the age of 18.

The Project is linked to the risks and impacts related to child labour that occur in the Project area, which includes buffer zones. This is purely because of the presence of ASM in the Project area. It cannot be seen as contributing to the risks and impacts related to child labour and it does not incentivise or benefit from child labour or ASM more broadly.

The impact rating before and after mitigation measures are applied is described in Table 6-75, which is the same due to the lack of control that the Project will be able to exercise on the impact. It is for the Project to not exacerbate this human rights impact.

Table 6-75: Child labour in ASM

Activity: ASM in the Project area						
Project phase: All phases						
HR3.1 - Impact Summary: Child labour						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating

⁸ The world map on Artisanalmining.org shows that all but one African country has ASM activity **Invalid source specified..**

Before Management	<i>Moderate</i>	<i>Small no. of RHs</i>	<i>Difficult</i>	3	3	
Management Measures:						
- Under the UNGPs, the Project is not required to provide for remediation of child labour impacts itself, but is expected to use its leverage to prevent and mitigate those impacts; - The Project can contribute to a variety of initiatives to prevent, mitigate and remediate the impacts of child labour with the support of ASM associations and CSOs. This can include: - raising awareness about child labour, H&S in ASM; - specific training and measures related to children's rights for security forces; - supporting CSOs that provide shelter and education for orphans who could be involved in ASM activities; - supporting CSOs that have initiatives to prevent and remediate child labour in ASM; and - supporting holiday programmes for school-children to keep them out of ASM activities during school holidays						
After Management	<i>Moderate</i>	<i>Small no. of RHs</i>	<i>Difficult</i>	3	3	

Human rights impact HR3.2: Inadequate OHS standards in ASM

As the gold panning activities observed were mainly on fairly flat surfaces, the risk of slope is considered moderate to low. The conservative inclusion of “moderate” in the rating, is because some mining was observed north of the Project area close to Gove, and this was in a depression/valley formed by a river, where slope failure is possible (although the sloping was relatively gentle). Women were also observed to be mining here. Other such activities closer to the Project area might be possible or might appear post-ESIA.

Furthermore, it is not known whether harmful chemicals such as mercury, arsenic or cyanide are used in the extraction and washing of gold panned.

The Project is linked to the risks and impacts related to the unsafe and unhealthy working conditions in the ASM activities that occur in the Project area, which includes buffer zones. It cannot be seen as contributing to these risks and impacts as it does not incentivise or benefit from unsafe or unhealthy working conditions.

The impact rating before and after mitigation measures are applied is described in Table 6-76, which is the same due to the lack of control that the Project will be able to exercise on the impact. It is for the Project to not exacerbate this human rights impact.

Table 6-76: Inadequate OHS standards in ASM

Activity: ASM in the Project area						
Project phase: All phases						
HR3.2 - Impact Summary: Inadequate OHS standards						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Moderate</i>	<i>Small no. of RHs</i>	<i>Difficult</i>	3	3	
Management Measures:						
- Under the UNGPs, the Project is not required to provide for remediation of impacts related to unsafe and unhealthy working conditions itself, but is expected to use its leverage to prevent and mitigate those impacts; - The Project can contribute to a variety of initiatives to improve H&S awareness amongst the artisanal miners: - support CSOs that have initiatives to raise awareness and promote safe and healthy working conditions; - work with ASM associations to improve the safe and healthy working conditions of their members, the use of PPE and access to medical services; - Implementing access restrictions could be viewed as an additional measure to prevent ASM activities within the project area. This step would help mitigate H&S risks that could arise if ASM were allowed unrestricted access; and - While the Project could pursue the enhancement of H&S standards, there are notable limitations regarding the number of individuals that can be effectively reached. These constraints underscore the importance of establishing formalised						

ASM areas with access controls. Additionally, it is important to acknowledge that certain artisanal miners may be resistant to H&S measures due to various reasons, including hardened attitudes, fatalism, or desperation.						
After Management	Moderate	Small no. of RHs	Difficult	3	3	

Human rights impact HR3.3: Interactions with security forces in ASM

The potential for artisanal miners to be confronted with public or private security forces once construction commences is possible. There is a belief that the ASM activities close to the Project area are illegal. This presumption might exacerbate confrontations with security forces as ASM is restricted from entering areas demarcated for construction activities, such as laydown areas and camps. Once construction is complete, ASM might again move into areas close to Project infrastructure – this could also lead to interactions with private or public security appointed or involved to ensure that access to certain Project areas is restricted e.g. for safety reasons.

Conversely, there are risks and impacts faced by workers, private security guards, and public security personnel who are at the forefront of confrontations with artisanal miners.

The Project may contribute to or be directly linked to risks and impacts arising from actions by public or private security forces. The severity of a specific incident will hinge on factors such as whether the Project had operational control at the time, whether it incentivised or endorsed the use of force, requested proportionate responses and whether armed, lethal force was used. Typically, the Project will have a higher level of contribution to risks and impacts caused by private security guards, given the greater extent of operational control it has over them compared to public security forces.

Guard dogs are also employed at times by security forces. This can cause severe injuries to artisanal miners, their handlers or others. Another common challenge ASM worldwide is the potential collusion of public security forces with artisanal miners or their tendency to turn a blind eye to ASM activities.

The impact rating before and after mitigation measures are applied is described in Table 6-77. Here, the Project will be able to exercise some control over the impact, since it could be caused by the involvement of security on the Project.

Table 6-77: Interactions with security forces in ASM

Activity: ASM in the Project area						
Project phase: All phases						
HR3.3 - Impact Summary: Interactions with security forces						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Significant</i>	<i>Small no. of RHs</i>	<i>Can be remediated</i>	4	3	
Management Measures:						
- For any private security forces hired: - Provide training on the use of force; - Implement reporting protocols for incidents involving the use of force; - Conduct due diligence assessments of any prior human rights allegations; - Provide training on interactions with children; - Provide training on VPSHR and GBVH; - Include relevant UNGP clauses in their contracts/agreements; - Provide first aid and medical attention to injured people; - Involve community leaders (and artisanal miners if possible) in human rights training to ensure a comprehensive understanding of the importance and universality of human rights, thus promoting a level playing field;						

4. Engage in discussions with relevant authorities regarding the regular rotation of public security forces to reduce opportunities for collusion. Such a rotational system would require the need for ongoing engagement and training on UNGP and security standards, protocols, and human rights expectations of the Project with the relevant public security forces; and 5. Establish, join or support a working group on CHSS.						
After Management	Moderate	Small no. of RHs	Can be remediated	3	3	

Impact theme 4: Workers Rights

Workers' rights are a crucial aspect of human rights, encompassing various areas such as non-discrimination, freedom of association, fair and favourable working conditions, safe and healthy work environments and freedom from child and forced labour.

Although PAK Yatirim and RNT could have very relatively good control over how their own workers are treated, it has less influence over the workers of its contractors and suppliers.

Smaller contractors and suppliers frequently lack familiarity with international standards like the ILO Declaration on Fundamental Principles and Rights at Work. They often exhibit weak human resource management practices and struggle with financial capacity, leading to challenges in providing decent working conditions and timely payment for their workforce.

The overall risks to contractors' and suppliers' workers' rights are linked to the effectiveness of the management systems of PAK Yatirim and RNT (in terms of contractor and supplier due diligence), as well as the capabilities of the contractors and suppliers themselves (in terms of aspects such as human resources and H&S).

A suitable framework for continuous HRDD on workers' rights (on safety, health and labour rights) among its contractors and suppliers should be included in agreements and contracts with contractors and suppliers. This should be done using a progressive, collaborative, and risk-based approach to identify and engage with different categories of contractors and suppliers based on their potential risks and impacts on workers' rights. PAK Yatirim and RNT need to collaborate with contractors and suppliers to strengthen the effectiveness of the grievance mechanisms available to their workers. This is a critical component of ongoing due diligence for workers' rights.

In areas with extreme poverty, one of the primary concerns for workers is the level of wages or remuneration, as it directly affects their standard of living. From the standpoint of workers' rights, wages should be evaluated concerning the minimum wage against whether they are sufficient to afford workers and their families an acceptable standard of living, often termed a "living wage"⁹. A minimum wage might be set above the poverty line (approximately United States Dollar [USD] 80 per month), but it could be below a "living wage".

Human rights impact HR4.1: Discrimination of PAK Yatirim, RNT, contractor and supplier workers

Some risks of discrimination between workers and employers might exist based on ethnicity, such as if there are San applicants. There is also a possibility that gender-based discrimination could take place.

Some tensions may arise between local and expatriate staff, staff from other provinces, union representatives (if present), and contractor workers, where staff and managers do not consistently respect the local language or culture. These impacts are usually perceived as more *disrespectful* than *abusive*.

⁹ A theoretical income level that allows individuals or families to afford adequate shelter, food, and other necessities.

The Project could cause this impact if its own staff are implicated in discriminatory practices towards contractor and supplier workers. If not, the Project would only be linked to it if it happens among its contractors and suppliers' workers.

The impact rating before and after mitigation measures are applied is described in Table 6-78.

Table 6-78: Discrimination of PAK Yatirim, RNT, contractor and supplier workers

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
HR4.1 - Impact Summary: Discrimination of PAK Yatirim, RNT, contractor and supplier workers						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Significant</i>	<i>Small no. of RHs</i>	<i>Can be remediated</i>	4	4	
Management Measures:						
1. Conduct due diligence on contractors and suppliers, including their subscription or acknowledgement of workers' rights aspects in their policies; 2. Include prohibitions on all forms of unfair or illegal discrimination based on race, nationality, religion, gender, age, sexual orientation, disability, ancestry, social origin, trade union membership, political belief or any other potential bias in contracts and agreements with contractors and suppliers; 3. Enterprise development programs could be done with local contractors where capacity can be built on non-discrimination; 4. Where possible, hire local contractors and suppliers; 5. Be mindful of appointing people and contractors that employ mostly women in "gendered" roles such as cleaning, and not in other activities of the Project; 6. Any assistance that is provided to local communities should not be assumed to also benefit the Khoi San groups, as they face widespread discrimination and exclusion. Any such benefits should be provided in a separate forum (e.g., mobile) and in a location that is distant from Bantu communities; 7. Where employment opportunities are advertised, especially local employment of semi-skilled and unskilled labour, care should be taken not to discriminate against Khoi San applicants. Consider informing Khoi San people of potential temporary employment opportunities in a separate forum as above and in the !Kung language spoken by them; 8. Where Khoi San applicants are successful in obtaining even temporary employment, the occurrence of workplace discrimination, harassment and bullying should be monitored closely; 9. Create awareness among contractors' employees on the importance of inclusivity and non-discrimination in the workplace. This could be done through visual media and toolbox talks on site, and other passive awareness media such as posters in dining and ablution areas; 10. Awareness raising of application opportunities should be done beforehand with the support of local municipal administrators and sobas to ensure that applicants can prepare the relevant documents. Capacity building with municipal administrators and sobas on the importance of inclusivity and non-discrimination might be necessary to ensure true support; and 11. Conduct labour audits of contractors and suppliers.						
After Management	<i>Moderate</i>	<i>Small no. of RHs</i>	<i>Can be remediated</i>	3	3	

Human rights impact HR4.2: Lack of freedom of association

There is a possibility that workers employed by PAK Yatirim, RNT, and its contractors and suppliers, lack freedom of association, either through formal union representation or other mechanisms such as worker committees. The severity of impacts related to the lack of freedom of association is included in the assessment, as it hinders workers' ability to advocate for their rights (such as collective bargaining) and negotiate with their employers for better working conditions.

The Project could cause this impact if its own staff do not have freedom of association rights. If not, the Project would only be linked to it if it happens among its contractors and suppliers' workers. As freedom of association issues are more likely to be found deeper in the Project's supply chain, the relationship is most likely to be one of linkage.

The impact rating before and after mitigation measures are applied is described in Table 6-79.

Table 6-79: Lack of freedom of association

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
HR4.2 - Impact Summary: Lack of freedom of association						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Moderate</i>	<i>Small no. of RHs</i>	<i>Can be remediated</i>	3	3	
Management Measures:						
1. Leverage any existing relationships with unions to support freedom of association for workers to reduce the risk of the Project contributing to human rights impacts associated with freedom of association; 2. Conduct due diligence on contractors and suppliers, including their views on freedom of association and collective bargaining in their policies; 3. Enterprise development programs could be done with local contractors where capacity can be built on freedom of association, collective bargaining and other workers' rights, management capacity, human resource management, providing written employee contracts, long hours and insufficient rest days or holidays, monthly salaries beneath the minimum wage and lack of benefits, inadequate PPE, and delays in payment of salaries; and 4. Be mindful of the potential unwillingness of contractor employees to report grievances for fear of losing their employment. Contractor management should reinforce positive messaging about the role of labour-related grievance mechanisms as part of due diligence and continuous improvement while providing strong and credible assurances about non-retaliation for raising concerns; and 5. Conduct labour audits of contractors and suppliers.						
After Management	<i>Minor</i>	<i>Individual RHs</i>	<i>Can be remediated</i>	2	3	

Human rights impact HR4.3: Unjust and unfavourable working conditions

There is a risk that workers employed by PAK Yatirim, RNT and local and national contractors and suppliers do not have access to just and favourable working conditions, as national labour standards for workers' rights may fall below international standards in key areas. Additionally, there are significant risks that not all local or national employers comply with basic national labour laws, especially beyond the primary tier of contractors and suppliers.

Although impacts on just and favourable working conditions can be addressed through compensation and revisions to employment policies, systemic issues such as inadequate wages, poor benefits, and delayed payments can be highly exploitative.

The Project could cause this impact if its own staff do not work in just and favourable conditions. If contracting and procurement practices drive prices down to a level where contractors or suppliers cannot allocate sufficient budget for decent working conditions, or if there are delays in payments that prevent contractors or suppliers from paying their workers on time, significant issues may arise, the Project could contribute to it.

The impact rating before and after mitigation measures are applied is described in Table 6-80.

Table 6-80: Unjust and unfavourable working conditions

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
HR4.3 - Impact Summary: Unjust and unfavourable working conditions						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Moderate</i>	<i>Small no. of RHs</i>	<i>Can be remediated</i>	3	3	
Management Measures:						
1. Provide onsite oversight and supervision into working conditions to ensure that adequate water and lunchtimes are provided, that PPE is used correctly, and so on;						

2.	Conduct due diligence on contractors and suppliers, including their views on commitments to offer fair remuneration, working hours and working conditions to their employees;					
3.	Enterprise development programs could be done with local contractors where capacity can be built on just and favourable working conditions standards and other worker's rights, management capacity, human resource management, providing written employee contracts, long hours and insufficient rest days or holidays, monthly salaries beneath the minimum wage and lack of benefits, inadequate PPE; and delays in payment of salaries;					
4.	Ensure that payments of contractors or suppliers are done within reasonable timeframes. If timeframes can be shortened to 14 days, it would allow small local contractors who often have little cash flow to be able to pay wages on time; and					
5.	Ensure that procurement processes take due consideration of, not only the cheapest contractors or suppliers, but also the costs required to provide workers with decent working conditions; and					
6.	Conduct labour audits of contractors and suppliers.					
After Management	<i>Minor</i>	<i>Individual RHs</i>	<i>Can be remediated</i>	2	3	

Human rights impact HR4.4: Unsafe and unhealthy working conditions

Although the Project will emphasise safe and healthy working conditions for its employees, contractors and suppliers, there remains a high potential severity of impacts, especially concerning workplace injuries and fatalities. This is particularly relevant in hazardous work environments such as work at heights, transportation, and security. The risks can also be comparatively high outside of the project area where PAK Yatirim or RNT can have oversight.

The Project could cause this impact if its workers do not work in safe and healthy working conditions. If this is only a problem with specific contractors and suppliers, the Project will contribute.

The impact rating before and after mitigation measures are applied is described in Table 6-81.

Table 6-81: Unsafe and unhealthy working conditions

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
HR4.4 - Impact Summary: Unsafe and unhealthy working conditions						
	Scale <i>Gravity</i>	Scope <i>No. of affected rights-holders</i>	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Major</i>	<i>Multiple RHs</i>	<i>Can be remediated</i>	5	3	
Management Measures:						
1. Conduct due diligence on contractors and suppliers, including their commitments to H&S in their policies; 2. Enforce, at PAK Yatirim and RNT, zero tolerance for fatalities, sound H&S planning, and the appropriate use of PPE and include such aspects in contracts and agreements with contractors and suppliers; 3. Enterprise development programs could be done with local contractors where capacity can be built on H&S, management capacity, human resource management, providing written employee contracts, long hours and insufficient rest days or holidays, monthly salaries beneath the minimum wage and lack of benefits, inadequate PPE, and delays in payment of salaries; and 4. Ensure that working conditions that PAK Yatirim and RNT have direct control over, are decent so as not to contribute to H&S issues experienced by contractor and supplier employees.						
After Management	<i>Moderate</i>	<i>Individual RHs</i>	<i>Can be remediated</i>	3	3	

Human rights impact HR4.5: Forced labour and modern slavery

The likelihood of forced labour within PAK Yatirim, RNT and PRODEL is low. However, there remains a possibility of forced labour and modern slavery further down the Project's supply chain. Therefore, it is essential to prioritise further supply chain risk assessment and due diligence in the more distant parts of the supply chain.

The relationship will be a direct linkage or contribution depending on the due diligence with specific contractors and suppliers. As forced labour is likely to be found deeper in the Project's supply chain, the relationship is most likely to be one of direct linkage.

The impact rating before and after mitigation measures are applied is described in Table 6-82.

Table 6-82: Forced labour and modern slavery

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
HR4.5 - Impact Summary: Forced labour and modern slavery						
	Scale Gravity	Scope No. of affected rights-holders	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Significant</i>	<i>Small no. of RHs</i>	<i>Difficult</i>	4	2	
Management Measures: 1. Conduct due diligence on contractors and suppliers, including their views on forced labour and modern slavery for instance, in their policies 2. Include prohibitions on all forms of forced labour and modern slavery in contracts and agreements with contractors and suppliers 3. Enterprise development programs could be done with local contractors where capacity can be built on forced labour, modern slavery and other worker's rights, management capacity, and human resource management 4. Conduct labour audits of contractors and suppliers						
After Management	<i>Minor</i>	<i>Individual RHs</i>	<i>Difficult</i>	3	2	

Human rights impact HR4.6: Child labour

The likelihood of child labour within PAK Yatirim, RNT, and PRODEL is low. However, there remains a possibility of child labour further down the Project's supply chain and globally. Risks of child labour exist in the sourcing of food or where domestic labour may be used. Therefore, it is essential to prioritise further supply chain risk assessment and due diligence in the more distant parts of the supply chain.

The relationship will be a direct linkage or contribution depending on the due diligence with specific contractors and suppliers. As child labour is likely to be found deeper in the Project's supply chain, the relationship is most likely to be one of direct linkage.

The impact rating before and after mitigation measures are applied is described in Table 6-83.

Table 6-83: Child labour

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
HR4.6 - Impact Summary: Child labour						
	Scale Gravity	Scope No. of affected rights-holders	Irremediability	Severity	Likelihood	Heat map rating
Before Management	<i>Significant</i>	<i>Small no. of RHs</i>	<i>Difficult</i>	4	2	
Management Measures: 1. Conduct due diligence on contractors and suppliers, including their acknowledgement of child labour in their policies 2. Include prohibitions on all forms of child labour in contracts and agreements with contractors and suppliers 3. Enterprise development programs could be done with local contractors where capacity can be built on child labour 4. Conduct labour audits of contractors and suppliers.						
After Management	<i>Minor</i>	<i>Individual RHs</i>	<i>Difficult</i>	3	2	

6.6 Impacts due to demining of landmines

Impact identification

The Project requires the demining of landmines within the Project footprint before construction activities can safely commence. Demining has been addressed as a *critical standalone operation*, separate from other environmental and socio-economic assessments, due to the high risk it poses to human safety and the potential for direct social and environmental impacts. Demining activities involve both non-technical and technical surveys, clearance of landmines, and subsequent site rehabilitation. This process is essential to ensure the safety of Project personnel, local communities, and the surrounding environment.

Key potential impacts include:

- Human safety risks to demining personnel and local communities;
- Environmental disturbance from demining operations, including vegetation clearing and soil disruption;
- Community health and safety impacts due to the presence of unexploded ordnances (UXOs); and
- Social and economic disruption in affected communities due to restricted access to demining areas.

Impact description

Environmental impacts associated with demining activities may include the following:

- Physical disturbance: Demining often requires clearing vegetation and disturbing soils, which can lead to habitat loss and increased erosion if not properly managed. The removal of landmines involves controlled detonations that can impact nearby flora and fauna; and
- Soil and water contamination: Improper handling or accidental detonation of landmines and unexploded ordnance can lead to soil and water contamination from explosive residues, posing long-term environmental risks.

Social impacts associated with demining activities may include the following:

- Safety risks to workers: Demining personnel face high safety risks, including potential injuries or fatalities from accidental detonations. This necessitates stringent safety protocols and use of personal protective equipment (PPE);
- Community disruption: Demining zones are restricted to public access, which may disrupt daily life and local economic activities, such as farming or artisanal mining; and
- Psychological impact: The presence of landmines poses ongoing psychological stress to local communities, affecting their sense of safety and well-being.

Impact assessment

The impact significance ratings of the identified potential impacts from demining activities during pre-construction and construction phases are provided in Table 6-84. Management measures are presented in the table. Impacts associated with the operational phase are not relevant, as demining is a pre-construction activity.

Table 6-84: Impacts due to demining

Activity: Demining of landmines								
Project phase: Pre-construction and construction								
DM1 – Impact Summary: High-risk environmental and social impacts due to demining activities, including safety risks, habitat disturbance, and contamination.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major</i>	<i>Medium term</i>	<i>Local</i>	<i>High</i>	<i>Likely</i>	<i>High</i>	-	<i>Medium</i>

Management Measures:**In addition to**

1. *Engage qualified demining contractors: Use certified contractors with proven experience to ensure best practices and safety standards are maintained throughout demining operations;*
2. *Community awareness and safety training: Conduct training and awareness programs with local communities to inform them about demining activities, associated risks, and safety protocols to minimise accidents;*
3. *Use of non-technical and technical surveys: Carry out comprehensive surveys to accurately identify hazardous areas before demining, reducing the risk of unintended exposure to landmines;*
4. *Establish safety zones and access restrictions: Implement safety zones around active demining sites and restrict access to unauthorised personnel to prevent accidents;*
5. *Emergency response and medical support: Ensure emergency response teams and medical support are available on-site during demining activities to provide immediate assistance in case of incidents;*
6. *Environmental rehabilitation post-demining: Implement rehabilitation measures, such as re-vegetation, to restore disturbed areas and reduce erosion after demining is completed; and*
7. *Regular monitoring and reporting: Monitor demining progress, incidents, and the effectiveness of safety measures, allowing for continuous improvement.*

After Management	Moderate	Short term	Local	Medium	Possible	Medium	-	Medium

6.7 Impacts of upstream and downstream services

6.7.1 Upstream impacts (sourcing and supply chain)

Impact identification

The Project will source various building materials and equipment from both local and international suppliers based on availability, specifications, and logistical considerations. The supply chain strategy balances cost efficiency, quality and timely delivery while adhering to environmental and social impact guidelines. Key materials include power transformers, switchgear, cables, steel structures and concrete, with high-voltage components imported from Europe and the USA. Locally, materials such as concrete poles and general construction supplies will be sourced from accredited Angolan suppliers. The Project will also handle hazardous materials, such as SF₆ gas and transformer oils, in adherence to international safety and environmental standards. Local and international suppliers will be selected based on their compliance with Angolan laws and regulations and Good International Industry Practice (GIIP) standards, ensuring proper storage, handling, and disposal of hazardous materials to mitigate environmental and health risks.

Key potential impacts include:

- Environmental impacts from upstream resource extraction and manufacturing;
- Environmental impacts from transport and logistics;
- Environmental impacts from the use of hazardous materials;
- Social impacts resulting from unfair and unethical labour practices;
- National, regional and local economic impacts; and
- Community health and safety impacts.

Impact description

Upstream environmental impacts associated with sourcing and supply chain may include the following:

- Resource extraction and manufacturing: The sourcing of materials such as steel structures, transformers, and cables from international suppliers (e.g, Europe and USA) involves resource extraction and manufacturing processes that can contribute to significant environmental impacts, including carbon emissions, energy consumption, and habitat disruption;
- Transport and logistics: Transporting materials internationally, especially heavy equipment and hazardous materials, generates carbon emissions and environmental pollution, increasing the Project's overall carbon footprint; and
- Use of hazardous materials: Importing hazardous materials such as SF₆ gas and transformer oils from Europe introduces risks related to spills, leaks, and improper handling during transport, which could lead to soil and water contamination.

Upstream social impacts associated with sourcing and supply chain may include the following:

- Labour practices: Sourcing from international suppliers raises concerns about the labour conditions at manufacturing sites, including worker safety, fair wages, and working hours, which may not always align with the Project's ethical standards;
- National, regional and local economic impact: The use of international suppliers can limit economic benefits to Angolan-based companies that employ in-country workers, thereby potentially missing opportunities to strengthen national, regional and local supply chains and create jobs within Angola; and
- Community health and safety: Transporting hazardous materials through populated areas poses risks to community health and safety, particularly in case of accidents or spills.

Impact assessment

The impact significance ratings of the identified potential impacts on upstream (sourcing and supply chain) impacts during construction are provided in Table 6-85, which are anticipated to be more

significant. Management measures are presented in the table. Impacts associated with the operational and decommissioning phases are considered to be similar to those of the construction phase, albeit less severe, and hence would apply the same management measures.

Table 6-85: Upstream (sourcing and supply chain) impacts (construction phase)

Activity: Sourcing and handling of building materials, equipment, and hazardous materials								
Project phase: Construction								
SC1 – Impact Summary: Environmental and social impacts from international and local supply chains, including emissions, resource extraction, and safety risks from hazardous material transport.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major</i>	<i>Long term</i>	<i>Regional</i>	High	<i>Likely</i>	High	-	<i>Medium</i>
Management Measures: 1. <i>Strengthen local supply chain: Enhance Angolan supplier capacity to reduce reliance on imports from international destinations, thereby lowering emissions linked to transportation and supporting national, regional and local economies;</i> 2. <i>Environmental standards in contracts: Ensure all suppliers comply with GIIP to minimise environmental and safety risks; Due diligence assessments of suppliers: Conduct assessments of potential suppliers to evaluate their EHS and social compliance and mitigate risks before engagement;</i> 3. <i>EHS training and compliance monitoring: Develop and implement training programmes and conduct regular monitoring of suppliers to ensure adherence to environmental and social standards;</i> 4. <i>Labour practices compliance: Enforce strict labour standards within contracts to ensure that all suppliers adhere to ethical labour practices, including fair wages, safe working conditions, and reasonable working hours, aligning with the Project's ethical standards;</i> 5. <i>Promote Local Economic Participation: Encourage procurement from national, regional, and local suppliers to boost economic benefits within Angola, fostering job creation and enhancing local supply chains; and</i> 6. <i>Community Health and Safety Protocols: Develop and implement strict safety protocols for transporting hazardous materials, including clear signage, driver training, and emergency response plans, to safeguard community health and safety during material transport.</i>								
After Management	<i>Moderate</i>	<i>Medium term</i>	<i>Regional</i>	Medium	<i>Possible</i>	Medium	-	<i>Medium</i>

6.7.2 Downstream impacts (waste management and disposal)

Impact identification

Due to the limited availability of local waste management facilities, designated storage areas will be established at the campsites until a certified waste management company, approved by the Ministry, is identified in Huambo, Huíla, or Luanda. Once an agreement is signed with the selected contractor, waste collection and disposal will commence when sufficient volumes are accumulated. The certified company will provide documentation confirming waste type, quantities, and treatment methods to ensure regulatory compliance. Waste disposal options under consideration include licensed landfills for general waste, recycling centres for materials like metal and concrete, and certified hazardous waste treatment facilities, with arrangements made for safe transport to licensed sites if local options are unavailable.

Key potential impacts include:

- Environmental impacts from waste generation;
- Environmental impacts from lack of local waste management facilities;
- Social impacts from community exposure to hazardous waste; and
- Local economic impacts.

Impact description

Downstream environmental impacts associated with waste management and disposal may include the following:

- **Waste generation:** The construction phase generates significant waste, including concrete, metals, packaging materials and hazardous materials like oils and batteries. Improper waste disposal can lead to soil and water contamination, particularly if local waste facilities lack the capacity to handle these waste streams safely;
- **Lack of local waste management facilities:** The absence of adequate local waste management infrastructure necessitates temporary storage and eventual transport to certified disposal sites at a significant distance from the Project area, increasing transport emissions and risk of environmental pollution during handling and transit;
- **Recycling and resource efficiency:** While efforts to recycle materials like metal scraps, packaging and electronic waste are planned, limited access to efficient recycling facilities may reduce the effectiveness of these measures, resulting in higher volumes of waste being sent to landfills;
- **Community exposure to hazardous waste:** Storing hazardous materials at campsites and transporting them through communities for disposal increases the risk of accidental exposure to toxic substances, affecting community health; and
- **Local economic impact:** The reliance on external waste management facilities, primarily located in larger urban centres such as Huambo, Huíla, or Luanda, limits the economic benefits that could be gained locally. The absence of certified waste management companies in the immediate project area restricts opportunities for local businesses to engage in waste collection, treatment, and recycling, which could otherwise contribute to local economic growth. This dynamic not only affects job creation but also reduces the potential for capacity building in waste management services within nearby communities. Additionally, contracting services from distant certified waste management companies increases project costs due to transport and logistical challenges, diverting potential revenue away from the local economy.

Impact assessment

The impact significance ratings of the identified potential impacts on downstream (waste management and disposal) impacts during construction are provided in Table 6-86, which are anticipated to be more significant. Management measures are presented in the table. Impacts associated with the operational and decommissioning phase are considered to be similar to those of the construction phase, albeit less severe, and hence would apply the same management measures.

Table 6-86: Downstream (waste management and disposal) impacts (construction phase)

Activity: Sourcing and handling of building materials, equipment, and hazardous materials								
Project phase: Construction								
SC2 – Impact Summary: Environmental and social impacts from improper waste management, potential contamination, and exposure to hazardous substances.								
	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ / -	Confidence
Before Management	<i>Major</i>	<i>Long term</i>	<i>Local to Regional</i>	High	<i>Likely</i>	High	-	<i>Medium</i>
Management Measures: 1. <i>Enhanced waste management protocols: Implement secure storage, labelling, and certified disposal of hazardous waste to prevent environmental contamination;</i> 2. <i>Recycling and resource efficiency: Prioritise recycling of materials such as metals and concrete to reduce the volume of waste sent to landfills;</i> 3. <i>Community safety measures: Engage with local communities near waste storage and disposal sites to raise awareness of potential risks and ensure safety measures are in place;</i> 4. <i>Support local waste management development: Encourage the development of local waste management capacities by investing in training and certification programs for local companies, where feasible, enabling them to handle various waste streams safely;</i> 5. <i>Local economic participation: Where feasible, prioritise contracts with local waste management service providers, even on a smaller scale, to foster local economic development and build a more sustainable and self-reliant waste management system; and</i> 6. <i>Documentation of EHS activities: Maintain detailed records of all waste handling, transport, and disposal activities to ensure regulatory compliance and accountability.</i>								
After Management	<i>Minor</i>	<i>Short term</i>	<i>Local</i>	Low	<i>Possible</i>	Low	-	<i>Medium</i>

6.8 Cumulative Impacts

This section outlines consideration of cumulative impacts of the Project with other key past, present and future developments impacting on the receiving environment. It should be read in conjunction with the cumulative impact assessment in the Addendum to the ESIA (Volume 6). The impact of the proposed Project on a cumulative scale was completed with the assumption that the proposed mitigation measures are successfully implemented.

6.8.1 Objectives for assessing cumulative impacts

The objectives of the cumulative impact assessment (CIA) are to:

- Present the rationale for the consideration of cumulative impacts, outlining the most important international guidelines;
- Identify the valued environmental and social components (VECs) that require consideration and describe their potential reaction to stresses;
- Identify the area of influence for cumulative impact consideration;
- Highlight potential key cumulative impacts in the area of influence; and
- Recommend management strategies to address potential cumulative impacts.

6.8.2 Rationale for consideration of cumulative impacts

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones (IFC, 2013). For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important based on scientific concerns and/or concerns of affected communities.

The IFC's Good Practice Handbook for Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (IFC, 2013) sets out the procedure to identify cumulative impacts and includes detail requirements and methodology to identify and quantify cumulative impacts for past, present and future activities in a receiving environment.

The undertaking of a CIA requires extensive knowledge and data of other developments and their impacts on the receiving environment. As this information is not readily accessible in the study area, a comprehensive CIA was not possible. It is worth noting that the Project is located in a predominantly rural setting interspersed by small towns and villages, subsistence farming and mining activities among unmodified Miombo woodlands and riverine areas. There is minimal development at large scale taking place in the Project area.

6.8.3 Identification of valued environmental and social components and area of influence

VECs are environmental and social attributes that are considered to be important in assessing risks that may be: physical features; habitats (e.g. biodiversity); ecosystem services; natural processes (e.g. water); social conditions (e.g. health, safety, economics); or cultural aspects (e.g. burial areas, sense of place). While VECs may be directly or indirectly affected by a specific development, they often are also affected by the cumulative effects of several developments. VECs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways.

Understanding the existing condition of VECs as well as their potential reaction to stresses and trends is therefore important. The most important VECs were identified through literature review, stakeholder engagement, specialist studies and the impact assessment. The VECs relate to natural environment, including land and vegetation, socio-economic development and the community. The following

identified VECs for the Project have been considered within direct and indirect areas of influence as described in Section 4.1.

The following key VECs have been identified:

- The Project area is located within the Zambezi River headwaters ecoregion supporting multiple key river systems in Southern Africa, including the Zambezi River and Okavango River. These river systems and catchments support a diversity of species and ecosystems and provide benefit to millions of people across multiple Southern African countries including Angola, Botswana, Zambia, Zimbabwe and Mozambique;
- The presence of Miombo Woodlands throughout the Project area that support species diversity as well as local socio-economic development and livelihood subsistence;
- Ecosystems services, including:
 - Presence of substantial groundwater resources and reliance on these resources for local rural populations;
 - Reliance on rivers in the Project area as a source of water and livelihood;
 - Extensive presence of agriculturally potential land currently being used for subsistence farming;
 - Ecosystem services that provide a sense of cultural heritage such as sacred sites, trees, rocky outcrops or hills and rivers;
- The presence of schools, hospitals and churches in the Project area particularly within the towns of Jamba, Cuvango and Chipindo. Rural populations in the Project area rely heavily on these towns for education, healthcare and economic benefit such as trade; and
- The prevalence of mining activities and potential for mining in the Project area, particularly around the town of Jamba. Both formal mining activities and ASM are evident in the area.

6.8.4 Natural and social external influences and stresses

The key natural and social external influences and stresses that may impact on the VECs that are located in the area of influence are presented below.

The natural influences and stresses include modified environmental conditions in and around the Project area due largely to changes in climatic conditions, potentially induced by climate change. The potential increase in frequency of extreme weather-related events could act as a stressor on VECs and cumulative impacts. Long-term climate change can place external influence on the availability of electricity to the region by impacting the water level in Gove Dam through intense drought-like events. The Project will utilise the hydroelectric dam to supply power to the area and this requires a stable supply water level. Maintaining a stable water level may impact on the availability of water downstream. On the other hand, excessive precipitation and flooding events can cause damage to Project related infrastructure and subsistence agricultural activities.

Social influences and stresses include high expectations from stakeholders for higher quality of life and opportunities, employment and local socio-economic development. Low employment levels can be a stressor as any new development, including the Project in question, would be seen as a potential source of employment and would be expected to meet local demands. It is unlikely that other external stressors will have a significance on cumulative impacts due to the rural nature of the Project area.

6.8.5 Key past, present and future developments in the study area

The Project extends over 170 km of undeveloped and rural land interspersed with small villages and towns, subsistence agriculture and little other development. The most notable past and current developments throughout the Project area include:

- The Gove hydroelectric dam currently provides electricity to the region and its reach will be expanded through this Project; and
- The Cassinga iron mines located around and south of Jamba are currently non-operational, however, there are potential plans to reopen and continue mining.

There is a potential that with the increase in access to electricity through the Project, there will be further industrial developments linked to the mining and agricultural industries.

6.8.6 Impact identification and assessment

The following cumulative impacts on VECs have been identified through the reconnaissance survey, specialist impact assessments, stakeholder engagement and desktop research.

Environmental

Cumulative impacts on valued environmental aspects are largely driven by the construction phase of the Project, the future presence of the OHL and associated infrastructure and environmental stressors such as climate change related effects. The following cumulative impacts are discussed below in terms of impact significance for the identified VECs:

CI1 – Cumulative impact on freshwater ecosystems and watercourses

The potential cumulative impact on the freshwater ecosystems and watercourses of the Zambezi River headwaters ecoregion can be considered negligible due to the localised scale of the Project and large extent of the catchment areas. It is likely that any sedimentation or pollution from construction activities will be diluted before reaching the larger watercourses and if any impacts are noted, this will be temporary. If mining activities increase in the Project area, there is a potential that sedimentation and pollution of watercourses may increase in significance however this is likely to occur after the construction of Project infrastructure. An increase in agricultural activities near watercourses is possible due to ease of access through the construction of maintenance roads and this could increase the sedimentation and potential pollution (from fertilisers) of these headwaters. There is a heavy reliance on these watercourses by local communities for subsistence livelihoods. Climate change related stressors may exacerbate the impacts felt downstream as well as for water users in the Project area.

CI2 – Cumulative impact on Miombo Woodland habitats

Cumulative impact on the Miombo Woodland habitats in the Project area include both environmental and socio-economic effects. The construction of the OHL and related infrastructure may exacerbate the fragmentation of these habitats, which are being impacted by ongoing subsistence agriculture activities. Opening up remote and inaccessible areas through the establishment of access roads can accelerate deforestation. These roads will allow local communities and others to harvest firewood and clear new woodland areas for farming.

CI3 – Cumulative impact on water resources

Other ecosystems services that should be considered in terms of cumulative impacts include water resources such as groundwater availability and the utilisation of rivers. There is a heavy reliance on groundwater for people in the Project area due to the rural locality and lack of access to water supply infrastructure. Impacts on groundwater are anticipated to be minimal however with the addition of climate change related stressors, groundwater availability may become an issue for those in a rural context who are heavily reliant on this resource. Additionally, the increased access to electricity by local communities following the operation of the Project could result in further development and utilisation of groundwater resources. Electric borehole pumps could be more commonly utilised thereby increasing water abstraction. This can in turn potentially affect groundwater availability in localised areas. In the longer-term, the Project could lead to over-utilisation of water resources (including rivers and streams) by enabling the development of large-scale economic activities (e.g. mining and agri-industry) in the Project's indirect area of influence.

C14 – Cumulative impact on road infrastructure and traffic

The construction of new access roads as well as improvement of existing roads within the Project area will greatly improve the infrastructure network. This network will mainly be utilised by construction vehicles however it is highly likely that other road users will make use of these new/improved access routes. This will result in greater traffic volumes (and associated safety risks) as well as contribute to deterioration of these roads necessitating more frequent maintenance during the construction and operational phases.

C15 – Cumulative impact on cultural heritage

Additional ecosystem services that may incur cumulative impacts include cultural heritage aspects such as sacred sites (natural features) and areas with a sense of cultural significance. The Project area is largely undeveloped and there is a potential that the construction of the OHLs may visually detract from its overall sense of place. In addition, it is difficult to determine the full impact of the Project on potential sacred sites or culturally significant areas as these have not all been identified as part of the baseline heritage study.

Socio-economic

In terms of social cumulative impacts, these include livelihoods, socio-economic and human rights impacts and are discussed below.

C16 – Cumulative impact on basic services

The current state of access to education and healthcare in the Project area is low. Although the Project is expected to contribute to the improvement of basic services, this benefit may be undermined in longer term. People may move into the beneficiary towns to access electricity and basic services such as hospitals and schools thereby putting pressure on this infrastructure.

C17 – Cumulative impact on land-based livelihoods

In the medium to long term, there is a possibility that people will move into the area in search of land-based livelihoods. This in turn can exacerbate ongoing land clearance and deforestation due to 'slash-and-burn' subsistence agriculture activities and charcoal production. These processes can lead to wildfires and a decline in soil fertility and quality, which will be aggravated by climate change induced conditions. Furthermore, land scarcity, disputes over ownership, and the slow pace of restitution programs can create significant tensions between displaced populations and those who remained. The destruction of agricultural infrastructure, land degradation, and loss of farming knowledge further undermine food security and economic stability. Additionally, landmines and unexploded ordnance remain a persistent hazard, limiting access to land and hindering agricultural recovery. As people return to their homes or migrate to urban areas, competition for resources and strained infrastructure often exacerbate poverty and social instability.

Social tensions can also arise due to unequal access to land, with marginalised groups, such as women, often facing additional barriers to land ownership. Weak land governance and the slow rebuilding of infrastructure hinder recovery efforts and deepen insecurity. Moreover, lingering armed groups or criminal activities can threaten community stability.

C18 - Cumulative impact on employment opportunities and socio-economic benefit

There is the potential for positive cumulative impact in the greater study area following the revitalisation and establishment of mines that have increased access to electricity. This will give rise to increased local employment opportunities and socio-economic benefits. Additionally, this increase in mining activity could encourage more ASM activities to establish in the Project area, with associated environmental and social impacts.

6.8.7 Management of cumulative impacts

The management of cumulative impacts will depend on the context in which the development is occurring (i.e., the impacts from other projects and natural drivers that affect the VECs). As cumulative impacts result from the actions of multiple stakeholders, the responsibility for their management is collective and may require a synergistic approach particularly between the proponent and local authorities as well as industries operating in the region.

The management of these cumulative impacts begins with the implementation and adherence to mitigation and management measures as presented in the ESMP, which embeds a precautionary approach. Ongoing monitoring of these cumulative impacts is also crucial in managing the significance of the impact particularly on sensitive VECs such as the freshwater ecosystems, Miombo Woodlands, indigenous peoples and socio-economic and cultural heritage contexts that adjoin and surround the direct project footprint.

6.9 Risk considerations and major hazards

It is necessary to take account of environmental and social risks, including major hazards, that may present challenges to the Project. A risk can be defined as a chance of an occurrence that may cause or threaten a negative effect or hazard. This can result from external or internal vulnerabilities that may be prevented or avoided. Risk management is embedded in Angolan environmental regulatory framework as well as international standards. The IFC Performance Standards (IFC, 2012) requires that developers assess potential risks and take actions to manage these risks to achieve defined sustainability objectives. This section features key external risks related to climate change and human rights that need to be factored into the management of the proposed Project during construction and operational phases, alongside the measures needed to address identified major hazards. For further details on major accidents associated with these hazards, refer to the Addendum to the ESIA (Volume 6).

6.9.1 Climate change-induced risks

There is growing vulnerability of Angola climate change-induced impacts (Miller, 1982), but despite this situation, the country lacks the regulatory systems to coordinate its climate change response. The country has been adversely impacted by prolonged drought, damaging flash floods and reduced crop production, severely affecting the economy of Angola (Mixed Migration Centre, 2023). Currently, Angola is experiencing its worst drought-related emergency in close to four decades as a result of climate change (ACAPS, 2023).

There is a risk that this situation can result in high levels of food insecurity, as occurred in the southern regions of the country in recent years where people are reliant on rain-fed agriculture. In Cunene, Huila and Namibe, there have been high levels of food insecurity in 2021 and 2022, affecting over 1.59 million people (FSIN, 2022). This figure increased to 2.3 million in 2023. Children have been especially vulnerable to this exposure, which has contributed to Angola's high ranking on the Childrens Climate Risk Index (UNICEF, 2023).

In terms of Project-specific risks, an overall trend of increasing temperatures and an increase in the frequency and, potentially, the severity of precipitation events during the rainy season could potentially pose a risk to the Project infrastructure in terms of construction and operation. Construction activities during the rainy season are at risk of damage caused by flooding and general inundation of construction sites posing health and safety risks. If pylon infrastructure and construction camps are not positioned with due care and consideration of floodlines, there is a risk that flooding events may cause damage. This extends to the operational phase where pylon foundations are at risk of damage due to flood waters if located within the conservative floodline buffers.

Increases in regional temperature can also pose a risk to equipment and infrastructure as well as the health and safety of construction and operation personnel. Considering climate change predictions, it is possible that temperatures can exceed 40 °C regularly across the Project area. Additionally, in terms of health and safety concerns, an increase in temperature and precipitation may increase the prevalence of vector borne diseases such as malaria. This has occupational and community health and safety implications beyond the Project.

During dry periods, it is predicted that drought-like conditions may occur more often and for longer periods. This will potentially pose a risk in terms of an increase in fires, availability of water resources and air quality in terms of health concerns. The risk to water resources availability in the Project area is a primary concern as prolonged drought spells could force additional reliance on groundwater in turn, increasing abstraction and potentially impacting users. The increase in fires and dust due to drought-like conditions may pose a risk to human health and place strain on existing healthcare systems.

It is difficult to manage climate change-induced risks as the effects can be wide-spread beyond the scope of the Project and it is also difficult to accurately predict the occurrence and impact of these climate change related events. Cognisance of achievable management measures for the Project is essential in mitigating the direct risk.

6.9.2 Human rights risks

Human rights are basic rights that allow individuals the freedom to lead a dignified life, free from fear or want, and free to express independent beliefs. These rights apply equally and universally in all countries and are set out in the 1948 Universal Declaration of Human Rights (UDHR). These include rights to life, liberty and security of person, freedom from torture and slavery, right to recognition and equality before the law, right to freedom of peaceful assembly and association, right to decent work. In addition, the ILO has identified eight core conventions covering fundamental principles and rights at work.

Angola has ratified several conventions and protocols related to human rights, including the International Covenant on Civil and Political Rights, Convention against Torture and Other Cruel Inhuman or Degrading Treatment or Punishment, Convention on the Elimination of All Forms of Discrimination against Women and the Convention on the Rights of the Child (United Nations Human Rights Treaties Bodies, 2023). Despite these international commitments, human rights risks are still prevalent in the country. Analyses by international organisations and ratings agencies have classified Angola as a medium risk country in terms of human rights, with persistent significant challenges to upholding these rights.

The key human rights risks that are of potential concern with regard to the Project include health and safety of workers and local communities, use of child labour and forced labour, impact on communities and their livelihoods, the impact to vulnerable groups and the impact to indigenous peoples.

In terms of health and safety, the implementation and adherence to OHS and CHSS plans would negate the majority of the risk associated with the Project. Although these health and safety risks are noted to be potentially severe, particularly during the construction phase of the Project, these can be mitigated through the implementation of appropriate management plans and awareness raising programmes.

The risk of child and forced labour is prevalent across Africa, particularly in informal economic activities such as ASM. It is important for the Project to strictly adhere to international and national policies, standards and guidelines by ensuring fair employment and procurement procedures. It becomes the responsibility of the Project proponent or contractor to ensure that procurement is also conducted in a manner that is transparent and ensures that the suppliers adhere to child and forced labour policies.

The risks associated with vulnerable groups and indigenous peoples are predominantly focussed on the increased marginalisation and discrimination of these groups. In terms of vulnerable groups, the risk is that women in the workplace are increasingly marginalised and discriminated against. Anti-discrimination policies would reduce this risk through implementation and awareness raising. Additionally, there are risks of reduced safety and access to resources due to the influx of workers potentially targeting vulnerable groups increasing health concerns, crime and gender-based violence.

It is also women who predominantly conduct subsistence activities such as farming, and water collection and the Project could potentially limit access to these livelihood activities. Awareness raising among workers and communities alike would be required to reduce these risks. In terms of the risk to indigenous peoples, this is based on marginalisation and discrimination. However, these groups (San) are known to occur approximately 70 km south of the Project area and therefore have no direct influence on the Project resulting in potentially low to no risk. The Project is encouraged to engage indigenous people with due respect and consideration as part of the SEP, if and when encountered. Implementation of the grievance mechanism could potentially assist with the identification of indigenous groups.

Security concerns and interactions with communities and ASM groups could potentially pose a risk to human rights. If not conducted in a manner which aligns to international standards and guidance, interactions with ASM groups could potentially become hostile or overly forceful leading to potential human rights impacts. Awareness raising, training and communication would assist security forces associated with the Project to align with international standards and conduct themselves in a peaceful manner while managing security risks. The SEP includes ASM groups as a key stakeholder for ongoing consultation if encountered. Although not encountered in the project areas during the baseline surveys, implementation of the grievance mechanism could potentially assist with the identification of ASM groups.

The proponent of the Project will need to ensure that human rights risks are managed by any third-party contractors that are appointed to construct and operate the facility. This will mitigate any reputational damage that may arise from applying labour practices that are not aligned to the national labour legislation, UDHR, ILO standards and VPSHR.

6.9.3 Major hazards

In the context of the Project, understanding and addressing major hazards is critical for ensuring the safety and integrity of infrastructure and operations. These hazards encompass a range of risks, including natural disasters such as floods, landslides, and extreme weather events, which are increasingly exacerbated by climate change as discussed in Section 6.10.1. Additionally, operational hazards, including fire risks from equipment malfunctions and the transportation of hazardous materials, pose significant challenges. Effective management strategies are essential to mitigate these risks and safeguard both personnel and local communities. This section outlines the comprehensive plans and protocols that must be implemented to prepare for and respond to these major hazards, ensuring resilience and safety throughout the lifecycle of the Project.

Natural disasters, such as floods, landslides, and extreme weather events, can significantly impact the Project's infrastructure and operational safety. As indicated in Section 6.10.1, these events are anticipated to become more frequent and severe due to changes in climate change. To mitigate these risks, the Emergency Preparedness and Response Plan (EPRP) (Section 7.4.5) is established, detailing procedures for responding to natural disasters. Infrastructure design principles that enhance resilience against extreme weather, such as elevated structures and reinforced materials must be incorporated. Regular training sessions must be held to prepare staff for emergency scenarios, and

community engagement initiatives must ensure that local populations are informed about potential risks and response strategies, fostering a collaborative approach to disaster preparedness.

Fire risks stemming from equipment malfunctions, dry vegetation near the powerline, or human activities are critical concerns for the Project. Additionally, the potential for wildfires increases if the servitude is not kept clear of bush and other flammable materials, which can significantly heighten the risk of fire spreading to infrastructure and surrounding areas. A robust Fire Risk and Prevention Management Plan will need to be developed following the framework in Section 7.5 to address these risks comprehensively. This plan must involve conducting regular inspections of electrical equipment and powerline clearances to prevent vegetation encroachment. Fire safety training must be provided for all employees, focusing on fire prevention strategies, recognition of potential fire hazards, and emergency response protocols. In addition, firebreaks must be maintained around critical infrastructure, and fire extinguishers must be strategically placed throughout the Project area to ensure readiness in case of a fire outbreak.

The presence of high-voltage powerlines and substations introduces significant risks associated with electrical accidents, including electrocutions, equipment malfunctions, and arc flashes. To effectively manage these risks, stringent safety protocols and comprehensive training measures will need to be implemented as outlined in the Occupational Health and Safety Management Plan (Section 7.4.12). This plan includes mandatory training programs for all personnel working near electrical infrastructure, emphasising the importance of using personal protective equipment (PPE), understanding lockout/tagout procedures, and conducting regular safety drills. Additionally, routine maintenance checks must be established to identify and address potential electrical hazards before they result in accidents.

The transportation of hazardous materials, such as insulating oil from transformers and other chemicals, presents potential risks to both the environment and public safety. The Hazardous Materials Management Plan will need to be developed following the framework in Section 7.5, to ensure that all transportation activities comply with local and international regulations regarding hazardous materials. This plan must outline safe transport procedures, including secure packaging, proper labelling, and the use of trained personnel for handling and transport. In the event of a spill or incident, detailed spill response strategies must be implemented, including immediate containment measures and communication protocols to notify relevant authorities and affected communities.

6.10 Alignment to applicable GIIP standards

In addition to meeting the requirements of relevant Angolan legislation set out in Section 3, the ESIA has also taken into consideration applicable GIIP standards (Section 3.5). As demonstrated in Section 3.6, significant alignment exists between the featured GIIP standards and guidelines to the IFC PSs which has been used as the benchmark against which the Project has been assessed. Table 6-87 provides a summary of the ESIA's alignment to the applicable IFC PSs.

Table 6-87: Alignment of ESIA to benchmark IFC PSs

IFC PS	Overall alignment	Key actions to give effect to performance standards
PS 1: Assessment and Management of Environmental and Social Risks and Impacts	There is clear understanding of the potential E&S risks and impacts that may arise as a result of the Project. Informed by the ESIA, a comprehensive ESMP has been prepared.	The following will need to be established and implemented: • EMS; • Organisational structure for Safety, Health, Environment and Community; and • Relevant management plans.
PS 2: Labour and Working Conditions	Labour and working condition risks and impacts were considered in the ESIA. The comprehensive ESMP takes account of national and international requirements in this regard.	The following will need to be established and/or implemented: • Grievance Management Procedure; and • Measures relating to labour and occupational health set out in the ESMP, in fulfilment of relevant Angolan legislation and ILO conventions.
PS 3: Resource Efficiency and Pollution Prevention	There is a good understanding of the need for resource efficiency and pollution prevention. As part of the detailed design process, PAK Yatirim should consider evaluating the installation of energy/water efficient technology and processes and assess GHG emissions.	The following will need to be established and/or implemented: • Technically and financially feasible measures to reduce the Project's consumption of energy and water; • GHG assessment; • Monitoring plans and reports during all Project phases; and • Waste Management Plan (WMP).
PS 4: Community Health, Safety, and Security	The ESIA evaluated potential community health, safety and security risks and impacts. A comprehensive ESMP was prepared to mitigate and manage any risks and impacts in this regard.	The following will need to be established and/or implemented: • OHS mitigation measures presented in the ESMP; • CHSS mitigation measures and plan; • EPRP; and • Stakeholder Engagement Plan, including a grievance mechanism.
PS 5: Land Acquisition and Involuntary Resettlement	As part of the ESIA process, a LARF was developed for potential resettlement planning and livelihood restoration. The LARF is included in the ESIA.	The following will need to be established and/or implemented: • Stakeholder Engagement Plan and Grievance Management Procedure; and • LARF.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Informed by a specialist site investigation, the ESIA determined the current biodiversity baseline conditions. It found that the vegetation on the site is substantially transformed and does not possess sensitive or critical habitats that would need to be conserved and sustainably managed. The ESMP identifies measures to mitigate the loss of vegetation.	The following will need to be established and/or implemented: • Measures set out in the ESMP to protect and enhance the biodiversity of the site post-development; and • Appointment of local suppliers that sustainably source primary materials required by the Project.

IFC PS	Overall alignment	Key actions to give effect to performance standards
PS 7: Indigenous Peoples	Indigenous peoples have been considered during this ESIA process however they are not directly affected by the Project nor are they located within the Project area. Potential risks and management measures have been identified.	The following will need to be established and/or implemented: Stakeholder Engagement Plan and Grievance Management Procedure.
PS 8: Cultural Heritage	The ESIA process identified that there are potential culturally significant heritage resources in the Project area. There is a potential that additional sacred sites, burials and cultural heritage sites may be identified through further stakeholder consultations and during pre-construction surveys and construction activities.	The following will need to be established and/or implemented: - A heritage chance find procedure has been developed for implementation during the construction phase; and - Stakeholder Engagement Plan and Grievance Management Procedure.